Oversight / NHS	
FHWA REGION VIII OVERSIGHT?	☐ NO ■ YES
NATIONAL HIGHWAY SYSTEM?	☐ NO ■ YES

DEPARTMENT OF TRANSPORTATION
STATE OF COLORADO

Related Projects:
P. E. UNDER PROJECT:
Project Number
Project Code: 19373

R.O.W. Projects:
R.O.W. Project Description

HIGHWAY CONSTRUCTION BID PLANS OF PROPOSED

COLORADO PROJECT NO. C 0703-399

EISENHOWER/JOHNSON MEMORIAL TUNNEL
24.9KV SWITCHGEAR REPLACEMENT

CLEAR CREEK AND SUMMIT COUNTIES

CONSTRUCTION PROJECT CODE NO. 19373

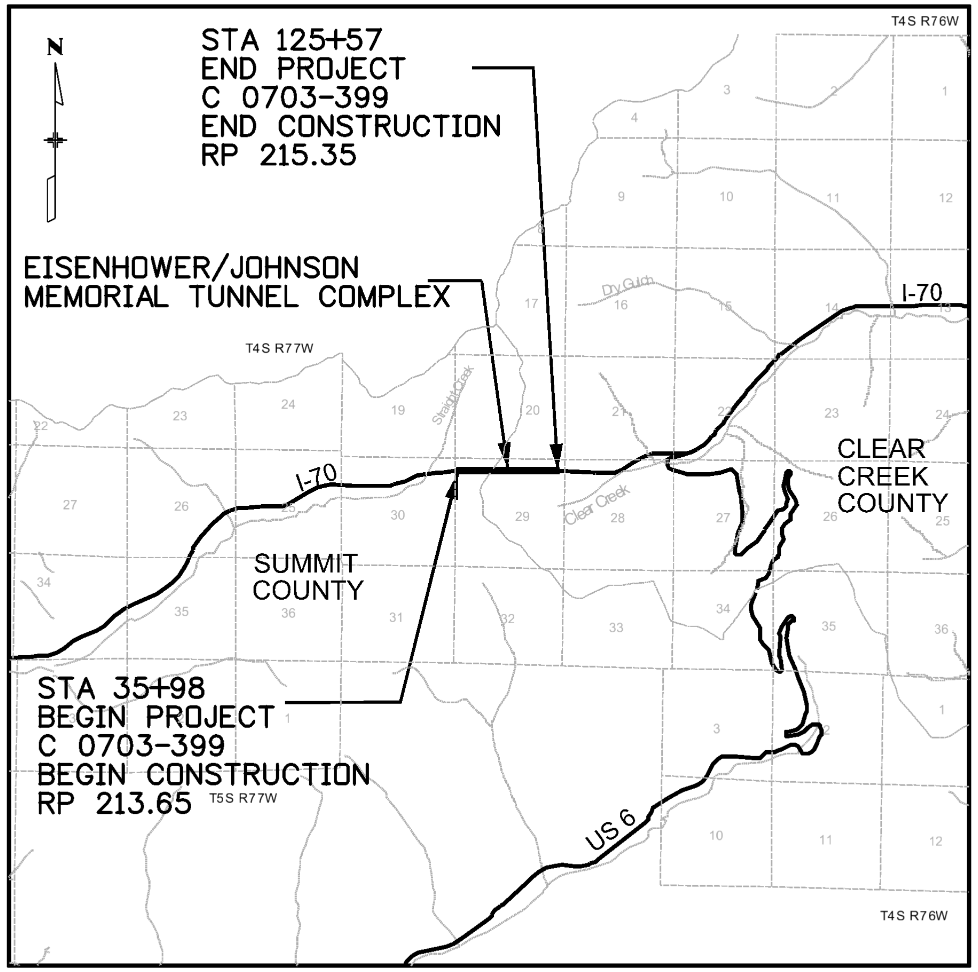
TABULATION OF LENGTH & DESIGN DATA

STATION	FEET		
	ROADWAY		MAJOR STR.
	I-70		
BEGIN PROJECT C 0703-399 = STA. 35+98 ON PROJECT IM 0702-257, M.P. 213.65	0		
STA. 35+98 BEGIN STRUCTURE NO. F-13-X AND F-13-Y			8,959
STA. 125+57 END STRUCTURE NO. F-13-X AND F-13-Y	0		
END PROJECT C 0703-399 = STA. 125+57 ON PROJECT IM 0702-257, M.P. 215.35			
TOTAL	0		8,959

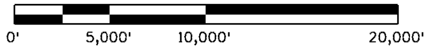
SUMMARY OF PROJECT LENGTH	FEET	MILES
ROADWAY (NET LENGTH) MAJOR STRUCTURE	0 8,959	0 1.70
PROJECT GROSS LENGTH	8,959	1.70

DESIGN DATA	I-70	
MAXIMUM RADIUS OF CURVE	NA	
MAXIMUM GRADE	NA	
MINIMUM S.S.D. HORIZONTAL	NA	
MINIMUM S.S.D. VERTICAL	NA	
MAXIMUM DESIGN SPEED	NA	
2012 DESIGN TRAFFIC	NA	
DHV TRUCKS %	NA	
CLEAR ZONE DISTANCE (TANGENT)	NA	
CLEAR ZONE DISTANCE (370 M RADIUS)	NA	
CONSTRUCTION CLEAR ZONE (MIN 18')	NA	

* FOR INFORMATION ONLY



PROJECT LOCATION MAP



Print Date: 8/18/2014	
File Name: 24.9-TitleSheet.dgn	
Horiz. Scale: 1:10000	Vert. Scale: As Noted
Unit Information	Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

Contract Information
Contractor:
Resident Engineer:
Project Engineer:
PROJECT STARTED: / / ACCEPTED: / /
Comments:

Project No./Code
C 0703-399
19373
Sheet Number 1

PLAN NUMBER	NEW OR REVISED	M STANDARD TITLE	PAGE NUMBER
■ M-100-1		STANDARD SYMBOLS (3 SHEETS)	1-3
■ M-100-2		ACRONYMS AND ABBREVIATIONS (4 SHEETS)	4-7
M-203-1	☐	APPROACH ROADS (REVISED ON JULY 08, 2013)	8
☐ M-203-2		DITCH TYPES	9
☐ M-203-11		SUPERELEVATION CROWNED AND DIVIDED HIGHWAYS (3 SHEETS)	10-12
☐ M-203-12		SUPERELEVATION STREETS (2 SHEETS)	13-14
☐ M-206-1		EXCAVATION AND BACKFILL FOR STRUCTURES (2 SHEETS)	15-16
☐ M-206-2		EXCAVATION AND BACKFILL FOR BRIDGES (2 SHEETS)	17-18
☐ M-208-1		TEMPORARY EROSION CONTROL (12 SHEETS)	19-30
☐ M-210-1		MAILBOX SUPPORTS (2 SHEETS)	31-32
☐ M-214-1		PLANTING DETAILS	33
M-412-1	☐	CONCRETE PAVEMENT JOINTS (5 SHEETS) (REVISED ON JULY 24, 2012)	~~34-38~~
☐ M-510-1		STRUCTURAL PLATE PIPE H-20 LOADING	39
M-601-1	☐	SINGLE CONCRETE BOX CULVERT (2 SHEETS) (REVISED ON AUGUST 27, 2013)	~~40-41~~
M-601-2	☐	DOUBLE CONCRETE BOX CULVERT (2 SHEETS) (REVISED ON AUGUST 27, 2013)	~~42-43~~
M-601-3	☐	TRIPLE CONCRETE BOX CULVERT (2 SHEETS) (REVISED ON AUGUST 27, 2013)	~~44-45~~
☐ M-601-10		HEADWALL FOR PIPES	46
☐ M-601-11		TYPE "S" SADDLE HEADWALLS FOR PIPE	47
☐ M-601-12		HEADWALLS AND PIPE OUTLET PAVING	48
☐ M-601-20		WINGWALLS FOR PIPE OR BOX CULVERTS	49
☐ M-603-1		METAL PIPE (4 SHEETS)	50-53
☐ M-603-2		REINFORCED CONCRETE PIPE	54
☐ M-603-3		PRECAST CONCRETE BOX CULVERT	55
☐ M-603-4		CORRUGATED POLYETHYLENE PIPE (AASHTO M294)	56
☐ M-603-5		POLYVINYL CHLORIDE (PVC) PIPE (AASHTO M304)	57
☐ M-603-10		CONCRETE AND METAL END SECTIONS (2 SHEETS)	58-59
☐ M-604-10		INLET, TYPE C	60
☐ M-604-11		INLET, TYPE D	61
☐ M-604-12		CURB INLET TYPE R (2 SHEETS)	62-63
☐ M-604-13		CONCRETE INLET TYPE 13	64
☐ M-604-20		MANHOLES (3 SHEETS)	65-67
☐ M-604-25		VANE GRATE INLET (5 SHEETS)	68-72
☐ M-605-1		SUBSURFACE DRAINS	73
☐ M-606-1		GUARDRAIL TYPE 3 W-BEAM (19 SHEETS)	74-92
M-606-13	☐	GUARDRAIL TYPE 7 F-SHAPE BARRIER (4 SHEETS) (REVISED ON AUGUST 30, 2013)	~~93-96~~
☐ M-606-14		PRECAST TYPE 7 CONCRETE BARRIER (3 SHEETS)	97-99

PLAN NUMBER	NEW OR REVISED	M STANDARD TITLE	PAGE NUMBER
☐ M-607-1		WIRE FENCES AND GATES (3 SHEETS)	100-102
☐ M-607-2		CHAIN LINK FENCE (3 SHEETS)	103-105
☐ M-607-3		BARRIER FENCE	106
☐ M-607-4		DEER FENCE AND GATES (3 SHEETS)	107-109
☐ M-607-10		PICKET SNOW FENCE	110
☐ M-607-15		ROAD CLOSURE GATE (9 SHEETS)	111-119
M-608-1	☐	CURB RAMPS (7 SHEETS) (REVISED ON JUNE 16, 2014)	~~120-125~~
M-609-1	☐	CURBS, GUTTERS, AND SIDEWALKS (4 SHEETS) (REVISED ON JULY 24, 2012)	~~126-129~~
☐ M-611-1		CATTLE GUARD (2 SHEETS)	130-131
☐ M-613-1		ROADWAY LIGHTING (4 SHEETS)	132-135
☐ M-614-1		RUMBLE STRIPS (3 SHEETS)	136-138
☐ M-614-2		SAND BARREL ARRAYS (2 SHEETS)	139-140
☐ M-615-1		EMBANKMENT PROTECTOR TYPE 3	141
☐ M-615-2		EMBANKMENT PROTECTOR TYPE 5	142
☐ M-616-1		INVERTED SIPHON	143
☐ M-620-1		FIELD LABORATORY CLASS 1	144
☐ M-620-2		FIELD LABORATORY CLASS 2 (2 SHEETS)	145-146
☐ M-620-11		FIELD OFFICE CLASS 1	147
☐ M-620-12		FIELD OFFICE CLASS 2	148
☐ M-629-1		SURVEY MONUMENTS (2 SHEETS)	149-150

COLORADO
DEPARTMENT OF TRANSPORTATION

M&S STANDARDS PLANS LIST

July 04, 2012

Revised on July 22, 2014

ALL OF THE M&S STANDARD PLANS, AS SUPPLEMENTED AND REVISED, APPLY TO THIS PROJECT WHEN USED BY DESIGNATED PAY ITEM OR SUBSIDIARY ITEM.

NEW OR REVISED STANDARD PLAN SHEETS APPLICABLE TO THIS PROJECT, INDICATED BY A MARKED BOX ■, WILL BE ATTACHED TO THE PLANS.

PLAN NUMBER	NEW OR REVISED	S STANDARD TITLE	PAGE NUMBER
☐ S-612-1		DELINEATOR INSTALLATIONS (7 SHEETS)	151-157
S-614-1	☐	GROUND SIGN PLACEMENT (2 SHEETS) (REVISED ON MARCH 07, 2014)	~~158-159~~
☐ S-614-2		CLASS I SIGNS	160
☐ S-614-3		CLASS II SIGNS	161
☐ S-614-4		CLASS III SIGNS (3 SHEETS)	162-164
☐ S-614-5		BREAK-AWAY SIGN SUPPORT DETAILS FOR GROUND SIGNS (2 SHEETS)	165-166
S-614-6	☐	CONCRETE FOOTINGS AND SIGN ISLANDS FOR CLASS III SIGNS (2 SHEETS) (REVISED ON SEPTEMBER 16, 2013)	~~167-168~~
S-614-8	☐	TUBULAR STEEL SIGN SUPPORT DETAILS (5 SHEETS) (REVISED ON MARCH 05, 2013)	~~169-173~~
☐ S-614-9		PEDESTRIAN PUSH BUTTON POST ASSEMBLY	174
☐ S-614-10		MARKER ASSEMBLY INSTALLATIONS	175
☐ S-614-11		MILEPOST SIGN DETAIL FOR HIGH SNOW AREAS	176
☐ S-614-12		STRUCTURE NUMBER INSTALLATION	177
☐ S-614-14		FLASHING BEACON AND SIGN INSTALLATIONS (3 SHEETS)	178-180
☐ S-614-20		TYPICAL POLE MOUNT SIGN INSTALLATIONS	181
☐ S-614-21		CONCRETE BARRIER SIGN POST INSTALLATIONS	182
☐ S-614-22		TYPICAL MULTI-SIGN INSTALLATIONS	183
☐ S-614-40		TYPICAL TRAFFIC SIGNAL INSTALLATION DETAILS (5 SHEETS)	184-188
S-614-40A	☐	ALTERNATIVE TRAFFIC SIGNAL INSTALLATION DETAILS (4 SHEETS) (REVISED ON SEPTEMBER 25, 2012)	~~189-192~~
☐ S-614-41		PEDESTAL POLE AND TEMPORARY SPAN WIRE SIGNALS	193
☐ S-614-42		CABINET FOUNDATION DETAIL (4 SHEETS)	194-197
☐ S-614-43		TRAFFIC LOOP AND MISCELLANEOUS SIGNAL DETAILS (10 SHEETS)	198-207
S-614-50	☐	STATIC SIGN MONOTUBE STRUCTURES (12 SHEETS) (REVISED ON NOVEMBER 28, 2012)	~~208-219~~
S-614-60	☐	DYNAMIC SIGN MONOTUBE STRUCTURES (14 SHEETS) (REVISED ON NOVEMBER 28, 2012)	~~220-233~~
S-627-1	☐	PAVEMENT MARKINGS (5 SHEETS) (REVISED ON JUNE 10, 2014)	~~234-238~~
S-630-1	☐	TRAFFIC CONTROLS FOR HIGHWAY CONSTRUCTION (20 SHEETS) (REVISED ON JULY 22, 2014)	~~239-258~~
☐ S-630-2		BARRICADES, DRUMS, CONCRETE BARRIERS (TEMP) AND VERTICAL PANELS	259
☐ S-630-3		FLASHING BEACON (PORTABLE) DETAILS	260
☐ S-630-4		STEEL SIGN SUPPORT (TEMPORARY) INSTALLATION DETAILS (2 SHEETS)	261-262
S-630-5	☐	PORTABLE RUMBLE STRIPS (TEMPORARY) (2 SHEETS) (REVISED ON JULY 26, 2013)	~~263-264~~
☐ S-630-6		EMERGENCY PULL-OFF AREA (TEMPORARY)	265
☐ S-630-7		ROLLING ROADBLOCKS FOR TRAFFIC CONTROL (3 SHEETS)	266-268

GonzalesJ 9:01:31 AM J:\184026 - CDOT Tunnel NPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-StdPlanList.dgn

Print Date: 8/18/2014
File Name: 24.9-StdPlanList.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

(R-X)

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

STANDARD PLAN LIST
Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 1

Project No./Code
C 0703-399
19373
Sheet Number 2

GENERAL NOTES

1. ELECTRICAL CONDUIT THAT IS INDICATED "TO BE REMOVED" SHALL BE REMOVED FROM THE SWITCHGEAR BACK AS NECESSARY TO CLEAR THE EXISTING SWITCHGEAR AND TO FACILITATE EXTENSION TO THE TEMPORARY SWITCHGEAR WIRE SHALL BE REPLACED BACK TO THE POINT OF CONNECTION.
2. THE TUNNEL IS LOCATED AT APPROXIMATELY 11,000 FEET ABOVE SEA LEVEL. ALL EQUIPMENT RATINGS SPECIFIED IN THE DRAWINGS AND SPECIFICATIONS SHALL APPLY TO THE INSTALLATION LOCATION AT THAT ELEVATION.
3. ALL PROPOSED LOCATIONS FOR TEMPORARY FEEDERS, ETC. SHALL BE REVIEWED WITH THE ENGINEER PRIOR TO ACTUAL INSTALLATION.
4. ALL CONDUITS, JUNCTION BOXES, AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE LATEST RULES AND REGULATIONS OF THE NATIONAL ELECTRIC CODE, CDOT STANDARDS, AND APPLICABLE LOCAL CODES.
5. CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURAL CONDITIONS. EXPOSED CONDUITS SHALL BE INSTALLED PARALLEL TO BEAMS AND WALLS WHENEVER POSSIBLE. SPARE CONDUITS SHALL HAVE NYLON PULL LINES RATED 200 LBS INSTALLED AND SHALL BE CAPPED.
6. ALL CONDUIT SHALL BE A MINIMUM OF ¾" RGS UNLESS OTHERWISE NOTED AND ALL POWER AND CONTROL CONDUCTORS SHALL BE A MINIMUM OF NO.12 AWG UNLESS OTHERWISE NOTED. ALL WIRE INSULATION TYPE SHALL BE XHHW, UNLESS OTHERWISE NOTED.
7. ALL SURFACE MOUNTED BOXES, AND CONDUITS SHALL BE MOUNTED SO AS TO MAINTAIN A ¾" AIR SPACE BETWEEN THE DEVICE AND THE WALL UNLESS OTHERWISE NOTED.
8. ALL CONDUIT RUNS CROSSING STRUCTURAL EXPANSION JOINTS SHALL HAVE EXPANSION AND DEFLECTION TYPE FITTINGS AT THAT LOCATION.
9. THE ELECTRICAL CONTRACTOR SHALL PROVIDE LAYOUTS FOR THE ELECTRICAL ROOMS BASED ON ACTUAL EQUIPMENT SIZE OF THE MANUFACTURER SELECTED. SUBMIT TO ENGINEER FOR REVIEW PRIOR TO INSTALLATION.
10. PROVIDE PHENOLIC TAGS WITH WHITE LETTERS ON BLACK BACKGROUND FOR ALL SWITCHGEAR CUBICLES, TRANSFORMERS, PANELBOARDS, AND COMMUNICATION EQUIPMENT. APPLY WITH SCREWS. REFER TO SPECIAL PROVISIONS. NAMEPLATES ON POWER CONTROL BOARD SHALL BE APPLIED WITH ADHESIVE.
11. PRIOR TO INSTALLATION OF ALL CONDUITS, THE ELECTRICAL CONTRACTOR SHALL COORDINATE LOCATIONS WITH THE ENGINEER.
12. ALL CONDUITS SHALL BE TAGGED WITH BRASS TAGS AT ALL TERMINATIONS AND BOXES AS PER SPECIAL PROVISIONS.
13. ASBESTOS WILL BE ENCOUNTED WHEN DRILLING INTO ELECTRIC ROOM CEILING AND MAY BE PRESENT IN THE EXISTING SWITCHGEAR. FOLLOW ABATEMENT PROCEDURES IN SPECIFICATIONS. THE COST OF WORK WILL BE INCLUDED IN PAY ITEMS NO. 250-00010, 250-00050, AND 250-00110.
14. IT IS ESTIMATED THAT ONE LUMP SUM ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT WILL BE REQUIRED FOR THIS PROJECT.
15. IT IS ESTIMATED THAT 40 HRS MONITORING TECHNICIAN WILL BE REQUIRED FOR THIS PROJECT.
16. IT IS ESTIMATED THAT 40 HRS HEALTH AND SAFETY OFFICER WILL BE REQUIRED FOR THIS PROJECT.
17. CONTRACTOR SHALL PROVIDE PROTECTION FOR THE FACILITY AND ITS EQUIPMENT AND FURNISHINGS. ANY DAMAGE TO CDOT PROPERTY SHALL BE REPAIRED OR REPLACED TO THE SATISFACTION OF THE PROJECT ENGINEER AT NO COST TO CDOT.
18. CONTRACTOR SHALL PROVIDE SPARE CIRCUIT BREAKERS AND GROUND AND TEST DEVICES FOR THE NEW 27KV SWITCHGEAR, ONE SPARE AND ONE GROUND AND TEST DEVICE FOR EACH VENTILATION BUILDING.
19. PRIOR TO DISCONNECTING ANY WIRING, THE CONTRACTOR SHALL ESTABLISH THE FUNCTION OF EACH EXISTING CONDUCTOR.

Print Date: 8/18/2014
File Name: 24.9-GeneralNotes.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

GENERAL NOTES
Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 1

Project No./Code
C 0703-399
19373
Sheet Number 3

GonzalesJ 9:01:43 AM J:\184026 - CDOT Tunnel\NPS 2011\E.EJMT_25kVSwitchgear_(TO5)\19373\Design\Drawings\Plan Sheet files\24.9-GeneralNotes.dgn

SUMMARY OF APPROXIMATE QUANTITIES

INDEX			CONTRACT ITEM NO.	CONTRACT ITEM	UNIT	EAST AND WEST VENTILATION BUILDINGS																		PROJECT TOTALS	
BOOK	PAGE	SHEET				PLAN	AS CONST.																	PLAN	AS CONST.
			202-00047	REMOVAL OF ELECTRICAL EQUIPMENT	LS	1																		1	
			210-00478	MODIFY POWER CONTROL BOARD	LS	1																		1	
			250-00010	ENVIRONMENT HEALTH AND SAFETY MANAGEMENT	LS	1																		1	
			250-00050	MONITORING TECHNICIAN	HOUR	40																		40	
			250-00110	HEALTH AND SAFETY OFFICER	HOUR	40																		40	
			613-04010	CONDUIT	LS	1																		1	
			613-10000	WIRING	LS	1																		1	
			613-80132	RELAY CABINET	EACH	2																		2	
			613-80268	STEP VOLTAGE REGULATOR	EACH	6																		6	
			613-80272	REGULATOR BYPASS SWITCH	EACH	6																		6	
			613-80274	STRUCTURE MTD DISCONNECT SWITCH	EACH	12																		12	
			613-80276	INVERTER SYSTEM	EACH	1																		1	
			613-81600	24.9kV SWITCHGEAR	EACH	2																		2	
			613-81602	TEMPORARY SWITCHGEAR	EACH	1																		1	
			626-00000	MOBILIZATION	EACH	1																		1	
				FORCE ACCOUNT																					
			700-70010	F/A MINOR CONTRACT REVISIONS	FA	1																		1	
			700-70011	F/A PARTNERING	FA	1																		1	
			700-70016	F/A FUEL COST ADJUSTMENT	FA	1																		1	
			700-70021	F/A ON-THE-JOB-TRAINEE	FA	1																		1	

Print Date: 8/20/2014
File Name: 24.9_SAQ-01.dgn
Horiz. Scale: 1:2 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

SUMMARY OF
APPROXIMATE QUANTITIES

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 1

Project No./Code
C 0703-399
19373
Sheet Number 4

GonzalesJ 9:53:46 AM J:\184045K - EJMT 24.9KV Switchgear\5.0 Project Data\5.1 Electrical\19373\Design\Drawings\Plan Sheet files\24.9_SAQ-01.dgn

TABULATION OF CONDUIT AND WIRING

CONDUIT DESIGNATION	CONDUIT SIZE	CDOT CIRCUIT DESIGNATION	ORIGIN	DESTINATION	FUNCTION	NO. OF WIRES	WIRE SIZE	613-CONDUIT (LS)					613-WIRING (LS)							
								LINEAR FOOT (FOR INFORMATION ONLY)					LINEAR FOOT (FOR INFORMATION ONLY)							
								3/4 INCH	1 INCH	1 1/4 INCH	1 1/2 INCH	4 INCH	NO. 12	NO. 10	NO. 8	NO. 6	NO. 2	NO. 1	NO. 1 35KV	NO. 1/0 35KV
EAST VENTILATION BUILDING																				
P1	4 IN	P1	24.9KV SWITCHGEAR	2400V TRANSFORMER 1B	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					70						85	255	
P2	4 IN	P2	24.9KV SWITCHGEAR	2400V TRANSFORMER 1A	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					50						65	195	
P2A	4 IN	P2	STEP VOLTAGE REGULATOR	24.9KV SWITCHGEAR	INCOMING LINE	3	NO.1/0 35KV, NO.1 GND					160						180		540
P2B	4 IN	P2	STEP VOLTAGE REGULATOR	24.9KV SWITCHGEAR	INCOMING LINE	3	NO.1/0 35KV, NO.1 GND					160						180		540
P11	4 IN	P11	24.9KV SWITCHGEAR	480V TRANSFORMER 1	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					60						75	225	
P12	4 IN	P12	24.9KV SWITCHGEAR	480V TRANSFORMER 2	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					60						75	225	
P13	4 IN	P13	24.9KV SWITCHGEAR-EAST BUILDING	24.9KV SWITCHGEAR-WEST BUILDING	24.9KV TIE FEEDER-EXISTING CABLE TO REMAIN	3	NO.1 35KV, NO.1 GND													
P800	1 IN		DISTRIBUTION PANEL DP-EV	INVERTER SYSTEM BYPASS TRANSFORMER	BYPASS POWER	2	NO. 6, NO. 10 GND		180					190		380				
P801	1 1/2		INVERTER SYSTEM BYPASS TRANSFORMER	INVERTER SYSTEM	BYPASS POWER	3	NO. 2, NO. 8 GND		10						15		45			
D3	1 IN	D3	125/250V DC PANEL	24.9KV SWITCHGEAR	125V DC CONTROL POWER	2	NO. 10		90					200						
D4	1 IN	D4	125/250V DC PANEL	24.9KV SWITCHGEAR	125V DC CONTROL POWER	2	NO. 10		90					200						
D101	1 1/4 IN		125/250V DC PANEL	INVERTER SYSTEM	250V DC POWER	2	NO. 2, NO. 8 GND			150					160		320			
C1	1 1/2 IN	C1	24.9KV SWITCHGEAR	CONTROL ROOM-POWER CONTROL BOARD	MAIN CONTROL AND POSITION INDICATION	6	NO. 12				40		900							
C2	1 1/2 IN	C2	24.9KV SWITCHGEAR	CONTROL ROOM-POWER CONTROL BOARD	TIE CONTROL AND POSITION INDICATION	6	NO. 12				40		900							
C3	1 1/2 IN	C3	24.9KV SWITCHGEAR	CONTROL ROOM-POWER CONTROL BOARD	TRANSFORMER NO. 2 CONTROL AND POSITION INDICATION	6	NO. 12				30		900							
C4	1 1/2 IN	C4	24.9KV SWITCHGEAR	CONTROL ROOM-POWER CONTROL BOARD	TRANSFORMER NO. 1 CONTROL AND POSITION INDICATION	6	NO. 12				30		900							
C5	1 IN	C5	24.9KV SWITCHGEAR	480V SWITCHGEAR	STANDBY GENERATOR INTERLOCK	9	NO. 12				20		540							
C1A,C1B	3/4 IN	C1A, C1B	24.9KV SWITCHGEAR	CONTROL ROOM-POWER CONTROL BOARD	TRANSFORMER NO. 1A CONTROL AND POSITION INDICATION	6	NO. 12	20					360							
C2A, C2B	3/4 IN	C2A, C2B	24.9KV SWITCHGEAR	CONTROL ROOM-POWER CONTROL BOARD	TRANSFORMER NO. 1B CONTROL AND POSITION INDICATION	6	NO. 12	20					360							
WEST VENTILATION BUILDING																				
P1	4 IN	P1	24.9KV SWITCHGEAR	2400V TRANSFORMER 1A	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					50						65	195	
P2	4 IN	P2	24.9KV SWITCHGEAR	2400V TRANSFORMER 1A	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					80						95	285	
P2A	4 IN	P2	STEP VOLTAGE REGULATOR	24.9KV SWITCHGEAR	INCOMING LINE	3	NO.1/0 35KV, NO.1 GND					160						180		540
P2B	4 IN	P2	STEP VOLTAGE REGULATOR	24.9KV SWITCHGEAR	INCOMING LINE	3	NO.1/0 35KV, NO.1 GND					160						180		540
P11	4 IN	P11	24.9KV SWITCHGEAR	480V TRANSFORMER 1	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					60						75	225	
P12	4 IN	P12	24.9KV SWITCHGEAR	480V TRANSFORMER 2	24.9KV FEEDER	3	NO.1 35KV, NO.1 GND					60						75	225	
P13	4 IN	P13	24.9KV SWITCHGEAR-EAST BUILDING	24.9KV SWITCHGEAR-WEST BUILDING	24.9KV TIE FEEDER-EXISTING CABLE TO REMAIN	3	NO.1 35KV, NO.1 GND													
D3	1 IN	D3	125V DC PANEL	24.9KV SWITCHGEAR	125V DC CONTROL POWER	2	NO. 10		90					200						
D4	1 IN	D4	125V DC PANEL	24.9KV SWITCHGEAR	125V DC CONTROL POWER	2	NO. 10		90					200						
C201	1 1/2 IN	C201	24.9KV SWITCHGEAR	REMOTE SUPERVISORY TERMINAL	MAIN CONTROL AND POSITION INDICATION	6	NO. 12				20		240							
C202	1 1/2 IN	C202	24.9KV SWITCHGEAR	REMOTE SUPERVISORY TERMINAL	TIE CONTROL AND POSITION INDICATION	6	NO. 12				30		300							
C203	1 1/2 IN	C203	24.9KV SWITCHGEAR	REMOTE SUPERVISORY TERMINAL	TRANSFORMER NO. 2 CONTROL AND POSITION INDICATION	6	NO. 12				30		300							
C204	1 1/2 IN	C204	24.9KV SWITCHGEAR	REMOTE SUPERVISORY TERMINAL	TRANSFORMER NO. 1 CONTROL AND POSITION INDICATION	6	NO. 12				40		360							
C1A,C1B	3/4 IN	C1A, C1B	24.9KV SWITCHGEAR	REMOTE SUPERVISORY TERMINAL	TRANSFORMER NO. 1A CONTROL AND POSITION INDICATION	6	NO. 12	30					300							
C2A, C2B	3/4 IN	C2A, C2B	24.9KV SWITCHGEAR	REMOTE SUPERVISORY TERMINAL	TRANSFORMER NO. 1B CONTROL AND POSITION INDICATION	6	NO. 12	30					300							
TOTALS								100	550	150	280	1130	6660	990	175	380	365	1330	1830	2160

Print Date: 8/18/2014
File Name: 24.9-CC-Schedule.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

TABULATION OF CONDUIT AND WIRING
Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 1

Project No./Code
C 0703-399
19373
Sheet Number 5

GonzalesJ 9:01:55 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-CC-Schedule.dgn

TABULATION OF ELECTRICAL EQUIPMENT

ITEM	NAME	UNIT	QUANTITY
202	REMOVAL OF ELECTRICAL EQUIPMENT	LS	1
210	MODIFY POWER CONTROL BOARD	LS	1
613	RELAY CABINET	EA	2
613	STEP VOLTAGE REGULATOR	EA	6
613	REGULATOR BYPASS SWITCH	EA	6
613	STRUCTURE MOUNTED DISCONNECT SWITCH	EA	12
613	INVERTER SYSTEM	EA	1
613	24.9KV SWITCHGEAR	EA	2
613	TEMPORARY SWITCHGEAR	EA	1

GonzalesJ 10:10:48 AM J:\184045K - EJMT 24.9KV Switchgear\5.0 Project Data\5.1 Electrical\19373\Design\Drawings\Plan Sheet files\24.9-Elec-Equip-Tab.dgn

Print Date: 8/20/2014
File Name: 24.9-Elec-Equip-Tab.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

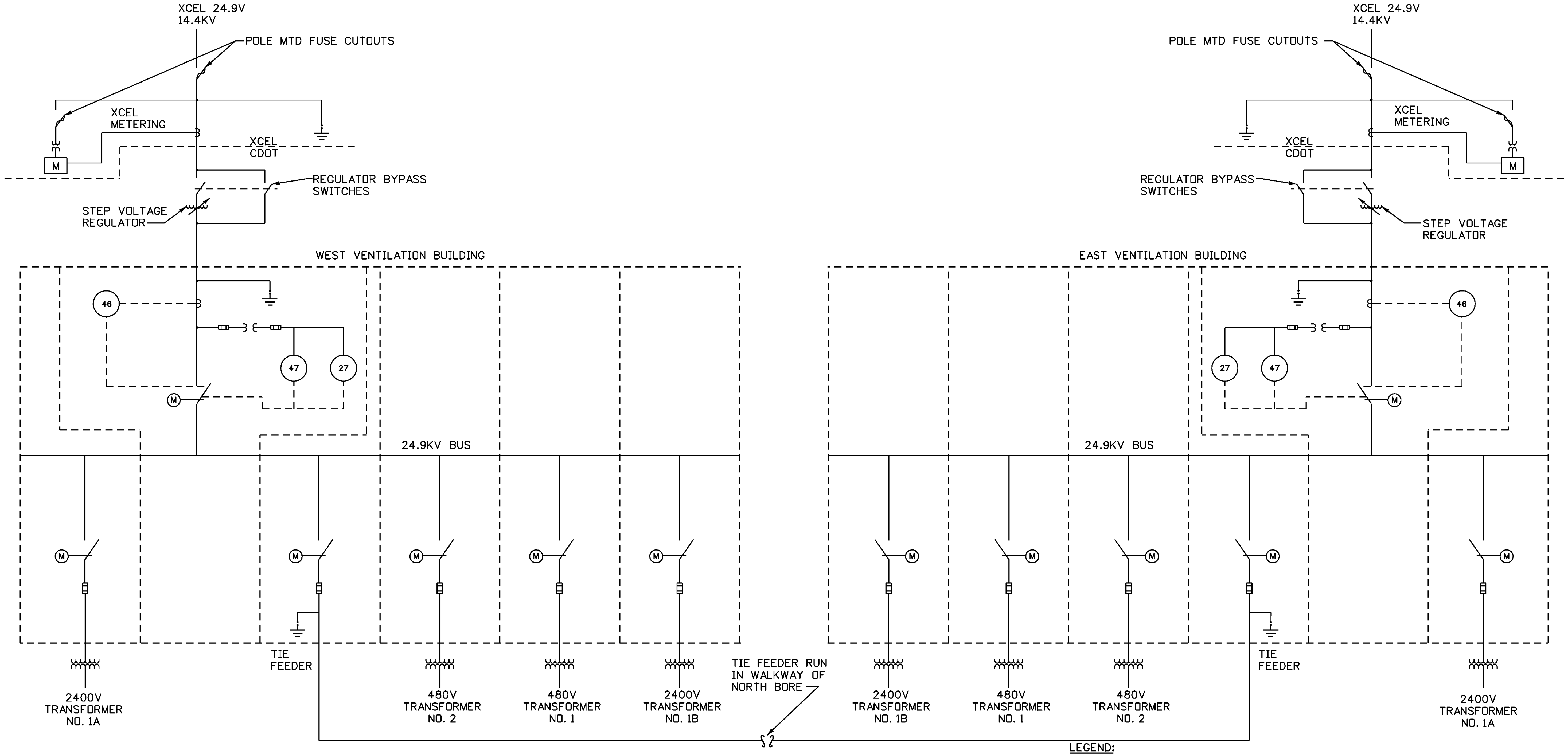
Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

TABULATION OF ELECTRICAL EQUIPMENT

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 1

Project No./Code
C 0703-399
19373
Sheet Number 6



EXISTING 24.9KV ONE-LINE DIAGRAM

N.T.S.

LEGEND:

▯	FUSE	Ⓜ	MOTOR OPERATOR
M	XCEL METER	27	UNDER VOLTAGE RELAY
	CURRENT TRANSFORMER	46	CURRENT BALANCE RELAY
−3 E−	POTENTIAL TRANSFORMER	47	PHASE SEQUENCE RELAY
⏚	LIGHTING ARRESTER		

Print Date: 8/18/2014
File Name: 24.9-Exist_One-Line.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

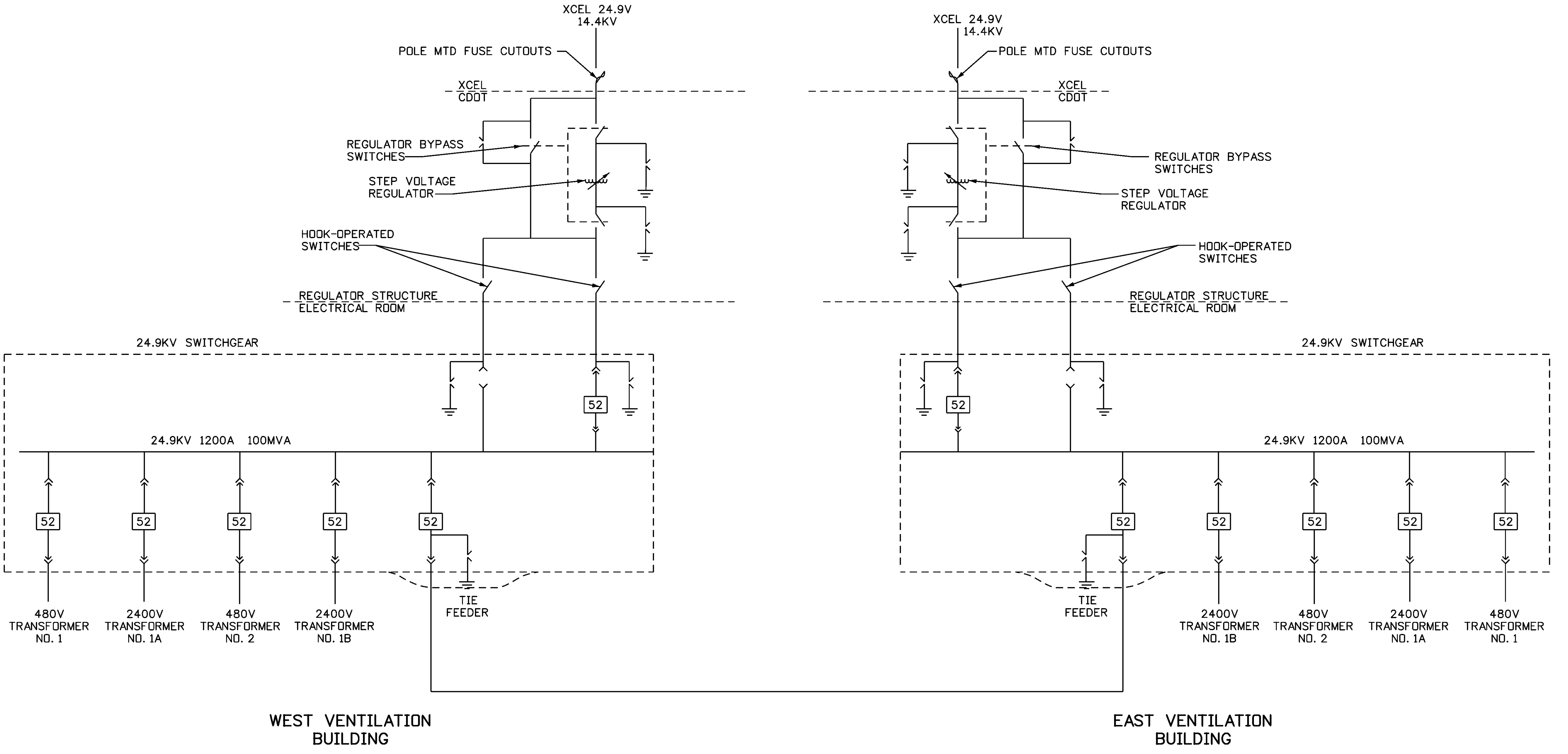
As Constructed
No Revisions:
Revised:
Void:

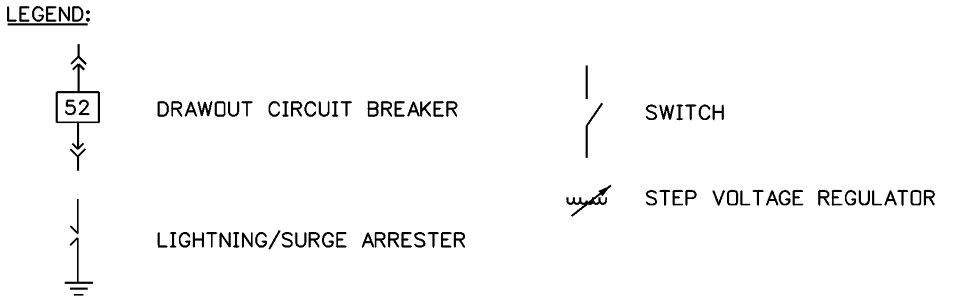
EXISTING ONE-LINE DIAGRAM

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 1 of 21

Project No./Code
C 0703-399
19373
Sheet Number 7

GonzalesJ 9:02:18 AM J:\184026 - CDOT TunnelNPS 2011\EJMT_25KVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-Exist_One-Line.dgn





NEW 24.9KV ONE-LINE DIAGRAM

N.T.S.

Print Date: 8/18/2014
File Name: 24.9-New_One-Line.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

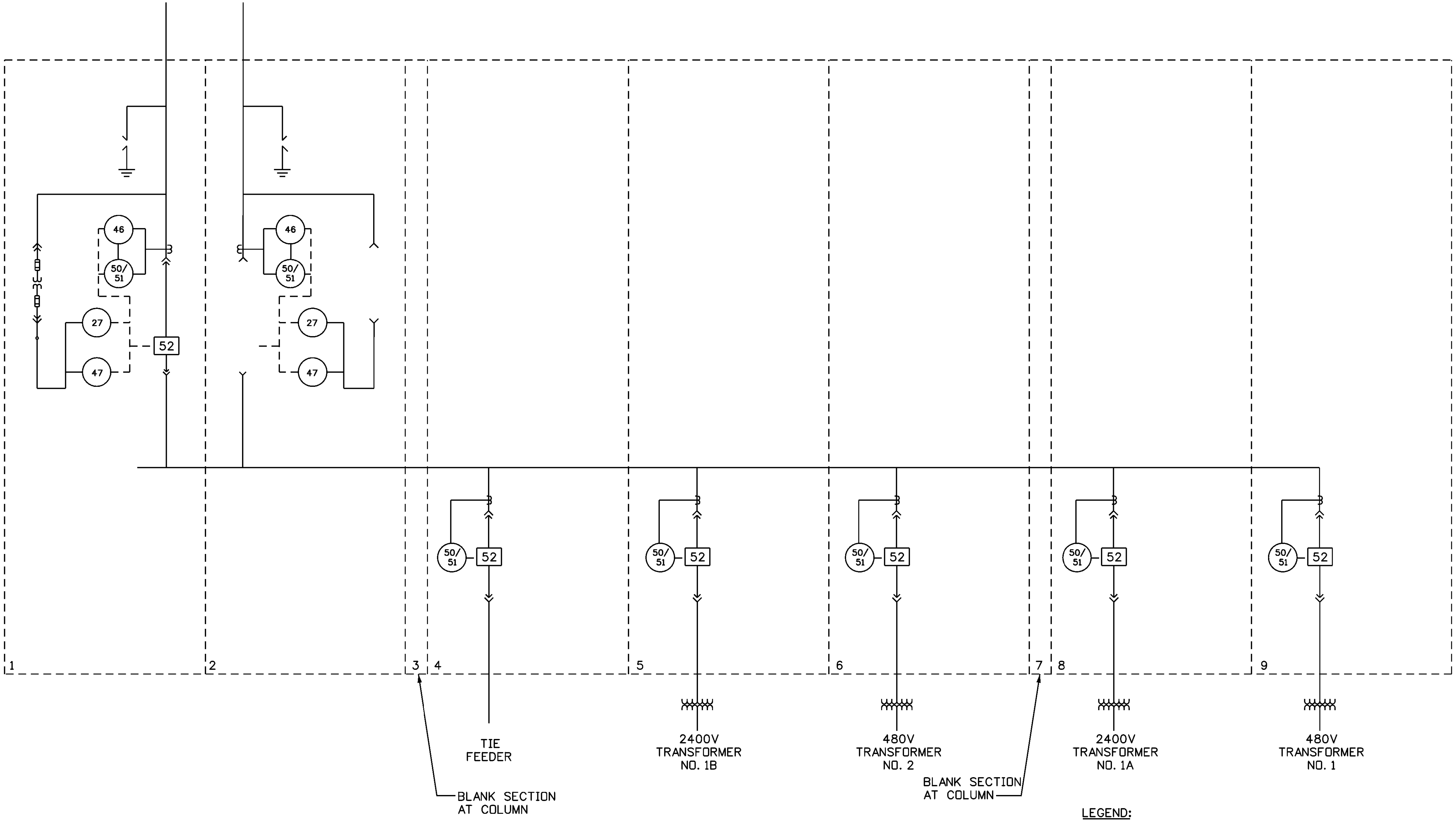
Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

NEW ONE-LINE DIAGRAM

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 2 of 21

Project No./Code
C 0703-399
19373
Sheet Number 8



NOTE:

EAST VENTILATION BUILDING SHOWN, WEST VENTILATION BUILDING SIMILAR BUT MIRROR IMAGE.

SWICTHGEAR DIAGRAM

N.T.S.

LEGEND:

	FUSE
M	XCEL METER
	CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
Ⓜ	MOTOR OPERATOR
27	UNDER VOLTAGE RELAY
46	CURRENT BALANCE RELAY
47	PHASE SEQUENCE RELAY
	LIGHTING ARRESTER

Print Date: 8/18/2014
File Name: 24.9-Switchgear-Diagram.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

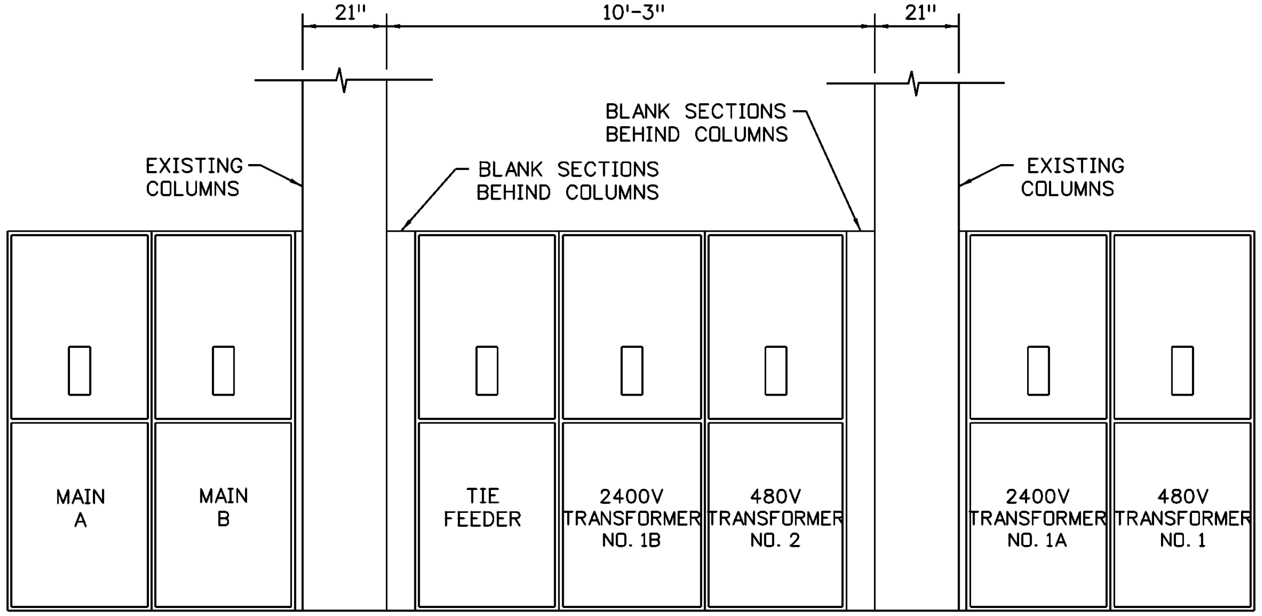
Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

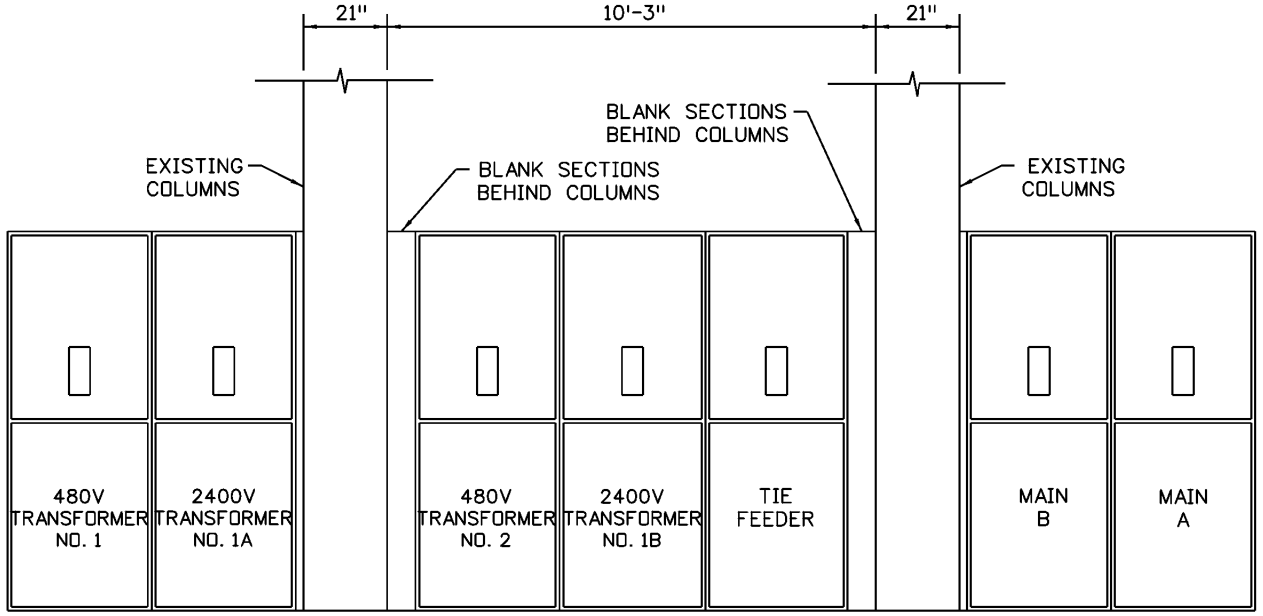
SWITCHGEAR DIAGRAM
Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset:
Subset Sheets: 3 of 21

Project No./Code
C 0703-399
19373
Sheet Number 9

GonzalesJ 9:02:32 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TDS)\19373\Design\Drawings\Plan Sheet files\24.9-Switchgear-Diagram.dgn



FRONT ELEVATION OF NEW 24.9KV SWITCHGEAR
EAST VENTILATION BUILDING
N.T.S.



FRONT ELEVATION OF NEW 24.9KV SWITCHGEAR
WEST VENTILATION BUILDING
N.T.S.

Print Date: 8/18/2014
File Name: 24.9-W_Vent-Front-Elev.dgn.dgn
Horiz. Scale: 1:4 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

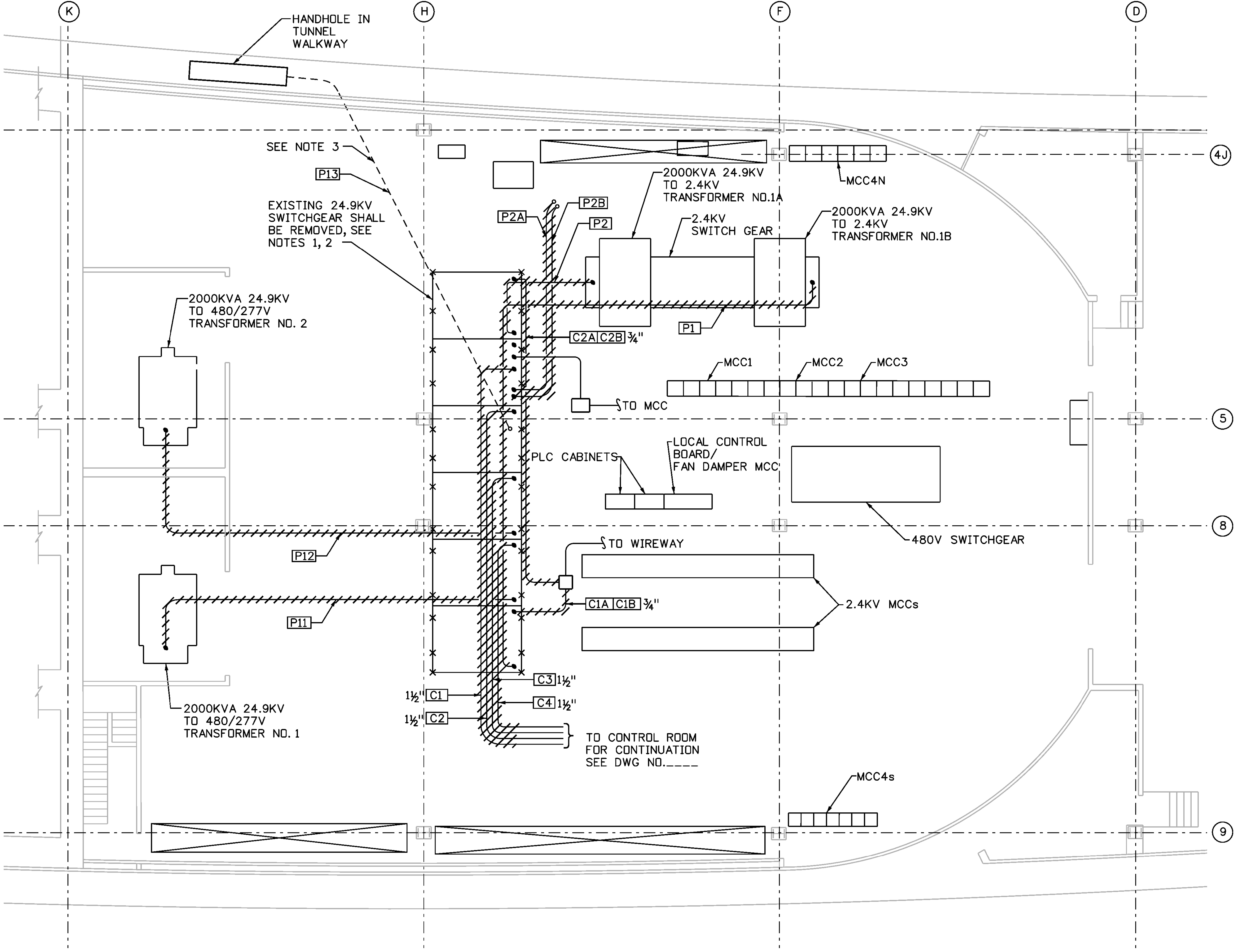
Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

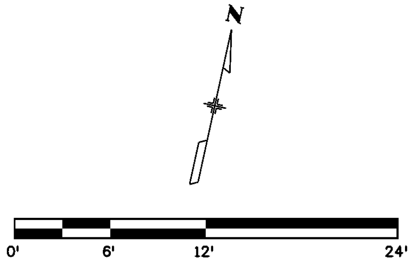
As Constructed
No Revisions:
Revised:
Void:

SWITCHGEAR ELEVATIONS
Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset:
Subset Sheets: 4 of 21

Project No./Code
C 0703-399
19373
Sheet Number 10

GonzalesJ 9:02:37 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TD5)\19373\Design\Drawings\Plan Sheet files\24.9-W_Vent-Front-Elev.dgn.dgn





LEGEND FOR EXISTING EQUIPMENT REMOVALS

⫽⫽⫽⫽⫽	CONDUIT AND WIRE TO BE REMOVED
☒	EQUIPMENT TO BE REMOVED

NOTES:

1. CUTBACK CONDUITS CONNECTING TO EXISTING SWITCHGEAR. FOR EXTENSION TO TEMPORARY SWITCHGEAR. NEW WIRE SHALL BE PROVIDED IN NEW AND EXISTING CONDUITS.
2. FOR TEMPORARY EQUIPMENT PLAN, SEE SHEET NO. 23.
3. EXISTING TIE FEEDER CABLE SHALL REMAIN.
4. FOR CONDUIT AND CABLE SCGHEDULE, SEE SHEET NO. 5.

Print Date: 8/18/2014
File Name: 24.9-E_Elec-Room.dgn
Horiz. Scale: 1:12 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

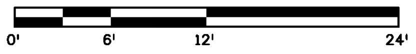
As Constructed
No Revisions:
Revised:
Void:

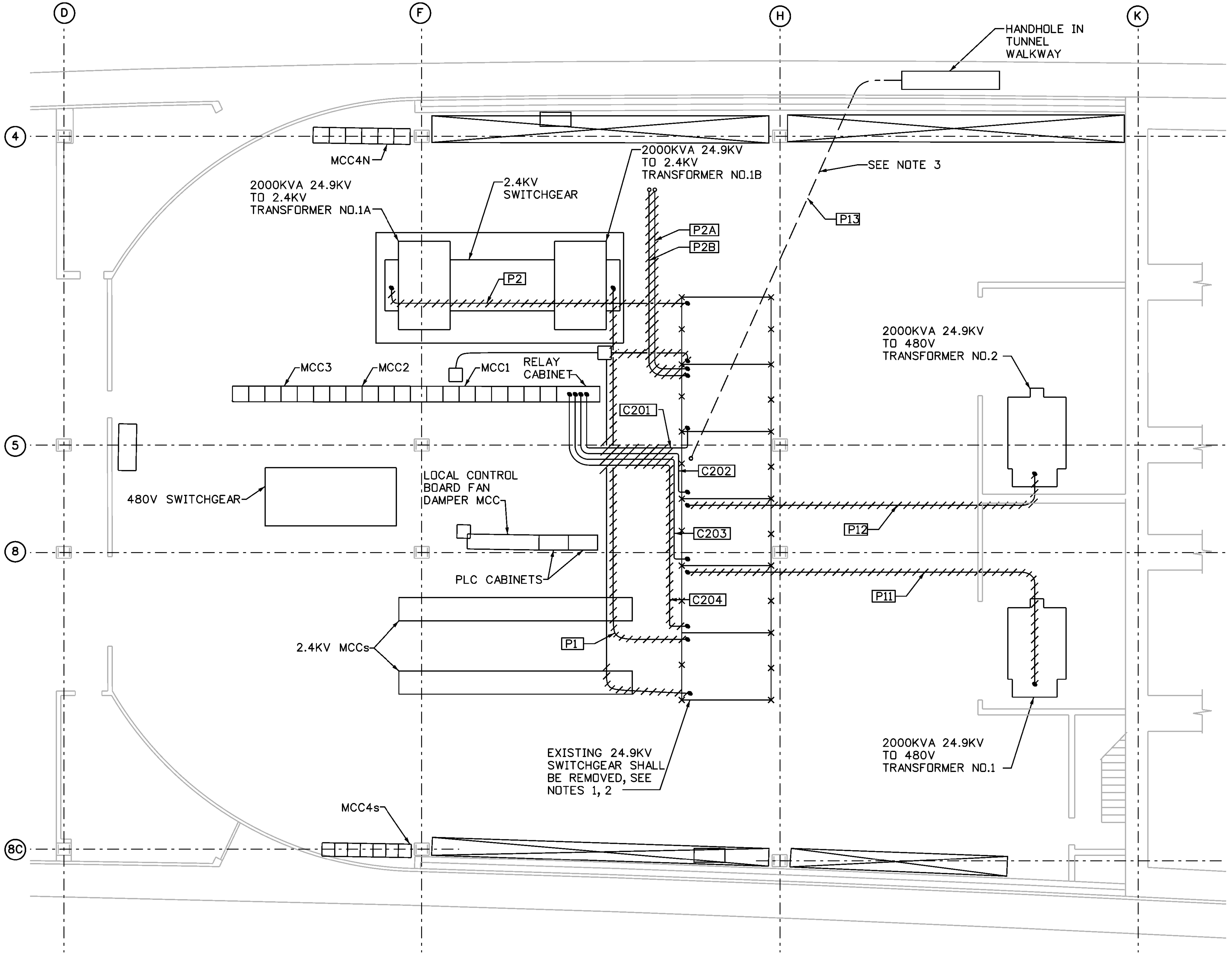
EAST VENTILATION BUILDING ELECTRICAL EQUIPMENT ROOM EXISTING PLAN

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 5 of 21

Project No./Code
C 0703-399
19373
Sheet Number 11

GonzalesJ 9:02:43 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-E_Elec-Room.dgn





LEGEND FOR EXISTING EQUIPMENT REMOVALS

⧸⧸⧸⧸⧸⧸	CONDUIT AND WIRE TO BE REMOVED
☒	EQUIPMENT TO BE REMOVED

NOTES:

1. CUTBACK CONDUITS CONNECTING TO EXISTING SWITCHGEAR. FOR EXTENSION TO TEMPORARY SWITCHGEAR. NEW WIRE SHALL BE PROVIDED IN NEW AND EXISTING CONDUITS.
2. FOR TEMPORARY EQUIPMENT PLAN, SEE SHEET NO. 23.
3. EXISTING TIE FEEDER CABLE SHALL REMAIN.
4. FOR CONDUIT AND CABLE SCHEDULE, SEE SHEET NO. 5.

Print Date: 8/18/2014
File Name: 24.9-W_Elec-Room.dgn
Horiz. Scale: 1:12 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

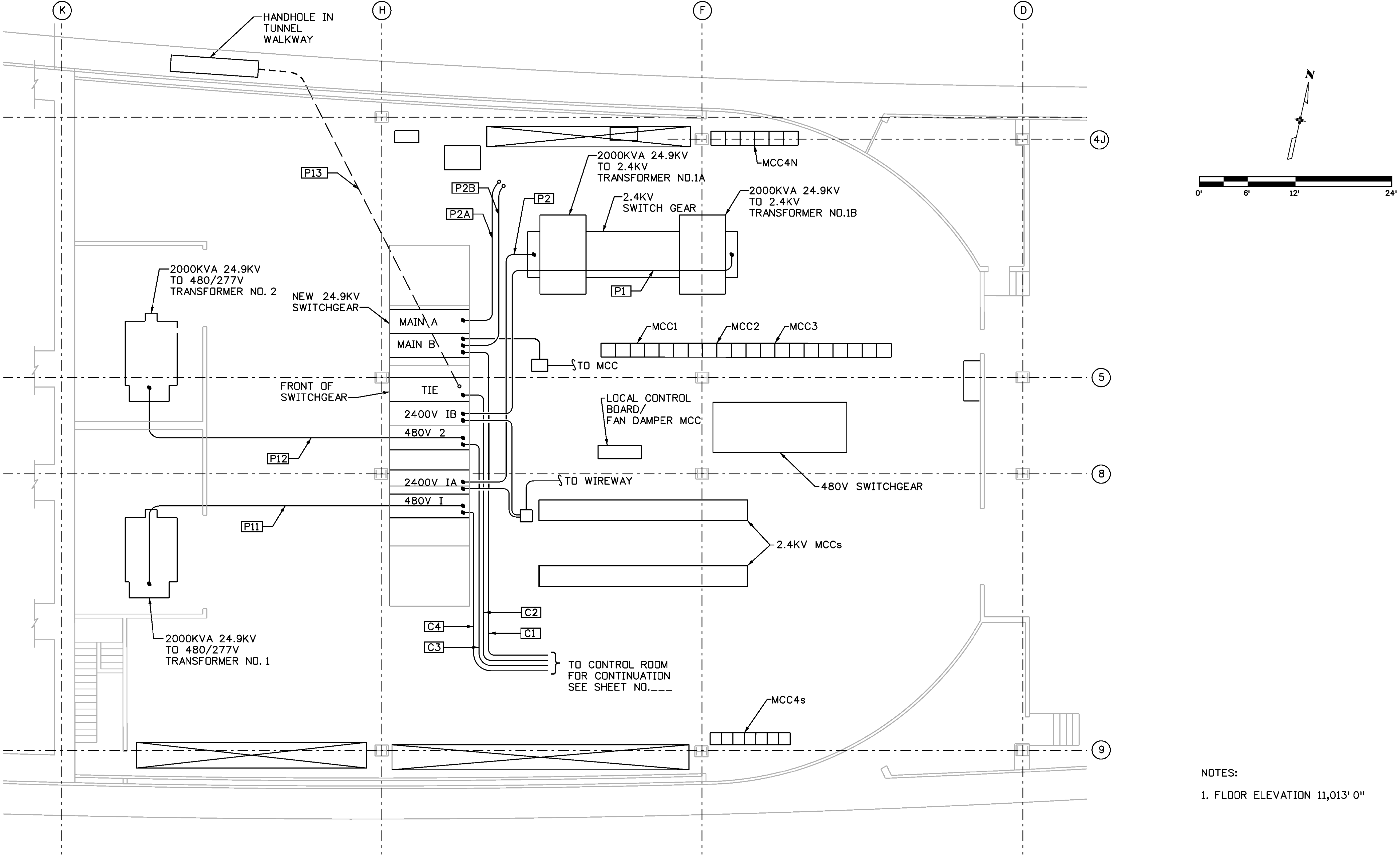
As Constructed
No Revisions:
Revised:
Void:

WEST VENTILATION BUILDING ELECTRICAL EQUIPMENT ROOM EXISTING PLAN

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 6 of 21

Project No./Code
C 0703-399
19373
Sheet Number 12

GonzalesJ 9:03:01 AM J:\184026 - CDOT Tunnel\NPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-W_Elec-Room.dgn



NOTES:

1. FLOOR ELEVATION 11,013' 0"

Print Date: 8/18/2014
File Name: 24.9-E_New-Elec-Room.dgn
Horiz. Scale: 1:12 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
Region 1
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
JDS

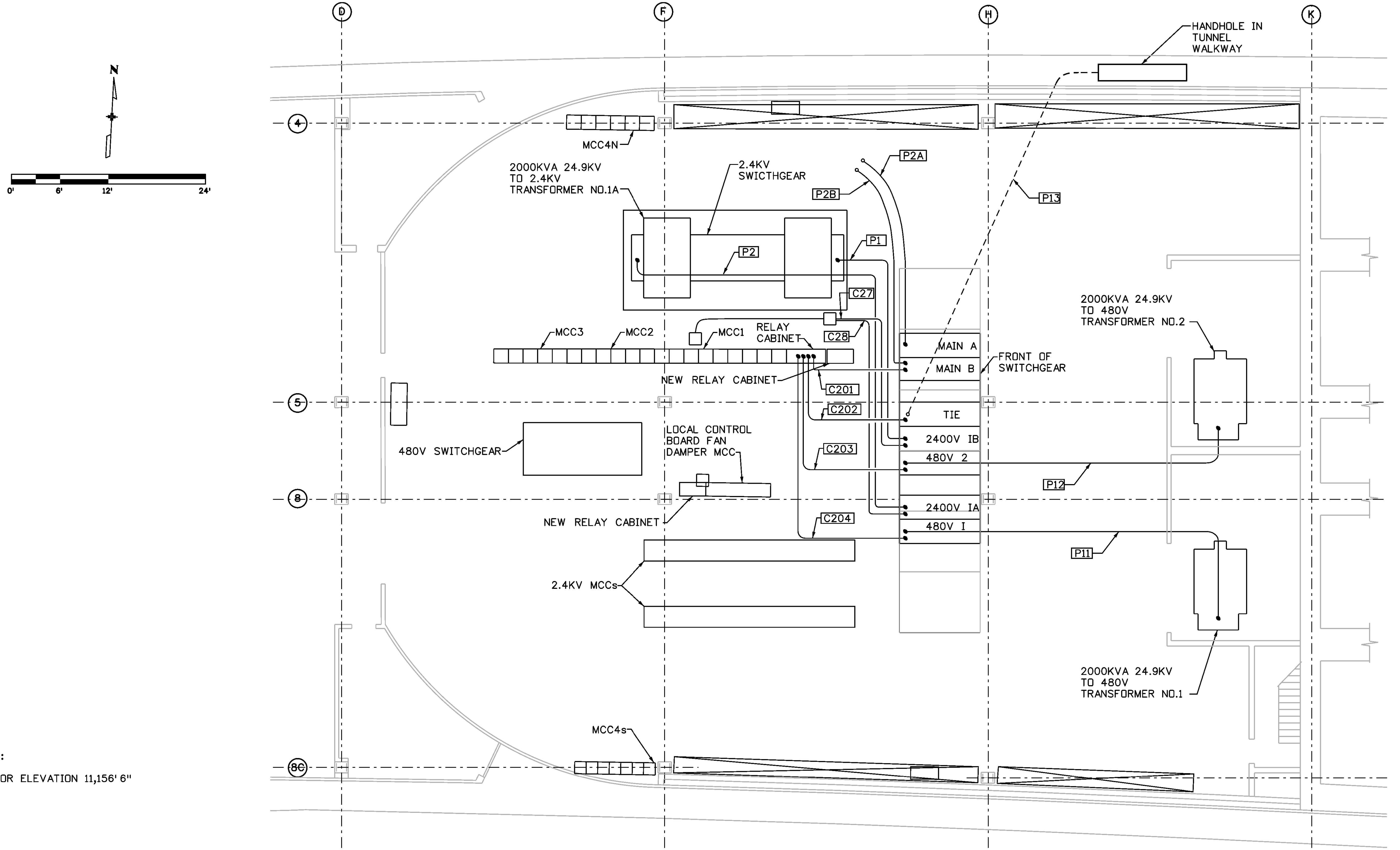
As Constructed
No Revisions:
Revised:
Void:

EAST VENTILATION ELECTRICAL EQUIPMENT ROOM PLAN - NEW

Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset:
Subset Sheets: 7 of 21

Project No./Code
C 0703-399
19373
Sheet Number 13

GonzalesJ 9:03:21 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-E_New-Elec-Room.dgn



NOTES:

1. FLOOR ELEVATION 11,156' 6"

Print Date: 8/18/2014	
File Name: 24.9-W_New-Elec-Room.dgn	
Horiz. Scale: 1:12	Vert. Scale: As Noted
Unit Information	Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

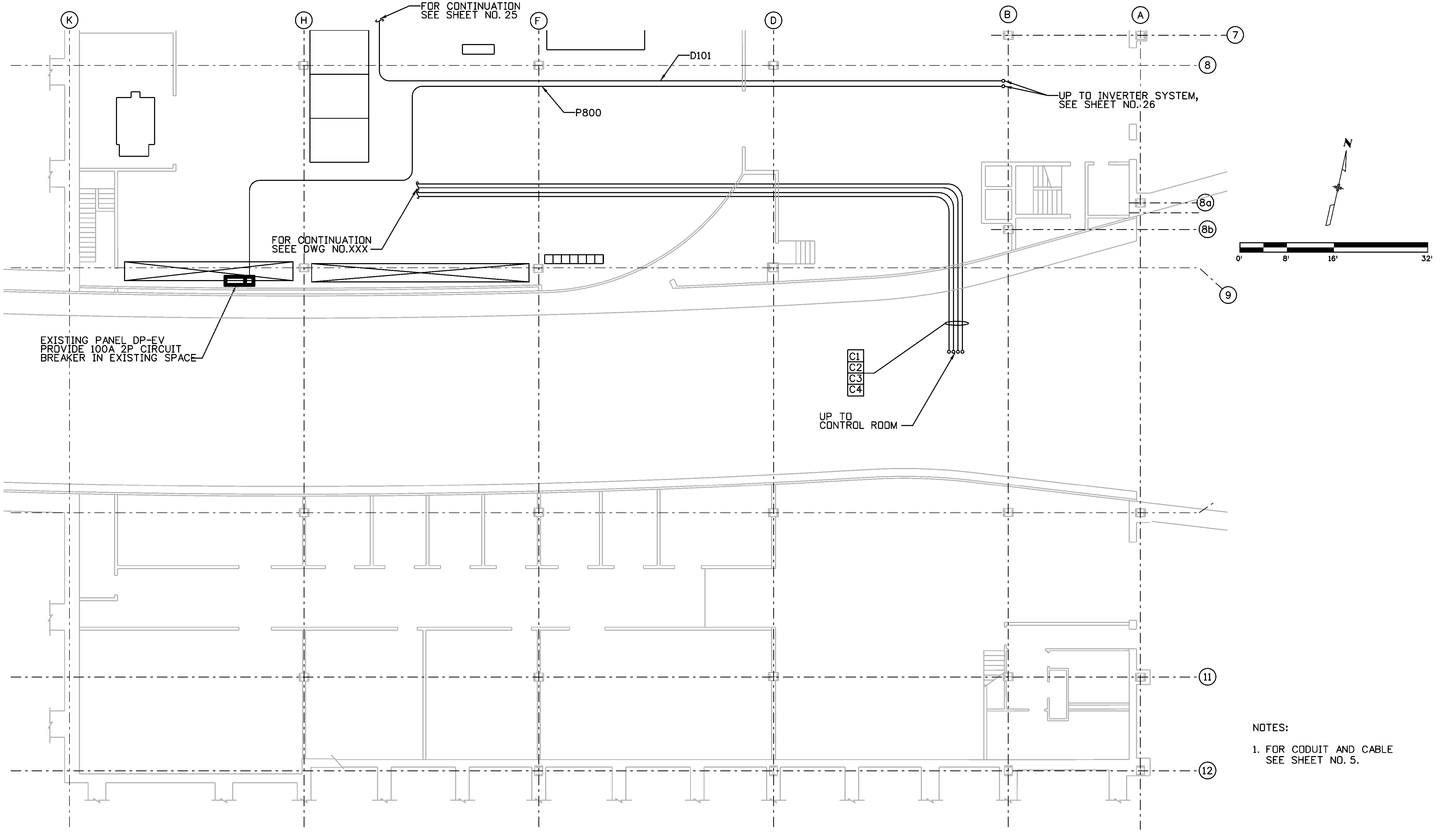
WEST VENTILATION
ELECTRICAL EQUIPMENT ROOM
PLAN - NEW

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 8 of 21

Project No./Code
C 0703-399
19373
Sheet Number 14

GonzalesJ 9:03:38 AM J:\184026 - CDOT Tunnel\NPS 2011\E.EJMT_25kVSwitchgear_(TD5)\19373\Design\Drawings\Plan Sheet files\24.9-W_New-Elec-Room.dgn

GonzalesJ 9:03:57 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TDS)\19373\Design\Drawings\Plan Sheet files\24.9-E_Vent-Room02.dgn



NOTES:

1. FOR CODUIT AND CABLE SEE SHEET NO. 5.

Print Date: 8/18/2014
File Name: 24.9-E_Vent-Room02.dgn
Horiz. Scale: 1:16 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

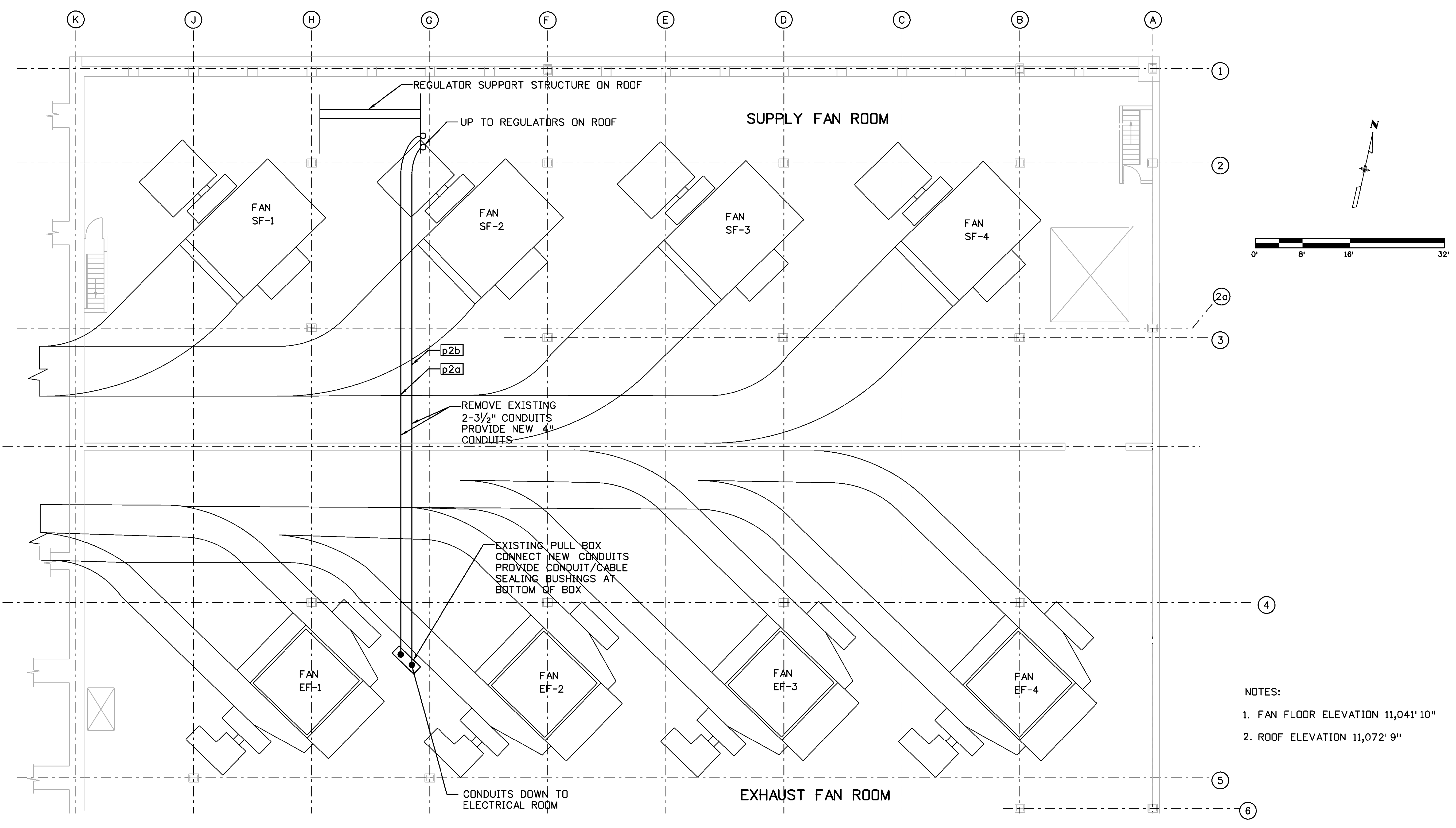
Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

EAST VENTILATION BUILDING
GROUND FLOOR PLAN SOUTH

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 9 of 21

Project No./Code
C 0703-399
19373
Sheet Number 15



NOTES:

1. FAN FLOOR ELEVATION 11,041' 10"
2. ROOF ELEVATION 11,072' 9"

Print Date: 8/18/2014
File Name: 24.9-E_Vent-Room01.dgn
Horiz. Scale: 1:16 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
CDOT
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

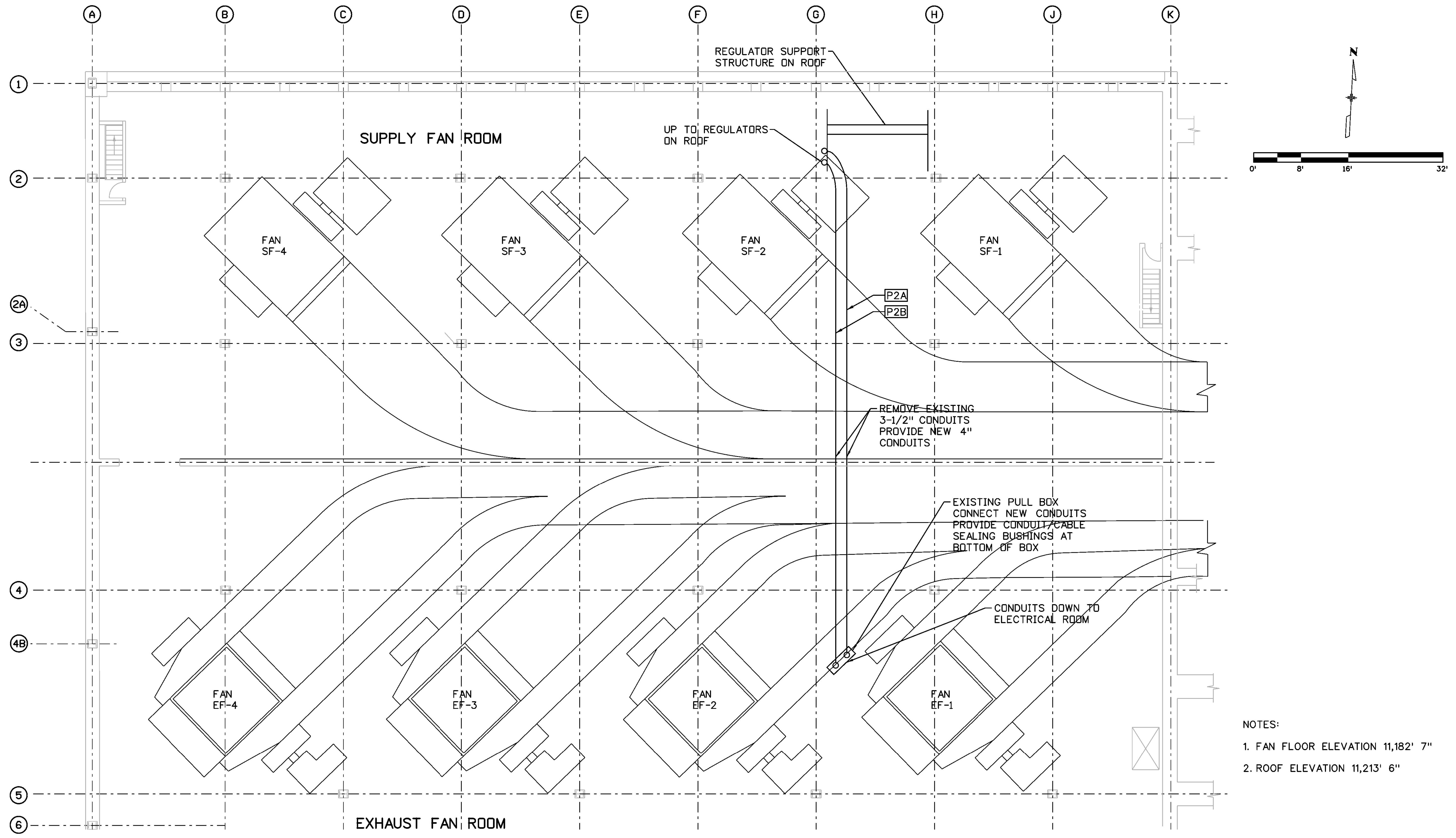
As Constructed
No Revisions:
Revised:
Void:

EAST VENTILATION BUILDING
FAN FLOOR
PLAN NORTH

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 10 of 21

Project No./Code
C 0703-399
19373
Sheet Number 16

GonzalesJ 9:04:06 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TO5)\19373\Design\Drawings\Plan Sheet files\24.9-E_Vent-Room01.dgn



NOTES:

1. FAN FLOOR ELEVATION 11,182' 7"
2. ROOF ELEVATION 11,213' 6"

Print Date: 8/18/2014
File Name: 24.9-W_Vent-Room.dgn
Horiz. Scale: 1:16 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1 JDS

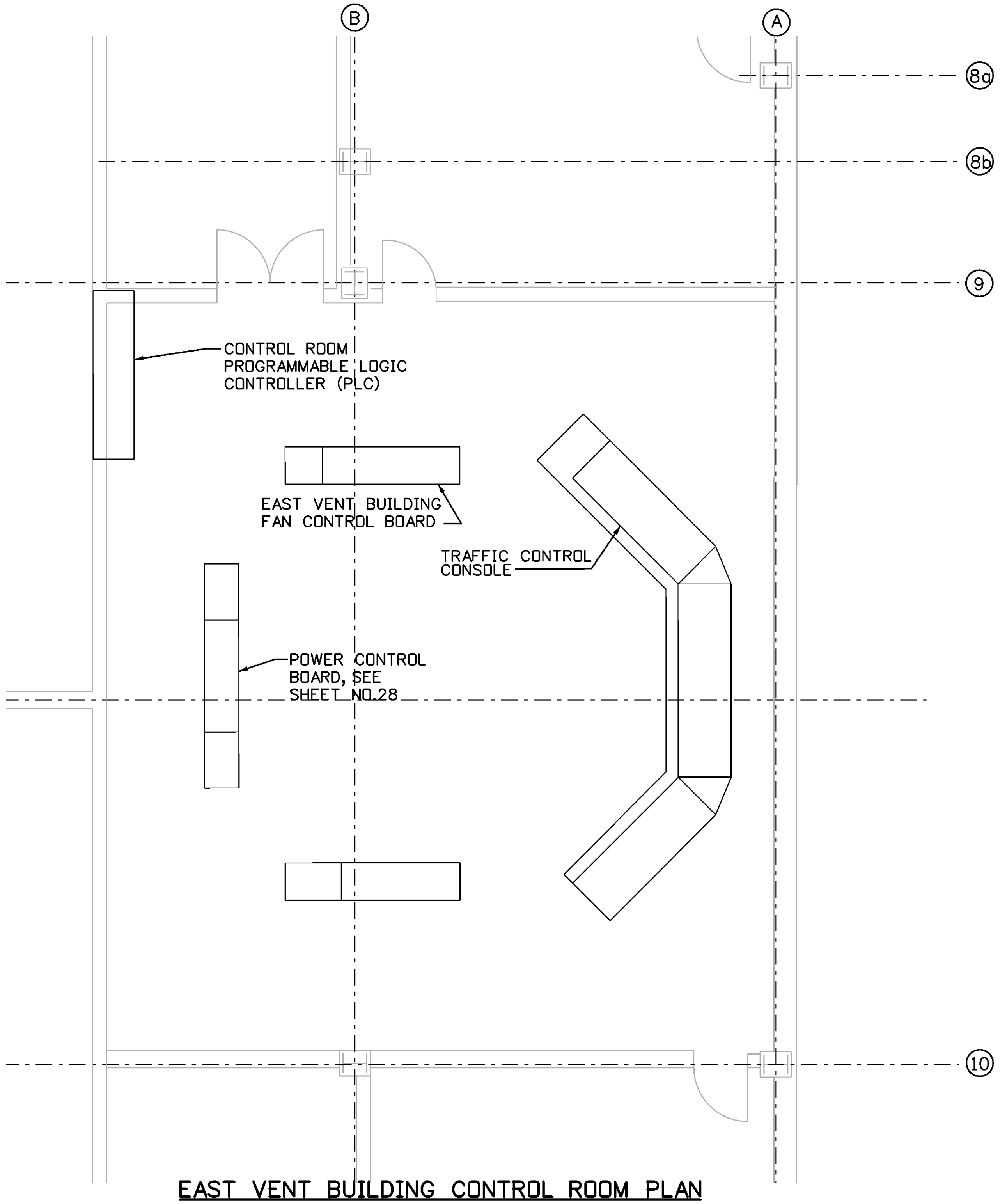
As Constructed
No Revisions:
Revised:
Void:

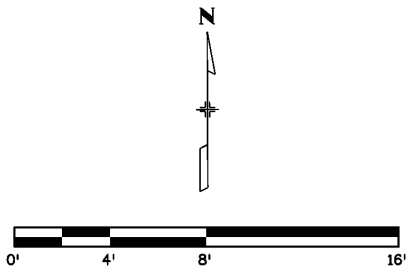
WEST VENTILATION BUILDING
FAN FLOOR PLAN NORTH

Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset: Subset Sheets: 11 of 21

Project No./Code
C 0703-399
19373
Sheet Number 17

GonzalesJ 9:04:14 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-W_Vent-Room.dgn





EAST VENT BUILDING CONTROL ROOM PLAN

Print Date: 8/18/2014
File Name: 24.9-E_Vent-Room03.dgn
Horiz. Scale: 1:8 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

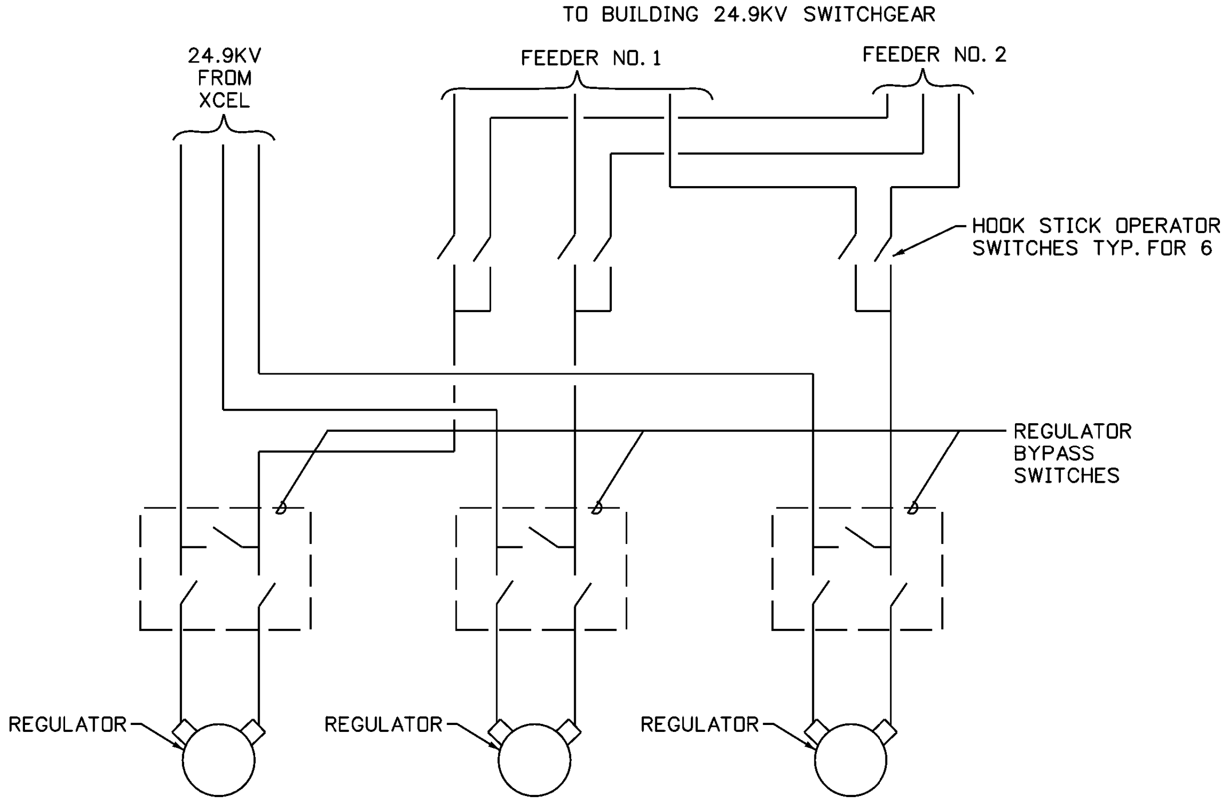
As Constructed
No Revisions:
Revised:
Void:

EAST VENTILATION BUILDING
CONTROL ROOM PLAN

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 12 of 21

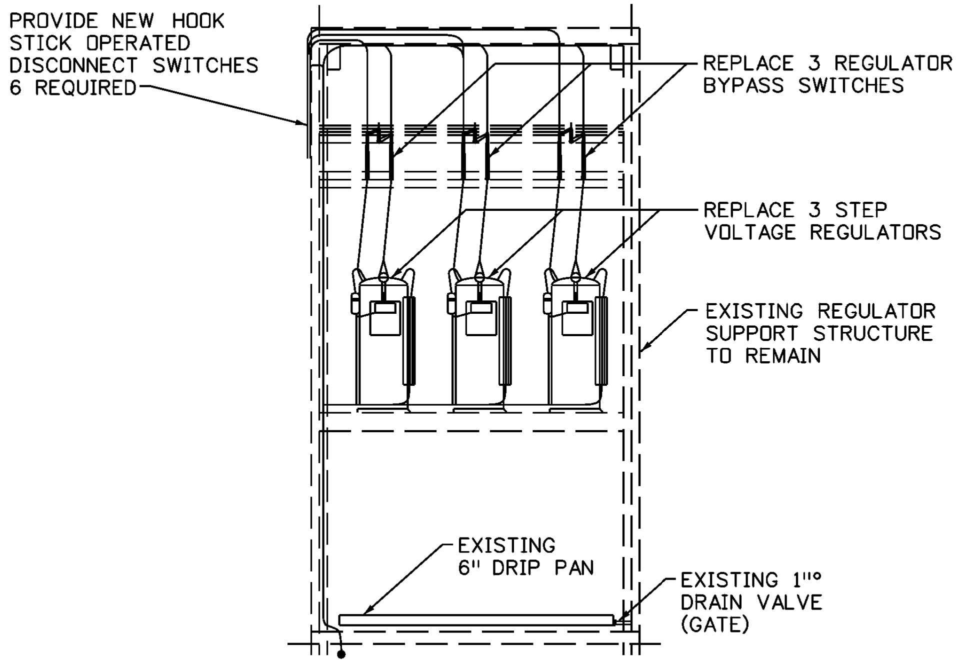
Project No./Code
C 0703-399
19373
Sheet Number 18

GonzalesJ 9:04:22 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-E_Vent-Room03.dgn



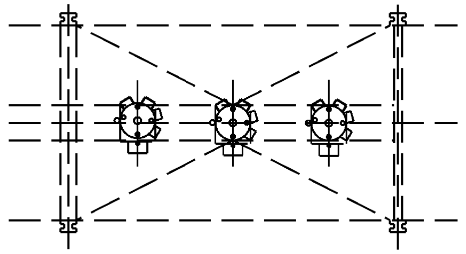
SCHEMATIC DIAGRAM AT REGULATORS

N.T.S.



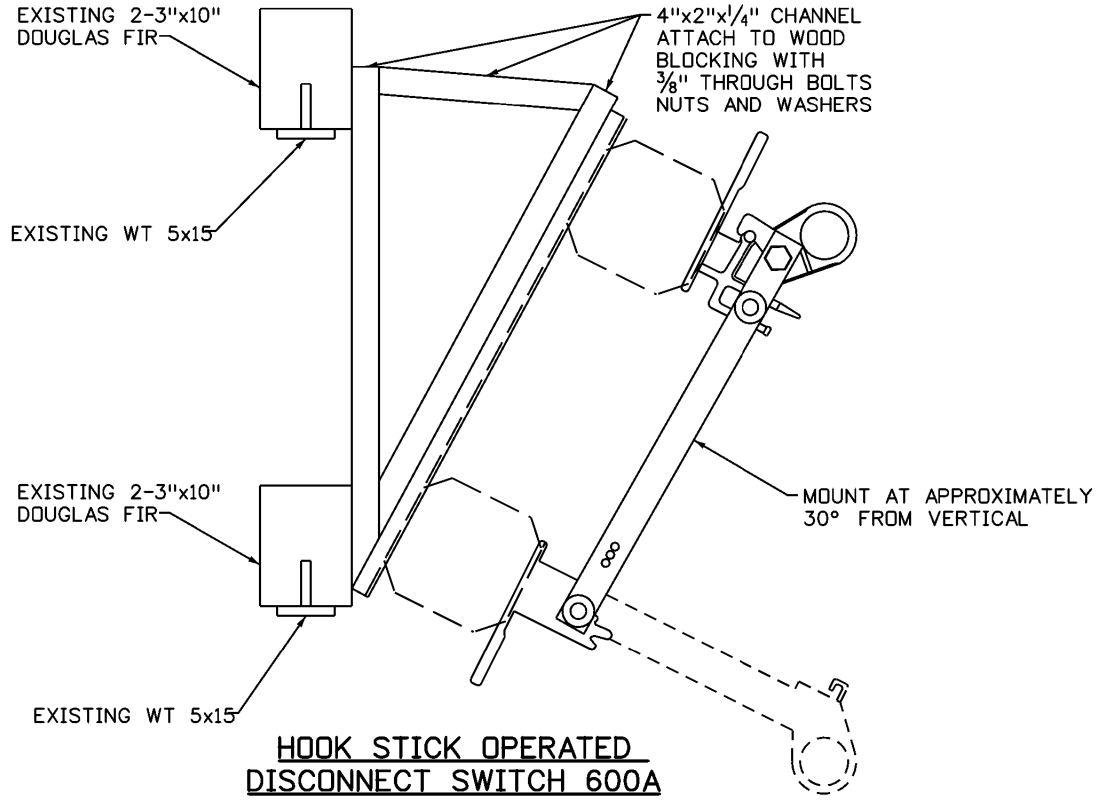
FRONT ELEVATION

N.T.S.



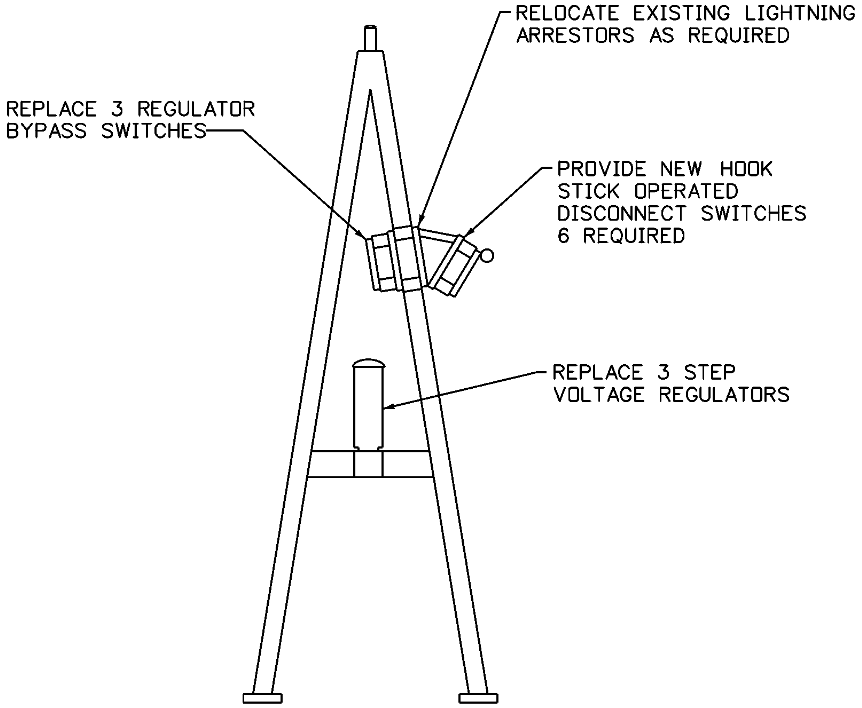
PLAN

N.T.S.



HOOK STICK OPERATED DISCONNECT SWITCH 600A

N.T.S.



REGULATORS AND SUPPORT STRUCTURE SIDE ELEVATION

N.T.S.

Print Date: 8/18/2014
File Name: 24.9-Detail02.dgn
Horiz. Scale: 1:12 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

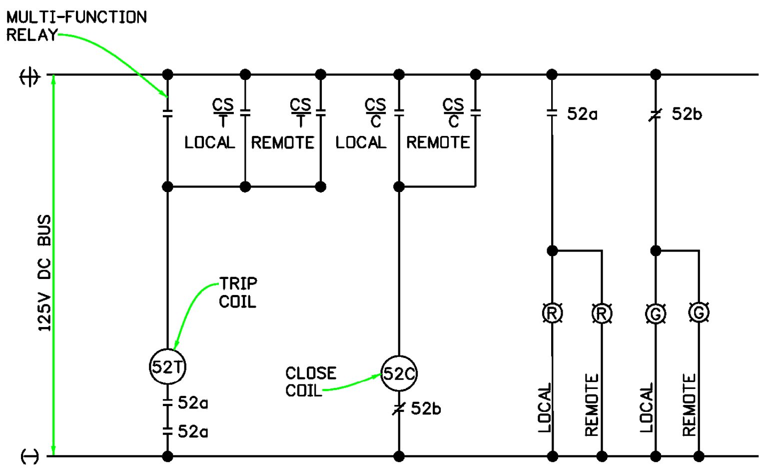
Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

DETAILS OF REGULATOR INSTALLATION

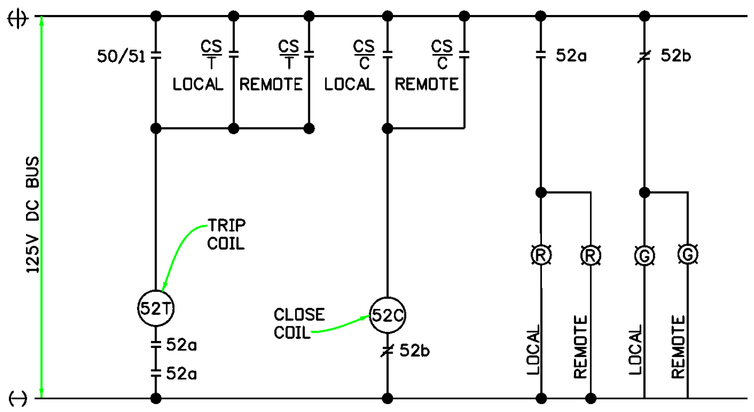
Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 13 of 21

Project No./Code
C 0703-399
19373
Sheet Number 19



MAIN CIRCUIT BREAK

N.T.S.



TIE AND FEEDER CIRCUIT BREAKERS

N.T.S.

CONTROL SWITCH KEY INTERLOCKS

	INTERLOCK NO. 1			INTERLOCK NO. 2			INTERLOCK NO. 3			
CONTROL SWITCH	INTERLOCK CODE	EXISTING KEY NUMBER	INTERLOCKED WITH	INTELOCK CODE	EXISTING KEY NUMBER	INTERLOCKED WITH	INTELOCK CODE	EXISTING KEY NUMBER	INTERLOCKED WITH	NOTES
WEST INCOMING BREAK CONTROL SWICTH	E	268	WEST TIE BREAKER, EAST TIE BREAKER, EAST INCOMING BREAKER CONTROL SWITCHES	F	790	WEST GENERATOR BREAKER CONTROL SWICTH	A	269	WEST INCOMING BREAKER SWICTHGEAR DOOR	ALL THREE REQUIRED TO CLOSE BREAKER
WEST TIE BREAKER CONTROL SWITCH	E	268	WEST INCOMING BREAKER, EAST TIE BREAKER, EAST INCOMING BREAKER, CONTROL SWITCHES	G	792	WEST GENERATOR BREAKER CONTROL SWICTH	B	270	WEST TIE BREAKE SWICTHGEAR DOOR	ALL THREE REQUIRED TO CLOSE BREAKER
EAST TIE BREAKER CONTROL SWITCH	E	268	WEST INCOMING BREAKER, WEST TIE BREAKER, EAST INCOMING BREAKER, CONTROL SWITCHES	H	795	EAST GENERATOR BREAKER CONTROL SWICTH	C	271	EAST TIE BREAKER SWICTHGEAR DOOR	ALL THREE REQUIRED TO CLOSE BREAKER
EAST INCOMING BREAKER CONTROL SWITCH	E	268	WEST INCOMING BREAKER, WEST TIE BREAKER, EAST TIE BREAKER CONTROL SWITCHES	J	797	EAST GENERATOR BREAKER CONTROL SWICTH	D	272	EAST INCOMING BREAKER SWICTHGEAR DOOR	ALL THREE REQUIRED TO CLOSE BREAKER
WEST GENERATOR BREAKER CONTROL SWITCH	E	790	WEST INCOMING BREAKER, CONTROL SWITCH	G	792	WEST TIE BREAKER CONTROL SWICTH	N/A	N/A		BOTH REQUIRED TO CLOSE BRAKER
EAST GENERATOR BREAKER CONTROL SWITCH	H	795	EAST TIE BREAKER CONTROL SWITCH	J	797	EAST INCOMING BREAKER CONTROL SWICTH	N/A	N/A		BOTH REQUIRED TO CLOSE BRAKER

KEY INTERLOCKING TABLE

		LOCK LOCATION						
INTERLOCK CODE	EXISTING KEY NUMBER	LOCK 1	LOCK 2	LOCK 3	LOCK 4	NO. OF KEYS	FUNCTION	NOTES
A	269	WEST INCOMING BREAKER CONTROL SWITCH	WEST INCOMING BREAKER SWITCHGEAR DOOR	N/A	N/A	1	REQUIRES BREAKER TO BE OPEN BEFORE SWITCHGAER DOOR CAN BE OPENED	
B	270	WEST TIE BREAKER CONTROL SWITCH	WEST TIE BREAKER SWITCHGEAR DOOR	N/A	N/A	1	REQUIRES BREAKER TO BE OPEN BEFORE SWITCHGAER DOOR CAN BE OPENED	
C	271	EAST TIE BREAKER CONTROL SWITCH	EAST TIE BREAKER SWITCHGEAR DOOR	N/A	N/A	1	REQUIRES BREAKER TO BE OPEN BEFORE SWITCHGAER DOOR CAN BE OPENED	
D	272	EAST INCOMING BREAKER CONTROL SWITCH	EAST INCOMING BREAKER SWITCHGEAR DOOR	N/A	N/A	1	REQUIRES BREAKER TO BE OPEN BEFORE SWITCHGAER DOOR CAN BE OPENED	
E	268	WEST INCOMING BREAKER CONTROL SWITCH	WEST TIE BREAKER CONTROL SWITCH	EAST TIE BREAKER CONTROL SWITCH	EAST INCOMING BREAKER CONTROL SWITCH	3	REQUIRES ONE OF THE FOUR BREAKERS TO BE OPEN TO PREVENT INERCONNECTON OF THE EAST AND WEST SIDE XCEL LINES	
F	790	WEST INCOMING BREAKER CONTROL SWITCH	WEST GENERATOR BREAKER CONTROL SWITCH	N/A	N/A	1	REQUIRES WEST INCOMING BREAKER TO BE OPEN BEFORE GENERATOR BREAKER CAN BE CLOSED	BOTH KEYS ARE REQUIRED TO CLOSE GENERATOR BREAKER
G	792	WEST TIE BREAKER CONTROL SWITCH	WEST GENERATOR BREAKER CONTROL SWITCH	N/A	N/A	1	REQUIRES WEST TIE BREAKER TO BE OPEN BEFORE GENERATOR BREAKER CAN BE CLOSED	BOTH KEYS ARE REQUIRED TO CLOSE GENERATOR BREAKER
H	795	EAST INCOMING BREAKER CONTROL SWITCH	EAST GENERATOR BREAKER CONTROL SWITCH	N/A	N/A	1	REQUIRES EAST TIE BREAKER TO BE OPEN BEFORE GENERATOR BREAKER CAN BE CLOSED	BOTH KEYS ARE REQUIRED TO CLOSE GENERATOR BREAKER
J	797	EAST TIE BREAKER CONTROL SWITCH	EAST GENERATOR BREAKER CONTROL SWITCH	N/A	N/A	1	REQUIRES EAST INCOMING BREAKER TO BE OPEN BEFORE GENERATOR BREAKER CAN BE CLOSED	BOTH KEYS ARE REQUIRED TO CLOSE GENERATOR BREAKER

Print Date: 8/18/2014
File Name: 24.9-Control-Diagram.dgn
Horiz. Scale: 1:2 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
Region 1
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
JDS

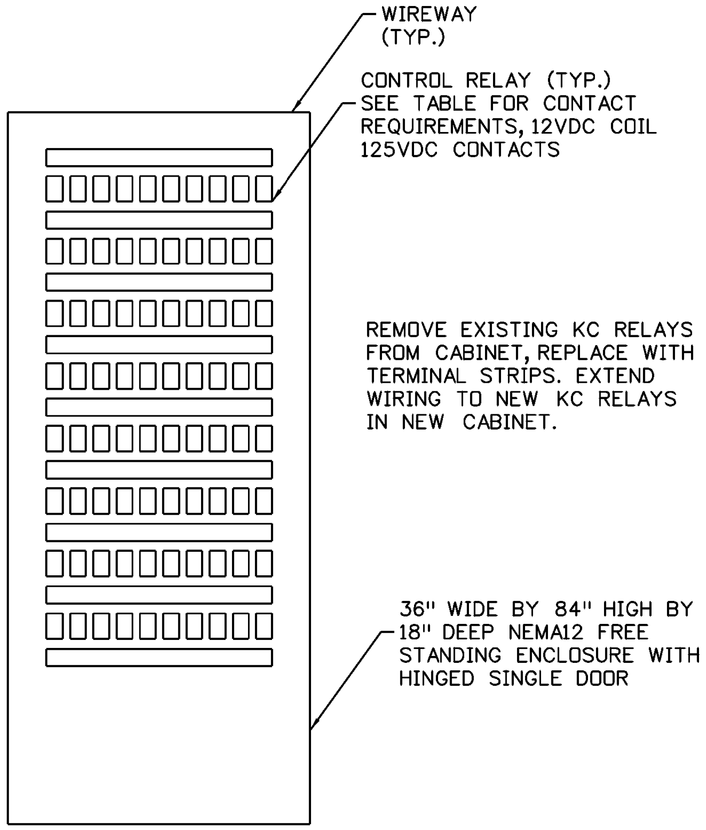
As Constructed
No Revisions:
Revised:
Void:

SWITCHGEAR SCHEMATIC DIAGRAMS

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 14 of 21

Project No./Code
C 0703-399
19373
Sheet Number 20

GonzalesJ 9:04:35 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-Control-Diagram.dgn



REMOVE EXISTING KC RELAYS FROM CABINET, REPLACE WITH TERMINAL STRIPS. EXTEND WIRING TO NEW KC RELAYS IN NEW CABINET.

NOTE:

1. NORTH BORE PANEL SHOWN. SOUTH BORE PANEL SIMILAR.

	NORTHBORE	CONTACTS	
RELAY NO.	FUNCTION	NO	NC
KC-1	24.9KV INCOMING OPEN	1	
KC-2	24.9KV INCOMING CLOSED	1	
KC-3	24.9KV TIE OPEN	1	
KC-4	24.9KV TIE CLOSED	1	
KC-5	24.9KV TRANSFORMER NO. 2 OPEN	1	
KC-6	24.9KV TRANSFORMER NO. 2 CLOSED	1	
KC-7	24.9KV TRANSFORMER NO. 1 OPEN	1	
KC-8	24.9KV TRANSFORMER NO. 1 CLOSED	1	
KC-9	480V TIE BREAKER OPEN	1	
KC-10	480V TIE BREAKER CLOSED	1	
KC-11	SPARE	2	2
KC-12	SPARE	2	2
KC-13	SPARE	2	2
KC-14	SPARE	2	2
KC-15	SPARE	2	2
KC-16	SPARE	2	2
KC-17	SPARE	2	2
KC-18	SPARE	2	2
KC-19	POWER PANEL RESET	2	2
KC-20	SPARE	2	2
KC-21	TRANSFER SUPPLY FAN NO. 1	2	2
KC-22	TRANSFER SUPPLY FAN NO. 2	2	2
KC-23	TRANSFER SUPPLY FAN NO. 3	2	2
KC-24	TRANSFER SUPPLY FAN NO. 4	2	2
KC-25	START SUPPLY FAN NO. 1 LOW SPEED	2	2
KC-26	START SUPPLY FAN NO. 2 LOW SPEED	2	2
KC-27	START SUPPLY FAN NO. 3 LOW SPEED	2	2
KC-28	START SUPPLY FAN NO. 4 LOW SPEED	2	2
KC-29	START SUPPLY FAN NO. 1 INTERMEDIATE SPEED	2	2
KC-30	START SUPPLY FAN NO. 2 INTERMEDIATE SPEED	2	2
KC-31	START SUPPLY FAN NO. 3 INTERMEDIATE SPEED	2	2
KC-32	START SUPPLY FAN NO. 4 INTERMEDIATE SPEED	2	2
KC-33	START SUPPLY FAN NO. 1 HIGH SPEED	2	2
KC-34	START SUPPLY FAN NO. 2 HIGH SPEED	2	2
KC-35	START SUPPLY FAN NO. 3 HIGH SPEED	2	2
KC-36	START SUPPLY FAN NO. 4 HIGH SPEED	2	2
KC-37	STOP SUPPLY FAN NO. 1	2	2
KC-38	STOP SUPPLY FAN NO. 2	2	2
KC-39	STOP SUPPLY FAN NO. 3	2	2
KC-40	STOP SUPPLY FAN NO. 4	2	2
KC-41	TRANSFER EXHAUST FAN NO. 1	2	2
KC-42	TRANSFER EXHAUST FAN NO. 2	2	2
KC-43	TRANSFER EXHAUST FAN NO. 3	2	2
KC-44	TRANSFER EXHAUST FAN NO. 4	2	2
KC-45	START EXHAUST FAN NO. 1 LOW SPEED	2	2
KC-46	START EXHAUST FAN NO. 2 LOW SPEED	2	2
KC-47	START EXHAUST FAN NO. 3 LOW SPEED	2	2
KC-48	START EXHAUST FAN NO. 4 LOW SPEED	2	2
KC-49	START EXHAUST FAN NO. 1 INTERMEDIATE SPEED	2	2
KC-50	START EXHAUST FAN NO. 2 INTERMEDIATE SPEED	2	2
KC-51	START EXHAUST FAN NO. 3 INTERMEDIATE SPEED	2	2
KC-52	START EXHAUST FAN NO. 4 INTERMEDIATE SPEED	2	2
KC-53	START EXHAUST FAN NO. 1 HIGH SPEED	2	2
KC-54	START EXHAUST FAN NO. 2 HIGH SPEED	2	2
KC-55	START EXHAUST FAN NO. 3 HIGH SPEED	2	2
KC-56	START EXHAUST FAN NO. 4 HIGH SPEED	2	2
KC-57	STOP EXHAUST FAN NO. 1	2	2
KC-58	STOP EXHAUST FAN NO. 2	2	2
KC-59	STOP EXHAUST FAN NO. 3	2	2
KC-60	STOP EXHAUST FAN NO. 4	2	2
KC-61	EMERGENCY NO. 1 ACB OPEN	1	
KC-62	EMERGENCY NO. 1 ACB CLOSED	1	
KC-63	EMERGENCY NO. 2 ACB OPEN	1	
KC-64	EMERGENCY NO. 2 ACB CLOSED	1	
KC-65	MCC 1 OPEN	1	
KC-66	MCC 2 CLOSED	1	
KC-67	MCC 2 OPEN	1	
KC-68	MCC 2 CLOSED	1	
KC-69	MCC 3A OPEN	1	
KC-70	MCC 3A CLOSED	1	
KC-71	MCC 3B OPEN	1	
KC-72	MCC 3B CLOSED	1	
KC-73	SPARE	1	
KC-74	SPARE	1	
KC-75	ICY ROAD SIGN	1	
KC-76	SPARE	1	
KC-77	ATS OPEN	1	
KC-78	ATS CLOSED	1	
KC-79	DC ON	2	2
KC-80	DC OFF	2	2

	SOUTHBORE	CONTACTS	
RELAY NO.	FUNCTION		
KC-1	24.9KV TRANSFORMER NO. 1A OPEN	NO	NC
KC-2	24.9KV TRANSFORMER NO. 1A CLOSED	1	
KC-3	24.9KV TRANSFORMER NO. 1B OPEN	1	
KC-4	24.9KV TRANSFORMER NO. 1B CLOSED	1	
KC-5	2400V NO. 1A OPEN	1	
KC-6	2400V NO. 1A CLOSED	1	
KC-7	2400V NO. 1B OPEN	1	
KC-8	2400V NO. 1B CLOSED	1	
KC-9	2400V TIE OPEN	1	
KC-10	2400V TIE CLOSED	1	
KC-11	EMERGENCY GENERATOR OPEN	1	
KC-12	EMERGENCY GENERATOR CLOSED	1	
KC-13	SPARE	1	
KC-14	SPARE	2	2
KC-15	SPARE	2	2
KC-16	SPARE	2	2
KC-17	SPARE	2	2
KC-18	SPARE	2	2
KC-19	SPARE	2	2
KC-20	PEAK SHAVE CLOSED	2	2
KC-21	TRANSFER WS-5	2	2
KC-22	TRANSFER WS-6	2	2
KC-23	TRANSFER WS-7	2	2
KC-24	START WS-5 LOW SPEED	2	2
KC-25	START WS-6 LOW SPEED	2	2
KC-26	START WS-7 LOW SPEED	2	2
KC-27	START WS-5 INTERMEWDIATE 1 SPEED	2	2
KC-28	START WS-6 INTERMEWDIATE 1 SPEED	2	2
KC-29	START WS-7 INTERMEWDIATE 1 SPEED	2	2
KC-30	START WS-5 INTERMEWDIATE 2 SPEED	2	2
KC-31	START WS-6 INTERMEWDIATE 2 SPEED	2	2
KC-32	START WS-7 INTERMEWDIATE 2 SPEED	2	2
KC-33	START WS-5 HIGH SPEED	2	2
KC-34	START WS-6 HIGH SPEED	2	2
KC-35	START WS-7 HIGH SPEED	2	2
KC-36	STOP WS-5	2	2
KC-37	STOP WS-6	2	2
KC-38	STOP WS-7	2	2
KC-39	PEAK SHAVE OPEN	2	2
KC-40	SPARE	2	2
KC-41	TRANSFER WE-5	2	2
KC-42	TRANSFER WE-6	2	2
KC-43	TRANSFER WE-7	2	2
KC-44	SPARE	2	2
KC-45	START WE-5 LOW SPEED	2	2
KC-46	START WE-6 LOW SPEED	2	2
KC-47	START WE-7 LOW SPEED	2	2
KC-48	START WE-5 INTERMEDIATE 1 SPEED	2	2
KC-49	START WE-6 INTERMEDIATE 1 SPEED	2	2
KC-50	START WE-7 INTERMEDIATE 1 SPEED	2	2
KC-51	START WE-5 INTERMEDIATE 2 SPEED	2	2
KC-52	START WE-6 INTERMEDIATE 2 SPEED	2	2
KC-53	START WE-7 INTERMEDIATE 2 SPEED	2	2
KC-54	START WE-5 HIGH SPEED	2	2
KC-55	START WE-6 HIGH SPEED	2	2
KC-56	START WE-7 HIGH SPEED	2	2
KC-57	STOP WE-5	2	2
KC-58	STOP WE-6	2	2
KC-59	STOP WE-7	2	2
KC-60	SPARE	2	2
KC-61	EMERGENCY GENERATOR FAST	2	2
KC-62	EMERGENCY GENERATOR SLOW	1	
KC-63	SPARE	1	
KC-64	SPARE	1	
KC-65	SPARE	1	
KC-66	SPARE	1	
KC-67	SPARE	1	
KC-68	SPARE	1	
KC-69	EMERGENCY GENERATOR START	1	
KC-70	SPARE	1	
KC-71	SPARE	2	2
KC-72	SPARE	2	2
KC-73	SPARE	2	2
KC-74	SPARE	2	2
KC-75	SPARE	2	2
KC-76	SPARE	2	2
KC-77	SPARE	2	2
KC-78	SPARE	2	2
KC-79	SPARE	2	2
KC-80	SPARE	2	2

Print Date: 8/18/2014
File Name: 24.9-W_Relay-Replace.dgn
Horiz. Scale: 1:14 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

WEST VENTILATION BUILDING
RELAY REPLACEMENT

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 15 of 21

Project No./Code
C 0703-399
19373
Sheet Number 21

GonzalesJ 9:04:43 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TO5)\19373\Design\Drawings\Plan Sheet files\24.9-W_Relay-Replace.dgn

SEQUENCE OF CONSTRUCTION:

1. INSTALL TEMPORARY SWITCHGEAR.
2. CONNECT TO CONTROL POWER SOURCE.
3. TEST TEMPORARY SWITCHGEAR FOR INTEGRITY AND PROPER OPERATION.
4. TRANSFER POWER TO EXISTING 24.9KV SWITCHGEAR FROM XCEL INCOMING LINE TO TIE FEEDER, REMOVE EXISTING REGULATORS AND BYPASS SWITCHES AND INSTALL NEW REGULATOR, BYPASS SWITCHES AND HOOK-OPERATED SWITCHES.
5. DURING THE POWER OUTAGE CREATED FOR STEP 4 ABOVE, TAKE INCOMING LINE OUT OF SERVICE, CUT BACK SPARE INCOMING FEEDER CONDUIT AT SWITCHGEAR END AND EXTEND SPARE FEEDER, NOW CALLED FEEDER NO. 2, TO TEMPORARY SWITCHGEAR.CONNECT SPARE FEEDER CABLES TO HOOK-OPERATED SWITCHES. ENERGIZE TEMPORARY SWITCHGEAR AND RE-ENERGIZE EXISTING SWITCHGEAR. CONNECT CONTROL FOR PARALLEL OPERATION OF TEMPORARY SWITCHGEAR WITH EXISTING SWITCHGEAR.
6. DE-ENERGIZE AND DISCONNECT FEEDER TO 480V TRANSFORMER NO. 1 FROM EXISTING 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO TEMPORARY SWITCHGEAR. EXTEND CONTROL WIRING AND TRANSFER CONTROL TO TEMPORARY SWITCHGEAR.
7. DE-ENERGIZE AND DISCONNECT FEEDER TO 2400V TRANSFORMER NO. 1A FROM EXISTING 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO TEMPORARY SWITCHGEAR. EXTEND CONTROL WIRING AND EXTEND CONTROL WIRE AND TRANSFER CONTROL TO TEMPORARY SWITCHGEAR.
8. DE-ENERGIZE AND DISCONNECT TIE FEEDER FROM EXISTING 24.9KV SWITCHGEAR AND INSTALL TEMPORARY SPLICE BOX AND EXTEND CONDUIT AND WIRE AND CONNECT TO TEMPORARY SWITCHGEAR. EXTEND CONTROL WIRING AND TRANSFER CONTROL TO TEMPORARY SWITCHGEAR.
9. DE-ENERGIZE AND DISCONNECT FEEDER TO 480V TRANSFORMER NO. 1B FROM EXISTING 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO TEMPORARY SWITCHGEAR. EXTEND CONTROL WIRING AND TRANSFER CONTROL TO TEMPORARY SWITCHGEAR.
10. DE-ENERGIZE AND DISCONNECT FEEDER TO 2400V TRANSFORMER NO. 1B FROM EXISTING 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO TEMPORARY SWITCHGEAR. EXTEND CONTROL WIRING AND TRANSFER CONTROL TO TEMPORARY SWITCHGEAR.
11. DEMOLISH EXISTING 24.9KV SWITCHGEAR.
12. INSTALL NEW SWITCHGEAR.
13. CONNECT TO CONTROL POWER SOURCE.
14. TEST NEW SWITCHGEAR FOR INTEGRITY AND PROPER OPERATION.
15. TRANSFER POWER AT TEMPORARY SWITCHGEAR FROM INCOMING LINE TO TIE FEEDER, TAKE INCOMING LINE OUT OF SERVICE, EXTEND INCOMING FEEDER CONDUIT AND CABLE TO NEW SWITCHGEAR. INSTALL NEW WIRE FROM HOOK SWITCHES TO NEW SWITCHGEAR. ENERGIZE NEW SWITCHGEAR AND RE-ENERGIZE TEMPORARY SWITCHGEAR. PROVIDE NEW CONTROL WIRING AND CONNECT CONTROL FOR PARALLEL OPERATION OF NEW SWITCHGEAR WITH TEMPORARY SWITCHGEAR.
16. DE-ENERGIZE AND DISCONNECT FEEDER TO 480V TRANSFORMER NO. 1 FROM TEMPORARY 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO NEW SWITCHGEAR. PROVIDE NEW CONTROL WIRING AND TRANSFER CONTROL TO NEW SWITCHGEAR.
17. DE-ENERGIZE AND DISCONNECT FEEDER TO 2400V TRANSFORMER NO. 1A FROM TEMPORARY 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO NEW SWITCHGEAR. PROVIDE NEW CONTROL WIRING AND TRANSFER CONTROL TO NEW SWITCHGEAR.
18. DE-ENERGIZE AND DISCONNECT TIE FEEDER FROM TEMPORARY 24.9KV SWITCHGEAR AND CONNECT TO NEW SWITCHGEAR. PROVIDE NEW CONTROL WIRING AND TRANSFER CONTROL TO NEW SWITCHGEAR.
19. DE-ENERGIZE AND DISCONNECT FEEDER TO 480V TRANSFORMER NO. 2 FROM TEMPORARY 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO NEW SWITCHGEAR. PROVIDE NEW CONTROL WIRING AND TRANSFER CONTROL TO NEW SWITCHGEAR.
20. DE-ENERGIZE AND DISCONNECT FEEDER TO 2400V TRANSFORMER NO. 1B FROM TEMPORARY 24.9KV SWITCHGEAR AND EXTEND CONDUIT, PROVIDE NEW WIRE AND CONNECT TO NEW SWITCHGEAR. PROVIDE NEW CONTROL WIRING AND TRANSFER CONTROL TO NEW SWITCHGEAR.
21. DE-ENERGIZE AND DISCONNECT AND REMOVE TEMPORARY SWITCHGEAR FOR USE AS TEMPORARY SWITCHGEAR IN THE REMAINING VENTILATION BUILDING.

Print Date: 8/18/2014
File Name: 24.9-E_Elec-StagingNotes.dgn
Horiz. Scale: 1:12 Vert. Scale: As Noted
Unit Information Unit Leader Initials
PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

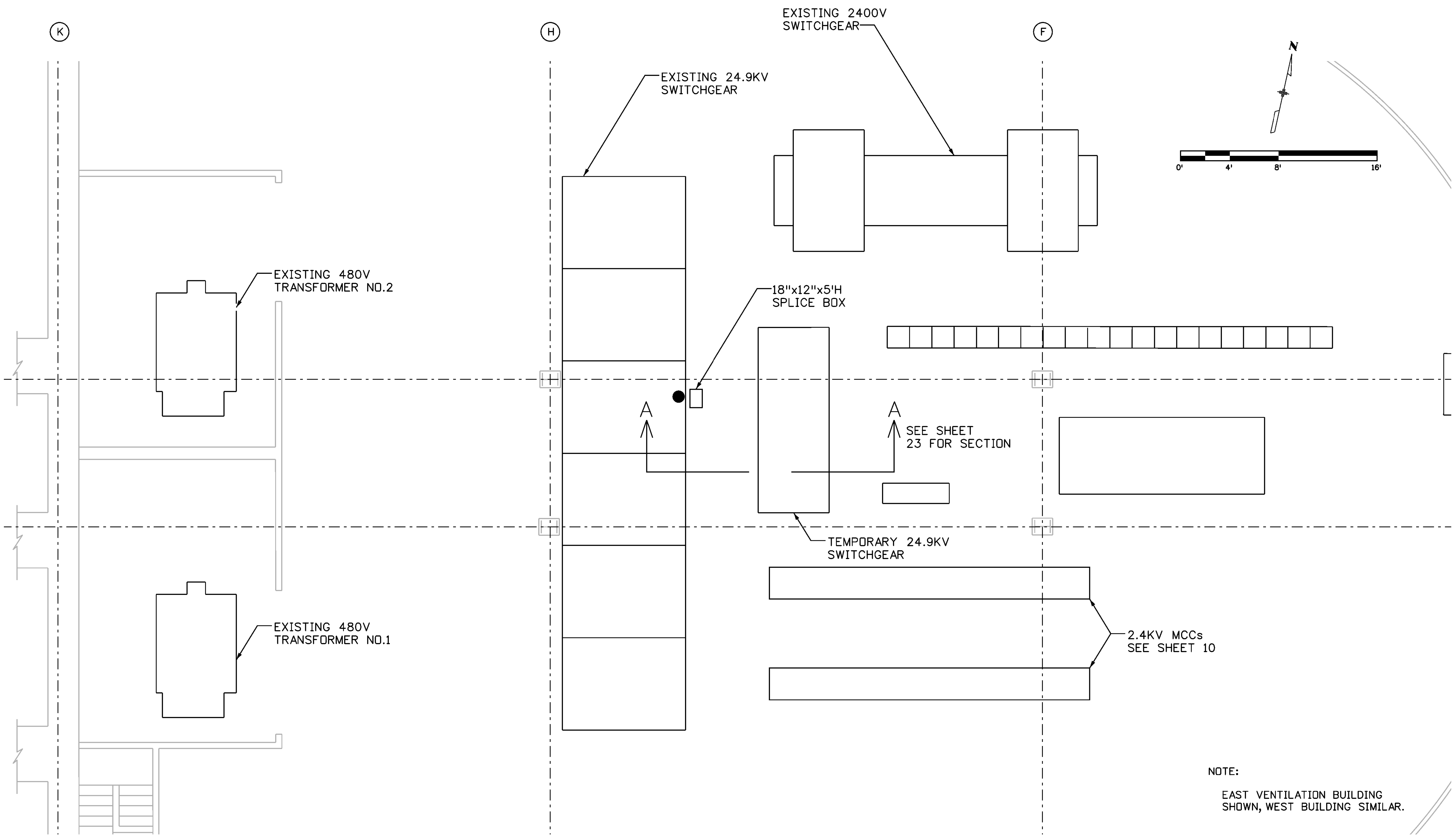
As Constructed
No Revisions:
Revised:
Void:

SEQUENCE OF CONSTRUCTION
Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset:
Subset Sheets: 16 of 21

Project No./Code
C 0703-399
19373
Sheet Number 22

GonzalesJ 9:04:50 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TDS)\19373\Design\Drawings\Plan Sheet files\24.9-E_Elec-StagingNotes.dgn

GonzalesJ 9:04:56 AM J:\184026 - CDOT Tunnel NPS 2011\E.EJMT_25kVSwitchgear_(TD5)\19373\Design\Drawings\Plan Sheet files\24.9-E_Elec-Staging-1.dgn



NOTE:

EAST VENTILATION BUILDING SHOWN, WEST BUILDING SIMILAR.

Print Date: 8/18/2014
File Name: 24.9-E_Elec-Staging-1.dgn
Horiz. Scale: 1:8 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

STAGING PLAN

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 17 of 21

Project No./Code
C 0703-399
19373
Sheet Number 23

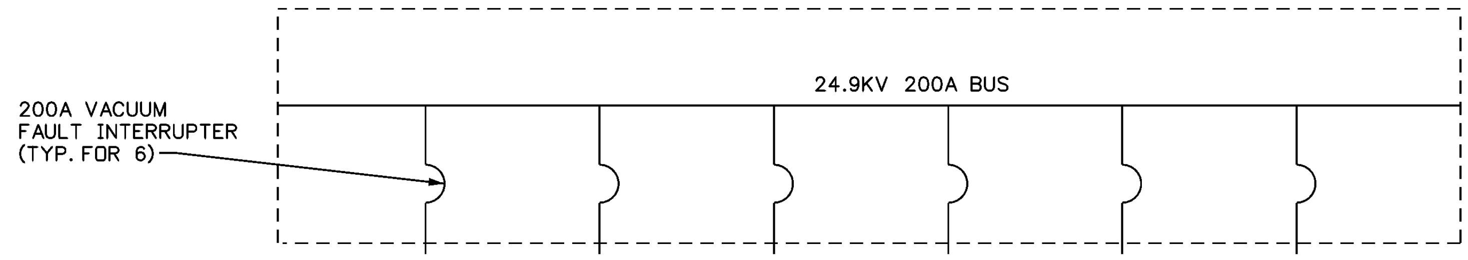
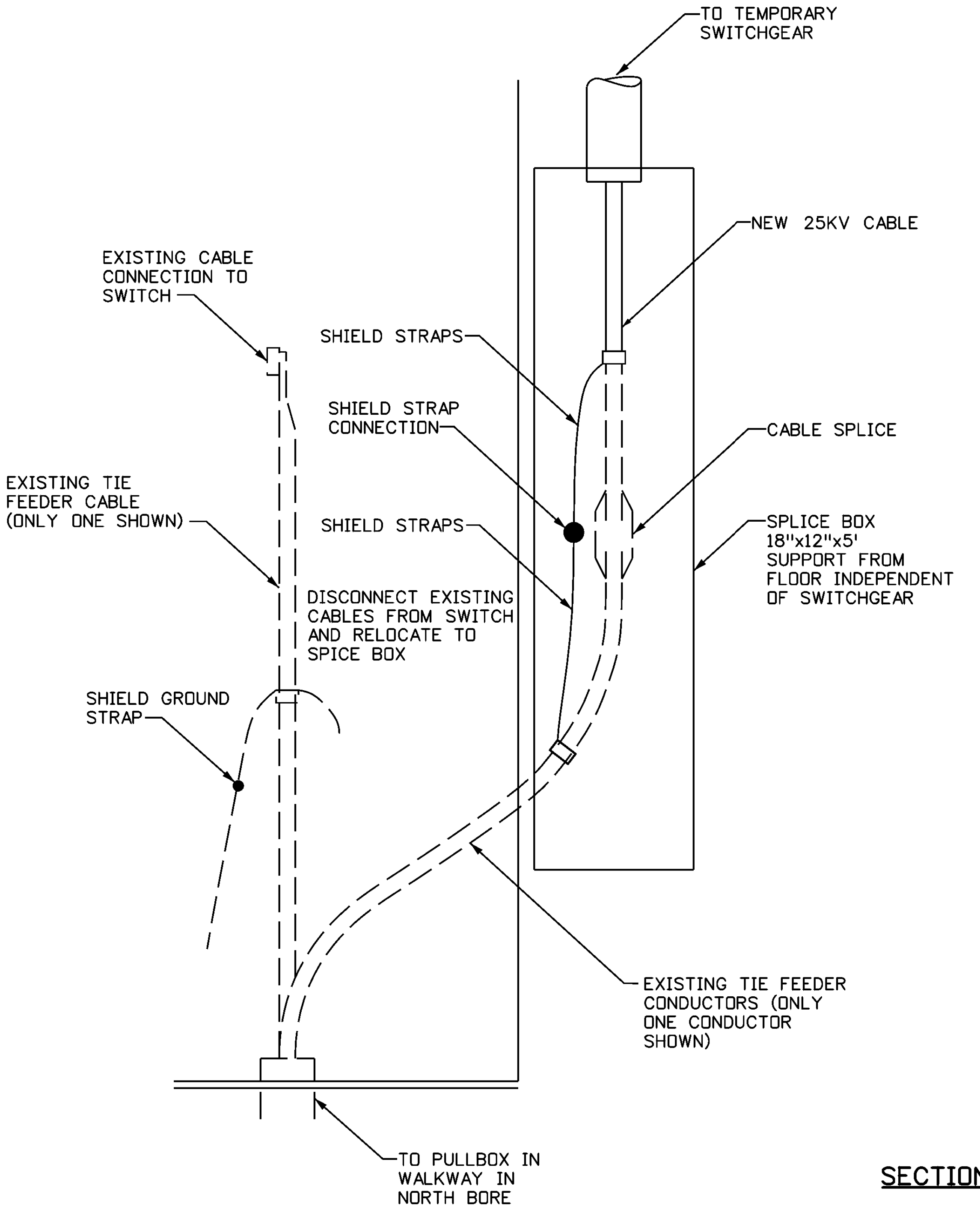
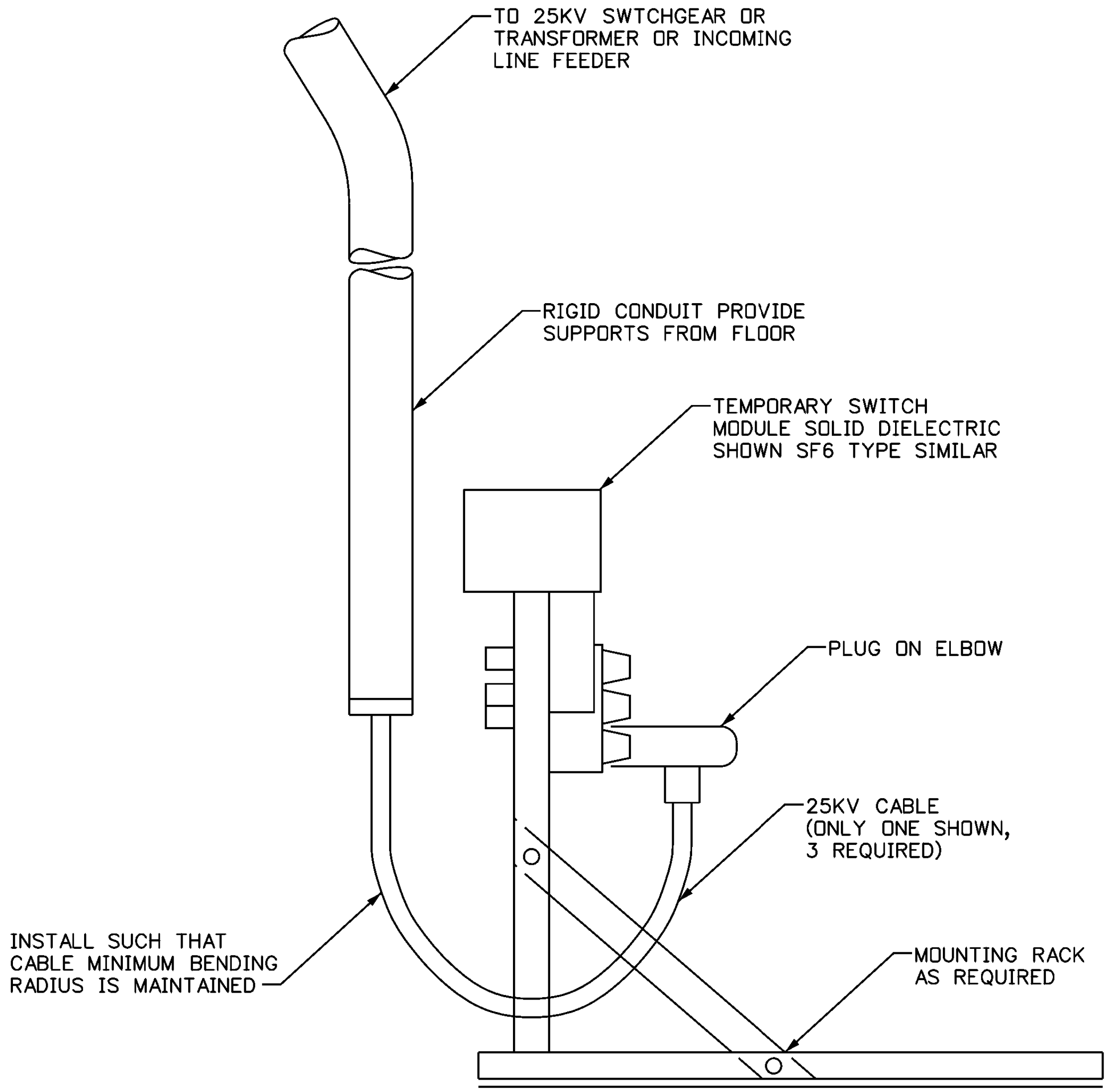


DIAGRAM OF TEMPORARY SWITCHGEAR

NOTES:

1. TEMPORARY SWITCHGEAR SHALL BE DESIGN FOR DEADFRONT, VAULT MOUNTED APPLICATION, WITH SOLID DIELECTRIC OR SF6 TYPE CONSTRUCTION.
2. EACH SWITCH WAY SHALL UTILIZE A 200A VACUUM FAULT INTERRUPTER.
3. EACH SWITCH WAY SHALL BE PROVIDED WITH MOTOR OPERATED OPEN-CLOSE MECHANISMS.
4. THE EXISTING SWITCHGEAR CONTROL SYSTEM UTILIZES 125V DC FOR CONTROL. PROVIDE INTERFACE RELAYS, IF REQUIRED, TO OPERATE TEMPORARY SWITCHES FROM EXISTING CONTROL SYSTEM.





SECTION A-A FROM SHEET NO. 22
N.T.S.

Print Date: 8/18/2014
File Name: 24.9-TempDetail.dgn
Horiz. Scale: 1:12 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
CDOT
CO
Region 1
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
JDS

As Constructed
No Revisions:
Revised:
Void:

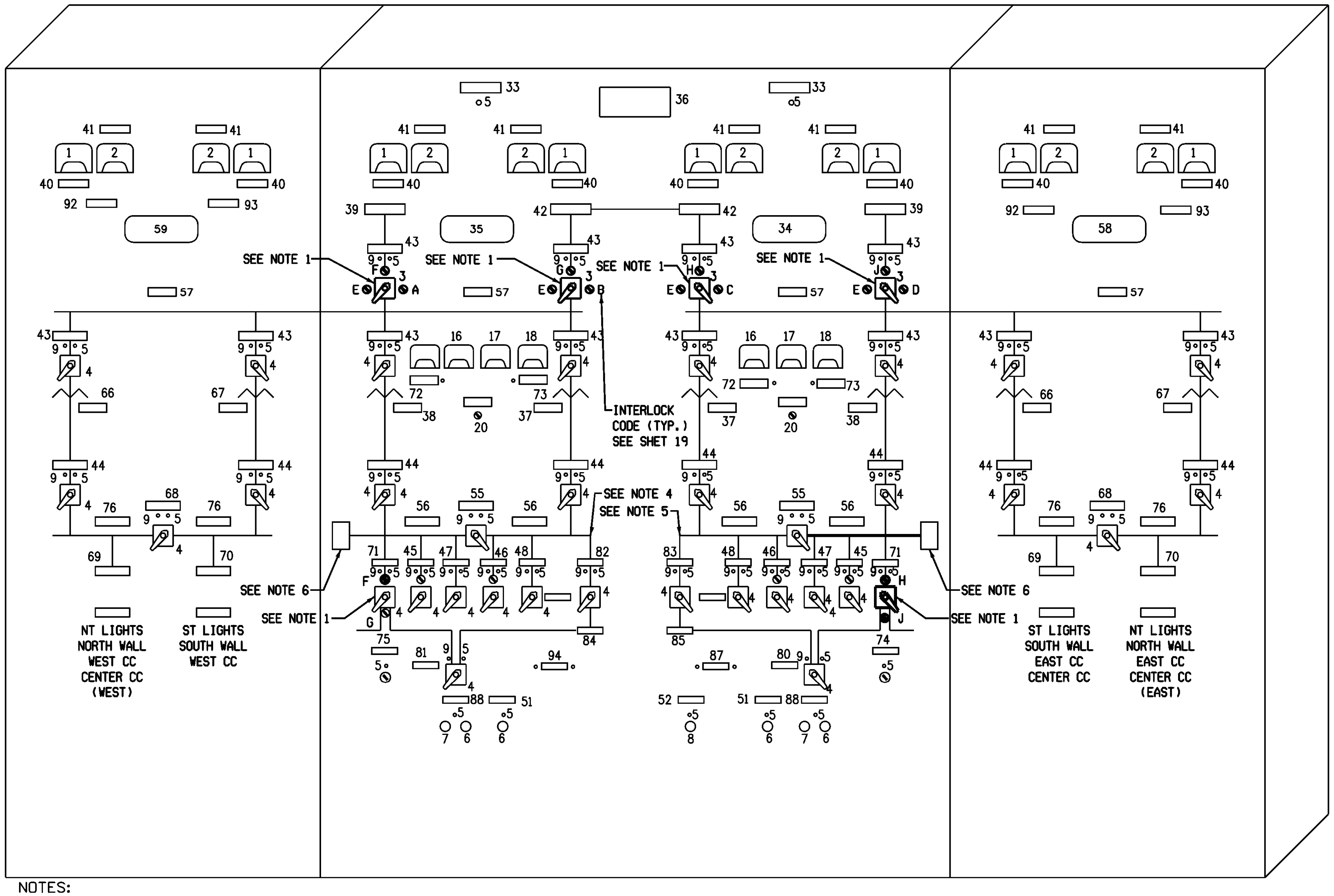
TEMPORARY EQUIPMENT DETAILS

Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 18 of 21

Project No./Code
C 0703-399
19373
Sheet Number 24

GonzalesJ 9:05:05 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-TempDetail.dgn

GonzalesJ 9:05:10 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-Detail01.dgn



EQUIPMENT LIST

1. AMMETER TYPE 171-141-LSV3 0-3000 AMP. SEE NOTE 3.
2. VOLTMETER TYPE 171-031-SJSJ AC 0-600 VOLTS. SEE NOTE 3.
3. SWITCH TYPE S81, 2 STAGE WITH KIRK KEYLOCK, 55-185285P3, ON-OFF.
4. SWITCH TYPE S81, 2 STAGE 55-185285F6, ON-OFF.
5. INDICATING LIGHTS, TYPE ET 16, RED, 125 V.D.C.
6. CR2940UA202B PUSH BUTTON.
7. CR2940UA202C PUSH BUTTON.
8. CR2940UB202A SELECTOR SWITCH.
9. INDICATING LIGHT, TYPE ET-16 GREEN 125 V.D.C.
10. 0-5 MILLIAMMETER, TYPE 171-FXFX WITH 0-3000 AMP SCALE.
11. 0-5 MILLIAMMETER, TYPE 171-FXFX WITH 0-600 VOLT SCALE.
12. TERMINAL BOARD, (NOT SHOWN) CR151B26.
13. TRANSFORMER #1.
14. TRANSFORMER #2.
15. SWITCH, TYPE SB1, WITH KIRK KEYLOCK, 55-188285P4.
16. AMP METER.
17. HERTZ METER.
18. VOLT METER.
19. APPROACH LOW OIL PRESSURE LIGHT.
20. GOVERNER CONTROL.
21. APPROACH HIGH WATER TEMPERATURE.
22. AMMETER, AC 0-800AMP.
23. VOLTMETER, AC 0-3000 VOLT.
24. 0-5 MILLIAMMETER WITH 0-800 AMP SCALE.
25. 0-5 MILLIAMMETER WITH 0-3000 VOLT SCALE.
26. 0-5 MILLIAMMETER WITH 0-1000 AMP SCALE.
27. 0-5 MILLIAMMETER WITH 55-65 HERTZ SCALE.
28. 0-5 MILLIAMMETER WITH 0-600 VAC SCALE.
29. INDICATING LIGHT, RED 125 V.D.C.
30. PUSHBUTTON RESET.
31. SELECTOR SWITCH, SPRING RETURN TO CENTER FROM LEFT & RIGHT POSITIONS, FAST-OFF-SLOW.
32. SELECTOR SWITCH, START-STOP.

NAMEPLATE SCHEDULE

FIRST LINE	SECOND LINE	THIRD LINE	DETAIL
33. POWER	ON		2
34. EAST	BUILDING		1
35. WEST	BUILDING		1
36. POWER	CONTROL	BOARD	1
37. TRANSFORMER	NO. 2	SECONDARY	2
38. TRANSFORMER	NO. 1	SECONDARY	2
39. PUBLIC SERVICE	INCOMING	LINE	2
40. AMMETER			2
41. VOLTMETER			2
42. 24.9 K.V.	EMERGENCY	TIE	2
43. LOAD	BREAK	SWITCH	2
44. AIR	CIRCUIT	BREAKER	2
45. MCC #1	FEEDER	BREAKER	2
46. MCC #2	FEEDER	BREAKER	2
47. MCC #3	FEEDER	BREAKER A	2
48. MCC #3	FEEDER	BREAKER B	2
51. BUILDING	POWER PANELS	RESET	2
52. SEDIMENTATION	TANKS	VENT. FAN	2
55. 480 VOLT	TIE BREAKER		2
56. 480 VOLT	BUSS		2
57. 24.9 K.V.	BUSS		2
58. EAST	BUILDING	SOUTH TUNNEL	1
59. WEST	BUILDING	NORTH TUNNEL	1
66. TRANSFORMER			2
67. TRANSFORMER	NO. 1A		2
68. 2400 VOLT	NO. 1B		2
69. MCC1A	TIE	BREAKER	2
70. MCC1B	EXHAUST		2
71. EMERGENCY	SUPPLY		2
72. APPROACHING	GENERATOR	BREAKER	2
73. APPROACHING	LOW OIL	PRESS	2
75. EMERGENCY	HIGH WATER	TEMP	2
76. 2400 VOLT	GENERATOR	CONTROL	2
80. EAST	BUSS		2
81. WEST	PEAK SHAVING		2
84. TRANSFER	PEAK SHAVING		3
85. TRANSFER	SWITCH	ATS-WV	4
87. EAST D.C.	SWITCH	ATS-EV	2
88. TUNNEL & BLDG.	UNDER VOLTAGE		2
92. EXHAUST	D.C. LIGHTS	CONTROL ON	2
93. SUPPLY			
94. WEST DC	UNDERVOLTAGE		

NOTES:

1. REPLACE EXISTING CONTROL SWITCHES AND KEY INTERLOCKS.
2. INDICATING LIGHTS SHALL BE MB120 BULB TYPE, NOT LED TYPE.
3. ALL MODIFICATIONS TO POWER BOARD TO BE PAID FOR AS ITEM 210-00478, MODIFY POWER CONTROL BOARD WITH THE FOLLOWING QUANTITIES:
4. LEFT LANE LIGHTS ST WEST CC AND CENTER CC NT WEST CC, NT CENTER CC (WEST).
5. LEFT LANE LIGHTS ST EAST CC NT EAST CC, NT CENTER CC (EAST).
6. 600HP FAN MOTORS FEEDER BREAKER (FCB).

EXISTING POWER CONTROL BOARD

N.T.S.

ITEM	QUANTITY	UNIT
MODIFY POWER CONTROL BOARD	1	LS

Print Date: 8/18/2014
File Name: 24.9-Detail01.dgn
Horiz. Scale: 1:2 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions

Date:	Comments	Init.

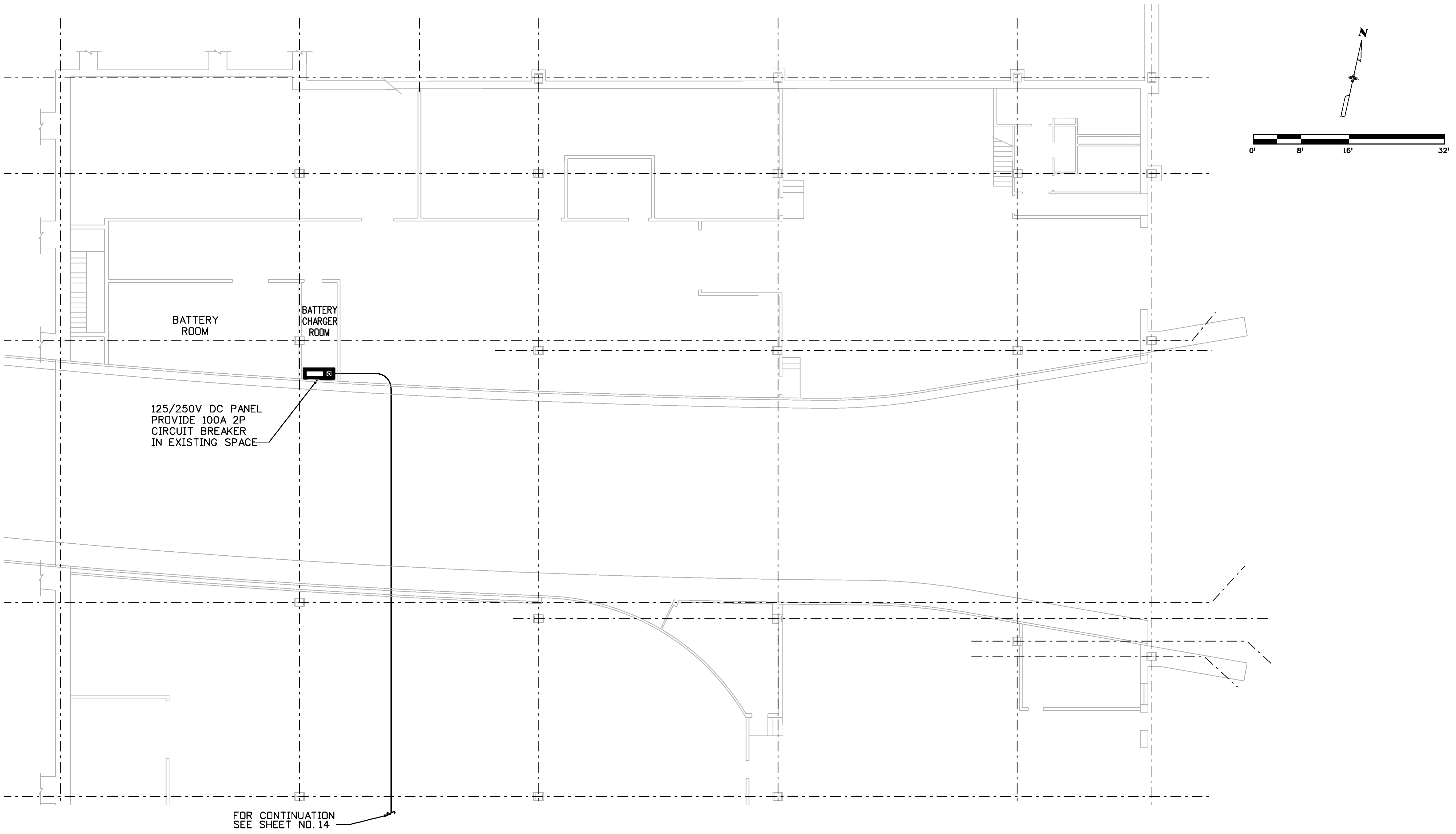
Colorado Department of Transportation
CDOT
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

POWER CONTROL BOARD
LAYOUT AND DETAILS

Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset:
Subset Sheets: 19 of 21

Project No./Code
C 0703-399
19373
Sheet Number 25



Print Date: 8/18/2014
File Name: 24.9-E_Vent-Room04.dgn
Horiz. Scale: 1:16 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

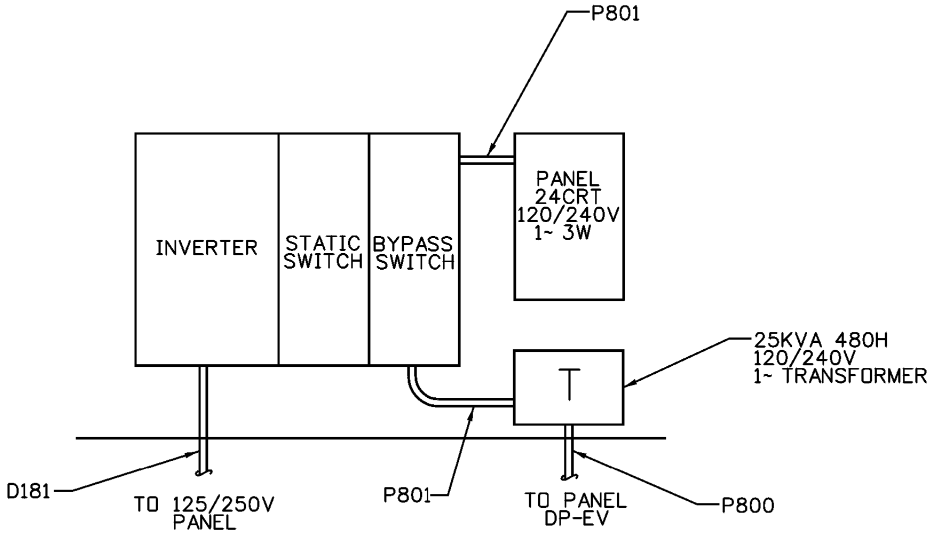
Colorado Department of Transportation
CDOT
CO
Region 1
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
JDS

As Constructed
No Revisions:
Revised:
Void:

EAST VENTILATION BUILDING
GROUND FLOOR PLAN NORTH
Designer: J. SHELDON
Detailer: H. PULIDO
Sheet Subset:
Structure Numbers
Subset Sheets: 20 of 21

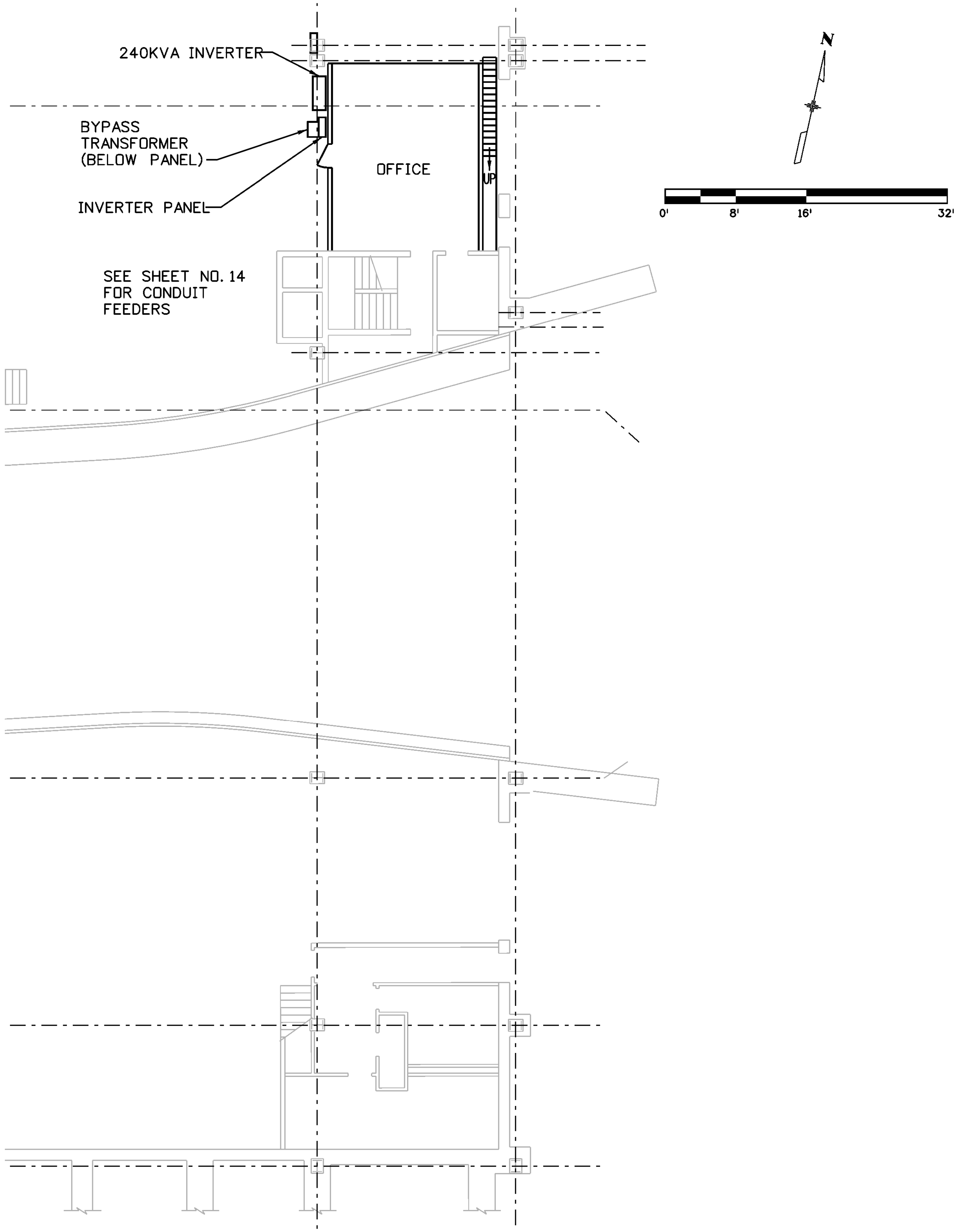
Project No./Code
C 0703-399
19373
Sheet Number 26

GonzalesJ 9:05:19 AM J:\184026 - CDOT TunnelNPS 2011\EJMT_25kVSwitchgear_(T05)\19373\Design\Drawings\Plan Sheet files\24.9-E_Vent-Room04.dgn



INVENTER SYSTEM

N.T.S.



Print Date: 8/18/2014
File Name: 24.9-E_Vent-Room05.dgn
Horiz. Scale: 1:16 Vert. Scale: As Noted
Unit Information Unit Leader Initials

PARSONS BRINCKERHOFF
555 17th Street, Suite 500
Denver, CO 80202
Phone: (303) 832-9091 Fax: (303) 728-1936

R-X

Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
425A Corporate Circle
Golden, CO 80401
Phone: 720-497-6959 FAX: 720-497-6951
Region 1
JDS

As Constructed
No Revisions:
Revised:
Void:

EAST VENTILATION BUILDING
PART FAN ROOM FLOOR PLAN
SOUTH AND INVERTER SYSTEM

Designer: J. SHELDON
Detailer: H. PULIDO
Structure Numbers
Sheet Subset:
Subset Sheets: 21 of 21

Project No./Code
C 0703-399
19373
Sheet Number 27

GonzalesJ 9:05:27 AM J:\184026 - CDOT TunnelNPS 2011\E.EJMT_25kVSwitchgear_(TD5)\19373\Design\Drawings\Plan Sheet files\24.9-E_Vent-Room05.dgn

OVERVIEW OF KIRK KEY INTERLOCKING

9TH JUNE 2015

EAST KIRK KEY NUMBERS

EMT = # RE 100797
EML = # RE 10 268
EMR = # RE 10272

EGT = # RE 100797
EGB = # RE 11 795

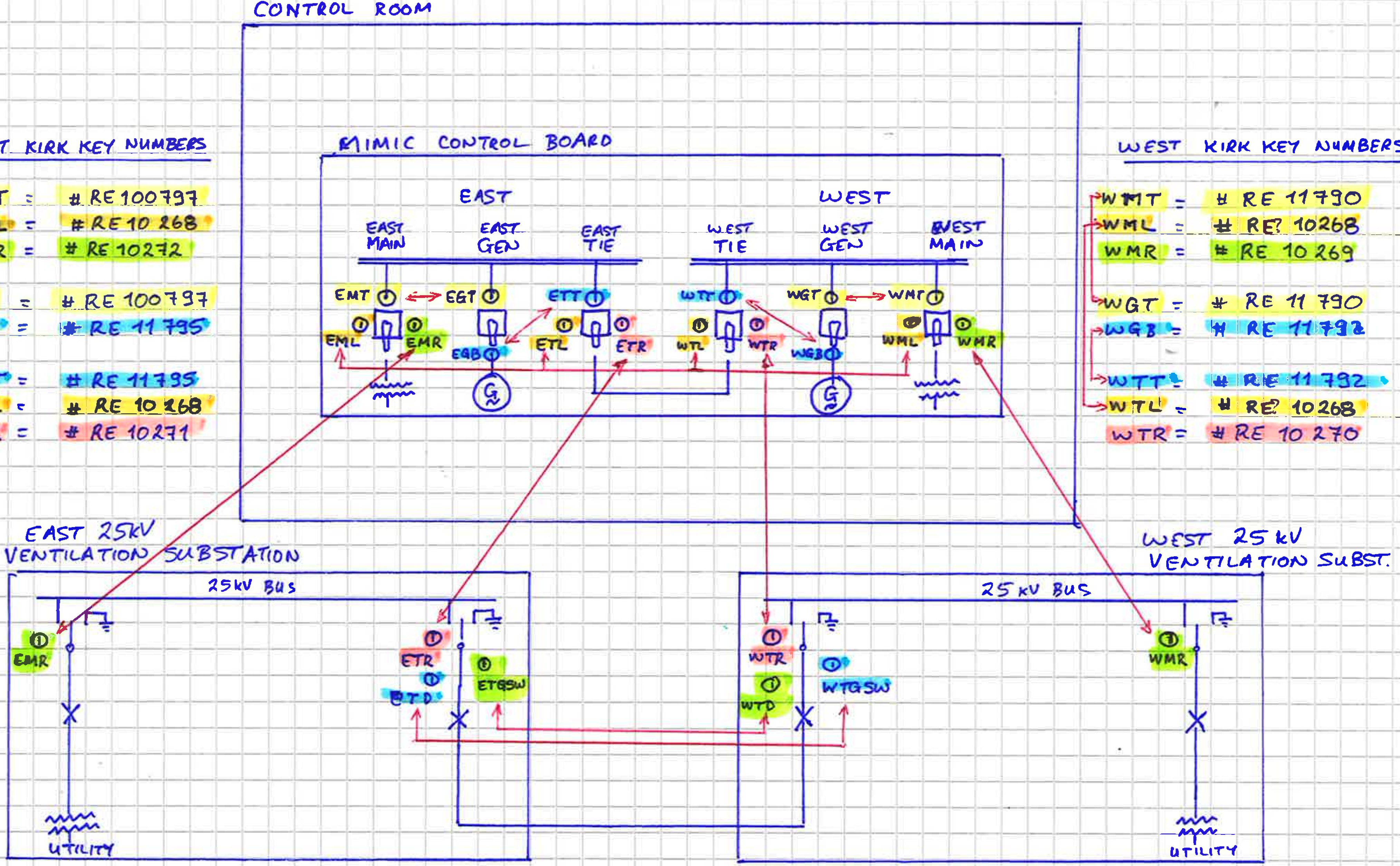
ETT = # RE 11795
ETL = # RE 10 268
ETR = # RE 10271

WEST KIRK KEY NUMBERS

WMT = # RE 11790
WML = # RE? 10268
WMR = # RE 10 269

WGT = # RE 11 790
WGB = # RE 11 792

WTT = # RE 11 792
WTL = # RE? 10268
WTR = # RE 10 270



Function of the keys EMR, ETR, WMR and WTR on the 25kV GIS

In the description of the Key Interlocking received on June 5 2015, a key on the right side of each of the breaker Control Switches East Main, East Tie, West Main and West Tie at the Mimic Control Board in the Control Room can be removed after the relevant switch is OPEN, and permits the Control Cabinet of the relevant section to be opened.

For ease of understanding, the following key names are used, as seen in the overview sketch.
EMR (key on the **R**ight of the control switch for the **E**ast **M**ain Breaker)
ETR (key on the **R**ight of the control switch for the **E**ast **T**ie Breaker)
WMR (key on the **R**ight of the control switch for the **W**est **M**ain Breaker)
WTR (key on the **R**ight of the control switch for the **W**est **T**ie Breaker)

The following implementation for this functionality in the 25 KV GIS is as proposed:

1. The Kirk Keys do not allow access to the Low Voltage Compartment of the switchgear (as I understand the present situation to be), but operate on the Disconnector.

2. The key must be inserted and turned in order to OPEN the disconnector (equivalent of Test position in AIS), and is trapped in this situation. The Disconnector must be CLOSED to release the key.

3. The control schematic issued for approval in May 2015 should be modified to permit control from the Remote 52CS control switch in the Control Room when the Disconnector is CLOSED, and permit control from the Local 52CS control switch on the door of the LV compartment when the Disconnector is OPEN.

4. The mechanical pushbuttons on the front of the CB mechanism are designed for Emergency operation, and bypass all electrical interlocking. The padlockable / sealable covers provided over these mechanical pushbuttons should normally be closed. The mechanical OFF pushbutton must be available for operation in case of Emergency, but the mechanical ON pushbutton should be padlocked or fitted with a lead seal, available for emergency switching by the responsible engineer only.

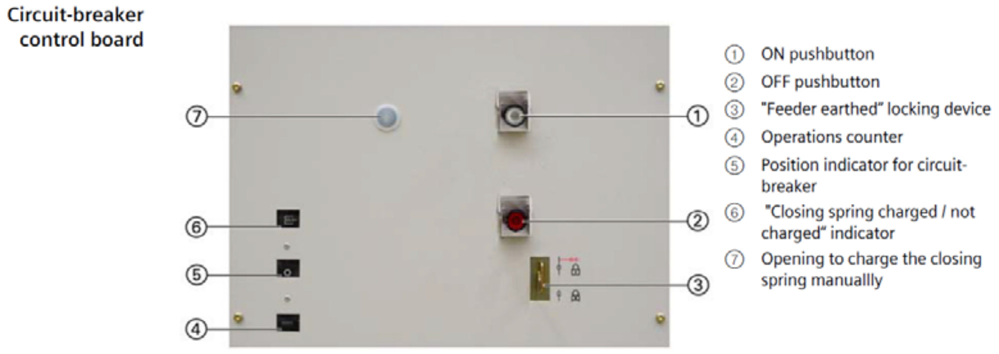


Fig. 199: Circuit-breaker control board

Disconnecting and/or Grounding of the cable between the East and West 25kV substations

In the Spec page 28b a Kirk Key interlock is specified for rear door of the compartment, interlocked with the Tie Circuit Breaker in the switchgear in the other ventilation building. The function is understood to be an interlock to access the cable connections only when the cable is not energized from the other side.

The proposal is to have 2 Kirk Keys in the Tie sections, one operating on the Disconnector and the other operating on the Ground Switch.
The **E**ast **T**ie **D**isconnector (ETD) has a barrel with the same key number as the Ground switch at West and the **W**est **T**ie **D**isconnector (WTD) has a barrel with the same key number as the Ground switch at East. For each case, only one key is provided.

If the cable is to be taken out of service, the following steps are required:

1. For example, the starting condition is that the Disconnectors of the Tie sections at both East and West are closed, and cable is energized from one side (e. g. West). The Keys ETD and WTD are trapped in the barrels of the respective Kirk Key locks while the disconnectors are closed. The CB at East is OPEN and ready for Remote switching from the control room.

2. CB at West is to be opened and the key WTR removed. The CB at East is already open, and the key ETR can be removed.

3. With these keys removed, remote switching of these panels is blocked.

4. The key ETR is taken to the 25kV ventilation substation and inserted into the lock in the Tie. With this key, the disconnector can be Opened. Key ETR is now trapped and ETD is released. The key ETD is to be taken to the substation West.

5. In the 25kV ventilation substation West, the key WTR is to be inserted into the lock in the Tie. With this key, the disconnector can be Opened. Key WTR is now trapped and WTD is released.
   The Key ETD is to be inserted into the barrel of the lock for the Ground Switch. The Ground Switch can now be closed, preparing to ground the cable. The key ETD is now trapped. Closing the CB now grounds the cable.
   The key WTD is to be removed and taken to the substation East.

6. In the 25kV ventilation substation East, the Key WTD is to be inserted into the barrel of the lock for the Ground Switch of the Tie. The Ground Switch can now be closed, preparing to ground the cable. The key WTD is now trapped. Closing the CB now grounds the cable.

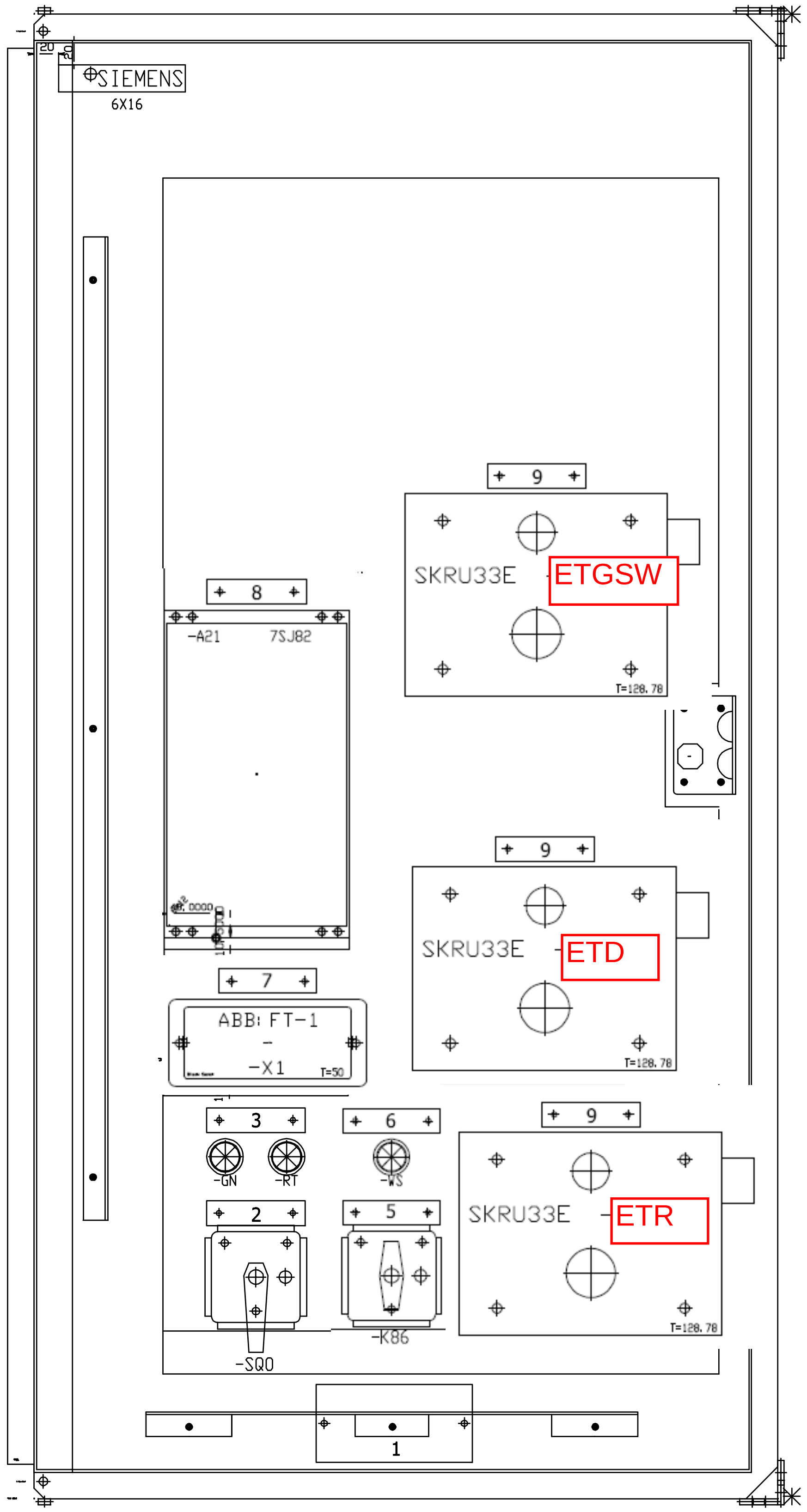
7. Removal of grounding is a reversal of this process.

ELCAD-Version 7.3.2 SP3
Last used: 21.05.15
FBSTP2
Archive: =J00 / D / D / 14

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

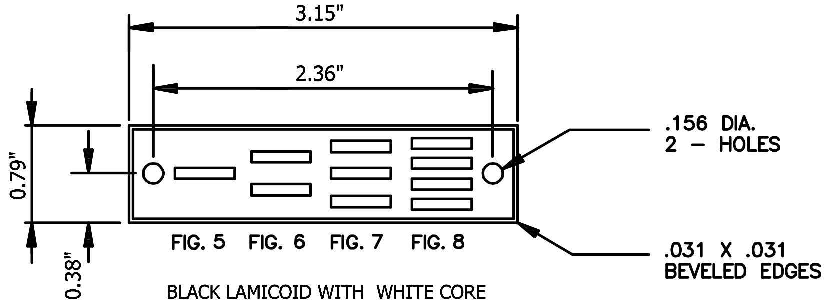
=J06
=JZ03
(Tie)



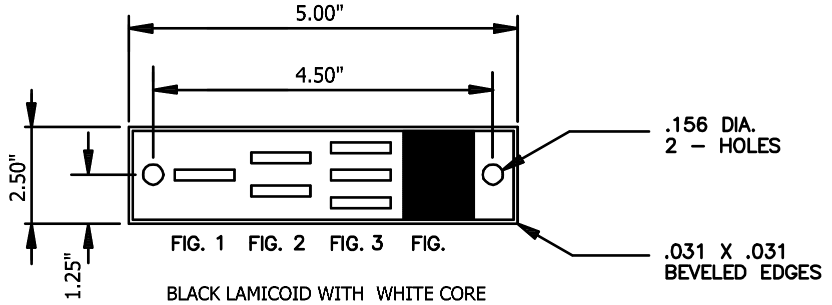
Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	TIE FEEDER			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	4	SELECTOR SWITCH	LOCAL REMOTE		6
1	5	LOCKOUT RELAY			5
1	6	LOCKOUT RELAY	HEALTHY		6
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9	KEY INTERLOCK			5
1	10				

This proposal is merely a sketch at present and must be checked in more detail if the proposal is acceptable.
Changes:
1. 43L/R removed
2. Lockout K86 and LED for Lockout Coil Healthy moved next to the 52CS
3. ABB FT-1 test switch moved to above 52CS
4. Protection relay moved upwards
5. Total of 3 Kirk SKRU locks present in the Tie.

The layout is similar in the Main incoming section JZ01, but without the Kirk SKRU units ETD and ETGSW



BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS



BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

Revision | Modification | Date | Name
Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 15kV SWITCHGEAR
GENERAL DOCUMENTS
DOOR LAYOUT
Arrangement drawing

=JZ00 D =J00
+J00
883314 (3) W92210-F2141-S004
D14
Sheet 14-
14 Sh.

COLORADO
DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
EISENHOWER/JOHNSON MEMORIAL TUNNELS
24.9kV SWITCHGEAR REPLACEMENT

The 2011 Standard Specifications for Road and Bridge Construction, controls construction of this project. The following special provisions supplement or modify the Standard Specifications and take precedence over the Standard Specifications and plans.

PROJECT SPECIAL PROVISIONS

COLORADO
DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
EISENHOWER/JOHNSON MEMORIAL TUNNELS
24.9kV SWITCHGEAR REPLACEMENT

STANDARD SPECIAL PROVISIONS

	Date	No. Pages
Revision of Section 103 - Escrow of Proposal Documentation	(May 5, 2011)	2
Revision of Section 105 - Disputes and Claims for Contract Adjustments	(January 30, 2014)	31
Revision of Section 105 -Violation of Working Time Limitation	(February 3, 2011)	1
Revision of Section 106 - Certificates of Compliance and Certified Test Reports	(February 3, 2011)	1
Revision of Section 106 -Material Sources	(October 31, 2013)	1
Revision of Section 106 - Supplier List	(January 30, 2014)	1
Revision of Section 107 - Project Payrolls	(May 2, 2013)	1
Revision of Section 107 - Responsibility for Damage Claims, Insurance Types and Coverage Limits	(February 3, 2011)	1
Revision of Section 107 - Warning Lights for Work Vehicles and Equipment	(January 30, 2014)	1
Revision of Section 108 - Project Schedule	(July 31, 2014)	6
Revision of Section 108 - Notice to Proceed	(July 31, 2014)	1
Revision of Section 108 - Liquidated Damages	(May 2, 2013)	1
Revision of Section 108 - Subletting of Contract	(January 31, 2013)	1
Revision of Sections 108 and 109 - Payment Schedule (Multiple Construction Years)	(Nov. 15, 2013)	1
Revision of Section 109 - Compensation for Compensable Delays	(May 5, 2011)	1
Revision of Section 109 - Fuel Cost Adjustment	(February 3, 2011)	2
Revision of Section 109 - Measurement of Quantities	(February 3, 2011)	1
Revision of Section 109 - Prompt Payment	(January 31, 2013)	1
Revision of Section 250 - Environmental, Health and Safety Management	(July 19, 2012)	1
Revision of Section 630 - Construction Zone Traffic Control	(February 17, 2012)	1
Affirmative Action Requirements - Equal Employment Opportunity	(February 3, 2011)	10
Disadvantaged Business Enterprise (DBE) Requirements	(Dec. 26, 2013)	9
Minimum Wages, Colorado, U.S. Department of Labor General Decision Number CO140023, MOD 3, Highway Construction for Eagle, Garfield, Grand, Jackson, Lake, Moffat, Pitkin, Rio Blanco, Routt and Summit counties.	(April 4, 2014)	8
On the Job Training	(July 29, 2011)	3
Partnering Program	(February 3, 2011)	1
Required Contract Provisions - Federal-Aid Construction Contracts	(October 31, 2013)	14

NOTICE TO BIDDERS

The proposal guaranty shall be a certified check, cashier's check, or bid bond in the amount of 5 percent of the Contractor's total bid.

Pursuant to subsections 102.04 and 102.05, it is recommended that bidders on this project review the work site and plan details with an authorized Department representative. Prospective bidders shall contact one of the following listed authorized Department representatives at least 12 hours in advance of the time they wish to go over the project.

Acting Tunnel Superintendent:	Kenny Martinez
West Program Engineer:	Steve Harelson
Resident Engineer:	Jana Spiker, PE Office Phone: 720-497-6959 Cell Phone: 303-503-0978
Project Engineer:	(As determined by the Resident Engineer)

The above referenced individuals are the only representatives of the Department with authority to provide any information, clarification, or interpretation regarding the plans, specifications, and any other contract documents or requirements.

Questions received from bidders along with CDOT responses will be posted on the CDOT web site listed below as they become available.

http://www.coloradodot.info/business/bidding/future-bidding-opportunities

If the bidder has a question or requests clarification that involves the bidder's innovative or proprietary means and methods, phasing, scheduling, or other aspects of construction of the project, the Project Engineer will direct the bidder to contact the Resident Engineer directly to address the question or clarification. The Resident Engineer will keep the bidder’s innovation confidential and will not share this information with other bidders.

The Resident Engineer will determine whether questions are innovative or proprietary in nature. If the Resident Engineer determines that a question does not warrant confidentiality, the bidder may withdraw the question. If the bidder withdraws the question, the Resident Engineer will not answer the question and the question will not be documented on the CDOT web site. If the bidder does not withdraw the question, the question will be answered, and both the question and CDOT answer will be posted on the web site. If the Resident Engineer agrees that a question warrants confidentiality, the Resident Engineer will answer the question, and keep both question and answer confidential. CDOT will keep a record of both question and answer in their confidential file.

All questions shall be directed to the CDOT contacts listed above no later than 7:00 A.M. Monday of the week of bid opening. Final questions and answers will be posted no later than Tuesday morning of bid opening week.

Questions and answers shall be used for reference only and shall not be considered part of the Contract.

COMMENCEMENT AND COMPLETION OF WORK

The Contractor shall select the date that work begins for this project. The Contractor shall notify the Engineer, in writing, at least 20 days before the proposed beginning date. The date that work begins shall be subject to the Region Transportation Director's approval. A different date may be authorized in writing by the Chief Engineer in the "Notice to Proceed."

The Contractor shall complete all work by July 1, 2016 in accordance with the "Notice to Proceed."

Stockpiling of materials before the beginning date is subject to the Engineer's approval. If such approval is given, stockpiled material will be paid for in accordance with Sections 109 and 626.

Section 108 of the Standard and Supplemental Specifications is hereby revised for this project as follows:

Subsection 108.03 shall include the following:

Salient features for this project are:

(1) Submittal of shop drawings to CDOT
(2) Release of Equipment for Manufacture
(3) Fabrication of New Equipment
(4) Installation of New Regulators and Temporary Switchgear in the West Building
(5) Demolition of Existing Switchgear in the West Building
(6) Installation of New Switchgear in West Building
(7) Removal of Temporary Switchgear from West Building
(8) Installation of New Regulators and Temporary Switchgear in the East Building
(9) Demolition of Existing Switchgear in the East Building
(10) Installation of New Switchgear in East Building
(11) Removal of Temporary Switchgear from East Building
(12) Final Test and Inspection
(13) Demobilization

DISADVANTAGED BUSINESS ENTERPRISE (DBE) CONTRACT GOAL

This is a federally-assisted construction project. As described in the CDOT DBE Standard Special Provision, the Bidder shall make good faith efforts to meet the following contract goal:

XXX Percent DBE participation.

ON THE JOB TRAINING CONTRACT GOAL

The Department has determined that On the Job Training shall be provided to trainees with the goal of developing full journey workers in the types of trade or classification involved. The contract goal for On the Job Trainees working in an approved training plan in this Contract has been established as follows:

Minimum number of total On the Job Training required ♦ hours

REVISION OF SECTION 102
PROJECT PLANS AND OTHER DATA

Section 102 of the Standard Specifications is hereby revised for this project as follows:

Subsection 102.05 shall include the following:

After the proposals have been opened, the low responsible bidder may obtain from CDOT's Printing and Visual Communications Center, 4201 East Arkansas Avenue, Denver, Colorado 80222, at no cost: 10 sets of plans and special provisions; and if available for the project, one set of full-size cross sections, one set of full-size major structure plan sheets, and one set of computer output data. If the low bidder has not picked up the plans and other available data by 4:00 p.m. on the second Friday after bid opening, they will be sent to the Resident Engineer in charge of the project. Additional sets of plans and other available data may be purchased on a cash sale basis from CDOT's Visual Communication Center at current reproduction prices. Subcontractors and suppliers may obtain plans and other data from the successful bidder or they may purchase copies on a cash sale basis from the Visual Communication Center at current reproduction prices.

REVISION OF SECTIONS 105
CONTRACTOR SUBMITTALS

Section 105 of the Standard Specifications is hereby revised for this project as follows:

In subsection 105.02 (c) add the following paragraph.

The Contractor shall submit shop drawings for all materials within 28 calendar days after Notice to Proceed.

In subsection 105.02, delete Table 105-1 and replace with the following:

TABLE 105-1
SUMMARY OF CONTRACTOR SUBMITTALS

Section No.	Description	Type	Contractor P.E. Seal Required?*
210	Power Control Board Modifications	Shop Drawing	No
613	24.9kV Switchgear	Shop Drawing	No
613	Step Voltage Regulator	Shop Drawing	No
613	Regulator Bypass Switch	Shop Drawing	No
613	Hook-Operated Disconnect Switch	Shop Drawing	No
613	Temporary Switchgear	Shop Drawing	No
613	Construction Sequencing Plan	Shop Drawing	No
613	Wire and Cable	Shop Drawing	No
613	Cable Splices	Shop Drawing	No
613	Conduit	Shop Drawing	No
613	Conduit Fittings and Supports	Shop Drawing	No
613	Junction and Pull Boxes	Shop Drawing	No
613	Wire Terminations	Shop Drawing	No
613	Hanger Rods	Shop Drawing	No
613	Channels	Shop Drawing	No
613	Mounting Hardware	Shop Drawing	No
613	Grounding and Bonding Connectors	Shop Drawing	No
613	Conduit Expansion Fittings	Shop Drawing	No
613	Testing Procedure and Test Reports	Shop Drawing	No

*: A PE seal is required where the Contractor has provided the design for the item, or performed engineering to modify the details shown on the plans. The PE seal is not required where complete details are provided on the plans.

1

REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK

Section 107 of the Standard Specifications is hereby revised as follows:

Add subsection 107.061 immediately following subsection 107.06 as follows:

107.061 Performance of Safety Critical Work. The following work elements are considered safety critical work for this project:

(1) Work requiring the use of cranes or other heavy lifting equipment to set a girder, to make overhead repairs, or includes special provisions for Removal of Bridge or Removal of Portion of Bridge. Also when construction materials are being lifted that may fall onto active traffic lanes.

The Contractor shall submit, for record purposes only, an initial detailed construction plan that addresses safe construction of each of the safety critical elements. When the specifications already require an erection plan, a bridge removal plan, or a removal of portion of bridge plan, it shall be included as a part of this plan. The detailed construction plan shall be submitted two weeks prior to the safety critical element conference described below. The construction plan shall be stamped "Approved for Construction" and signed by the Contractor. The construction plan will not be approved by the Engineer.

The Construction Plan shall include the following:

(1) Safety Critical Element for which the plan is being prepared and submitted.
(2) Contractor or subcontractor responsible for the plan preparation and the work.
(3) Schedule, procedures, equipment, and sequence of operations, that comply with the working hour limitations
(4) Temporary works required: falsework, bracing, shoring, etc.
(5) Additional actions that will be taken to ensure that the work will be performed safely.
(6) Names and qualifications of workers who will be in responsible charge of the work:
    A. Years of experience performing similar work
    B. Training taken in performing similar work
    C. Certifications earned in performing similar work
(7) Names and qualifications of workers operating cranes or other lifting equipment
    A. Years of experience performing similar work
    B. Training taken in performing similar work
    C. Certifications earned in performing similar work
(8) The construction plan shall address how the Contractor will handle contingencies such as:
    A. Unplanned events (storms, traffic accidents, etc.)
    B. Structural elements that don't fit or line up
    C. Work that cannot be completed in time for the roadway to be reopened to traffic
    D. Replacement of workers who don't perform the work safely
    E. Equipment failure
    F. Other potential difficulties inherent in the type of work being performed
(9) Name and qualifications of Contractor's person designated to determine and notify the Engineer in writing when it is safe to open a route to traffic after it has been closed for safety critical work.

2

REVISION OF SECTION 107

PERFORMANCE OF SAFETY CRITICAL WORK

(10) Erection plan or bridge removal plan when submitted as required elsewhere by the specifications. Plan requirements that overlap with above requirements may be submitted only once.

A safety critical element conference shall be held two weeks prior to beginning construction on each safety critical element. The Engineer, the Contractor, the safety critical element subcontractors, and the Contractor's Engineer shall attend the conference. Required pre-erection conferences or bridge removal conferences may be included as a part of this conference.

After the safety critical element conference, and prior to beginning work on the safety critical element, the Contractor shall submit a final construction plan to the Engineer for record purposes only. The final construction plan shall be stamped "Approved for Construction" and signed by the Contractor.

The Contractor shall perform safety critical work only when the Engineer is on the project site. The Contractor's Engineer shall be on site to inspect and provide written approval of safety critical work for which he provided signed and sealed construction details. Unless otherwise directed or approved, the Contractor's Engineer need not be on site during the actual performance of safety critical work, but shall be present to conduct inspection for written approval of the safety critical work.

When ordered by the Engineer, the Contractor shall immediately stop safety critical work that is being performed in an unsafe manner or will result in an unsafe situation for the traveling public. Prior to stopping work, the Contractor shall make the situation safe for work stoppage. The Contractor shall submit an acceptable plan to correct the unsafe process before the Engineer will authorize resumption of the work.

When ordered by the Engineer, the Contractor shall remove workers from the project that are performing the safety critical work in a manner that creates an unsafe situation for the public in accordance with subsection 108.05.

Should an unplanned event occur or the safety critical operation deviate from the submitted plan, the Contractor shall immediately cease operations on the safety critical element, except for performing any work necessary to ensure worksite safety, and provide proper protection of the work and the traveling public. If the Contractor intends to modify the submitted plan, he shall submit a revised plan to the Engineer prior to resuming operations.

All costs associated with the preparation and implementation of each safety critical element construction plan will not be measured and paid for separately, but shall be included in the work.

Nothing in the section shall be construed to relieve the Contractor from ultimate liability for unsafe or negligent acts or to be a waiver of the Colorado Governmental Immunity Act on behalf of the Department.

REVISION OF SECTION 202
REMOVAL OF ELECTRICAL EQUIPMENT

Section 202 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 202.01 shall include the following:

The work shall include the demolition and removal of the existing 24.9kV Switchgear, electrical equipment, feeders, conduit, and wire as shown on the plans.

Subsection 202.02 shall include the following:

The Contractor shall coordinate with CDOT EJMT Maintenance Staff and obtain the approval of the Engineer prior to disconnecting or de-energizing any existing feeder or circuit to ensure operational and safety control. All conduit ends shall be sealed to prevent the entrance of water.

Subsection 202.11 shall include the following:

Removal of Electrical Equipment will not be measured but shall be paid for as a single lump sum basis for all work, materials, and equipment required for removal of all electrical equipment required for the removal and replacement of the Switchgear as specified herein.

Removal of Electrical Equipment shall include the removal of switchgear, voltage regulators, conduit, electrical cable complete with associated items. This payment will include the removal, hauling and, disposal of all abandoned or non-used electrical items which in any way hinders or obstructs the installation of the new electrical equipment indicated on the plans. Included in the term “associated items” is all equipment required to perform the complete demolition of the electrical items as required for the tunnel facility. This payment will also include the relocation or rearrangement of all electrical items that are presently in use or energized which in any way hinders or obstructs the installation of the new electrical equipment indicated on the plans. All materials and equipment removed shall become the property of the Contractor.

Subsection 202.12 shall include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
Removal of Electrical Equipment	Lump Sum

REVISION OF SECTION 210
MODIFY POWER CONTROL BOARD

Section 210 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 210.01 shall include the following:

The work shall also include modifications to the existing Power Control Board located in the Control Room of the East Ventilation Building as shown in the plans.

Subsection 210.02 shall include the following:

Modifications to Existing Power Control Board shall be made in accordance with the requirements of the Revision of Section 613, 24.9kV Switchgear Assemblies.

Subsection 210.12 shall include the following:

Modify Power Control Board will be measured but will be paid for on a lump sum basis.

Subsection 210.13 shall include the following:

Payment for Modify Power Control Board will be the contract lump sum bid and will be full compensation for all equipment, labor and materials required to complete the item as specified herein.

Payment will be made under:

Pay Item	**Pay Unit**
Modify Power Control Board	Lump Sum

REVISION OF SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

Section 250 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 250.01 shall include the following:

This work will also include inspections, assessment, removal and disposal of asbestos material encountered as a result of any drilling into the electrical room ceiling and at other locations required to complete the work as shown in the plans.

Subsection 250.09, first paragraph shall include the following:

(5) Materials handling and stockpiling as required

(6) Disposal of solid waste and hazardous waste

Subsection 250.09, delete the fifth paragraph and replace with the following:

Materials stockpiled under the requirements of this specification will not be measured and paid for separately but shall be included in the lump sum price for Environmental, Health and Safety Management. Disposal of solid waste and hazardous waste materials will not be measured and paid for separately but shall be included in the lump sum price for Environmental, Health and Safety Management.

Subsection 250.10, delete the fifth and sixth paragraphs and replace with the following:

Payment for Materials Handling (Stockpile) will not be made separately but shall be included in the contract lump sum price for Environmental, Health and Safety Management and shall include furnishing all materials, labor, equipment and incidentals necessary to complete this work, and all handling of the material prior to disposal. This also includes haul, stockpile, water collection, and security.

Payment for Solid Waste Disposal and Hazardous Waste Disposal will not be made separately but shall be included in the contract lump sum price for Environmental, Health and Safety Management and shall include furnishing all materials, labor, equipment, tools, storage containers for transport, containerization of material for up to 60 days, and incidentals necessary to complete this work. This also includes all handling of the material, loading for disposal, unloading for disposal, and all associated fees.

1

REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.01 shall include the following:

The work shall also include furnishing, handling, storing and installing all conduit, wireway, hanger system, conduit fittings, sealing boots, wall penetrations, ceiling/roof penetrations, mounting hardware, and anchors, fasteners and supports for fastening conduit and equipment to the building structure.

Subsection 613.02(c) shall include the following:

(c) *Conduit*. Unless otherwise noted in these specifications or shown on the plans, all conduits shall be metal Galvanized Rigid Conduit (GRC). GRC shall be mild steel, hot-dip galvanized conduit complying with ANSI C80.1 and FS WW-C-581 and shall be UL listed. All conduit material shall comply with the applicable standards of ASTM, NEMA, ICEA, and where applicable shall be UL listed.

Conduit shall be ¾ inch trade size or larger or as indicated on the plans, and shall be manufactured by National Electrical Products Company, Youngstown Steel and Tube Company, Republic Steel, Allied Steel Tube and Conduit Company, or approved equal.

Liquidtight flexible metal conduit shall be minimum 3/4-inch trade size and shall comply with UL-1 Listed, standard weight, flexible, galvanized steel conduit with a heavy wall neoprene or polyurethane jacket. Fittings shall be galvanized steel designed for use with liquidtight flexible metal conduit and comply with UL Standard 514.

Elbows, bends, and similar offsets shall be made of full weight materials complying with the above and shall be coated and threaded the same as conduit. Threads for conduit, couplings, and fittings shall be full depth and clean cut.

Material for Fittings shall comply with ANSI/NEMA FB-1.

Conduit Expansion Fittings shall be O-Z./Gedney type AX, EX, EXDS, TX, or EXE; Crouse Hinds type XJ; Appleton expansion fitting or approved equal.

Factory fabricated metal connectors of the size, rating material type, and class required for each service shall be provided.

Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.

The finish shall consist of a wash and phosphate undercoat and an ANSI 61 gray polyester powder finish. Hardware and latches are zinc plated with a yellow chromate finish.

(j) A hanger system for the support of conduits and wireways shall be provided. Support shall be provided for conduits at 10 foot intervals and within 18 inches of terminations, in accordance with the requirements of the National Electrical Code. The materials for the hanger system shall conform to the following:

2

REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

(1) Conduit Clamps shall be one hole or two-hole, cadmium plated or galvanized heavy gauge steel, or galvanized malleable iron.

(2) Hanger Rod: Galvanized Steel or electro-galvanized and zinc chromate coated steel, 3/8-inch minimum.

(3) Channels, Fittings, Hangers, Clamps, and Accessories: Unless otherwise indicated, all surface mounted supporting channels and associated fittings, clamps and accessories shall be galvanized steel. Channels shall be constructed of 12-gauge minimum, 1-5/8-inch deep by 1-5/8-inch wide minimum. Hangers shall be steel which is hot-dip galvanized after fabrication.

(4) Nuts, bolts, and washers shall be Type 316 stainless steel.

Subsection 613.03 shall include the following:

All equipment and materials that are damaged during transport, and which the Engineer deems to be non-functional or unfit for use, will be repaired or replaced at the Contractor's expense.

Equipment shall be stored in a clean, dry space and protected from dirt, fumes, water, construction debris, and any physical damage.

Auxiliary heaters shall be provided for all equipment that would be damaged by moisture condensation.

The Contractor shall examine the areas and conditions under which electrical equipment is to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

Supporting devices shall be installed as follows:

(1) Provide anchors with sufficient strength to support four times the load imposed by the combined conduit and conductor weight. Anchors shall be seismic rated for Zone 3 requirements.

(2) Hollow Masonry: Toggle bolt type expansion anchors.

(3) Solid Masonry: Expansion anchors or preset inserts.

(4) Metal Surfaces: Machine screws, bolts, or welded studs.

(5) Wood Surfaces: Wood screws.

(6) Concrete Surfaces: Concrete screw anchors, wedge anchors, or sleeve anchors or approved equal. Power driven (powder actuated) studs shall not be used.

Subsection 613.07 shall be deleted in its entirety and replaced with the following:

613.07 Conduit. Electrical conduit shall be installed in accordance with the applicable requirements described in the Department of Transportation's, *A Policy on the Accommodation of Utilities on Colorado Highways Rights-of-Way*, as amended, and the following:

3

REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Conduit runs in structures are shown on the plans only for information. Locations will be established during construction by the Contractor with approval of the Engineer. Conduit and cable shall be so located as to avoid any interference with known present or known future construction installations. Existing conduit to be reused shall be

cleaned with a mandrel 1/2 inch smaller than conduit's inside diameter (ID) and a cylindrical wire brush of diameter equal to conduit's ID, followed by a swab of the same size as the conduit's ID.

The ends of all conduits, whether shop or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made square and true so that the ends will butt or come together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used for coupling metal type conduit, an approved threaded union coupling shall be used. All threads on all ferrous metal conduit, not previously treated with a corrosion preventative, shall be painted with conducting rust preventive paint before couplings are made up. All couplings for metal type conduit shall be tightened until the ends of the conduit are brought together, providing a continuous electrical connection throughout the entire length of the conduit run. Where the coating on ferrous metal conduit has been damaged in handling or installing, such damaged places shall be painted with rust preventive paint.

All metal type conduit ends shall be threaded and shall be capped until wiring is started. When caps are removed, the threaded ends shall be provided with conduit bushings or transition fittings as applicable.

Liquidtight flexible metal conduit shall be used only when necessary as the final conduit connection to electrical equipment and other utilization devices. Connections to equipment subject to vibration, calibration, periodic removal, or where specifically indicated or noted on the plans shall be made with between 18 and 24 inches of Liquidtight flexible metal conduit.

It shall be the option of the Contractor, at no expense to the Department, to install pull boxes to facilitate the work.

The Contractor shall route exposed conduit parallel and perpendicular to walls and adjacent piping.

The Contractor shall maintain a minimum 6-inch clearance between conduit and piping.

The Contractor shall arrange conduit supports to prevent distortion of alignment by wire pulling operations.

The Contractor shall group conduit in parallel runs where practical, and use conduit supports constructed of galvanized steel channel with conduit clamps, designed to provide the proper separation between the conduits.

The Contractor shall fasten conduit with approved malleable iron clamps before conductors are pulled. Do not use spring steel clips for conduit clamps. The Contractor shall remove all wire used for temporary conduit support during construction.
The Contractor shall support conduit at a maximum of 10 feet on center.

The Contractor shall install no more than the equivalent of three 90-degree bends between end points of any conduit run. Adequately sized boxes shall be installed to meet this requirement whether specifically shown or not in the Plans.

Conduit bodies shall not be used to make sharp changes in direction, as around beams or corners. All bends shall be via standard radius sweeps. LB fittings shall be a mogul cast fitting with a gasket and cover.

4

REVISION OF SECTION 613 ELECTRICAL CONDUIT AND WIRING

The Contractor shall use hydraulic one-shot conduit bender or factory elbows for bends in conduit.

The Contractor shall avoid moisture traps where possible; where unavoidable, provide conduit body with drain fitting at conduit low point.

Conduit offsets shall be properly made and installed where required. Where two or more conduit offsets or bends are installed in parallel, they shall be symmetrically formed and arranged.

Conduit shall be supported on each side of conduit bends or fittings and not more than 2 feet away from any junction box or pull box, if utilized.

Conduit shall not be fastened to other conduits or pipes for support.

Conduits and conduit boxes shall be of such sizes and numbers and shall be so installed that the required number of conductors may be drawn in without injury or excessive strain. The Contractor will be permitted to increase the size of conduits and number of boxes, if he so desires, to facilitate a speedier and less complicated installation, however, such changes shall be at his expense.

Where fasteners are required in concrete floors, walls or ceilings, expansion anchors shall be used unless noted otherwise

(1) The minimum allowable anchor working load for existing concrete strength f'c = 3,000 psi, shall be certified in writing for Tension = 6,800 lbs and Shear = 5,000 lbs.

(2) The corresponding ultimate anchor capacity shall be certified in writing for Tension = 22,000 lbs and Shear = 18,000 lbs.

(3) The concrete anchors and the Type 316 stainless steel bolts, nuts, and washers shall be supplied by one of the following manufacturer or an approved equal:

   a. HILTI Corporation
   b. Williams
   c. Marine Fasteners

(4) All anchors supplied shall be from one manufacturer.

(5) The bolts shall be installed by first drilling holes into existing concrete and effectively cleaning any loose material from the drilled holes. The Contractor shall exercise care in locating and drilling the holes so as to avoid damage to existing reinforcing steel bars and concrete.
(6) The Contractor shall follow the installation procedures recommended by the manufacturer, including, but not limited to, the size and depth of hole for the required bolt size, the type of drilling tools preferred, surface preparation.

Inserting wooden plugs in concrete or masonry will not be accepted as a base for conduit fastenings, nor will conduit or pipe straps be welded to steel structures.

Openings in floors, walls, ceilings or roofs required for the installation of the conduit shall be sealed and patched to match the existing area after the installation is complete.

5

REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Rigid metallic conduits shall have expansion fittings installed at every expansion joint and as specified in the NEC. The expansion fittings shall provide for 4-inch conduit movement, 2-inches in either direction. A 14-inch bonding jumper, designed for use in conjunction with the expansion fitting shall be installed around every expansion fitting.

Subsection 613.08 shall be deleted in its entirety and replaced with the following:

613.08 Wiring. The material shall comply with the applicable standards of ASTM, NEMA, ICEA, and where applicable shall be UL listed.

600-volt wire and cable shall be copper, not less than 98% conductivity.

Insulation shall be type XHHW. Wire shall be stranded. All wire sizes shown are in American Wire Gauge sizes.

All power wire shall be color coded as follows:

Conductor	**120 Volt**	**277/480 Volt**
Ungrounded	Black-Red	Brown (ΦA)-Orange (ΦB)-Yellow (ΦC)
Grounded	White	Gray
Grounding	Green	Green

Factory fabricated metal connectors of the size, rating material type, and class required for each service shall be provided.

35kV cable shall be shielded, with a semi-conducting strand shield, ethylene propylene rubber insulation, semi-conducting insulation shield, copper tape shield, and polyvinyl chloride jacket. The insulation level shall be 100 percent. Terminations shall be made using stress cones, and the shields shall be grounded at the switchgear. The other end of the shield shall not be grounded.

Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.

Subsection 613.10 shall be deleted in its entirety and replaced with the following:

613.10 Testing. Prior to final acceptance, the Contractor shall demonstrate to the Engineer's satisfaction that electrical installations are in proper working condition, provide all instrumentation and labor required to perform all inspection and tests as described herein. All tests shall be performed in the presence of the Department personnel or Department's authorized Engineer. All test results shall be documented and submitted to the Engineer for approval.

Subsection 613.11 shall include the following:

Electrical Conduit of the specified diameter will not be measured and paid for separately but shall be included in the lump sum item, Conduit.

Wire and cable will not be measured and paid for separately but shall be included in the lump sum item, Wiring.

Conduit clamps, channels, associated accessories, hardware and hanger system described herein and the installation thereof shall not be measured separately, but shall be incidental to the work.

6

REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Subsection 613.12 shall include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
Conduit	Lump Sum
Wiring	Lump Sum

Payment for conduit shall also include all conduit connections and terminations, pull and junction boxes, conduit fittings, hangers and supports, and identification materials.

Payment for Wiring shall also include all wire and cable splices, terminations, and identification tags.

1

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

Section 613 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Add the following subsection:

613.13 This Section specifies the requirements for metal-enclosed, medium voltage metal-clad draw-out type vacuum-type circuit breaker switchgear. The general arrangement of the switchgear shall be as follows:

(1) Main circuit breaker section A, with 1200 ampere frame circuit breaker with associated potential transformer compartment.

(2) Main circuit breaker section B, with 1200 ampere frame circuit breaker with associated potential transformer compartment. One circuit breaker and potential transformer assembly shall be provided to insert in either one of the two main compartments. Each compartment shall be provided with a protective relay.

(3) Blank section with through busing, to accommodate column in electrical room.

(4) Tie circuit breaker section, with 1200 ampere frame circuit breaker unit and protective relay.

(5) Feeder circuit breaker section for 2400V transformer no. 1B, with 1200 ampere frame circuit breaker unit and protective relay.

(6) Feeder circuit breaker section for 480V transformer no. 2, with 1200 ampere frame circuit breaker unit and protective relay.

(7) Blank section with through busing, to accommodate column in electrical room.

(8) Feeder circuit breaker section for 2400V transformer no. 1A, with 1200 ampere frame circuit breaker unit and protective relay.

(9) Feeder circuit breaker section for 480V transformer no. 1, with 1200 ampere frame circuit breaker unit and protective relay.

MATERIALS

Add the following subsections:

613.14 Design and Performance. Design and performance of components and methods specified herein shall comply with all applicable Federal, State, and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

(1) American National Standards Institute (ANSI)

(2) National Electrical Manufacturers Association (NEMA)

(3) National Fire Protection Association (NFPA)

2
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

(4) Underwriters Laboratories (UL)

The switchgear shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ANSI, NEMA, and UL Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

The tunnel is located at an elevation of approximately 11,000 ft. above sea level. The equipment to be provided shall be fully rated for the various parameters in this Specification at that altitude.

613.15 Quality Assurance. Switchgear and all components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

Entities manufacturing equipment shall have experience on at least two projects involving complexities similar to those required under this Contract.

The switchgear and circuit breakers shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for Zone 1 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 0.09g, and a Zero Period Acceleration (ZPA) of 0.075g. The tests shall fully envelope this response spectrum for all equipment natural frequencies up to at least 35 Hz.

613.16 Submittals. See Section105 for general submittal requirements. The switchgear submittal shall include the following information:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line diagram
6. Schematic diagram
7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
    a. Switchgear assembly short-circuit withstand rating
    b. Enclosure internal arc short circuit rating
    c. Voltage
    d. Continuous current
    e. Basic impulse level
11. Major component ratings including:

12. 3
13. REVISION OF SECTION 613
14. 24.9KV SWITCHGEAR ASSEMBLIES

  a. Voltage
  b. Continuous current
  c. Interrupting ratings

15. Cable terminal sizes
16. Product data sheets
17. Connection details between close-coupled assemblies
18. Composite floor plan of close-coupled assemblies
19. Key interlock scheme drawing and sequence of operations
20. Descriptive bulletins
21. Certification that the equipment is suitable for installation and operation at an elevation of 11,000 feet above sea level
22. The following information shall be submitted for record purposes:
    a. Final as-built drawings and information for items listed in paragraph 1.04
    b. Wiring diagrams
    c. Certified production test reports
    d. Installation information including equipment anchorage provisions
    e. Seismic certification

613.17 Spare Parts And Special Tools.

A complete set of the following indicated spare parts shall be furnished for each of the two switchgear assemblies.

Furnish one spare circuit breaker for each switchgear assembly.

Furnish one ground and test device for each switchgear assembly for each switchgear assembly.

A minimum of six (6) spare fuses of each size and type used in the switchgear shall be furnished for each switchgear assembly.

Furnish one set of all special tools required for the erection, operation, and maintenance of all equipment furnished for each switchgear assembly.

Furnish a minimum of three (3) half-pint containers of paint matching the exterior finish of the enclosure for each switchgear assembly.

Furnish six (6) spare indicating lamps of each type installed for each switchgear assembly.

Furnish one (1) container of contact lubricant for each switchgear assembly.

Furnish one (1) portable breaker lifting device for each switchgear assembly.

4
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

613.18 Manufacturers. Medium voltage switchgear shall be manufactured by General Electric Company, Square D Company, Cutler Hammer, Siemens or an approved equal.

613.19 Ratings. The switchgear shall have the following ratings, as shown on the Contract Drawings:

1. Nominal System Voltage: 24.9/14.4 kV, 3 phase, 3 wire, solidly grounded neutral
2. Rated Maximum Voltage: 27kV
3. Rated Frequency: 60 Hertz
4. Rated Insulation Level: 125kV
5. Rated Continuous Current: 1200 Amperes

6. Rated Short-Circuit Current: 22kA
7. Rated Short Circuit MVA: 1000MVA
8. Short Circuit Current Bus Bracing: 22kA
9. Control Voltage: 125V DC

613.20 Construction Features. Switchgear shall be factory assembled, suitable for indoor use, dead front, metal enclosed, free standing, arc-flash resistant, and completely equipped with removable medium voltage vacuum circuit breakers, fuses, instrument transformers, relays, metering, switches, and associated devices as described herein and as shown on the Contract Drawings and conforming to ANSI C37.20.2, C37.55, C37.100, and NEMA SG 5.

Provisions shall be made for extension of the switchgear in both directions. Circuit breakers shall be removable, drawout type.

All breakers shall be arranged as shown on the Contract Drawings.

No polyvinyl chloride (PVC) materials, insulation or products shall be used in switchgear, except for removable insulating boots on bus work.

613.21 Construction. The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. The 27 kV switchgear structures shall be provided with one full height hinged rear cover.

The construction of the switchgear shall permit the addition of new circuit breaker sections at the end of the lineup.

The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. Provide rails to allow withdrawal of each 27 kV circuit breaker for inspection and maintenance without the use of a separate lifting device.

The switchgear assembly shall be of arc resistant construction that provides Type-2 accessibility around the perimeter (front, sides, and rear) of the line-up in accordance with IEEE C37.20.7.

5

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

Each individual vertical section of the switchgear shall include integral and top mounted pressure release flaps to facilitate a controlled upward release of arc created overpressures, smoke, and gasses. Individual vertical sections shall be of a unitized design to allow removal of a damaged vertical section after a fault incident, without requiring the removal of the adjacent vertical sections.

The main bus shall be copper with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, cycloaliphatic epoxy. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers. Main bus shall be rated 1200 amperes. . Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

A copper ground bus shall extend the entire length of the switchgear.

The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10% spare terminals shall be provided. One control circuit cutout device shall be provided in each circuit breaker housing. Switchgear secondary wire shall be #12 AWG, type SIS rated 600 volt, 90 degrees C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

Incoming line and feeder cable lugs shall be 2- hole mounting, long barrel, copper compression lugs.
Feeders shall be for conduit and cable. Cable entry shall be from either the top or the bottom of the enclosure, as indicated on the Drawings.

613.22 Circuit Breakers. The circuit breakers shall be horizontal drawout type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on cycloaliphatic epoxy supports. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.

Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

6
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

The circuit breaker compartment door shall be mechanically interlocked with the breaker levering mechanism to prevent opening of the door unless the breaker is first opened and withdrawn to Test/Disconnected position with the door closed.

The design shall allow normal circuit breaker functions to be carried out with the door closed. Those functions include: manual open and close, manual levering to and from connected position, and manual charging of the circuit breaker closing springs. Shatter proof viewing windows shall be provided on the door to enable viewing of circuit breaker position inside the compartment, circuit breaker contact status (open/closed), and spring charged/discharged indication.

When a remote operable electrical levering device is specified under the accessories, the design shall allow levering of the circuit breaker using such a device with the door closed.

The breakers shall be electrically operated by the following control voltages: 125-volt DC close and 125 volt DC trip. Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.

DC control voltage shall be supplied by from existing battery/charger system.

613.23 Protective Relays. The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays as indicated on the drawings and described hereafter in this specification. Relays shall be mounted in a separate area metal barriered from medium voltage.

Relays shall be Microprocessor-Based Protective Relays. For incoming line circuit breakers: Cutler-Hammer FP-5000, or equivalent by General Electric Multilin or Basler or other equal microprocessor-based multi-function protective relay, with ANSI device functions 51/50, 54/50N, 46, 59, 27, 32, 67, 46, 55, 81O, 81U, 47, and 50BF. The relay shall also includes metering functions. For tie and transformer feeder circuit breakers: Cutler-Hammer DT 3000, or equivalent by General Electric Multilin or Basler or other equal microprocessor-based multi-function overcurrent relay, with ANSI device functions 51/50, 51/50N, or 51/50G, and 86.

613.24 Auxiliary Devices. Ring type current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The standard location for the current transformers on the bus side and line side of the breaker units shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

Voltage or potential transformers shall be supplied. Voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment. Rails shall be provided for auxiliary drawers to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn. Voltage transformers for each assembly shall consist of three 14.4kV to 120 volt transformers with primary and secondary fuses.

Lightning/Surge Arresters shall be intermediate class, rated for 18kV.

613.25 Enclosures. Indoor switchgear shall be provided with a NEMA 1 enclosure.

7

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

The switchgear shall be installed inside an electrical room. Arc exhaust shall be discharged into the space above the switchgear.

613.26 Nameplates. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, white characters on black background, and secured with screws. Characters shall be 3/16-inch high, minimum. Furnish master nameplate for each switchgear lineup giving information in accordance with IEEE Std C37.20.2-1999, section 7.4.1 and IEEE C37.20.7, section 6.3. Circuit nameplates shall be provided with circuit designations as shown on purchaser's single-line diagrams.

Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

613.27 Finish. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

613.28 Accessories. The switchgear manufacturer shall furnish accessories for test, inspection, maintenance, and operation. Two sets of accessories shall be furnished, one set for each of the two switchgear locations. Each accessory set shall include:

1. One – Maintenance tool for manually charging the breaker closing spring and manually opening the shutter
2. One – Levering crank for moving the breaker between test and connected positions
3. One – Test jumper for electrically operating the breaker while out of its compartment
4. One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails, when applicable
5. One – Set of rail extensions, when applicable
6. One – Portable lifting device for lifting the breaker on or off the rails
7. One – Ramp for rolling breaker mounted in lower compartment directly onto the floor
8. One – Test cabinet for testing electrically operated breakers outside housing
9. One – "Dockable" transport dolly for moving breaker about outside its compartment
10. One – Universal Remote Power Racking Device

613.29 Corona-Free Design. The switchgear shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

613.30 Partial Discharge Sensing Equipment. The switchgear shall be equipped with factory installed partial discharge (PD) sensors and relay for continuous monitoring of the partial discharges under normal operation. The partial discharge sensing shall identify potential insulation problems (insulation degradation) by trending of PD data over time so that corrective actions can be planned and implemented before permanent insulation deterioration develops.

8

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

The PD sensing and monitoring system shall consist of sensors and relay(s) specifically developed for such applications. One sensor shall be installed over floating stress shields of specially designed bus or line side primary bushings, at every two vertical section for detection of partial discharges within the switchgear compartments. An sensor shall also be provided for installation around ground shields of the incoming and outgoing power cable terminations for detection of PD activity in the cables up to 100 feet from the switchgear. Output signals from each shall be factory wired to PD monitoring relay for continuous monitoring.

613.31 Bills of Material. The metal-clad switchgear auxiliary section for control and instrumentation shall include the following:

1. Three – Line-to-ground voltage transformers
2. Three – Current transformers

The metal-clad switchgear main circuit breaker section for control of a main circuit breaker shall include the following:

1. One – Drawout power circuit breaker
2. Three – Current transformers, single secondary
3. One – Circuit breaker control switch with red and green indicating lights
4. One – Microprocessor-based three-phase and ground overcurrent relay, ANSI device numbers 27 Undervoltage, 46 Current Balance, 47 Phase Voltage Reversal, 51/50/N Instantaneous and Time Overcurrent
5. One – Nameplate
6. One – Set of cable lugs.
7. Three – Lightning/Surge Arresters, intermediate class, rated 18kV.

The metal-clad switchgear tie breaker section for control of a tie breaker shall include the following:

1. One – Drawout power circuit breaker
2. Three – Current transformers, single secondary
3. One – Circuit breaker control switch with red and green indicating lights
4. One – Microprocessor-based three-phase and ground overcurrent relay, ANSI device number 51/50/N
5. One – Set of cable lugs
6. One – Nameplate
7. Tie circuit breaker shall be provided with a key interlock on the rear door of the compartment, interlocked with the tie circuit breaker in the switchgear in the other ventilation building.
8. Three – Lightning/Surge Arresters, intermediate class, rated 18kV.

Each metal-clad switchgear feeder breaker section for control of a feeder circuit breaker shall include the following:

1. One – Drawout power circuit breaker
2. Three – Current transformers, single secondary
3. One – Circuit breaker control switch with red and green indicating lights

4. One – Microprocessor-based 3-phase and ground relay, ANSI device number 51/50/N
5. One – Nameplate
6. One – Set of cable lugs.

613.32 Relays, Control Switches and Fuses. Protective relays shall conform to ANSI C 37.90 and be of the semiflush mounted, removable type, with built-in test facilities. Current transformer secondaries shall be automatically short circuited when the relay is removed from its case. Auxiliary relays shall be surface mounted and front connected.
In addition, the main and tie circuit breakers shall be provided with electro-mechanical lockout relays, with manual reset, that shall be engaged when the breakers are tripped on overcurrent.

Control, transfer, and instrument switches shall be of the heavy duty rotary, multi-position, cam operated, multi-stage type, with dust cover, rated 600VAC, with silver to silver contacts rated for continuous current of 20 amperes. Each circuit breaker control switch shall have red and green target. Each switch shall be equipped with engraved plastic escutcheon or nameplate identifying its function and position. Handle styles shall be pistol grip for control, and oval for instrument or transfer switches.

Each Circuit Breaker shall be provided with a control switch on the door of each circuit breaker cubicle for performing breaker close and open operations. Mechanical red/green targets shall be incorporated in the switch to indicate breaker “Closed/Open” position. A spring-return mechanism shall return the switch handle to the normal vertical position.

613.33 Indicating Lamps. Indicating lamps shall be light emitting diodes (LED) of the low voltage, low burden series resistor type, with lens colors as approved by the Engineer. Lamps shall be replaceable from the front of the panel.

613.34 Terminal Blocks. Terminal blocks for all external control connections shall be 600 volt, barrier type, having a minimum rating of 20 amperes with identifying marker strips. Terminal strips in each cubicle, shall have at least 20 percent spare terminals and shall be in accordance with NEMA ICS 4. Terminal blocks for current transformer secondary connections shall be of the short circuiting type.

613.35 Nameplates and Mimic Bus. Nameplates shall be provided for each switchgear, for each cubicle, and for all externally and internally mounted devices, including, but not limited to, instruments, meters, control switches, and relays to identify its function, and where applicable, its position.

Nameplates shall consist of letters and numbers back engraved on a laminated thermosetting plastic material, providing white letters and numbers on a black background. Size of letters and figures shall be approximately 1/8 inch for device nameplates and 7/16 inch for cubicle nameplates, and 1 inch for switchgear designations.

Nameplates shall be fastened with two oval-head stainless steel machine screws.

Number, location and designation of nameplates shall be as approved by the Engineer.

Mimic bus shall be provided on the face of the switchgear representing actual bus arrangements within the switchgear assembly. Circuit breaker control switches and indicating lights shall be located in the proper position on the mimic bus. The mimic bus shall be 1/8 x 3/4 inch, high strength thermosetting plastic material, secured every twelve (12) inches with self tapping screws.

10
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

613.36 Interlocking. New control switches with key interlocking shall be provided for the Power Control Board located in the Control Room in the East Ventilation Building. See paragraph 613.49. See paragraph 613.31 for additional interlocking requirements.

613.37 Additional Grounding Requirements. The switchgear shall be provided with a solderless copper ground lug attached to a non-painted surface in each section of the switchgear. The lugs shall have the capacity for connection of two No. 4/0 wires.

613.38 Shop Painting. Prior to assembly and before shop painting, all surfaces of the switchgear enclosure shall be thoroughly cleaned of rust, oil, grease, dirt and mill scale and receive a phosphatizing treatment, and then be primered with one coat of rust-inhibitor for a dry film thickness of 1-2 mils.

The exterior and interior of the switchgear shall be given two or more finish coats of corrosion resistant paint for a final dry film thickness of at least 2-4 mils. The color of the finish on the switchgear shall be ANSI number 61 light gray.

Alternative painting process, such as electrostatically applied paint, can be utilized, subject to the approval of the Engineer.

613.39 Factory Testing. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability
2. Circuit breakers operated over the range of minimum to maximum control voltage
3. Factory setting of contact gap
4. One-minute dielectric test per ANSI standards
5. Final inspections and quality checks

The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces
2. One-minute dielectric test per ANSI standards on primary and secondary circuits
3. Partial discharge tests, when applicable.
4. Operation of wiring, relays and other devices verified by an operational sequence test
5. Final inspection and quality check.

The manufacturer shall provide three (3) certified copies of factory test reports.

The owner’s representative will witness factory tests as outlined above.

1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed.

11

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

CONSTRUCTION REQUIREMENTS

Add the following subsections:

613.40 Delivery, Storage, and Handling. Prior to shipment, the switchgear assembly shall be cleaned by wiping with a clean, dry cloth.

Oil and grease marks shall be removed and wiped dry. All insulation shall be cleaned thoroughly. Dirt, soot, grease, or paint shall be removed from the circuit breaker contacts and surface of the entire current carrying structures.

All relays and instruments shall be firmly blocked to prevent damage during shipment.

The overall dimensions and weight of each shipping section shall be limited to the maximum allowable by applicable state and local codes governing shipment of materials over public roads or construction site handling limitations, whichever is less. Each shipping section shall have a label indicating dimensions and weight.

All equipment and materials shall be suitably wrapped, crated, boxed, or otherwise prepared for shipment to prevent damage during handling and shipping. All openings shall be properly protected to prevent the entrance of any dirt or debris. All parts not constructed to be normally exposed to the weather shall be suitably weatherproofed.

Each box or crate shall be equipped with suitable lifting devices to facilitate unloading and shall contain a detailed packing list.

Packaging shall be labeled and numbered so that each section or assembly may be identified before being uncrated. Any items not fully assembled to the switchgear structure shall be packaged separately. Removable circuit breaker units shall be packaged and shipped separately.

Adequate means shall be provided for lifting by fork lifts and cranes and for moving the equipment on rollers. Lift points shall be marked on each crate.

Indoor switchgear that cannot be installed immediately shall be stored in a dry, clean location within a heated building. During storage, the switchgear shall be placed on a level surface.

613.41 Field Supervision. Provide the services of a qualified, factory-trained switchgear manufacturer’s representative to provide technical field support in the installation and start-up of the equipment specified in this Section. The manufacturer’s representative shall provide technical direction and assistance in general assembly of the equipment, connections, calibrations, adjustments, and testing of the assembly and components contained therein.

613.42 Field Tests. Field tests shall be performed in accordance with the manufacturer's recommendations, International Electrical Testing Association (NETA), NEMA, UL, ANSI, and as required in this Section and/or as directed by the Engineer. Tests shall be performed only after the equipment has been thoroughly cleaned.

All Work shall be performed with due regard for the protection of personnel and equipment.

Test shall be performed only after the equipment has been thoroughly cleaned.

12

REVISION OF SECTION 613

24.9KV SWITCHGEAR ASSEMBLIES

All field tests shall be conducted in the presence of the Engineer or his designee for the purpose of demonstrating that the equipment and systems comply with the requirements of this Section to assure the Engineer that the entire installation meets applicable codes and standards requirements, and that all systems will function as designed.

All controls shall be checked individually prior to operational tests. Wiring diagrams and manufacturer's drawings shall be marked during checkout. Checked items shall be marked in yellow; discrepancies shall be corrected, and modifications shall be recorded in red. Marked wiring diagrams and manufacturer's drawings shall be submitted to the Engineer.

Record all test values, settings, and calibrations and furnish the Engineer with copies of test reports after completion of each individual test. These reports shall include a description of the test procedures. All test data for each test required in this Section shall be recorded on test forms.

The Engineer shall be advised, in writing, upon failure of any equipment or material to pass the tests performed or to properly function as intended.

Integrity Tests: The switchgear shall successfully complete the following tests as recommended by NETA and listed under the “Switchgear and Switchboard Assemblies” Section:

1. Visual and Mechanical Inspection
    a. Inspect for physical, electrical, and mechanical condition.
    b. Compare equipment nameplate information with latest one-line diagram and report discrepancies.
    c. Check for proper anchorage, required clearances, physical damage, and proper alignment.
    d. Inspect all doors, panels, and sections for paint, debris, scratches, fit, and missing hardware.
    e. Verify that fuse and/or circuit breaker sizes and types correspond to the Contract Drawings.
    f. Verify that current and voltage transformer ratios correspond to the Contract Drawings.
    g. Inspect all bus connections for high resistance. Use low-resistance ohmmeter, or check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer’s instructions for proper torque levels.
    h. Test all electrical and mechanical interlock systems for proper operation and sequencing.
        i. Closure attempt shall be made on locked open devices.
        ii. Opening attempt shall be made on locked close devices.
        iii. Key exchange shall be made with devices operating in off-normal positions.
    i. Clean entire switchgear using manufacturer’s approved methods and materials.
    j. Inspect insulation’s for evidence of physical damage or contaminated surfaces.
    k. Verify proper barrier and shutter installation and operation.
    l. Lubrication
        i. Verify appropriate contact lubricant on moving current carrying parts.
        ii. Verify appropriate lubrication on moving and sliding surfaces.

13
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

   m. Exercise all active components.
   n. Inspect all mechanical indicating devices for proper operation.

2. Electrical Tests
   a. Perform tests on all instrument transformers in accordance with NETA published values.
   b. Perform ground-resistance tests in accordance with NETA published values.
   c. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground for one (1) minute. Test voltages and minimum resistances shall be in accordance with NETA published values.
   d. Perform an overpotential test on each bus section, each phase-to-ground, for one (1) minute at values recommended by the manufacturer.
   e. Perform insulation-resistance test on shipping split control wiring. Do not perform this test on wiring connected to solid-state components.
   f. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.
   g. Perform secondary voltage energization test on all control power circuits and voltage tests as detailed below in paragraph k, and l. Check voltage levels at each point on terminal boards and at each terminal device.
   h. Perform current injection test on entire current circuit in each section of switchgear.
      i. Perform current tests by primary injection, where possible, with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit.
      ii. Where primary injection is impractical, utilize secondary injection with a minimum of 1.0 ampere.
      iii. Test current at each device.
   i. Determine accuracy of all meters and calibrate watt-hour meters per NETA recommendations.
   j. Perform phasing check on double ended switchgear to ensure proper bus phasing from each source.
   k. Potential Transformer Circuits
      i. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check voltage at all devices.
      ii. Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

613.43 Records of Tests. Types of Records: Maintain complete and accurate records of all tests. These records shall include the following:

1. Description of test equipment used, including serial numbers.
2. Equipment or circuit identification, description, and location.
3. Complete nameplate data, including serial number.
4. Readings and measurements taken, including temperature and humidity.
5. Description of test, including date and tester's signature.

14
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

6. Test results (written description as required).
7. Other observable data applicable to equipment tests.
8. Description of any necessary corrective actions.
9. Certification of satisfactory completion of wiring and installation in accordance with applicable items of this Section.

613.44 Training. Provide at the construction site training sessions for Authority personnel, for two (2) - eight (8) hour days.

The training sessions shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

613.45 Step Voltage Regulators. Voltage regulators shall comply IEEE C57.15 and shall be of the outdoor, self-cooled, 55/65 degrees C temperature rise, single-phase type. Windings and the load-tap-changing mechanism shall be mineral-oil-immersed. When operating under load, a regulator shall provide plus and minus 10 percent automatic voltage regulation in approximately 5/8 percent steps, with 16 steps above and 16 steps below rated voltage. Automatic control equipment shall provide Class 1 accuracy. Bypass surge arresters shall be suitable for a grounded system and for the associated regulator voltage. Distribution class surge arresters shall be mounted next to each incoming line bushing on a regulator tank-mounted bracket and connected to a surge arrester ground pad-mounted on the regulator tank.

Ratings:

Ratings at 60 Hz shall be

Maximum voltage	14.4kV
Basic Insulation Level (BIL)	150
Current	200A

613.46 Regulator Bypass Switches. Switches shall be of the outdoor, hookstick-operated, single-pole, single-throw, vertical-break type suitable for the indicated mounting. Switches shall be of a type designed to provide bypass of a single-phase regulator circuit by an integral sequence which always occurs when each switch is opened or closed. Each opening sequence shall initially bypass the single-phase regulator circuit, then open the input and output circuits, and finally interrupt the exciting current. Opening any single-phase regulator circuit shall not be possible until after the bypass circuit is closed. Ratings at 60 Hz shall be in accordance with IEEE C37.41 and as follows:

Maximum voltage	25.8kV
Nominal voltage class	25kV
BIL	150kV
Momentary asymmetrical current in the closed position	40kA
Momentary asymmetrical current in the bypass position	30kA
Continuous and interrupting current	600A

Standard accessories and components in accordance with IEEE C57.15 shall be provided. Single-phase units shall be provided with additional components and accessories required by IEEE C57.15 for three-phase units.

15
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

613.47 Structure Mounted disconnect Switches. Hookstick-operated switches shall be distribution class, single pole, single throw and shall be rated for 600 amperes continuous and 40kA momentary. Switches shall be rated for 25.8kV, with a BIL rating of 125kV.

613.47 Relays and Relay Enclosures. Relays for use in the switchgear control system in the West Ventilation Building shall be heavy duty industrial type with modular construction. The relays shall accommodate up to four convertible contact cartridges. Terminals shall accommodate ring or spade type wire terminations. Relays shall be rated for 5 amperes continuous current and shall be rated to make or break 1.1 amperes inductive load and 4 amperes resistive load. The estimated service life of the relays shall be 15 years at 60 operations per hour for a break current of 1 ampere.

Enclosures shall be NEMA 12 rated, with door with continuous piano hinge and three point latching mechanism. Enclosures shall be sized as indicated on the drawings. Enclosure shall be constructed of 12 gauge steel and shall be finished with ANSI 61 gray polyester powder paint on the outside and white polyester powder paint inside. A full size subpanel shall be provided in the rear of the enclosure.

Wiring shall be installed in slotted wiring duct. Terminal strips in new and existing enclosures shall be barrier type with two screws per terminal, capable of accommodating ring type wire terminals.

613.48 Temporary Switchgear. Temporary switchgear shall be vault-type rated for a maximum voltage of 27kV using molded rubber elbow type terminators. The switchgear shall be either solid-dielectric type or shall utilize SF6 gas.

The temporary switchgear shall consist of six 25kV rated three phase switch ways, five with vacuum interrupter overcurrent devices and one switch only, which shall be the main switch. The six switch ways shall each be provided with motor operated open-close for connection to the existing switchgear control system. The existing switchgear control system operates on 125 volts d-c, interfacing relays shall be provided for equipment requiring 120 volt a-c control.

The switch shall interrupt all load and fault currents within the vacuum bottle. Each fault interrupter switch mechanism shall consist of three individual vacuum bottle assemblies mechanically linked to a single spring-assisted operating mechanism. Manual opening and closing of each way shall be via an operating handle.

Cable entrances shall consist of 200A load break apparatus bushings per IEEE 386.

For the vacuum interrupters, an electronic control shall be provided to monitor load and fault current on all three phases of the interrupter. The current transformers encapsulated within the solid dielectric modules provide control power and current sensing. No external power source shall be required for overcurrent protection. Operational temperature range of the control shall be -40°C to +65°C. Maximum time for power up and ready to trip when closing on a circuit shall be ten percent of the trip time or 1/2 cycle, whichever is greater. Trip selection may be made with the interrupter energized. The range of Phase Overcurrent minimum trip settings shall be 15-300A (500:1 CT). The control shall include 30 Time Current Characteristic (TCC) curves, which shall be field selectable using dip switches. The control shall be equipped with multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. All settings shall be inputted via selector knobs located on the faceplate of the control. The control shall include a last cause of trip indicator. Trip modules shall not require a computer or other external device for inputting trip settings or other operational parameters.

16

REVISION OF SECTION 613

24.9KV SWITCHGEAR ASSEMBLIES

Solid dielectric type switchgear shall comply with the following:

The switch shall consist of a solid dielectric insulated load break switches and resettable vacuum fault interrupters electronically controlled.

The switch shall comply with requirements of the latest revision of applicable industry standards, including: IEEE C57.12.28, IEEE C37.74, IEEE C37.60, ANSI/IEEE 386, IEC60529, IEEE 592. The switch manufacturer shall be ISO 9001:2008 and ISO 14001:2004 certified.

The switch shall be designed for front access to cables and operators. The switch shall be a dead-front design. The operating mechanism housing shall be stainless steel with a viewing window for verification of vacuum interrupter contact position. The mechanism housing shall be painted ANSI 70 light gray using corrosion-resistant epoxy paint. Operating handles shall be padlockable and adaptable to keylock schemes. The operating shaft shall be stainless steel providing maximum corrosion resistance. A double "O" ring shaft seal shall be used for a leak resistant, long life seal. The solid dielectric modules shall be coated with a semi-conductive layer of epoxy, providing a completely dead front device. The semi-conductive layer shall be tested to IEEE 592 to ensure it can carry fault current to ground so as to ensure operator safety.

The switch shall be rated:

Maximum Design Voltage, kV	27
Impulse Level (BIL) Voltage, kV	125
Continuous Current, Amperes	630
Load break Current, Amperes	630
One Minute Withstand (dry), AC kV	50
Production Test Rating (kV)	40
15 Minute Withstand, DC kV	78
Momentary Current, kA asymmetrical	20
Fault Close Current, kA asymmetrical	20
Fault Interrupter rating, kA asymmetrical	20
Fault Interrupter rating, kA symmetrical	12.5
Mechanical Endurance, Operations	2000

SF6 type switchgear shall comply with the following:

The switch shall consist of load interrupting, SF6 insulated, 630A rotary puffer switches and electronically controlled fault interrupters.

The switch shall comply with requirements of the latest revisions of applicable industry standards, including: IEEE C37.71, IEEE C37.74, IEEE C37.60, IEEE 386. The switch manufacturer shall be ISO 9001:2008 and ISO 14001:2004 certified.

Switch construction shall be as follows: Switch contacts and cable entrance terminations shall be contained in a single welded mild steel tank with entrances internally connected by copper conductors. Construction shall be a dead front design. Switches shall be shipped factory filled with SF6 gas conforming to ASTM D-2472. Switch tanks shall be painted ASA70 light gray using a corrosion-resistant epoxy paint.

17

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

Each switching way shall be equipped with an internally mounted operating mechanism capable of providing quick-make, quick-break operation in either switching direction. The mechanism shall be capable of delivering sufficient torque and shall be provided with latches for each position to assure load interrupting, fault closing and momentary ratings. All switch positions shall be clearly identified, padlockable and adaptable to keylock schemes. The operating mechanism shall be actuated from outside the switch tank with an operating handle. The operating shaft shall be made of stainless steel. A double "O" ring type operating shaft seal shall be used for a leak resistant, long life seal. Switch contacts shall be of a rotary puffer design made with copper alloy contacts with silver plating to assure permanent, low contact resistance. Each rotating contact shall simultaneously disengage from two fixed contacts. Contact travel shall be 90 degrees to assure efficient arc extinction and a wide open contact gap. Arcing is confined away from the main contact surfaces. The stationary contacts shall be supported independent of the cable entrance bushings, eliminating possible misalignment. Auxiliary blades used for load interruption are not acceptable.

The fault interrupter shall consist of vacuum bottles and a spring-assisted operating mechanism. The mechanism used shall be designated for three phase operation. The mechanism shall consist of three vacuum bottles mechanically linked to a single spring-assisted operating mechanism. The vacuum interrupter operating mechanism shall consist of the support assembly, linkage, spring latch mechanism, and solenoid utilized for electronic tripping. Maximum interrupting time shall be three cycles (50 msec). The movable contact shaft shall be flagged to indicate the contact position, open or closed. This contact position indicator shall be fully visible through viewing windows supplied in the switch tank. Each tap phase is to be equipped with an individual 630A vacuum interrupter fully enclosed in an SF6 insulated switch tank. Electrical opening shall be by a solenoid that is activated from sources external to the switch tank. Manual reset or closing of the fault interrupter shall be mechanical with the use of an external operating handle. The mechanical linkage assembly shall provide for a "trip-free" operation which allows the fault interrupter to interrupt independent of the operating handle.

The switch shall be rated:

Maximum Design Voltage, kV	27
Impulse Level (BIL) Voltage, kV	125
Continuous Current, Amperes	630
Load break Current, Amperes	630
One Minute Withstand (dry), AC kV	60
Production Test Rating (kV)	40
15 Minute Withstand, DC kV	78
Momentary Current, kA, ASYM	20
Fault-Close Current, kA, ASYM	20
One Second Current, kA, SYM	12.5
Fault Interrupting Rating, kA, SYM	12.5
Mechanical Endurance, Operations	2000
Load Break Operations at 600 Amperes	500

At the completion of the project, the temporary switchgear will become the property of the Contractor and shall be removed from the project site and disposed of by the Contractor.

613.49 Modifications to Existing Power Control Board. The existing Power Control Board, located in the Control Room of the East Ventilation Building shall be modified as indicated on the drawings. New control switches shall be as specified in paragraph 613.36, and shall be provided with key interlocks as indicated on the drawings. Keys for key interlocks shall be furnished in the quantity required, and one spare key of each type shall be provided which shall be turned over to CDOT. Indicating lamps shall be MB120V.

18
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

613.50 Inverter System. A 20kW inverter system shall be provided which shall obtain its primary power from the existing 125/250V battery system. The inverter system shall include the inverter unit, static switch, maintenance bypass switch, transformer for the bypass supply, panel for the inverter output and circuit breakers for the 250V d-c supply and the 480V a-c bypass supply. The inverter output shall be 120/240V a-c single phase, three-wire.

The Inverter system shall operate in the following modes:

1. Normal: The AC load is continuously powered by the inverter.

2. Bypass: If the UPS must be taken out of service for maintenance or repair, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the load. The switch shall be located in its own compartment such that there is no power inside the UPS compartment when in bypass.

3. Service: If the inverter system requires service, power to the load will be supplied through the maintenance bypass switch. Transfer to the maintenance bypass shall be done with no loss of power to the load.

AC Output shall provide the following:

1. Load Rating: 105% continuous load rating at 104deg F (40 deg C) for any combination of linear and non-linear loads

2. Voltage Regulation: ±3% for balanced load, ±5% for 100% unbalanced load

3. Voltage Adjustment Range: ±5% manually

4. Line Drop Compensation: Adjustable 0 to +5% of nominal voltage

5. Frequency Regulation: 0.1%

6. Efficiency: Defined as output kW/input kW at rated lagging load power factor.

7. Not less than 90% at all loads from 50% to 100% of rated load at 0.9 power factor lagging

8. Voltage Transients: 100% Load Step ±5%, loss of/return to AC input power ±1%

9. Output Voltage Transients: Voltage transients shall be limited to a maximum deviation from nominal system output volts of plus or minus 5% with recovery to within 1% of the nominal output voltage within one electrical cycle (16 milliseconds) for each of the following conditions. Limits shall apply to any inverter load within the inverter rating, and frequency shall be maintained at 60 Hz ± 0.1 Hz. The system shall not transfer to bypass under these conditions. The conditions are: 100% load step, loss or return of AC input power, momentary sags, surges or spikes on the input to the inverter, uninterrupted transfer of the critical load to and from the output output and bypass power line (manually initiated or automatic).

10. Voltage Harmonic Distortion: Maximum 2% RMS total (linear load), Maximum 2.5% RMS total for up to 100% non-linear load, per IEC 62040-3

19
REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

11. Current Harmonic Distortion: Maximum 8% RMS total (linear load), Maximum 8% RMS total for up to 100% non-linear load

12. Overload at full Output Voltage with ±1% voltage regulation: 105% continuously, 110% of full load for 60 minutes, 150% of full load for a minimum of 60 seconds.

13. Current Limit: adjustable, 100% - 200% of full load current

14. Fault Clearing: Sub-cycle current of at least 200% of normal full load current, for 200 milliseconds (when bypass is not available), and 1000% for 200ms in Inverter pulse-parallel operation when bypass is available

Front panel controls:

1. A startup screen shall be provided on the front panel that is user-interactive in text and graphic form and provides a step-by-step guide for the user to bring the inverter on-line.

2. Two buttons shall provide the means for the user to transfer the load to Bypass and back on inverter. A Sync-scope shall be provided to display the phasing between Bypass and Output in graphical representation.

3. Two buttons shall provide the means for the user to shut down the inverter and transfer the load to bypass or shut down the entire system.

4. A pushbutton shall be provided which will sequentially transfer the load to the bypass supply, open the inverter output breaker.

Front panel indications:

1. A touch screen display panel shall be provided that allows viewing the following: Input Voltage, Input Current, Output Voltage, Line-to-Line and Line-to-Neutral, Output Current, Output Frequency, Total kVA and kW, and Power Factor per phase.

METHOD OF MEASUREMENT

Add the following subsections:

613.51 Measurement. Electrical Switchgear Assemblies, Step Voltage Regulators, Regulator Bypass Switches, Structure Mounted Disconnect Switches, Temporary Switchgear and Inverter System will be measured by each unit furnished, installed and accepted as described herein.

20

REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

613.52 Payment. The completed and accepted work for conduits will be paid for at the contract unit price for the pay items listed below that appear in the bid schedule.

Pay Item	**Pay Unit**
24.9kV Switchgear	Each
Step Voltage Regulator	Each
Regulator Bypass Switch	Each
Structure Mounted Disconnect Switch	Each
Temporary Switchgear	Each
Inverter System	Each
Relay Cabinet	Each

1

REVISION OF SECTION 613
BONDING AND GROUNDING

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.01 shall include the following:

This work shall also consist of furnishing and installing bonding and grounding in the tunnel, at structures, and electrical equipment as indicated on the Contract Drawings. Grounding electrodes and grounding conductors are included herein.

Subsection 613.02 shall include the following:

(l) *Bonding and Grounding*. Bonding and grounding components shall be fabricated of the specified materials and constructed as follows:

1. Mechanical Connectors: All copper alloy compression type.
    a. Manufacturers: Thomas & Betts Series 54000, American Electric-Blackburn, Carolina Galvanizing Corporation or approved equal.
    b. Connection of grounding conductor to grounding conductor.
    c. Provide exothermic weld connections where indicated.
2. Exothermic connections shall meet the following requirements:
    a. Manufacturers: Cadweld, ERICO Products, Inc., Thermoweld, Techweld, or approved equal.
    b. Provide exothermic connection in which powdered metals are dumped into a graphite crucible mounted over the components to be connected and then ignited by a spark. The resulting molten metal slag flows over the conductors and welds them together.
        i. Use in lieu of mechanical compression connectors, where indicated.
        ii. Connection of grounding conductor to ground rods.
3. Grounding Conductors:
    a. In conduit: Stranded, bare copper as indicated on the Drawings.
    b. Buried: Stranded, covered copper as indicated on the Drawings.
4. Grounding Connectors: All copper alloy ground connectors, specification grade. Use Burndy, OZ Gedney "G" Series, Thomas & Betts, American Electric-Blackburn, or approved equal.
5. All grounding materials and components shall be U.L. listed.

Subsection 613.03 shall include the following:

The bonding and grounding of the types specified above shall be installed as follows:

1. Install products in accordance with manufacturer's instructions.
2. Install rod electrodes at locations indicated with exothermic connections to cables. Install additional rod electrodes as required to achieve a maximum of 25 ohms resistance to ground.
3. Provide bonding to meet Regulatory Requirements and as specified herein.

2

REVISION OF SECTION 613 BONDING AND GROUNDING

4. All metallic, non-current carrying elements in manholes and on structures pertaining to this work, shall be bonded to the ground system. This shall include, but not be limited to, frames for all manhole racks, manhole ring and cover in new electrical manhole, and angle iron frame and covers in the tunnel manholes.

Subsection 613.11 shall include the following:

Grounding connectors, grounding conductors and associated components described herein and the installation thereof will not be measured and paid for separately. Included in the term “associated components” are all equipment required to perform the complete installation of bonding and grounding required for the tunnel facility. The completed and accepted work for bonding and grounding shall not be paid for separately, but will be incidental to the equipment included.

1

REVISION OF SECTION 613
ELECTRICAL IDENTIFICATION

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.01 shall include the following:

This work shall also consist of furnishing and installing nameplates and labels on new equipment and markers on wire and cable installed in the tunnel and as indicated herein and on the Contract Drawings. Color coding requirements are included in this Section.

References. The most recent version of the following laws, codes, regulations, guides, and standards form a part of this Section and Contractor shall comply therewith.

1. American National Standards Institute (ANSI):
   a. A13.1 - Scheme for Identification of Piping Systems.
   b. Z535.1-2002 - Safety Color Code.
   c. Z535.2-2002 - Environment and Facility Safety Signs.
   d. Z535.3-2002 - Criteria for Safety Symbols.
   e. Z535.4-2002 - Product Safety Signs and Labels.
   f. Z535.5-2002 - Safety Tags and Barricades (for Temporary Hazards).
2. Code of Federal Regulations (CFR):
   a. 29 CFR 1910.145 - Occupation Safety and Health Standards (OSHA) Specification for Accident Prevention Signs and Tags.
   b. 29 CFR 1910.144 - Occupation Safety and Health Standards (OSHA) Safety Color Code for Marking Physical Hazards.
3. National Fire Protection Association (NFPA):
   a. 70 - National Electrical Code (NEC) 2011 Edition.
4. Underwriters Laboratories (UL):
   a. UL 969 - Marking and Labeling Systems.

Subsection 613.02 shall include the following:

Identification Devices. A single type of identification product for each of the following applications. Use colors prescribed by ANSI A13.1, NEC.

1. Colored Adhesive Marking Tape for phase identification of Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick. Tape shall be electrical grade.
2. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

Conduit Markers. Conduit markers shall be brass tags, 1 ¼ inch in diameter, attached to the conduits using stainless steel wire with a non-removable crimp type connection. Conduit markers shall be marked with the identification number of the conduit as listed in the conduit and wire schedules on the Drawings. Where a conduit contains only a single circuit, the circuit number shall also be marked on the conduit tag.

2

REVISION OF SECTION 613
ELECTRICAL IDENTIFICATION

Color-Coding Cable Ties. Nylon, self-locking type. Colors to suit coding scheme.

Engraved-Plastic Labels, Signs, and Instruction Plates. Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background. Self-adhesive signs and labels shall be provided on electrical enclosures.

Fasteners for Nameplates and Signs. Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

Subsection 613.11 shall include the following:

Nameplates, labels, cable markers, and associated components described herein and the installation thereof will not be measured and paid for separately, but shall be incidental to the equipment that they identify.

FORCE ACCOUNT ITEMS

DESCRIPTION

This special provision contains the Department's estimate for force account items included in the Contract. The estimated amounts marked with an asterisk will be added to the total bid to determine the amount of the performance and payment bonds. Force Account work shall be performed as directed by the Engineer.

BASIS OF PAYMENT

Payment will be made in accordance with subsection 109.04. Payment will constitute full compensation for all work necessary to complete the item.

Force account work valued at $5,000 or less, that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

Force Account Item	Estimated Quantity	Amount
F/A Minor Contract Revisions	F.A.	$175,000
F/A On the Job Trainee	Hour	$ ♦
F/A Fuel Cost Adjustment	F.A.	$ 1,000
F/A Partnering	F.A.	$ 2,000

TRAFFIC CONTROL PLAN – GENERAL

The key elements of the Contractor's method of handling traffic (MHT) are outlined in subsection 630.10.
The components of the Traffic Management Plan for this project are included in Subsection 104.04 and Section 630 of the Standard Specifications.

Special Traffic Control Plan requirements for this project are as follows:

During the construction of this project, traffic shall use the present traveled roadway.

The Contractor shall not have construction equipment or materials in the lanes open to traffic at any time, unless directed.

Fifteen (15) minute full traffic stop closures will be permitted as pre-approved by the engineer for the cutover from existing to temporary and temporary to new switchgear. Contractor may propose an alternate method for approval of the Engineer.

All Traffic control requiring full traffic stop closures will be performed by CDOT personnel. A minimum of two (2) weeks notice shall be given to the Engineer before each planned operation requiring these closures.

CDOT reserves the right to direct the Contractor to leave the tunnel at any time due to emergencies or unforeseen circumstances, as they may occur. The Engineer shall have the full authority to make this determination and direct the Contractor accordingly. To comply with tunnel emergency procedures, cell phones will be on site with work crew(s) supervisor as well as two-way tunnel frequency radio at all times.

Employee vehicle parking is prohibited where it conflicts with safety, access or flow of traffic. No employee parking will be allowed within the center section. Access to the center section will be limited to the Contractor's vehicle and shall be coordinated with the project Engineer. West side access to the center section will be from the eastbound parking lot. East side access to the center section will be from the westbound parking lot.

All costs incidental to the foregoing requirements shall be included in the original contract prices for the project.

1

SPECIAL CONSTRUCTION REQUIREMENTS

It is the responsibility of the Contractor to ensure that the appropriate special requirements are adhered to:

1. The Contractor shall take appropriate action to protect against asbestos contamination and worker exposure when penetrating the control room and electrical ceiling (Fan Room Floor) in the West and East Ventilation buildings. The ceilings of these rooms have approximately ½ inch sprayed-on asbestos covered by approximately one inch of foil-backed fiberglass insulation.
2. All Contractor employees will be required to undergo a background check and will be provided with an identification badge. ID badges must be worn and displayed at all times when working in and around the tunnel complex. All background information is confidential and is to assure building security at EJMT. Two (2) access keys will be provided to contractor employees as determined by the Engineer. No copies of these keys shall be made. Doors shall remain locked at all times. All parking permits, keys and ID badges must be returned to the tunnel control upon completion of project or employee last day.
3. One staging area will be available to the Contractor in the vicinity of the tunnel as directed by the Engineer. The final size of the staging area shall be submitted to the Engineer prior to construction. The staging area shall be defined with eight-foot high chain link fence to be provided by the Contractor. Cost for fencing to secure the staging area shall not be paid for separately, but included in the work. Locking gates shall be provided for access. Temporary lighting shall be provided by the Contractor. Storage within the electrical rooms will be available as directed by the Engineer.
4. All work requiring an electrical outage shall be performed during specific outage periods as identified by the Engineer. A minimum of two (2) weeks notice shall be given to the Engineer before each planned outage.

   All complete outages shall be scheduled with the Engineer and shall only be performed during the hours of 8PM to 6AM each day, Sunday night through Friday Morning.

   CDOT personnel will operate and disable all switchgear, motor controls, and power switching equipment as necessary for the work. At no time will the contractor operate any of the above equipment himself.

   CDOT personnel will ground out, lock out and tag out all switchgear, motor controls and power switching equipment as necessary for the work. The Contractor will verify grounding and lock out/tag out and will add his locks and tags to the equipment to LockOut/Tag Out.

5. The Contractor shall keep one set of plans, reviewed shop drawings and working drawings available on the project site at all times. This set shall be defined as the “construction drawings”. The Contractor shall note on these construction drawings all changes and deviations from the work shown on the plans, shop drawings and working drawings. The construction drawings shall be kept current as the work progresses and notations shall be made within seven days of the change or deviation.

   The first sheet or page of each set of construction drawings shall be stamped “As Constructed” and signed by the Contractor.

   Upon completion of the work and prior to final payment, the construction drawings shall be submitted to the Engineer.

6. The Contractor shall provide its own sanitary facility for use by Contractor personnel. CDOT restroom facilities shall not be used by the Contractor.

2
SPECIAL CONSTRUCTION REQUIREMENTS

The Contractor shall coordinate all operations requiring the EJMT Maintenance Staff with scheduled Holidays and special events. No work will be allowed for the following events:

1. Tuesday November 25 through Sunday November 30, 2014……Thanksgiving Weekend
2. Saturday December 20, 2014 through Sunday January 4, 2015 Christmas/ New Year
3. Friday May 22 through Wednesday May 27, 2015………………Memorial Day Weekend
4. Friday July 3 through Sunday July 5, 2015 .... Independence Day Weekend
5. Friday September 4 through Monday September 7, 2015 .... Labor Day Weekend
6. Tuesday November 24 through Sunday November 29, 2015........ Thanksgiving Weekend
7. Saturday December 19, 2015 through Sunday January 3, 2016 …Christmas/ New Year
8. Friday May 27 through Wednesday June 1, 2016………………Memorial Day Weekend

All costs associated with the foregoing requirements will not be paid for separately, but it will be included in the cost of doing the work.

1
UTILITIES

The Contractor shall comply with Article 1.5 of Title 9, CRS ("Excavation Requirements") when excavating or grading is planned in the area of underground utility facilities. The Contractor shall notify all affected utilities at least two (2) business days, not including the actual day of notice, prior to commencing such operations. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) at 811, to have locations of UNCC registered lines marked by member companies. All other underground facilities shall be located by contacting the respective owner. Please note that UNCC marks only its member's facilities – Other facilities, such as ditches and drainage pipes may exist, and it is the Contractor's responsibility to investigate, locate and avoid such facilities. Utility service laterals shall also be located prior to beginning excavation or grading.

The following table includes contacts within CDOT that can assist in locating CDOT owned facilities. Please note CDOT is now affiliated with UNCC. Locators will mark CDOT owned facilities except for CDOT Fiber Optic backbone. For Fiber locates call Dave Judy 303-880-0784. For additional assistance, call 303-365-7312.

UTILITY OWNER / ADDRESS	CONTACT / EMAIL	PHONE / FAX
CDOT Electric – Region 1 EJMT (Tunnel) Offices at Eisenhower tunnel	Ken Martinez Kenny.Martinez@state.co.us	303-512-5733
CDOT Utilities – Region 1 18500 E. Colfax Ave. Aurora, CO 80011	Dave Ruble, Utility Engineer Dave.Ruble@state.co.us Tracy Vance, Asst. Utility Engineer Tracy.Vance@state.co.us David (Red) Campbell, Utility Inspector David.Campbell@state.co.us	303-757-9250 303-757-9927 303-757-9850
CDOT ITS (FIBER) (Comcast Maintains and Locates) 425 C Corporate Circle Room 109 Golden, CO 80401	Rich Sembrat - Fiber Manager Richard.Sembrat@state.co.us Dave Judy Dave.Judy@state.co.us	303-512-5804 – Office 303-880-0784 – Cell
CDOT Traffic Signals Mountain Areas Only 219 County Road 1003 Frisco, CO 80443	Steve Smith steve.smith@state.co.us	(970)668-0253 Office (970)485-0136 Cell (970)668-0276 Fax
Loren Vawser XCEL Energy (West Portal)	Loren.vawser@xcelenergy.com	970-262-4034
Jonnye Worrell XCEL Energy (East Portal)	Jonnye.worrell@xcelenergy.com	303-445-4504

Although no conflict with any utility is expected the Contractor shall coordinate with the CDOT Project Engineer and any appropriate utility company to facilitate the installation, placement and relocation of all utilities impacted on this project.

The work described in these plans and specifications requires full cooperation between the Contractor and the utility owners in accordance with Subsection 105.11 in conducting their respective operations, so the utility work can be completed with minimum delay to all parties concerned. Also, in accordance with the plans and specifications, and as directed by the Engineer, the Contractor shall keep each utility owner advised of any work being done to its facility, so that each utility owner can coordinate its inspections for final acceptance of the work with the Engineer.

2
UTILITIES

The Contractor shall coordinate the work with the owners of the utilities impacted by the work. Coordination with utility owners includes, but is not limited to, staking construction features, providing and periodically updating an accurate construction schedule which includes all utility work elements, providing written notification of upcoming required utility work elements as the construction schedule indicates, allowing the expected number of working days for utilities to complete necessary relocation work, conducting necessary utility coordination meetings, and all other necessary accommodations as directed by the Project Engineer. Surveying and/or staking of utility relocations to be performed by the owner shall be the responsibility of the utility owner.

Prior to excavating or performing any earthwork operations, the Contractor shall positively locate all potential conflicts with existing underground utilities and proposed construction, as determined by the Contractor according to proposed methods and schedule of construction. The Contractor shall modify construction plans to avoid existing underground facilities as needed, and as approved by the Engineer.

The CDOT Contractor shall provide traffic control for any utility work expected to be coordinated with construction, as directed by the CDOT Engineer.

All costs incidental to the foregoing requirements will not be paid for separately but shall be included in the work.

SIEMENS

Customer:	QED	Offer 8DA10
Project:	MV GIS 24.9 kV - East Building	8DAB-33334
Reference:	250005-SF14891719-10	

8DA10

Gas Insulated, Metal-Enclosed

Medium-Voltage Switchgear

Single Busbar System

Technical Description

“East Building GIS”

Contents

1 Switchgear Description

1.1. General

The offered switchgear 8DA10 is an SF6-insulated, type-tested, single-phase metal-enclosed medium-voltage vacuum interrupter switchgear designed as single-busbar switchgear for indoor installation.

The SF_6-gas is only used as insulating, but not as quenching medium. The insulation level required is maintained inside the gas compartments without additional insulation material. Enclosures have degree of protection IP65. The single pole encapsulation with modular housings consists of corrosion-resistant aluminium housings.

The modular design allows the replacement of the panel connection housing or the circuit breaker without interrupting the main horizontal busbar operation.

Each closed gas compartment has its own pressure relief which prevents rupture of the housing in case of an arc fault.

The monitoring of the gas compartment is carried out with alarm contact manometers.

The offered switchgear is tested according to ANSI / IEEE C37.20.7-2007 type 2B internal arc-fault standard.

The switchgear is UL certified and will have UL-label on the switchgear

1.2. Panel Design

Each of the three single poles of the panel are arranged from front to back. Each pole consists of a vertical housing with the vacuum interrupter and a horizontal bus housing mounted on top of the circuit breaker housing containing the three-position switch and the busbar.

Circuit-breaker housings and busbar housings are separated from each other with gas-tight bushings.

The cable connection compartment housing with the cable sockets is located below the circuit breaker.

1.3. Switchgear Housings

The switchgear housings consist of a corrosion-resistant high nickel content aluminium alloy and are assembled using O-rings for gas tightness.

The rated operating pressure amount of max. 120 kPa relative gas pressure (depends on isolation level and rated current) at 20° C.

The individual gas compartments are monitored using alarm contact manometers.

1.4. Circuit-Breaker

Circuit-breakers are vacuum circuit-breakers of the 3AH4 product series. The circuit breaker operating drive and the vacuum switching interrupter are maintenance-free up to 10,000 switching cycles as a standard design.

The maintenance-free operating mechanism has the following equipment features:

- Motor charged stored-energy spring operated mechanism with auto-reclosing capability.
- "Trip-Free" according to IEC 6227-100
- Auxiliary switch contacts for control / signaling as specified in the Scope of Supply, Chapter 5.
- Operations counter

- Circuit breaker trip solenoid
- Circuit breaker close solenoid
- Auxiliary switch contacts for control / signalling as specified in the Scope of Supply, Chapter 5.
- 'Spring charged' indication
- Open/close mechanical position indication
- Mechanical OFF pushbutton
- Mechanical ON pushbutton
- The mechanical grounding lever is lockable and tagable for a grounded feeder circuit.

Endurance class of circuit-breaker:

Function	Class	Standard	Properties	
BREAKING	M2	IEC 62271-100	10,000 x	Mechanically without maintenance *
	E2	IEC 62271-100	10,000 x	rated normal current without maintenance *
			50 x	rated short-circuit breaking current without maintenance
	C2	IEC 62271-100	Very low probability of restrikes	

* Option: 30.000 operating cycles

1.5. Three Position Switch

To reduce moving parts, the disconnector and grounding switches are designed as single three-position switches. In combination with the circuit-breaker, the non-load break three-position switch is used for fault close (make-proof) feeder grounding.

The disconnector / ground stationary and movable contacts are mounted in the busbar housings. Mechanical coupling is made through an external shaft.

The three-position switch operating mechanism is located on the panel front. For the two operating functions (disconnecting and grounding) separate interlocked operating handles are provided.

The switching positions of the three-position-switches are visually monitored (as required by NEC article 225) using a web-camera system and are displayed with a provided laptop.

The maintenance-free operating mechanism has the following equipment features:

- Manual or optional motor operating mechanism as specified in the Scope of Supply, Chapter 5
- Auxiliary contacts for disconnector switch: 4NO + 4NC + 2CO
- Auxiliary contacts for grounding switch: 2NO + 2NC + 4CO
- Mechanical switch position indication for connected and grounding switch positions
- Manual operation with mechanical interlock to the circuit-breaker
- Locking device as specified in the Scope of Supply, Chapter 5

Endurance class of three-position disconnector:

Function	Class	Standard	Properties	
DISCONNECTING	M1	IEC 62271-102	2.000 x	mechanically without maintenance
READY-TO-GROUND			1,000 x	mechanically without maintenance
GROUNDING	E2 [1)]	IEC 62271-102	50 x	rated short-circuit making current I_{ma} without maintenance

[1)] By closing the circuit-breaker

1.6. Interlocks

1.6.1. Vertical section internal interlocking

The combination of non load-break three-position switch and circuit-breaker meet the following vertical section internal interlock conditions:

To prevent the three-position switch from operating under load, the three-position switch is mechanically interlocked to only operate with the circuit-breaker in the open position.

The three-position switch can only be brought into the ready-to-earth position if the disconnector and circuit-breaker are open.

The three-position switch is prevented from switching through from the CLOSED state into the "ready-to-earth" state.

Closing of the circuit breaker is blocked if the three-position switch is in an intermediate position.

1.6.2. Vertical section internal and overall interlocking

All internal vertical section interlocks are mechanical. In tie-breaker and tie-riser sections, additional electromagnetic interlocks are provided. If the control voltage fails, an interlocked emergency operation of the feeder is possible.

1.6.3. Grounding of the feeder

For grounding of the feeder, reliable "verification interlocking" is provided: Only after the three-position switch has been switched into the "ready-to-ground" position can the feeder be grounded by closing the circuit-breaker.

The remote control and protective relay tripping operation of the circuit breaker are automatically disabled as soon as the three-position switch is switched to the "ready-to-ground" position and the feeder grounded locking device is padlocked.

A "feeder grounded" locking device prevents the local mechanical and electrical tripping by blocking the tripping mechanism of the circuit breaker mechanically.

1.6.4. Un-grounding of the feeder

Once grounded, the feeder remains in the grounded position.

The locking device is removed and the circuit-breaker must be manually opened with the mechanical OPEN push-button of the circuit-breaker.

The three-position switch can be operated as described above.

1.7. Power Cable Connection

Power cable connections are accessible from below from an elevated platform / mezzanine or the cable vault. Cable connections are designed for fully insulated inside cone connections as per DIN EN 50181.

There is a variety of combinations for cable connections for single-core or multiple-core cables per phase with the cable sizes 2/0 AWG through 1000 kcmil.

Iso-phase bus-bar connections can be made with solid-insulated bus-bars or with gas-insulated bus-bars.

Quoted equipment is specified in the Scope of Supply, Chapter 5

The following suppliers are released:

Company	Type of cable plugs
Pfisterer	CONNEX size 2, size 3 and size 4
Südkabel	SEIK
nkt cables	CPI 2, CPI 3

1.8. Current Transformers

Current transformers are designed as toroidal current transformers. The CTs are mounted on the outside of the single phase aluminum housing, without any dielectric or thermal stresses.

Current transformers are specified in the Scope of Supply, Chapter 5

1.9. Voltage Transformers

Voltage transformers are designed as inductive, cast-resin insulated voltage transformers in metal-enclosed safe-to-touch design. The VTs are located outside the gas compartments.

The voltage transformers can get connected to the busbar directly or over a three position switch

Voltage transformers for feeders can be plugged directly or connected through a separate cable at the cable connection.

Voltage transformers are specified in the Scope of Supply, Chapter 5

1.10. Busbar

The busbar consists of profile copper.

1.11. Low-voltage Compartment

Low-voltage compartments are located on the vertical section front above the operating mechanisms of the circuit-breaker and the three-position switch. The electrical control connections from section to section are made via flexible cable harnesses. Control wiring is run in a wire-way located at the top of the LV compartment.

Internal vertical section wires run in metal-enclosed wiring ducts. The metal-enclosed wiring ducts are located on the left and on the right in the front part of the switchgear enclosure and are accessible from the front.

Inside the low-voltage compartment, secondary equipment is mounted on a rear mounting plate or on a DIN-rail system. Individual secondary devices can be integrated in the door of the low-voltage compartment.

Wiring is performed as specified in the Scope of Supply, Chapter 5

2 Special Switchgear Features

2.1. Operational Reliability

The gas-tight enclosure of all live parts from to busbar down to the cable excludes any external influences on the primary part.

Single-pole enclosure and long-time experience in the application of this switchgear has proven its exceptional operational reliability.

2.2. Personnel Safety

Personnel safety is achieved by internal single-pole enclosure of the primary circuit tested to ANSI / IEEE C37.20.7-2007 type 2B internal arc-resistant design.

2.3. Environmental Independence

Due to the gas-tight enclosure, 8DA10 is almost insensitive to environmental effects. Moreover, the dielectric strength (BIL) and rated voltage are independent of the site altitude.

2.4. Environmental Compatibility

The switchgear forms a hermetically sealed system in accordance with IEC 62271 part 1 over the complete life time of the unit, i.e. the SF6 gas exchanging is not necessary under normal operating conditions.

2.5. Compactness

The low pressure SF6 insulation enables very compact dimensions, offering at the same time a high switchgear performance. This provides an economical utilization of floor space, especially in cities and metropolitan areas for both existing rooms and new buildings.

2.6. Modularity

The modularity of the switchgear allows e.g. to replace the circuit-breaker module without isolating the busbars.

Due to its modular design 8DA10 shows a high re-availability even in case of fault.

3 Standards

		IEC-Standard **EN-Standard**	**Title**
Switchgear		62 271-1	High-voltage switchgear and controlgear – Part 1: Common specifications
		62 271-200	A.C. metal- enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
Switching devices	Circuit-breakers	62 271-100	High-voltage alternating-current circuit-breakers
	Disconnectors and earthing switches	62 271-102	High-voltage alternating current disconnectors and earthing switches
Voltage detecting systems		61 243-5	Voltage detecting systems (VDS)
Surge arresters Surge limiters		60 099	Surge arresters
Degree of protection		60 262	Degrees of protection by enclosures (IP Code)
Degree of protection		60 529	Degrees of protection by enclosures (IK Code)
Insulation		60 071	Insulation co-ordination
Instrument transformers	Current transformers	61 869-1	Instrument transformers
	Voltage transformers	61 869-2	Instrument transformers
	Voltage transformers	61 869-3	Instrument transformers
SF_6		60 376	Specification of technical grade sulphur hexafluoride (SF_6) for use in el. equipment
SF_6		62 271-4	Use and handling of sulphur hexafluoride (SF_6)
Installation		61 936-1	Power installations exceeding 1 kV
Environmental conditions		60 721-3-3	Classification of environmental conditions
Operation		EN 50 110	Operation of electrical installations

4 Technical Data

Voltages

Rated voltage .... 27.0 kV
Operating voltage .... 24.94 kV
Rated short-duration power-frequency withstand voltage .... 70 kV
Rated lightning impulse withstand voltage .... 125 kV
Rated frequency .... 60 Hz

Short-circuit ratings

Rated short-time withstand current .... 25.0 kA
Rated peak withstand current .... 65 kA
Rated duration of short-circuit .... 3 s
Rated short-circuit making current (max.) .... 65 kA
Rated short-circuit breaking current .... 25.0 kA

Current ratings

Rated normal current of the busbar .... 1250 A
Max. permissible busbar current at 40 °C .... 1200 A

General switchgear data

Type of arrangement .... Free-standing arrangement with rear walls
Degree of protection for enclosure, operating side and lateral surfacesIP3XD (IP4X for LV compartment)
Degree of protection, primary part IP65
Partition class .... PM
Loss of service continuity .... LSC 2
Internal arc classification .... 2B 25 kA 0.5 s
Exterior section standard colour
Mimic diagram colour .... black/red (standard)
Vertical section width .... 600 mm
Vertical section depth .... 1625 mm
Vertical section height with low-voltage compartment .... 2700 mm
Height of switchgear room (min.) .... 2900 mm
Width of control aisle (min.) .... 800 mm

5 Scope of Supply

The switchgear is designed as a single-busbar switchgear according to the enclosed single-line diagram.

Item No.	Quantity	Typical No.	Description
5.1	1	=JZ01	CB Panel 1250 A / Main A
5.2	1	=JZ02	CB Panel 1250 A / Main B
5.3	1	=JZ03	CB Panel 1250 A / Tie
5.4	1	=JZ04	Dummy panel
5.5	4	=JZ05	CB Panel 1250 A / Feeder
5.6	1	=JZ00	*Switchgear accessories*
5.7	1		Customer-specific designs

In case of particularly customer-specific design it might be possible that individual points of the switchgear description are not valid anymore.

The offered scope of supply is equipped in detail as follows:

Item No.	Quantity	Description	Typical No.
5.1	1	**CB Panel 1250 A / Main A** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ01**
5.1.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.1.1.1	3	**Voltage transformers at the busbar** Voltage transformer type: GBEA Single-pole plug-in design with HV fuses, inductive type, climate-independent, secondary connection by means of plugs inside the panel. Arranged outside the primary enclosure. **with three-position disconnector** Switching positions voltage transformer ON-OFF-EARTHED, installation within SF6-filled busbar compartment, mechanism outside the gas compartment with manual operating mechanism with camerasystem for monitoring the switching positions of the three-position-switch Locking device at the disconnector and earthing switch (separate function) Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO 3 x single-pole Metal-enclosed Voltage of secondary winding: 120 / v3 V Rating and class of secondary winding: WXY / Cl. 0.3 Voltage of earth-fault winding: Rating and class of earth-fault winding: With routine test certificate	
5.1.2		**Panel construction**	
5.1.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	

5.1.2.2 1 **Vacuum circuit-breaker**
Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front.
Rated voltage: 27.0 kV
Rated short-time withstand current: 25.0 kA
Rated current: 1250 A
With motor operating stored-energy mechanism
Rated operating sequence O - 0,3 s - CO - 3 min - CO
with 1 shunt release
Auxiliary voltage of motor-drive DC 125 V
Auxiliary voltage of closing solenoid DC 125 V
Auxiliary voltage of 1st shunt release DC 125 V
Free contacts of auxiliary switch 7NO + 4NC + 2CO
with mechanical switching ON mechanism, padlockable and sealable
with mechanical switching OFF mechanism, padlockable and sealable
Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"

5.1.2.3 3 **Current transformers at feeder (B) (B bzw. C1)**
Current transformer type: 4MC4_90
Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel.
Arranged outside the primary enclosure.
Current transformer installation in the panel
3 x 1 core in L1/L2/L3
Primary current, core 1 : 1200 A MR
Secondary current, core 1 : 5 A
Rating, class and overcurrent factor of core 1 : C200
With routine test certificate

5.1.3 **Panel connection**

5.1.3.1 1 **Panel connection at feeder**
by 2 cable per phase plug size 3

5.1.3.2 1 **Capacitive voltage detecting system at the feeder**
Design:
LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage

5.1.3.3 3 **Voltage transformers at the feeder (short cable connection)**
Voltage transformer type: GBEI
Single-pole plug-in design with HV fuses, inductive type, climate-independent, secondary connection by means of plugs, primary connection via plug-in cable link.
Length: 10 m
Arranged outside the primary enclosure.
3 x single-pole
Metal-enclosed
Voltage of secondary winding: 120 / v3 V

		Rating and class of secondary winding: WXY / Cl. 0.3 With routine test certificate
5.1.3.4	3	**Surge arrester** Surge arrester Connex size 2 Rated discharge current 10 kA Rated voltage Ur 24 kV Continuous load voltage Uc 19 kV company Pfisterer
5.1.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1PG0+L0S Multifunction Protection Relay 7SJ64 or similar
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	1	EWC:LOR/7803D Lock-out relays Series 24 LOR
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	6	LJK:1506SC short circuit terminal block
	12	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	2	3RV1611-1DG14 circuit breaker for voltage transformer 3-pole 3A
	2	3RV1901-1A auxil. switch 1NO+1NC
	1	8MR2170-1CA thermostat 250V AC, 1NC
	1	XDA:HSD140C/250R/110V resistor 250 ohm, 40W
	1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
	1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
	1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
	1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC

1	3SB3901-1DF LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A lampholder BA 9S
3	3SB3922-0AV accessories for inscription plate 12,5x27mm
3	3SB1901-2AA inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0 fibre-optic duplex data line 3m
1	RFV:140X55-S circuit label 140x55mm
3	RFV:75X20-S resopal label 75x20mm
2	RFV:150X50 resopal label 150X50mm

Item No.	Quantity	Description	Typical No.
5.2	1	**CB Panel 1250 A / Main B** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ02**
5.2.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.2.2		**Panel construction**	
5.2.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	
5.2.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.2.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3	

		Primary current, core 1 : 1200 A MR Secondary current, core 1 : 5 A Rating, class and overcurrent factor of core 1 : C200 With routine test certificate
5.2.3		**Panel connection**
5.2.3.1	1	**Panel connection at feeder** by 1 cable per phase plug size 2 and by 2 cable per phase plug size 3
5.2.3.2	1	**Capacitive voltage detecting system at the feeder** Design: LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage
5.2.3.3	3	**Surge arrester** Surge arrester Connex size 2 Rated discharge current 10 kA Rated voltage Ur 24 kV Continuous load voltage Uc 19 kV company Pfisterer
5.2.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1PG0+L0S Multifunction Protection Relay 7SJ64 or similar
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	1	EWC:LOR/7803D Lock-out relays Series 24 LOR
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	6	LJK:1506SC short circuit terminal block
	12	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	1	8MR2170-1CA

	thermostat 250V AC, 1NC
1	XDA:HSD140C/250R/110V resistor 250 ohm, 40W
1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC
1	3SB3901-1DF LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A lampholder BA 9S
3	3SB3922-0AV accessories for inscription plate 12,5x27mm
3	3SB1901-2AA inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0 fibre-optic duplex data line 3m
1	RFV:140X55-S circuit label 140x55mm
3	RFV:75X20-S resopal label 75x20mm
2	RFV:150X50 resopal label 150X50mm

Item No.	Quantity	Description	Typical No.
5.3	1	**CB Panel 1250 A / Tie** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ03**
5.3.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.3.2		**Panel construction**	
5.3.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	
5.3.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.3.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3	

		Primary current, core 1 : 1200 A MR Secondary current, core 1 : 5 A Rating, class and overcurrent factor of core 1 : C200 With routine test certificate
5.3.3		**Panel connection**
5.3.3.1	1	**Panel connection at feeder** by 2 cable per phase plug size 3
5.3.3.2	1	**Capacitive voltage detecting system at the feeder** Design: LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage
5.3.3.3	3	**Surge arrester** Surge arrester Connex size 2 Rated discharge current 10 kA Rated voltage Ur 24 kV Continuous load voltage Uc 19 kV company Pfisterer
5.3.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1FE0+L0S overcurrent-time protection relay 7SJ64 or equivalent
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	1	EWC:LOR/7803D Lock-out relays Series 24 LOR
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	6	LJK:1506SC short circuit terminal block
	12	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	1	8MR2170-1CA thermostat 250V AC, 1NC
	1	XDA:HSD140C/250R/110V

	resistor 250 ohm, 40W
1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC
1	3SB3901-1DF LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A lampholder BA 9S
3	3SB3922-0AV accessories for inscription plate 12,5x27mm
3	3SB1901-2AA inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0 fibre-optic duplex data line 3m
1	RFV:140X55-S circuit label 140x55mm
3	RFV:75X20-S resopal label 75x20mm
2	RFV:150X50 resopal label 150X50mm

5.3.5 Customer-specific designs

1 Key interlock KF1 with KirkKey lock for a hand operated three-position switch.

The key function KF1 has the following characteristics:
- Key releases in disconnector switch "OPEN"
- Key trapped in disconnector switch "CLOSED"

Item No.	Quantity	Description	Typical No.
5.4	1	**Dummy panel** Maximum permissible feeder current at 40 °C:	**=JZ04**
5.4.1		**Busbar system** Single-pole insulated busbars for single-busbar system	

Item No.	Quantity	Description	Typical No.
5.5	4	**CB Panel 1250 A / Feeder** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ05**
5.5.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.5.2		**Panel construction**	
5.5.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	
5.5.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.5.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3	

		Primary current, core 1 : 1200 A MR Secondary current, core 1 : 5 A Rating, class and overcurrent factor of core 1 : C200 With routine test certificate
5.5.3		**Panel connection**
5.5.3.1	1	**Panel connection at feeder** by 1 cable per phase plug size 3
5.5.3.2	1	**Capacitive voltage detecting system at the feeder** Design: LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage
5.5.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1FE0+L0S overcurrent-time protection relay 7SJ64 or equivalent
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	3	LJK:1506SC short circuit terminal block
	6	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	1	8MR2170-1CA thermostat 250V AC, 1NC
	1	XDA:HSD140C/250R/110V resistor 250 ohm, 40W
	1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
	1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
	1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
	1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC
	1	3SB3901-1DF

		LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF	LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A	lampholder BA 9S
3	3SB3922-0AV	accessories for inscription plate 12,5x27mm
3	3SB1901-2AA	inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0	fibre-optic duplex data line 3m
1	RFV:140X55-S	circuit label 140x55mm
3	RFV:75X20-S	resopal label 75x20mm
2	RFV:150X50	resopal label 150X50mm

Item No.	Quantity	Description	Typical No. =JZ00
		Switchgear accessories comprising:	
	2	End walls	
	1	Service flap within the left end wall	
	1	Laptop flap within the end wall right	
	1	Gas pressure indication for busbar system	
	1	Gas pressure indication with auxiliary contacts 2NO	
	1	Operation and installation manual 8DA10 ANSI Design 2012 in american	
	16	1 set fixing material	
	6	Voltage detector for LRM-system	
	7	Cable support rail for 8DA10 feeder	
	1	Touch-up set	
	1	Varnish	
	1	Small accessories for wiring	
	1	Laptop for ANSI Design	
	1	Cable Termination Kit, size 2-3	
	1	SF6 Gas Cylinder	
	10	Set of Cable Plugs, size 2 or 3	
	1	Standard accessories 8DAB10 Standard accessories consisting of: 1 handle for disconnector drive 1 handle for earthing switch drive 1 hand-crank for charging circuit-breaker drive 1 socket-spanner for LV-doors 1 pre-selection key for three-position disconnector 1 TORX-screwdriver 1 Touch-up set colour "light basic" (SN700) 1 operation and installation manual in specified language	
	1	Camera system accessories	

6 Documentation

6.1	Single-Line Diagram	Annex 1
6.2	Panel Arrangement Diagram	Annex 2
6.3	Constructional Data	Annex 3
6.4	Side View Of Typicals	Annex 4
6.5	Gas Compartment Arrangement	Annex 5

Customer: QED
Project: MV GIS 24.9 kV - West Building
Reference: 250005-SF14891719-20

Offer 8DA10
8DAB-33337

8DA10

Gas Insulated, Metal-Enclosed

Medium-Voltage Switchgear

Single Busbar System

Technical Description

“West Building GIS”

Contents

1 Switchgear Description

1.1. General

The offered switchgear 8DA10 is an SF6-insulated, type-tested, single-phase metal-enclosed medium-voltage vacuum interrupter switchgear designed as single-busbar switchgear for indoor installation.

The SF_6-gas is only used as insulating, but not as quenching medium. The insulation level required is maintained inside the gas compartments without additional insulation material. Enclosures have degree of protection IP65. The single pole encapsulation with modular housings consists of corrosion-resistant aluminium housings.

The modular design allows the replacement of the panel connection housing or the circuit breaker without interrupting the main horizontal busbar operation.

Each closed gas compartment has its own pressure relief which prevents rupture of the housing in case of an arc fault.

The monitoring of the gas compartment is carried out with alarm contact manometers.

The offered switchgear is tested according to ANSI / IEEE C37.20.7-2007 type 2B internal arc-fault standard.

The switchgear is UL certified and will have UL-label on the switchgear

1.2. Panel Design

Each of the three single poles of the panel are arranged from front to back. Each pole consists of a vertical housing with the vacuum interrupter and a horizontal bus housing mounted on top of the circuit breaker housing containing the three-position switch and the busbar.

Circuit-breaker housings and busbar housings are separated from each other with gas-tight bushings.

The cable connection compartment housing with the cable sockets is located below the circuit breaker.

1.3. Switchgear Housings

The switchgear housings consist of a corrosion-resistant high nickel content aluminium alloy and are assembled using O-rings for gas tightness.

The rated operating pressure amount of max. 120 kPa relative gas pressure (depends on isolation level and rated current) at 20° C.

The individual gas compartments are monitored using alarm contact manometers.

1.4. Circuit-Breaker

Circuit-breakers are vacuum circuit-breakers of the 3AH4 product series. The circuit breaker operating drive and the vacuum switching interrupter are maintenance-free up to 10,000 switching cycles as a standard design.

The maintenance-free operating mechanism has the following equipment features:

- Motor charged stored-energy spring operated mechanism with auto-reclosing capability.
- "Trip-Free" according to IEC 6227-100
- Auxiliary switch contacts for control / signaling as specified in the Scope of Supply, Chapter 5.
- Operations counter

- Circuit breaker trip solenoid
- Circuit breaker close solenoid
- Auxiliary switch contacts for control / signalling as specified in the Scope of Supply, Chapter 5.
- 'Spring charged' indication
- Open/close mechanical position indication
- Mechanical OFF pushbutton
- Mechanical ON pushbutton
- The mechanical grounding lever is lockable and tagable for a grounded feeder circuit.

Endurance class of circuit-breaker:

Function	Class	Standard	Properties
BREAKING	M2	IEC 62271-100	10,000 x Mechanically without maintenance *
	E2	IEC 62271-100	10,000 x rated normal current without maintenance * 50 x rated short-circuit breaking current without maintenance
	C2	IEC 62271-100	Very low probability of restrikes

* Option: 30.000 operating cycles

1.5. Three Position Switch

To reduce moving parts, the disconnector and grounding switches are designed as single three-position switches. In combination with the circuit-breaker, the non-load break three-position switch is used for fault close (make-proof) feeder grounding.

The disconnector / ground stationary and movable contacts are mounted in the busbar housings. Mechanical coupling is made through an external shaft.

The three-position switch operating mechanism is located on the panel front. For the two operating functions (disconnecting and grounding) separate interlocked operating handles are provided.

The switching positions of the three-position-switches are visually monitored (as required by NEC article 225) using a web-camera system and are displayed with a provided laptop.

The maintenance-free operating mechanism has the following equipment features:

- Manual or optional motor operating mechanism as specified in the Scope of Supply, Chapter 5
- Auxiliary contacts for disconnector switch: 4NO + 4NC + 2CO
- Auxiliary contacts for grounding switch: 2NO + 2NC + 4CO
- Mechanical switch position indication for connected and grounding switch positions
- Manual operation with mechanical interlock to the circuit-breaker
- Locking device as specified in the Scope of Supply, Chapter 5

Endurance class of three-position disconnector:

Function	Class	Standard	Properties	
DISCONNECTING	M1	IEC 62271-102	2.000 x	mechanically without maintenance
READY-TO-GROUND			1,000 x	mechanically without maintenance
GROUNDING	E2 [1]	IEC 62271-102	50 x	rated short-circuit making current I_{ma} without maintenance

[1] By closing the circuit-breaker

1.6. Interlocks

1.6.1. Vertical section internal interlocking

The combination of non load-break three-position switch and circuit-breaker meet the following vertical section internal interlock conditions:

To prevent the three-position switch from operating under load, the three-position switch is mechanically interlocked to only operate with the circuit-breaker in the open position.

The three-position switch can only be brought into the ready-to-earth position if the disconnector and circuit-breaker are open.

The three-position switch is prevented from switching through from the CLOSED state into the "ready-to-earth" state.

Closing of the circuit breaker is blocked if the three-position switch is in an intermediate position.

1.6.2. Vertical section internal and overall interlocking

All internal vertical section interlocks are mechanical. In tie-breaker and tie-riser sections, additional electromagnetic interlocks are provided. If the control voltage fails, an interlocked emergency operation of the feeder is possible.

1.6.3. Grounding of the feeder

For grounding of the feeder, reliable "verification interlocking" is provided: Only after the three-position switch has been switched into the "ready-to-ground" position can the feeder be grounded by closing the circuit-breaker.

The remote control and protective relay tripping operation of the circuit breaker are automatically disabled as soon as the three-position switch is switched to the "ready-to-ground" position and the feeder grounded locking device is padlocked.

A "feeder grounded" locking device prevents the local mechanical and electrical tripping by blocking the tripping mechanism of the circuit breaker mechanically.

1.6.4. Un-grounding of the feeder

Once grounded, the feeder remains in the grounded position.

The locking device is removed and the circuit-breaker must be manually opened with the mechanical OPEN push-button of the circuit-breaker.

The three-position switch can be operated as described above.

1.7. Power Cable Connection

Power cable connections are accessible from below from an elevated platform / mezzanine or the cable vault. Cable connections are designed for fully insulated inside cone connections as per DIN EN 50181.

There is a variety of combinations for cable connections for single-core or multiple-core cables per phase with the cable sizes 2/0 AWG through 1000 kcmil.

Iso-phase bus-bar connections can be made with solid-insulated bus-bars or with gas-insulated bus-bars.

Quoted equipment is specified in the Scope of Supply, Chapter 5

The following suppliers are released:

Company	Type of cable plugs
Pfisterer	CONNEX size 2, size 3 and size 4
Südkabel	SEIK
nkt cables	CPI 2, CPI 3

1.8. Current Transformers

Current transformers are designed as toroidal current transformers. The CTs are mounted on the outside of the single phase aluminum housing, without any dielectric or thermal stresses.

Current transformers are specified in the Scope of Supply, Chapter 5

1.9. Voltage Transformers

Voltage transformers are designed as inductive, cast-resin insulated voltage transformers in metal-enclosed safe-to-touch design. The VTs are located outside the gas compartments.

The voltage transformers can get connected to the busbar directly or over a three position switch

Voltage transformers for feeders can be plugged directly or connected through a separate cable at the cable connection.

Voltage transformers are specified in the Scope of Supply, Chapter 5

1.10. Busbar

The busbar consists of profile copper.

1.11. Low-voltage Compartment

Low-voltage compartments are located on the vertical section front above the operating mechanisms of the circuit-breaker and the three-position switch. The electrical control connections from section to section are made via flexible cable harnesses. Control wiring is run in a wire-way located at the top of the LV compartment.

Internal vertical section wires run in metal-enclosed wiring ducts. The metal-enclosed wiring ducts are located on the left and on the right in the front part of the switchgear enclosure and are accessible from the front.

Inside the low-voltage compartment, secondary equipment is mounted on a rear mounting plate or on a DIN-rail system. Individual secondary devices can be integrated in the door of the low-voltage compartment.

Wiring is performed as specified in the Scope of Supply, Chapter 5

2 Special Switchgear Features

2.1. Operational Reliability

The gas-tight enclosure of all live parts from to busbar down to the cable excludes any external influences on the primary part.

Single-pole enclosure and long-time experience in the application of this switchgear has proven its exceptional operational reliability.

2.2. Personnel Safety

Personnel safety is achieved by internal single-pole enclosure of the primary circuit tested to ANSI / IEEE C37.20.7-2007 type 2B internal arc-resistant design.

2.3. Environmental Independence

Due to the gas-tight enclosure, 8DA10 is almost insensitive to environmental effects. Moreover, the dielectric strength (BIL) and rated voltage are independent of the site altitude.

2.4. Environmental Compatibility

The switchgear forms a hermetically sealed system in accordance with IEC 62271 part 1 over the complete life time of the unit, i.e. the SF6 gas exchanging is not necessary under normal operating conditions.

2.5. Compactness

The low pressure SF6 insulation enables very compact dimensions, offering at the same time a high switchgear performance. This provides an economical utilization of floor space, especially in cities and metropolitan areas for both existing rooms and new buildings.

2.6. Modularity

The modularity of the switchgear allows e.g. to replace the circuit-breaker module without isolating the busbars.

Due to its modular design 8DA10 shows a high re-availability even in case of fault.

3 Standards

		IEC-Standard **EN-Standard**	**Title**
Switchgear		62 271-1	High-voltage switchgear and controlgear – Part 1: Common specifications
		62 271-200	A.C. metal- enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
Switching devices	Circuit-breakers	62 271-100	High-voltage alternating-current circuit-breakers
	Disconnectors and earthing switches	62 271-102	High-voltage alternating current disconnectors and earthing switches
Voltage detecting systems		61 243-5	Voltage detecting systems (VDS)
Surge arresters Surge limiters		60 099	Surge arresters
Degree of protection		60 262	Degrees of protection by enclosures (IP Code)
Degree of protection		60 529	Degrees of protection by enclosures (IK Code)
Insulation		60 071	Insulation co-ordination
Instrument transformers	Current transformers	61 869-1	Instrument transformers
	Voltage transformers	61 869-2	Instrument transformers
	Voltage transformers	61 869-3	Instrument transformers
SF_6		60 376	Specification of technical grade sulphur hexafluoride (SF_6) for use in el. equipment
SF_6		62 271-4	Use and handling of sulphur hexafluoride (SF_6)
Installation		61 936-1	Power installations exceeding 1 kV
Environmental conditions		60 721-3-3	Classification of environmental conditions
Operation		EN 50 110	Operation of electrical installations

4 Technical Data

Voltages

Rated voltage	27.0 kV
Operating voltage	24.94 kV
Rated short-duration power-frequency withstand voltage	70 kV
Rated lightning impulse withstand voltage	125 kV
Rated frequency	60 Hz

Short-circuit ratings

Rated short-time withstand current	25.0 kA
Rated peak withstand current	65 kA
Rated duration of short-circuit	3 s
Rated short-circuit making current (max.)	65 kA
Rated short-circuit breaking current	25.0 kA

Current ratings

Rated normal current of the busbar	1250 A
Max. permissible busbar current at 40 °C	1200 A

General switchgear data

Type of arrangement	Free-standing arrangement with rear walls
Degree of protection for enclosure, operating side and lateral surfaces	IP3XD (IP4X for LV compartment)
Degree of protection, primary part	IP65
Partition class	PM
Loss of service continuity	LSC 2
Internal arc classification	2B 25 kA 0.5 s
Exterior section standard colour	
Mimic diagram colour	black/red (standard)
Vertical section width	600 mm
Vertical section depth	1625 mm
Vertical section height with low-voltage compartment	2700 mm
Height of switchgear room (min.)	2900 mm
Width of control aisle (min.)	800 mm

5 Scope of Supply

The switchgear is designed as a single-busbar switchgear according to the enclosed single-line diagram.

Item No.	Quantity	Typical No.	Description
5.1	1	=JZ01	CB Panel 1250 A / Main A
5.2	1	=JZ02	CB Panel 1250 A / Main B
5.3	1	=JZ03	CB Panel 1250 A / Tie
5.4	1	=JZ04	Dummy panel
5.5	4	=JZ05	CB Panel 1250 A / Feeder
5.6	1	=JZ00	*Switchgear accessories*
5.7	1		Customer-specific designs

In case of particularly customer-specific design it might be possible that individual points of the switchgear description are not valid anymore.

The offered scope of supply is equipped in detail as follows:

Item No.	Quantity	Description	Typical No.
5.1	1	**CB Panel 1250 A / Main A** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ01**
5.1.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.1.1.1	3	**Voltage transformers at the busbar** Voltage transformer type: GBEA Single-pole plug-in design with HV fuses, inductive type, climate-independent, secondary connection by means of plugs inside the panel. Arranged outside the primary enclosure. **with three-position disconnector** Switching positions voltage transformer ON-OFF-EARTHED, installation within SF6-filled busbar compartment, mechanism outside the gas compartment with manual operating mechanism with camerasystem for monitoring the switching positions of the three-position-switch Locking device at the disconnector and earthing switch (separate function) Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO 3 x single-pole Metal-enclosed Voltage of secondary winding: 120 / v3 V Rating and class of secondary winding: WXY / Cl. 0.3 Voltage of earth-fault winding: Rating and class of earth-fault winding: With routine test certificate	
5.1.2		**Panel construction**	
5.1.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	

5.1.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"
5.1.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3 Primary current, core 1 : 1200 A MR Secondary current, core 1 : 5 A Rating, class and overcurrent factor of core 1 : C200 With routine test certificate
5.1.3		**Panel connection**
5.1.3.1	1	**Panel connection at feeder** by 2 cable per phase plug size 3
5.1.3.2	1	**Capacitive voltage detecting system at the feeder** Design: LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage
5.1.3.3	3	**Voltage transformers at the feeder (short cable connection)** Voltage transformer type: GBEI Single-pole plug-in design with HV fuses, inductive type, climate-independent, secondary connection by means of plugs, primary connection via plug-in cable link. Length: 10 m Arranged outside the primary enclosure. 3 x single-pole Metal-enclosed Voltage of secondary winding: 120 / v3 V

		Rating and class of secondary winding: WXY / Cl. 0.3 With routine test certificate
5.1.3.4	3	**Surge arrester** Surge arrester Connex size 2 Rated discharge current 10 kA Rated voltage Ur 24 kV Continuous load voltage Uc 19 kV company Pfisterer
5.1.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1PG0+L0S Multifunction Protection Relay 7SJ64 or similar
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	1	EWC:LOR/7803D Lock-out relays Series 24 LOR
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	6	LJK:1506SC short circuit terminal block
	12	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	2	3RV1611-1DG14 circuit breaker for voltage transformer 3-pole 3A
	2	3RV1901-1A auxil. switch 1NO+1NC
	1	8MR2170-1CA thermostat 250V AC, 1NC
	1	XDA:HSD140C/250R/110V resistor 250 ohm, 40W
	1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
	1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
	1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
	1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC

1	3SB3901-1DF LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A lampholder BA 9S
3	3SB3922-0AV accessories for inscription plate 12,5x27mm
3	3SB1901-2AA inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0 fibre-optic duplex data line 3m
1	RFV:140X55-S circuit label 140x55mm
3	RFV:75X20-S resopal label 75x20mm
2	RFV:150X50 resopal label 150X50mm

Item No.	Quantity	Description	Typical No.
5.2	1	**CB Panel 1250 A / Main B** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ02**
5.2.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.2.2		**Panel construction**	
5.2.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	
5.2.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.2.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3	

		Primary current, core 1 : 1200 A MR Secondary current, core 1 : 5 A Rating, class and overcurrent factor of core 1 : C200 With routine test certificate
5.2.3		**Panel connection**
5.2.3.1	1	**Panel connection at feeder** by 1 cable per phase plug size 2 and by 2 cable per phase plug size 3
5.2.3.2	1	**Capacitive voltage detecting system at the feeder** Design: LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage
5.2.3.3	3	**Surge arrester** Surge arrester Connex size 2 Rated discharge current 10 kA Rated voltage Ur 24 kV Continuous load voltage Uc 19 kV company Pfisterer
5.2.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1PG0+L0S Multifunction Protection Relay 7SJ64 or similar
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	1	EWC:LOR/7803D Lock-out relays Series 24 LOR
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	6	LJK:1506SC short circuit terminal block
	12	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	1	8MR2170-1CA

	thermostat 250V AC, 1NC
1	XDA:HSD140C/250R/110V resistor 250 ohm, 40W
1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC
1	3SB3901-1DF LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A lampholder BA 9S
3	3SB3922-0AV accessories for inscription plate 12,5x27mm
3	3SB1901-2AA inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0 fibre-optic duplex data line 3m
1	RFV:140X55-S circuit label 140x55mm
3	RFV:75X20-S resopal label 75x20mm
2	RFV:150X50 resopal label 150X50mm

Item No.	Quantity	Description	Typical No.
5.3	1	**CB Panel 1250 A / Tie** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ03**
5.3.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.3.2		**Panel construction**	
5.3.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	
5.3.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.3.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3	

		Primary current, core 1 : 1200 A MR Secondary current, core 1 : 5 A Rating, class and overcurrent factor of core 1 : C200 With routine test certificate
5.3.3		**Panel connection**
5.3.3.1	1	**Panel connection at feeder** by 2 cable per phase plug size 3
5.3.3.2	1	**Capacitive voltage detecting system at the feeder** Design: LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage
5.3.3.3	3	**Surge arrester** Surge arrester Connex size 2 Rated discharge current 10 kA Rated voltage Ur 24 kV Continuous load voltage Uc 19 kV company Pfisterer
5.3.4		**Low-voltage compartment** Height: 1200 mm
	1	7SJ6415-5EC92-1FE0+L0S overcurrent-time protection relay 7SJ64 or equivalent
	1	ABB:129A514G01 test socket 10-pole for flush mounting
	1	EWC:LOR/7803D Lock-out relays Series 24 LOR
	2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
	2	3RT1916-1DG00 suppression diode 12-250V DC
	1	EWC:2446D CB control switch Series 24
	1	EWC:24203B-1 local remote selector switch Series 24
	6	LJK:1506SC short circuit terminal block
	12	LJK:DIN_R-1 Rail adapter for Marathonterminal
	1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
	2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
	1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
	4	5ST3010-0HG auxil.contact 1NO+1NC
	1	8MR2170-1CA thermostat 250V AC, 1NC
	1	XDA:HSD140C/250R/110V

		resistor 250 ohm, 40W
1	3SB3001-6BA20	signal lamp assembly, red with concentric rings
1	3SB3001-6BA40	signal lamp assembly, green with concentric rings
1	3SB3001-6BA60	signal lamp assembly, white with concentric rings
1	3SB3901-1CF	LED lamp, red, 230VAC, 110-160VDC
1	3SB3901-1DF	LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF	LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A	lampholder BA 9S
3	3SB3922-0AV	accessories for inscription plate 12,5x27mm
3	3SB1901-2AA	inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0	fibre-optic duplex data line 3m
1	RFV:140X55-S	circuit label 140x55mm
3	RFV:75X20-S	resopal label 75x20mm
2	RFV:150X50	resopal label 150X50mm

5.3.5 Customer-specific designs

1 Key interlock KF1 with KirkKey lock for a hand operated three-position switch.

The key function KF1 has the following characteristics:

- Key releases in disconnector switch "OPEN"
- Key trapped in disconnector switch "CLOSED"

Item No.	Quantity	Description	Typical No.
5.4	1	**Dummy panel** Maximum permissible feeder current at 40 °C:	**=JZ04**
5.4.1		**Busbar system** Single-pole insulated busbars for single-busbar system	

Item No.	Quantity	Description	Typical No.
5.5	4	**CB Panel 1250 A / Feeder** Maximum permissible feeder current at 40 °C: 1200 A	**=JZ05**
5.5.1		**Busbar system** Single-pole insulated busbars for single-busbar system	
5.5.2		**Panel construction**	
5.5.2.1	1	**Three-position disconnector** Switching position ON-OFF-EARTHED, installation within busbar compartment, mechanism outside the gas compartment With manual operating mechanism with camera system for monitoring the switching positions of the three-position-switch With electromagnetic interlocking at the disconnector and earthing switch Auxiliary voltage of electromagnetic interlock: DC 125 V Free auxiliary contacts disconnector switch: 5NO + 5NC + 5CO Free auxiliary contacts earthing switch: 5NO + 5NC + 5CO with Locking device at the disconnector and earthing switch (separate function)	
5.5.2.2	1	**Vacuum circuit-breaker** Vacuum interrupter inside the switching pole compartment, motor operating stored-energy mechanism installed at panel front. Rated voltage: 27.0 kV Rated short-time withstand current: 25.0 kA Rated current: 1250 A With motor operating stored-energy mechanism Rated operating sequence O - 0,3 s - CO - 3 min - CO with 1 shunt release Auxiliary voltage of motor-drive DC 125 V Auxiliary voltage of closing solenoid DC 125 V Auxiliary voltage of 1st shunt release DC 125 V Free contacts of auxiliary switch 7NO + 4NC + 2CO with mechanical switching ON mechanism, padlockable and sealable with mechanical switching OFF mechanism, padlockable and sealable Circuit breaker / Locking device "Feeder earthed" only possible in position "Earthing switch ON"	
5.5.2.3	3	**Current transformers at feeder (B) (B bzw. C1)** Current transformer type: 4MC4_90 Designed as a ring-core current transformer, single-pole, inductive type, climate-independent, secondary connection via terminal strip inside the low-voltage compartment of the panel. Arranged outside the primary enclosure. Current transformer installation in the panel 3 x 1 core in L1/L2/L3	

Primary current, core 1 : 1200 A MR
Secondary current, core 1 : 5 A
Rating, class and overcurrent factor of core 1 : C200
With routine test certificate

5.5.3 **Panel connection**

5.5.3.1 1 **Panel connection at feeder**
by 1 cable per phase plug size 3

5.5.3.2 1 **Capacitive voltage detecting system at the feeder**
Design:
LRM system (low-resistance modified) with plug-in indicator for the chosen operating voltage

5.5.4 **Low-voltage compartment**
Height: 1200 mm

1	7SJ6415-5EC92-1FE0+L0S overcurrent-time protection relay 7SJ64 or equivalent
1	ABB:129A514G01 test socket 10-pole for flush mounting
2	3RH1140-1BG40 auxiliary relay 125V DC, 4NO
2	3RT1916-1DG00 suppression diode 12-250V DC
1	EWC:2446D CB control switch Series 24
1	EWC:24203B-1 local remote selector switch Series 24
3	LJK:1506SC short circuit terminal block
6	LJK:DIN_R-1 Rail adapter for Marathonterminal
1	5SJ4203-7HG41 mcb, 2-pole, 3A, UL 489
2	5SJ4206-7HG41 mcb, 2-pole, 6A, UL 489
1	5SJ4118-7HG41 mcb, 1-pole, 15A, UL 489
4	5ST3010-0HG auxil.contact 1NO+1NC
1	8MR2170-1CA thermostat 250V AC, 1NC
1	XDA:HSD140C/250R/110V resistor 250 ohm, 40W
1	3SB3001-6BA20 signal lamp assembly, red with concentric rings
1	3SB3001-6BA40 signal lamp assembly, green with concentric rings
1	3SB3001-6BA60 signal lamp assembly, white with concentric rings
1	3SB3901-1CF LED lamp, red, 230VAC, 110-160VDC
1	3SB3901-1DF

	LED lamp, green, 230VAC, 110-160VDC
1	3SB3901-1QF
	LED lamp, white, 230VAC, 110-160VDC
3	3SB3400-1A
	lampholder BA 9S
3	3SB3922-0AV
	accessories for inscription plate 12,5x27mm
3	3SB1901-2AA
	inscription plate 12,5x27mm
1	6XV8100-0BE14-0AD0
	fibre-optic duplex data line 3m
1	RFV:140X55-S
	circuit label 140x55mm
3	RFV:75X20-S
	resopal label 75x20mm
2	RFV:150X50
	resopal label 150X50mm

Item No.	Quantity	Description	Typical No. =JZ00
		Switchgear accessories comprising:	
	2	End walls	
	1	Service flap within the left end wall	
	1	Laptop flap within the end wall right	
	1	Gas pressure indication for busbar system	
	1	Gas pressure indication with auxiliary contacts 2NO	
	1	Operation and installation manual 8DA10 ANSI Design 2012	
	16	1 set fixing material	
	6	Voltage detector for LRM-system	
	7	Cable support rail for 8DA10 feeder	
	1	Touch-up set	
	1	Varnish	
	1	Small accessories for wiring	
	1	Laptop for ANSI Design	
	1	Cable Termination Kit, size 2-3	
	1	SF6 Gas Cylinder	
	10	Set of Cable Plugs, size 2 or 3	
	1	Standard accessories 8DAB10 Standard accessories consisting of: 1 handle for disconnector drive 1 handle for earthing switch drive 1 hand-crank for charging circuit-breaker drive 1 socket-spanner for LV-doors 1 pre-selection key for three-position disconnector 1 TORX-screwdriver 1 Touch-up set colour "light basic" (SN700) 1 operation and installation manual in specified language	
	1	Camera system accessories	

6 Documentation

6.1	Single-Line Diagram	Annex 1
6.2	Panel Arrangement Diagram	Annex 2
6.3	Constructional Data	Annex 3
6.4	Side View Of Typicals	Annex 4
6.5	Gas Compartment Arrangement	Annex 5

SIEMENS

Medium-Voltage Switchgear

Type 8DA Extendable Fixed-Mounted Circuit-Breaker Switchgear up to 40.5 kV

Single Busbar, Single-Pole Metal-Enclosed, Metal-Clad, Gas-Insulated

Medium-Voltage
Switchgear

OPERATING
INSTRUCTIONS

Order No.: 861-9272.9
Revision: 03
Issue: 01-03-2006

Siemens AG
Power Transmission and Distribution Group
Medium-Voltage Switchgear and Transmission Division

1992

Evaluation of the **Technical Testing Station** by DATech (German Accreditation Body for Technology) in accordance with **DIN EN 45 001** and accreditation of the **Technical Testing Station** for the testing areas High-Voltage Switching Devices and Switchgear by DATech as
Testing Laboratory Switchgear Factory Frankfurt/M., Siemens AG
DAR (German Accreditation Council) registr. number: DAT-P-013/92-00
and as
PEHLA Testing Laboratory Frankfurt/M.
DAR registr. number: DAT-P-013/92-50

1995

Introduction and application of a quality and environmental management system for the **Medium-Voltage Switchgear and Systems Division** in accordance with **DIN EN ISO 9001** and **DIN EN ISO 14001** Quality and environmental systems - Model for quality assurance in design, development, production, installation and serving.
Certification of the quality and environmental management system by DQS (German Association for the Certification of Quality and Environmental Management Systems)
DQS registr. number: 3473-02

About these Instructions

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation or operation.

Should further information be desired or should particular problems arise which are not covered sufficently by these instructions, the matter should be referred to the local Siemens Service Centre.

The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The Sales Contract contains the entire obligations of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty.

To connect or install devices from other manufacturer’s, the associated user information and ratings have to be considered.

If you want to make suggestions for improvement of these instructions, or if there is something you do not understand, please contact the address given below:

Division PTD M2.

Siemens Aktiengesellschaft

Power Transmission and Distribution

Carl-Benz-Str. 22

D-60386 Frankfurt

Germany

Subject to modifications.

Contents

Safety instructions

1 Signal terms and definitions

⚠	**DANGER!**
	as used in these instructions, this means that personal injuries can occur if the relevant precautionary measures are not taken. ⇨ Observe the safety instructions.

⚠	**ATTENTION!**
	as used in these instructions, this means that damage to property or environment can occur if the relevant precautionary measures are not taken. ⇨ Observe the safety instructions.

☞	**NOTE!**
	as used in these instructions, this points at facilitations of work, particularities for operation or possible maloperation. ⇨ Observe the notes.

Symbols used

⇨ Operation symbol:Identifies an operation. Asks the operator to perform an operation.

✔ Result symbol:Identifies the result of an operation.

2 General instructions

Independently of the safety instructions given in these operating instructions, the local laws, ordinances, guidelines and standards for operation of electrical equipment as well as for labour, health and environmental protection apply.

Five Safety Rules of Electrical Engineering

The Five Safety Rules of Electrical Engineering must generally be observed during operation of the products and components described in these operating instructions:

- Isolating.
- Securing against reclosing.
- Verifying safe isolation from supply.
- Earthing and short-circuiting.
- Covering or barriering adjacent live parts.

3 Due application

The switchgear corresponds to the relevant laws, prescriptions and standards applicable at the time of delivery. If correctly used, they provide a high degree of safety by means of logical mechanical interlocks and shockproof metal enclosure of live parts.

DANGER!

The perfect and safe operation of this switchgear is conditional on:

⇨ Observance of operating and installation instructions.

⇨ Qualified personnel.

⇨ Proper transportation and correct storage of the switchgear.

⇨ Correct installation and commissioning.

⇨ Diligent operation and maintenance.

⇨ Observance of the instructions applicable at site for installation, operation and safety.

4 Qualified personnel

Qualified personnel in accordance with these instructions are persons certified by the Switchgear Factory Frankfurt who are familiar with transport, installation, commissioning, maintenance and operation of the product and have appropriate qualifications for their work, e.g.:

- Training and instruction or authorisation to switch on, switch off, earth and identify power circuits and equipment / systems as per the relevant safety standards.
- Training and instruction about the relevant safety standards and the use of appropriate safety equipment.
- Training in first aid and behaviour in the event of possible accidents.

Description

5 Application and typical uses

Extendable fixed-mounted circuit-breaker switchgear of the 8DA series is mainly used in transformer and distribution substations as well as for switching duties in industrial plants and railways systems.

The panels are designed for rated voltages up to 40.5 kV and rated currents up to 2500 A. They are suitable for a maximum permissible rated short-circuit current of 100 kA and a maximum short-circuit breaking current of 40 kA.

6 Features

The fixed-mounted circuit-breaker switchgear of the 8DA series has the following features:

- Factory-assembled, type-tested, metal-enclosed and metal-clad switchgear for indoor installations
- SF_6-gas
- Safe-to-touch connection systems for cables as well as for solid-insulated and SF_6-gas insulated bar
- Single-pole metal enclosure
- Minimum fire load
- Maintenance-free
- Complete switchgear interlocking system with logical mechanical interlocks
- Primary part independent of environmental effects (pollution, humidity and small animals) due to hermetically sealed enclosure

This provides:

- Maximum personal safety
- Maximum security of operation

7 Type classification

The following table shows the different types of the 8DA series.

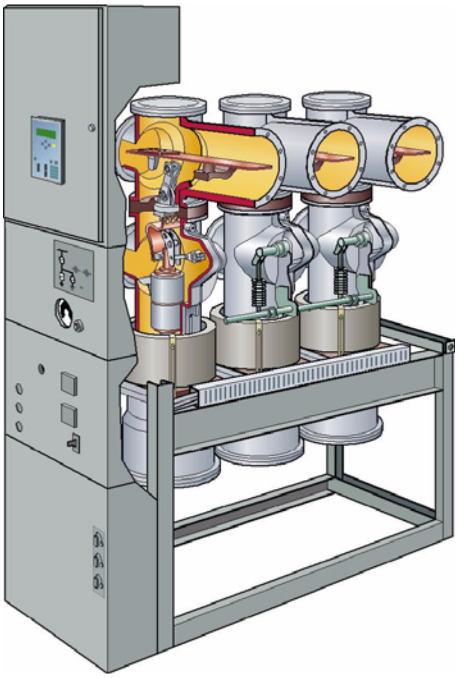


Fig. 1: 8DA10 (3-pole)

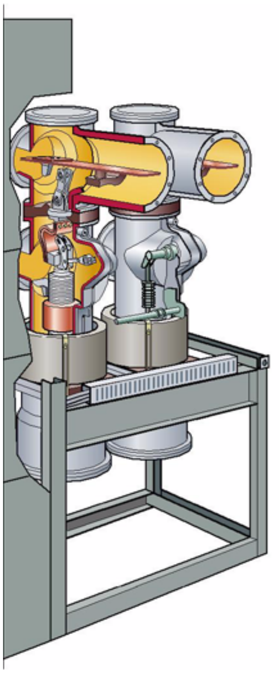


Fig. 2: 8DA12 (2-pole)

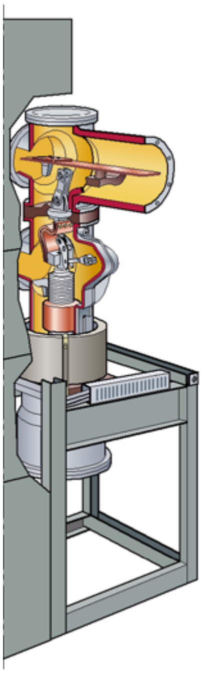


Fig. 3: 8DA11 (1-pole)

8 Circuit-breaker panel

8.1 Function

The circuit-breaker panel is the basic panel type of the 8DA series. The circuit-breaker panel can fulfil the function "incoming feeder" or "outgoing feeder". It can carry or switch all rated busbar and feeder currents as well as the short-circuit currents quoted on the respective rating plates.

8.2 Frame

- Support for switchpanel poles and switchgear front
- Forms the cable connection compartment

8.3 Low-voltage compartment

- For accommodation of protection, control, measuring and metering equipment
- With plug-in cables of the circuit-breaker and three-position disconnector operating mechanisms on C-profile, with screw-type connections for the incoming and outgoing cables (e. g. bus wires)
- Devices can be optionally mounted in the door or on mounting plates inside the low-voltage compartment

8.4 Switchpanel pole

- Poles arranged one behind the other.

- One switchpanel pole consists of a vertically arranged housing with a vacuum interrupter inside.

- The busbar housing with the three-position disconnector inside is arranged horizontally over the switchpanel pole.

8.5 Switchpanel

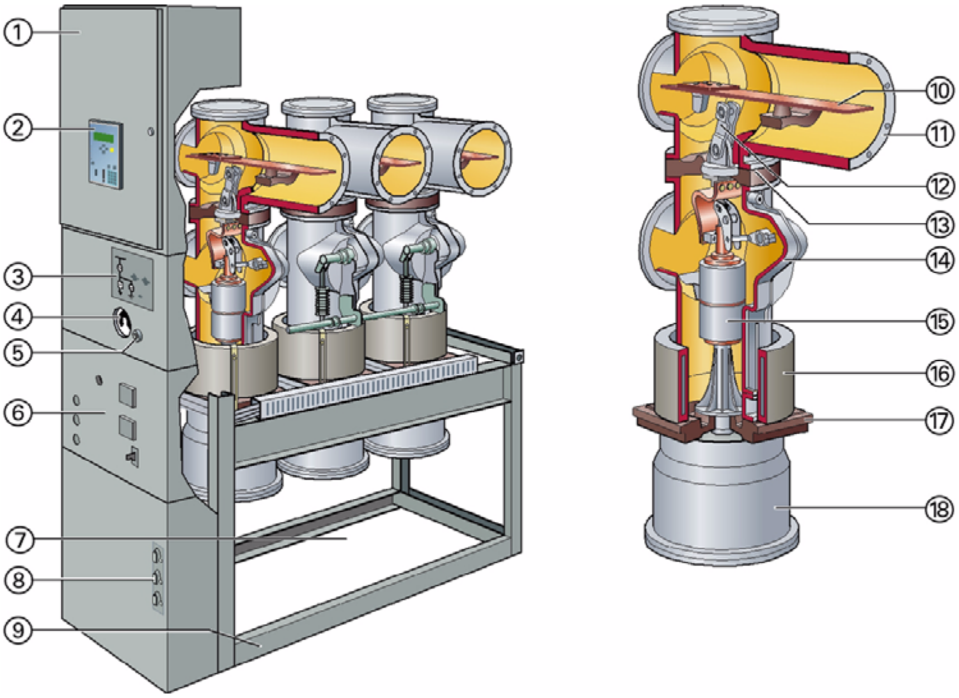


Fig. 4: 8DA10 circuit-breaker panels and switchpanel pole

①	Low-voltage compartment (standard heights: 850/ 1200 mm)	⑩	Busbar
②	SIPROTEC protection and control unit (option)	⑪	Cast-aluminium busbar housing
③	Control and indication board for three-position disconnector	⑫	Three-position disconnector
④	Gas pressure indicator for feeder gas compartments (B0)	⑬	Upper bushing
⑤	Gas filling socket	⑭	Circuit-breaker housing
⑥	Control and indication board for vacuum circuit-breaker	⑮	Vacuum interrupter
⑦	Cable connection compartment	⑯	Current transformer
⑧	Sockets for voltage detection system	⑰	Lower bushing
⑨	Frame	⑱	Panel connection housing

9 Circuit-breaker

9.1 Design

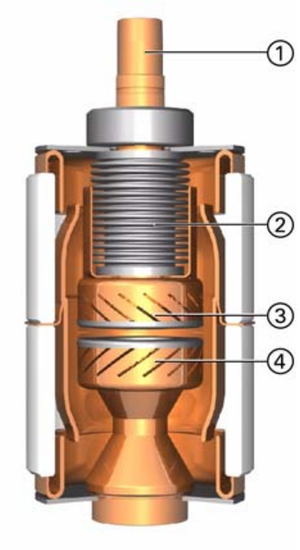
The vacuum circuit-breaker 3AH49 is an integral component of the switchpanel and consists of the following components:

- Operating mechanism with stored-energy spring mechanism and control elements
- Switching rods for contact operation
- 1 to 3 switchpanel poles with vacuum interrupters

Mechanical interlock

The circuit-breaker and the three-position disconnector are mechanically interlocked against each other. The mechanical interlock prevents the circuit-breaker from being closed as long as the three-position disconnector is not in a defined end position (CLOSED/OPEN). Furthermore the mechanical interlock prevents the three-position disconnector from being operated while the circuit-breaker is closed.

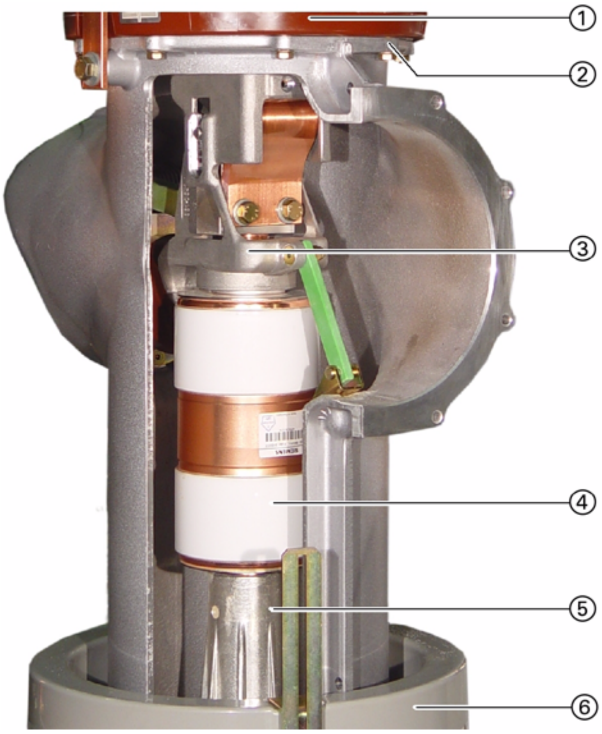
Vacuum interrupters



① Connection bolt
② Metal bellows
③ Moving contact
④ Fixed contact

Fig. 5: Sectional view of a vacuum interrupter

The vacuum interrupter is fixed at the connecting piece of the circuit-breaker pole. The fixed contact ④ is directly connected to the housing. The moving contact ③ is firmly connected to the connection bolt ① and is centrally aligned in the guide. The metal bellows ② inside the interrupter forms the vacuum-tight connection to the gas compartment.

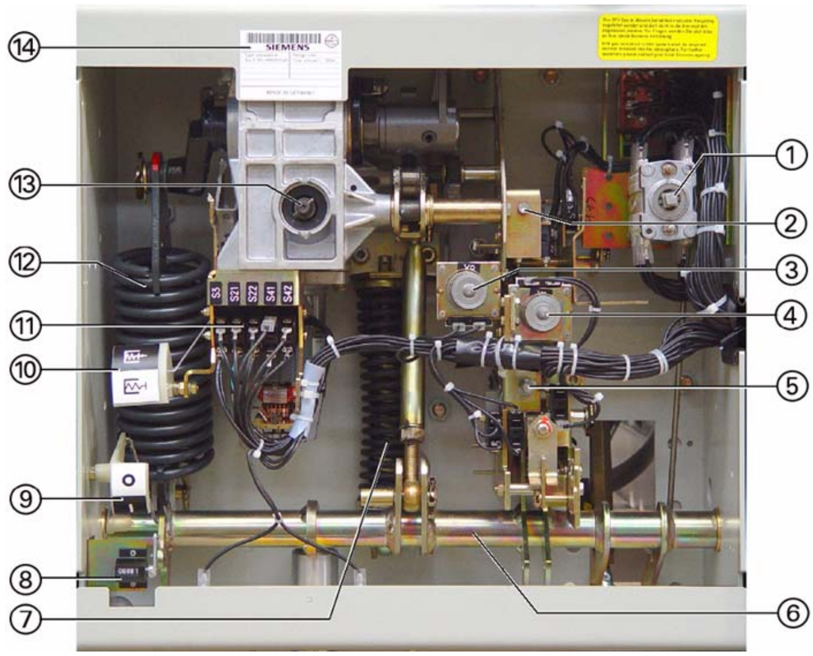


①	Bushing
②	Top flange
③	Interrupter support
④	Vacuum interrupter (example type)
⑤	Connecting piece
⑥	Current transformer

Fig. 6: Sectional view of switchpanel pole with vacuum interrupter

9.2 Operating mechanism box

Design The operating mechanism box is closed with a removable front plate. In front plate there are openings for the control elements and indicators. The operating mechanism box accommodates all components required to operate the circuit-breaker.



①	Auxiliary switch S1
②	ON pushbutton
③	Closing solenoid
④	Shunt release
⑤	OFF pushbutton
⑥	Operating shaft for circuit-breaker
⑦	Opening spring
⑧	Operating cycle counter
⑨	Switch position indicator for circuit-breaker
⑩	"Closing spring charged / not charged" indicator
⑪	Position switches
⑫	Closing spring
⑬	Gear with hand crank coupling
⑭	Rating plate

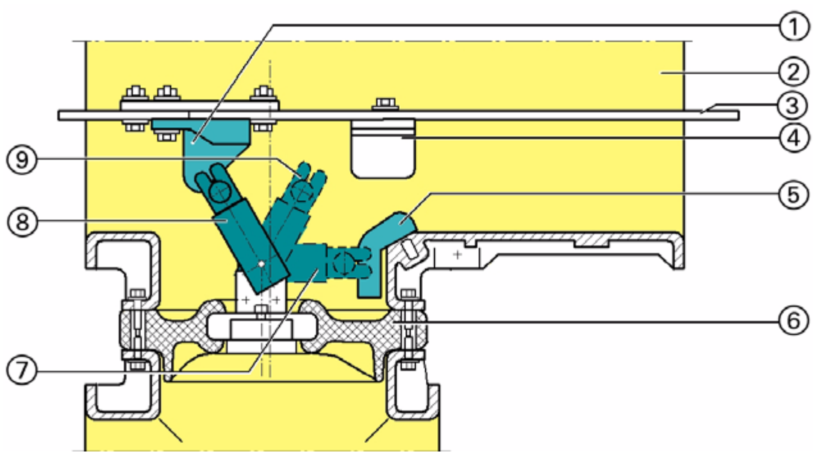
Fig. 7: Circuit-breaker operating mechanism without front plate

Function Depending on its design, the circuit-breaker is closed electrically or mechanically with the ON pushbutton. The operating power is transmitted to the vacuum interrupters through an operating linkage. The closing spring is immediately recharged by the motor after closing.

If the motor supply voltage fails, the closing spring can be charged manually. To do this, there is an opening in the removable front plate with the hand crank coupling of the gear behind. The charging condition of the spring can be read on the indicator.

10 Three-position disconnector

Function The three-position disconnector combines the functions of a disconnector and an earthing switch. It is designed for no-load operation only.



① Fixed contact, CLOSED position

② Busbar housing

③ Busbar

④ Busbar support

⑤ Fixed contact, READY-TO-EARTH position

⑥ Bushing

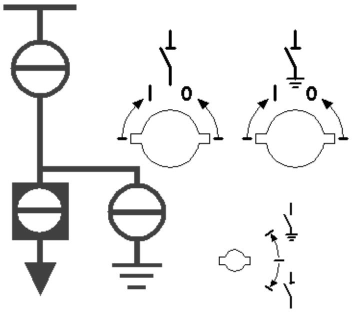
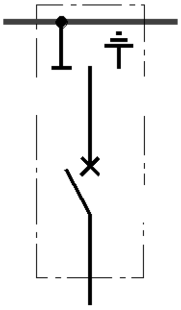
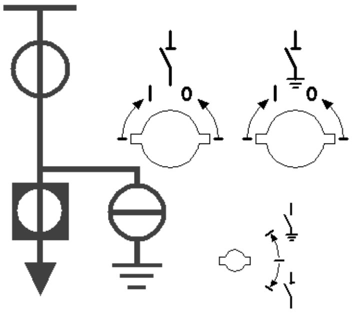
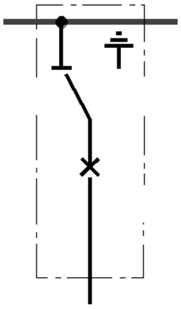
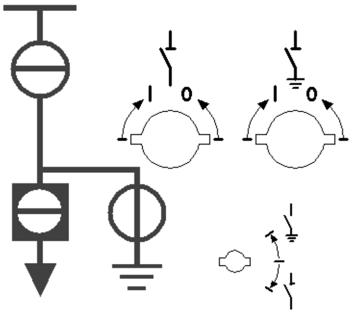
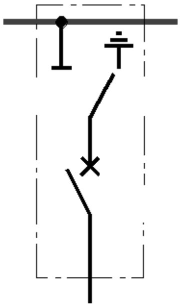
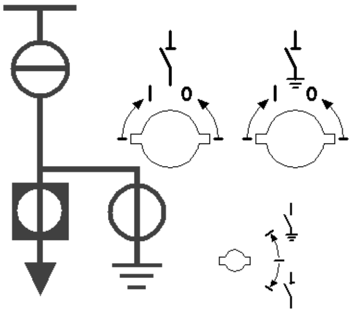
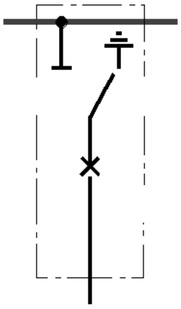
⑦ Moving contact, READY-TO-EARTH position

⑧ Moving contact, CLOSED position

⑨ Moving contact, OPEN position

Fig. 8: Three-position disconnector with busbar and bushing

Switch positions

Switch positions	Switch position indicator	Basic scheme
 OPEN		 - Three-position disconnector OPEN- Circuit-breaker OPEN
 CLOSED		 - Three-position disconnector CLOSED- Circuit-breaker CLOSED
 READY-TO-EARTH		 - Three-position disconnector READY-TO-EARTH- Circuit-breaker OPEN
 EARTHED		 - Three-position disconnector EARTHED- Circuit-breaker CLOSED

11 Current and voltage transformers

11.1 Voltage transformers

Features

- According to IEC 60 044-2 (for railway applications, EN 50152-3-3)
- Cast-resin insulated
- Inductive operation
- Safe-to-touch due to metal coating (safe-to-touch by means of an additional cover)
- Safe-to-touch due to metal enclosure

Option:

- Designed as low-power voltage transformer (resistor divider):
  - According to IEC 60 044-7
  - Mounted over the panel connection as flange dividers, or pluggable in any free socket as an inside-cone plug-in system
  - Suitable for all protection and measuring functions
  - No ferroresonance possible anymore
  - No disconnection for switchgear or cable tests
  - Resistant against transient overvoltages
  - Extended voltage measuring range from 0.4 to 1.2 times rated voltage
  - High reliability and availability
  - Short-circuit-proof
  - Rating-independent wiring
  - System-conformity to numerical secondary systems

Voltage transformer types

Mounting locations	Type	Remark
Busbar	4MT3	optionally with voltage transformer disconnector
	4MU1	
	4MT6	
Panel connection	4MU32	external
	4MU34	
	4MU36	
	4MT72	directly pluggable
	4MT74	
	4MT76	

11.2 Current transformers

Features

- According to IEC 60 044-1(EN 50152-3-2 for railway applications)
- Designed as ring-core current transformers:
  - Ring core as carrier of secondary winding
  - Main circuit corresponds to primary winding

- Arranged outside the primary enclosure (switchgear housing) due to single-pole design of the panel
- Free of dielectrically stressed cast-resin parts (due to design)

Mounting locations

- On the busbar
- On the circuit-breaker housing
- At the panel connection
- On the cable

12 Gas compartments

Function The distribution of the gas compartments is decisive for the feasibility of work during operation and the resulting operational restrictions. Thus, in case of fault, the distribution of the gas compartments determines the extent of work. The following example shows the distribution of the gas compartments in a single-pole insulated switchgear with the associated gas weights and gas compartment volumes required to reorder SF_6-gas. As for data to other configurations please contact your local Siemens representative.

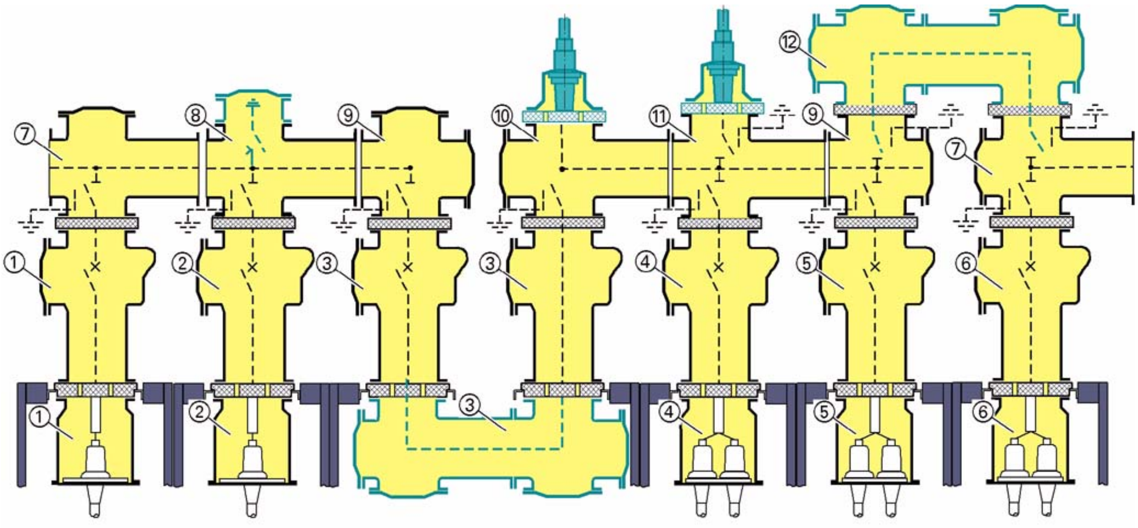


Fig. 9: Example of a panel combination. Gas compartments with identical numbers are interconnected.

Gas compartment		SF6-gas weight per panel at rated operating pressure (relative) and 20 °C ambient temperature				Gas compartment volume
		Left end panel / intermediate panel (right end panel)				Left end panel / intermediate panel (right end panel)
		50 kPa	70 kPa	100 kPa	120 kPa	
① ②	Circuit-breaker housing with plug-in connection 1x plug size 3	0.9 kg	-	1.1 kg	1.3 kg	94 l
③	Circuit-breaker housing with longitudinal connection	2.4 kg	-	3.2 kg	3.5 kg	339 l
④ ⑤ ⑥	Circuit-breaker housing with plug-in connection 2x plug size 3	0.9 kg	-	1.2 kg	1.3 kg	96 l
⑦	Busbar housing for components and top-mounted busbar sectionaliser	0.8 kg (0.7 kg)	0.9 kg (0.7 kg)	-	1.2 kg (1.0 kg)	87 l (68 l)
⑧	Busbar housing with busbar earthing switch	0.9 kg (0.8 kg)	1.1 kg (0.8 kg)	-	1.3 kg (1.1 kg)	97 l (78 l)
⑨	Busbar housing without components or with non-disconnectable voltage transformer	0.8 kg (0.6 kg)	0.9 kg (0.7 kg)	-	1.1 kg (0.9 kg)	81 l (62 l)
⑩	Busbar housing with non-disconnectable connection	0.9 kg (0.7 kg)	1.0 kg (0.8 kg)	-	1.3 kg (1.0 kg)	92 l (73 l)
⑪	Busbar housing with disconnectable connection	1.0 kg (0.9 kg)	1.2 kg (1.0 kg)	-	1.5 kg (1.2 kg)	107 l (88 l)
⑫	Top-mounted busbar sectionaliser	1.3 kg	1.5 kg	-	1.9 kg	138 l

13 Panel connections

13.1 Overview

The fully insulated panel connections are available for cables with inside-cone plug-in system, or for solid-insulated or gas-insulated bars. Three different sizes of cable plugs are available, depending on the cable cross-section. Besides single connections, multiple connections for a maximum of six cables are possible, too. With multiple connections it is also possible to combine different interface types. Multiple connections for two cables can also be used to connect a voltage transformer (external or plug-in type) instead of the second cable.

13.2 Panel connection types

Interface types

Inside cone cable plugs (Make Pfisterer, Type Connex)

Interface size	**2**	**2**	**3**	**3**	**3S**	**4**
Capacitve voltage tap	no	yes	no	yes	yes	no
Rated normal current (A)	800	800	1250	1250	1250	1250
rated lightning impulse withstand voltage (kV)	200	200	200	200	250	325
rated short-duration power-frequency withstand voltage (kV)	95	95	95	95	95	140
min. cable cross section (mm^2)	25	25	50	50	50	95
min. Leiterdurchmesser (mm)	4,9	4,9	7,2	7,2	7,2	9,3
max. Querschnitt (mm^2)	325	325	800	800	800	1200
max. wire diameter (mm)	22,3	22,3	34,6	34,6	34,6	45,4
min. diameter incl. Insulation (mm)	13,5	13,5	15,5	15,5	15,5	33
max. diameter incl. Insulation (mm)	40,0	36,0	51,0	47,0	47,0	66,0

Examples

① Switchgear frame (upper part)
② Panel connection housing, SF_6-insulated
③ Panel connection for inside-cone plug-in system
④ Switchgear frame (lower part)
⑤ Floor of switchgear room
⑥ Voltage transformer, plug-in type
⑦ Solid-insulated bar
⑧ Gas-insulated bar

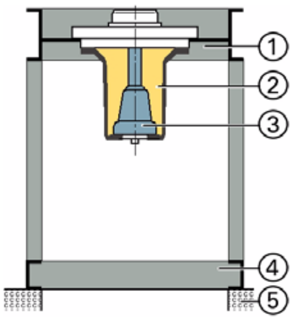


Fig. 10: Single cable connection, interface type 2

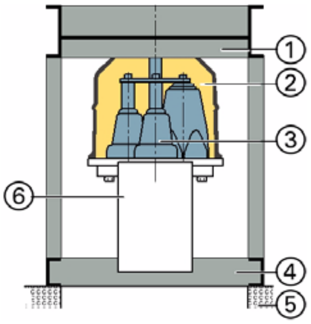


Fig. 11: Multiple cable connection with plug-in voltage transformer

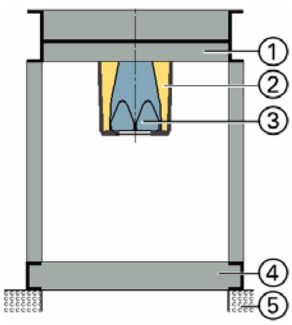


Fig. 12: Single cable connection, interface type 3

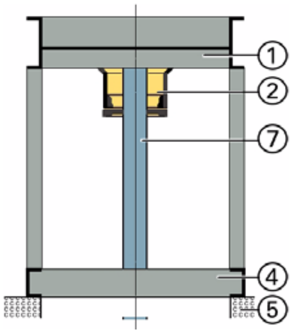


Fig. 13: Connection for solid-insulated bar 1)

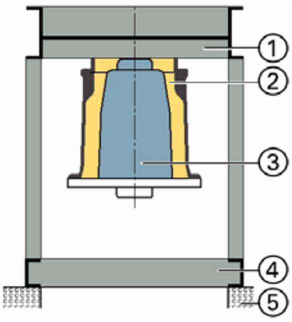


Fig. 14: Single cable connection, interface type 4

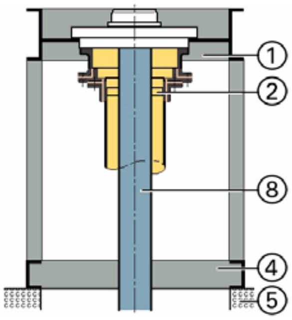


Fig. 15: Connection for gas-insulated bar 1)

1) Gas compartment sealed by the connection flange of the bar. Gas compartment is only filled at 10 kPa.

14 Technical data

14.1 Electrical data

Complete switchgear

	8DA10						8DA11 / 8DA12	
Rated								
voltage	kV	12	24	36	38	40.5	17.5	27.5
frequency	Hz	50/60	50/60	50/60	50/60	50/60	16.7	50/60
short-duration power-frequency withstand voltage	kV	28	50	70	80	85/95	50	95
lightning impulse withstand voltage	kV	75	125	170	200	185	125	200
short-circuit breaking current	max. kA	40	40	40	40	40	31.5	31.5
short-time withstand current 3s	max. kA	40	40	40	40	40	31.5	31.5
short-circuit making current	max. kA	100	100	100	105	100	80	80
peak withstand current	max. kA	100	100	100	100	100	80	80
normal current of busbar	max. A	3150	3150	3150	3150	3150	2500	2500
normal current of feeders	max. A	2000	2000	2000	2000	2000	2000	2000

14.2 Three-position disconnector

	8DA10						8DA11 / 8DA12	
Rated								
voltage	kV	12	24	36	38	40.5	17.5	27.5
short-duration power-frequency withstand voltage	kV	32	60	80	90	90/110	50	95
lightning impulse withstand voltage	kV	85	145	195	230	218	145	220

14.3 Vacuum circuit-breaker

Switching times

Switching times	Component		Duration	Unit
Closing time			95	ms
Charging time			<15	s
Opening time	Shunt release Additional release 3AX 11	(Y1) (Y2), (Y4),(Y7)	<70 <55	ms ms
Arcing time			<15	ms
Breaking time	Shunt release Additional release 3AX 11	(Y1) (Y2), (Y4),(Y7)	<85 <70	ms ms
Dead time			300	ms
Close-open contact time	Shunt release Additional release 3AX 11	(Y1) (Y2), (Y4),(Y7)	<90 <70	ms ms
Minimum command duration CLOSE OPEN OPEN	 Closing solenoid Shunt release Additional release 3AX 11	 (Y9) (Y1) (Y2), (Y4),(Y7)	 45 40 20	 ms ms ms
Short-time impulse duration of c.b. tripping signal	1st shunt release 2nd/3rd shunt release		15 10	m sms

Number of operating cycles

Rated normal current	10 000 times
Short-circuit breaking current	50 times

Closing time The interval of time between the initiation (command) of the closing operation and the instant when the contacts touch in all poles.

Opening time The interval of time between the initiation (command) of the opening operation and the instant when the contacts separate in all poles.

Arcing time The interval of time from the first initiation of an arc and the instant of final arc extinction in all poles.

Breaking time The interval of time between the initiation (command) of the opening operation and the instant of final arc extinction in the last quenching pole (= opening time and arcing time).

Close-open contact time The interval of time - in a make-break operating cycle - between the instant when the contacts touch in the first pole in the closing process, and the instant when the contacts separate in all poles in the subsequent opening process.

Motor operating mechanism The operating mechanisms of the 3AH vacuum circuit-breakers are suitable for auto-reclosing. For DC operation, the maximum power consumption is approx. 350 W. For AC operation, the maximum power consumption is approx. 400 VA.

The rated current of the motor protection equipment is shown in the following table:

Rated supply voltage	Recommended rated current for the protection equipment
DC 24	8
DC 48	6
DC 60	4
DC/AC 11050/60 Hz	2
DC 220/AC 23050/60 Hz	1.6
*) M.c.b. assembly type 8RL74 or m.c.b. with C-characteristic	

The supply voltage may deviate from the rated supply voltage specified in the table by -15% to +10%.

The breaking capacity of the auxiliary switch 3SV92 is shown on the following tables:

Breaking capacity	Operating voltage [V]	Normal current [A]	
AC 40 to 60 Hz	up to 230	10	
		Resistive load	Inductive load
DC	24	10	10
	48	10	9
	60	9	7
	110	5	4
	220	2.5	2

Closing solenoid (Y9)

The closing solenoid 3AY1510 closes the circuit-breaker. After completion of a closing operation, the closing solenoid is de-energised internally. It is available for AC or DC voltage. Power consumption: 140 W or 140 VA.

Shunt releases

The shunt releases are used for automatic and deliberate tripping of circuit-breakers. They are designed for connection to external voltage (DC or AC voltage). In special cases, for deliberate tripping, they can also be connected to a voltage transformer.

Shunt releases based on two different principles are used:

- The **shunt release (Y1)** 3AY1510 is used as standard in the basic circuit-breaker version. With this design, the circuit-breaker is opened electrically. Power consumption: 140 W or. 140 VA.
- The **shunt release (Y2)** 3AX1101 with energy store is fitted if more than one shunt release is required. With this design, the electrical opening command is transferred magnetically and thus, the circuit-breaker is opened. Power consumption: 70 W or 50 VA.

Undervoltage release

Undervoltage releases are tripped automatically through an electromagnet or deliberately. The deliberate tripping of the undervoltage release generally takes place via a NC contact in the tripping circuit or via a NO contact by short-circuiting the magnet coil. With this type of tripping, the short-circuit current is limited by the built-in resistors. Power consumption: 20 W or 20 VA.

Circuit-breaker tripping signal

When the circuit-breaker is tripped by a release (e.g. by protection tripping) there is a signal through the NO contact -S6. If the circuit-breaker is tripped deliberately with the mechanical pushbutton, this signal is suppressed by the NC contact -S7.

C.t-operated releases (Y6)

The following c.t.-operated releases are available:

- The c.t.-operated release **3AX1102** consists of an energy store, a latching mechanism and an electromagnetic system.Rated tripping current: 0.5 A/1 A
- The c.t.-operated release **3AX1104** (low-energy release) is adequate for a tripping pulse of ≤ 0.1 Ws in connection with adequate protection systems. It is used if auxiliary voltage is missing, tripping via protection relay.

Varistor module

ATTENTION!

Switching overvoltages can damage electronic control devices.

⇨ Do not switch off inductive consumers in DC circuits.

With the varistor module 3AX1526, the inductances of the circuit-breaker operating mechanism and the circuit-breaker control system (motor, closing solenoid, shunt release and auxiliary contactor) can be operated with DC. The module limits the overvoltage to approx. 500 V and is available for rated operating voltages from 60 V (DC) up to 220 V (DC). It contains two separate varistor circuits.

14.4 Insulating gas SF_6

Sulphur hexafluoride SF_6 according to IEC 60 376 is used as insulating gas.SF_6 insulates live parts between each other and against earth potential.

Features

- Non-toxic
- Odourless
- Colourless
- Non-inflammable
- Chemically neutral
- Electronegative
- Heavier than air

Filling degree of the pressure gas cylinders

1,04 kg SF_6 / litre cylinder volume (valid at a max. ambient temperature of + 65 °C).

Vapour pressure over liquid SF_6

In the supplied cylinders about 2/3 of the cylinder volume is liquid at + 20 °C, the rest is saturated SF_6-vapour.

Vapour pressure as a function of temperature

Temperature	Vapour pressure
+ 20 °C	2100 kPa
+ 30 °C	2700 kPa
+ 65 °C	7000 kPa(test pressure of cylinder)

Transport regulations

According to Annex 1 of the European agreement about international transportation of hazardous materials on the road (ADR), Siemens SF_6-gas insulated medium-voltage switchgear do not belong to the category of hazardous materials in respect of transportation, and are exempted from special transport regulations according to ADR, Clause 1.1.3.1 b).

Storage

Store the cylinders in vertical position in a cool place

Gas pressures in kPa at 20°C

	Busbar housing				
Rated feeder current [A] *	≤ 2500 *				
Rated busbar current [A] *	≤ 2500				3150
Rated voltage [kV]	≤ 36	40.5	36 to 40.5	40.5	≤ 40.5
Rated lightning impulse withstand voltage [kV]	≤ 170	185	200	185	≤ 200
Rated short-duration power-frequency withstand voltage [kV]	≤ 70	85	80	95	≤ 95
Rated operating pressure [kPa]	50	70	120		
Min. operating pressure [kPa]	30	50	100		
Signal "pressure drops" [kPa]	30	50	100		
Max. operating pressure [kPa]	90	120	180		
Signal "pressure increases" [kPa]	90	120	180		
All gas pressures are gauge pressures. The operating pressure depends on the temperature. The value can be corrected according to characteristics to suit the conditions at the place of installation. * Rated feeder current 2500 A only possible for disconnector panels. All other panel types only up to 2000 A.					

	Circuit-breaker housing				
Rated feeder current [A] *	≤ 1600	>1600 up to 2500 *	≤ 2500 *		
Rated busbar current [A] *	./.				
Rated voltage [kV]	≤ 36	≤ 36	40.5		36 to 40.5
Rated lightning impulse withstand voltage [kV]	≤ 170	≤ 170	185		200
Rated short-duration power-frequency withstand voltage [kV]	≤ 70	≤ 70	85	95	80
Rated operating pressure [kPa]	50	100		120	
Min. operating pressure [kPa]	30	80		100	
Signal "pressure drops" [kPa]	30	80		100	
Max. operating pressure [kPa]	90	150		180	
Signal "pressure increases" [kPa]	90	150		180	

All gas pressures are gauge pressures. The operating pressure depends on the temperature. The value can be corrected according to characteristics to suit the conditions at the place of installation.

* Rated feeder current 2500 A only possible for disconnector panels. All other panel types only up to 2000 A.

Gas pressure - temperature characteristics

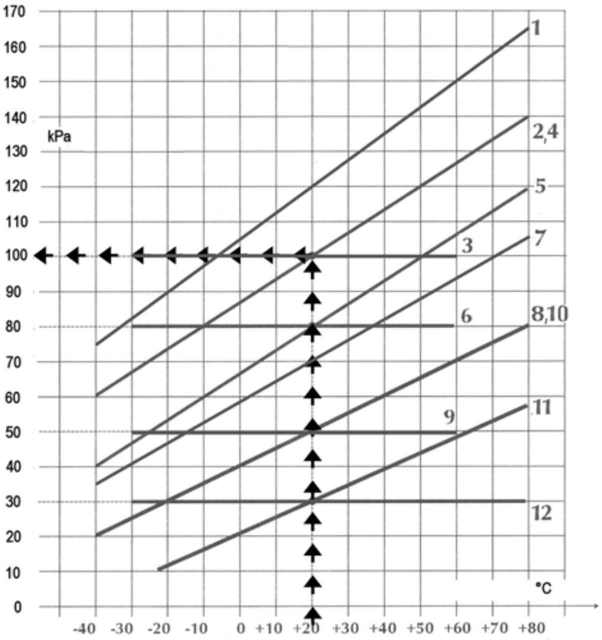


Fig. 16: Characteristics of gas pressure as a function of temperature

Example for 20°C

Rated operating pressure**		Min. operating pressure		Signal "pressure drops"	
Value at 20°C	Characteristic	Value at 20°C	Characteristic	Value at 20°C	Characteristic
120 kPa	No. 1	100 kPa	No. 2	100 kPa	No. 3
100 kPa	No. 4	80 kPa	No. 5	80 kPa	No. 6
70 kPa	No. 7	50 kPa	No. 8	50 kPa	No. 9
50 kPa	No. 10	30 kPa	No. 11	30 kPa	No. 12
Characteristic 1 = Characteristic 11, Characteristic 4 = Characteristic 8** Permissible deviation10 kPa					

14.5 Protection against ingress of solid foreign bodies, electric shock and water

The fixed-mounted circuit-breaker switchgear of the 8DA series complies with the following degrees of protection according to IEC 60529:

- IP3XD for external enclosure
- IP65 for parts under high voltage

Degree of protection	Type of protection
IP3XD	**Protection against ingress of solid foreign bodies:**Protected against ingress of solid foreign bodies, diameter ≥2.5 mm. **Protection against ingress of water:**No specification. **Protection against electric shock:**Protected against access to hazardous parts with a wire (test probe with diameter 1 mm, length 100 mm, must be sufficiently clear of hazardous parts).
IP65	**Protection against ingress of solid foreign bodies:**Dust-tight; protection against ingress of dust. **Protection against ingress of water:**Protected against water jets; water directed against the enclosure from any direction in the form of a jet must not have any harmful effect. **Protection against electric shock:**Protected against access to hazardous parts: Wire (test probe with diameter 1 mm) must not be allowed to ingress.

14.6 Basic prescriptions and standards

The fixed-mounted circuit-breaker switchgear 8DA10 for indoor installation complies with the following prescriptions and standards:

		IEC/EN Standard	**VDE Standard**
Switchgear		60 694	0670-1000
		62 271-200	0671-200
Switching devices	Circuit-breaker	62 271-100	0671-100
	Disconnector/earthing switch	62 271-102	0671-102
	Switch-disconnector	60 265	0670-301
	Switch-disconnector/fuse combination	62 271-105	0671-105
Voltage detection systems		61 243-5	0682-415
Surge arresters		60 099	0675
Degree of protection		60 529	0470-1
Instrument transformers	Current transformers	60 044-1	0414-1
	Voltage transformers	60 044-2	0414-2
	Combined transformers	60 044-3	0414-3
SF_6		60 376	0373-1
		60 480	0373-2
Installation		61 936-1	0101
Environmental conditions		60 721-3-3	DIN EN 60 721-3-3

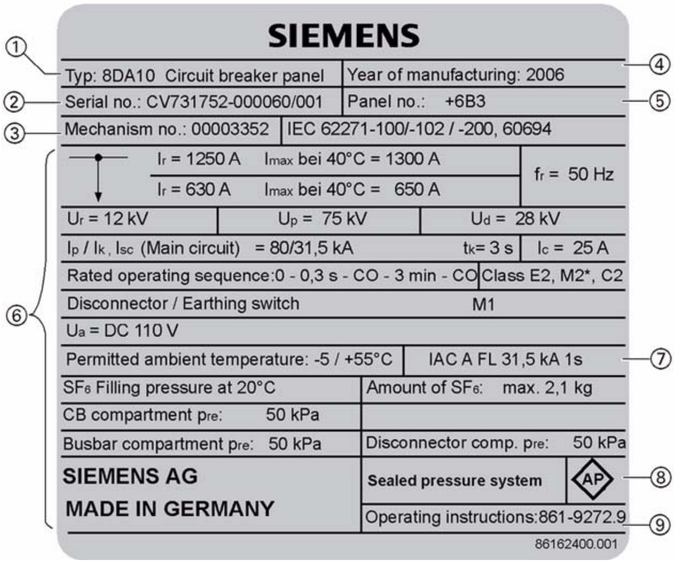
14.7 Special standards for railway switchgear

Additionally, the fixed-mounted circuit-breaker switchgear 8DA11 and 8DA12 corresponds to the following prescriptions and standards for railway applications:

	IEC Standard	EN Standard
Supply voltage	IEC 60850	EN 50163
Switchgear		EN 50152
Insulation coordination		EN 50124

14.8 Rating plates

Switchpanel The rating plate contains all information that is binding for the panel. It is provided on the inside of the door of the low-voltage compartment of each panel. If the circuit-breaker class is specified as M2*, a maximum of 30,000 (20,000 in railway switchgear) mechanical operating cycles are possible with the circuit-breaker. If the disconnector class is specified as M1**, a maximum of 3,000 mechanical operating cycles are possible with the disconnector in railway switchgear.



Typ: 8DA10 Circuit breaker panel | Year of manufacturing: 2006
Serial no.: CV731752-000060/001 | Panel no.: +6B3
Mechanism no.: 00003352 | IEC 62271-100/-102 / -200, 60694
I_r = 1250 A I_{max} bei 40°C = 1300 A
I_r = 630 A I_{max} bei 40°C = 650 A
f_r = 50 Hz
U_r = 12 kV | U_p = 75 kV | U_d = 28 kV
I_p / I_k, I_{sc} (Main circuit) = 80/31,5 kA | t_k= 3 s | I_c = 25 A
Rated operating sequence:0 - 0,3 s - CO - 3 min - CO | Class E2, M2*, C2
Disconnector / Earthing switch M1
U_a = DC 110 V
Permitted ambient temperature: -5 / +55°C | IAC A FL 31,5 kA 1s
SF_6 Filling pressure at 20°C | Amount of SF_6: max. 2,1 kg
CB compartment p_{re}: 50 kPa
Busbar compartment p_{re}: 50 kPa | Disconnector comp. p_{re}: 50 kPa
SIEMENS AG | Sealed pressure system
MADE IN GERMANY | Operating instructions:861-9272.9
86162400.001

①	Switchgear type
②	Serial number
③	Operating mechanism number
④	Year of manufacture
⑤	Panel number
⑥	Technical data
⑦	Internal arc classification
⑧	Pressure test mark of the SF_6-gas housing
⑨	Number of operating instructions for the panel

Fig. 17: Rating plate of switchgear

IAC classification This data (see item ⑦) describes the internal arc classification of the panel according to IEC 62271-200. The entries **IAC A FL 31.5 kA 1 s** in the example shown mean:

- **IAC:** Internal Arc Classification
- **A:** Degree of accessibility A; for authorised personnel only; switchgear in closed service location; access for expert personnel only.
- **F:** Internal arc classification for the front side (Front)
- **L:** Internal arc classification for the lateral surfaces (Lateral)
- **31,5 kA:** Tested short-circuit current
- **1 s:** Test duration

The IAC classification is referred to each panel. The data on the rating plate (see item ⑦) describes the areas classified for the corresponding panel.

15 Accessories

15.1 Standard accessories

- Operating and installation instructions
- Operating lever for three-position disconnector: DISCONNECTING function
- Operating lever for three-position disconnector: EARTHING/READY-TO-EARTH function
- Emergency operating lever for three-position disconnector
- Hand crank to charge the circuit-breaker closing spring
- Double-bit key

15.2 Other accessories

According to the order documents/purchase order (selection):

- Cable plugs / adapter systems
- Surge arresters / limiters
- Voltage detection system CAPDIS S1+/CAPDIS S2+
- LRM voltage indicators, plug-in type (e. g. make Horstmann)

- Test units to check the capacitive interface and the voltage indicators

- Phase comparison test units (e.g. make Pfisterer, type EPV)

Operation

⚠	**DANGER!**
	The internal arc classification of the switchgear according to IEC 62271-200 has only been proved by tests for the switchgear sides with internal arc classification and with closed high-voltage compartments. ⇨ Determine the IAC classification of the switchgear by means of the data on the rating plate (see Page 26, "Rating plates"). ⇨ Regulations for access to switchgear areas without internal arc classification according to IEC 62271-200 must be defined by the entrepreneur or the switchgear owner.

16 Control elements and indicators

Overview

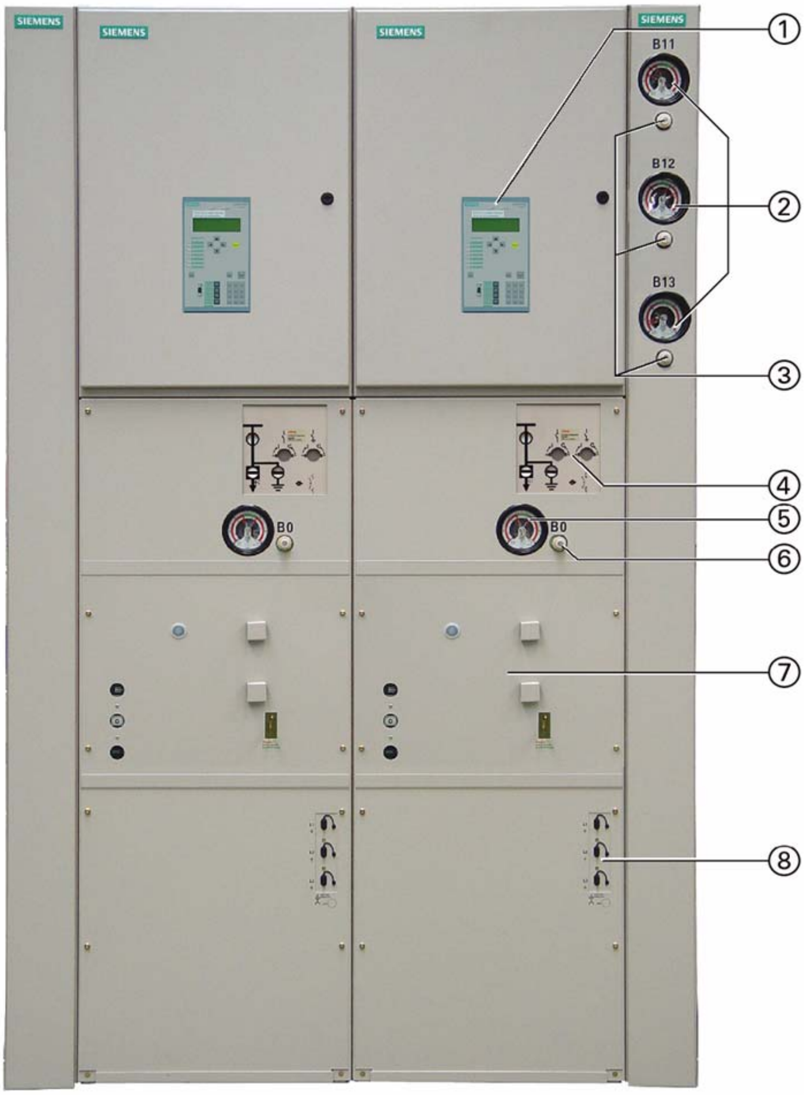


Fig. 18: Control elements and indicators of the circuit-breaker panel

① SIPROTEC protection and control unit (option)

② Manometer for gas compartment monitoring of busbar gas compartments L1, L2, L3

③ Filling socket for busbar gas compartments L1, L2, L3

④ Control and indication board for three-position disconnector

⑤ Manometer for gas compartment monitoring of feeder gas compartments

⑥ Filling socket for feeder gas compartments

⑦ Control and indication board for circuit-breaker

⑧ Sockets for LRM voltage detection system

Operating tools The operating levers for the three-position disconnector functions DISCONNECTING and READY-TO-EARTH have a slot and a nose, which are arranged in such a way that the levers can only be used for their respective function. The emergency operating lever only has a slot, and may exclusively be used as described (see Page 38, "Emergency operation of the three-position disconnector").

Fig. 19: Operating lever forDISCONNECTING function

Fig. 20: Operating lever forREADY-TO-EARTH function (cross bar marked red)

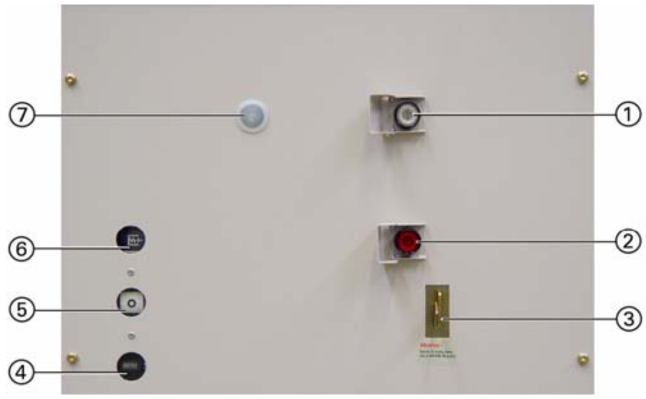
Fig. 21: Emergency operating lever

Fig. 22: Hand crank to charge the closing spring

Fig. 23: Double-bit key 5 mm

17 Operating the circuit-breaker

Circuit-breaker control board



① ON pushbutton
② OFF pushbutton
③ "Feeder earthed" locking device
④ Operating cycle counter
⑤ Switch position indicator forcircuit-breaker
⑥ "Closing spring charged / not charged" indicator
⑦ Opening to charge the closing spring manually

Fig. 24: Circuit-breaker control board

17.1 Closing the circuit-breaker manually

Preconditions

- "Feeder earthed" locking device is open
- Closing spring is charged

⇨ Operate the ON pushbutton in the circuit-breaker control board.

✔ The switch position indicator changes to "I" position. The circuit-breaker is closed.

17.2 Opening the circuit-breaker manually

If the control voltage fails, the circuit-breaker can only be opened mechanically by hand.

NOTE!

If the feeder is earthed through the three-position disconnector and the circuit-breaker, all electrical OFF signals are ineffective.

Preconditions

- "Feeder earthed" locking device is open

DANGER!

If the "feeder earthed" locking device is padlocked, the circuit-breaker cannot be opened, neither electrically nor mechanically.

⇨ Padlock only if the feeder is earthed.

⇨ Operate the OFF pushbutton in the circuit-breaker control board.

✔ The circuit-breaker is open.

17.3 Recommendation for sealing the pushbuttons

ATTENTION!

If you close manually, all electrical and mechanical interlocks are ineffective.

⇨ To guarantee safe operation of the interlocks:Seal/lock the pushbuttons (see table below).

Recommendation for sealing/locking

Panel types	Sealing
Incoming or outgoing feeder panels	ON pushbutton
Bus sectionaliser panels	ON pushbutton and OFF pushbutton

17.4 Test operation without auxiliary voltage

ATTENTION!

On circuit-breakers with undervoltage release 3AX1103:If the retaining screw of the striker pin is not set back from position B to position A after the test operation without auxiliary voltage, the undervoltage release will not function.

⇨ After the test operation without auxiliary voltage, set the retaining screw of the striker pin back from position B to position A.

Perform the following actions to guarantee that the circuit-breaker is ready for operation:

⇨ Charge the closing spring (see Page 33, "Charging the closing spring manually").

⇨ Operate the ON pushbutton in the circuit-breaker control board.
✔ The circuit-breaker is closed.

⇨ Operate the OFF pushbutton in the circuit-breaker control board.
✔ The circuit-breaker is open.

⇨ Set the retaining screw of the striker pin from position A to B.

17.5 Test operation with auxiliary voltage (motor operating mechanism)

⇨ Switch on the supply voltage.
✔ The motor operating mechanism starts up and charges the closing spring.

⇨ Check whether the "closing spring charged" indication appears.

⇨ Operate the ON pushbutton in the circuit-breaker control board.
✔ The closing spring is charged by the motor.

⇨ Check whether the switch position "circuit-breaker CLOSED" appears.

⇨ Operate the OFF pushbutton in the circuit-breaker control board.

⇨ Check whether the switch position "circuit-breaker OPEN" appears.

17.6 Charging the closing spring manually

The closing spring is charged by the motor after applying the control voltage. The energy required for the switching sequence OPEN-CLOSED-OPEN (auto-reclosing) is stored in the closing spring about 15 seconds after closing the circuit-breaker.

Fig. 25: "Closing spring charged" indication

Fig. 26: "Closing spring not charged" indication

The hand crank is required to charge the closing spring manually if the control voltage fails.

DANGER!

Risk of injury by sudden rotation of hand crank. If you use a hand crank **without a freewheel** to charge the spring, the hand crank will rotate when the control voltage is switched on again (motor starts up) and can lead to injury.

⇨ Use special hand crank **with freewheel** from the accessories.

⇨ Remove cover from cutout.

⇨ Insert hand crank.

⇨ Turn hand crank clockwise approx. 30 turns until the indication "closing spring charged" appears.

⇨ Remove hand crank.

⇨ Close cutout with cover.

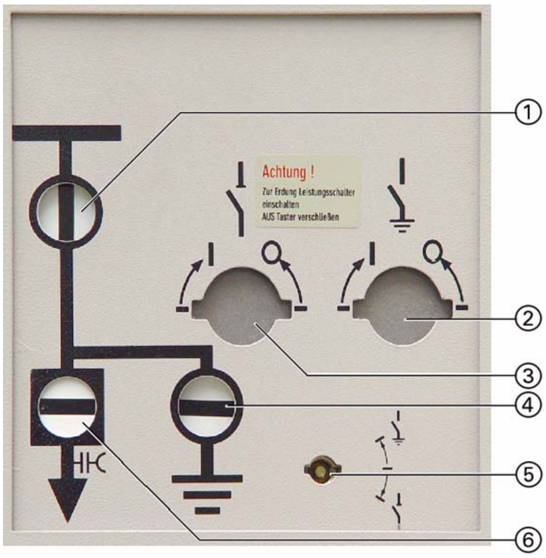
18 Three-position disconnector operation

The procedures described in this section apply to:
- Disconnectable voltage transformers or disconnectable busbar connections

- Top-mounted bus sectionaliser
- Switching operations on circuit-breaker panels
- Switching operations on bus sectionaliser panels

18.1 Control elements and indicators

Control board on the switchgear front



① Switch position indicator for three-position disconnector (DISCONNECTING function)

② Actuating opening for earthing switch (EARTHING/READY-TO-EARTH function)

③ Actuating opening for disconnector (DISCONNECTING function)

④ Switch position indicator for three-position disconnector (EARTHING/READY-TO-EARTH function)

⑤ Opening for selector key

⑥ Switch position indicator for circuit-breaker

Fig. 27: Control board on the switchgear front

The manual switching operations DISCONNECTING or READY-TO-EARTH must be preselected with a double-bit key. Pre-selection is only possible if the associated switching operation is permissible.

Switch position indicator at the rear

The position of the three-position disconnector is indicated both at the front and at the rear of the switchgear. The switch position indicator at the rear is located on the side of the outermost busbar housing, over the circuit-breaker housing.

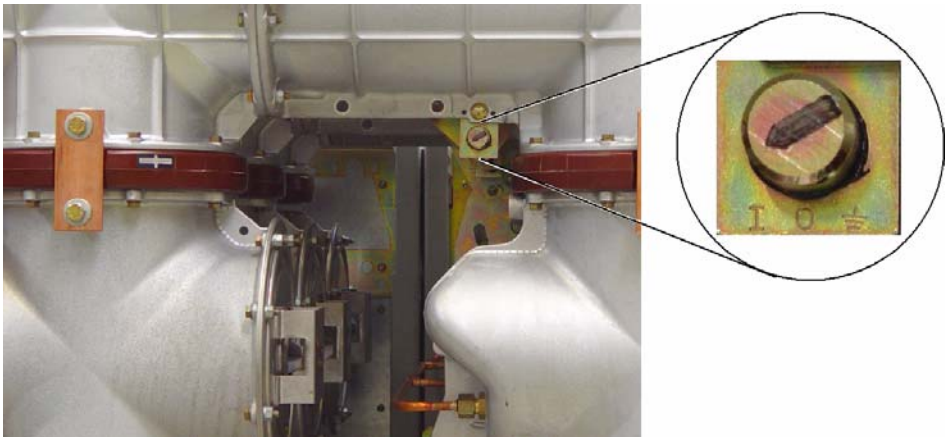


Fig. 28: Switch position indicator at the rear

18.2 Closing the three-position disconnector manually

	ATTENTION!
⚠	In circuit-breaker panels, a mechanical interlock prevents the three-position disconnector from being operated under load. ⇨ Open the circuit-breaker (see Page 31, "Opening the circuit-breaker manually").

	ATTENTION!
⚠	In disconnector panels without electromechanical/mechanical interlock, maloperation of the three-position disconnector is possible. Here, the three-position disconnector can be operated under load. Operating under load will destroy the three-position disconnector! ⇨ Do not operate the three-position disconnector under load.

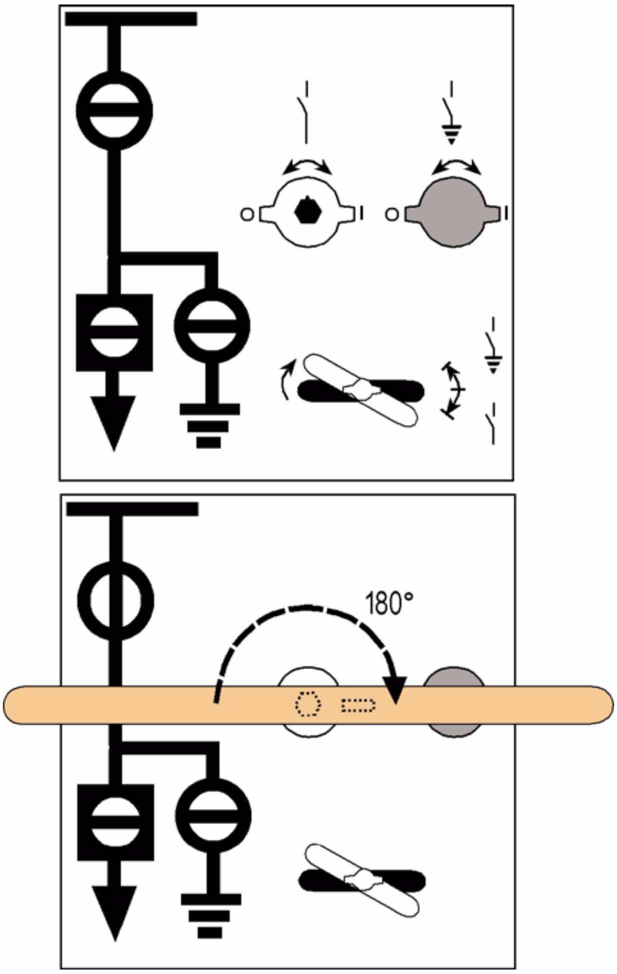


Fig. 29: Closing the three-position disconnector

⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **clockwise** as far as it will go.

✔ The opening for the DISCONNECTING function is free.

⇨ Hold the lever for the DISCONNECTING function in horizontal position (nose on the left) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the DISCONNECTING function 180° **clockwise** (nose on the right).

✔ The three-position disconnector is closed.The switch position indicator changes to CLOSED position.

⇨ Remove the operating lever for the DISCONNECTING function.

⇨ Turn the double-bit key **counter-clockwise** and remove it.

✔ The opening for the DISCONNECTING function is closed.

18.3 Opening the three-position disconnector manually

⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **clockwise** as far as it will go.

✔ The opening for the DISCONNECTING function is free.

⇨ Hold the lever for the DISCONNECTING function in horizontal position (nose on the right) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the DISCONNECTING function 180° **counter-clockwise** (nose on the left).

✔ The three-position disconnector is open.The switch position indicator changes to OPEN position.

⇨ Remove the operating lever for the DISCONNECTING function.

⇨ Turn the double-bit key **counter-clockwise** and remove it.

✔ The opening for the DISCONNECTING function is closed.

18.4 Activating the ready-to-earth function manually

ATTENTION!

In circuit-breaker panels, a mechanical interlock prevents the three-position disconnector from being operated under load.

⇨ Open the circuit-breaker (see Page 31, "Opening the circuit-breaker manually").

ATTENTION!

In disconnector panels without electromechanical/mechanical interlock, maloperation of the three-position disconnector is possible. Here, the three-position disconnector can be operated under load. Operating under load will destroy the three-position disconnector!

⇨ Do not operate the three-position disconnector under load.

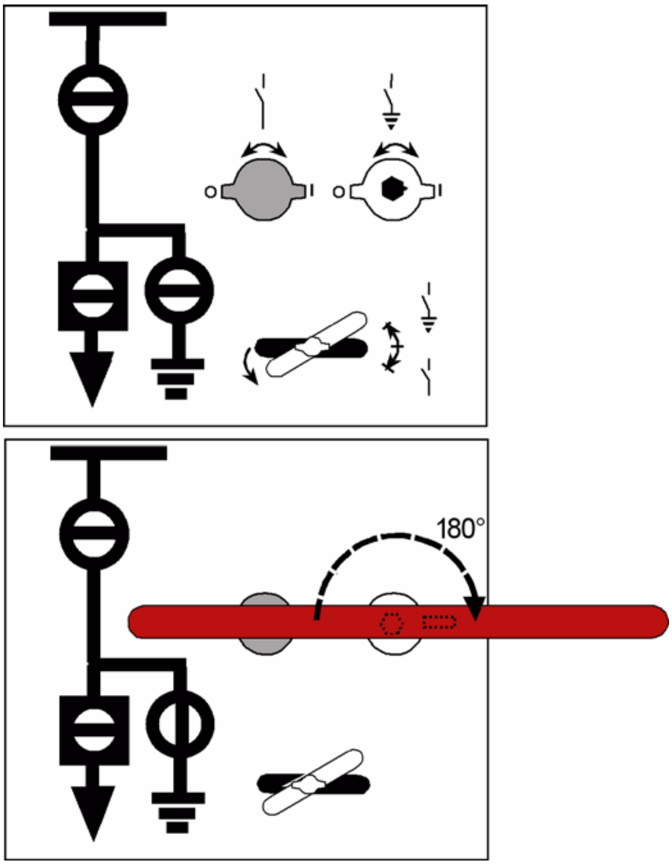


Fig. 30: Operating the three-position disconnector for the READY-TO-EARTH function

➪ Insert the double-bit key and turn **counter-clockwise**.

✔ The opening for the READY-TO-EARTH function is free.

➪ Hold the operating lever for the READY-TO-EARTH function in horizontal position (nose on the left) and push it onto the hexagonal shaft as far as it will go.

➪ Turn the operating lever for the READY-TO-EARTH function 180° **clockwise**.

✔ The nose of the operating lever for the READY-TO-EARTH is on the right and the READY-TO-EARTH function is established.The switch position indicator changes to READY-TO-EARTH position.

➪ Remove the operating lever for the READY-TO-EARTH function.

➪ Turn the double-bit key **clockwise** and remove it.

✔ The opening for the READY-TO-EARTH function is closed.

DANGER!

Danger! High voltage!The earthing process is **not** completed until the circuit-breaker is closed.

➪ Close the circuit-breaker after having switched the three-position disconnector to READY-TO-EARTH position.

18.5 Deactivating the ready-to-earth function

➪ Open the circuit-breaker see Page 31, "Opening the circuit-breaker manually".

⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **counter-clockwise** as far as it will go.
✔ The opening for the READY-TO-EARTH function is free.

⇨ Hold the operating lever for the READY-TO-EARTH function in horizontal position (nose on the right) and push it onto the hexagonal shaft as far as it will go.

⇨ Turn the operating lever for the READY-TO-EARTH function 180° **counter-clockwise** (nose on the left).
✔ The three-position disconnector is open.The switch position indicator changes to OPEN position.

⇨ Remove the operating lever for the READY-TO-EARTH function.

⇨ Turn the double-bit key **clockwise** and remove it.
✔ The opening for the READY-TO-EARTH function is closed.

18.6 Three-position disconnector with auxiliary voltage (motor operating mechanism)

Three-position disconnectors with motor operating mechanism can also be controlled from remote according to their design.

18.7 Emergency operation of the three-position disconnector

If the motor voltage of the three-position disconnector with motor operating mechanism fails, and the three-position disconnector is in no defined end position, you must operate the three-position disconnector manually with the emergency operating lever.

Emergency operation of the DISCONNECTING function

ATTENTION!

The emergency operating lever does not have a stop. Switching with the emergency operating lever beyond the end position of the DISCONNECTING function of the three-position disconnector will damage the three-position disconnector.

⇨ Do not turn the emergency operating lever beyond the horizontal position.

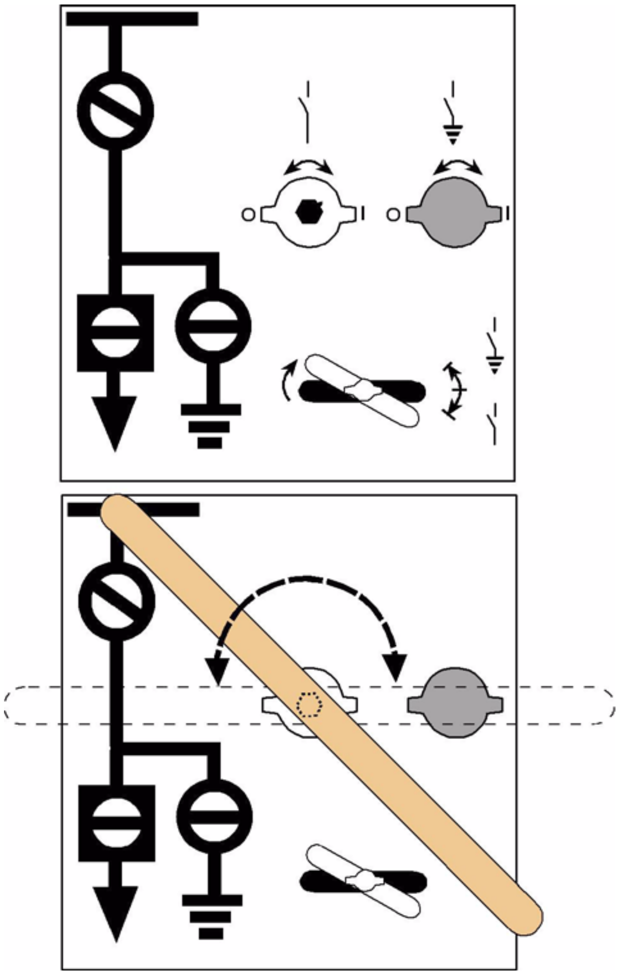


Fig. 31: Emergency operation of the DISCONNECTING function of the three-position disconnector

- ➪ Insert the double-bit key.
- ➪ Turn the double-bit key **clockwise** and remove it.
- ✔ The opening for the DISCONNECTING function is free.

- ➪ Push the emergency operating lever onto the hexagonal shaft for the DISCONNECTING function so that the pin of the hexagonal shaft fits in the slot of the emergency operating lever.

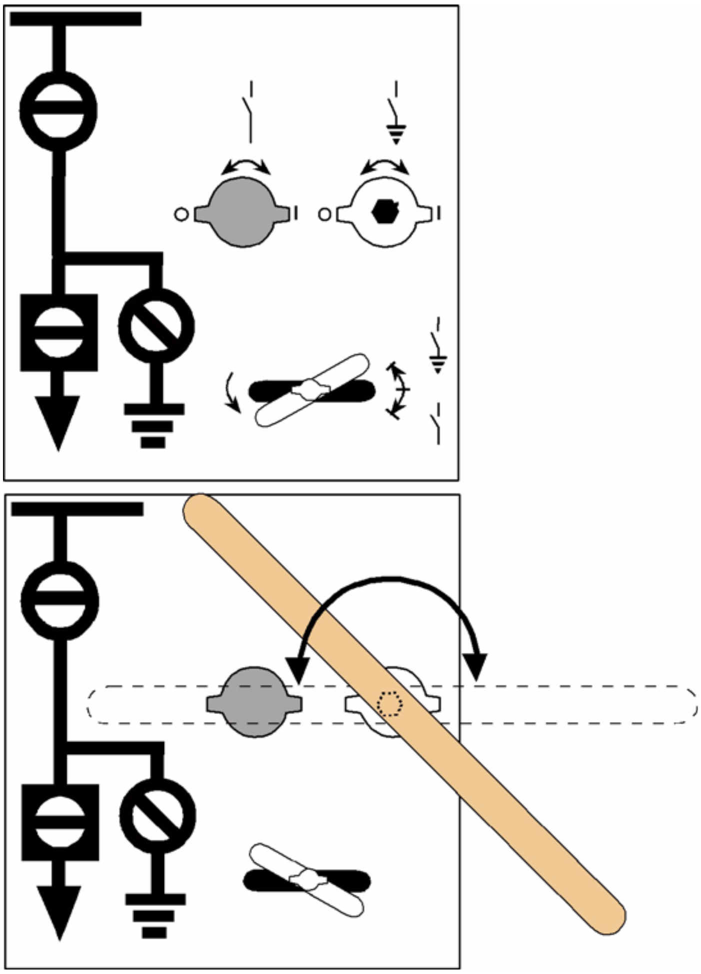
To switch the DISCONNECTING function of three-position disconnector to the desired end position (CLOSED or OPEN), perform the following actions:

- ➪ Turn the emergency operating lever until the switch position indicator changes to CLOSED or OPEN position.
- ✔ The emergency operating lever is in **horizontal** position, the marking of the slot is **at the bottom**: The three-position disconnector is in **CLOSED** position.Or:The emergency operating lever is in **horizontal** position, the mark of the slot is **at the top**: The three-position disconnector is in **OPEN** position.

- ➪ Remove the emergency operating lever.
- ➪ Turn the double-bit key **counter-clockwise** and remove it.
- ✔ The opening for the DISCONNECTING function is closed.

Emergency operation of the READY-TO-EARTH function

	ATTENTION!
⚠	The emergency operating lever does not have a stop. Switching with the emergency operating lever beyond the end position of the READY-TO-EARTH function of the three-position disconnector will damage the three-position disconnector. ⇨ Do not turn the emergency operating lever beyond the vertical position.



⇨ Insert the double-bit key.

⇨ Turn the double-bit-key **counter-clockwise** as far as it will go.

✔ The opening for the READY-TO-EARTH function is free.

⇨ Push the emergency operating lever onto the hexagonal shaft for the READY-TO-EARTH function so that the pin of the hexagonal shaft fits in the slot of the emergency operating lever.

To switch the the READY-TO-EARTH function of the three-position disconnector to the desired end position (READY-TO-EARTH or OPEN), perform the following actions:

⇨ Turn the emergency operating lever until the switch position indicator changes to READY-TO-EARTH or OPEN position.

✔ The emergency operating lever is in **vertical** position, the marking of the slot is **on the left**: The three-position disconnector is in **READY-TO-EARTH** position.Or:The emergency operating lever is in **vertical** position, the marking of the slot is **on the right**: The three-position disconnector is in **OPEN** position.

⇨ Remove the emergency operating lever.

⇨ Turn the double-bit key **clockwise** and remove it.

✔ The opening for the READY-TO-EARTH function is closed.

Switching operations after emergency operation

⇨ Perform further manual switching operations only with the associated operating levers for the DISCONNECTING or READY-TO-EARTH functions.

19 Feeder earthing and de-earthing

DANGER!

High voltage! Danger!Do always observe the Five Safety Rules:

⇨ Isolate the switchgear.

⇨ Secure against reclosing.

⇨ Verify safe isolation from supply.

⇨ Earth and short-circuit.

⇨ Cover or barrier adjacent live parts.

DANGER!

Danger! High voltage!The earthing process is **not** completed until the circuit-breaker is closed.

⇨ Close the circuit-breaker after having switched the three-position disconnector to READY-TO-EARTH position.

ATTENTION!

Earthing under load will destroy the three-position disconnector.

⇨ Open the circuit-breaker see Page 31, "Opening the circuit-breaker manually".

⇨ Make sure that the feeder is isolated from supply.

19.1 Feeder earthing

ATTENTION!

If the "feeder earthed" locking device is padlocked, the circuit-breaker cannot be opened, neither electrically nor mechanically.

⇨ Fit the padlock only if the feeder is earthed.

⇨ Switch the three-position disconnector to READY-TO-EARTH position see Page 36, "Activating the ready-to-earth function manually".

⇨ Close the circuit-breaker (see Page 31, "Closing the circuit-breaker manually").

⇨ Pull the moving part of the "feeder earthed" locking device upwards.

⇨ Padlock the locking device.

19.2 Feeder de-earthing

⇨ Remove the padlock at the “feeder earthed” locking device.

✔ The moving part of the locking device folds downwards automatically.

NOTE!

In circuit-breaker operating mechanisms with undervoltage release, the circuit-breaker trips automatically after removing the padlock if

⇨ the panel is earthed and

⇨ auxiliary voltage is available.

⇨ Open the circuit-breaker (see Page 31, "Opening the circuit-breaker manually").

⇨ Switch the three-position disconnector to OPEN position (see Page 36, "Opening the three-position disconnector manually ").

20 Operation of the busbar earthing switch

20.1 Control elements and indicators

① Additional compartment for busbar earthing switch drive

② Switch position indicator

③ Actuating opening

④ Operating spindle at the operating lever

⑤ Setscrew at the operating spindle

Fig. 32: Manual operating mechanism for busbar earthing switch

Fig. 33: Operating lever for busbar earthing switch

The busbar earthing switch is equipped with a high-speed closing facility for make -proof earthing of the busbar.

The cover of the actuating opening is padlocked mechanically or interlocked electromechanically. The opening for inserting or removing the operating lever is only released if the busbar earthing switch is in a defined end position.

If the space in the switchgear room is limited, you can undo the setscrew and change the position of the operating spindle at the operating lever by 45°.

20.2 Closing

	DANGER!
⚠	High voltage! Danger!By no means may the busbar make-proof earthing switch be operated under load, as it will be destroyed in case of repetition. ⇨ Observe the Five Safety Rules. ⇨ Disconnect the incoming and outgoing feeders in all panels.

	ATTENTION!
⚠	The electromechanical interlock can be deactivated if the operating lever is not removed after a switching operation. ⇨ Remove the operating lever after every switching operation.

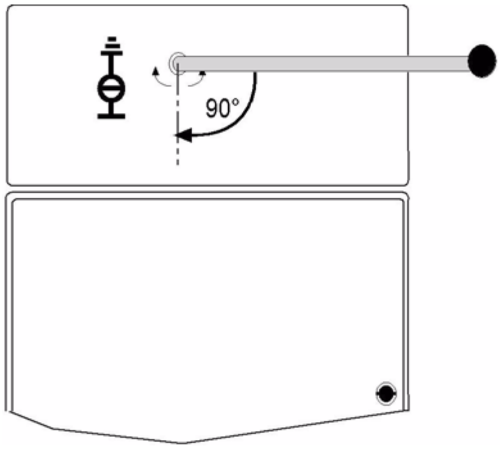


Fig. 34: Closing the busbar earthing switch

⇨ Hold the operating lever in horizontal position.

⇨ Insert the operating lever in the actuating opening as far as it will go.

⇨ Press the operating lever into the actuating opening with one hand over the operating spindle, and move it downwards by 90° with the other hand as far as it will go.

⇨ Remove the operating lever.

⇨ In case of mechanical interlock: Fit a padlock.

✔ The busbar earthing switch is closed.

20.3 Opening

⚠	**DANGER!**
	Avoid any intermediate position of the busbar make-proof earthing switch during the opening process. Reversal will not be possible! ⇨ Perform the opening operation continuously and up to the end position. ⇨ Do not use force (torque approx. 140 Nm).

⚠	**ATTENTION!**
	The electromechanical interlock can be deactivated if the operating lever is not removed after a switching operation. ⇨ Remove the operating lever after every switching operation.

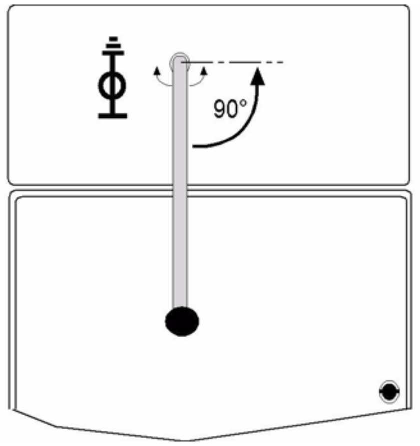


Fig. 35: Opening the busbar earthing switch

⇨ Hold the operating lever in vertical position.

⇨ Insert the operating lever in the actuating opening as far as it will go.

⇨ Press the operating lever into the actuating opening with one hand over the operating spindle, and move it upwards by 90° with the other hand as far as it will go.

⇨ Remove the operating lever.

⇨ In case of mechanical interlock: Fit a padlock.

✔ The busbar earthing switch is open.

21 Interlocks

Switching devices may only be controlled and operated in logical dependence on the switch position of other devices. Unpermissible switching operations must be blocked in order to

- provide full protection for the personnel,
- prevent switchgear damages and power failures.

The interlocks are mainly of the mechanical type.

Interlocking conditions

Feeder and circuit-breaker panel of bus sectionaliser		
Switching operation	Switching operation only possible if	Type
Disconnector CLOSED/OPEN	circuit-breaker OPEN earthing switch OPEN	mechanicalmechanical
Earthing switch CLOSED/OPEN	circuit-breaker OPEN disconnector OPEN	mechanicalmechanical
Circuit-breaker CLOSED	disconnector or earthing switchnot in intermediate position (shutter closed)	mechanical
Circuit-breaker OPEN	not locked by a locking device	mechanical
Additionally, electromechanical interlocks may be fitted for disconnectors and earthing switches or for earthing switches.		

Bus riser of bus sectionaliser / Disconnectable busbar connection / Top-mounted busbar sectionaliser		
Switching operation	Switching operation only possible if	Type
Disconnector CLOSED/OPEN	associated circuit-breaker OPENearthing switch OPEN	electromechanicalmechanical
Earthing switch CLOSED/OPEN	associated circuit-breaker OPENdisconnector OPEN	electromechanicalmechanical
Additionally, electromechanical interlocks may be fitted for disconnectors and earthing switches or for earthing switches.		

Disconnectable busbar voltage transformer		
Switching operation	Switching operation only possible if	Type
Disconnector CLOSED/OPEN	earthing switch OPEN	mechanical
Earthing switch CLOSED/OPEN	disconnector OPEN	mechanical
Additionally, electromechanical interlocks may be fitted for disconnectors and earthing switches or for earthing switches.		

Busbar earthing switch		
Switching operation	Switching operation only possible if	Type
Earthing switch CLOSED/OPEN	opening for operating lever open	optionally mechanical or electromechanical

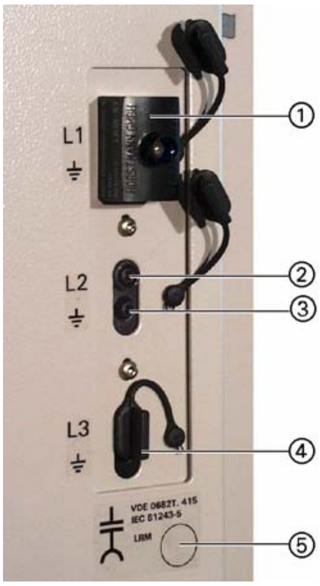
22 Verification of safe isolation from supply

The panels are equipped with voltage detection systems.

Use voltage indicators according to IEC 61 243-5 or DIN VDE 0682-415 only.

The function of the voltage indicator must have been checked:
- with test unit according to IEC 61 243-5 or DIN VDE 0682-415
- on live equipment

The function of the coupling section must have been checked:
- IEC 61 243-5 or DIN VDE 0682-415



①	Voltage indicator type LRM, make Horstmann
②	Interface (capacitive test socket) for L2
③	Earthing socket
④	Cover of test sockets
⑤	Documentation of the repeat test of the interface condition

Fig. 36: Verification of safe isolation from supply

⇨ Remove the covers from the interface (capacitive test sockets L1, L2, L3).

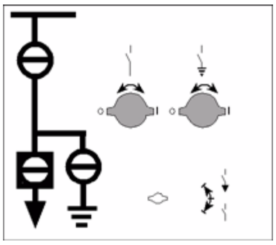
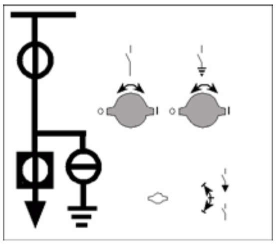
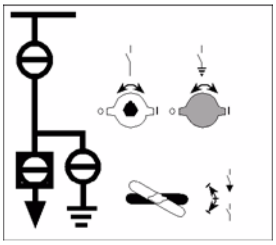
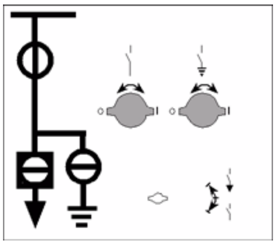
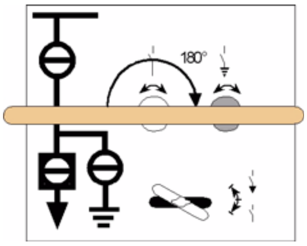
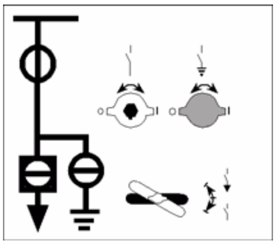
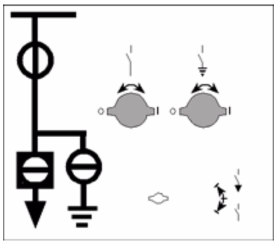
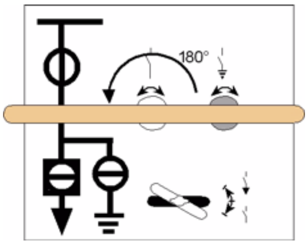
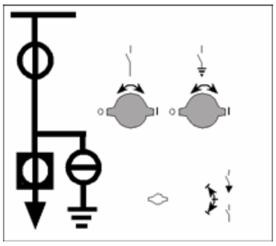
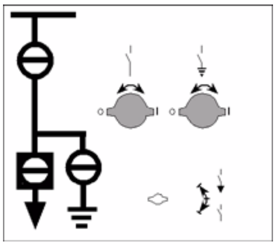
⇨ Plug the voltage indicator in all three phases L1, L2, L3 of the interface.

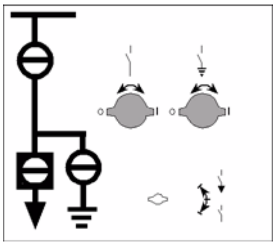
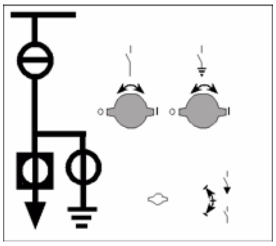
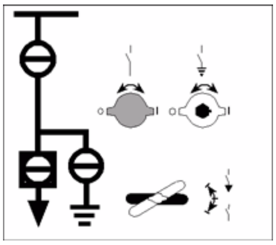
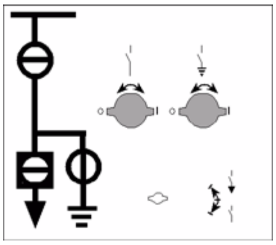
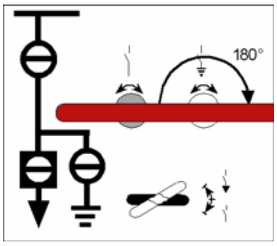
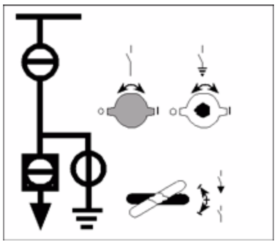
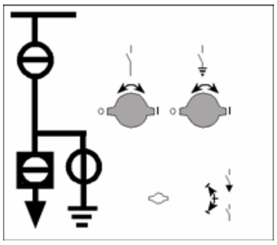
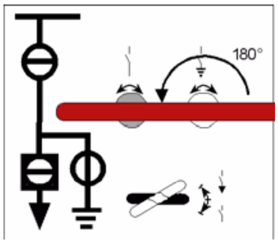
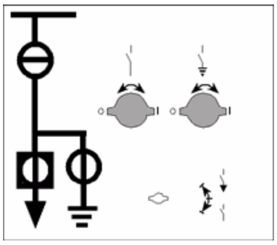
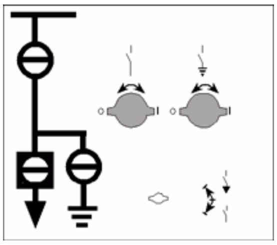
✔ If the indicator does not flash or light up in **any** of the three test sockets, the phases are not live.

⇨ Replace the covers on the interface.

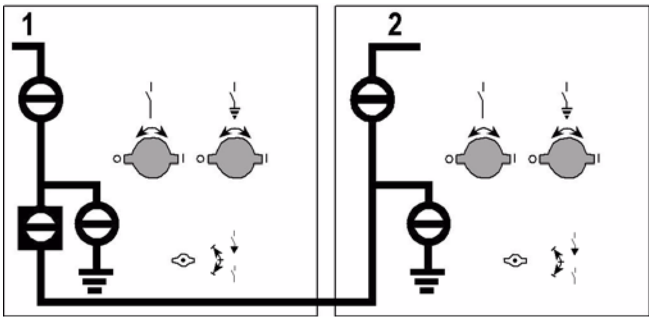
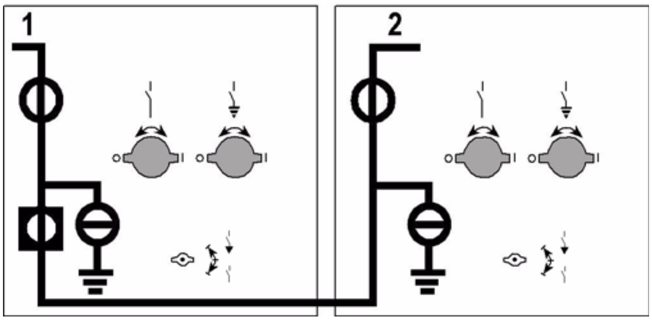
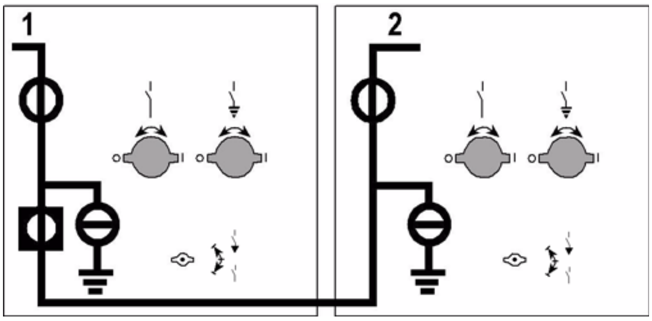
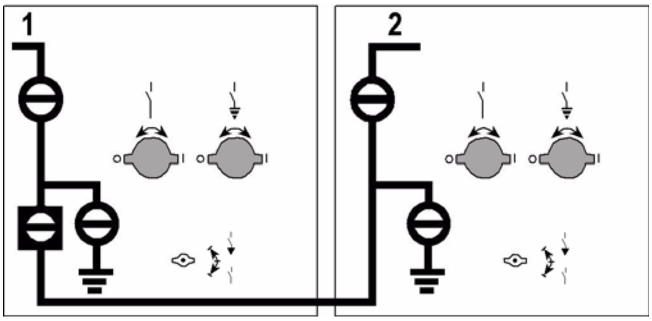
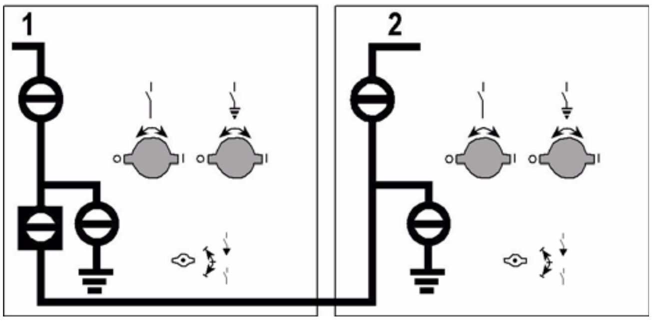
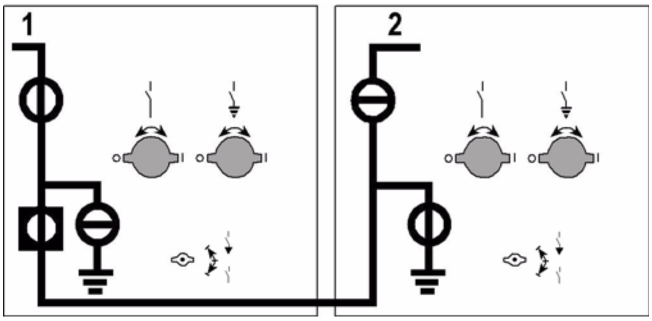
23 Overview of switching operations

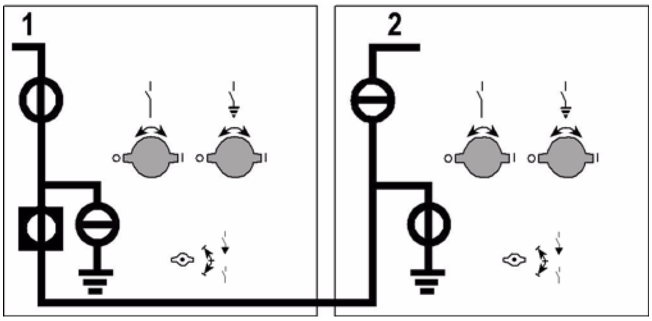
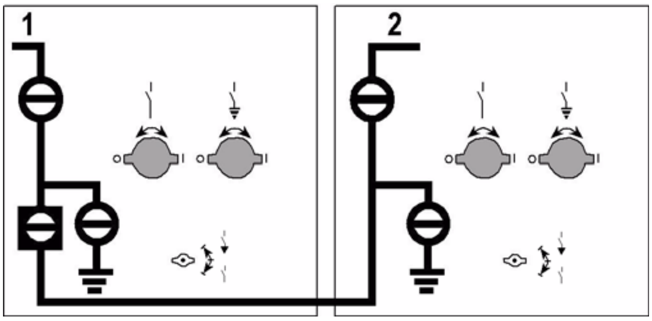
23.1 Switching operations in the circuit-breaker panel

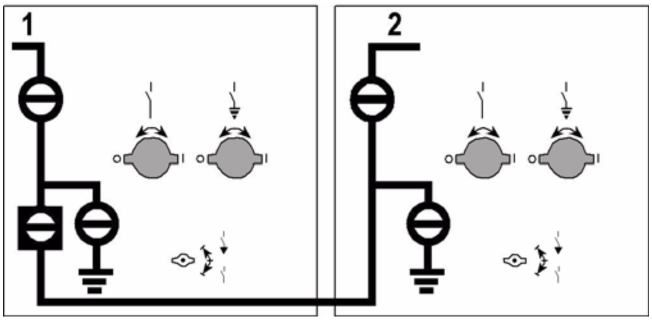
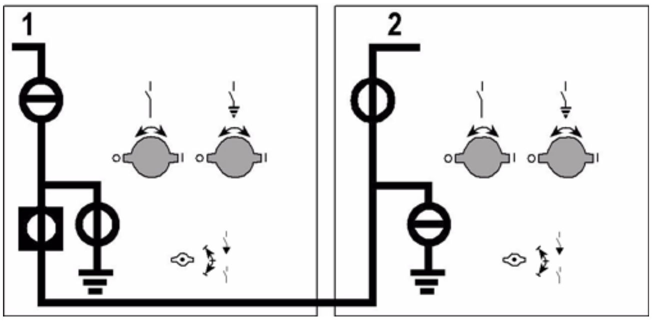
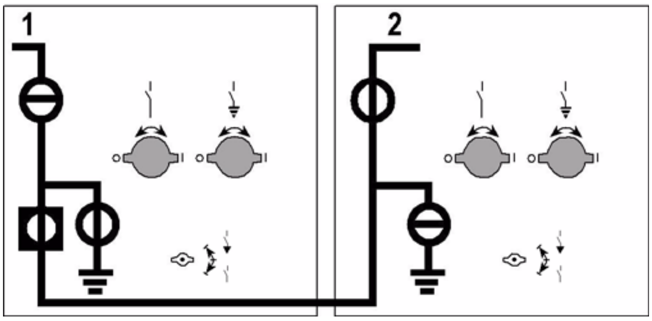
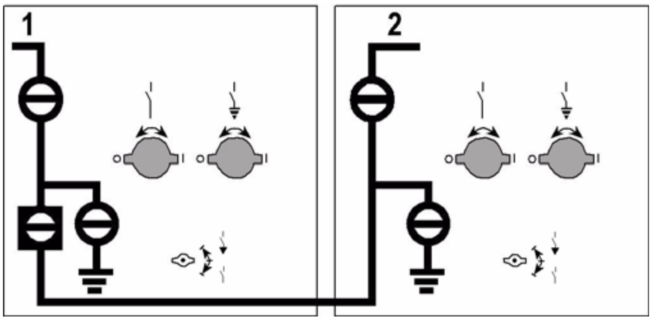
Connecting feeder with busbar	Disconnecting feeder from busbar
1  Initial situation	**1**  Initial situation
2  1. Insert double-bit key. 2. Turn clockwise. Opening for DISCONNECTING function is free.	**2**  1. Open the circuit-breaker.
3  1. Hold operating lever for DISCONNECTING in horizontal position (nose on the left) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever forDISCONNECTING function 180° clockwise.	**3**  1. Insert double-bit key. 2. Turn clockwise. Opening for DISCONNECTING function is free.
4  1. Remove operating lever for DISCONNECTING function. 2. Turn double-bit key counter- clockwise and remove it. Opening for DISCONNECTING function is closed.	**4**  1. Hold operating lever for DISCONNECTING in horizontal position (nose on the right) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever forDISCONNECTING function 180° counter-clockwise.
5  1. Close the circuit-breaker. The feeder is connected with the busbar.	**5**  1. Remove operating lever forDISCONNECTING function. 2. Turn double-bit key counter- clockwise and remove it. Opening for DISCONNECTING function is closed. The feeder is disconnected from the busbar.

Feeder earthing	**Feeder de-earthing**
1  Initial situation	**1**  Initial situation
2  1. Insert double-bit key. 2. Turn counter-clockwise. Opening for READY-TO-EARTH function is free.	**2**  1. Remove padlock at "feeder earthed" locking device. 2. Open the circuit-breaker.
3  1. Hold operating lever for READY-TO-EARTH in horizontal position (nose on the left) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever forREADY-TO-EARTH function 180° counter-clockwise.	**3**  1. Insert double-bit key. 2. Turn counter-clockwise. Opening for READY-TO-EARTH function is free.
4  1. Remove operating lever for READY-TO-EARTH function. 2. Turn double-bit key clockwise and remove it. Opening for READY-TO-EARTH function is closed.	**4**  1. Hold operating lever for READY-TO-EARTH in horizontal position (nose on the right) and push onto hexagonal shaft as far as it will go. 2. Turn operating lever forREADY-TO-EARTH function 180° clockwise.
5  1. Close the circuit-breaker. 2. Padlock "feeder earthed" locking device. Opening for READY-TO-EARTH function is closed. The feeder is earthed.	**5**  1. Remove operating lever for READY-TO-EARTH function. 2. Turn double-bit key clockwise and remove it. Opening for READY-TO-EARTH function is closed. The feeder is de-earthed.

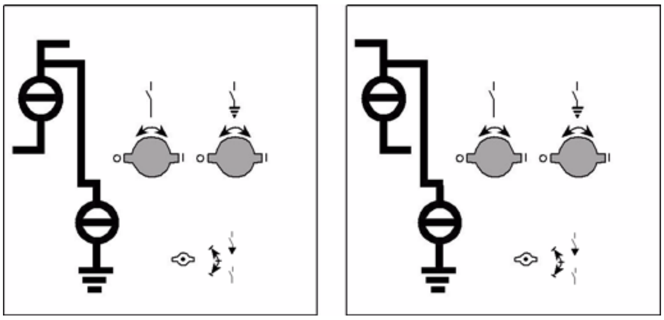
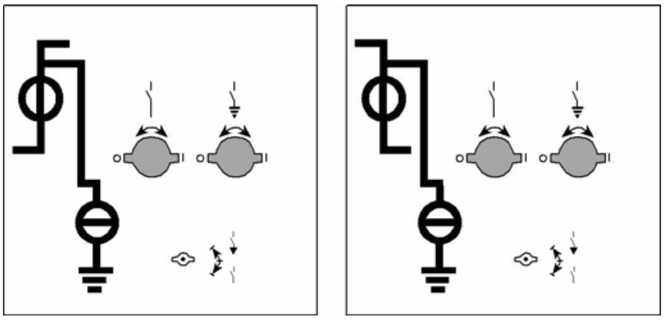
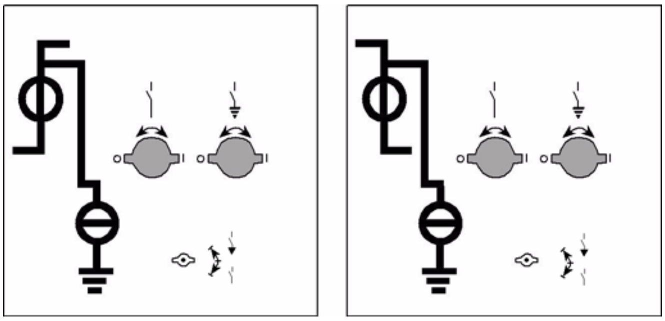
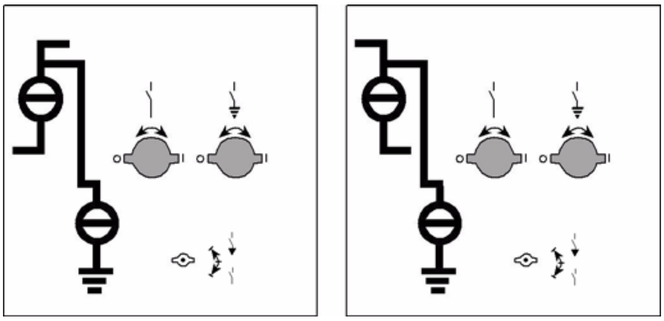
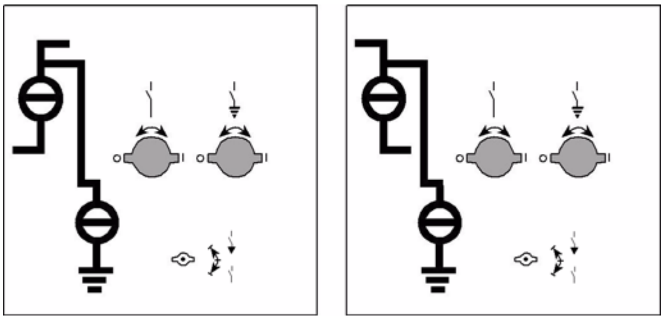
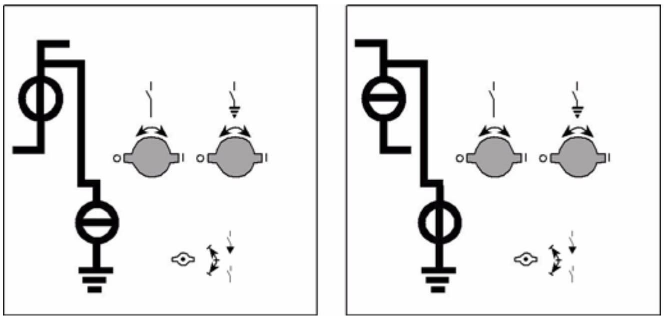
23.2 Switching operations in the bus sectionaliser

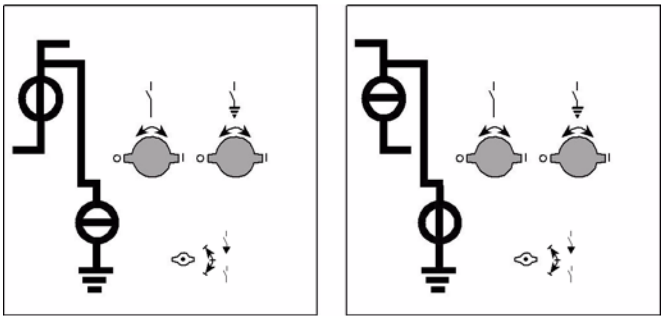
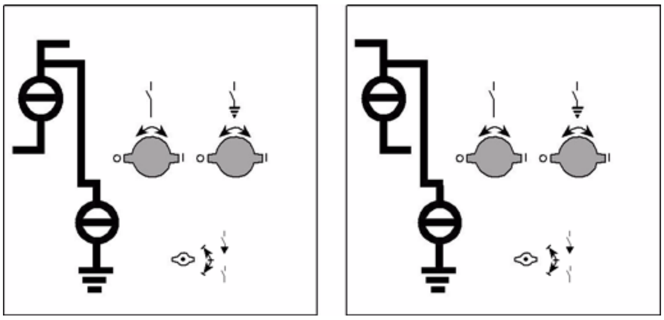
Coupling busbar sections **1**  Initial situation	**2**  1. "CLOSE" disconnector in circuit-breaker panel.2. "CLOSE" disconnector in bus riser panel.3. "CLOSE" circuit-breaker in circuit-breaker panel.
Decoupling busbar sections **1**  Initial situation	**2**  1. "OPEN" circuit-breaker in circuit-breaker panel.2. "OPEN" disconnector in circuit-breaker panel.3. "OPEN" disconnector in bus riser panel.
Earthing busbar section 1 **1**  Initial situation	**2**  1. "CLOSE" disconnector in circuit-breaker panel.2. "CLOSE" earthing switch in bus riser panel.3. L"CLOSE" circuit-breaker in circuit-breaker panel.4. Padlock "feeder earthed" locking device.

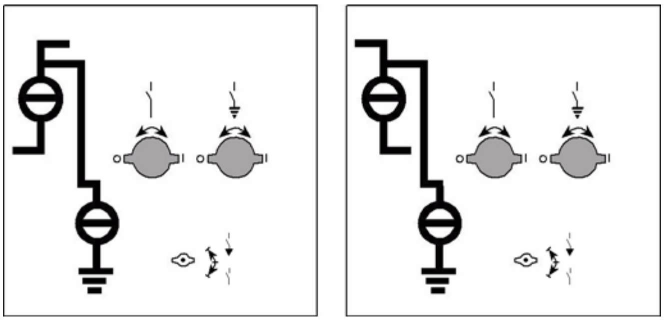
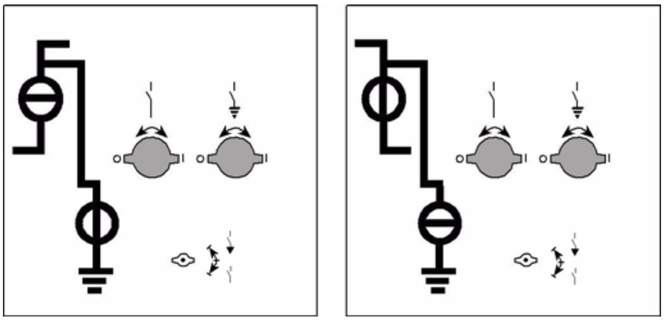
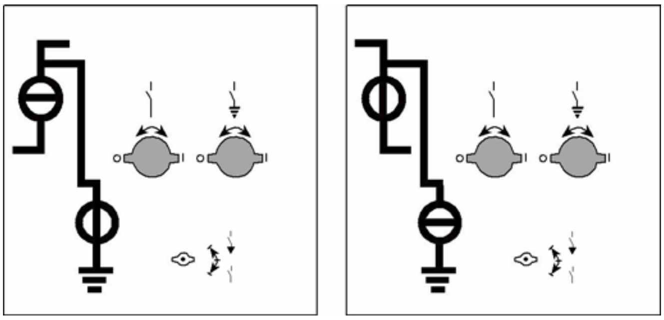
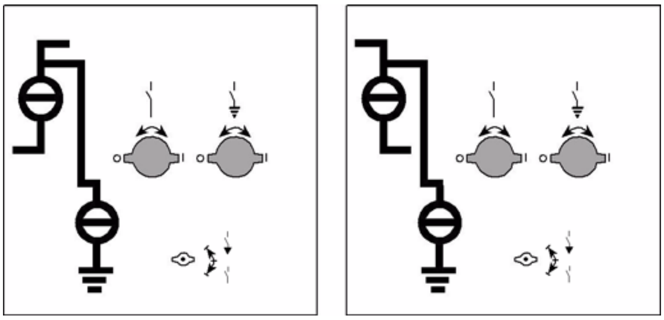
De-earthing busbar section 1 **1**  Initial situation	**2**  1. "OPEN" circuit-breaker in circuit-breaker panel.2. "OPEN" earthing switch in bus riser panel.3. "OPEN" disconnector in circuit-breaker panel.

Earthing busbar section 2 **1**  Initial situation	**2**  1. "CLOSE" disconnector in bus riser panel.2. "CLOSE" earthing switch in circuit-breaker panel.3. "CLOSE" circuit-breaker in circuit-breaker panel.4. Padlock "feeder earthed" locking device.
De-earthing busbar section 2 1  Initial situation	2  1. "OPEN" circuit-breaker in circuit-breaker panel.2. "OPEN" earthing switch in circuit-breaker bus riser panel.3. "OPEN" disconnector in bus riser panel.

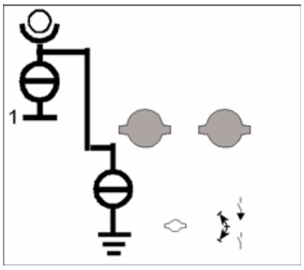
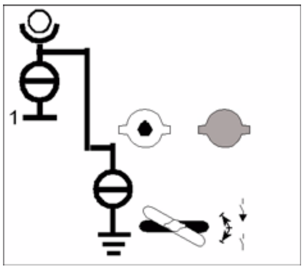
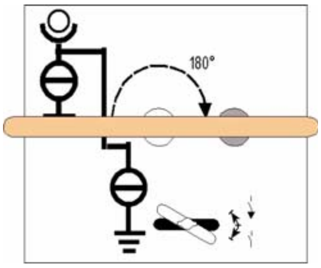
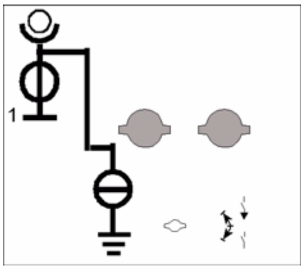
23.3 Switching operations in top-mounted bus sectionaliser

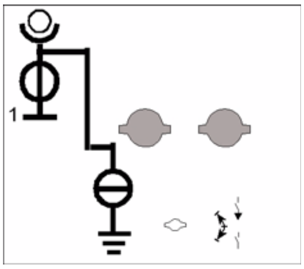
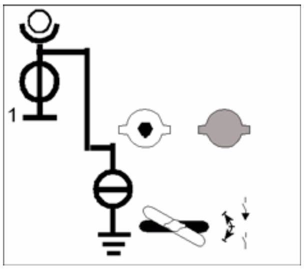
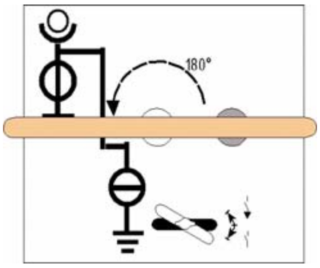
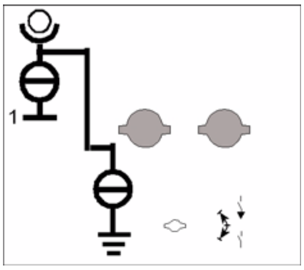
Coupling busbar sections **1**  Initial situation	**2**  1. "CLOSE" disconnector in left-hand busbar section. 2. "CLOSE" disconnector in right-hand busbar section.
Decoupling busbar sections **1**  Initial situation	**2**  1. "OPEN" disconnector in left-hand busbar section. 2. "OPEN" disconnector in right-hand busbar section.
Earthing busbar section 1 **1**  Initial situation	**2**  1. "CLOSE" disconnector in left-hand busbar section. 2. "CLOSE" earthing switch in right-hand busbar section.

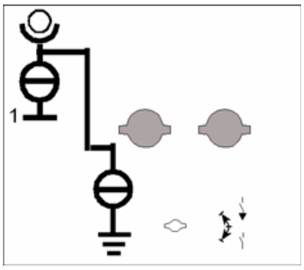
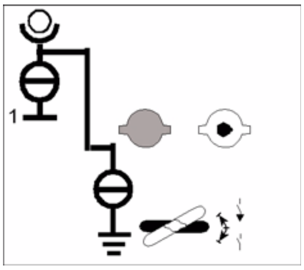
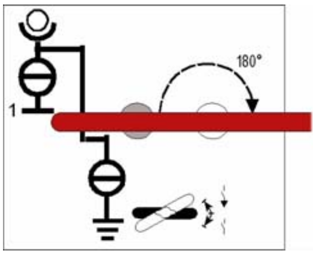
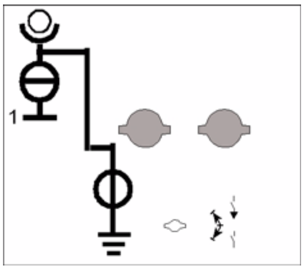
De-earthing busbar section 1 **1**  Initial situation	**2**  1. "OPEN" earthing switch in right-hand busbar section. 2. "OPEN" disconnector in left-hand busbar section.

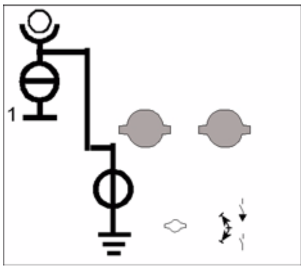
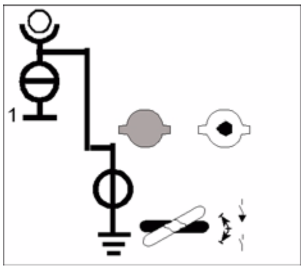
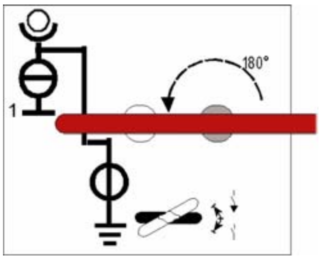
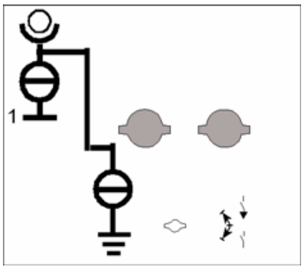
Earthing busbar section 2 **1**  Initial situation	**2**  1. "CLOSE" disconnector in right-hand busbar section. 2. "CLOSE" earthing switch in left-hand busbar section.
De-earthing busbar section 2 1  Initial situation	2  1. "OPEN" earthing switch in left-hand busbar section. 2. "OPEN" disconnector in right-hand busbar section.

23.4 Switching operations for disconnectable voltage transformers

Connecting voltage transformers with busbar			
1	**2**	**3**	**4**
			

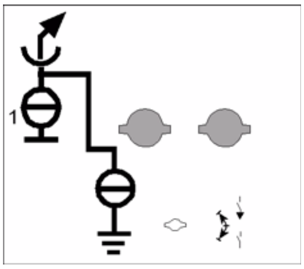
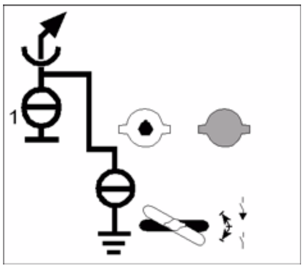
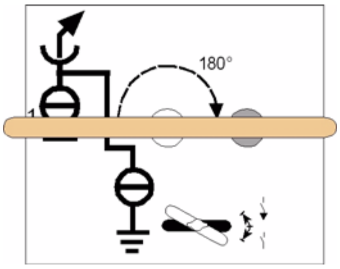
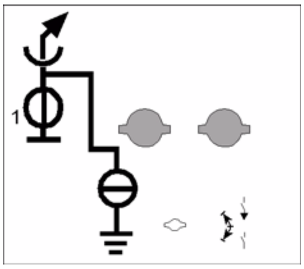
Disconnecting voltage transformers from busbar			
1	**2**	**3**	**4**
			

Earthing voltage transformers			
1	**2**	**3**	**4**
			

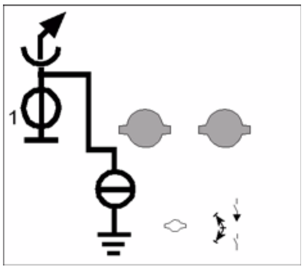
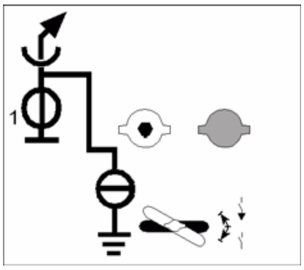
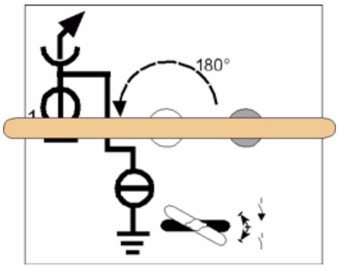
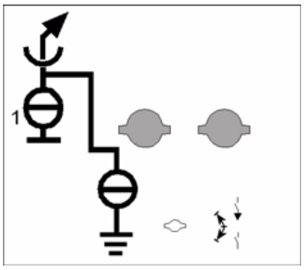
De-earthing voltage transformers			
1	**2**	**3**	**4**
			

23.5 Switching operations for disconnectable busbar connection

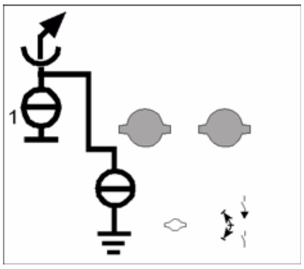
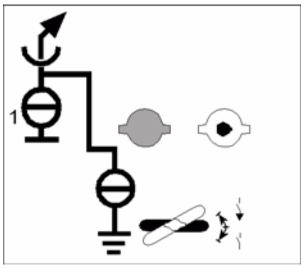
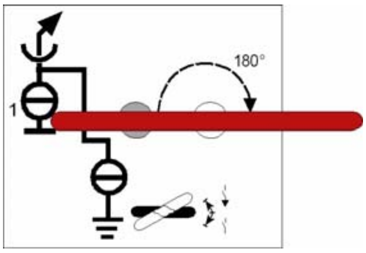
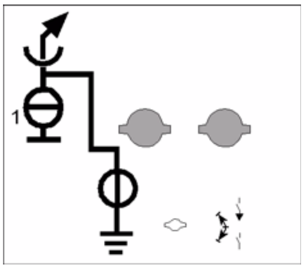
Connecting busbar with feeder

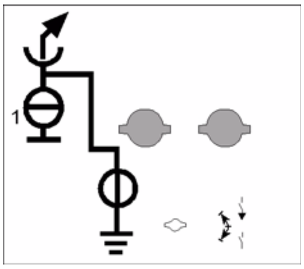
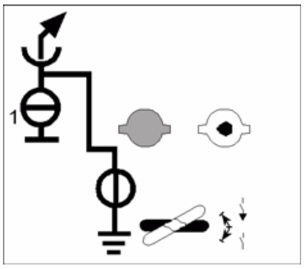
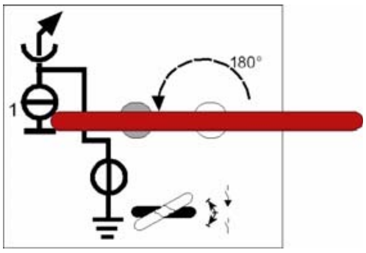
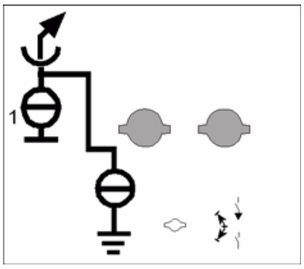
1	2	3	4
			

Disconnecting busbar from feeder

1	2	3	4
			

Feeder earthing

1	2	3	4
			

<table>
<tr><th colspan="4">Feeder de-earthing</th></tr>
<tr>
<td>1
 </td>
<td>2
 </td>
<td>3
 </td>
<td>4
 </td>
</tr>
</table>

24 Cable testing

24.1 Function test

Before commissioning, a high DC voltage is applied to the cables for test. A possibility for cable testing is described hereafter.

The following table contains the maximum values for the DC test voltage:

Rated voltage of switchgear kV	DC test voltage,maximum value kV	AC test voltage 0.1 Hz, maximum value kV
12	48	19
24	72	38
36	72	57
40,5	72	57

24.2 Safety instructions

DANGER!

High voltage! Danger!Cable testing may produce flashovers which can cause death or serious bodily injuries.

⇨ Cable testing may only be performed by qualified personnel who is familiar with the danger involved.

⇨ The permissible test voltages must not be exceeded.

⇨ Keep safety distances.

⇨ Install barriers.

⇨ Switch on warnings.

ATTENTION!

If the voltage transformer is energised, or if it is of the non-disconnectable type, the test voltage can destroy the voltage transformer and cause personal injuries.

⇨ Earth disconnectable voltage transformers before cable testing.

⇨ Remove non-disconnectable voltage transformers.

ATTENTION!

The voltage indicators CAPDIS-S1+ and CAPDIS-S2+ may be damaged at test voltages > 15 kV and frequencies < 16 2/3 Hz.

⇨ Short-circuit voltage indicators with the earthing points of the test sockets.

24.3 Procedure

Cable testing with dismantled cable

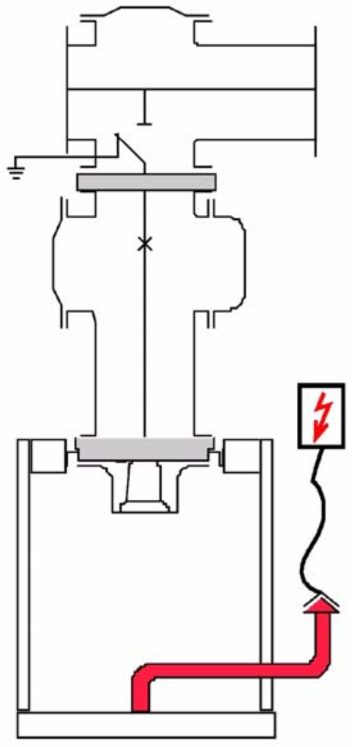


Fig. 37: Test arrangement with dismantled cable

⇨ Earth the feeder (see Page 41, "Feeder earthing").

⇨ Earth the voltage transformers (see Page 41, "Feeder earthing" or remove non-disconnectable voltage transformers).

⇨ Remove cable to be tested.

⇨ Screw test adapter onto cable termination.

⇨ Connect test lead.

⇨ Perform voltage test.

Cable testing with connected cable

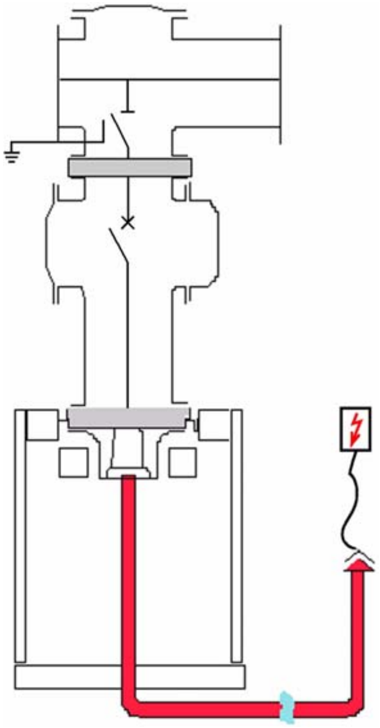


Fig. 38: Test arrangement with connected cable

- ➩ Earth the feeder (see Page 41, "Feeder earthing").
- ➩ Earth the voltage transformers (see Page 41, "Feeder earthing" or remove non-disconnectable voltage transformers).
- ➩ Short-circuit capacitive test sockets and test sockets on integrated voltage detection systems (e. g. CAPDIS).
- ➩ Open the circuit-breaker (see Page 31, "Opening the circuit-breaker manually").
- ➩ Switch three-position disconnector to OPEN position (see Page 36, "Opening the three-position disconnector manually ").
- ➩ Close the circuit-breaker (see Page 31, "Closing the circuit-breaker manually").
- ➩ Screw test adapter onto cable termination.
- ➩ Connect test lead.
- ➩ Perform voltage test.

Servicing

25 Maintenance

25.1 Switchgear maintenance

Under normal operating conditions the fixed-mounted circuit-breaker switchgear 8DA and the 3AH49 circuit-breaker are maintenance-free. We recommend to inspect the switchgear according to the following maintenance recommendation. To prevent any danger during maintenance, please observe the following safety instructions.

25.2 Safety instructions

DANGER!

High voltage! Danger!Do always observe the Five Safety Rules:

⇨ Isolate the switchgear.

⇨ Secure against reclosing.

⇨ Verify safe isolation from supply.

⇨ Earth and short-circuit.

⇨ Cover or barrier adjacent live parts.

DANGER!

High voltage! Danger!Touching live parts will cause death or serious injuries.

⇨ Switchgear maintenance may be performed only by qualified personnel who are familiar with the danger associated with maintenance.

25.3 Maintenance recommendation

The switchgear should be inspected at the following intervals:

	8DA10	**8DA11/12**
Visual inspection	every 5 years	every 5 years
State inspection	every 10 years	every 10 years
Maintenance	after 1000 operating cycles of the disconnectors and earthing switches or after 10000 operating cycles of the circuit-breaker see Page 62, "Maintenance of the vacuum circuit-breaker operating mechanism"	after 3000 operating cycles of the disconnectors or 1000 operating cycles of the earthing switches or after 10000 operating cycles of the circuit-breaker

These intervals are guidelines which have to be adjusted to the different operating conditions (e. g. dusty environment, frequent condensation, etc.). The maintenance actions with the associated test and maintenance operations are shown in the following table.

DANGER!

Danger of suffocation! SF_6-gas is heavier than air and concentrates first near to the floor and in floor openings.

⇨ Do not let SF_6-gas get into the environment.

⇨ While working with SF_6-gas, provide for sufficient ventilation.

⇨ After working with SF_6-gas, vent the cable basement and any hollows in the floors with special care.

⇨ Observe the safety data sheet for SF_6-gas.

⇨ Cover or barrier adjacent live parts.

⇨ To be done generally before working with SF_6-gas: Check and document re-usability (dew-point, gas quality) of the SF_6.

Maintenance recommendation

Visual inspection	**Condition inspection**	**Maintenance**	
X	X	X	Check and document SF_6-gas pressure (see Page 23, "Insulating gas SF_6")
	X	X	Check and document dew-point (humidity content) (≤ –15° C)
	X	X	Check and document gas quality (air content) (SF_6-share ≥ 95 %)
		X	Check operating mechanism and interlocking of disconnector and earthing switch (if required, grease linkage and bearings)
		X	Vacuum circuit-breaker operating mechanism
		X	**In all gas compartments - if gas has to be exchanged -, or upon reaching the number of operating cycles:** ⇨ Evacuate SF6-gas. ⇨ Replace desiccant bags. ⇨ Replace O-rings. ⇨ Fill in SF_6-gas. ⇨ Check and document gas pressure. ⇨ Check tightness.
		X	**Check additionally in all compartments with three-position disconnector:** ⇨ Operate disconnector and earthing switch for test and verfiy that the switch positions are reached correctly. ⇨ Check contact surfaces, rotary insulators and operating linkages for signs of wear. ⇨ If required, clean the insulating bushings with a vacuum cleaner. ⇨ Grease contact surfaces and joints of the operating linkages.

25.4 Procedure for bolted joints and seals

Please observe the following procedure for maintenance of switchgear parts with bolted joints:

⇨ Recommendation: Always replace the spring elements on loosened bolted joints.

Please observe the following procedure for maintenance of switchgear parts with seals:

⇨ Always replace removed O-rings with new onesO-rings are available at your Siemens Service Centre

⇨ Clean the surfaces and grooves in the flanges with a lint-free rag

⇨ Check the surfaces before installation

⇨ Grease the O-rings and place them in the grooves of the flanges.

⇨ If required, place desiccant bags in the cover.

⇨ Fit the cover.

⇨ Bolt the flanges tight cross-wise with the hexagonal bolts M8 with new spring elements. Tightening torque: 20 Nm.

25.5 Maintenance of the vacuum circuit-breaker operating mechanism

Under normal operating conditions the fixed-mounted circuit-breaker switchgear 8DA and the 3AH49 circuit-breaker are maintenance-free.

After 10,000 operating cycles or depending on the respective operating conditions (e. g. dusty environment, frequent condensation, etc.) we recommend to inspect the switchgear according to the above maintenance recommendation. To do this, you may only use the materials specified hereafter on the individual functional parts of the circuit-breaker.

Permissible cleaning agents / lubricants:

- **For bearings, sliding surfaces:**
  Isoflex Topas L 32
  Klüber - Lubrication KG
  Geisenhauer Str. 7
  Postfach 70 10 47
  D-81310 München
- **For bearings that are inaccessible for grease, and bearings of the auxiliary switch S1:**
  Tellus Öl 32
  Shell Direct GmbH
  Suhrenkamp 71
  D-22335 Hamburg

ATTENTION!

The parts of the switchgear that cannot be dismantled may be damaged if they come into contact with cleaning agents.

⇨ Do not treat joints and bearings which **cannot be** dismantled with a cleaning agent.

⇨ Clean the external parts of the circuit-breaker at regular intervals.

⇨ Renew the anti-corrosion protection greasing.

⇨ Operate the circuit-breaker several times mechanically for test.

25.6 Cleaning agents and cleaning aids

⚠	**DANGER!**
	For protection of personnel and environment: ⇨ Read the instructions for use of cleaning agents carefully. ⇨ Observe the warnings (e.g. inflammable!, corrosive!, etc.)

Cleaning agents	HAKU 1025-920	Contains carbon hydrogen!
	Household cleaner	For cleaning electrostatically stressed insulation (e.g. epoxy resin)
Cleaning aids	Lint-free cleaning paper	For applying and cleaning liquid cleaning agent (single use)
	Brush	
	Cleaning rag	
	Vacuum cleaner	

25.7 Lubricants

Designation	**Manu-facturer**	**Application**	**Remark**	**Packing/Quantity**
Polylub GLY 801	Siemens	Current-carrying fixed-mounted connections (current conductors and earthing bars, connections), flanges with O-rings	No greasing effect; used as mounting aid for O-rings; mounting paste for flanges	Tube (0.25 kg)
Barrierta GTE 403	Klüber	Contact blades and contact pieces of the three-position disconnectors	Observe the designation "GTE 403" in order to avoid mistakes with other Barrieta products	Tube (0.02 kg)
Longtherm 2+	Molykote	Bearings of the operating linkage	Not suitable for greasing points on the circuit-breaker operating mechanism	

25.8 Switchgear extension and replacement of panels and components

For switchgear extension and replacement of components, please contact the local Siemens Service Centre.

Information required for spare part orders of single components and devices:

- Type and serial number of the switchgear and the circuit-breaker (see rating plates)
- Precise designation of the device or component, if applicable on the basis of the information and illustrations in the associated instructions, a drawing, sketch or circuit diagram

25.9 Spare parts

Due to the fact that all parts of this switchgear type have been optimised to last the normal service life, it is not possible to recommend particular spare parts.

25.10 Service life and disposal

Service life The maximum permissible number of mechanical operating cycles of the built-in circuit-breakers is 30,000. The current number of operating cycles can be checked on the mechanical operating cycle counter.

Disposal The fixed-mounted circuit-breaker switchgear of the 8DA series is an environmentally compatible product.

At the end of the service life, the switchgear material should be recycled. The switchgear can be disposed of in environment-compatible manner in compliance with existing legislation.

The components of the switchgear can be recycled as mixed scrap; however, dismantling as far as possible into sorted scrap is the more environmentally compatible way.

The switchgear consists of the following materials:

- Steel
- Copper
- Aluminium
- Cast-resin
- Fibre-reinforced plastics
- Rubber materials
- Sulphur hexafluoride (SF_6)
- Ceramic materials
- Lubricants

The switchgear does not contain hazardous materials as defined in the hazardous material regulations.

As this is an SF_6-insulated switchgear, the gas enclosed in the gas compartment must be evacuated, collected and recycled. To do this, observe the necessary safety measures according to the instruction leaflet for accident prevention"SF_6-Switchgear " of the professional association for fine mechanics and electrical engineering. Outside Germany, the locally applicable regulations must be followed.

Should you require further information, please contact your Siemens Service Centre.

26 Index

Impressum

Power Transmission and Distribution
Medium Voltage
Schaltanlagenwerk Frankfurt
Carl-Benz-Str. 22
D-60386 Frankfurt

Sturgeon ELECTRIC
12150 East 112th Avenue
Henderson, CO 80640

TRANSMITTAL SHEET

Attention: John Crowder
Company: 1776 Lincoln St Suite 600
Denver, Co. 80203

Phone:
Fax:

Date: 9/1/2016
Sturgeon Job No.: 822611
Transmittal No.: 0020
Re:

We are sending you the attached following items:

___ Shop Drawings
___ Specifications
x Other: As Built:

___ Prints
___ Copy of Letter

___ Change Order
___ Samples

Copies	Date	Description
1	9/1/2016	East Side Switchgear- Undervoltage As-Built Drawings

These are transmitted as checked below:

___ For Approval
___ For Your Use
___ As Requested
___ For Review and Comment
___ For Bids Due ________

___ Approved as Submitted
___ Approved as Noted
___ Returned for Corrections

___ Resubmit
___ Submit
___ Return
___ Other ________
___ Prints Returned After Loaned to Us

___ Copies for Approval
___ Copies for Distribution
___ Corrected Prints

Remarks:

Copy To:

Signed: James Shireman- Project Manager
(Name & Title)

Received By:

Date Received:

Siemens AG

Energy Management - Medium Voltage & Systems

Circuit diagram

for

Purchaser CRUM ELECTRIC SUPPLY COMPANY INC.

User COLORADO DEPARTMENT OF TRANSPORT

Plant VENTILATION BUILDING EAST

Plant section 8DA10 25kV SWITCHGEAR
MAIN A

Typical =JZ01

Project reference number

Date of issue 08-27-15

Customer document number

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

SIEMENS AG

Archive: =J01 / A / / / 1

Project: 883314

Documentation identifier A / =J01 / / 1

Manufacturer document number (3) W92210-F2141-S011-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J01 / A / A / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
A	=J01 +J01	/1	(3) W92210-F2141-S011-B	1-	1	08-27-15	8DA10 25kV SWITCHGEAR MAIN A COVER SHEET Cover sheet	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A1	(3) W92210-F2141-S012-B	1+	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A2	(3) W92210-F2141-S012-B	2+	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A3	(3) W92210-F2141-S012-B	3+	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A4	(3) W92210-F2141-S012-B	4-	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	G1	(3) W92210-F2141-S015-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	G2	(3) W92210-F2141-S015-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M1	(3) W92210-F2141-S015-B	1+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M2	(3) W92210-F2141-S015-B	2+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M3	(3) W92210-F2141-S015-B	3+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M4	(3) W92210-F2141-S015-B	4+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M5	(3) W92210-F2141-S015-B	5+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M6	(3) W92210-F2141-S015-B	6+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M7	(3) W92210-F2141-S015-B	7+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	A =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A		+J01 A1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314	(3) W92210-F2141-S012-B Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents		4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J01 / A / A / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
S	=J01 +J01	M8	(3) W92210-F2141-S015-B	8+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M9	(3) W92210-F2141-S015-B	9+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A INDICATIONS SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M10	(3) W92210-F2141-S015-B	10-	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	S1	(3) W92210-F2141-S015-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	S2	(3) W92210-F2141-S015-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z1	(3) W92210-F2141-S015-B	1+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CIRCUIT BREAKER Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z2	(3) W92210-F2141-S015-B	2+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A THREE POSITION SWITCH Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z3	(3) W92210-F2141-S015-B	3+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A THREE POSITION SWITCH Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z4	(3) W92210-F2141-S015-B	4+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A GAS PRESSURE MONITORING Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z5	(3) W92210-F2141-S015-B	5+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A GAS PRESSURE MONITORING Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z6	(3) W92210-F2141-S015-B	6+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A PROTECTION AND CONTROL DEVICE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z7	(3) W92210-F2141-S015-B	7+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z8	(3) W92210-F2141-S015-B	8+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z9	(3) W92210-F2141-S015-B	9-	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 A =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	+J01 A2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314 (3) W92210-F2141-S012-B Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents	4 Sh.

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
V	=J01 +.B	/1	(3) W92210-F2141-S018-B	1+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XR1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/2	(3) W92210-F2141-S018-B	2+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-X90 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/3	(3) W92210-F2141-S018-B	3+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XT1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/4	(3) W92210-F2141-S018-B	4+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XT5 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/5	(3) W92210-F2141-S018-B	5+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/6	(3) W92210-F2141-S018-B	6+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/7	(3) W92210-F2141-S018-B	7+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/8	(3) W92210-F2141-S018-B	8+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/9	(3) W92210-F2141-S018-B	9+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/10	(3) W92210-F2141-S018-B	10+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/11	(3) W92210-F2141-S018-B	11+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/12	(3) W92210-F2141-S018-B	12+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/13	(3) W92210-F2141-S018-B	13+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/14	(3) W92210-F2141-S018-B	14+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
TABLE OF DOCUMENTS
List of documents

=JZ01 A =J01
+J01
A3
883314
(3) W92210-F2141-S012-B
Sheet 3+
4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J01 / A / A / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J01 / A / A / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

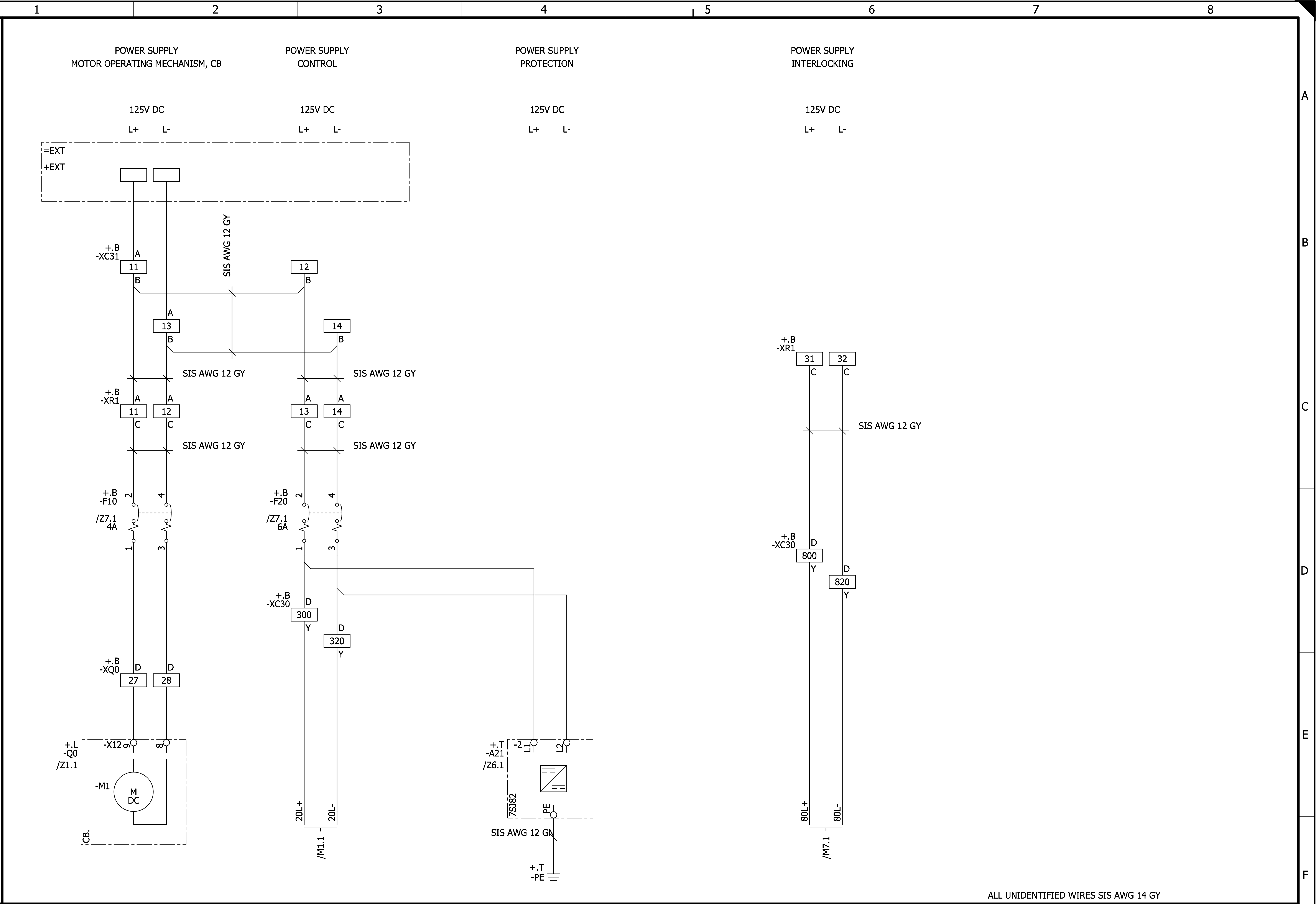
Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
V	=J01 +.B	/15	(3) W92210-F2141-S018-B	15+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XB11 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/16	(3) W92210-F2141-S018-B	16-	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XPE Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 A =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	+J01 A4
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314 (3) W92210-F2141-S012-B Sheet 4-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents	4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / G / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

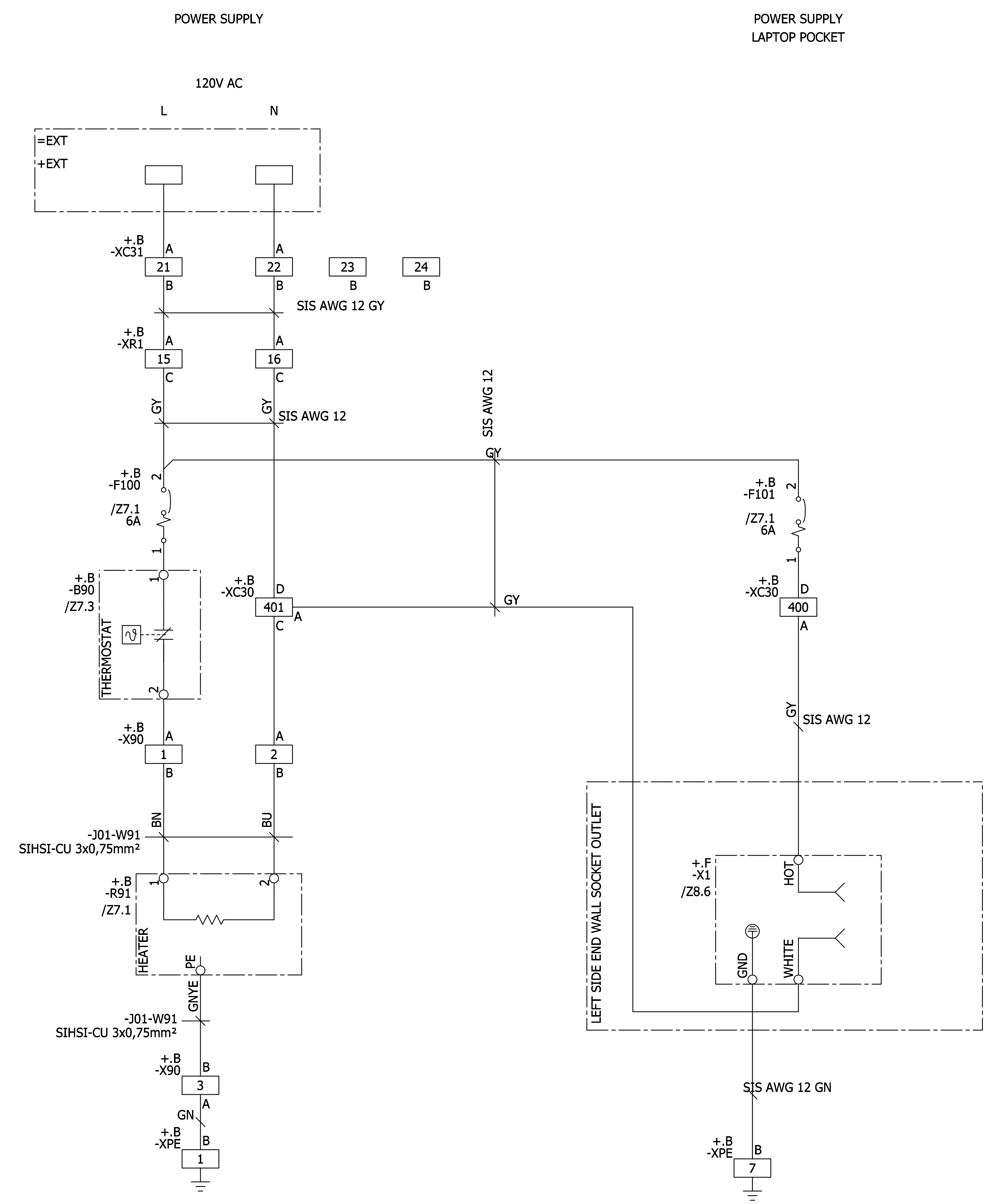
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
G1
883314
(3) W92210-F2141-S015-B
Sheet 1+
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / G / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



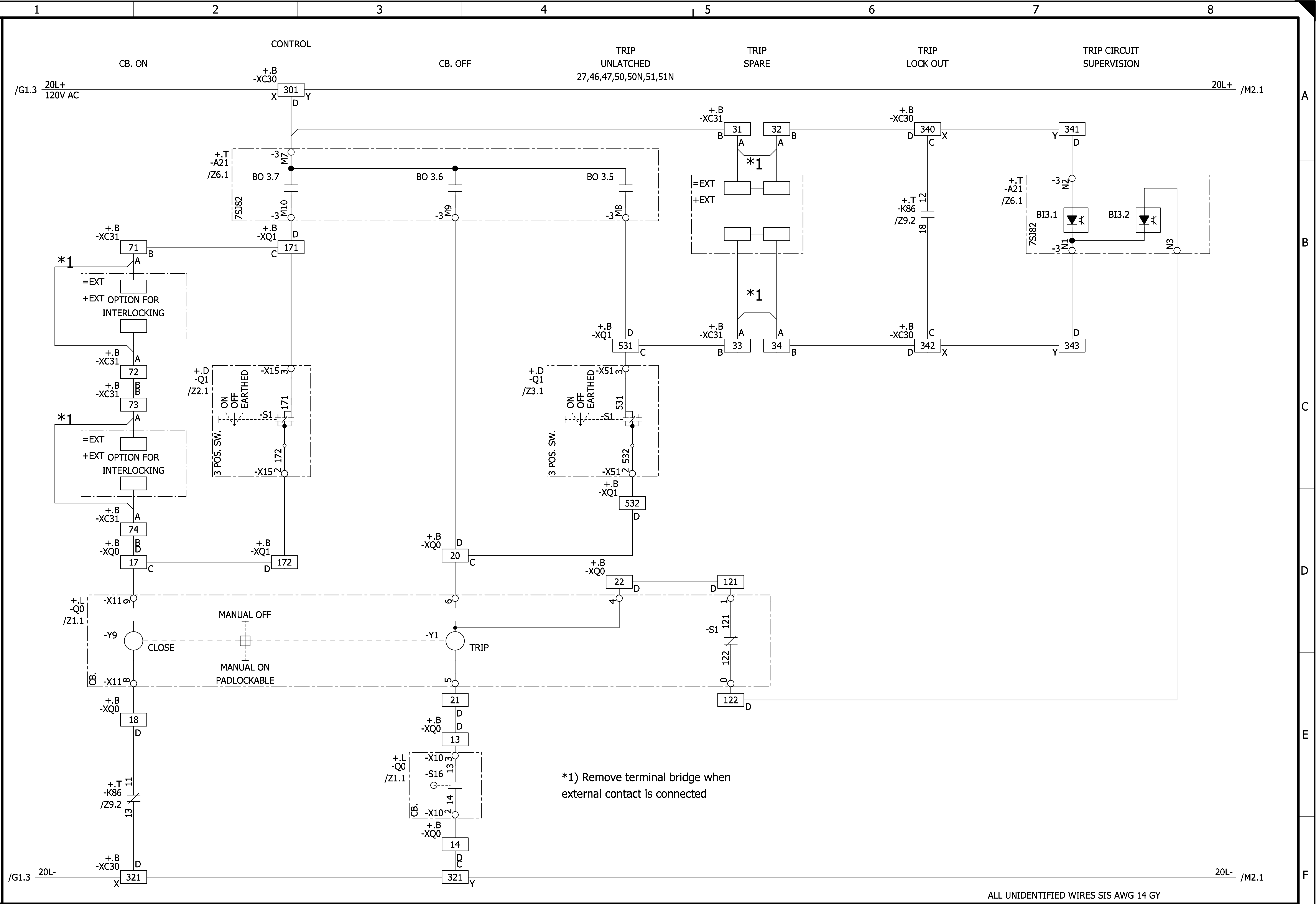
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	G2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S015-B		Sheet 2-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



*1) Remove terminal bridge when external contact is connected

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

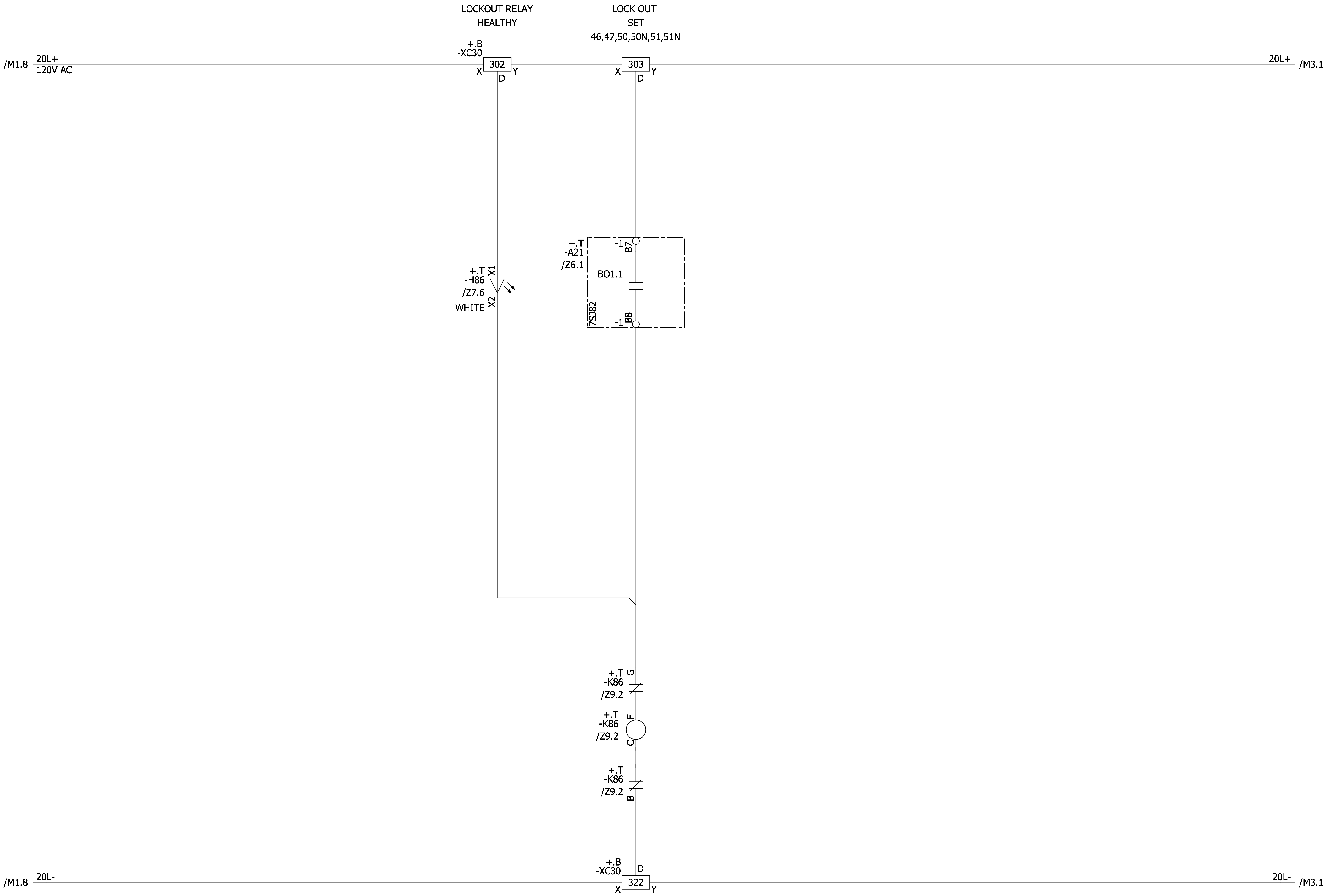
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
M1
883314
(3) W92210-F2141-S015-B
Sheet 1+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



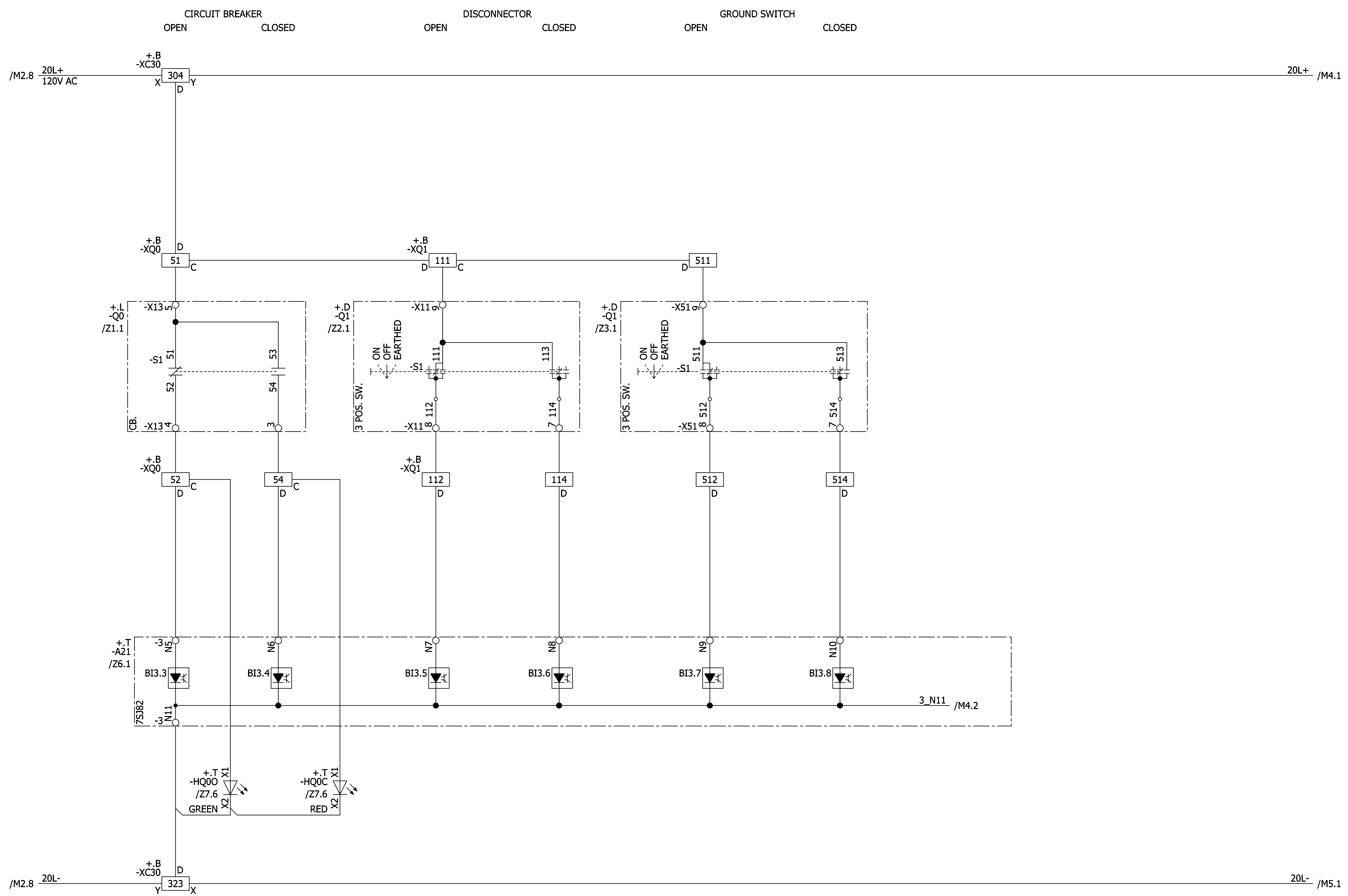
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ01	S =J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	M2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S015-B		Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

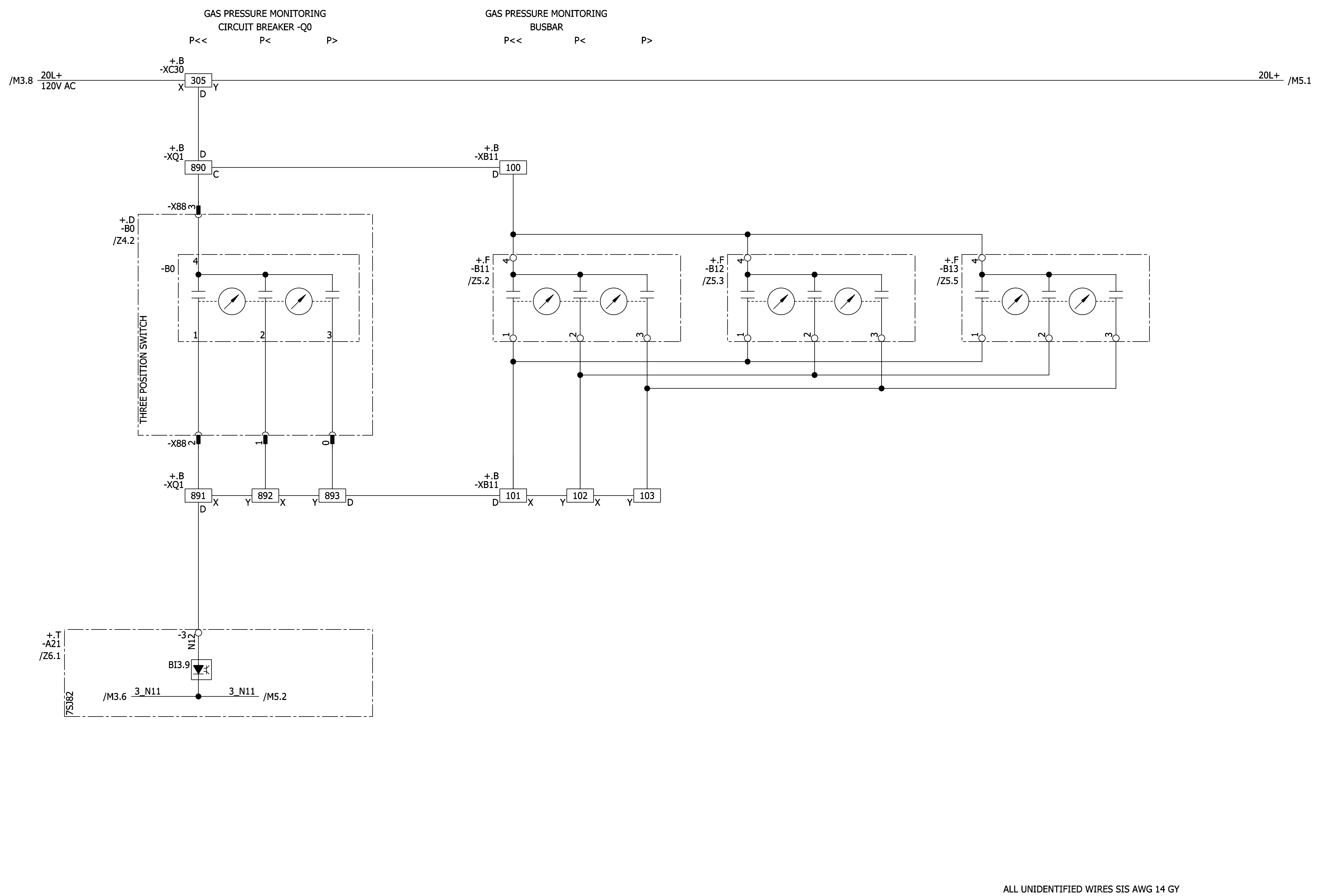
Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S =J01
+J01
M3
883314
(3) W92210-F2141-S015-B
Sheet 3+
10 Sh.



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date	05-18-15
Drawn	Ten-Thomé
Appr.	Magnuson
Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
M4
883314
(3) W92210-F2141-S015-B
Sheet 4+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 4

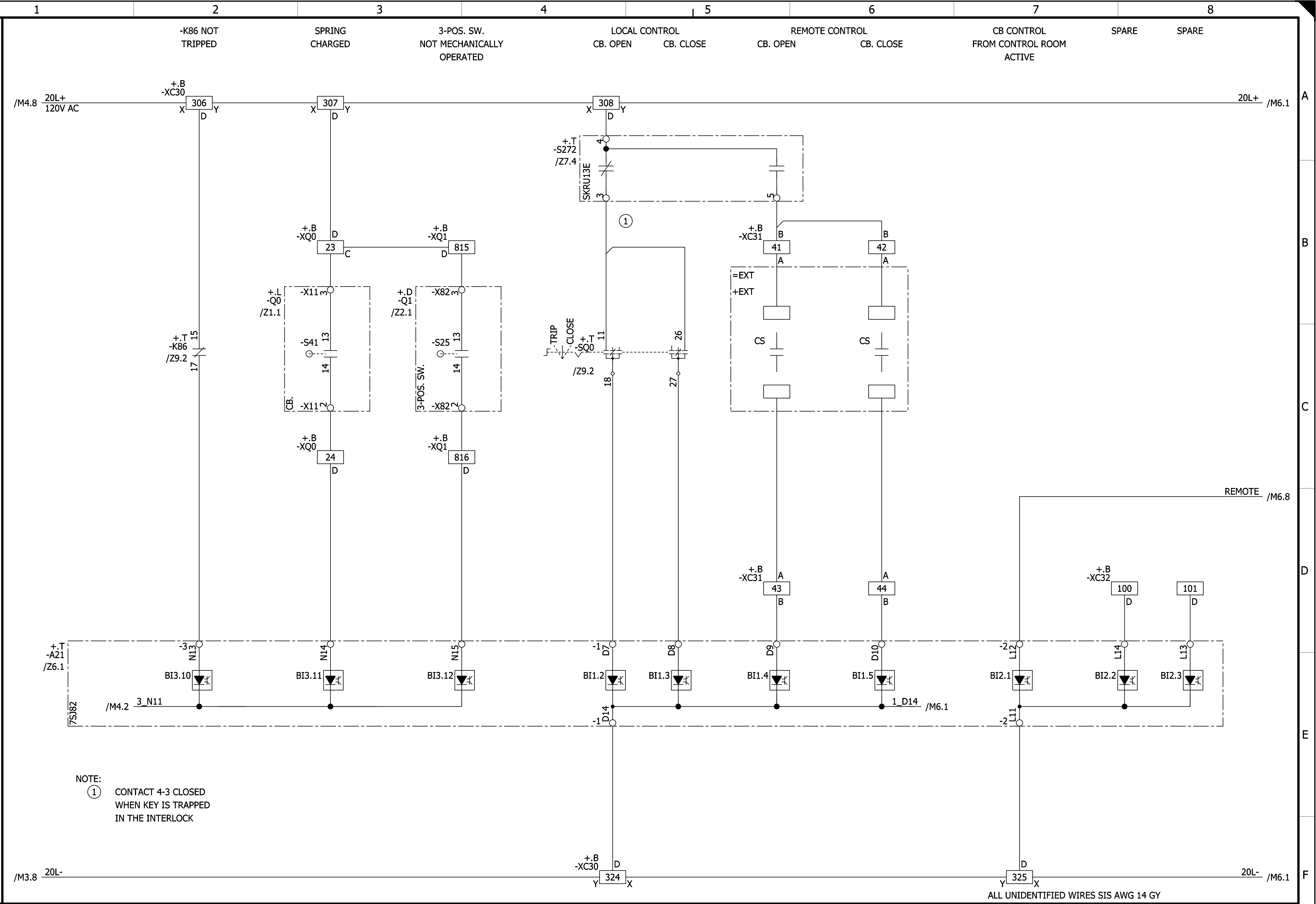
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



NOTE:
① CONTACT 4-3 CLOSED
WHEN KEY IS TRAPPED
IN THE INTERLOCK

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

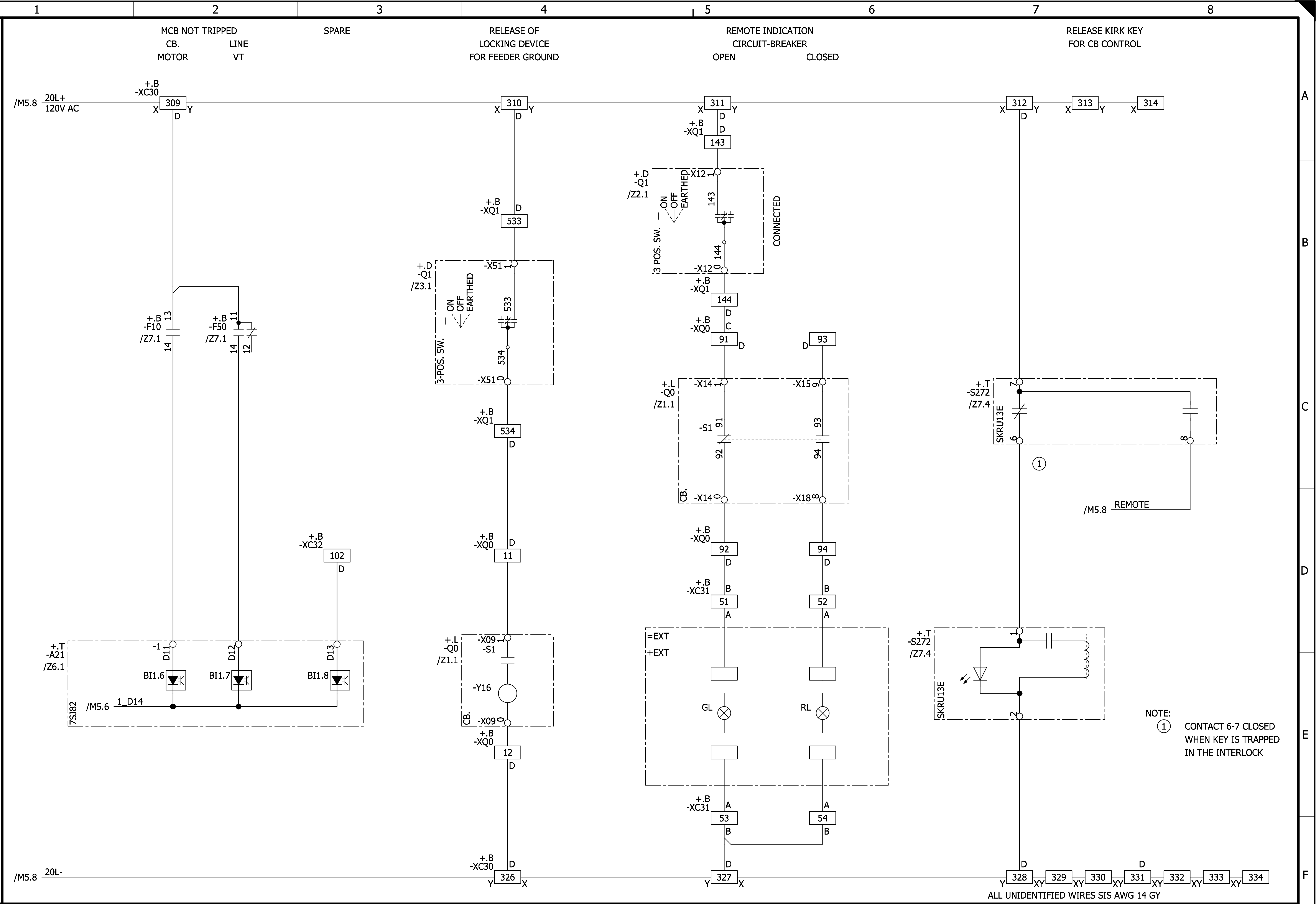
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
M5
883314
(3) W92210-F2141-S015-B
Sheet 5+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

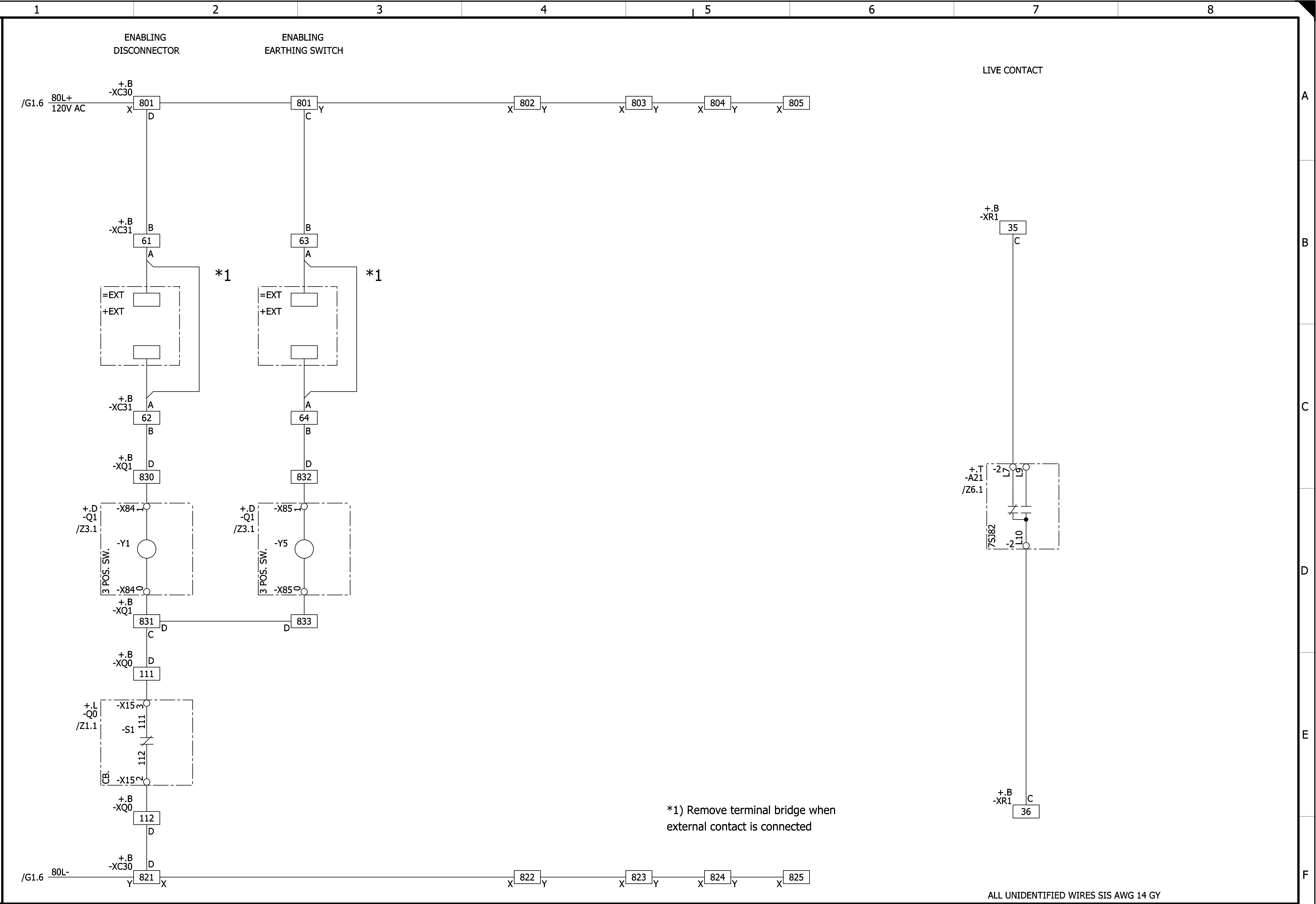


				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	M6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S015-B		Sheet 6+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



*1) Remove terminal bridge when external contact is connected

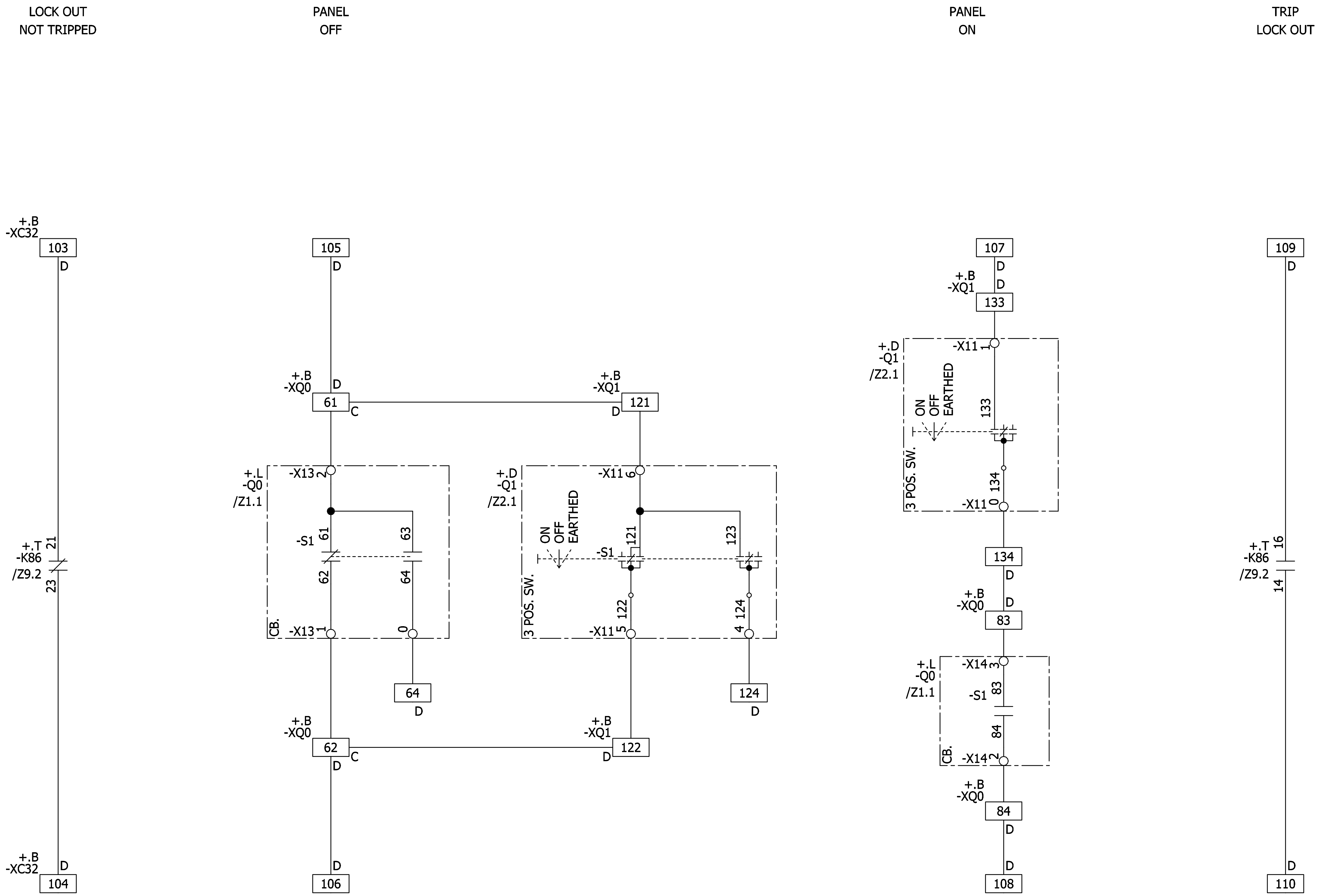
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	=JZ01		+J01	M7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314		(3) W92210-F2141-S015-B	Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

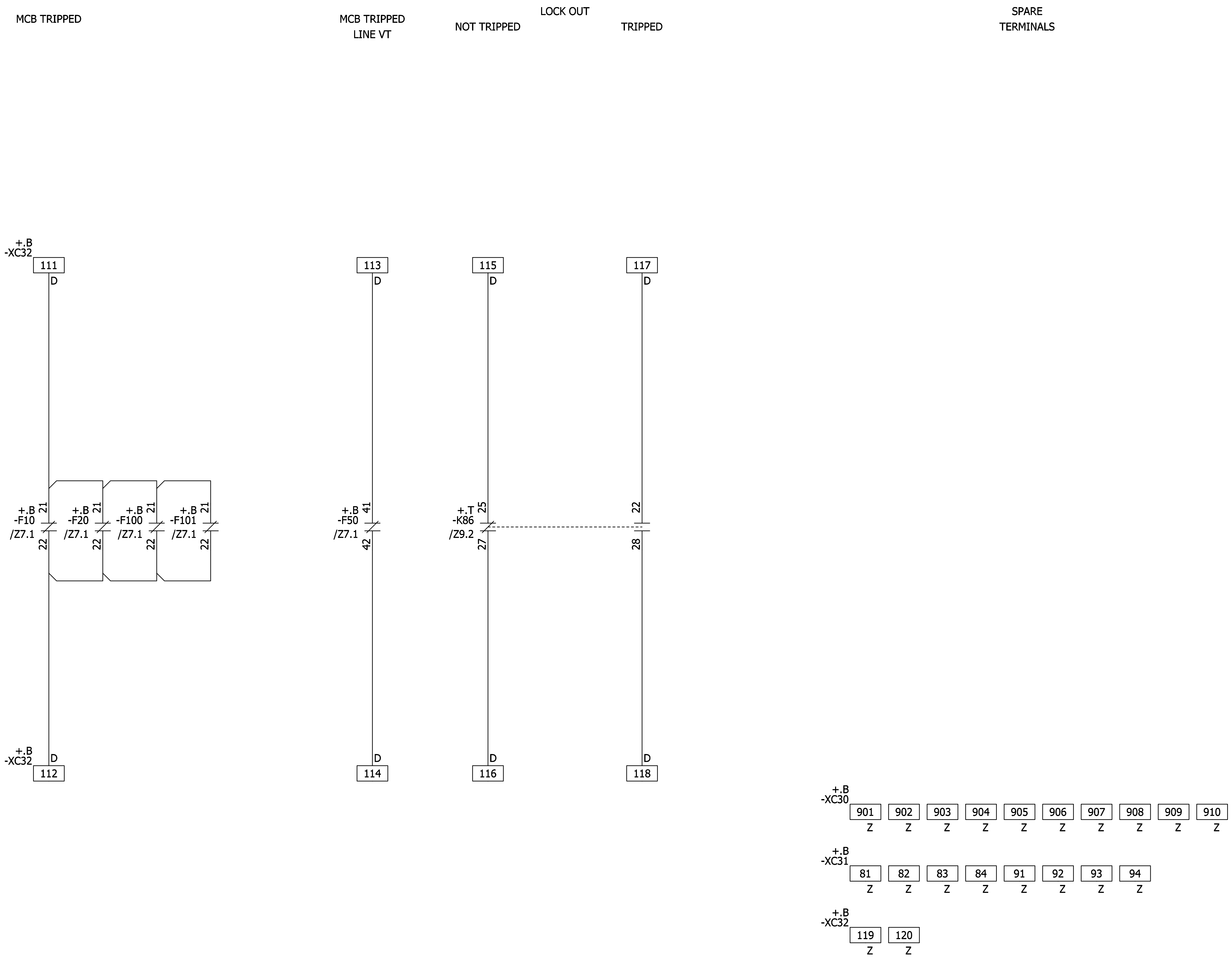
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01 S =J01
+J01
M8
883314
(3) W92210-F2141-S015-B
Sheet 8+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

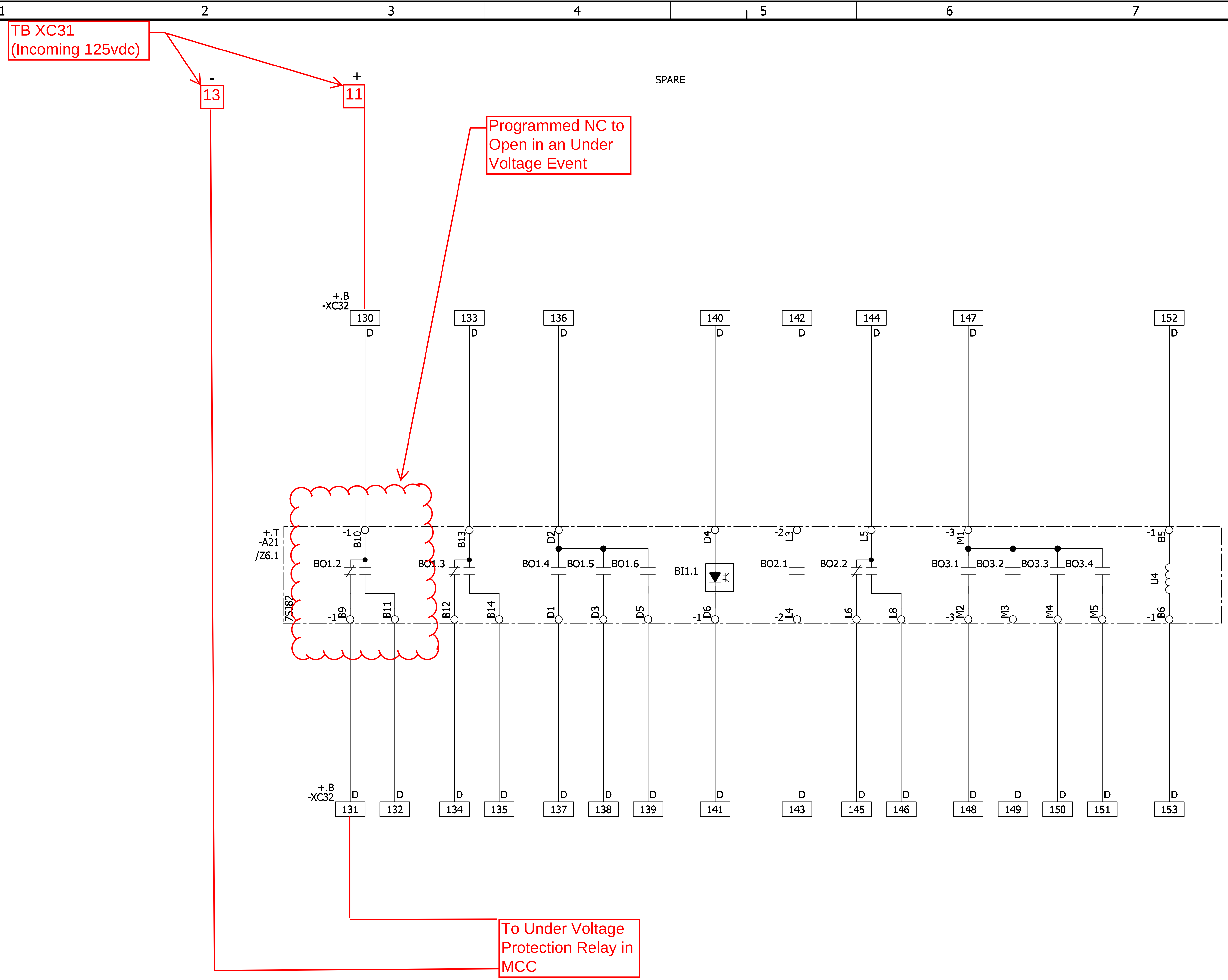
8DA10 25kV SWITCHGEAR
MAIN A
INDICATIONS SPARE
Circuit diagram

=JZ01
S =J01
+J01
M9
Sheet 9+
883314
(3) W92210-F2141-S015-B
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

Date	05-18-15
Drawn	Ten-Thomé
Appr.	Magnuson
Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

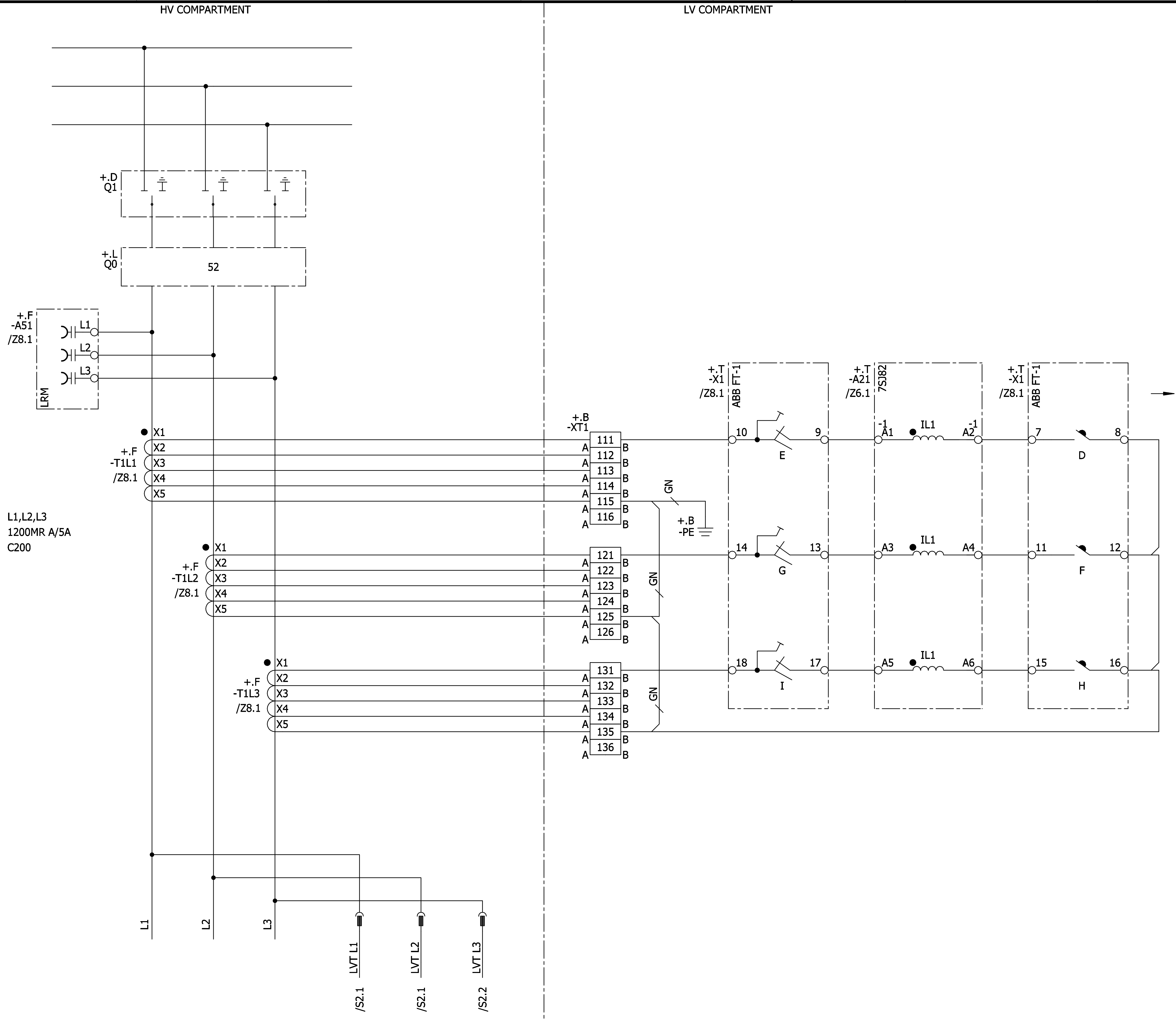
8DA10 25kV SWITCHGEAR
MAIN A
SPARE
Circuit diagram

=JZ01 S =J01
+J01
M10
883314
(3) W92210-F2141-S015-B
Sheet 10-
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / S / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1200 A
MULTI-RATIO CT

CURRENT RATING (A) 1200:5	SECONDARY TAPS
100:5	X2-X3
200:5	X1-X2
300:5	X1-X3
400:5	X4-X5
500:5	X3-X4
600:5	X2-X4
800:5	X1-X4
900:5	X3-X5
1000:5	X2-X5
1200:5	X1-X5

ALL UNIDENTIFIED WIRES SIS AWG 12 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

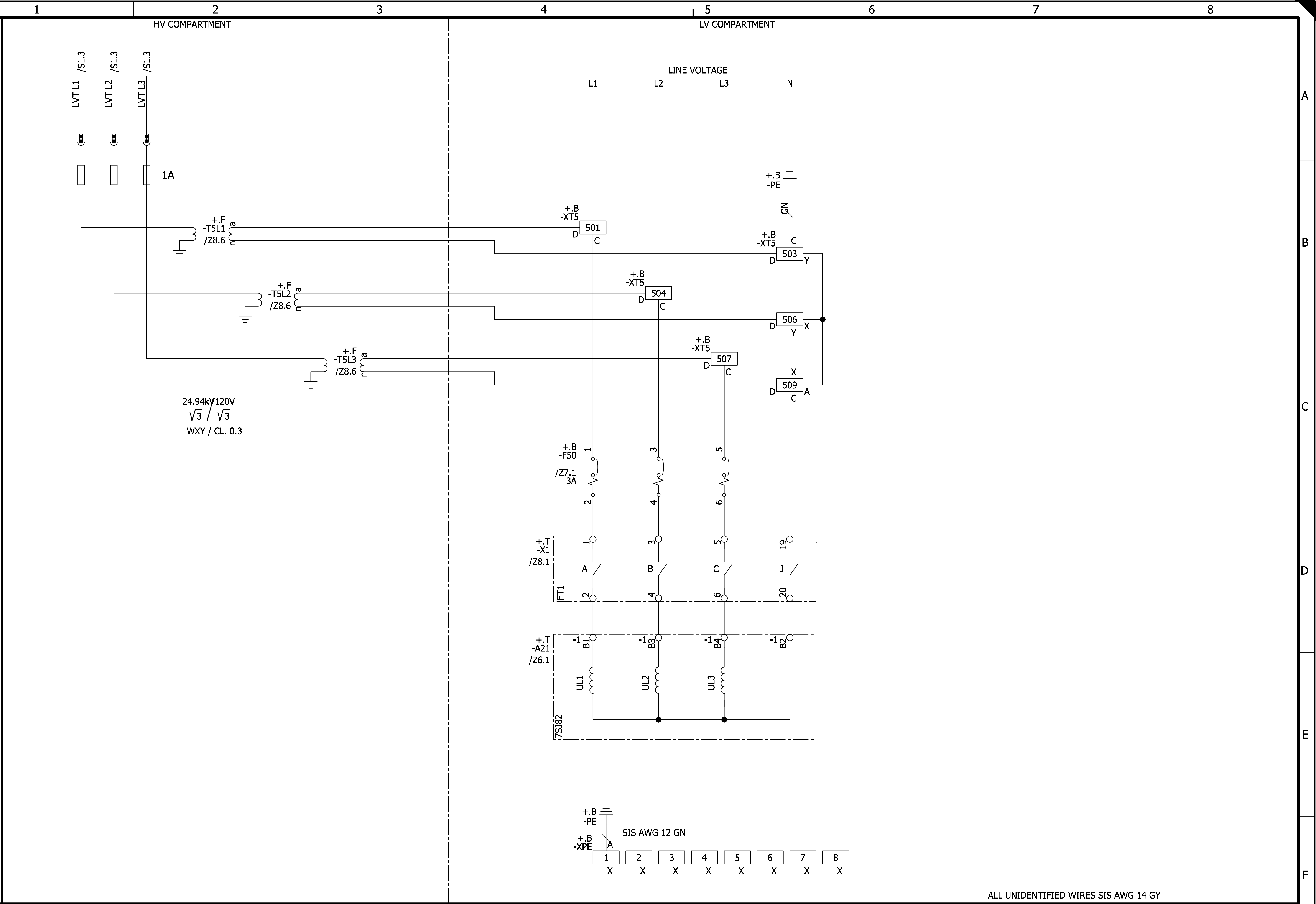
8DA10 25kV SWITCHGEAR
MAIN A
TRANSFORMER CIRCUITS
Circuit diagram

=JZ01
S
=J01
+J01
S1
883314
(3) W92210-F2141-S015-B
Sheet 1+
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / S / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

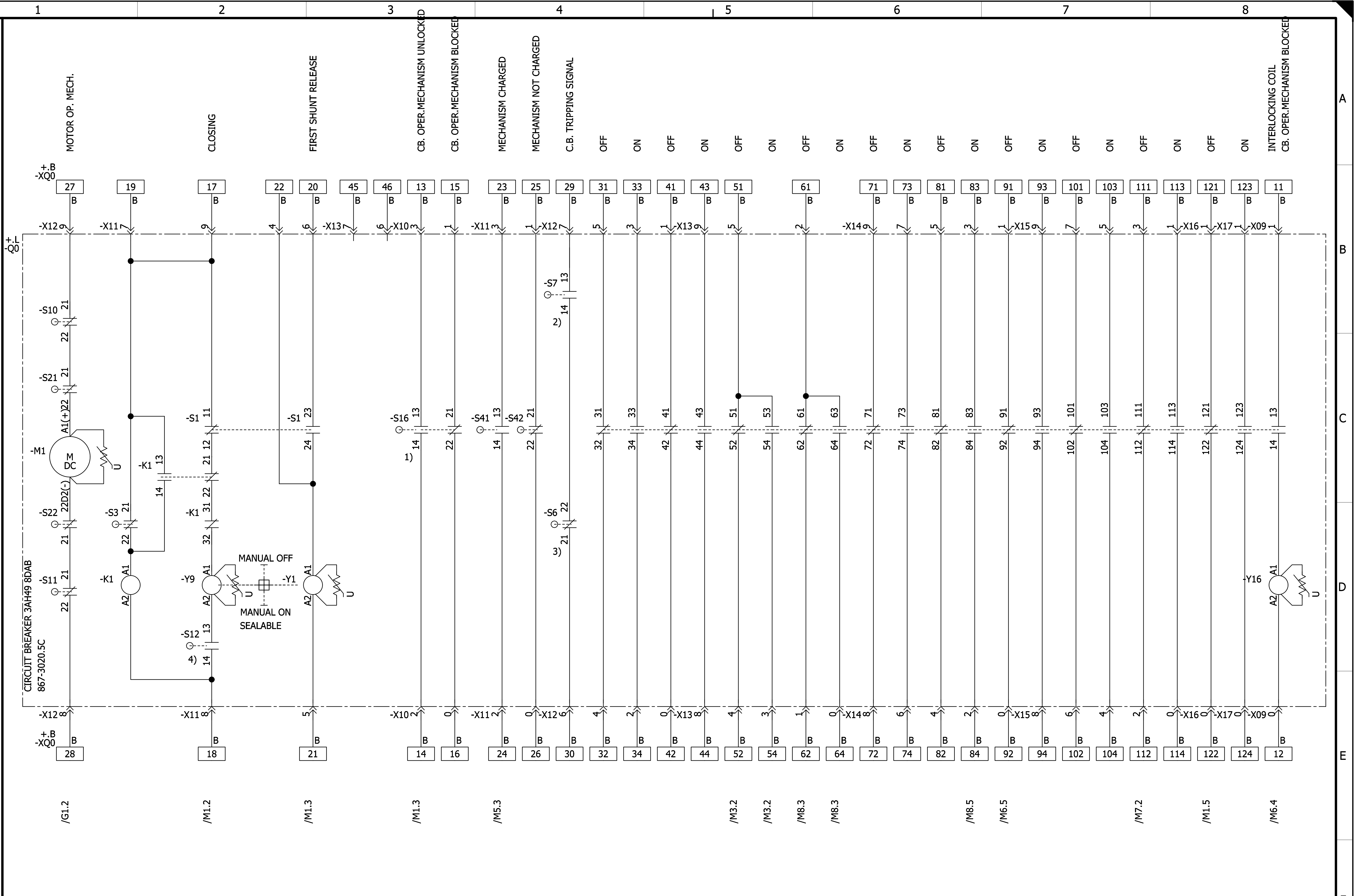
8DA10 25kV SWITCHGEAR
MAIN A
TRANSFORMER CIRCUITS
Circuit diagram

=JZ01 S =J01
+J01 S2
883314 (3) W92210-F2141-S015-B Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) OPERATES WHEN CB. TRIP IS NOT LOCKED OUT

2) OPERATES WHEN MECH. OFF IS NOT PRESSED

3) OPERATES WHEN NO TRIPPING

4) INTERLOCKING OF ELECTRICAL CLOSING OF THE CB IN CASE OF MANUAL OPERATION OF THE THREE-POSITION SWITCH

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

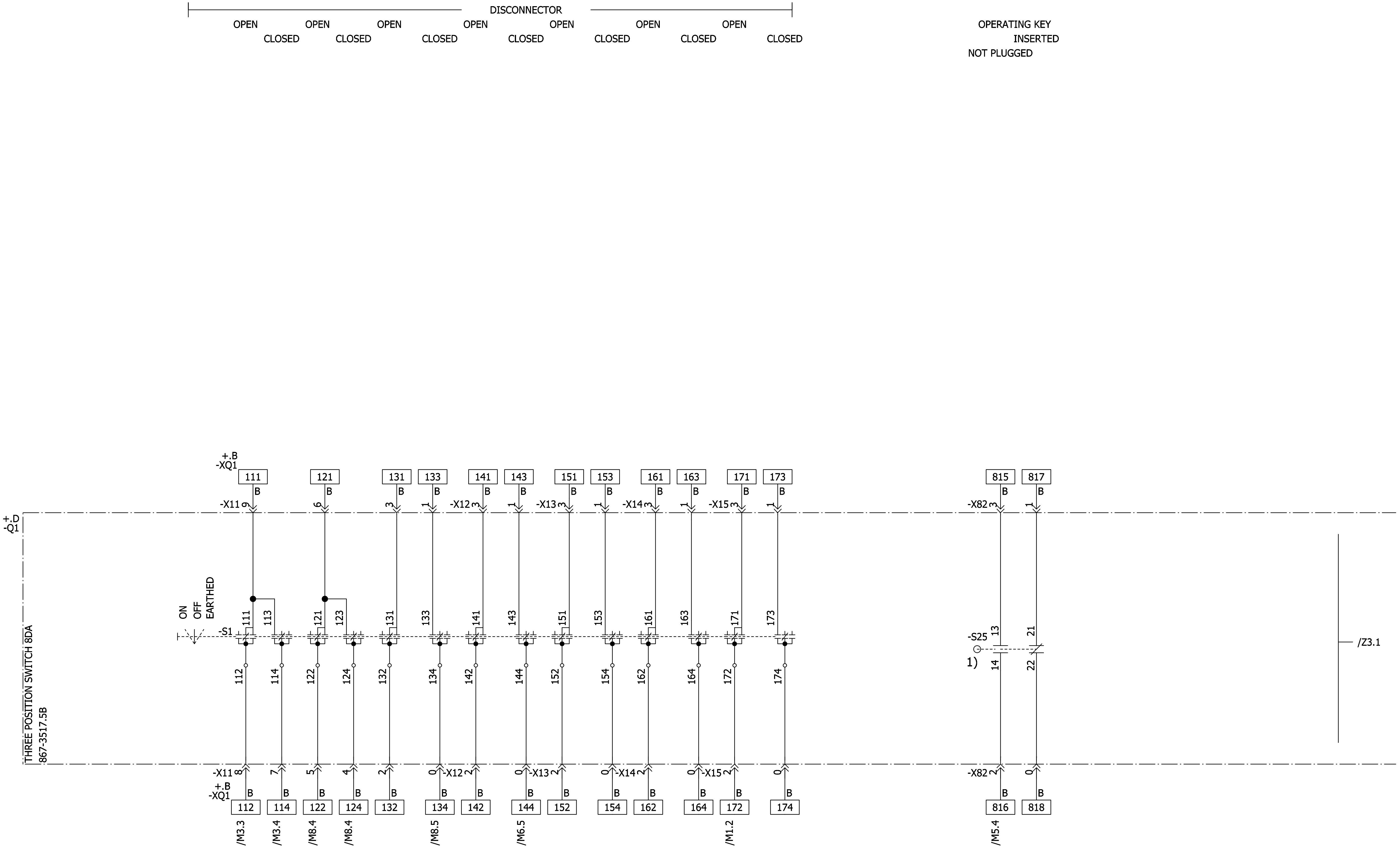
8DA10 25kV SWITCHGEAR
MAIN A
CIRCUIT BREAKER
Circuit diagram

=JZ01
S
=J01
+J01
Z1
883314
(3) W92210-F2141-S015-B
Sheet 1+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) SHOWN WITH LEVER INSERTED

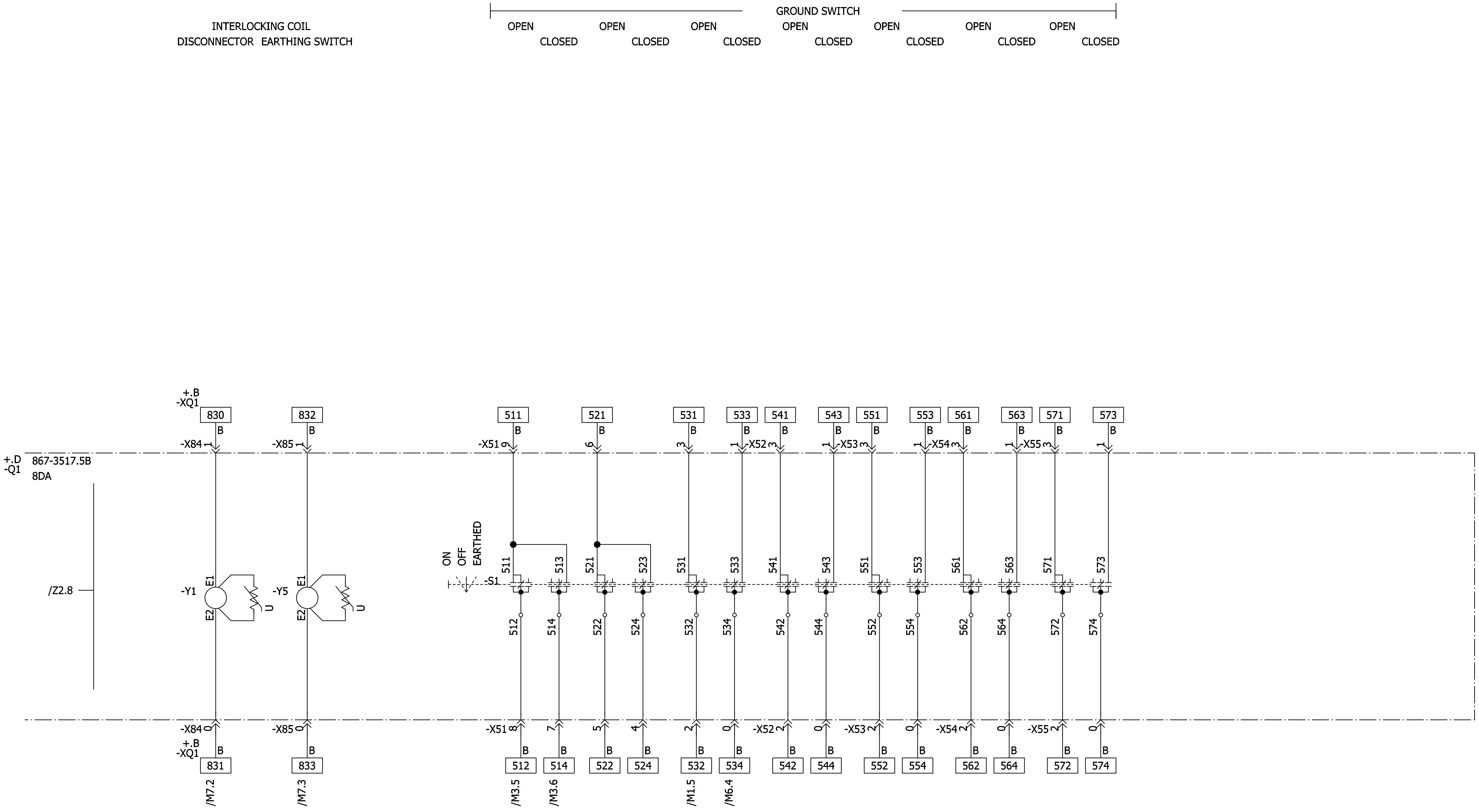
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	Z2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		THREE POSITION SWITCH	883314	(3) W92210-F2141-S015-B		Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name			
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
THREE POSITION SWITCH
Circuit diagram

=JZ01
S =J01
+J01
Z3
883314
(3) W92210-F2141-S015-B
Sheet 3+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 4

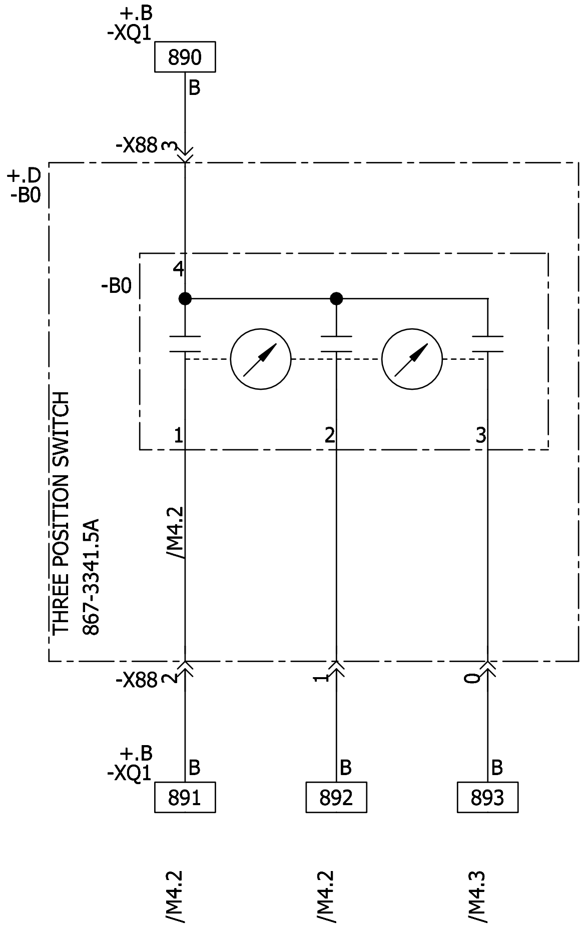
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

GAS PRESSURE MONITORING
CIRCUIT BREAKER -Q0
P<< P< P>

PLEASE NOTE:

MANOMETER WITH 3 ALARM CONTACTS (OPTION)
CONTACT 1: UNDERPRESSURE P<<
CONTACT 2: UNDERPRESSURE P<
CONTACT 3: OVERPRESSURE P>



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
GAS PRESSURE MONITORING
Circuit diagram

=JZ01
S
=J01
+J01
Z4
883314
(3) W92210-F2141-S015-B
Sheet 4+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

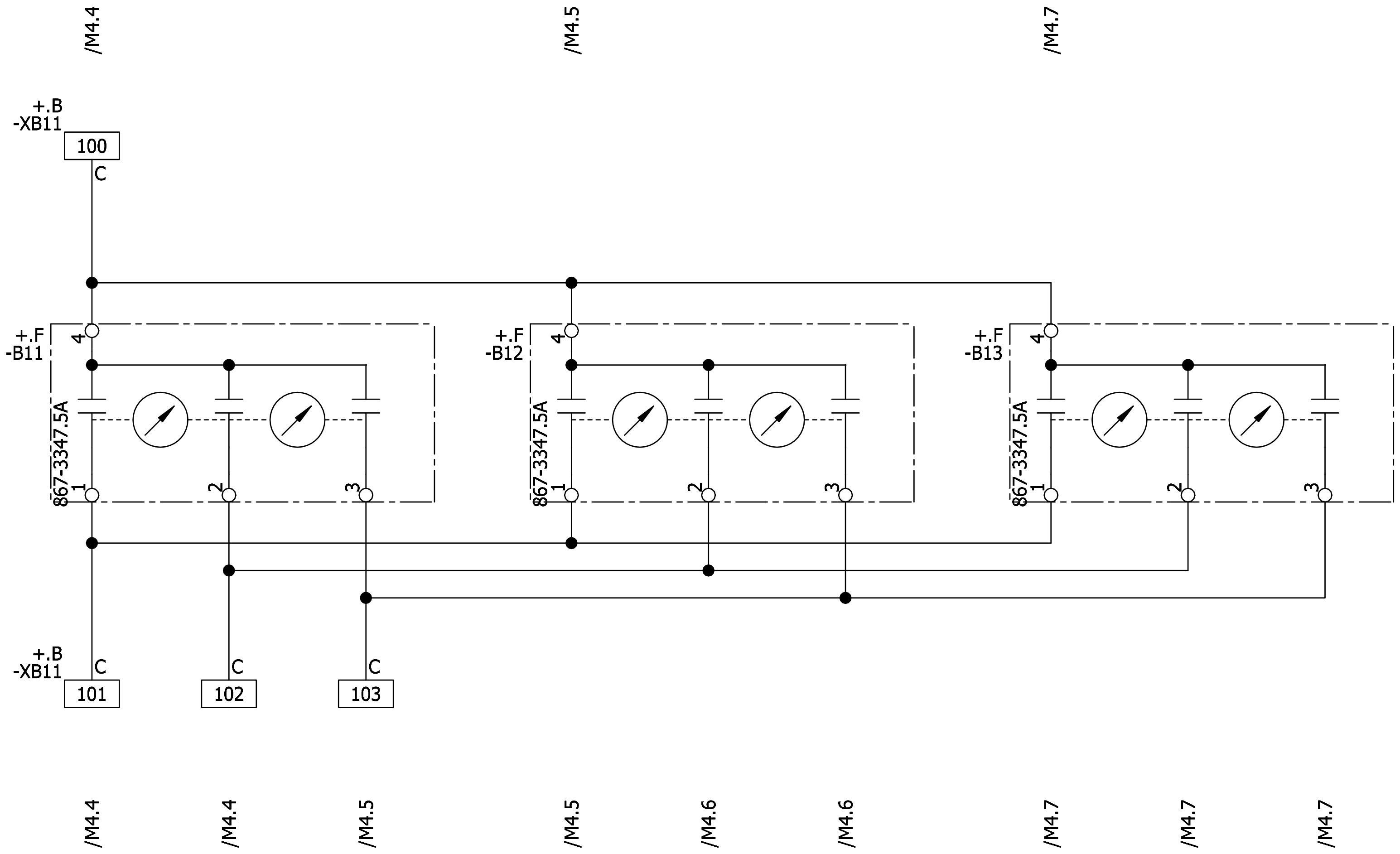
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

GAS PRESSURE MONITORING BUSBAR 1

P<< P< P>

PLEASE NOTE:

MANOMETER WITH 3 ALARM CONTACTS (OPTION)
CONTACT 1: UNDERPRESSURE P<<
CONTACT 2: UNDERPRESSURE P<
CONTACT 3: OVERPRESSURE P>



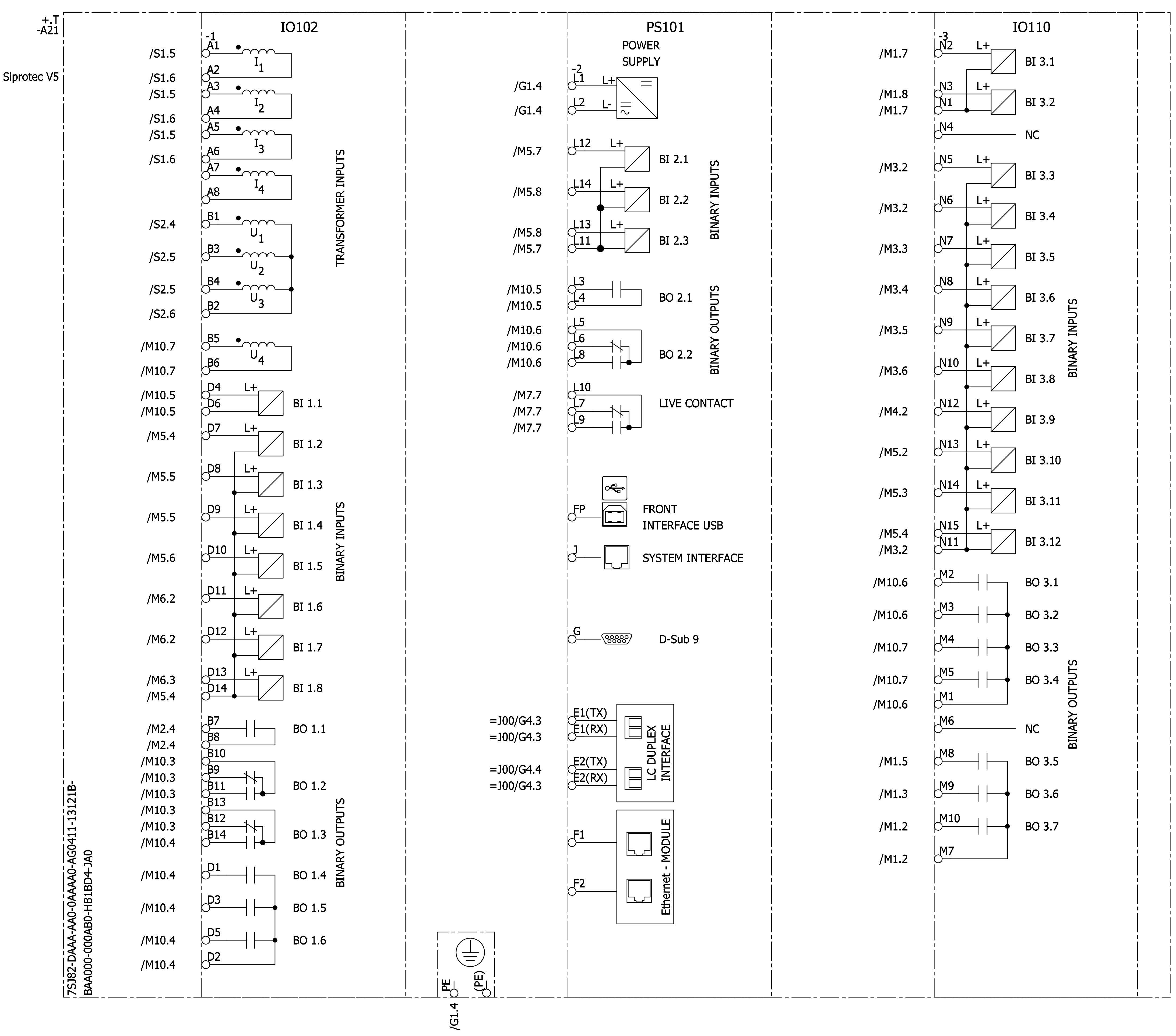
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	Z5
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		GAS PRESSURE MONITORING	883314	(3) W92210-F2141-S015-B		Sheet 5+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
PROTECTION AND CONTROL DEVICE
Circuit diagram

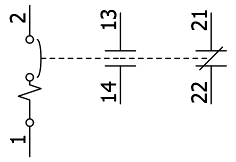
883314
(3) W92210-F2141-S015-B

=JZ01
S
=J01
+J01
Z6
Sheet 6+
9 Sh.

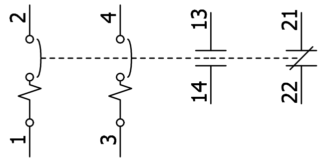
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

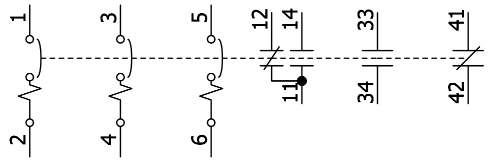
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



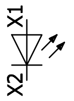
+.B -F100 5SJ4106-7HG41 5ST3010-0HG 1 POLE, 6A	/G2.2		/M9.3
+.B -F101 5SJ4106-7HG41 5ST3010-0HG 1 POLE, 6A	/G2.4		/M9.3



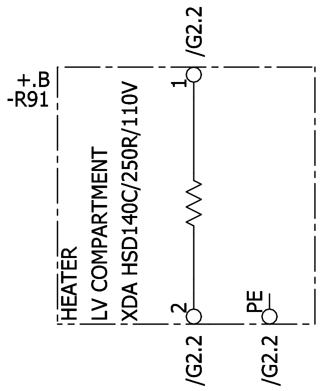
+.B -F10 5SJ4204-7HG41 5ST3010-0HG 2 POLE, 4A	/G1.2	/G1.2	/M6.2	/M9.2
+.B -F20 5SJ4206-7HG41 5ST3010-0HG 2 POLE, 6A	/G1.3	/G1.3		/M9.3

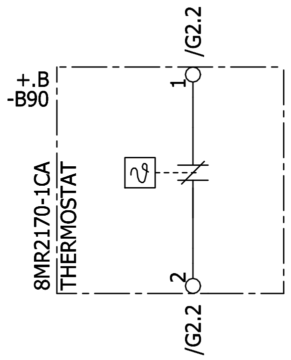


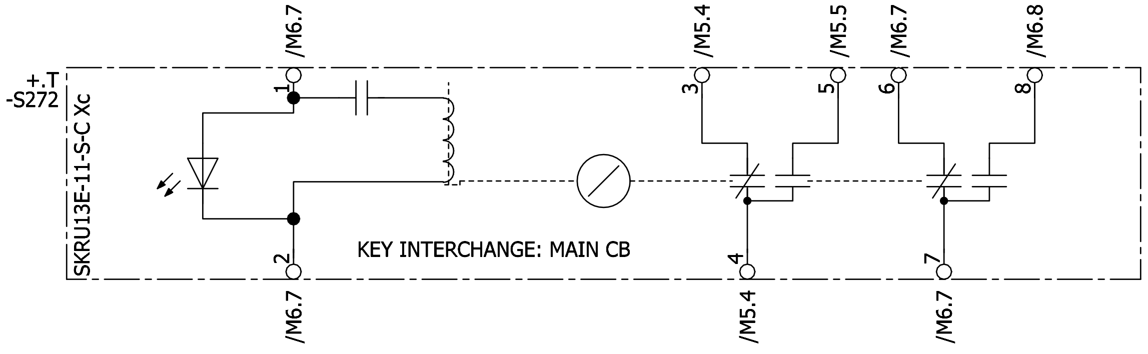
+.B -F50 3RV1611-1DG14 3pol., 3A 3RV1901-1A	/S2.4	/S2.5	/S2.5	/M6.2		/M9.4



+.T -HQ0O 3SB3400-1A CB//OPEN GREEN 3SB3001-6BA40 3SB3901-1DF	/M3.2
+.T -HQ0C 3SB3400-1A CB//CLOSED RED 3SB3001-6BA20 3SB3901-1CF	/M3.3
+.T -H86 3SB3400-1A LOCKOUT HEALTHY WHITE 3SB3001-6BA60 3SB3901-1QF	/M2.4







AUXILARY SWITCH
CIRCUITS 3-4 AND 6-7 ARE NORMALLY CLOSED
AND
CIRCUITS 5-4 AND 8-7 ARE NORMALLY OPEN
WHEN THE KEY IS TRAPPED IN THE INTERLOCK

KIRK KEY INTERLOCK WITH KEY NORMALLY TRAPPED IN LOCK
KEY REMOVABLE WHEN SOLENOID IS ENERGIZED

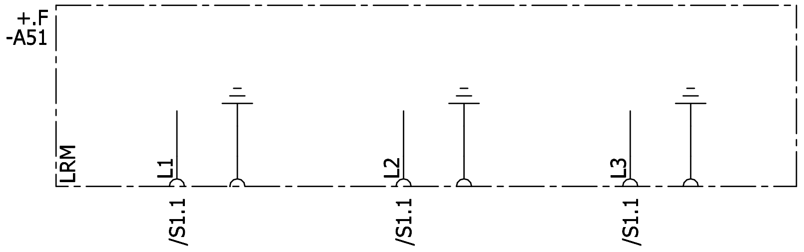
PUSHBUTTON (CLOSE TO ENERGIZE SOLENOID)
SIGNAL LAMP INDICATES WHEN SOLENOID CAN BE ENERGIZED

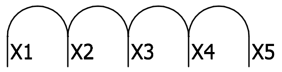
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01 Z7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S015-B	Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

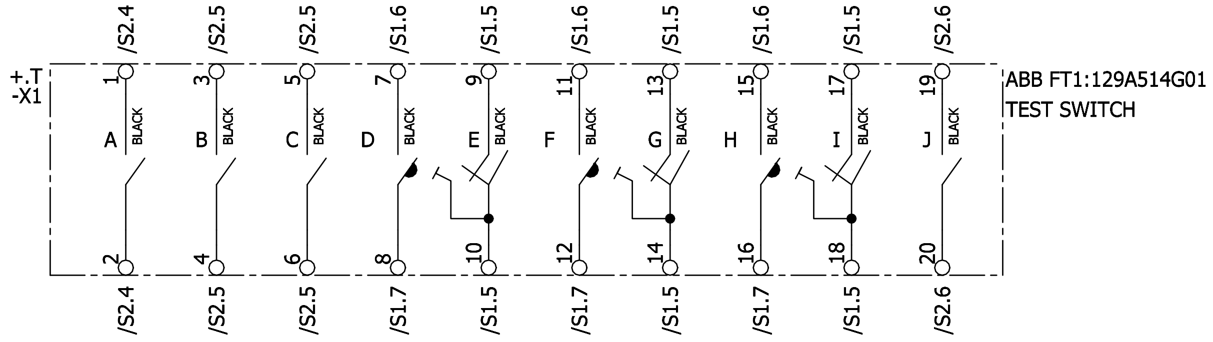
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

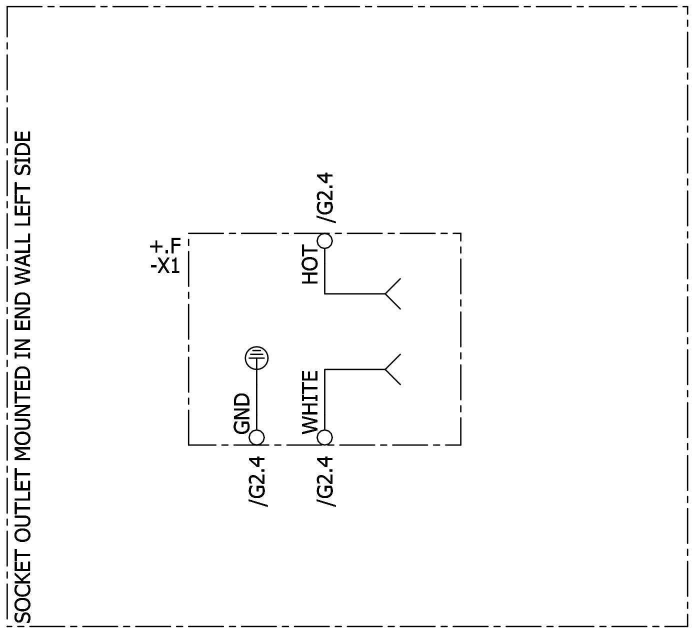




+.F -T1L1	/S1.2	/S1.2	/S1.2
+.F -T1L2	/S1.2	/S1.2	/S1.2
+.F -T1L3	/S1.2	/S1.2	/S1.2

+.F -T5L1	/S2.2
+.F -T5L2	/S2.3
+.F -T5L3	/S2.3





				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A		+J01 Z8
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S015-B Sheet 8+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram		9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 9

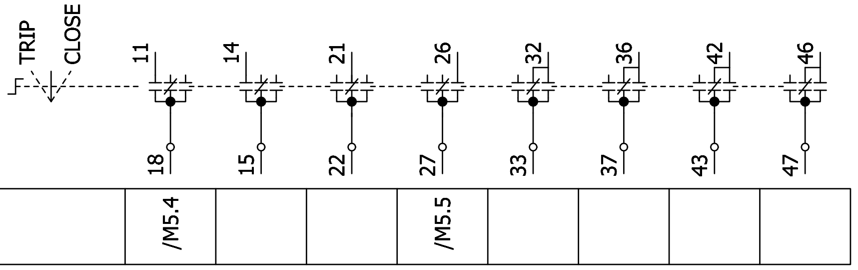
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

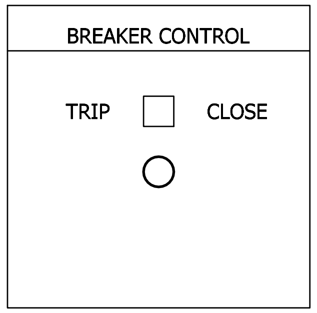
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

nat =NORMAL AFTER TRIP

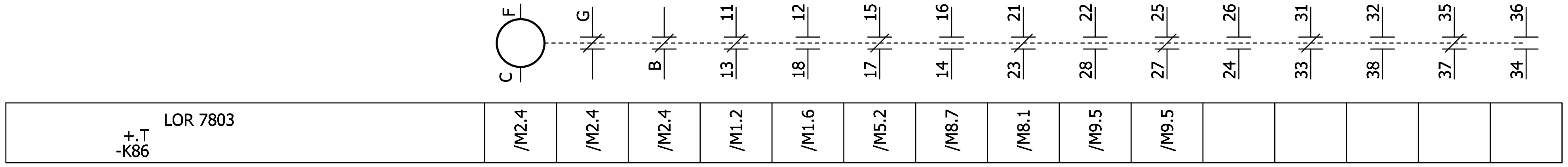
nac =NORMAL AFTER CLOSE

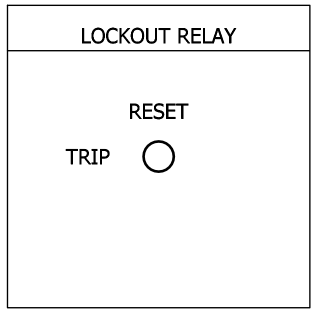
DECK	CONTACTS	POS			
		TRIP	nat	nac	CLOSE
1	11 – 18	X			
	14 – 15	X			
2	21 – 22		X	X	
	26 – 27				X
3	32 – 33			X	X
	36 – 37			X	X
4	42 – 43			X	X
	46 – 47			X	X





DECK	CONTACTS	POSITION	
		TRIP	RESET
I	B – C		X
	F – G		X
1	11 – 13		X
	12 – 18	X	
	15 – 17		X
	16 – 14	X	
2	21 – 23		X
	22 – 28	X	
	25 – 27		X
	26 – 24	X	
3	31 – 33		X
	32 – 38	X	
	35 – 37		X
	36 – 34	X	





				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	Z9
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S015-B		Sheet 9-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				9 Sh.

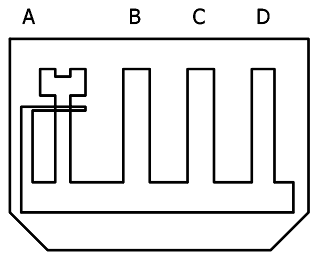
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13
Archive: =J01 / V / / / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

1	2	3	4	5	6	7	8	9	10	11	12	13	14



Cable connection to termination

A B C D

Terminal	Terminal block type	Wire type
11-46	UPCV3K	
	PLUG PC 4/6-STF-7,62	
	UPCV3K-F BEFORE AND AFTER EACH BLOCK OF 6 UPCV3K TERMINALS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 24

Termination A Destination Item designation	Terminal strip Link	Terminal strip Term.-no.	Terminal strip Cross-ref.	Termination B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
		-XR1				
-XC31 :11 B	○	11	=J00/G1.3		-F10 :2	=J02 +.B -XR1 :11 B
-XC31 :13 B	○	12	=J00/G1.3		-F10 :4	=J02 +.B -XR1 :12 B
-XC31 :12 B	○	13	=J00/G1.3		-F20 :2	=J02 +.B -XR1 :13 B
-XC31 :14 B	○	14	=J00/G1.3		-F20 :4	=J02 +.B -XR1 :14 B
-XC31 :21 B	○	15	=J00/G1.3		-F100 :2	=J02 +.B -XR1 :15 B
-XC31 :22 B	○	16	=J00/G1.3		-XC30 :401 D	=J02 +.B -XR1 :16 B
	○	21	=J00/G1.3			=J02 +.B -XR1 :21 B
	○	22	=J00/G1.3			=J02 +.B -XR1 :22 B
	○	23	=J00/G1.3			=J02 +.B -XR1 :23 B
	○	24	=J00/G1.3			=J02 +.B -XR1 :24 B
	○	25	=J00/G1.3			=J02 +.B -XR1 :25 B
	○	26	=J00/G1.3			=J02 +.B -XR1 :26 B
	○	31	=J00/G2.3		-XC30 :800 D	=J02 +.B -XR1 :31 B
	○	32	=J00/G2.3		-XC30 :820 D	=J02 +.B -XR1 :32 B
	○	33	=J00/G2.3			=J02 +.B -XR1 :33 B
	○	34	=J00/G2.3			=J02 +.B -XR1 :34 B
	○	35	=J00/G2.3		+.T -A21-2 :L7	=J02 +.B -XR1 :35 B
	○	36	=J00/G2.3		+.T -A21-2 :L10	=J02 +.B -XR1 :36 B
	○	41	=J00/G3.3			
	○	42	=J00/G3.3			
	○	43	=J00/G3.3			
	○	44	=J00/G3.3			
	○	45	=J00/G3.3			
	○	46	=J00/G3.3			

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

⌒ Cover
—×— Insulation plate
—××— Higher level insulation plate
◉ Test socket
○⌐○ Disconnector

Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XR1
Connection table

=JZ01 V =J01
+.B
883314
(3) W92210-F2141-S018-B
/1
Sheet 1+
16 Sh.

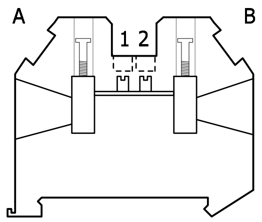
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11-UT
Archive: =J01 / V / / / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1	-J01-W91	SIHSI-CU 3x0,75mm²		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BN														
BU														
GNYE														



1 = Plug-in bridge left
2 = Plug-in bridge right

Cable connection to termination A B

Terminal	Terminal block type	Wire type
1-3	UT 4	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 3

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation	
		-X90 1 2 JUMPER					
-B90	:2	○ □ □ ○	1	/G2.2		-R91	:1
-XC30	:401 C	○ □ □ ○	2	/G2.2		-R91	:2
-XPE	:1 B	○ □ □ ○	3	/G2.2		-R91	:PE

Screen bus	→
N-bus	
PE-PEN-bus	
Used cores total	3
Continued on sheet	

A	Cable clamp	⌒	Cover
B	Screen bus	─┼─	Insulation plate
C	Screwed cable gland	─┼┼─	Higher level insulation plate
D	Plug housing	◉	Test socket
E	Insulated	o⌐o	Disconnector

Revision	Modification	Date	Name			
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-X90
Connection table

883314

=JZ01 V =J01 +.B

(3) W92210-F2141-S018-B

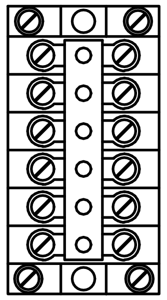
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination
A
B

Terminal	Terminal block type	Wire type
111-136	LJK:1506SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 18

-XT1

Termination A Destination Item designation				Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation			
+.F	-T1L1	:X1			111	/S1.4		+.T	-X1	:10
+.F	-T1L1	:X2			112	/S1.4				
+.F	-T1L1	:X3			113	/S1.4				
+.F	-T1L1	:X4			114	/S1.4				
+.F	-T1L1	:X5			115	/S1.4			-XT1	:125 B
							=J01	+.B	-PE	
			⌓		116	/S1.4				
+.F	-T1L2	:X1			121	/S1.4		+.T	-X1	:14
+.F	-T1L2	:X2			122	/S1.4				
+.F	-T1L2	:X3			123	/S1.4				
+.F	-T1L2	:X4			124	/S1.4				
+.F	-T1L2	:X5			125	/S1.4			-XT1	:115 B
									-XT1	:135 B
			⌓		126	/S1.4				
+.F	-T1L3	:X1			131	/S1.4		+.T	-X1	:18
+.F	-T1L3	:X2			132	/S1.4				
+.F	-T1L3	:X3			133	/S1.4				
+.F	-T1L3	:X4			134	/S1.4				
+.F	-T1L3	:X5			135	/S1.4			-XT1	:125 B
								+.T	-X1	:16
			⌓		136	/S1.4				

Screen bus	
N-bus	
PE-PEN-bus	
Used cores total	
Continued on sheet	

⌓ Cover
–✕– Insulation plate
–✕✕– Higher level insulation plate
◉ Test socket
○⌐○ Disconnector

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XT1
Connection table

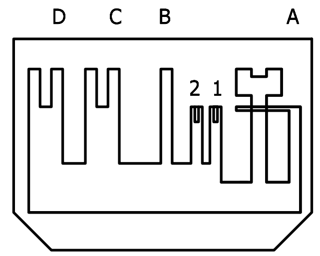
=JZ01	V	=J01		
		+.B	/3	
883314	(3) W92210-F2141-S018-B		Sheet 3+	16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
501-509	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 6

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination D Destination Item designation	Termination C Destination Item designation	Slot B Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.		Termination A Destination Item designation
			-XT5				
			JUMPER 2 1				
+.F -T5L1 :a	-F50 :1		● □ □	501	/S2.4	⊖	
+.F -T5L1 :n	=J01 +.B -PE		● ■ □	503	/S2.6	⊖	
+.F -T5L2 :a	-F50 :3		● □ □	504	/S2.5	⊖	
+.F -T5L2 :n			● ■ □	506	/S2.6	⊖	
+.F -T5L3 :a	-F50 :5		● □ □	507	/S2.5	⊖	
+.F -T5L3 :n	+.T -X1 :19		● ■ □	509	/S2.6	⊖	

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

⌒ Cover
—×— Insulation plate
—⨯⨯— Higher level insulation plate
◉ Test socket
○⌐○ Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XT5
Connection table

=JZ01
V
=J01
+.B
/4
883314
(3) W92210-F2141-S018-B
Sheet 4+
16 Sh.

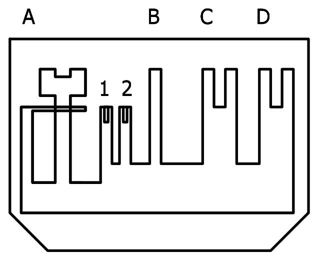
CopyRight (C) Siemens AG 2015 All Rights Reserved

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 58

Cable connection to termination

A ☐ B ◤ C ◥ D ◢

1	2	3	4	5	6	7	8	9

Terminal strip -XC30

Link 1	Link 2 (JUMPER)	Term.-no.	Cross-ref.	Termination A Destination Item designation	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
■	□	300	/G1.3				-F20 :1
■	□	301	/M1.2				+.T -A21-3 :M7
■	□	302	/M2.4				+.T -H86 :X1
■	□	303	/M2.4				+.T -A21-1 :B7
■	□	304	/M3.2				-XQ0 :51 D
■	□	305	/M4.2				-XQ1 :890 D
■	□	306	/M5.2				+.T -K86 :15
■	□	307	/M5.3				-XQ0 :23 D
■	□	308	/M5.4				+.T -S272 :4
■	□	309	/M6.2				-F10 :13
■	□	310	/M6.4				-XQ1 :533 D
■	□	311	/M6.5				-XQ1 :143 D
■	□	312	/M6.7				+.T -S272 :7
■	□	313	/M6.7				
■	□	314	/M6.8				
□	■	320	/G1.3				-F20 :3
□	■	321	/M1.2			-XQ0 :14 D	+.T -K86 :13
□	■	322	/M2.4				+.T -K86 :B
□	■	323	/M3.2				+.T -A21-3 :N11
□	■	324	/M5.4				+.T -A21-1 :D14
□	■	325	/M5.7				+.T -A21-2 :L11
□	■	326	/M6.4				-XQ0 :12 D
□	■	327	/M6.5				-XC31 :53 B
□	■	328	/M6.7				+.T -S272 :2
□	■	329	/M6.7				
□	■	330	/M6.7				
□	■	331	/M6.8				
□	■	332	/M6.8				
□	■	333	/M6.8				
□	■	334	/M6.8				
■	□	340	/M1.6			+.T -K86 :12	-XC31 :32 B
■	□	341	/M1.7				+.T -A21-3 :N2
□	■	342	/M1.6			+.T -K86 :18	-XC31 :34 B
□	■	343	/M1.7				+.T -A21-3 :N1
□	□	400	/G2.4	+.F -X1 :HOT			-F101 :1
□	□	401	/G2.2	+.F -X1 :WHITE		-X90 :2 A	-XR1 :16 C
■	□	800	/G1.6				-XR1 :31 C
■	□	801	/M7.2			-XC31 :63 B	-XC31 :61 B
■	□	802	/M7.4				
■	□	803	/M7.5				

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

→	A Cable clamp	⌒	Cover
	B Screen bus	─╳─	Insulation plate
	C Screwed cable gland	─╳╳─	Higher level insulation plate
	D Plug housing	◉	Test socket
	E Insulated	⊸○	Disconnector

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC30
Connection table

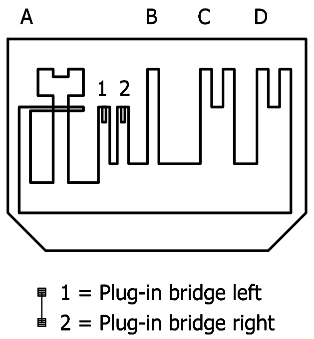
=JZ01
V =J01
+.B
/5
883314
(3) W92210-F2141-S018-B
Sheet 5+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 58

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation

Terminal strip -XC30

Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
■	□	●	804	/M7.5			
■	□	●	805	/M7.6			
□	■	●	820	/G1.6			-XR1 :32 C
□	■	●	821	/M7.2			-XQ0 :112 D
□	■	●	822	/M7.4			
□	■	●	823	/M7.5			
□	■	●	824	/M7.5			
□	■	●	825	/M7.6			
□	□	●	901	/M9.7			
□	□	●	902	/M9.7			
□	□	●	903	/M9.7			
□	□	●	904	/M9.7			
□	□	●	905	/M9.7			
□	□	●	906	/M9.8			
□	□	●	907	/M9.8			
□	□	●	908	/M9.8			
□	□	●	909	/M9.8			
□	□	●	910	/M9.8			

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp — Cover
B Screen bus — Insulation plate
C Screwed cable gland — Higher level insulation plate
D Plug housing — Test socket
E Insulated — Disconnector

Revision	Modification	Date	Name							
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 V =J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	+.B	/6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J01+.B-XC30	883314 (3) W92210-F2141-S018-B	Sheet 6+
				Norm		Orig./Prep.for/Prep.by		Connection table		16 Sh.

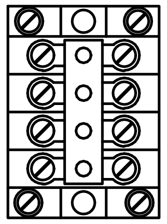
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination
A
B

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

-XC31

Termination A Destination Item designation				Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation		
=EXT	+EXT				11	/G1.2		-XR1	:11 A
								-XC31	:12 B
					12	/G1.3		-XR1	:13 A
								-XC31	:11 B
=EXT	+EXT				13	/G1.2		-XR1	:12 A
								-XC31	:14 B
					14	/G1.3		-XR1	:14 A
								-XC31	:13 B
=EXT	+EXT				21	/G2.2		-XR1	:15 A
=EXT	+EXT				22	/G2.2		-XR1	:16 A
					23	/G2.2			
					24	/G2.3			
		-XC31	:32 A		31	/M1.5	+.T	-A21-3	:M7
=EXT	+EXT								
		-XC31	:31 A		32	/M1.5		-XC30	:340 D
=EXT	+EXT								
		-XC31	:34 A		33	/M1.5		-XQ1	:531 C
=EXT	+EXT								
		-XC31	:33 A		34	/M1.5		-XC30	:342 D
=EXT	+EXT								
=EXT	+EXT				41	/M5.5		-XC31	:42 B
							+.T	-S272	:5
=EXT	+EXT				42	/M5.6		-XC31	:41 B
=EXT	+EXT				43	/M5.5	+.T	-A21-1	:D9
=EXT	+EXT				44	/M5.6	+.T	-A21-1	:D10
=EXT	+EXT				51	/M6.5		-XQ0	:92 D
=EXT	+EXT				52	/M6.6		-XQ0	:94 D
=EXT	+EXT				53	/M6.5		-XC31	:54 B
								-XC30	:327 D
=EXT	+EXT				54	/M6.6		-XC31	:53 B
		-XC31	:62 A		61	/M7.2		-XC30	:801 D
=EXT	+EXT								
		-XC31	:61 A		62	/M7.2		-XQ1	:830 D
=EXT	+EXT								
		-XC31	:64 A		63	/M7.3		-XC30	:801 C
=EXT	+EXT								
		-XC31	:63 A		64	/M7.3		-XQ1	:832 D
=EXT	+EXT								
		-XC31	:72 A		71	/M1.2		-XQ1	:171 C
=EXT	+EXT								

Screen bus	
N-bus	
PE-PEN-bus	
Used cores total	
Continued on sheet	

- ⌒ Cover
- ✕ Insulation plate
- ✕✕ Higher level insulation plate
- ◉ Test socket
- ○⌐○ Disconnector

Revision	Modification	Date	Name				
A	CERTIFIED	06-30-15	BM	Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT	
				Appr.	Magnuson	VENTILATION BUILDING EAST	
				Norm		Orig./Prep.for/Prep.by	

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC31
Connection table

=JZ01	V	=J01	
		+.B	/7
883314	(3) W92210-F2141-S018-B		Sheet 7+
			16 Sh.

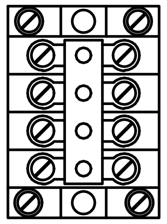
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination
A
B

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation
		-XC31				
-XC31 :71 A			72	/M1.2		-XC31 :73 B
=EXT +EXT						
-XC31 :74 A			73	/M1.2		-XC31 :72 B
=EXT +EXT						
-XC31 :73 A	⌒		74	/M1.2		-XQ0 :17 D
=EXT +EXT						
			81	/M9.7		
			82	/M9.7		
			83	/M9.7		
	⌒		84	/M9.7		
			91	/M9.7		
			92	/M9.8		
			93	/M9.8		
	⌒		94	/M9.8		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
✕	Insulation plate
✕✕	Higher level insulation plate
◉	Test socket
⊶	Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC31
Connection table

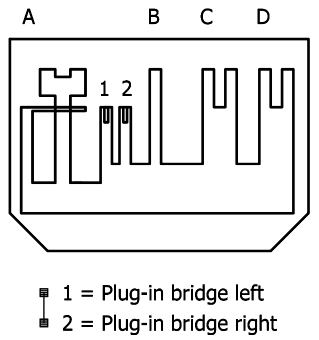
=JZ01 V =J01 +.B /8
883314
(3) W92210-F2141-S018-B
Sheet 8+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 45

Cable connection to termination
A B C D
1 2 3 4 5 6 7 8 9

-XC32

1 2 JUMPER

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖ □ □ ● — —	100	/M5.8			+.T -A21-2 :L14
	⊖ □ □ ● — —	101	/M5.8			+.T -A21-2 :L13
	⊖ □ □ ● — —	102	/M6.3			+.T -A21-1 :D13
	⊖ □ □ ● — —	103	/M8.1			+.T -K86 :21
	⊖ □ □ ● — —	104	/M8.1			+.T -K86 :23
	⊖ □ □ ● — —	105	/M8.3			-XQ0 :61 D
	⊖ □ □ ● — —	106	/M8.3			-XQ0 :62 D
	⊖ □ □ ● — —	107	/M8.5			-XQ1 :133 D
	⊖ □ □ ● — —	108	/M8.5			-XQ0 :84 D
	⊖ □ □ ● — —	109	/M8.7			+.T -K86 :16
	⊖ □ □ ● — —	110	/M8.7			+.T -K86 :14
	⊖ □ □ ● — —	111	/M9.2			-F10 :21
	⊖ □ □ ● — —	112	/M9.2			-F10 :22
	⊖ □ □ ● — —	113	/M9.4			-F50 :41
	⊖ □ □ ● — —	114	/M9.4			-F50 :42
	⊖ □ □ ● — —	115	/M9.5			+.T -K86 :25
	⊖ □ □ ● — —	116	/M9.5			+.T -K86 :27
	⊖ □ □ ● — —	117	/M9.5			+.T -K86 :22
	⊖ □ □ ● — —	118	/M9.5			+.T -K86 :28
	⊖ □ □ ● — —	119	/M9.7			
	⊖ □ □ ● — —	120	/M9.7			
	⊖ □ □ ● — —	130	/M10.3			+.T -A21-1 :B10
	⊖ □ □ ● — —	131	/M10.3			+.T -A21-1 :B9
	⊖ □ □ ● — —	132	/M10.3			+.T -A21-1 :B11
	⊖ □ □ ● — —	133	/M10.3			+.T -A21-1 :B13
	⊖ □ □ ● — —	134	/M10.3			+.T -A21-1 :B12
	⊖ □ □ ● — —	135	/M10.4			+.T -A21-1 :B14
	⊖ □ □ ● — —	136	/M10.4			+.T -A21-1 :D2
	⊖ □ □ ● — —	137	/M10.4			+.T -A21-1 :D1
	⊖ □ □ ● — —	138	/M10.4			+.T -A21-1 :D3
	⊖ □ □ ● — —	139	/M10.4			+.T -A21-1 :D5
	⊖ □ □ ● — —	140	/M10.5			+.T -A21-1 :D4
	⊖ □ □ ● — —	141	/M10.5			+.T -A21-1 :D6
	⊖ □ □ ● — —	142	/M10.5			+.T -A21-2 :L3
	⊖ □ □ ● — —	143	/M10.5			+.T -A21-2 :L4
	⊖ □ □ ● — —	144	/M10.6			+.T -A21-2 :L5
	⊖ □ □ ● — —	145	/M10.6			+.T -A21-2 :L6
	⊖ □ □ ● — —	146	/M10.6			+.T -A21-2 :L8
	⊖ □ □ ● — —	147	/M10.6			+.T -A21-3 :M1
	⊖ □ □ ● — —	148	/M10.6			+.T -A21-3 :M2

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	—X—	Insulation plate
C Screwed cable gland	—XX—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⁄○	Disconnector

Revision	Modification	Date	Name			
				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC32
Connection table

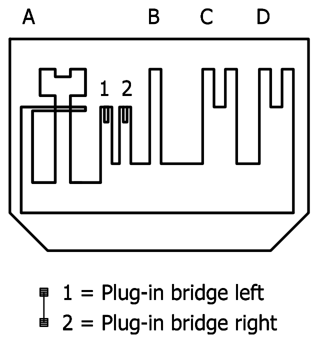
=JZ01
V
=J01
+.B
/9
883314
(3) W92210-F2141-S018-B
Sheet 9+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 45

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9	Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										-XC32					
										1 2 JUMPER					
										⊖ □ □ ●	149	/M10.6			+.T -A21-3 :M3
										⊖ □ □ ●	150	/M10.7			+.T -A21-3 :M4
										⊖ □ □ ●	151	/M10.7			+.T -A21-3 :M5
										⊖ □ □ ●	152	/M10.7			+.T -A21-1 :B5
										⊖ □ □ ●	153	/M10.7			+.T -A21-1 :B6

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A	Cable clamp	⌒	Cover
B	Screen bus	─┼─	Insulation plate
C	Screwed cable gland	─┼┼─	Higher level insulation plate
D	Plug housing	◉	Test socket
E	Insulated	○╱○	Disconnector

Revision	Modification	Date	Name			
				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC32
Connection table

=JZ01 V =J01 +.B /10

883314 (3) W92210-F2141-S018-B

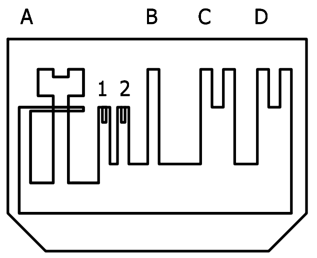
Sheet 10+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 11

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XQ0					
	1 2 JUMPER					
	⊖ □ □ ● — —	11	/M6.4	+.L -Q0-X09 :1		-XQ1 :534 D
	⊖ □ □ ● — —	12	/M6.4	+.L -Q0-X09 :0		-XC30 :326 D
	⊖ □ □ ● — —	13	/M1.3	+.L -Q0-X10 :3		-XQ0 :21 D
	⊖ □ □ ● — —	14	/M1.3	+.L -Q0-X10 :2		-XC30 :321 C
	⊖ □ □ ● — —	15	/Z1.3	+.L -Q0-X10 :1		
	⊖ □ □ ● — —	16	/Z1.3	+.L -Q0-X10 :0		
	⊖ □ □ ● — —	17	/M1.2	+.L -Q0-X11 :9	-XQ1 :172 D	-XC31 :74 B
	⊖ □ □ ● — —	18	/M1.2	+.L -Q0-X11 :8		+.T -K86 :11
	⊖ □ □ ● — —	19	/Z1.1	+.L -Q0-X11 :7		
	⊖ □ □ ● — —	20	/M1.3	+.L -Q0-X11 :6	-XQ1 :532 D	+.T -A21-3 :M9
	⊖ □ □ ● — —	21	/M1.3	+.L -Q0-X11 :5		-XQ0 :13 D
	⊖ □ □ ● — —	22	/M1.4	+.L -Q0-X11 :4		-XQ0 :121 D
	⊖ □ □ ● — —	23	/M5.3	+.L -Q0-X11 :3	-XQ1 :815 D	-XC30 :307 D
	⊖ □ □ ● — —	24	/M5.3	+.L -Q0-X11 :2		+.T -A21-3 :N14
	⊖ □ □ ● — —	25	/Z1.4	+.L -Q0-X11 :1		
	⊖ □ □ ● — —	26	/Z1.4	+.L -Q0-X11 :0		
	⊖ □ □ ● — —	27	/G1.2	+.L -Q0-X12 :9		-F10 :1
	⊖ □ □ ● — —	28	/G1.2	+.L -Q0-X12 :8		-F10 :3
	⊖ □ □ ● — —	29	/Z1.4	+.L -Q0-X12 :7		
	⊖ □ □ ● — —	30	/Z1.4	+.L -Q0-X12 :6		
	⊖ □ □ ● — —	31	/Z1.4	+.L -Q0-X12 :5		
	⊖ □ □ ● — —	32	/Z1.4	+.L -Q0-X12 :4		
	⊖ □ □ ● — —	33	/Z1.4	+.L -Q0-X12 :3		
	⊖ □ □ ● — —	34	/Z1.4	+.L -Q0-X12 :2		
	⊖ □ □ ● — —	41	/Z1.5	+.L -Q0-X12 :1		
	⊖ □ □ ● — —	42	/Z1.5	+.L -Q0-X12 :0		
	⊖ □ □ ● — —	43	/Z1.5	+.L -Q0-X13 :9		
	⊖ □ □ ● — —	44	/Z1.5	+.L -Q0-X13 :8		
	⊖ □ □ ● — —	45	/Z1.3	+.L -Q0-X13 :7		
	⊖ □ □ ● — —	46	/Z1.3	+.L -Q0-X13 :6		
	⊖ □ □ ● — —	51	/M3.2	+.L -Q0-X13 :5	-XQ1 :111 D	-XC30 :304 D
	⊖ □ □ ● — —	52	/M3.2	+.L -Q0-X13 :4	+.T -HQ0O :X1	+.T -A21-3 :N5
	⊖ □ □ ● — —	54	/M3.2	+.L -Q0-X13 :3	+.T -HQ0C :X1	+.T -A21-3 :N6
	⊖ □ □ ● — —	61	/M8.3	+.L -Q0-X13 :2	-XQ1 :121 D	-XC32 :105 D
	⊖ □ □ ● — —	62	/M8.3	+.L -Q0-X13 :1	-XQ1 :122 D	-XC32 :106 D
	⊖ □ □ ● — —	64	/M8.3	+.L -Q0-X13 :0		
	⊖ □ □ ● — —	71	/Z1.6	+.L -Q0-X14 :9		
	⊖ □ □ ● — —	72	/Z1.6	+.L -Q0-X14 :8		
	⊖ □ □ ● — —	73	/Z1.6	+.L -Q0-X14 :7		
	⊖ □ □ ● — —	74	/Z1.6	+.L -Q0-X14 :6		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌓	Cover
B Screen bus	—×—	Insulation plate
C Screwed cable gland	—××—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Date	05-18-15
				Norm	

Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ0
Connection table

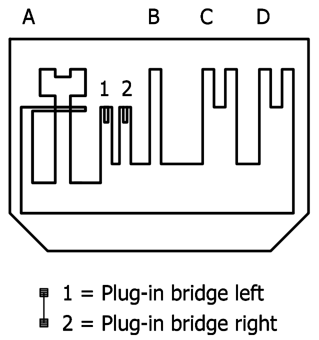
=JZ01
V
=J01
+.B
/11
883314
(3) W92210-F2141-S018-B
Sheet 11+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 12

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A ☐ B ◤ C ◥ D ◢

Cable connection 1	2	3	4	5	6	7	8	9	Termination A Destination Item designation	Terminal strip -XQ0 Link (1 2 JUMPER)	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										⊖ □ □ ● — —	81	/Z1.6	+.L -Q0-X14 :5		
										⊖ □ □ ● — —	82	/Z1.6	+.L -Q0-X14 :4		
										⊖ □ □ ● — —	83	/M8.5	+.L -Q0-X14 :3		-XQ1 :134 D
										⊖ □ □ ● — —	84	/M8.5	+.L -Q0-X14 :2		-XC32 :108 D
										⊖ □ □ ● — —	91	/M6.5	+.L -Q0-X14 :1	-XQ1 :144 D	-XQ0 :93 D
										⊖ □ □ ● — —	92	/M6.5	+.L -Q0-X14 :0		-XC31 :51 B
										⊖ □ □ ● — —	93	/M6.6	+.L -Q0-X15 :9		-XQ0 :91 D
										⊖ □ □ ● — —	94	/M6.6	+.L -Q0-X15 :8		-XC31 :52 B
										⊖ □ □ ● — —	101	/Z1.7	+.L -Q0-X15 :7		
										⊖ □ □ ● — —	102	/Z1.7	+.L -Q0-X15 :6		
										⊖ □ □ ● — —	103	/Z1.7	+.L -Q0-X15 :5		
										⊖ □ □ ● — —	104	/Z1.7	+.L -Q0-X15 :4		
										⊖ □ □ ● — —	111	/M7.2	+.L -Q0-X15 :3		-XQ1 :831 C
										⊖ □ □ ● — —	112	/M7.2	+.L -Q0-X15 :2		-XC30 :821 D
										⊖ □ □ ● — —	113	/Z1.8	+.L -Q0-X15 :1		
										⊖ □ □ ● — —	114	/Z1.8	+.L -Q0-X15 :0		
										⊖ □ □ ● — —	121	/M1.5	+.L -Q0-X16 :1		-XQ0 :22 D
										⊖ □ □ ● — —	122	/M1.5	+.L -Q0-X16 :0		+.T -A21-3 :N3
										⊖ □ □ ● — —	123	/Z1.8	+.L -Q0-X17 :1		
										⊖ □ □ ● — —	124	/Z1.8	+.L -Q0-X17 :0		

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	—✕—	Insulation plate
C Screwed cable gland	—✕✕—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ0
Connection table

883314
(3) W92210-F2141-S018-B

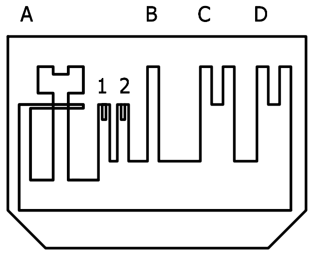
=JZ01 V =J01
+.B
/12
Sheet 12+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 13

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A B C D

1 2 3 4 5 6 7 8 9

-XQ1

1 2 JUMPER

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖ □ □ ●	111	/M3.3	+.D -Q1-X11 :9	-XQ1 :511 D	-XQ0 :51 C
	⊖ □ □ ●	112	/M3.3	+.D -Q1-X11 :8		+.T -A21-3 :N7
	⊖ □ □ ●	114	/M3.4	+.D -Q1-X11 :7		+.T -A21-3 :N8
	⊖ □ □ ●	121	/M8.4	+.D -Q1-X11 :6		-XQ0 :61 C
	⊖ □ □ ●	122	/M8.4	+.D -Q1-X11 :5		-XQ0 :62 C
	⊖ □ □ ●	124	/M8.4	+.D -Q1-X11 :4		
	⊖ □ □ ●	131	/Z2.3	+.D -Q1-X11 :3		
	⊖ □ □ ●	132	/Z2.3	+.D -Q1-X11 :2		
	⊖ □ □ ●	133	/M8.5	+.D -Q1-X11 :1		-XC32 :107 D
	⊖ □ □ ●	134	/M8.5	+.D -Q1-X11 :0		-XQ0 :83 D
	⊖ □ □ ●	141	/Z2.3	+.D -Q1-X12 :3		
	⊖ □ □ ●	142	/Z2.3	+.D -Q1-X12 :2		
	⊖ □ □ ●	143	/M6.5	+.D -Q1-X12 :1		-XC30 :311 D
	⊖ □ □ ●	144	/M6.5	+.D -Q1-X12 :0		-XQ0 :91 C
	⊖ □ □ ●	151	/Z2.4	+.D -Q1-X13 :3		
	⊖ □ □ ●	152	/Z2.4	+.D -Q1-X13 :2		
	⊖ □ □ ●	153	/Z2.4	+.D -Q1-X13 :1		
	⊖ □ □ ●	154	/Z2.4	+.D -Q1-X13 :0		
	⊖ □ □ ●	161	/Z2.4	+.D -Q1-X14 :3		
	⊖ □ □ ●	162	/Z2.4	+.D -Q1-X14 :2		
	⊖ □ □ ●	163	/Z2.5	+.D -Q1-X14 :1		
	⊖ □ □ ●	164	/Z2.5	+.D -Q1-X14 :0		
	⊖ □ □ ●	171	/M1.2	+.D -Q1-X15 :3	-XC31 :71 B	+.T -A21-3 :M10
	⊖ □ □ ●	172	/M1.2	+.D -Q1-X15 :2		-XQ0 :17 C
	⊖ □ □ ●	173	/Z2.5	+.D -Q1-X15 :1		
	⊖ □ □ ●	174	/Z2.5	+.D -Q1-X15 :0		
	⊖ □ □ ●	511	/M3.5	+.D -Q1-X51 :9		-XQ1 :111 C
	⊖ □ □ ●	512	/M3.5	+.D -Q1-X51 :8		+.T -A21-3 :N9
	⊖ □ □ ●	514	/M3.6	+.D -Q1-X51 :7		+.T -A21-3 :N10
	⊖ □ □ ●	521	/Z3.4	+.D -Q1-X51 :6		
	⊖ □ □ ●	522	/Z3.4	+.D -Q1-X51 :5		
	⊖ □ □ ●	524	/Z3.4	+.D -Q1-X51 :4		
	⊖ □ □ ●	531	/M1.5	+.D -Q1-X51 :3	-XC31 :33 B	+.T -A21-3 :M8
	⊖ □ □ ●	532	/M1.5	+.D -Q1-X51 :2		-XQ0 :20 C
	⊖ □ □ ●	533	/M6.4	+.D -Q1-X51 :1		-XC30 :310 D
	⊖ □ □ ●	534	/M6.4	+.D -Q1-X51 :0		-XQ0 :11 D
	⊖ □ □ ●	541	/Z3.5	+.D -Q1-X52 :3		
	⊖ □ □ ●	542	/Z3.5	+.D -Q1-X52 :2		
	⊖ □ □ ●	543	/Z3.5	+.D -Q1-X52 :1		
	⊖ □ □ ●	544	/Z3.5	+.D -Q1-X52 :0		

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	―×―	Insulation plate
C Screwed cable gland	―××―	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⁄○	Disconnector

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ1
Connection table

883314

=JZ01

V

=J01
+.B

(3) W92210-F2141-S018-B

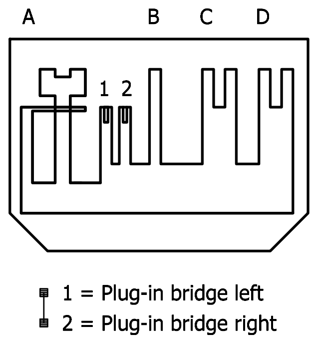
/13
Sheet 13+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 14

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A ☐ B ◤ C ◥ D ◢

1	2	3	4	5	6	7	8	9

-XQ1

Termination A Destination Item designation	Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	□	□	●	551	/Z3.5	+.D -Q1-X53 :3		
	□	□	●	552	/Z3.5	+.D -Q1-X53 :2		
	□	□	●	553	/Z3.6	+.D -Q1-X53 :1		
	□	□	●	554	/Z3.6	+.D -Q1-X53 :0		
	□	□	●	561	/Z3.6	+.D -Q1-X54 :3		
	□	□	●	562	/Z3.6	+.D -Q1-X54 :2		
	□	□	●	563	/Z3.6	+.D -Q1-X54 :1		
	□	□	●	564	/Z3.6	+.D -Q1-X54 :0		
	□	□	●	571	/Z3.6	+.D -Q1-X55 :3		
	□	□	●	572	/Z3.6	+.D -Q1-X55 :2		
	□	□	●	573	/Z3.7	+.D -Q1-X55 :1		
	□	□	●	574	/Z3.7	+.D -Q1-X55 :0		
	□	□	●	815	/M5.4	+.D -Q1-X82 :3		-XQ0 :23 C
	□	□	●	816	/M5.4	+.D -Q1-X82 :2		+.T -A21-3 :N15
	□	□	●	817	/Z2.7	+.D -Q1-X82 :1		
	□	□	●	818	/Z2.7	+.D -Q1-X82 :0		
	□	□	●	830	/M7.2	+.D -Q1-X84 :1		-XC31 :62 B
	□	□	●	831	/M7.2	+.D -Q1-X84 :0	-XQ0 :111 D	-XQ1 :833 D
	□	□	●	832	/M7.3	+.D -Q1-X85 :1		-XC31 :64 B
	□	□	●	833	/M7.3	+.D -Q1-X85 :0		-XQ1 :831 D
	□	□	●	890	/M4.2	+.D -B0-X88 :3	-XB11 :100 D	-XC30 :305 D
	■	□	●	891	/M4.2	+.D -B0-X88 :2		+.T -A21-3 :N12
	■	□	●	892	/M4.2	+.D -B0-X88 :1		
	■	□	●	893	/M4.3	+.D -B0-X88 :0		-XB11 :101 D

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

Cover
Insulation plate
Higher level insulation plate
Test socket
Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ1
Connection table

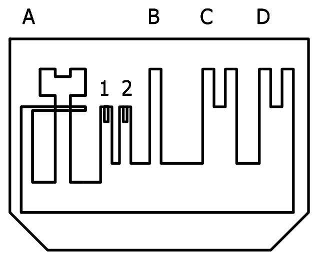
=JZ01 V =J01 +.B
883314 (3) W92210-F2141-S018-B
/14
Sheet 14+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 15

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-103	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 4

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation	Terminal strip -XB11 Link 1 2 JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖ □ □ ●	100	/M4.4		+.F -B11 :4	-XQ1 :890 C
	⊖ ■ □ ●	101	/M4.4		+.F -B11 :1	-XQ1 :893 D
	⊖ ■ □ ●	102	/M4.4		+.F -B11 :2	
	⊖ ■ □ ●	103	/M4.5			

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

Cover
Insulation plate
Higher level insulation plate
Test socket
Disconnector

Revision	Modification	Date	Name			
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XB11
Connection table

=JZ01 V =J01 +.B /15
883314 (3) W92210-F2141-S018-B
Sheet 15+
16 Sh.

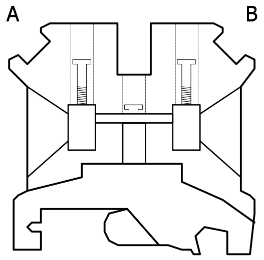
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11
Archive: =J01 / V / / 16

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
1-8	UT 4-PE	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 8

Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation
	-XPE			
=J01 +.B -PE	○	1	/G2.2	-X90 :3 A
	○	2	/S2.5	
	○	3	/S2.5	
	○	4	/S2.5	
	○	5	/S2.5	
	○	6	/S2.5	
	○	7	/G2.4	+.F -X1 :GND
	○	8	/S2.6	

Screen bus →	A Cable clamp	⌓	Cover
N-bus	B Screen bus	✕	Insulation plate
PE-PEN-bus	C Screwed cable gland	✕✕	Higher level insulation plate
Used cores total	D Plug housing	◉	Test socket
Continued on sheet	E Insulated	⚬⚬	Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XPE
Connection table

=JZ01 V =J01 +.B /16

883314 (3) W92210-F2141-S018-B

12150 East 112th Avenue
Henderson, CO 80640

TRANSMITTAL SHEET

Attention: John Crowder
Company: 1776 Lincoln St Suite 600
Denver, Co. 80203

Phone:
Fax:

Date: 9/1/2016
Sturgeon Job No.: 822611
Transmittal No.: 0021
Re:

We are sending you the attached following items:

___ Shop Drawings
___ Specifications
_x_ Other: As Built:
___ Prints
___ Copy of Letter
___ Change Order
___ Samples

Copies	Date	Description
1	9/1/2016	West Side Switchgear- Undervoltage As-Built Drawings

These are transmitted as checked below:

___ For Approval
___ For Your Use
___ As Requested
___ For Review and Comment
___ For Bids Due ________
___ Approved as Submitted
___ Approved as Noted
___ Returned for Corrections
___ Resubmit
___ Submit
___ Return
___ Other ________
___ Prints Returned After Loaned to Us
___ Copies for Approval
___ Copies for Distribution
___ Corrected Prints

Remarks:

Copy To:

Signed: James Shireman- Project Manager
(Name & Title)

Received By:

Date Received:

Siemens AG

Energy Management - Medium Voltage & Systems

Circuit diagram

for

Purchaser CRUM ELECTRIC SUPPLY COMPANY INC.

User COLORADO DEPARTMENT OF TRANSPORT

Plant VENTILATION BUILDING WEST

Plant section 8DA10 25kV SWITCHGEAR
TIE FEEDER

Typical =JZ03

Project reference number

Date of issue 08-27-15

Customer document number

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

SIEMENS AG

Archive: =J01 / A / / / 1

Project: 883597

Documentation identifier A / =J01 / / 1

Manufacturer document number (3) W92210-F2142-S011-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J01 / A / A / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
A	=J01 +J01	/1	(3) W92210-F2142-S011-B	1-	1	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER COVER SHEET Cover sheet	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A1	(3) W92210-F2142-S012-B	1+	3	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A2	(3) W92210-F2142-S012-B	2+	3	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A3	(3) W92210-F2142-S012-B	3-	3	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	G1	(3) W92210-F2142-S015-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	G2	(3) W92210-F2142-S015-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M1	(3) W92210-F2142-S015-B	1+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M2	(3) W92210-F2142-S015-B	2+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M3	(3) W92210-F2142-S015-B	3+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M4	(3) W92210-F2142-S015-B	4+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M5	(3) W92210-F2142-S015-B	5+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M6	(3) W92210-F2142-S015-B	6+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M7	(3) W92210-F2142-S015-B	7+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M8	(3) W92210-F2142-S015-B	8+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
TABLE OF DOCUMENTS
List of documents

=JZ03
A
=J01
+J01
A1
883597
(3) W92210-F2142-S012-B
Sheet 1+
3 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J01 / A / A / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
S	=J01 +J01	M9	(3) W92210-F2142-S015-B	9+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M10	(3) W92210-F2142-S015-B	10+	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER INDICATIONS SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M11	(3) W92210-F2142-S015-B	11-	11	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	S1	(3) W92210-F2142-S015-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	S2	(3) W92210-F2142-S015-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z1	(3) W92210-F2142-S015-B	1+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER CIRCUIT BREAKER Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z2	(3) W92210-F2142-S015-B	2+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER THREE POSITION SWITCH Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z3	(3) W92210-F2142-S015-B	3+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER THREE POSITION SWITCH Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z4	(3) W92210-F2142-S015-B	4+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER GAS PRESSURE MONITORING Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z5	(3) W92210-F2142-S015-B	5+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER PROTECTION AND CONTROL DEVICE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z6	(3) W92210-F2142-S015-B	6+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z7	(3) W92210-F2142-S015-B	7+	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z8	(3) W92210-F2142-S015-B	8-	8	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/1	(3) W92210-F2142-S018-B	1+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XR1 Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	A	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER			+J01	A2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		TABLE OF DOCUMENTS	883597	(3) W92210-F2142-S012-B		Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents				3 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J01 / A / A / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
V	=J01 +.B	/2	(3) W92210-F2142-S018-B	2+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-X90 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/3	(3) W92210-F2142-S018-B	3+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XT1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/4	(3) W92210-F2142-S018-B	4+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/5	(3) W92210-F2142-S018-B	5+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/6	(3) W92210-F2142-S018-B	6+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/7	(3) W92210-F2142-S018-B	7+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/8	(3) W92210-F2142-S018-B	8+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/9	(3) W92210-F2142-S018-B	9+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/10	(3) W92210-F2142-S018-B	10+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/11	(3) W92210-F2142-S018-B	11+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/12	(3) W92210-F2142-S018-B	12+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/13	(3) W92210-F2142-S018-B	13+	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/14	(3) W92210-F2142-S018-B	14-	14	08-27-15	8DA10 25kV SWITCHGEAR TIE FEEDER +.B-XPE Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT	
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST	
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by	

Siemens AG

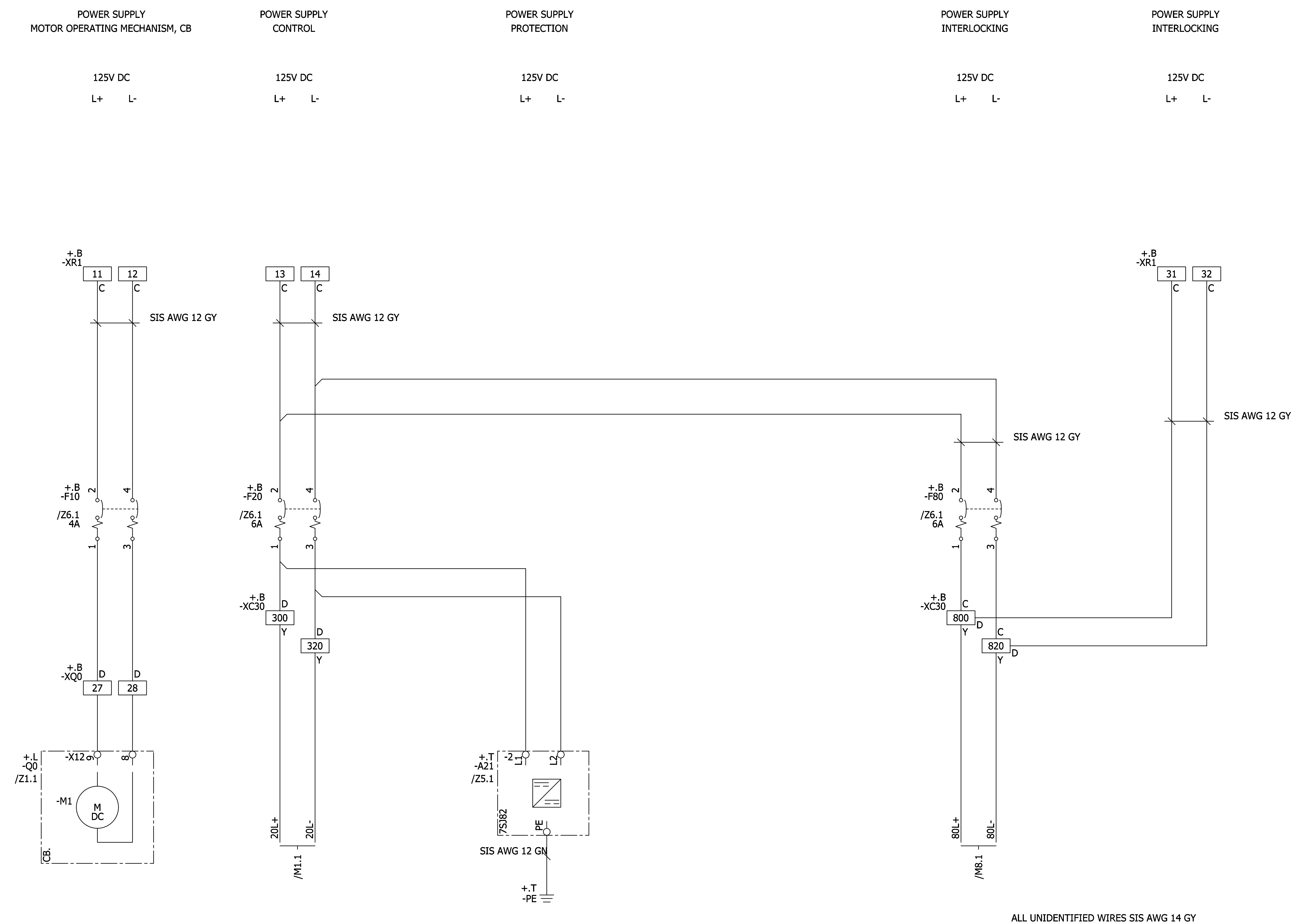
8DA10 25kV SWITCHGEAR
TIE FEEDER
TABLE OF DOCUMENTS
List of documents

=JZ03	A	=J01		
		+J01	A3	
883597	(3) W92210-F2142-S012-B		Sheet 3- 3 Sh.	

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / G / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



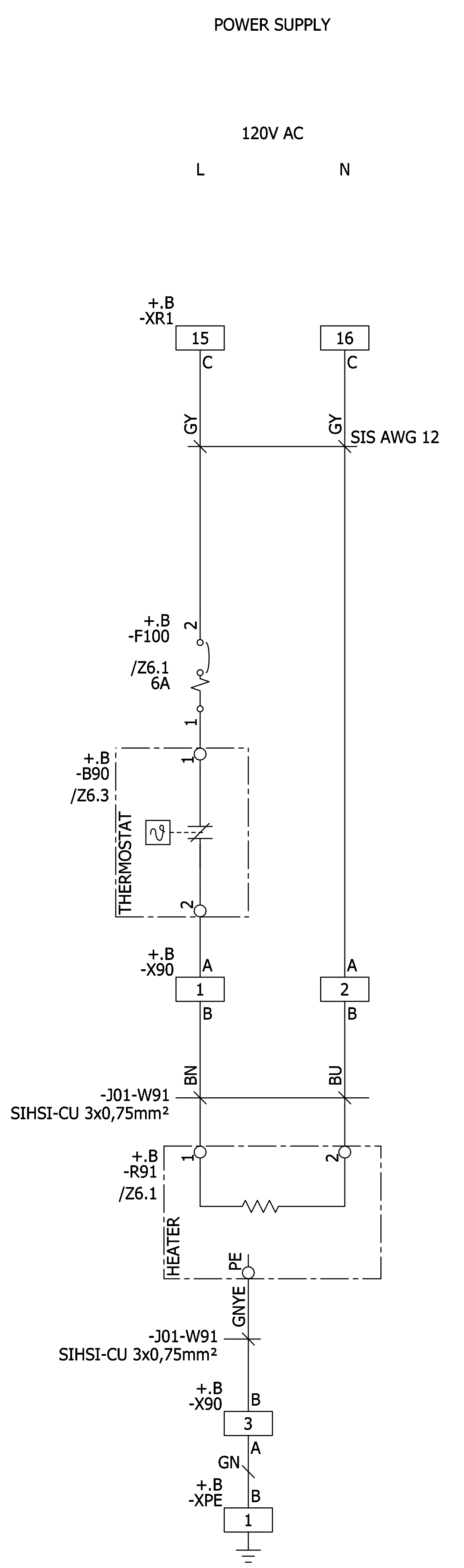
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ03	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER				+J01 G1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		CONTROL SCHEMATIC	883597	(3) W92210-F2142-S015-B		Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / G / 2

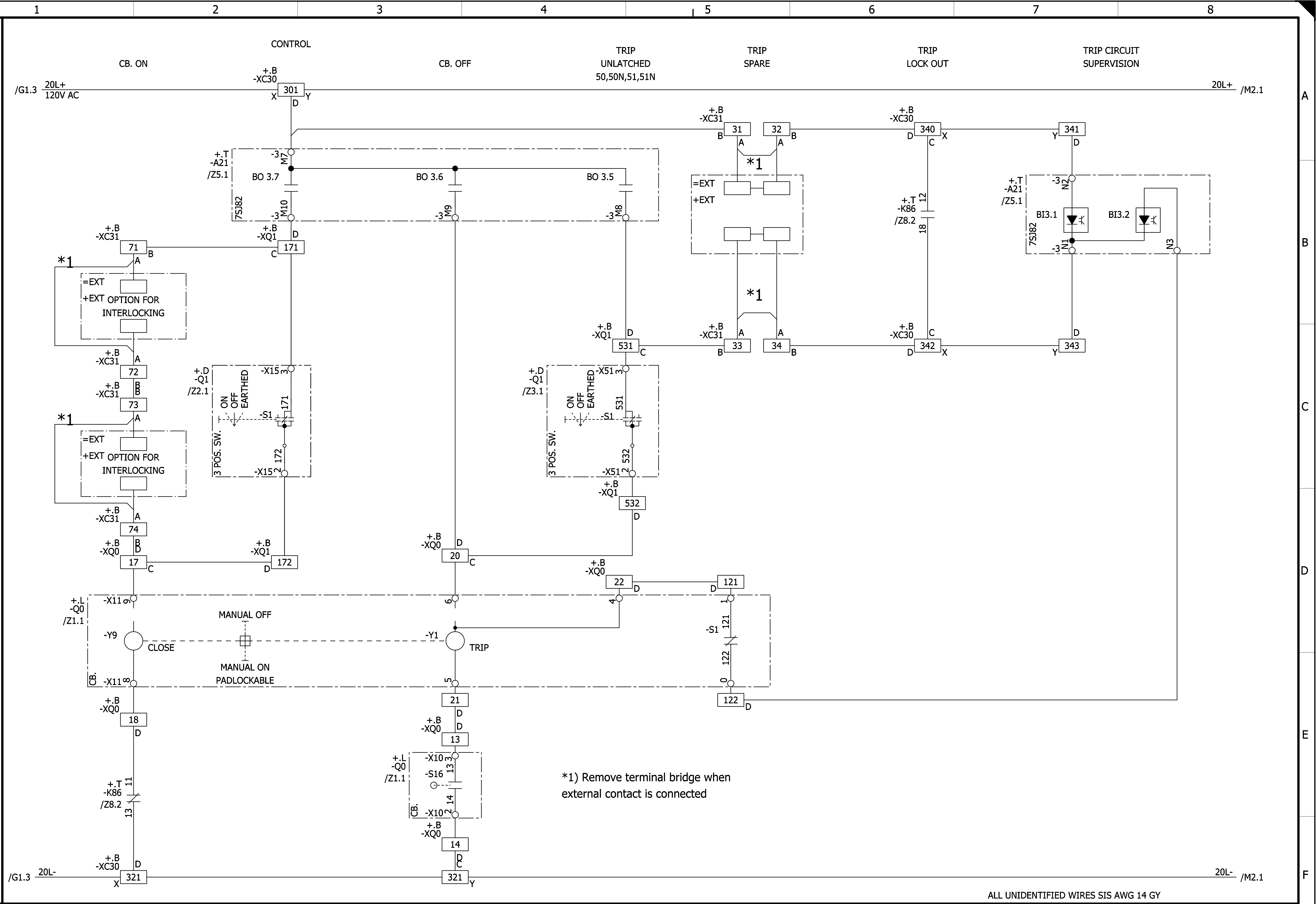
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER			+J01	G2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		CONTROL SCHEMATIC	883597	(3) W92210-F2142-S015-B		Sheet 2-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				2 Sh.



*1) Remove terminal bridge when external contact is connected

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
CONTROL SCHEMATIC
Circuit diagram

=JZ03
S
=J01
+J01
M1
883597
(3) W92210-F2142-S015-B
Sheet 1+
11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 1

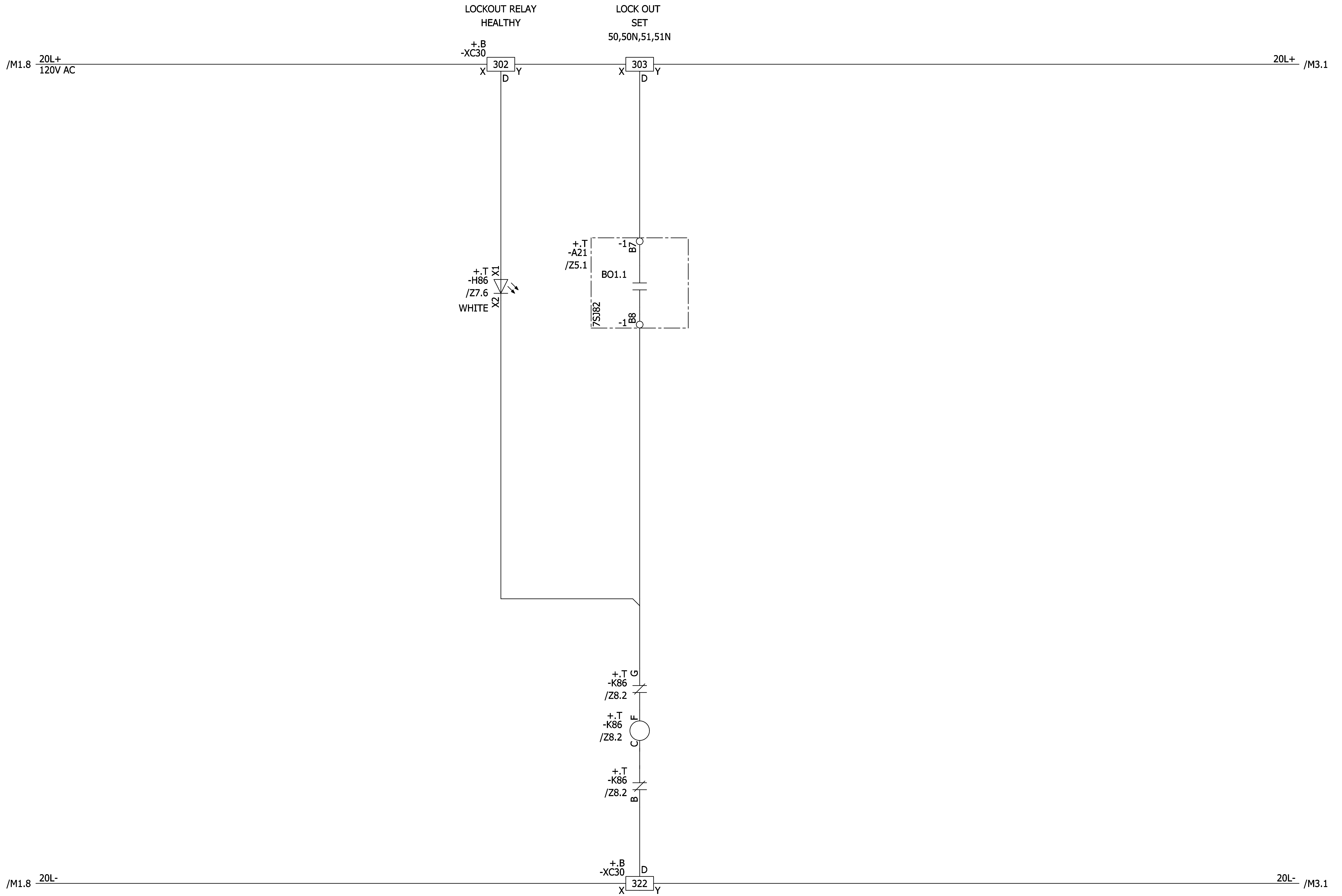
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

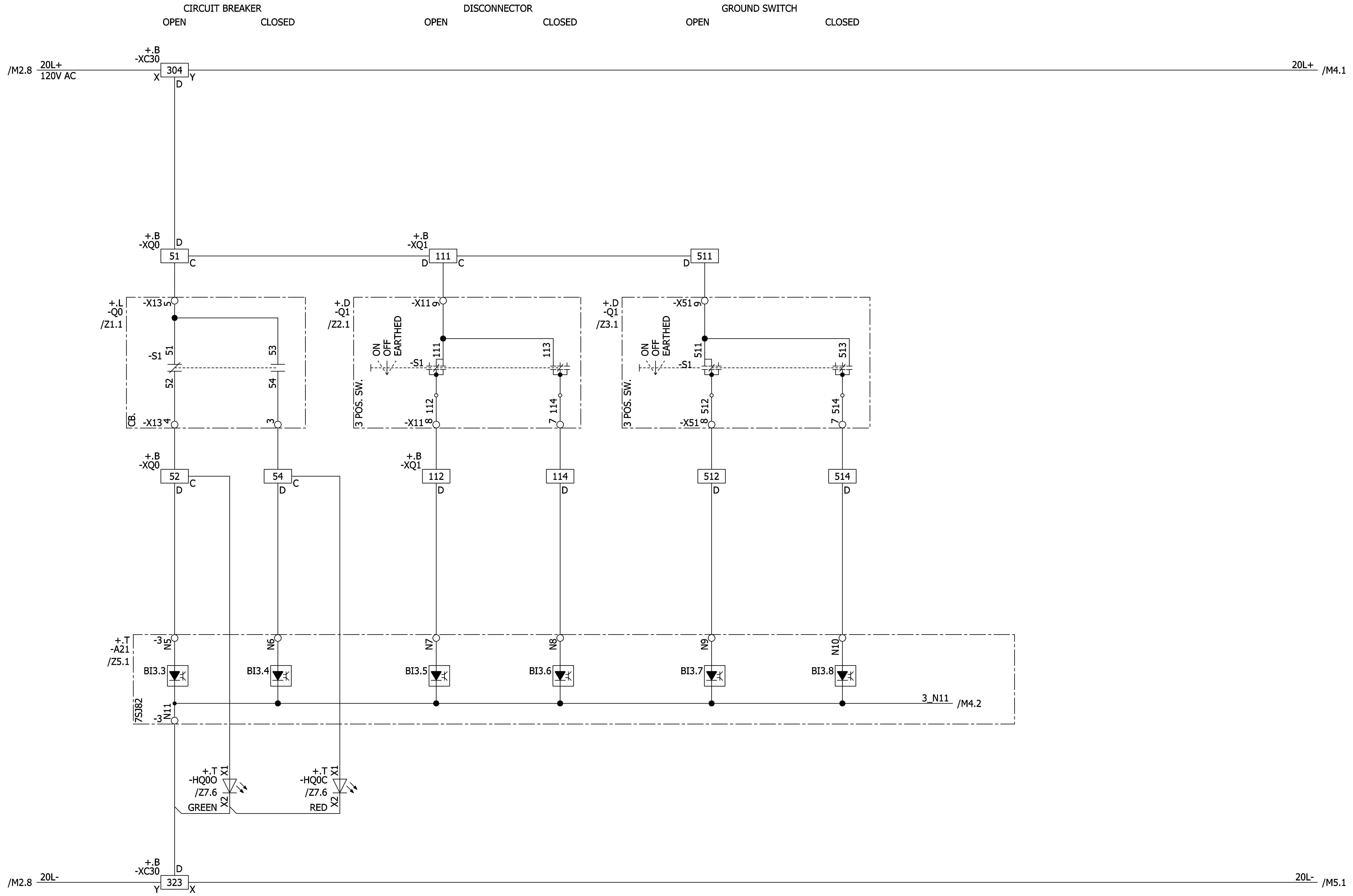
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		CONTROL SCHEMATIC
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram

=JZ03
S
=J01
+J01
M2
883597
(3) W92210-F2142-S015-B
Sheet 2+
11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
CONTROL SCHEMATIC
Circuit diagram

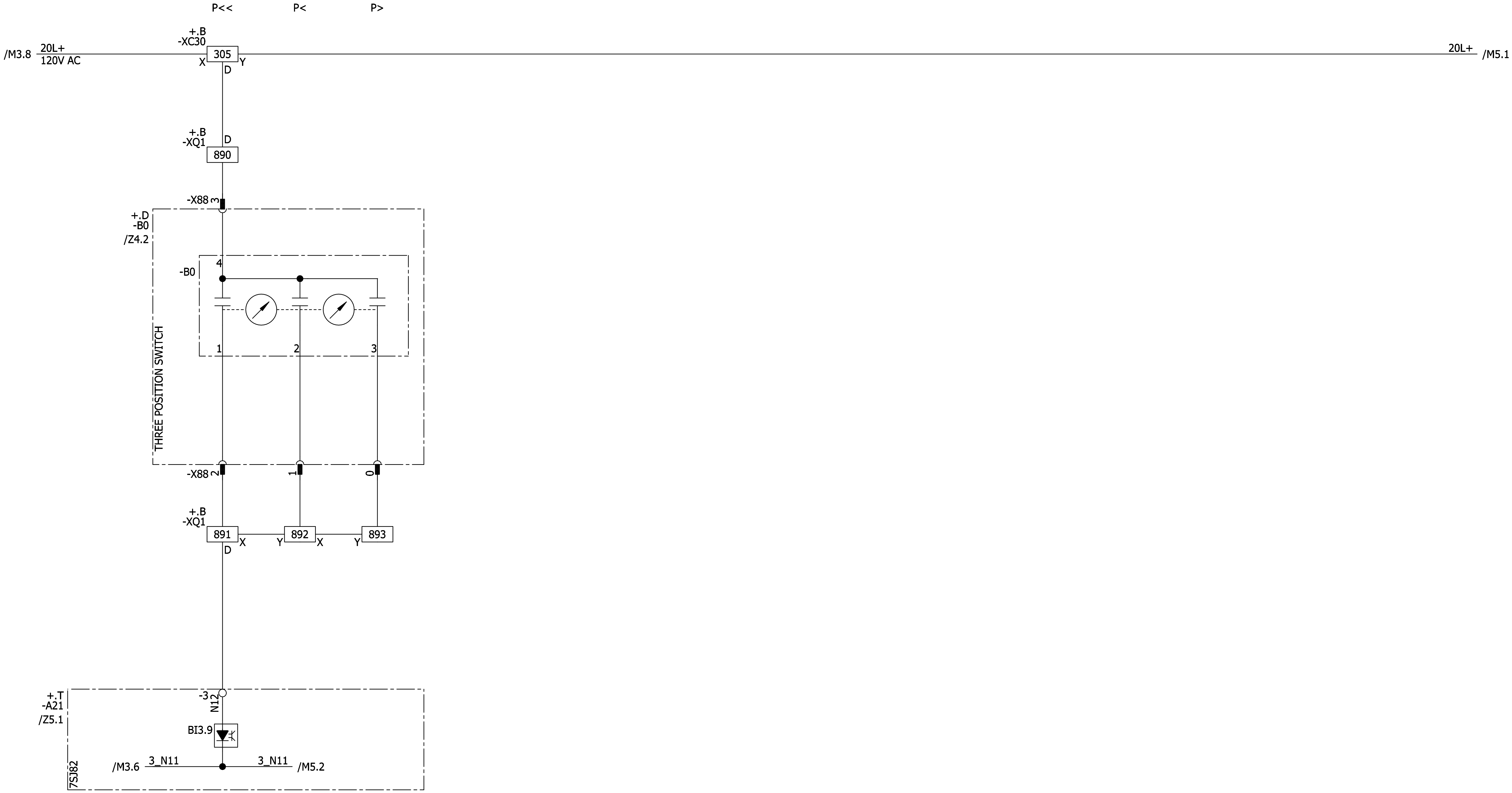
=JZ03
S
=J01
+J01
M3
883597
(3) W92210-F2142-S015-B
Sheet 3+
11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

GAS PRESSURE MONITORING
CIRCUIT BREAKER -Q0



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

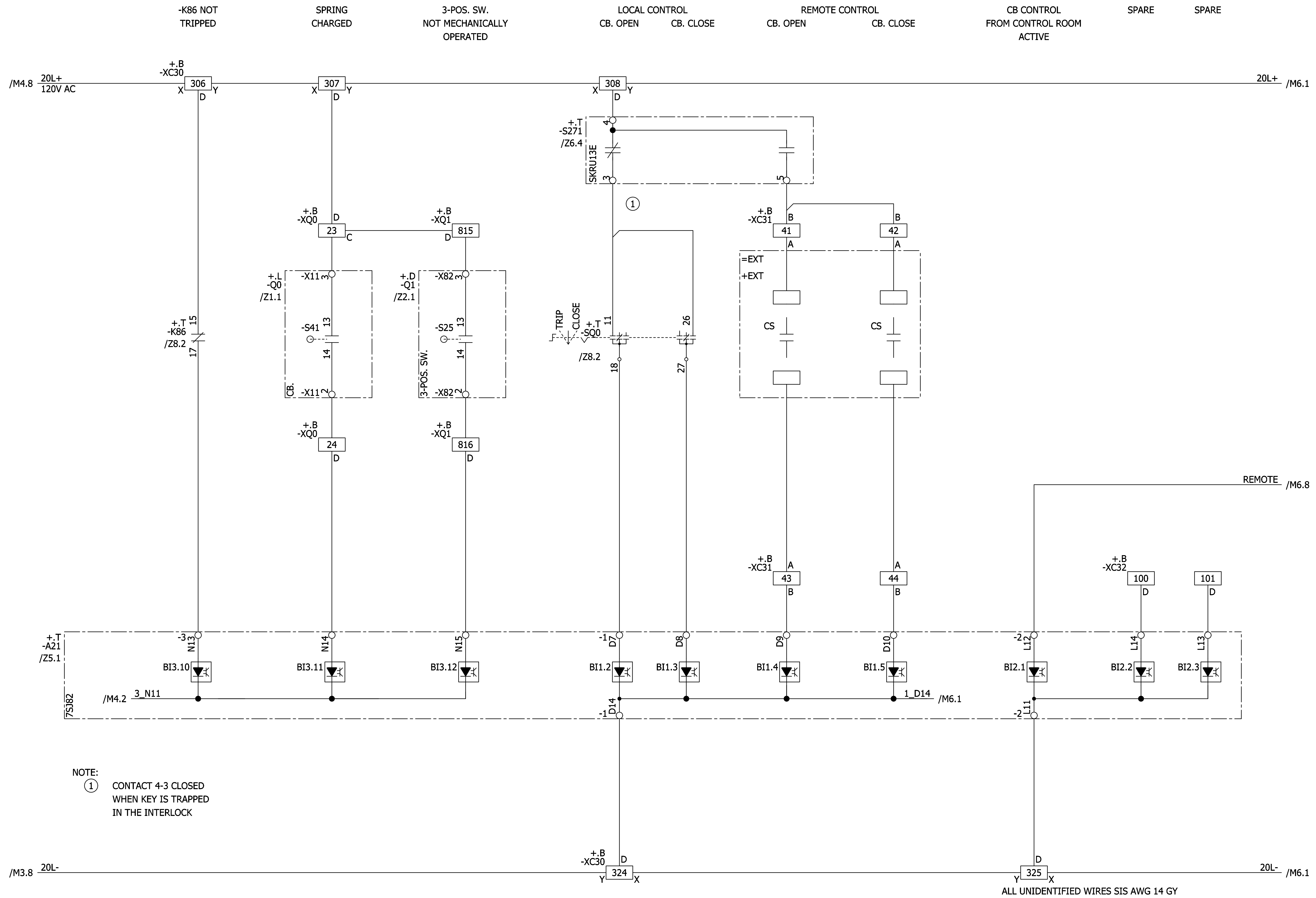
8DA10 25kV SWITCHGEAR
TIE FEEDER
CONTROL SCHEMATIC
Circuit diagram

=JZ03	S	=J01 +J01	M4
883597	(3) W92210-F2142-S015-B		Sheet 4+ 11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

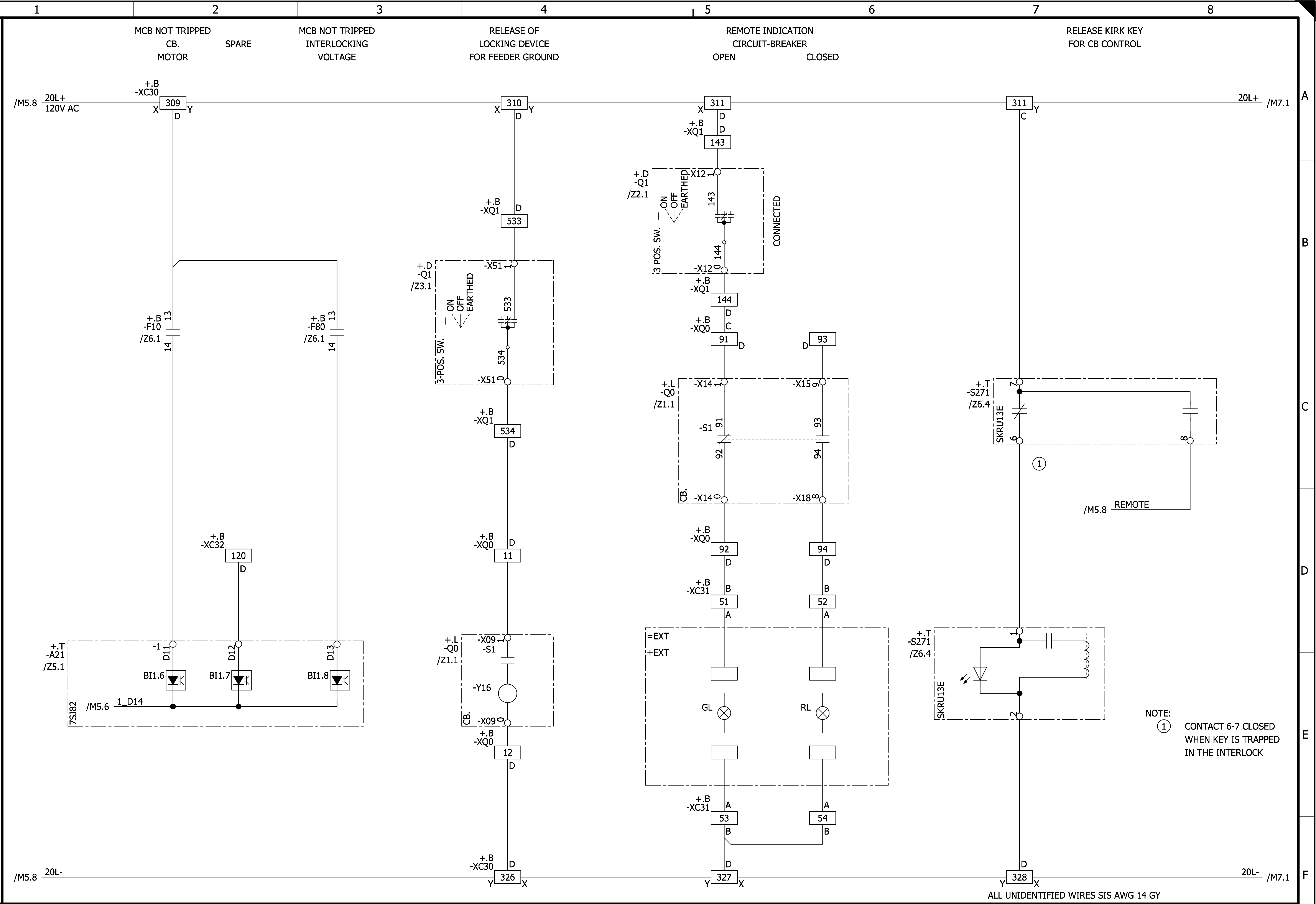
Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



NOTE:
① CONTACT 4-3 CLOSED
WHEN KEY IS TRAPPED
IN THE INTERLOCK

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER			+J01 M5
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		CONTROL SCHEMATIC	883597	(3) W92210-F2142-S015-B	Sheet 5+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			11 Sh.



ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Revision	Modification	Date	Name				
A	CERTIFIED	06-30-15	BM	Date	05-18-15		
B	IFC	08-27-15	BM	Drawn	Ten-Thomé		
				Appr.	Magnuson		
				Norm			

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

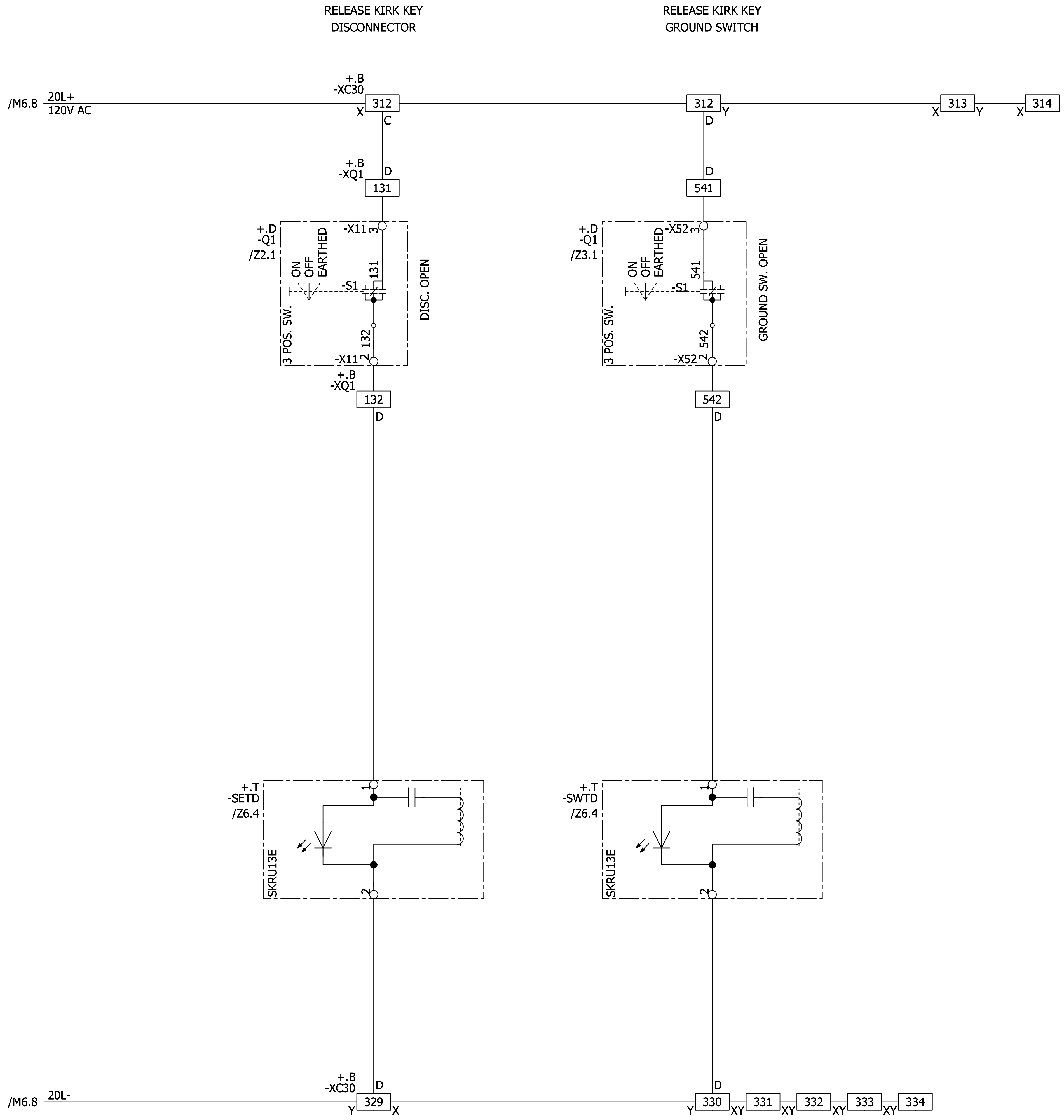
8DA10 25kV SWITCHGEAR
TIE FEEDER
CONTROL SCHEMATIC
Circuit diagram

=JZ03
S
=J01
+J01
M6
883597
(3) W92210-F2142-S015-B
Sheet 6+
11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



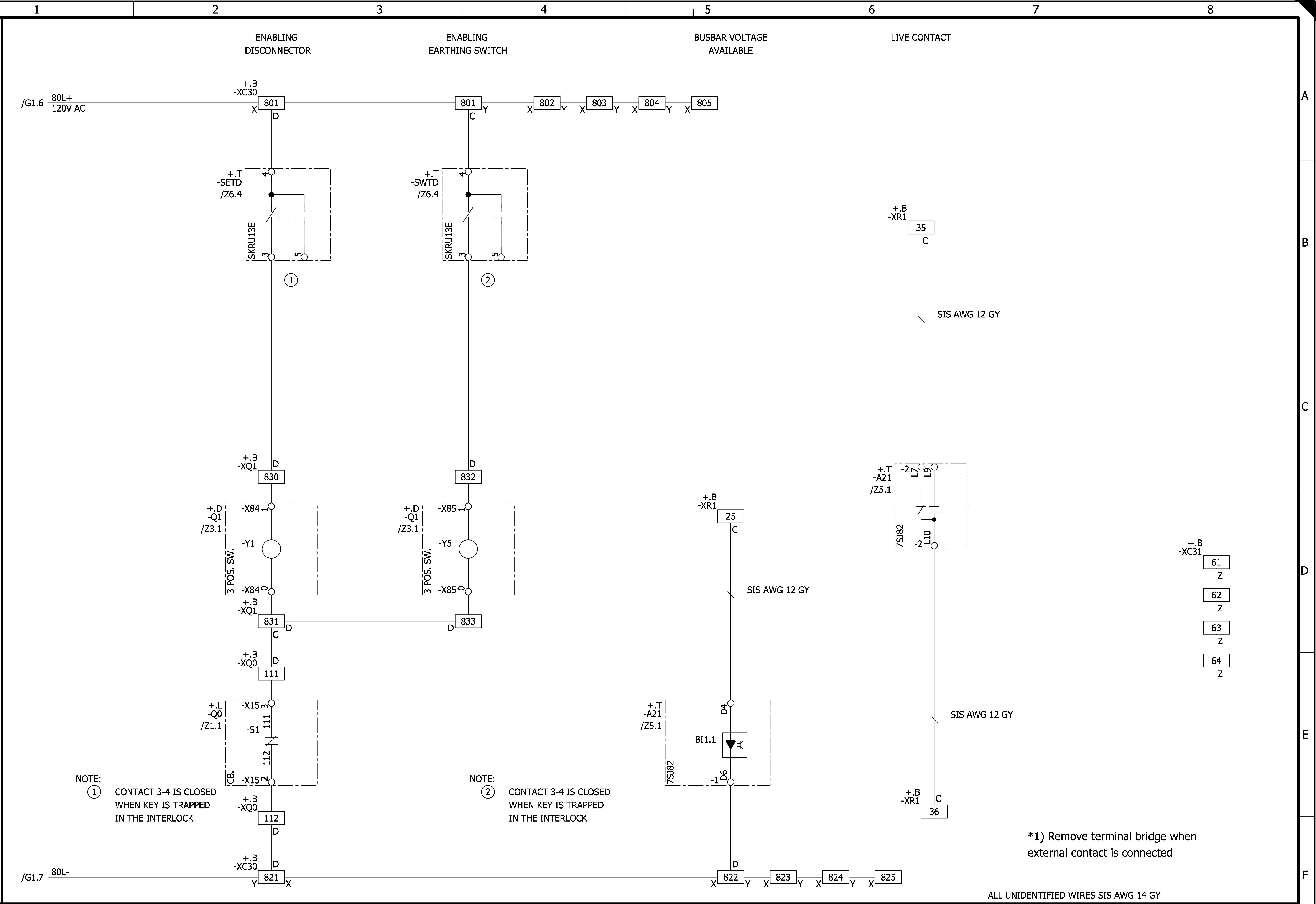
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER			+J01	M7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		CONTROL SCHEMATIC	883597	(3) W92210-F2142-S015-B	Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

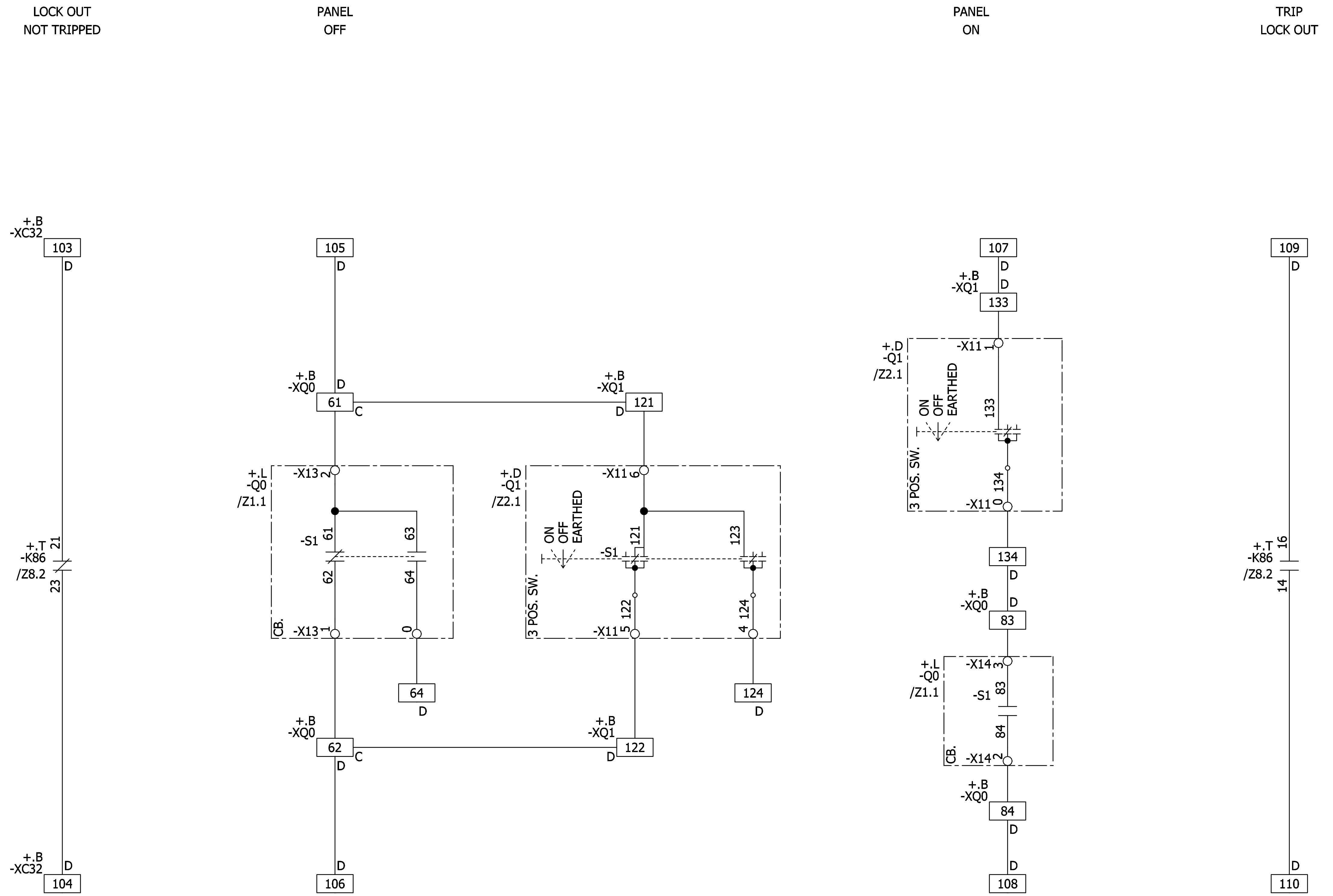


				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER		+J01 M8
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		CONTROL SCHEMATIC	883597	(3) W92210-F2142-S015-B Sheet 8+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram		11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST

Siemens AG

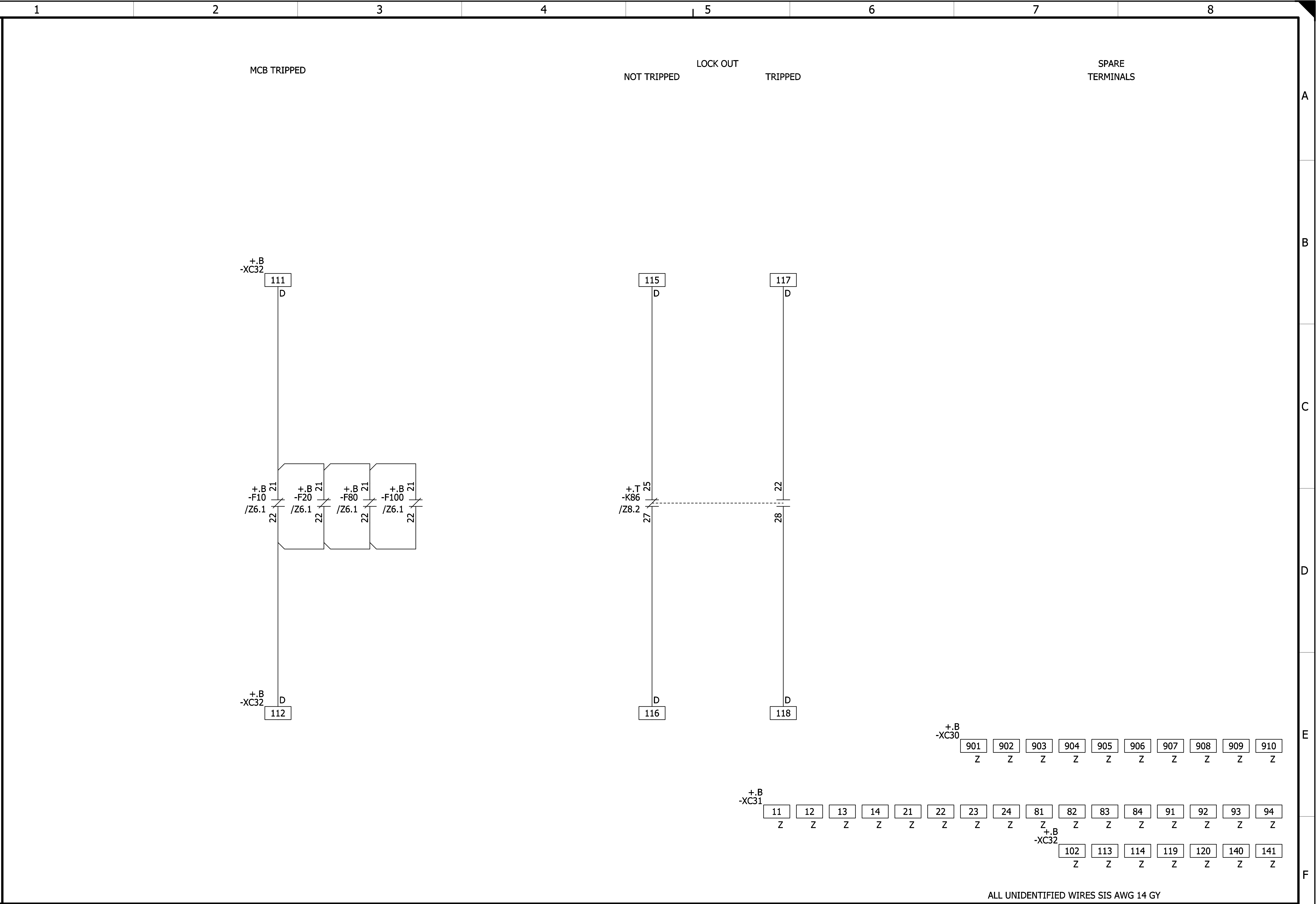
8DA10 25kV SWITCHGEAR
TIE FEEDER
CONTROL SCHEMATIC
Circuit diagram

=JZ03
S
=J01
+J01
M9
883597
(3) W92210-F2142-S015-B
Sheet 9+
11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date	05-18-15
Drawn	Ten-Thomé
Appr.	Magnuson
Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

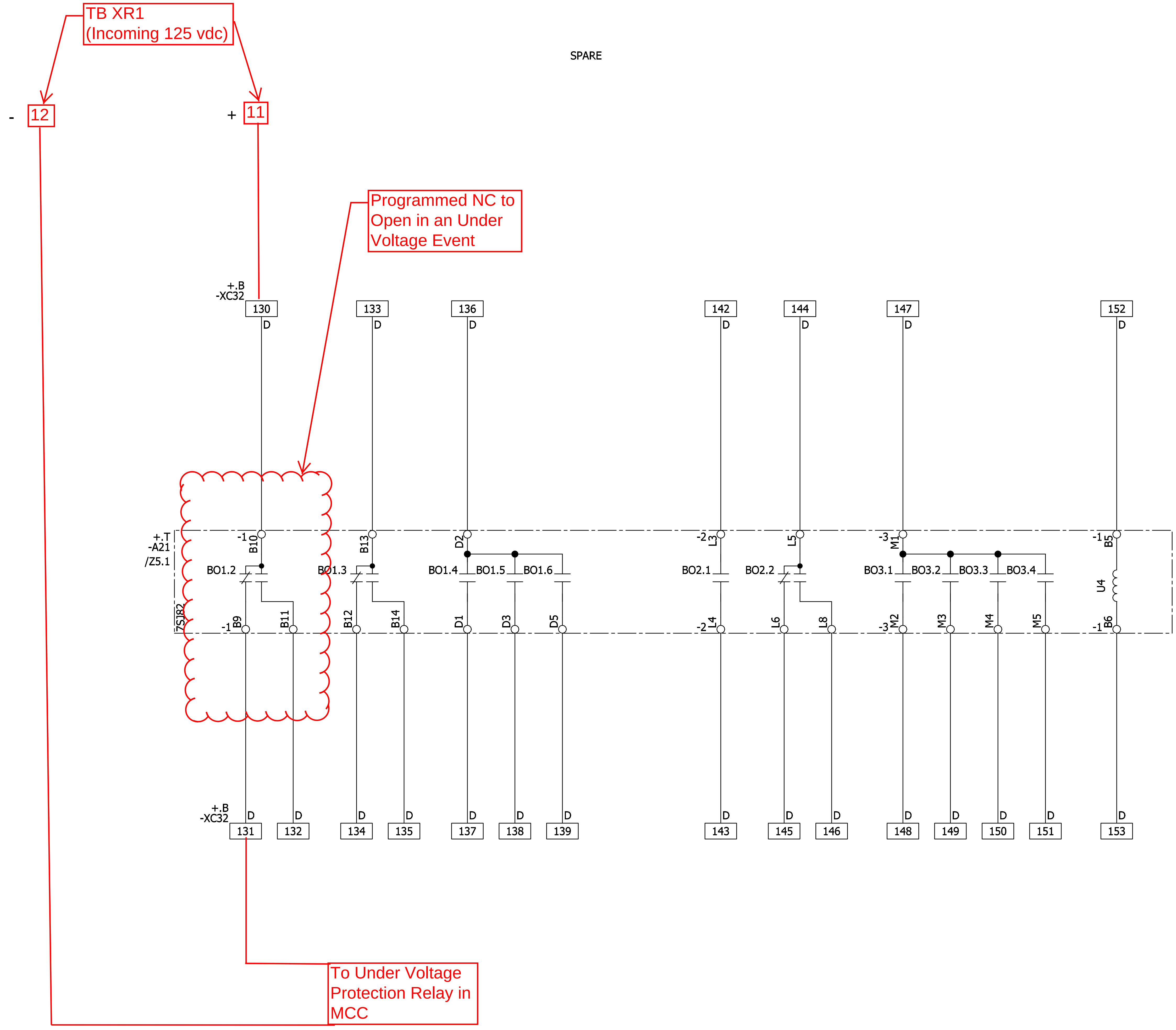
8DA10 25kV SWITCHGEAR
TIE FEEDER
INDICATIONS SPARE
Circuit diagram

=JZ03
S =J01
+J01
M10
883597
(3) W92210-F2142-S015-B
Sheet 10+
11 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 11

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



TB XR1
(Incoming 125 vdc)

Programmed NC to Open in an Under Voltage Event

To Under Voltage Protection Relay in MCC

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER			+J01	M11
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		SPARE	883597	(3) W92210-F2142-S015-B		Sheet 11-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				11 Sh.

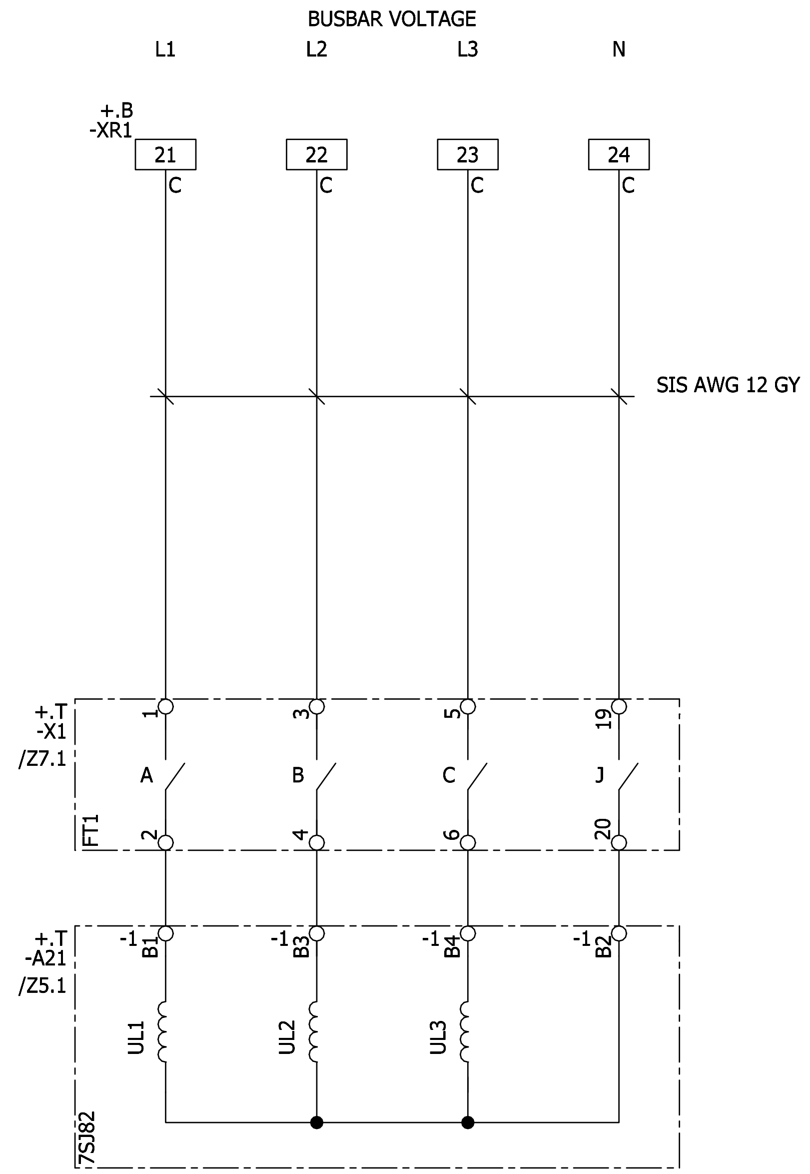
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / S / 1

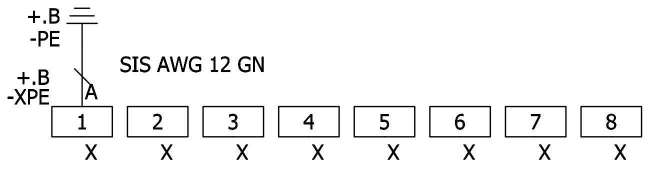
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

HV COMPARTMENT

LV COMPARTMENT





ALL UNIDENTIFIED WIRES SIS AWG 14 GY

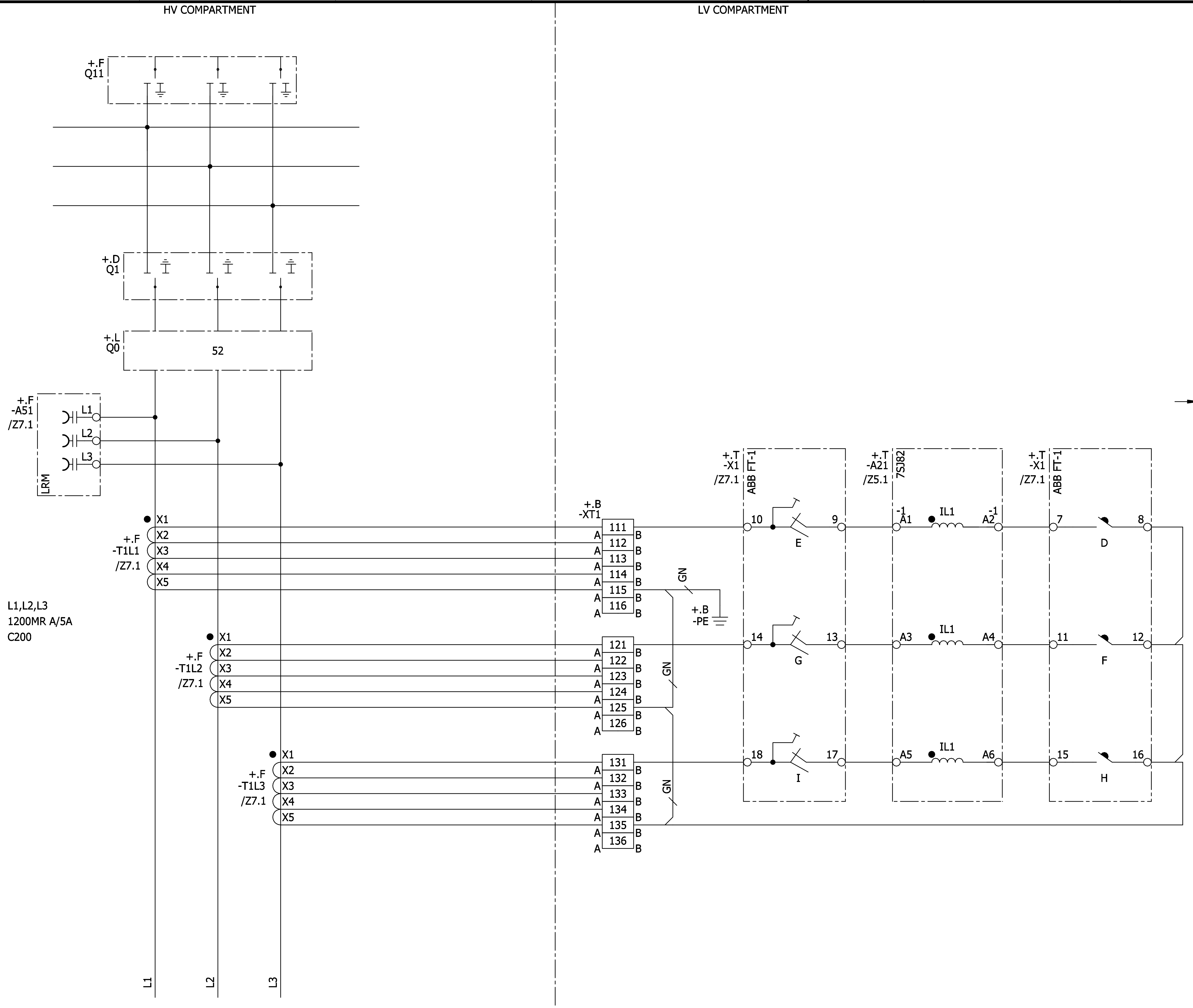
Revision	Modification	Date	Name	Norm	
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
TRANSFORMER CIRCUITS
Circuit diagram

=JZ03
S
=J01
+J01
S1
883597
(3) W92210-F2142-S015-B
Sheet 1+
2 Sh.



1200 A
MULTI-RATIO CT

CURRENT RATING (A) 1200:5	SECONDARY TAPS
100:5	X2-X3
200:5	X1-X2
300:5	X1-X3
400:5	X4-X5
500:5	X3-X4
600:5	X2-X4
800:5	X1-X4
900:5	X3-X5
1000:5	X2-X5
→ 1200:5	X1-X5

ALL UNIDENTIFIED WIRES SIS AWG 12 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

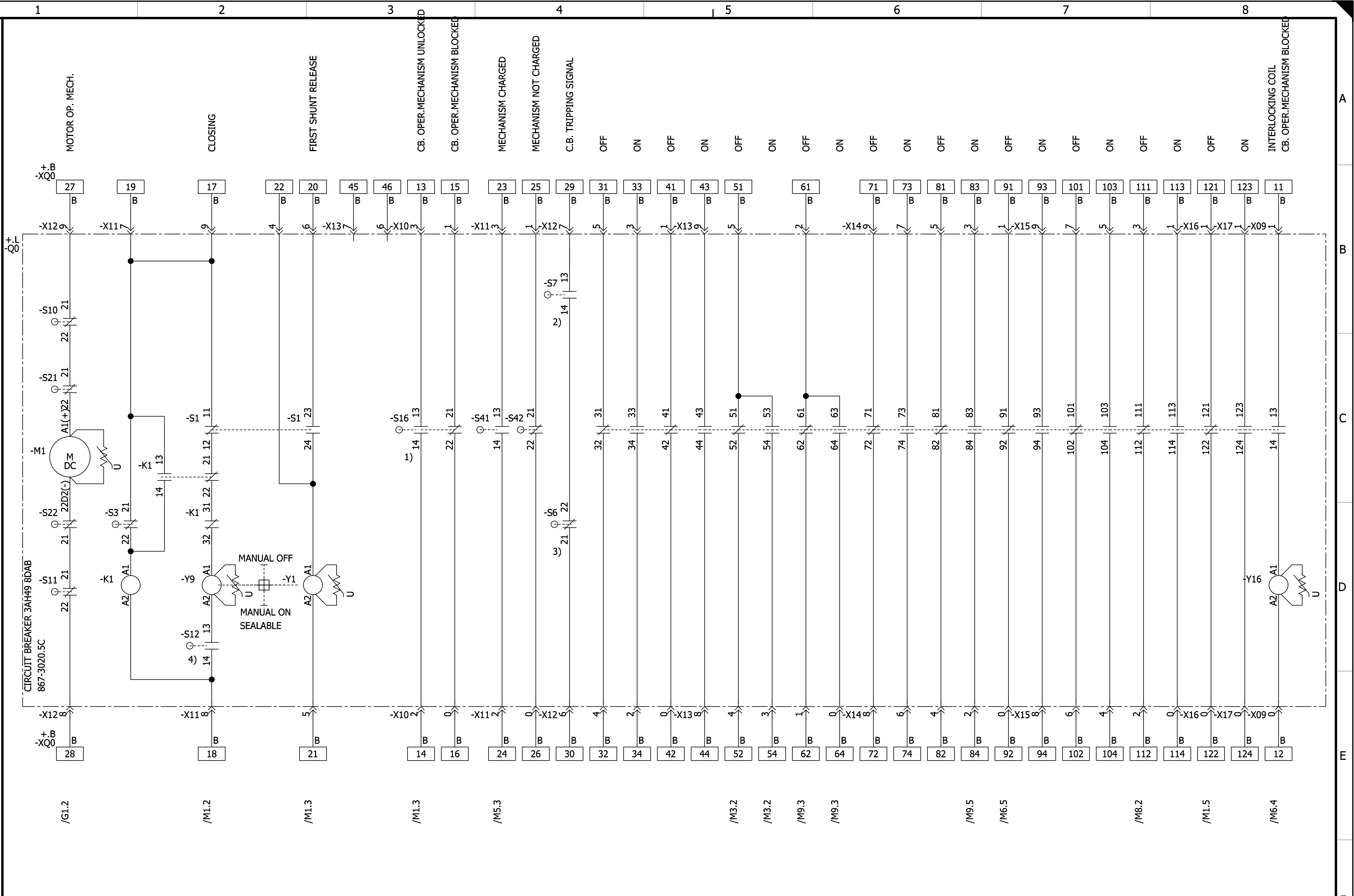
8DA10 25kV SWITCHGEAR
TIE FEEDER
TRANSFORMER CIRCUITS
Circuit diagram

=JZ03
S
=J01
+J01
S2
883597
(3) W92210-F2142-S015-B
Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) OPERATES WHEN CB. TRIP IS NOT LOCKED OUT

2) OPERATES WHEN MECH. OFF IS NOT PRESSED

3) OPERATES WHEN NO TRIPPING

4) INTERLOCKING OF ELECTRICAL CLOSING OF THE CB IN CASE OF MANUAL OPERATION OF THE THREE-POSITION SWITCH

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

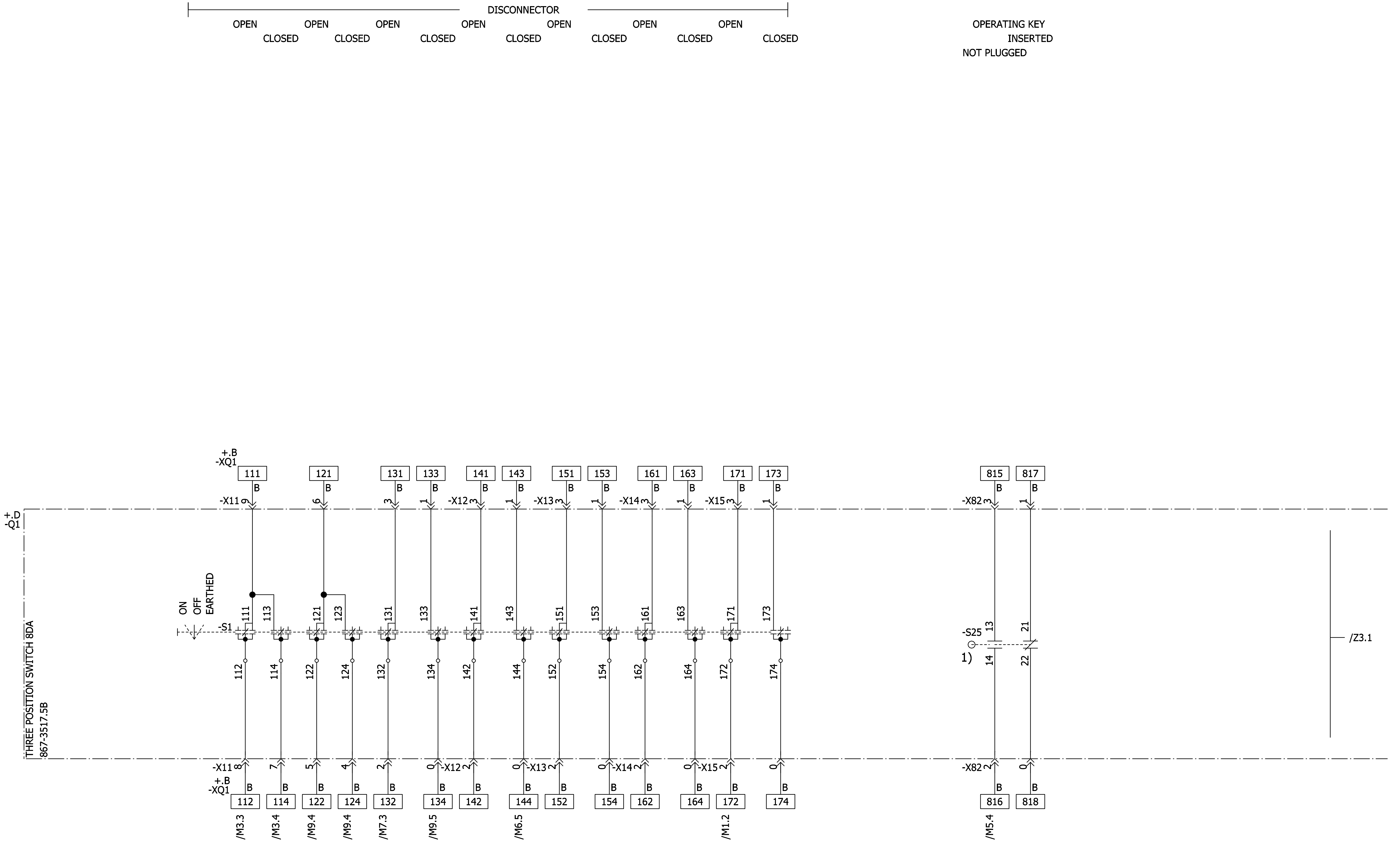
8DA10 25kV SWITCHGEAR
TIE FEEDER
CIRCUIT BREAKER
Circuit diagram

=JZ03
S
=J01
+J01
Z1
883597
(3) W92210-F2142-S015-B
Sheet 1+
8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) SHOWN WITH LEVER INSERTED

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

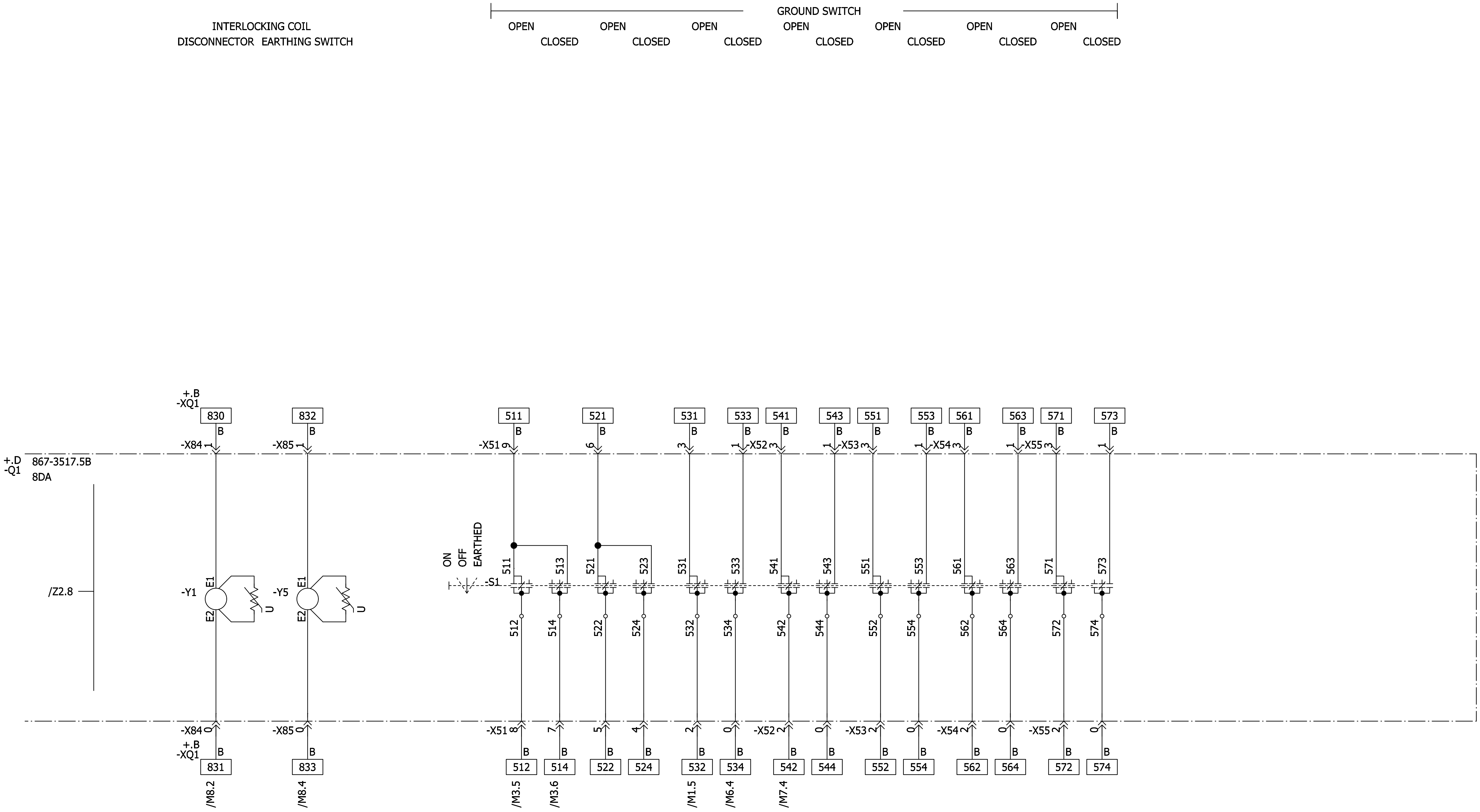
8DA10 25kV SWITCHGEAR
TIE FEEDER
THREE POSITION SWITCH
Circuit diagram

=JZ03	S	=J01	
		+J01	Z2
883597	(3) W92210-F2142-S015-B		Sheet 2+
			8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ03	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER				+J01	Z3
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		THREE POSITION SWITCH	883597	(3) W92210-F2142-S015-B			Sheet 3+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram					8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 4

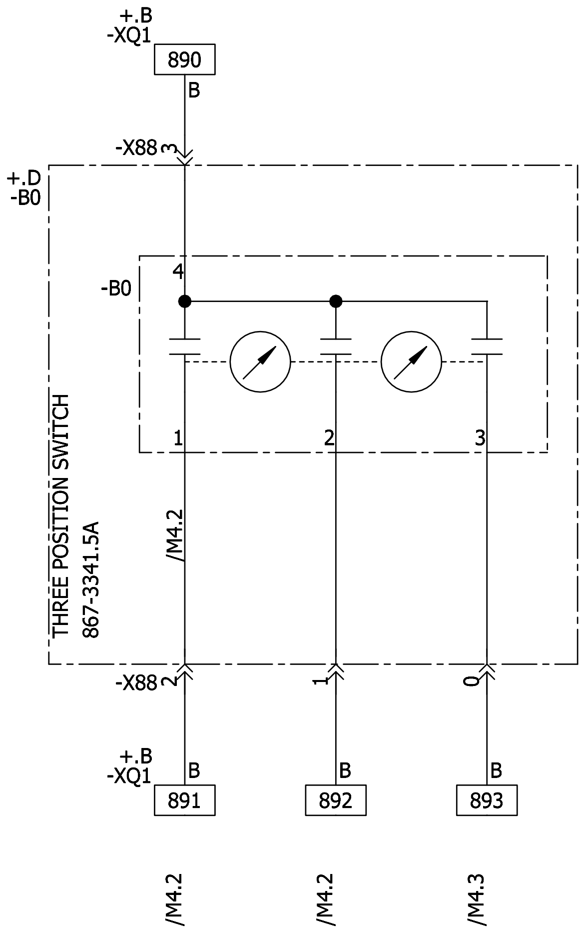
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

GAS PRESSURE MONITORING
CIRCUIT BREAKER -Q0
P<< P< P>

PLEASE NOTE:

MANOMETER WITH 3 ALARM CONTACTS (OPTION)
CONTACT 1: UNDERPRESSURE P<<
CONTACT 2: UNDERPRESSURE P<
CONTACT 3: OVERPRESSURE P>



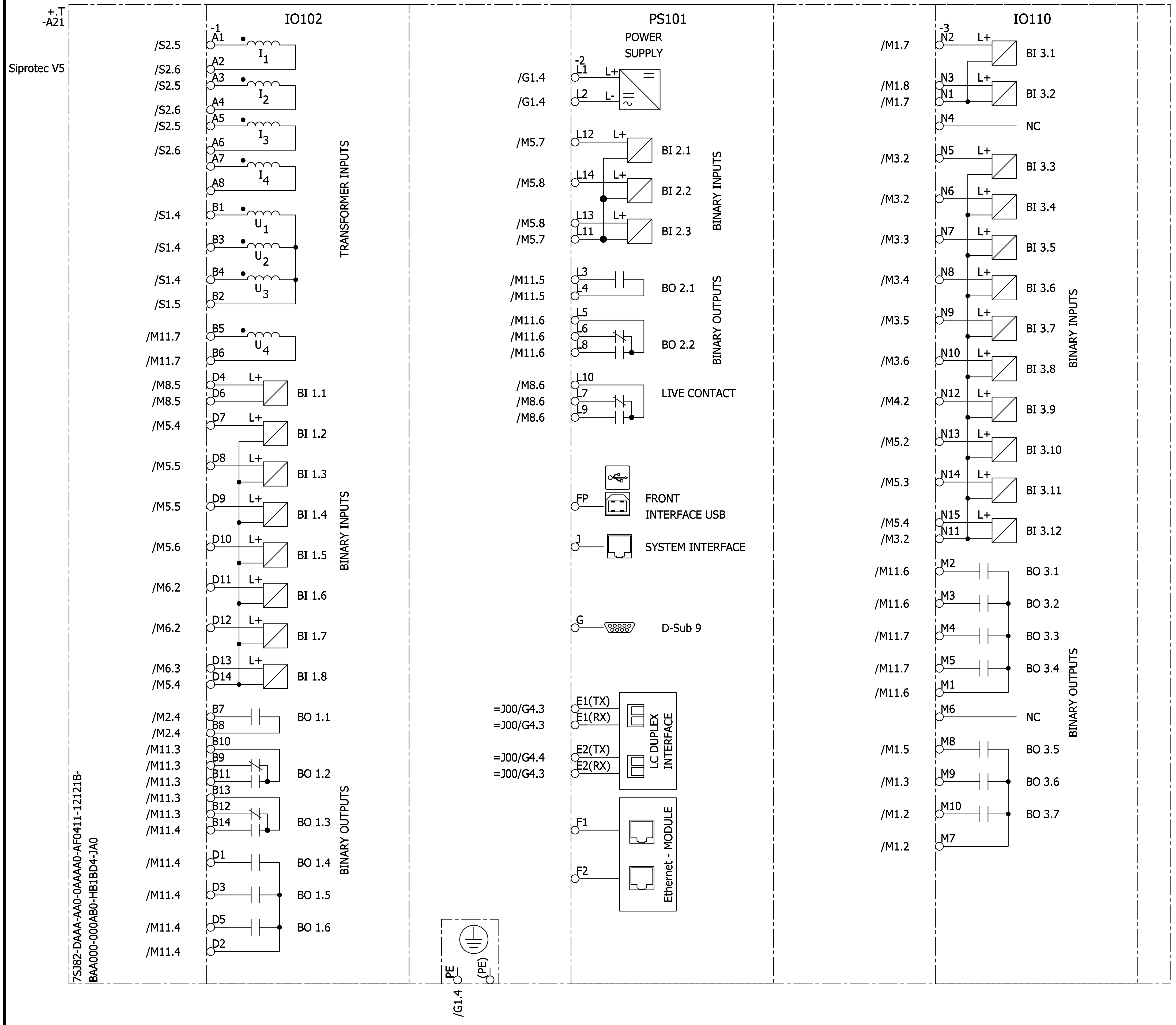
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name						
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03 S =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER	+J01 Z4
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		GAS PRESSURE MONITORING	883597 (3) W92210-F2142-S015-B Sheet 4+
				Norm		Orig./Prep.for/Prep.by		Circuit diagram	8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

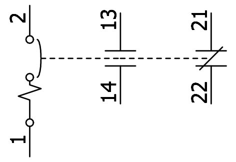
8DA10 25kV SWITCHGEAR
TIE FEEDER
PROTECTION AND CONTROL DEVICE
Circuit diagram

883597
(3) W92210-F2142-S015-B
=JZ03
S
=J01
+J01
Z5
Sheet 5+
8 Sh.

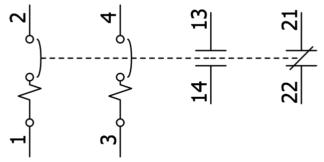
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

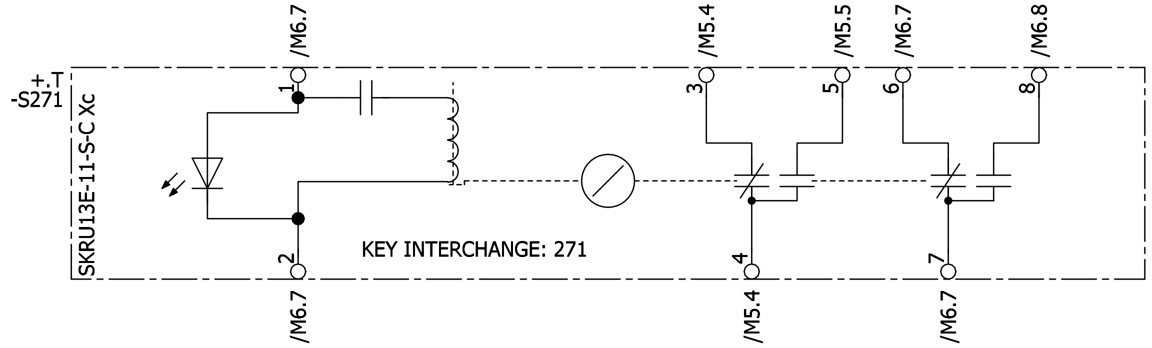
Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



+.B -F100	5SJ4106-7HG41 5ST3010-0HG 1 POLE, 6A	/G2.2		/M10.3



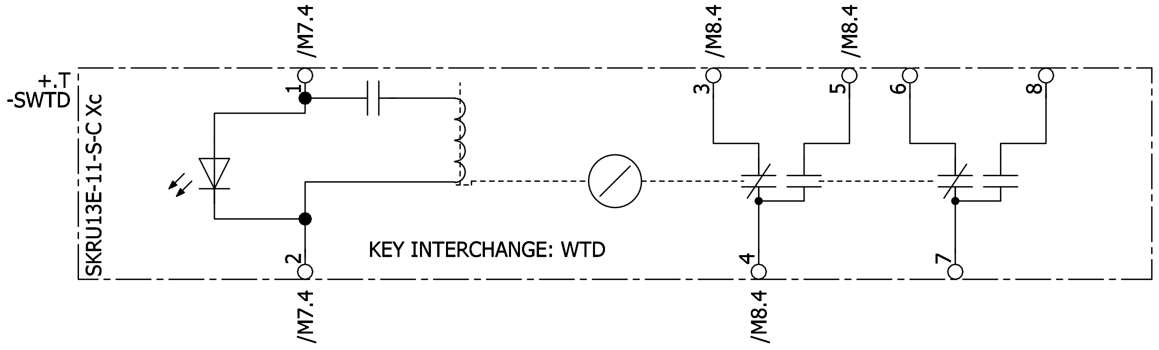
+.B -F10	5SJ4204-7HG41 5ST3010-0HG 2 POLE, 4A	/G1.2	/G1.2	/M6.2	/M10.2
+.B -F20	5SJ4206-7HG41 5ST3010-0HG 2 POLE, 6A	/G1.3	/G1.3		/M10.3
+.B -F80	5SJ4206-7HG41 5ST3010-0HG 2 POLE, 6A	/G1.6	/G1.7	/M6.3	/M10.3



AUXILARY SWITCH
CIRCUITS 3-4 AND 6-7 ARE NORMALLY CLOSED
AND
CIRCUITS 5-4 AND 8-7 ARE NORMALLY OPEN
WHEN THE KEY IS TRAPPED IN THE INTERLOCK

KIRK KEY INTERLOCK WITH KEY NORMALLY TRAPPED IN LOCK
KEY REMOVABLE WHEN SOLENOID IS ENERGIZED

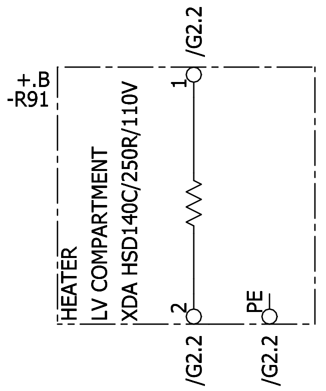
PUSHBUTTON (CLOSE TO ENERGIZE SOLENOID)
SIGNAL LAMP INDICATES WHEN SOLENOID CAN BE ENERGIZED

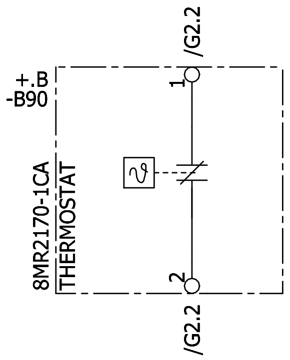


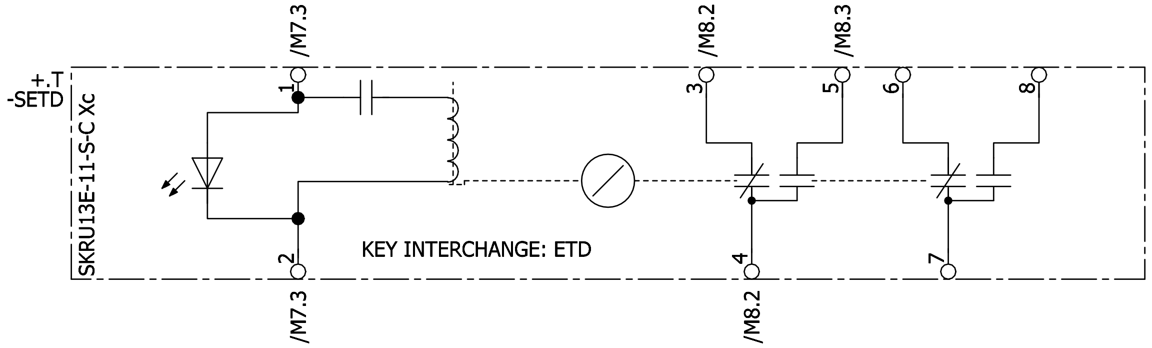
AUXILARY SWITCH
CIRCUITS 3-4 AND 6-7 ARE NORMALLY CLOSED
AND
CIRCUITS 5-4 AND 8-7 ARE NORMALLY OPEN
WHEN THE KEY IS TRAPPED IN THE INTERLOCK

KIRK KEY INTERLOCK WITH KEY NORMALLY TRAPPED IN LOCK
KEY REMOVABLE WHEN SOLENOID IS ENERGIZED

PUSHBUTTON (CLOSE TO ENERGIZE SOLENOID)
SIGNAL LAMP INDICATES WHEN SOLENOID CAN BE ENERGIZED







AUXILARY SWITCH
CIRCUITS 3-4 AND 6-7 ARE NORMALLY CLOSED
AND
CIRCUITS 5-4 AND 8-7 ARE NORMALLY OPEN
WHEN THE KEY IS TRAPPED IN THE INTERLOCK

KIRK KEY INTERLOCK WITH KEY NORMALLY TRAPPED IN LOCK
KEY REMOVABLE WHEN SOLENOID IS ENERGIZED

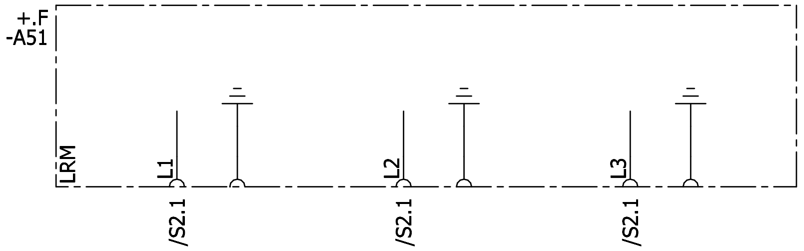
PUSHBUTTON (CLOSE TO ENERGIZE SOLENOID)
SIGNAL LAMP INDICATES WHEN SOLENOID CAN BE ENERGIZED

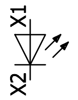
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER		+J01 Z6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		SECONDARY EQUIPMENT	883597	(3) W92210-F2142-S015-B Sheet 6+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram		8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 7

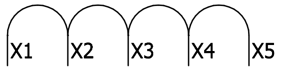
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:





+.T -HQ0O	3SB3400-1A CB//OPEN GREEN 3SB3001-6BA40 3SB3901-1DF	/M3.2
+.T -HQ0C	3SB3400-1A CB//CLOSED RED 3SB3001-6BA20 3SB3901-1CF	/M3.3
+.T -H86	3SB3400-1A LOCKOUT HEALTHY WHITE 3SB3001-6BA60 3SB3901-1QF	/M2.4



+.F -T1L1	/S2.2	/S2.2	/S2.2
+.F -T1L2	/S2.2	/S2.2	/S2.2
+.F -T1L3	/S2.2	/S2.2	/S2.2

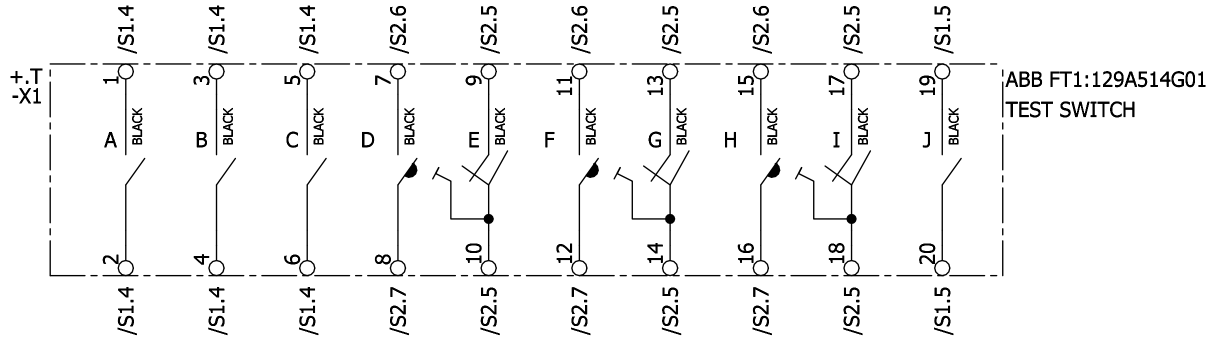


ABB FT1:129A514G01
TEST SWITCH

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ03	S =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER		+J01 Z7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		SECONDARY EQUIPMENT	883597	(3) W92210-F2142-S015-B Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram		8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 8

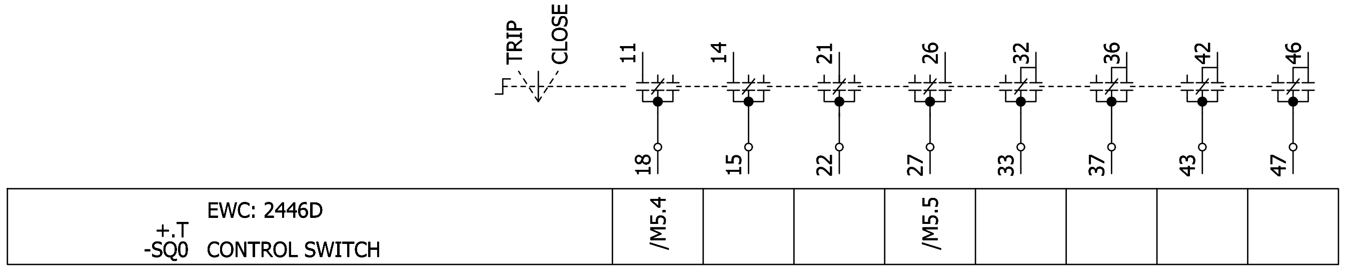
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

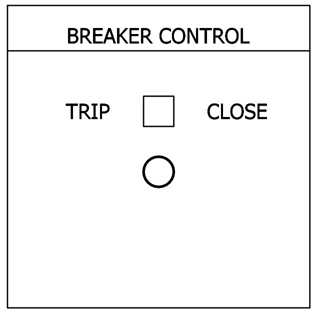
Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

nat =NORMAL AFTER TRIP

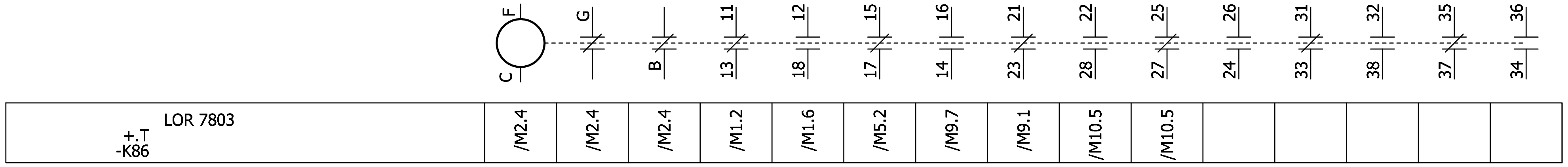
nac =NORMAL AFTER CLOSE

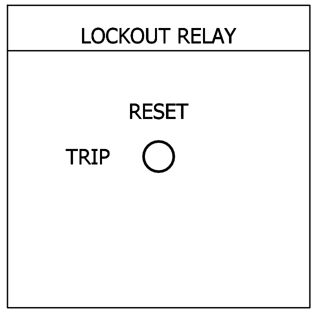
DECK	CONTACTS	POS			
		TRIP	nat	nac	CLOSE
1	11 – 18	X			
	14 – 15	X			
2	21 – 22		X	X	
	26 – 27				X
3	32 – 33			X	X
	36 – 37			X	X
4	42 – 43			X	X
	46 – 47			X	X





DECK	CONTACTS	POSITION	
		TRIP	RESET
I	B – C		X
	F – G		X
1	11 – 13		X
	12 – 18	X	
	15 – 17		X
	16 – 14	X	
2	21 – 23		X
	22 – 28	X	
	25 – 27		X
	26 – 24	X	
3	31 – 33		X
	32 – 38	X	
	35 – 37		X
	36 – 34	X	





				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
SECONDARY EQUIPMENT
Circuit diagram

=JZ03 S =J01
+J01 Z8
883597 (3) W92210-F2142-S015-B Sheet 8-
8 Sh.

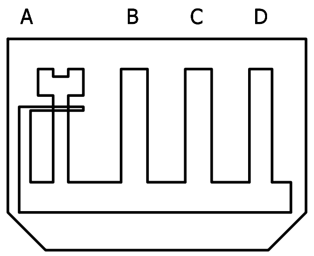
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13
Archive: =J01 / V / / / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

1	2	3	4	5	6	7	8	9	10	11	12	13	14



Cable connection to termination

A B C D

Terminal	Terminal block type	Wire type
11-46	UPCV3K	
	PLUG PC 4/6-STF-7,62	
	UPCV3K-F BEFORE AND AFTER EACH BLOCK OF 6 UPCV3K TERMINALS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 24

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
		-XR1						
		○	11	=J00/G1.3			-F10 :2	=J02 +.B -XR1 :11 B
		○	12	=J00/G1.3			-F10 :4	=J02 +.B -XR1 :12 B
		○	13	=J00/G1.3			-F20 :2	=J02 +.B -XR1 :13 B
		○	14	=J00/G1.3			-F20 :4	=J02 +.B -XR1 :14 B
		○	15	=J00/G1.3			-F100 :2	=J02 +.B -XR1 :15 B
		○	16	=J00/G1.3			-X90 :2 A	=J02 +.B -XR1 :16 B
		○	21	=J00/G1.3			+.T -X1 :1	=J02 +.B -XR1 :21 B
		○	22	=J00/G1.3			+.T -X1 :3	=J02 +.B -XR1 :22 B
		○	23	=J00/G1.3			+.T -X1 :5	=J02 +.B -XR1 :23 B
		○	24	=J00/G1.3			+.T -X1 :19	=J02 +.B -XR1 :24 B
		○	25	=J00/G1.3			+.T -A21-1 :D4	=J02 +.B -XR1 :25 B
		○	26	=J00/G1.3				=J02 +.B -XR1 :26 B
		○	31	=J00/G2.3			-XC30 :800 D	=J02 +.B -XR1 :31 B
		○	32	=J00/G2.3			-XC30 :820 D	=J02 +.B -XR1 :32 B
		○	33	=J00/G2.3				=J02 +.B -XR1 :33 B
		○	34	=J00/G2.3				=J02 +.B -XR1 :34 B
		○	35	=J00/G2.3			+.T -A21-2 :L7	=J02 +.B -XR1 :35 B
		○	36	=J00/G2.3			+.T -A21-2 :L10	=J02 +.B -XR1 :36 B
		○	41	=J00/G3.3				
		○	42	=J00/G3.3				
		○	43	=J00/G3.3				
		○	44	=J00/G3.3				
		○	45	=J00/G3.3				
		○	46	=J00/G3.3				

Screen bus →	A Cable clamp	⌒	Cover
N-bus	B Screen bus	—×—	Insulation plate
PE-PEN-bus	C Screwed cable gland	—××—	Higher level insulation plate
Used cores total	D Plug housing	◉	Test socket
Continued on sheet	E Insulated	○⁄○	Disconnector

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XR1
Connection table

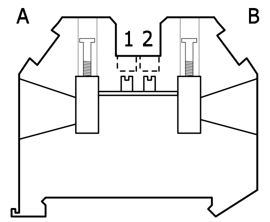
=JZ03
V
=J01
+.B
/1
883597
(3) W92210-F2142-S018-B
Sheet 1+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11-UT
Archive: =J01 / V / / / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1	-J01-W91	SIHSI-CU 3x0,75mm²		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				



1 = Plug-in bridge left
2 = Plug-in bridge right

Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
1-3	UT 4	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Termination A Destination Item designation		Terminal strip Link			Term.-no.	Cross-ref.	Termination B Destination Item designation	
																	-X90 1 2 JUMPER						
BN															-B90	:2	○	□ □	○	1	/G2.2	-R91	:1
BU															-XR1	:16 C	○	□ □	○	2	/G2.2	-R91	:2
GNYE															-XPE	:1 B	○	□ □	○	3	/G2.2	-R91	:PE

Screen bus	→
N-bus	
PE-PEN-bus	
Used cores total	3
Continued on sheet	

A Cable clamp	⌒	Cover
B Screen bus	—*—	Insulation plate
C Screwed cable gland	—**—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name				
A	CERTIFIED	06-30-15	BM	Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT	
				Appr.	Magnuson	VENTILATION BUILDING WEST	
				Norm		Orig./Prep.for/Prep.by	

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-X90
Connection table

=JZ03 V =J01
+.B
/2

883597
(3) W92210-F2142-S018-B
Sheet 2+
14 Sh.

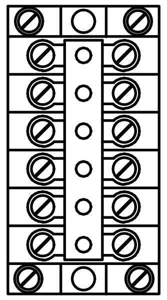
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination
A
B

Terminal	Terminal block type	Wire type
111-136	LJK:1506SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 18

-XT1

Termination A Destination Item designation				Link	Term.-no.	Cross-ref.	Termination B Destination Item designation			
+.F	-T1L1	:X1			111	/S2.4		+.T	-X1	:10
+.F	-T1L1	:X2			112	/S2.4				
+.F	-T1L1	:X3			113	/S2.4				
+.F	-T1L1	:X4			114	/S2.4				
+.F	-T1L1	:X5			115	/S2.4			-XT1	:125 B
							=J01	+.B	-PE	
					116	/S2.4				
+.F	-T1L2	:X1	⌒		121	/S2.4		+.T	-X1	:14
+.F	-T1L2	:X2			122	/S2.4				
+.F	-T1L2	:X3			123	/S2.4				
+.F	-T1L2	:X4			124	/S2.4				
+.F	-T1L2	:X5			125	/S2.4			-XT1	:115 B
									-XT1	:135 B
					126	/S2.4				
+.F	-T1L3	:X1	⌒		131	/S2.4		+.T	-X1	:18
+.F	-T1L3	:X2			132	/S2.4				
+.F	-T1L3	:X3			133	/S2.4				
+.F	-T1L3	:X4			134	/S2.4				
+.F	-T1L3	:X5			135	/S2.4			-XT1	:125 B
								+.T	-X1	:16
					136	/S2.4				
			⌒							

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
—✕—	Insulation plate
—✕✕—	Higher level insulation plate
◉	Test socket
o⌐o	Disconnector

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST		=J01+.B-XT1
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Connection table

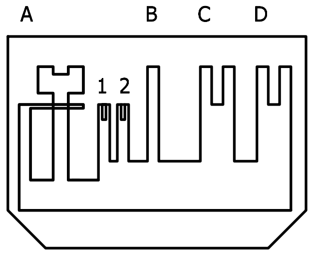
=JZ03	V	=J01	
		+.B	/3
883597	(3) W92210-F2142-S018-B		Sheet 3+
			14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 56

Cable connection to termination

A B C D

1 2 3 4 5 6 7 8 9

Termination A Destination Item designation

-XC30

1 2 JUMPER

Link 1	Link 2	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
■	□	300	/G1.3			-F20 :1
■	□	301	/M1.2			+.T -A21-3 :M7
■	□	302	/M2.4			+.T -H86 :X1
■	□	303	/M2.4			+.T -A21-1 :B7
■	□	304	/M3.2			-XQ0 :51 D
■	□	305	/M4.2			-XQ1 :890 D
■	□	306	/M5.2			+.T -K86 :15
■	□	307	/M5.3			-XQ0 :23 D
■	□	308	/M5.4			+.T -S271 :4
■	□	309	/M6.2			-F10 :13
■	□	310	/M6.4			-XQ1 :533 D
■	□	311	/M6.5		+.T -S271 :7	-XQ1 :143 D
■	□	312	/M7.3		-XQ1 :131 D	-XQ1 :541 D
■	□	313	/M7.5			
■	□	314	/M7.6			
□	■	320	/G1.3			-F20 :3
□	■	321	/M1.2		-XQ0 :14 D	+.T -K86 :13
□	■	322	/M2.4			+.T -K86 :B
□	■	323	/M3.2			+.T -A21-3 :N11
□	■	324	/M5.4			+.T -A21-1 :D14
□	■	325	/M5.7			+.T -A21-2 :L11
□	■	326	/M6.4			-XQ0 :12 D
□	■	327	/M6.5			-XC31 :53 B
□	■	328	/M6.7			+.T -S271 :2
□	■	329	/M7.3			+.T -SETD :2
□	■	330	/M7.4			+.T -SWTD :2
□	■	331	/M7.4			
□	■	332	/M7.5			
□	■	333	/M7.5			
□	■	334	/M7.5			
■	□	340	/M1.6		+.T -K86 :12	-XC31 :32 B
■	□	341	/M1.7			+.T -A21-3 :N2
□	■	342	/M1.6		+.T -K86 :18	-XC31 :34 B
□	■	343	/M1.7			+.T -A21-3 :N1
■	□	800	/G1.6		-F80 :1	-XR1 :31 C
■	□	801	/M8.2		+.T -SWTD :4	+.T -SETD :4
■	□	802	/M8.4			
■	□	803	/M8.4			
■	□	804	/M8.5			
■	□	805	/M8.5			

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp — Cover
B Screen bus — Insulation plate
C Screwed cable gland — Higher level insulation plate
D Plug housing — Test socket
E Insulated — Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XC30
Connection table

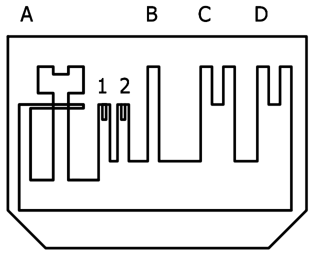
=JZ03 V =J01
+.B
/4
883597
(3) W92210-F2142-S018-B
Sheet 4+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 56

Cable connection to termination

A ☐ B ◤ C ◥ D ◢

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation

Terminal strip -XC30

Link 1	Link 2 (JUMPER)	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
□	■	820	/G1.7		-F80 :3	-XR1 :32 C
□	■	821	/M8.2			-XQ0 :112 D
□	■	822	/M8.5			+.T -A21-1 :D6
□	■	823	/M8.5			
□	■	824	/M8.6			
□	■	825	/M8.6			
□	□	901	/M10.7			
□	□	902	/M10.7			
□	□	903	/M10.7			
□	□	904	/M10.7			
□	□	905	/M10.7			
□	□	906	/M10.8			
□	□	907	/M10.8			
□	□	908	/M10.8			
□	□	909	/M10.8			
□	□	910	/M10.8			

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover	
B Screen bus	⊥	Insulation plate	
C Screwed cable gland	╪	Higher level insulation plate	
D Plug housing	◉	Test socket	
E Insulated	○⌐○	Disconnector	

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XC30
Connection table

=JZ03 V =J01 +.B
883597
(3) W92210-F2142-S018-B
/5
Sheet 5+
14 Sh.

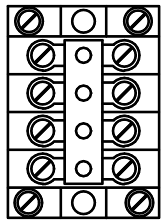
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ☐

Terminal: 11-94

Terminal block type: LJK:1504SC
+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK
(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)
NOTE:REMOVE SHORTING BAR

Wire type: FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation
		-XC31				
			11	/M10.5		
			12	/M10.6		
			13	/M10.6		
	⌒		14	/M10.6		
			21	/M10.6		
			22	/M10.6		
			23	/M10.7		
	⌒		24	/M10.7		
-XC31 :32 A			31	/M1.5		+.T -A21-3 :M7
=EXT +EXT						
-XC31 :31 A			32	/M1.5		-XC30 :340 D
=EXT +EXT						
-XC31 :34 A			33	/M1.5		-XQ1 :531 C
=EXT +EXT						
-XC31 :33 A	⌒		34	/M1.5		-XC30 :342 D
=EXT +EXT						
=EXT +EXT			41	/M5.5		-XC31 :42 B
						+.T -S271 :5
=EXT +EXT			42	/M5.6		-XC31 :41 B
=EXT +EXT			43	/M5.5		+.T -A21-1 :D9
=EXT +EXT	⌒		44	/M5.6		+.T -A21-1 :D10
=EXT +EXT			51	/M6.5		-XQ0 :92 D
=EXT +EXT			52	/M6.6		-XQ0 :94 D
=EXT +EXT			53	/M6.5		-XC31 :54 B
						-XC30 :327 D
=EXT +EXT	⌒		54	/M6.6		-XC31 :53 B
			61	/M8.8		
			62	/M8.8		
			63	/M8.8		
	⌒		64	/M8.8		
-XC31 :72 A			71	/M1.2		-XQ1 :171 C
=EXT +EXT						
-XC31 :71 A			72	/M1.2		-XC31 :73 B
=EXT +EXT						
-XC31 :74 A			73	/M1.2		-XC31 :72 B
=EXT +EXT						
-XC31 :73 A	⌒		74	/M1.2		-XQ0 :17 D
=EXT +EXT						
			81	/M10.7		
			82	/M10.7		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
‐✕‐	Insulation plate
‐✕✕‐	Higher level insulation plate
◉	Test socket
○⁄○	Disconnector

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XC31
Connection table

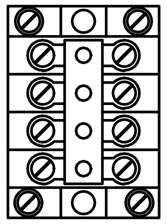
=JZ03 V =J01
+.B /6
883597 (3) W92210-F2142-S018-B Sheet 6+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				



Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation
		-XC31				
			83	/M10.7		
	⌒		84	/M10.8		
			91	/M10.8		
			92	/M10.8		
			93	/M10.8		
	⌒		94	/M10.8		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
✕	Insulation plate
✕✕	Higher level insulation plate
◉	Test socket
○⌐○	Disconnector

Revision	Modification	Date	Name			
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XC31
Connection table

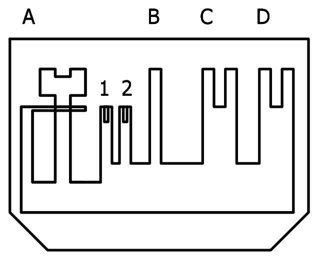
=JZ03 V =J01
+.B
883597 (3) W92210-F2142-S018-B
/7
Sheet 7+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 45

Cable connection to termination

A ☐ B ☐ C ☐ D ☐

Cable connection to termination 1	2	3	4	5	6	7	8	9	Termination A Destination Item designation	Terminal strip -XC32 Link 1 2 JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										⊖ □ □ ● — —	100	/M5.8			+.T -A21-2 :L14
										⊖ □ □ ● — —	101	/M5.8			+.T -A21-2 :L13
										⊖ □ □ ● — —	102	/M10.7			
										⊖ □ □ ● — —	103	/M9.1			+.T -K86 :21
										⊖ □ □ ● — —	104	/M9.1			+.T -K86 :23
										⊖ □ □ ● — —	105	/M9.3			-XQ0 :61 D
										⊖ □ □ ● — —	106	/M9.3			-XQ0 :62 D
										⊖ □ □ ● — —	107	/M9.5			-XQ1 :133 D
										⊖ □ □ ● — —	108	/M9.5			-XQ0 :84 D
										⊖ □ □ ● — —	109	/M9.7			+.T -K86 :16
										⊖ □ □ ● — —	110	/M9.7			+.T -K86 :14
										⊖ □ □ ● — —	111	/M10.2			-F10 :21
										⊖ □ □ ● — —	112	/M10.2			-F10 :22
										⊖ □ □ ● — —	113	/M10.7			
										⊖ □ □ ● — —	114	/M10.8			
										⊖ □ □ ● — —	115	/M10.5			+.T -K86 :25
										⊖ □ □ ● — —	116	/M10.5			+.T -K86 :27
										⊖ □ □ ● — —	117	/M10.5			+.T -K86 :22
										⊖ □ □ ● — —	118	/M10.5			+.T -K86 :28
										⊖ □ □ ● — —	119	/M10.8			
										⊖ □ □ ● — —	120	/M6.2			+.T -A21-1 :D12
										⊖ □ □ ● — —	130	/M11.3			+.T -A21-1 :B10
										⊖ □ □ ● — —	131	/M11.3			+.T -A21-1 :B9
										⊖ □ □ ● — —	132	/M11.3			+.T -A21-1 :B11
										⊖ □ □ ● — —	133	/M11.3			+.T -A21-1 :B13
										⊖ □ □ ● — —	134	/M11.3			+.T -A21-1 :B12
										⊖ □ □ ● — —	135	/M11.4			+.T -A21-1 :B14
										⊖ □ □ ● — —	136	/M11.4			+.T -A21-1 :D2
										⊖ □ □ ● — —	137	/M11.4			+.T -A21-1 :D1
										⊖ □ □ ● — —	138	/M11.4			+.T -A21-1 :D3
										⊖ □ □ ● — —	139	/M11.4			+.T -A21-1 :D5
										⊖ □ □ ● — —	140	/M10.8			
										⊖ □ □ ● — —	141	/M10.8			
										⊖ □ □ ● — —	142	/M11.5			+.T -A21-2 :L3
										⊖ □ □ ● — —	143	/M11.5			+.T -A21-2 :L4
										⊖ □ □ ● — —	144	/M11.6			+.T -A21-2 :L5
										⊖ □ □ ● — —	145	/M11.6			+.T -A21-2 :L6
										⊖ □ □ ● — —	146	/M11.6			+.T -A21-2 :L8
										⊖ □ □ ● — —	147	/M11.6			+.T -A21-3 :M1
										⊖ □ □ ● — —	148	/M11.6			+.T -A21-3 :M2

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	—×—	Insulation plate
C Screwed cable gland	—××—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name	Norm	
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XC32
Connection table

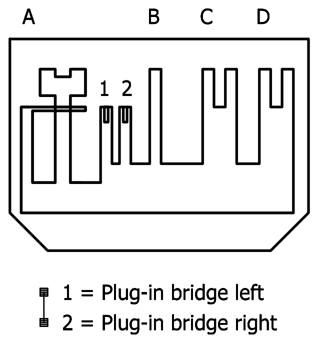
=JZ03
V
=J01
+.B
/8
883597
(3) W92210-F2142-S018-B
Sheet 8+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 45

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9	Termination A Destination Item designation	Link 1 2 JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										-XC32					
										⊖ □ □ ●	149	/M11.6			+.T -A21-3 :M3
										⊖ □ □ ●	150	/M11.7			+.T -A21-3 :M4
										⊖ □ □ ●	151	/M11.7			+.T -A21-3 :M5
										⊖ □ □ ●	152	/M11.7			+.T -A21-1 :B5
										⊖ □ □ ●	153	/M11.7			+.T -A21-1 :B6

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover	
B Screen bus	—✕—	Insulation plate	
C Screwed cable gland	—✕✕—	Higher level insulation plate	
D Plug housing	◉	Test socket	
E Insulated	○⌐○	Disconnector	

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XC32
Connection table

=JZ03 V =J01
+.B
883597 (3) W92210-F2142-S018-B
/9
Sheet 9+
14 Sh.

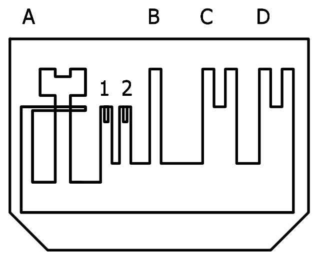
CopyRight (C) Siemens AG 2015 All Rights Reserved

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A B C D

Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
			-XQ0				
⊖ □	□	● — —	11	/M6.4	+.L -Q0-X09 :1		-XQ1 :534 D
⊖ □	□	● — —	12	/M6.4	+.L -Q0-X09 :0		-XC30 :326 D
⊖ □	□	● — —	13	/M1.3	+.L -Q0-X10 :3		-XQ0 :21 D
⊖ □	□	● — —	14	/M1.3	+.L -Q0-X10 :2		-XC30 :321 C
⊖ □	□	● — —	15	/Z1.3	+.L -Q0-X10 :1		
⊖ □	□	● — —	16	/Z1.3	+.L -Q0-X10 :0		
⊖ □	□	● — —	17	/M1.2	+.L -Q0-X11 :9	-XQ1 :172 D	-XC31 :74 B
⊖ □	□	● — —	18	/M1.2	+.L -Q0-X11 :8		+.T -K86 :11
⊖ □	□	● — —	19	/Z1.1	+.L -Q0-X11 :7		
⊖ □	□	● — —	20	/M1.3	+.L -Q0-X11 :6	-XQ1 :532 D	+.T -A21-3 :M9
⊖ □	□	● — —	21	/M1.3	+.L -Q0-X11 :5		-XQ0 :13 D
⊖ □	□	● — —	22	/M1.4	+.L -Q0-X11 :4		-XQ0 :121 D
⊖ □	□	● — —	23	/M5.3	+.L -Q0-X11 :3	-XQ1 :815 D	-XC30 :307 D
⊖ □	□	● — —	24	/M5.3	+.L -Q0-X11 :2		+.T -A21-3 :N14
⊖ □	□	● — —	25	/Z1.4	+.L -Q0-X11 :1		
⊖ □	□	● — —	26	/Z1.4	+.L -Q0-X11 :0		
⊖ □	□	● — —	27	/G1.2	+.L -Q0-X12 :9		-F10 :1
⊖ □	□	● — —	28	/G1.2	+.L -Q0-X12 :8		-F10 :3
⊖ □	□	● — —	29	/Z1.4	+.L -Q0-X12 :7		
⊖ □	□	● — —	30	/Z1.4	+.L -Q0-X12 :6		
⊖ □	□	● — —	31	/Z1.4	+.L -Q0-X12 :5		
⊖ □	□	● — —	32	/Z1.4	+.L -Q0-X12 :4		
⊖ □	□	● — —	33	/Z1.4	+.L -Q0-X12 :3		
⊖ □	□	● — —	34	/Z1.4	+.L -Q0-X12 :2		
⊖ □	□	● — —	41	/Z1.5	+.L -Q0-X12 :1		
⊖ □	□	● — —	42	/Z1.5	+.L -Q0-X12 :0		
⊖ □	□	● — —	43	/Z1.5	+.L -Q0-X13 :9		
⊖ □	□	● — —	44	/Z1.5	+.L -Q0-X13 :8		
⊖ □	□	● — —	45	/Z1.3	+.L -Q0-X13 :7		
⊖ □	□	● — —	46	/Z1.3	+.L -Q0-X13 :6		
⊖ □	□	● — —	51	/M3.2	+.L -Q0-X13 :5	-XQ1 :111 D	-XC30 :304 D
⊖ □	□	● — —	52	/M3.2	+.L -Q0-X13 :4	+.T -HQ0O :X1	+.T -A21-3 :N5
⊖ □	□	● — —	54	/M3.2	+.L -Q0-X13 :3	+.T -HQ0C :X1	+.T -A21-3 :N6
⊖ □	□	● — —	61	/M9.3	+.L -Q0-X13 :2	-XQ1 :121 D	-XC32 :105 D
⊖ □	□	● — —	62	/M9.3	+.L -Q0-X13 :1	-XQ1 :122 D	-XC32 :106 D
⊖ □	□	● — —	64	/M9.3	+.L -Q0-X13 :0		
⊖ □	□	● — —	71	/Z1.6	+.L -Q0-X14 :9		
⊖ □	□	● — —	72	/Z1.6	+.L -Q0-X14 :8		
⊖ □	□	● — —	73	/Z1.6	+.L -Q0-X14 :7		
⊖ □	□	● — —	74	/Z1.6	+.L -Q0-X14 :6		

Termination A Destination Item designation

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	⊣	Insulation plate
C Screwed cable gland	⫲	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XQ0
Connection table

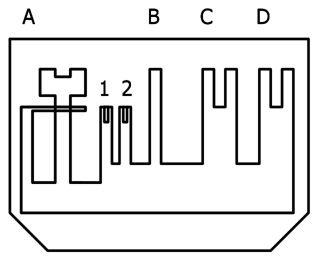
=JZ03 V =J01
+.B
883597
(3) W92210-F2142-S018-B
/10
Sheet 10+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 11

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation	Terminal strip -XQ0 Link (1 2 JUMPER)	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖ □ □ ●	81	/Z1.6	+.L -Q0-X14 :5		
	⊖ □ □ ●	82	/Z1.6	+.L -Q0-X14 :4		
	⊖ □ □ ●	83	/M9.5	+.L -Q0-X14 :3		-XQ1 :134 D
	⊖ □ □ ●	84	/M9.5	+.L -Q0-X14 :2		-XC32 :108 D
	⊖ □ □ ●	91	/M6.5	+.L -Q0-X14 :1	-XQ1 :144 D	-XQ0 :93 D
	⊖ □ □ ●	92	/M6.5	+.L -Q0-X14 :0		-XC31 :51 B
	⊖ □ □ ●	93	/M6.6	+.L -Q0-X15 :9		-XQ0 :91 D
	⊖ □ □ ●	94	/M6.6	+.L -Q0-X15 :8		-XC31 :52 B
	⊖ □ □ ●	101	/Z1.7	+.L -Q0-X15 :7		
	⊖ □ □ ●	102	/Z1.7	+.L -Q0-X15 :6		
	⊖ □ □ ●	103	/Z1.7	+.L -Q0-X15 :5		
	⊖ □ □ ●	104	/Z1.7	+.L -Q0-X15 :4		
	⊖ □ □ ●	111	/M8.2	+.L -Q0-X15 :3		-XQ1 :831 C
	⊖ □ □ ●	112	/M8.2	+.L -Q0-X15 :2		-XC30 :821 D
	⊖ □ □ ●	113	/Z1.8	+.L -Q0-X15 :1		
	⊖ □ □ ●	114	/Z1.8	+.L -Q0-X15 :0		
	⊖ □ □ ●	121	/M1.5	+.L -Q0-X16 :1		-XQ0 :22 D
	⊖ □ □ ●	122	/M1.5	+.L -Q0-X16 :0		+.T -A21-3 :N3
	⊖ □ □ ●	123	/Z1.8	+.L -Q0-X17 :1		
	⊖ □ □ ●	124	/Z1.8	+.L -Q0-X17 :0		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A	Cable clamp	⌒	Cover
B	Screen bus	✕	Insulation plate
C	Screwed cable gland	✕✕	Higher level insulation plate
D	Plug housing	◉	Test socket
E	Insulated	○⁄○	Disconnector

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XQ0
Connection table

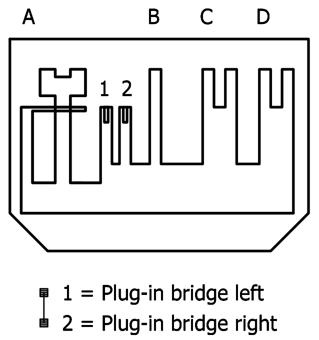
=JZ03 V =J01 +.B /11
883597 (3) W92210-F2142-S018-B
Sheet 11+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / 12

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A ☐ B ☐ C ☐ D ☐

1	2	3	4	5	6	7	8	9

Terminal strip -XQ1

Termination A Destination Item designation	Link 1 2 JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖ ☐ ☐ ●	111	/M3.3	+.D -Q1-X11 :9	-XQ1 :511 D	-XQ0 :51 C
	⊖ ☐ ☐ ●	112	/M3.3	+.D -Q1-X11 :8		+.T -A21-3 :N7
	⊖ ☐ ☐ ●	114	/M3.4	+.D -Q1-X11 :7		+.T -A21-3 :N8
	⊖ ☐ ☐ ●	121	/M9.4	+.D -Q1-X11 :6		-XQ0 :61 C
	⊖ ☐ ☐ ●	122	/M9.4	+.D -Q1-X11 :5		-XQ0 :62 C
	⊖ ☐ ☐ ●	124	/M9.4	+.D -Q1-X11 :4		
	⊖ ☐ ☐ ●	131	/M7.3	+.D -Q1-X11 :3		-XC30 :312 C
	⊖ ☐ ☐ ●	132	/M7.3	+.D -Q1-X11 :2		+.T -SETD :1
	⊖ ☐ ☐ ●	133	/M9.5	+.D -Q1-X11 :1		-XC32 :107 D
	⊖ ☐ ☐ ●	134	/M9.5	+.D -Q1-X11 :0		-XQ0 :83 D
	⊖ ☐ ☐ ●	141	/Z2.3	+.D -Q1-X12 :3		
	⊖ ☐ ☐ ●	142	/Z2.3	+.D -Q1-X12 :2		
	⊖ ☐ ☐ ●	143	/M6.5	+.D -Q1-X12 :1		-XC30 :311 D
	⊖ ☐ ☐ ●	144	/M6.5	+.D -Q1-X12 :0		-XQ0 :91 C
	⊖ ☐ ☐ ●	151	/Z2.4	+.D -Q1-X13 :3		
	⊖ ☐ ☐ ●	152	/Z2.4	+.D -Q1-X13 :2		
	⊖ ☐ ☐ ●	153	/Z2.4	+.D -Q1-X13 :1		
	⊖ ☐ ☐ ●	154	/Z2.4	+.D -Q1-X13 :0		
	⊖ ☐ ☐ ●	161	/Z2.4	+.D -Q1-X14 :3		
	⊖ ☐ ☐ ●	162	/Z2.4	+.D -Q1-X14 :2		
	⊖ ☐ ☐ ●	163	/Z2.5	+.D -Q1-X14 :1		
	⊖ ☐ ☐ ●	164	/Z2.5	+.D -Q1-X14 :0		
	⊖ ☐ ☐ ●	171	/M1.2	+.D -Q1-X15 :3	-XC31 :71 B	+.T -A21-3 :M10
	⊖ ☐ ☐ ●	172	/M1.2	+.D -Q1-X15 :2		-XQ0 :17 C
	⊖ ☐ ☐ ●	173	/Z2.5	+.D -Q1-X15 :1		
	⊖ ☐ ☐ ●	174	/Z2.5	+.D -Q1-X15 :0		
	⊖ ☐ ☐ ●	511	/M3.5	+.D -Q1-X51 :9		-XQ1 :111 C
	⊖ ☐ ☐ ●	512	/M3.5	+.D -Q1-X51 :8		+.T -A21-3 :N9
	⊖ ☐ ☐ ●	514	/M3.6	+.D -Q1-X51 :7		+.T -A21-3 :N10
	⊖ ☐ ☐ ●	521	/Z3.4	+.D -Q1-X51 :6		
	⊖ ☐ ☐ ●	522	/Z3.4	+.D -Q1-X51 :5		
	⊖ ☐ ☐ ●	524	/Z3.4	+.D -Q1-X51 :4		
	⊖ ☐ ☐ ●	531	/M1.5	+.D -Q1-X51 :3	-XC31 :33 B	+.T -A21-3 :M8
	⊖ ☐ ☐ ●	532	/M1.5	+.D -Q1-X51 :2		-XQ0 :20 C
	⊖ ☐ ☐ ●	533	/M6.4	+.D -Q1-X51 :1		-XC30 :310 D
	⊖ ☐ ☐ ●	534	/M6.4	+.D -Q1-X51 :0		-XQ0 :11 D
	⊖ ☐ ☐ ●	541	/M7.4	+.D -Q1-X52 :3		-XC30 :312 D
	⊖ ☐ ☐ ●	542	/M7.4	+.D -Q1-X52 :2		+.T -SWTD :1
	⊖ ☐ ☐ ●	543	/Z3.5	+.D -Q1-X52 :1		
	⊖ ☐ ☐ ●	544	/Z3.5	+.D -Q1-X52 :0		

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

Cover
Insulation plate
Higher level insulation plate
◉ Test socket
Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Date	05-18-15
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING WEST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XQ1
Connection table

883597
(3) W92210-F2142-S018-B

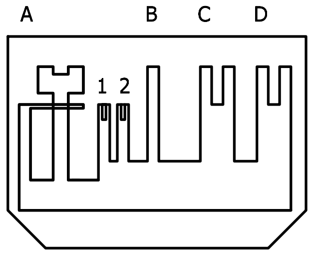
=JZ03
V
=J01
+.B
/12
Sheet 12+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 13

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A ☐ B ◩ C ◳ D ◪

1	2	3	4	5	6	7	8	9

Termination A
Destination
Item designation

Terminal strip

-XQ1

Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
□	□	●	551	/Z3.5	+.D -Q1-X53 :3		
□	□	●	552	/Z3.5	+.D -Q1-X53 :2		
□	□	●	553	/Z3.6	+.D -Q1-X53 :1		
□	□	●	554	/Z3.6	+.D -Q1-X53 :0		
□	□	●	561	/Z3.6	+.D -Q1-X54 :3		
□	□	●	562	/Z3.6	+.D -Q1-X54 :2		
□	□	●	563	/Z3.6	+.D -Q1-X54 :1		
□	□	●	564	/Z3.6	+.D -Q1-X54 :0		
□	□	●	571	/Z3.6	+.D -Q1-X55 :3		
□	□	●	572	/Z3.6	+.D -Q1-X55 :2		
□	□	●	573	/Z3.7	+.D -Q1-X55 :1		
□	□	●	574	/Z3.7	+.D -Q1-X55 :0		
□	□	●	815	/M5.4	+.D -Q1-X82 :3		-XQ0 :23 C
□	□	●	816	/M5.4	+.D -Q1-X82 :2		+.T -A21-3 :N15
□	□	●	817	/Z2.7	+.D -Q1-X82 :1		
□	□	●	818	/Z2.7	+.D -Q1-X82 :0		
□	□	●	830	/M8.2	+.D -Q1-X84 :1		+.T -SETD :3
□	□	●	831	/M8.2	+.D -Q1-X84 :0	-XQ0 :111 D	-XQ1 :833 D
□	□	●	832	/M8.4	+.D -Q1-X85 :1		+.T -SWTD :3
□	□	●	833	/M8.4	+.D -Q1-X85 :0		-XQ1 :831 D
□	□	●	890	/M4.2	+.D -B0-X88 :3		-XC30 :305 D
■	□	●	891	/M4.2	+.D -B0-X88 :2		+.T -A21-3 :N12
■	□	●	892	/M4.2	+.D -B0-X88 :1		
■	□	●	893	/M4.3	+.D -B0-X88 :0		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A	Cable clamp	⌒	Cover
B	Screen bus	✕	Insulation plate
C	Screwed cable gland	✕✕	Higher level insulation plate
D	Plug housing	◉	Test socket
E	Insulated	○⁄○	Disconnector

CopyRight (C) Siemens AG 2015 All Rights Reserved

Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING WEST
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.

Siemens AG

8DA10 25kV SWITCHGEAR
TIE FEEDER
=J01+.B-XQ1
Connection table

=JZ03
V
=J01
+.B
/13
883597
(3) W92210-F2142-S018-B
Sheet 13+
14 Sh.

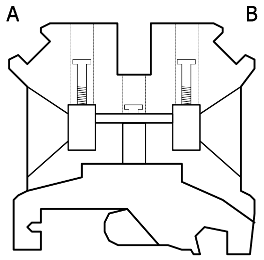
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11
Archive: =J01 / V / / / 14

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883597.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
1-8	UT 4-PE	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 8

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Termination B Destination Item designation
	-XPE			
=J01 +.B -PE	○	1	/G2.2	-X90 :3 A
	○	2	/S1.7	
	○	3	/S1.7	
	○	4	/S1.7	
	○	5	/S1.8	
	○	6	/S1.8	
	○	7	/S1.8	
	○	8	/S1.8	

Screen bus →	A Cable clamp	Cover
N-bus	B Screen bus	Insulation plate
PE-PEN-bus	C Screwed cable gland	Higher level insulation plate
Used cores total	D Plug housing	Test socket
Continued on sheet	E Insulated	Disconnector

Revision	Modification	Date	Name						
A	CERTIFIED	06-30-15	BM	Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TIE FEEDER	
				Appr.	Magnuson	VENTILATION BUILDING WEST		=J01+.B-XPE	
				Norm		Orig./Prep.for/Prep.by		Connection table	

=JZ03 V =J01 +.B /14

883597 (3) W92210-F2142-S018-B Sheet 14- 14 Sh.

Siemens AG

Energy Management - Medium Voltage & Systems

Circuit diagram

for

Purchaser CRUM ELECTRIC SUPPLY COMPANY INC.

User COLORADO DEPARTMENT OF TRANSPORT

Plant VENTILATION BUILDING EAST

Plant section 8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS

Typical =JZ00

Project reference number

Date of issue 08-27-15

Customer document number

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

SIEMENS AG

Archive: =J00 / A / / / 1

Project: 883314

Documentation identifier A / =J00 / / 1

Manufacturer document number (3) W92210-F2141-S001-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J00 / A / A / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
A	=J00 +J00	/1	(3) W92210-F2141-S001-B	1-	1	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS COVER SHEET Cover sheet	EM MS O GIS SWF PR OP SEN FFM
A	=J00 +J00	A1	(3) W92210-F2141-S002-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J00 +J00	A2	(3) W92210-F2141-S002-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
B	=J00 +J00	B1	(3) W92210-F2141-S003-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS GENERAL INFORMATION Overview diagram	EM MS O GIS SWF PR OP SEN FFM
B	=J00 +J00	B2	(3) W92210-F2141-S003-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS SINGLE LINE DIAGRAM Overview diagram	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D1	(3) W92210-F2141-S004-B	1+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS FRONT VIEW Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D2	(3) W92210-F2141-S004-B	2+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS PLAN VIEW Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D3	(3) W92210-F2141-S004-B	3+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS CONSTRUCTIONAL DATA =JZ01 Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D4	(3) W92210-F2141-S004-B	4+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS CONSTRUCTIONAL DATA =JZ03 Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D5	(3) W92210-F2141-S004-B	5+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS CONSTRUCTIONAL DATA =JZ05 Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D6	(3) W92210-F2141-S004-B	6+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS CONSTRUCTIONAL DATA =JZ05_1 Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D7	(3) W92210-F2141-S004-B	7+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS GENERAL INFORMATION Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D8	(3) W92210-F2141-S004-B	8+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS GAS ARRANGEMENT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D9	(3) W92210-F2141-S004-B	9+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS GENERAL INFORMATION Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
TABLE OF DOCUMENTS
List of documents

=JZ00 A =J00
+J00 A1
883314
(3) W92210-F2141-S002-B
Sheet 1+
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J00 / A / A / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
D	=J00 +J00	D10	(3) W92210-F2141-S004-B	10+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS DOOR LAYOUT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D11	(3) W92210-F2141-S004-B	11+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS DOOR LAYOUT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D12	(3) W92210-F2141-S004-B	12+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS DOOR LAYOUT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D13	(3) W92210-F2141-S004-B	13+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS DOOR LAYOUT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D14	(3) W92210-F2141-S004-B	14+	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS DOOR LAYOUT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
D	=J00 +J00	D15	(3) W92210-F2141-S004-B	15-	15	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS DOOR LAYOUT Arrangement drawing	EM MS O GIS SWF PR OP SEN FFM
S	=J00 +J00	G1	(3) W92210-F2141-S006-B	1+	4	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS BUS WIRE DIAGRAM Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J00 +J00	G2	(3) W92210-F2141-S006-B	2+	4	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS BUS WIRE DIAGRAM Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J00 +J00	G3	(3) W92210-F2141-S006-B	3+	4	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS BUS WIRE DIAGRAM Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J00 +J00	G4	(3) W92210-F2141-S006-B	4-	4	08-27-15	8DA10 25kV SWITCHGEAR GENERAL DOCUMENTS BUS WIRE DIAGRAM Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
TABLE OF DOCUMENTS
List of documents

=JZ00
A
=J00
+J00
A2
883314
(3) W92210-F2141-S002-B
Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / B / B / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

THIS DRAWING ONLY SHOWS POSSIBLE OPTIONS.
PROJECT-SPECIFIC CONFIGURATION TO BE CHECKED IN DETAIL DESIGN.

DESIGNATION OF ELECTRICAL ITEMS

Each terminal connection is uniquely identified by this code. The complete designation is made up of blocks identified by prefix signs.
= Plant
+ Location
- Kind / Number / Function
: Terminal

The Plant designation block has the prefix "="
This also serves to identify the section and the circuit diagram of each section.
It appears in the title block of each page.
For example =H02

The Location designation block has the prefix "+"
This is in general the same as the Plant designation.
For example +H02

The fine location code has the prefix "+."
It defines e.g. the mounting position of a device.
+.T Door
+.B Device mounting plate
+.F Frame (Switchgear chassis)
+.D 3-Position-Switch
+.L Circuit Breaker

The Kind / Function designation block has the prefix "-"
It identifies the function of a device.

For example
-A Assemblies (multiple functions)
-F Protection
-H Signalling device
-K Relay
-Q Switching device (power circuit)
-X Terminal

The Kind / Function designation block is followed by a suffix between 1 and 10 digits.
The suffix can e.g. be enumerated or specific to identify the function more detailed.

For example
-K10 Relay 10
-T1L1 CT in phase A

PAGE NUMBERING

The pages of the documentation for each section are numbered according to the following structure:

A A List of Documents
S G Power Supply Schematic
S M Schematic Diagram
S S Three Line Diagram
S Z Device Detail Drawing
V / Terminals

CROSS REFERENCES

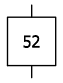
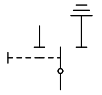
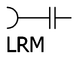
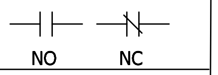
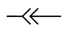
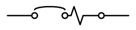
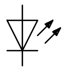
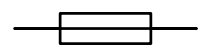
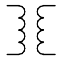
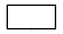
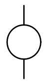
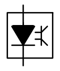
Details of each device used are given in the S / Z-pages. A cross reference to the page where a terminal of the device is used is also provided there.

For example /M1.3 means schematic diagram page M1, column 3.

REVISION INDEX EXPLANATION

A	REVISION AS COMMENTED / APPROVED
P#	AS BUILT REVISION NO. #
R#	AS COMMISSIONED REVISION NO. # (# 0 - NO REVISION)

GENERAL DRAWING LEGEND

CIRCUIT BREAKER	 52
3 POSITION SWITCH	
CAPACITIVE VOLTAGE INDICATION	 LRM
CONTACT	 NO NC
SOCKET AND PLUG	
MINIATURE CIRCUIT BREAKER	
INDICATING LIGHT (LED TYPE)	
FUSE	
VOLTAGE TRANSFORMER	
CURRENT TRANSFORMER	
SURGE ARRESTOR	
TERMINAL CONNECTION	
COIL (E.G. RELAY, INTERLOCKING COIL)	
BINARY INPUT	

TERMINAL DESCRIPTION EXPLANATION

LOCATION WITHIN COMPARTMENT → +.B
TERMINAL STRIP NAME → -X6
TERMINAL NUMBER → 501
TERMINAL CONNECTION LOCATION → C

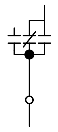
LEGEND FOR CIRCUIT BREAKER (Q0)

-K1	ANTI-PUMPING RELAY
-M	SPRING CHARGING MOTOR
-S1	CIRCUIT BREAKER AUXILIARY CONTACTS
-S3	LIMIT SWITCH, OPEN WHEN CB SPRING IS CHARGED
-S6	CIRCUIT BREAKER TRIP SIGNAL (IMPULSE)
-S7	BLOCK OF CB TRIPPING SIGNAL DURING MANUAL OPEN COMMAND
-S13	BLOCK OF CB TRIPPING WHEN 3-POS SW IS OPERATED MANUALLY
-S16	OPEN WHEN CB OFF BLOCKING LEVER IS LIFTED
-S21/22	LIMIT SWITCH, OPEN WHEN CB SPRING IS CHARGED
-S41	LIMIT SWITCH, CLOSED WHEN CB SPRING IS CHARGED
-S42	LIMIT SWITCH, OPEN WHEN CB SPRING IS CHARGED
-V1-V4	VARISTOR
-S10/11	LIMIT SWITCH, CUTS OFF POWER TO MOTOR WHEN MECHANICAL CLOSE IS PRESSED
-Y1	1ST TRIPPING COIL (f)
-Y2	2ND TRIPPING COIL (f)
-Y7	UNDERVOLTAGE TRIP COIL (r) (SUPPLY VOLTAGE)
-Y9	CLOSING COIL
-Y16	RELEASE COIL FOR CB OFF BLOCKING LEVER

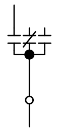
LEGEND FOR DISCONNECTOR & GROUND SWITCH (Q1)

-S1	DISCONNECTOR + GROUND SWITCH AUXILIARY CONTACTS
-S24/25	OPERATES WHEN MANUAL OPERATION IS EXECUTED (INDICATES MANUAL OPERATION OF DISC. OR GROUND SWITCH)
-Y1	INTERLOCKING COIL ISOLATING SWITCH
-Y5	INTERLOCKING COIL GROUND SWITCH
-B0	MANOMETER FOR CB / CABLE HOUSING

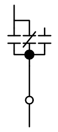
DISCONNECTOR OPEN



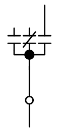
DISCONNECTOR CLOSED



GROUNDING SWITCH OPEN



GROUNDING SWITCH CLOSED



GENERAL DEVICE LEGEND

-Q0	CIRCUIT BREAKER
CC	CLOSING COIL -Y9
TC1	1ST TRIPPING COIL -Y1
TC2	2ND TRIPPING COIL -Y2
-Q1	3 POSITION SWITCH
-Q10	3 POSITION SWITCH RISER PANEL
-Q61	3 POSITION SWITCH BUSBAR VOLTAGE TRANSFORMER
-Y1	INTERLOCKING COIL ISOLATING SWITCH
-Y5	INTERLOCKING COIL GROUND SWITCH
-A51	CAPACITIVE VOLTAGE INDICATOR
-T1	CURRENT TRANSFORMER
-T5	POWER TRANSFORMER LINE
-T15	POWER TRANSFORMER BUSBAR
-T9X	ZERO SEQUENCE CURRENT TRANSFORMER

ANSI DEVICE NUMBERS EXAMPLES

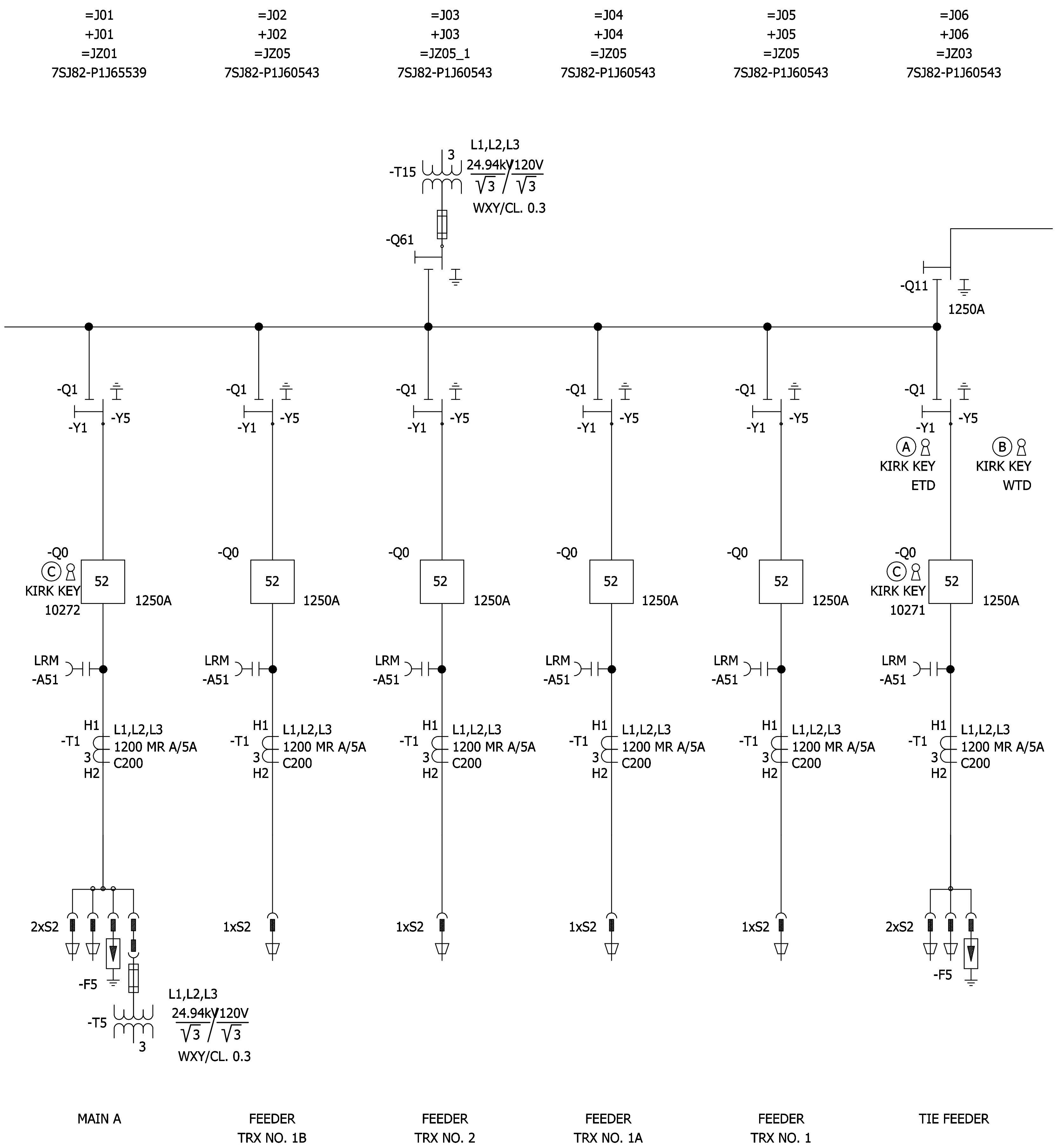
14	LOCKED ROTOR
21	DISTANCE PROTECTION
25	SYNCHROCHECK FUNCTION
26	APPARATUS THERMAL DEVICE
27	UNDERVOLTAGE PROTECTION (PRIMARY VOLTAGE)
48	STARTING TIME SUPERVISION
49	THERMAL OVERLOAD PROTECTION
50	DEFINITE TIME OVERCURRENT
51	INVERSE TIME OVERCURRENT
51M	LOAD JAM PROTECTION
63	PRESSURE
66	RESTART INHIBIT
67	DIRECTIONAL OVERCURRENT
71	TRANSFORMER OIL LEVEL
74	SUPERVISION (E.G. TRIP COIL)
79	AUTOMATIC RECLOSE
81	FREQUENCY PROTECTION
86	LOCK OUT FUNCTION
87	DIFFERENTIAL PROTECTION

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ00	B	=J00	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS				+J00	B1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		GENERAL INFORMATION	883314	(3) W92210-F2141-S003-B			Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Overview diagram					2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / B / B / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



NOTE:

Ⓐ KIRK KEY IS CAPTIVE WHEN ISOLATOR SWITCH IS CLOSED

Ⓑ KIRK KEY IS CAPTIVE WHEN GROUND SWITCH IS CLOSED

Ⓒ KIRK KEY MUST BE INSERTED IN ORDER TO OPERATE CB FROM BCS

SYSTEM/RATED FREQUENCY	OPERATING VOLTAGE:	RATED VOLTAGE:	RATED SHORT-TIME WITHSTAND CURRENT:	RATED NORMAL CURRENT	AUXILIARY VOLTAGE, CONTROL/PROTECTION	AMBIENT AIR TEMP / NORMAL CURRENT
3~60Hz	24.94kV	27.0kV	25kA (3s)	1250A	125V DC	40°C / 1200A

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
SINGLE LINE DIAGRAM
Overview diagram

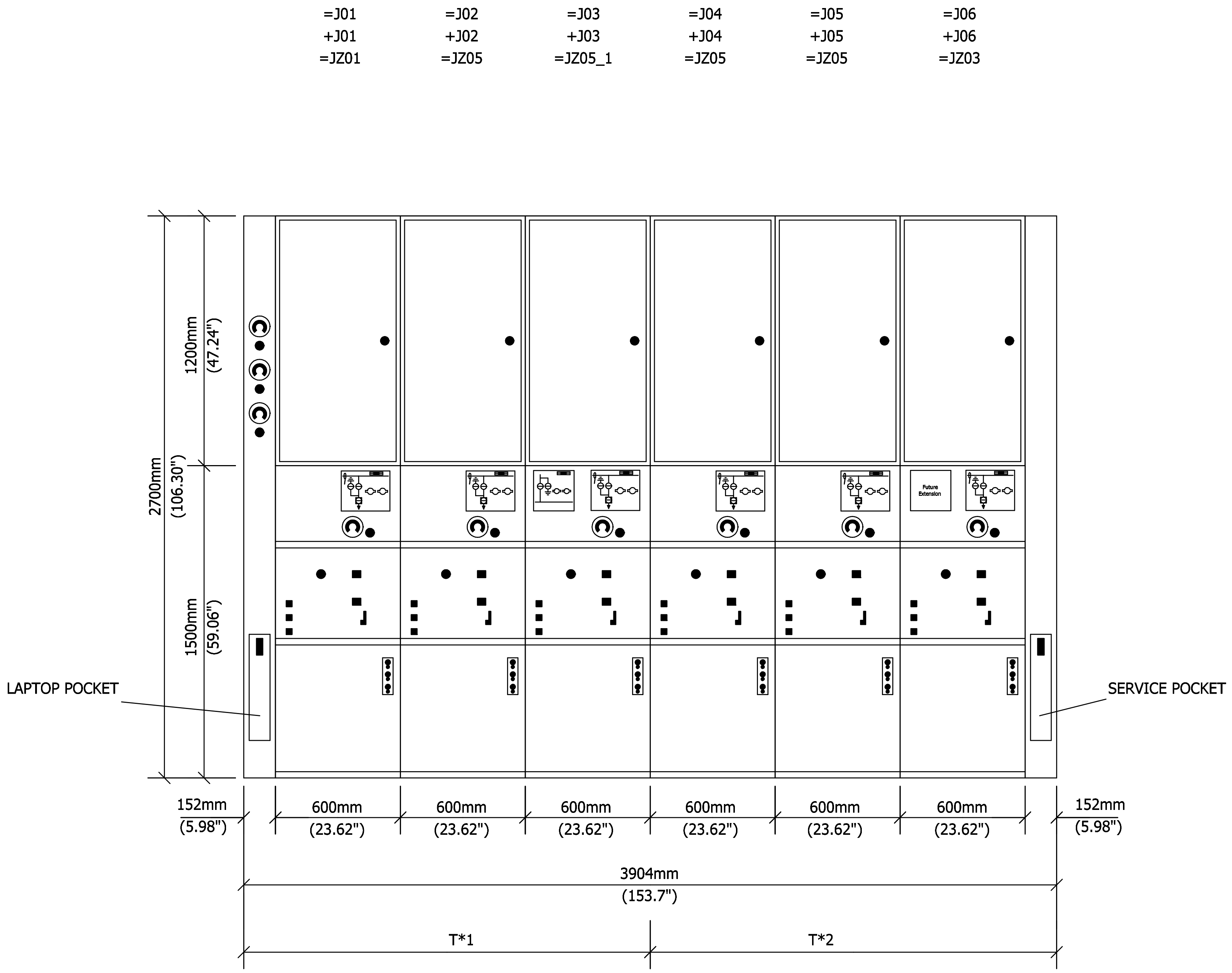
=JZ00
B =J00
+J00
B2
883314
(3) W92210-F2141-S003-B
Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

FRONT VIEW



T*1 = SHIPPING SECTION 1
T*2 = SHIPPING SECTION 2

LOAD DATA AND MINIMUM DISTANCES

1.)	PERMANENT LOADS	
Fv	VERTICAL SINGLE LOAD	8.8 kN
2.)	NOT PERMANENT LOADS	
pa	LIVELOAD	11.2 kN/m²
3.)	MINIMUM DISTANCES	
	OPERATING AISLE	≥ 800 mm *)
	WALL CLEARANCE LEFT OR RIGHT NECESSARY	≥ 500 mm **)
	WALL CLEARANCE LEFT OR RIGHT POSSIBLE	≥ 100 mm **)
	HEIGHT OF CEILING	≥ 2900 mm

THESE CONSTRUCTIONAL DATA OF SIEMENS AG ARE NOT BINDING FOR CONSTRUCTION. THEY ARE ONLY VALID AS A BASE FOR PRODUCTION OF BINDING CONSTRUCTIONAL DRAWINGS. FURTHER INFORMATION ACCORDING CONSTRUCTIONAL DATA CAN BE FOUND IN THE RELATED OPERATING AND INSTRUCTION MANUAL.

THE LOCATION AND DETAIL DIAGRAMS DO HAVE SYMBOLIC CHARACTER AND DO NOT SHOW THE ACTUAL SCOPE OF SUPPLY.

*) According to national regulations
**)In case of switchable devices at busbar a minimum distance of 800mm (alternatively left or right side) is required.

FOR FITTINGS AT THE BUSBAR OBSERVE ADDITIONAL HEIGHT OF PANELS.

1) THE FLOOR PENETRATION FOR THE HIGH-VOLTAGE TERMINATIONS SHOULD TAKE THE FORM OF A CONTINUOUS SLOT FOR EACH ROW OF PANELS. BEAM BENEATH THE PANEL JUNCTION IS POSSIBLE.
2) FLOOR PENETRATION REQUIRED IF THERE IS A BEAM BENEATH THE PANEL JUNCTION.

TOLERANCES:
FALL (MAX.) 1MM/1M, 2MM OVER THE TOTAL LENGTH, FLATNESS 1MM WITHIN 1m MEASURED LENGTH. ADJUST TOLERANCES WITH SHMS.

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
FRONT VIEW
Arrangement drawing

=JZ00
D =J00
+J00
D1
883314
(3) W92210-F2141-S004-B
Sheet 1+
15 Sh.

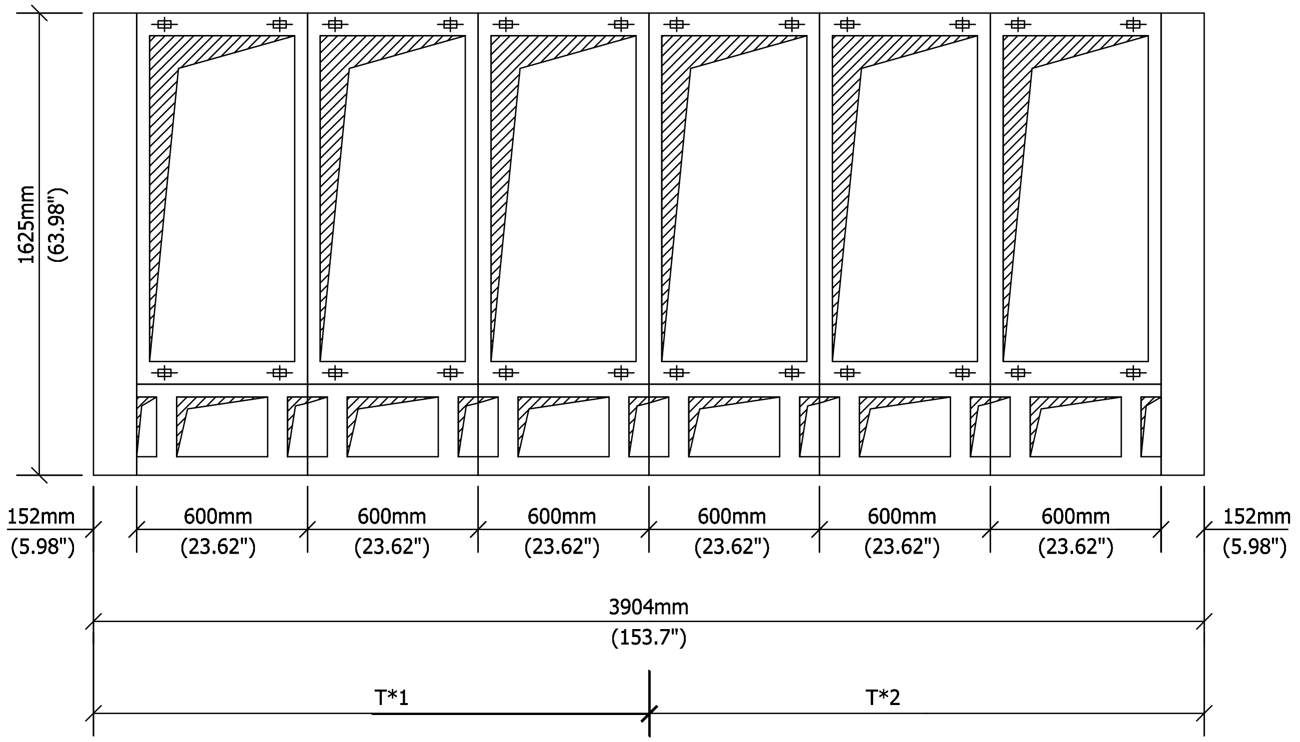
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

PLAN VIEW

=J01	=J02	=J03	=J04	=J05	=J06
+J01	+J02	+J03	+J04	+J05	+J06
=JZ01	=JZ05	=JZ05_1	=JZ05	=JZ05	=JZ03



T*1 = SHIPPING SECTION 1
T*2 = SHIPPING SECTION 2

LOAD DATA AND MINIMUM DISTANCES

1.)	PERMANENT LOADS	
Fv	VERTICAL SINGLE LOAD	8.8 kN
2.)	NOT PERMANENT LOADS	
pa	LIVELOAD	11.2 kN/m²
3.)	MINIMUM DISTANCES	
	OPERATING AISLE	≥ 800 mm *)
	WALL CLEARANCE LEFT OR RIGHT NECESSARY	≥ 500 mm **)
	WALL CLEARANCE LEFT OR RIGHT POSSIBLE	≥ 100 mm **)
	HEIGHT OF CEILING	≥ 2900 mm

THESE CONSTRUCTIONAL DATA OF SIEMENS AG ARE NOT BINDING FOR CONSTRUCTION. THEY ARE ONLY VALID AS A BASE FOR PRODUCTION OF BINDING CONSTRUCTIONAL DRAWINGS. FURTHER INFORMATION ACCORDING CONSTRUCTIONAL DATA CAN BE FOUND IN THE RELATED OPERATING AND INSTRUCTION MANUAL.

THE LOCATION AND DETAIL DIAGRAMS DO HAVE SYMBOLIC CHARACTER AND DO NOT SHOW THE ACTUAL SCOPE OF SUPPLY.

*) According to national regulations
**)In case of switchable devices at busbar a minimum distance of 800mm (alternatively left or right side) is required.

FOR FITTINGS AT THE BUSBAR OBSERVE ADDITIONAL HEIGHT OF PANELS.

1) THE FLOOR PENETRATION FOR THE HIGH-VOLTAGE TERMINATIONS SHOULD TAKE THE FORM OF A CONTINUOUS SLOT FOR EACH ROW OF PANELS. BEAM BENEATH THE PANEL JUNCTION IS POSSIBLE.
2) FLOOR PENETRATION REQUIRED IF THERE IS A BEAM BENEATH THE PANEL JUNCTION.

TOLERANCES:
FALL (MAX.) 1MM/1M, 2MM OVER THE TOTAL LENGTH, FLATNESS 1MM WITHIN 1m MEASURED LENGTH. ADJUST TOLERANCES WITH SHMS.

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
PLAN VIEW
Arrangement drawing

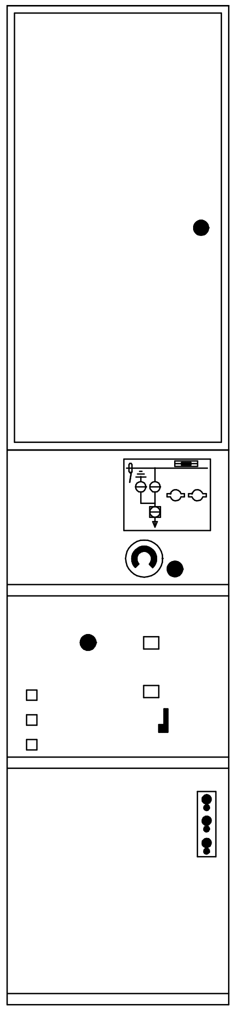
=JZ00	D	=J00	
		+J00	D2
883314	(3) W92210-F2141-S004-B		Sheet 2+
			15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 3

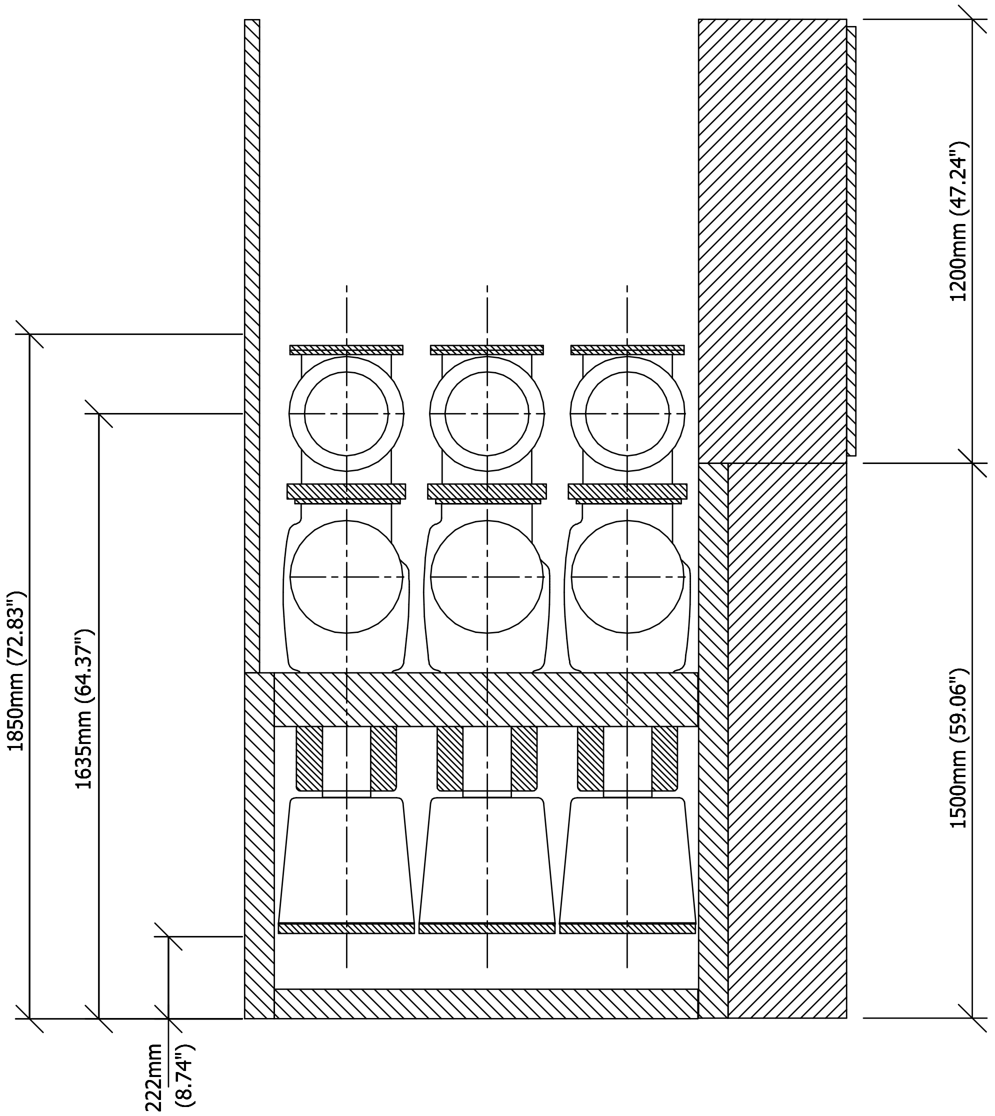
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

FRONT VIEW



SIDE VIEW

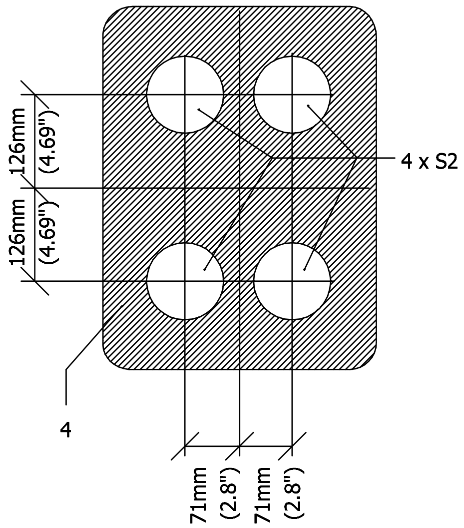


Inscription:

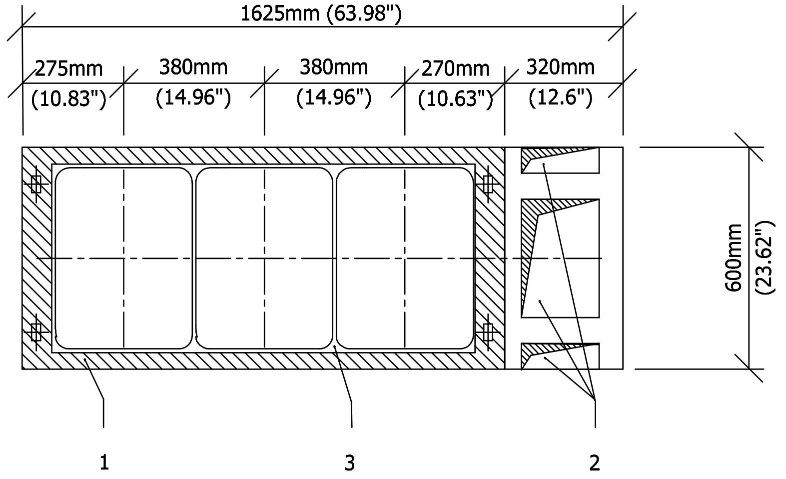
1. Base frame
2. Area for floor openings for control cables
3. Floor opening (e.g. for high-voltage cable)
4. Plug connection - detail view

THE LOCATION AND DETAIL DIAGRAMS
DO HAVE SYMBOLIC CHARACTER AND
DO NOT SHOW THE ACTUAL SCOPE OF
SUPPLY.

TOP VIEW

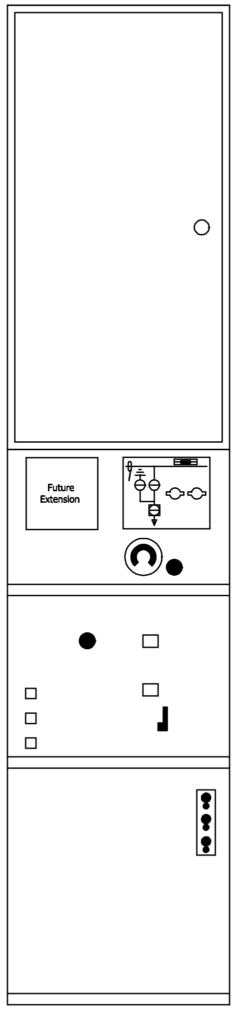


BOTTOM VIEW

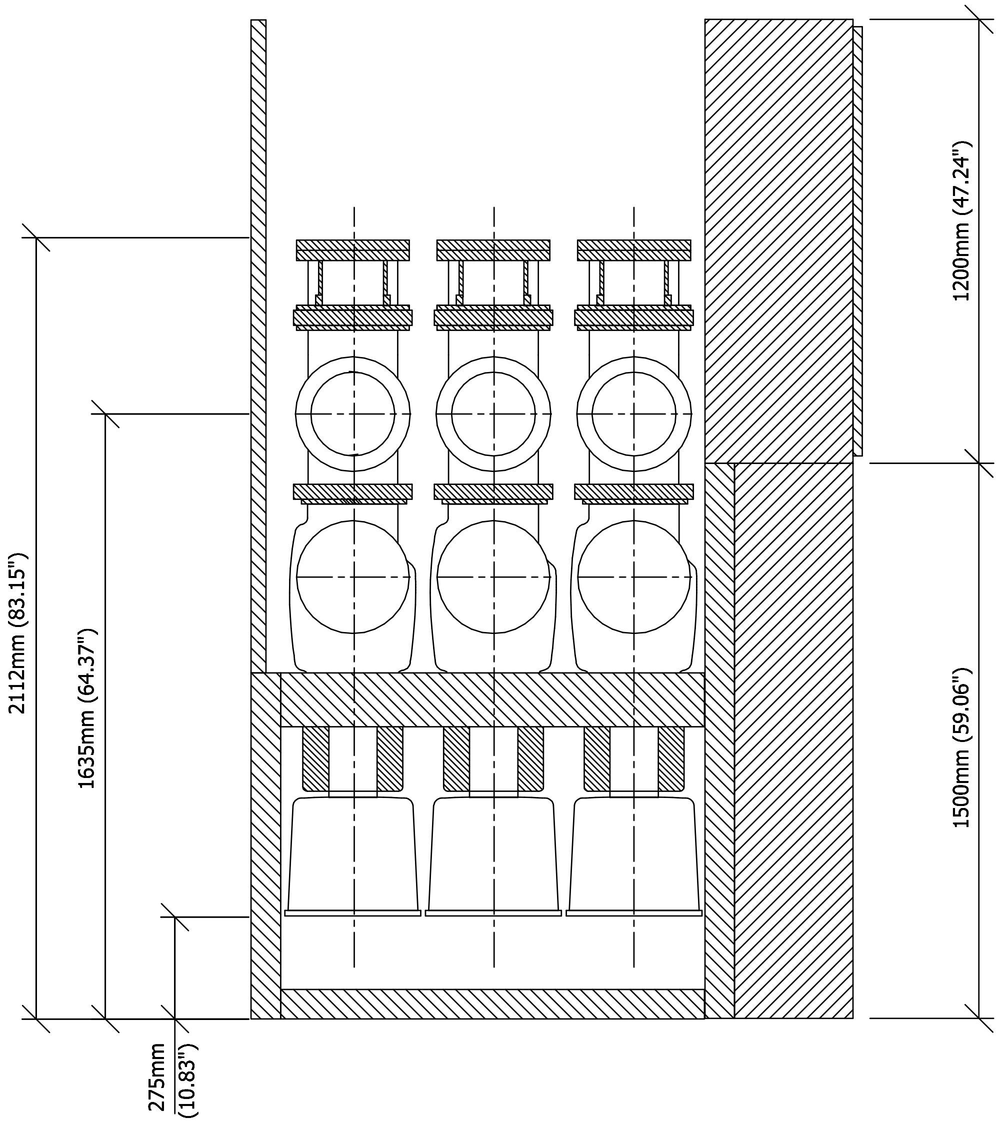


				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ00	D	=J00	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS				+J00	D3
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONSTRUCTIONAL DATA =JZ01	883314	(3) W92210-F2141-S004-B			Sheet 3+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Arrangement drawing					15 Sh.

FRONT VIEW



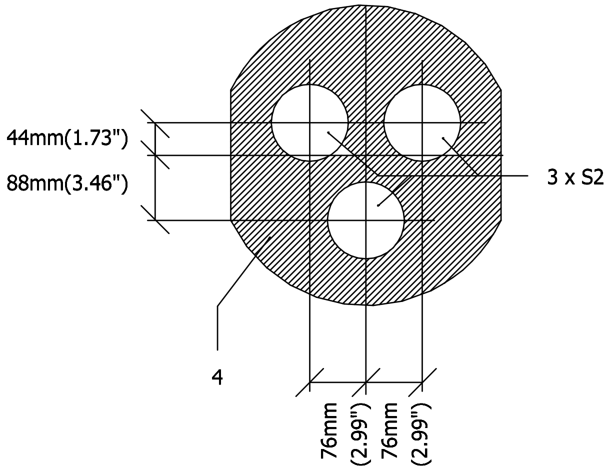
SIDE VIEW



TOP VIEW

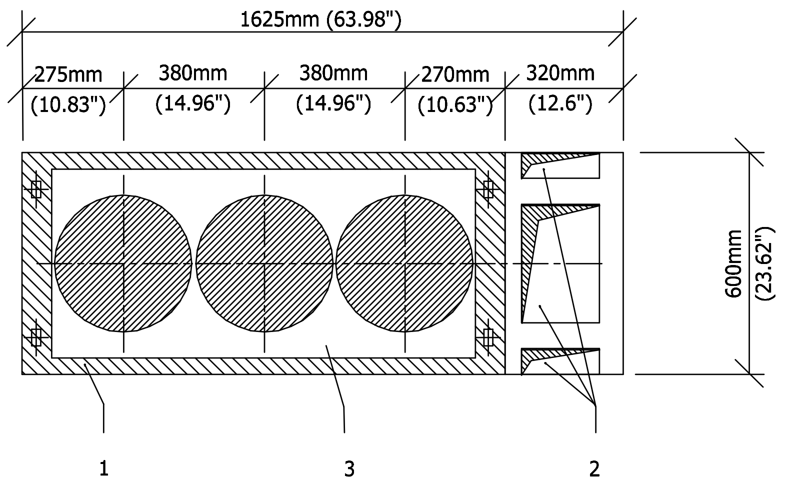
Inscription:

1. Base frame
2. Area for floor openings for control cables
3. Floor opening (e.g. for high-voltage cable)
4. Plug connection - detail view



THE LOCATION AND DETAIL DIAGRAMS
DO HAVE SYMBOLIC CHARACTER AND
DO NOT SHOW THE ACTUAL SCOPE OF
SUPPLY.

BOTTOM VIEW



ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

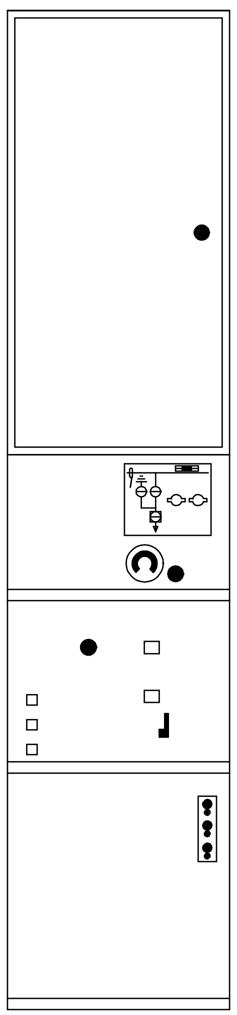
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ00	D	=J00
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS			+J00
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONSTRUCTIONAL DATA =JZ03	883314	(3) W92210-F2141-S004-B	D4 Sheet 4+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Arrangement drawing			15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 5

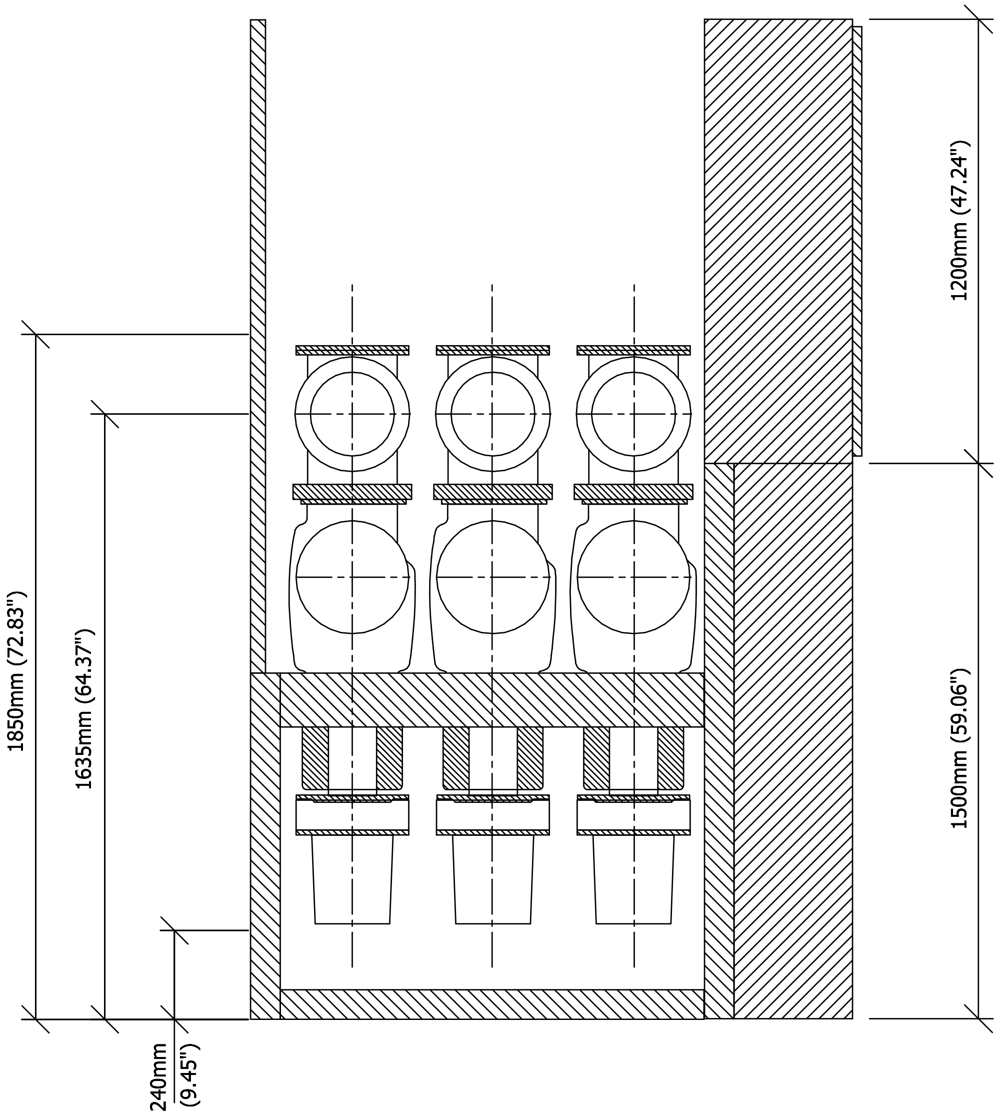
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

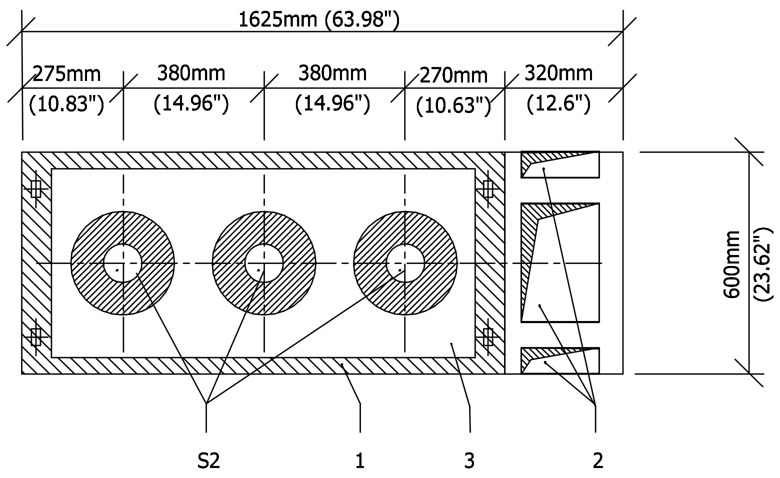
FRONT VIEW



SIDE VIEW



BOTTOM VIEW



Inscription:

1. Base frame
2. Area for floor openings for control cables
3. Floor opening (e.g. for high-voltage cable)

THE LOCATION AND DETAIL DIAGRAMS
DO HAVE SYMBOLIC CHARACTER AND
DO NOT SHOW THE ACTUAL SCOPE OF
SUPPLY.

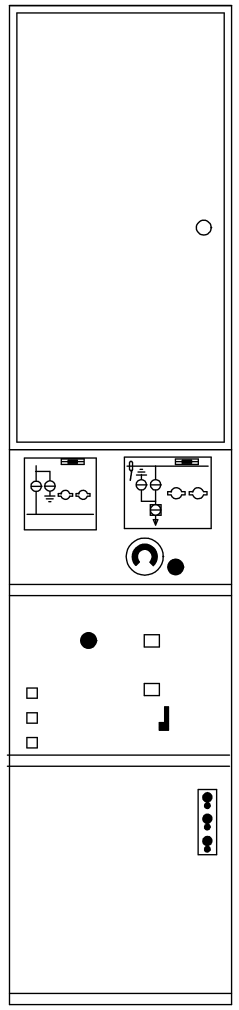
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ00	D	=J00	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS				+J00	D5
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONSTRUCTIONAL DATA =JZ05	883314	(3) W92210-F2141-S004-B			Sheet 5+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Arrangement drawing					15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 6

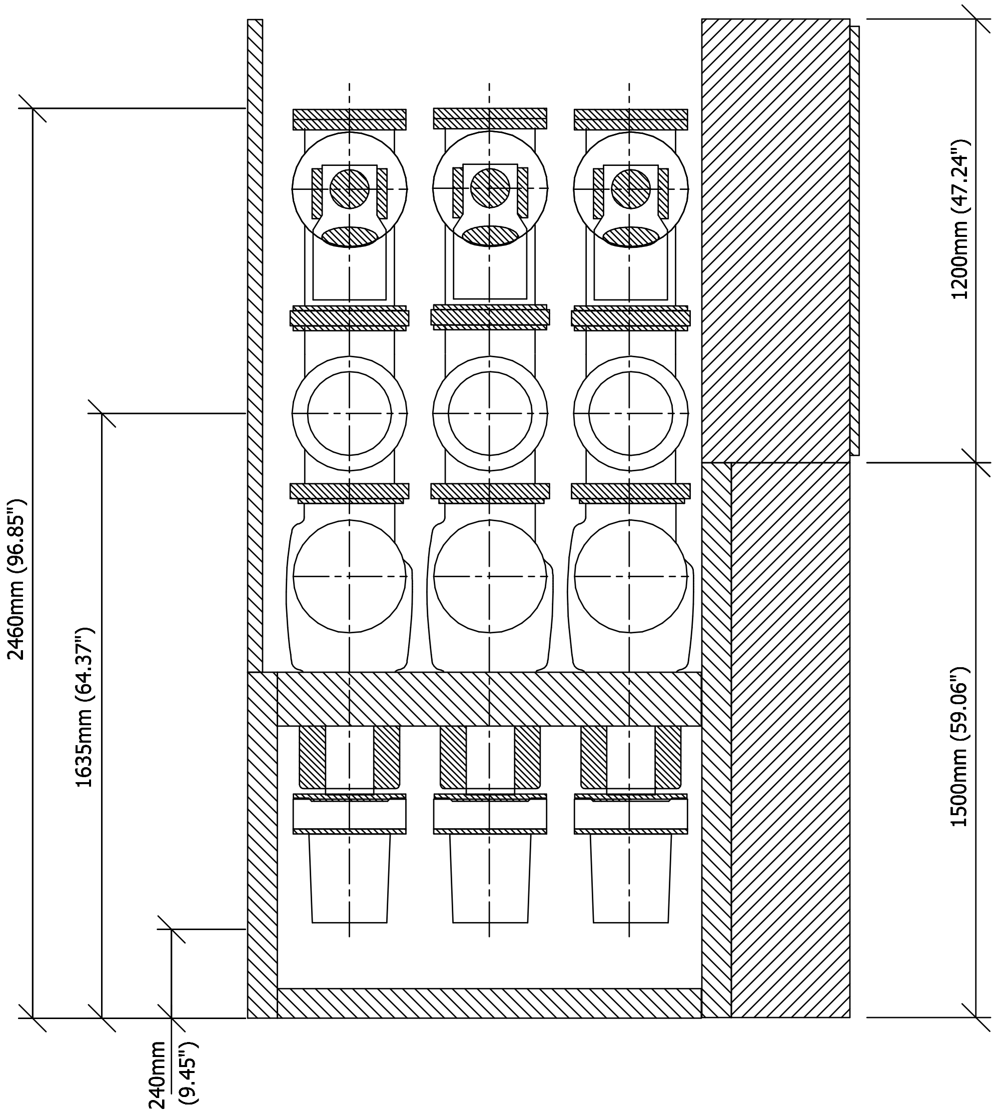
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

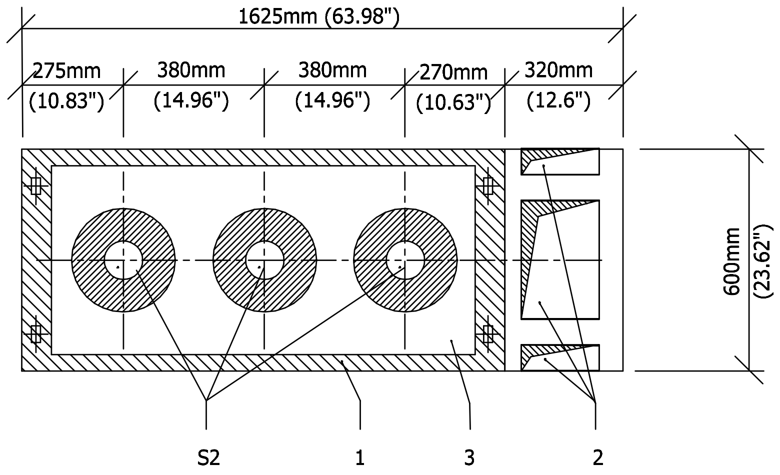
FRONT VIEW



SIDE VIEW



BOTTOM VIEW



Inscription:

1. Base frame
2. Area for floor openings for control cables
3. Floor opening (e.g. for high-voltage cable)

THE LOCATION AND DETAIL DIAGRAMS
DO HAVE SYMBOLIC CHARACTER AND
DO NOT SHOW THE ACTUAL SCOPE OF
SUPPLY.

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

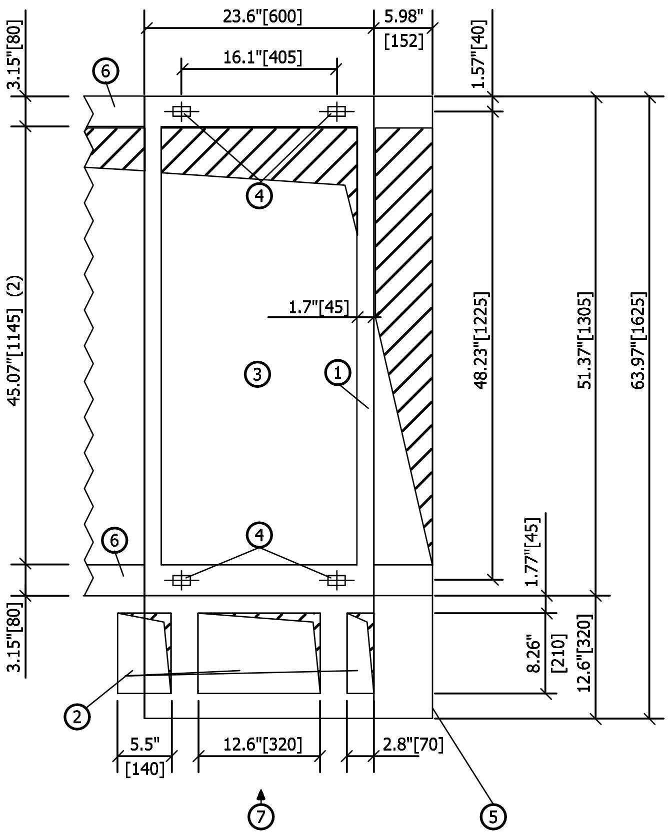
8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
CONSTRUCTIONAL DATA =JZ05_1
Arrangement drawing

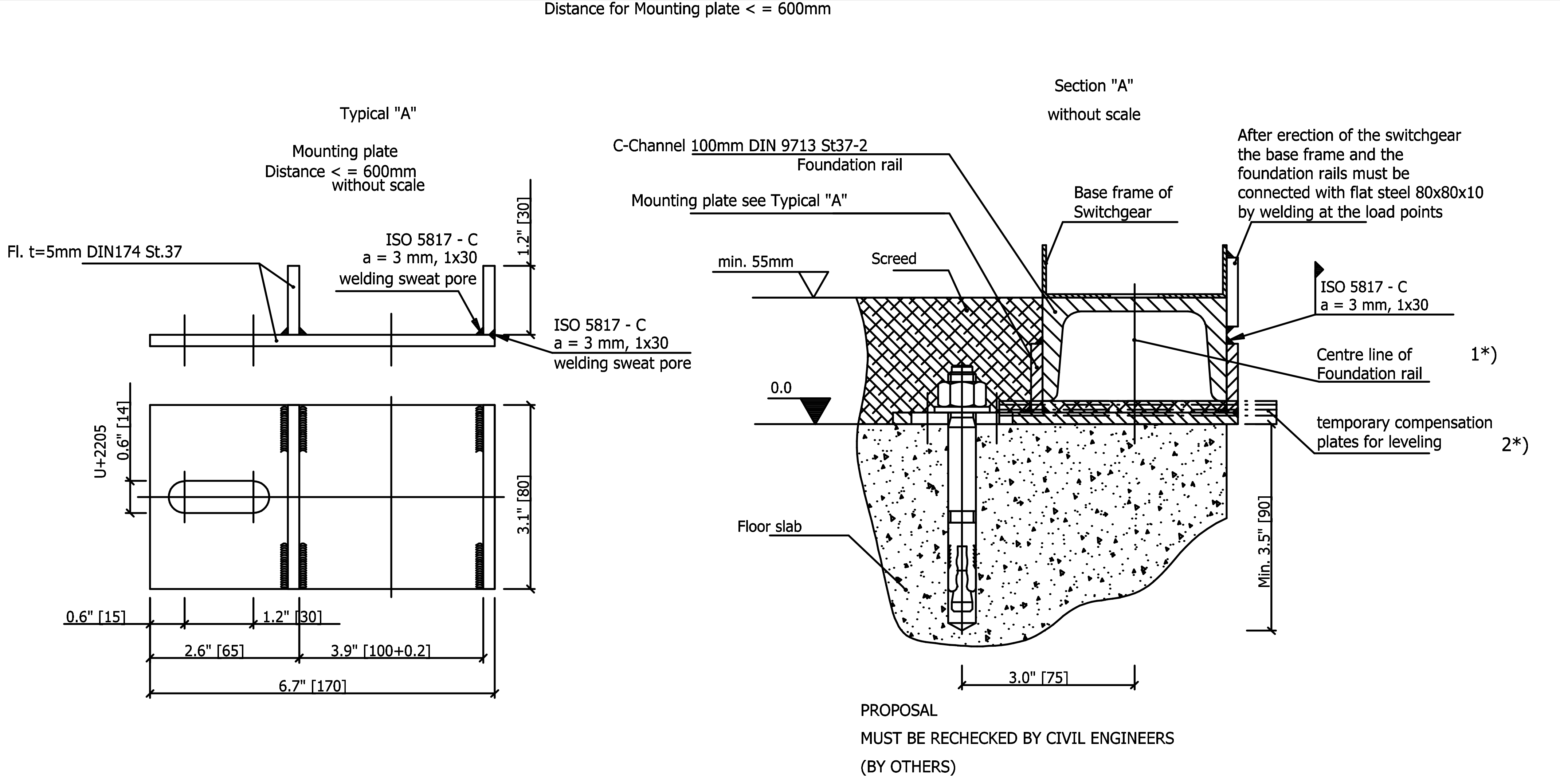
=JZ00 D =J00
+J00
D6
883314 (3) W92210-F2141-S004-B
Sheet 6+
15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:





PROPOSAL
MUST BE RECHECKED BY CIVIL ENGINEERS
(BY OTHERS)

① BASE FRAME

② AREA FOR FLOOR OPENINGS AND CONTROL CABLES

③ FLOOR OPENINGS FOR HIGH-VOLTAGE CABLES

④ STANDARD DESIGN:
-FIXING HOLES (26x45] FOR M10
-INTERCONNECT TWO POINTS DIAGONALLY
ASEISMIC DESIGN:
-FIXING HOLES (12x40] FOR M10
-INTERCONNECT ALL FOUR POINTS

⑤ SWITCHGEAR END WALL

⑥ FOUNDATION RAILS

⑦ OPERATING SIDE OF THE PANEL

(2) FOR LARG PANEL CONNECTION HOUSINGS (VERSION 7 AND 8)
THE DIMENSION MUST NO BE SMALLER THAN 45.07"[1145].

NOTES:

SECONDARY CABLES TO ENTER SWITCHGEAR FROM THE BOTTOM

THE FLOOR PENETRATION FOR THE HIGH VOLTAGE TERMINATIONS SHOULD TAKE THE FORM OF A CONTINOUS SLOT FOR EACH ROW OF PANELS. BEAMS BENEATH THE PANEL JUNCTION IS POSSIBLE.

△2 FLOOR PENETRATION REQUIRED IF THERE IS A BEAM BENEATH THE PANEL JUNCTION (MAY NOT BE REQUIRED).

▨ FLOOR OPENING

△1

MINIMUM DISTANCES

SERVICE PASSAGE	40 in.
WALL CLEARANCE LEFT	16 in.
WALL CLEARANCE RIGHT	16 in.
WALL CLEARANCE REAR	2 in.
HEIGHT OF CEILING	110.25 in.

TRANSPORT WEIGHTS

1 Panel : 1653 lb
2 Panels: 3306 lb
3 Panels: 4960 lb
4 Panels: 6613 lb

TOLERANCES:

FALL (MAX.) 1MM/1M LENGTH, 2MM OVER THE TOTAL LENGTH;

FLATNESS 1MM WITHIN 1M MEASURED LENGTH.

ADJUST TOLERANCES WITH SHIMS.

LOAD DATA

VERTICAL SINGLE LOAD : Fv = 7 kN/PANEL
LIVELOAD : Pa = 8 kN/m

NOTE:

- THE METAL FIXING RAILS SHOULD BE LEVEL AND FLAT IN ACCORDANCE WITH THE TOLERANC DOWN IN DIN 43661, THAT IS, 1MM PER M, BUT A MAXIMUM OF 2MM OVER THE TOTAL SWIT LENGTH.

- WHERE FOUNDATION RAILS BUTT AGAINST EACH OTHER, THEY SHOULD BE WELDED TOGETHER FULL CROSS-SECTION IN ORDER TO SATISFY THE EARTH CONTINUITY REQUIREMENTS.

- ON HOLD BEFORE LAYING THE FINAL FLOOR SCREED, ENSURE THAT THE RAILS ARE PROPERL WITH A WATER GAUGE (OR SIMILAR DEVICE) BY LAYING UNDER OF COMPENSATION PLATES A TOGETHER. THE SUPPORTING CEMENT FOR THE FOUNDATION RAILS MUST BE CONTINUOUS AND BEARING OVER THE TOTAL RAIL LENGTH.

- EARTHQUAKE RESISTENT INSTALLATION IS REQUIRED, THE COMPENSATING PLATES, FOUNDAT AND THE SWITCHBOARD STRUCTURE MUST BE WELDED TO ONE ANOTHER AND TO A FLAT STEEL ANCHORED INTO THE BASE CONCRETE (NELSON ANCHOR) AS DESCRIBED, FOR EXAMPLE, IN S INSTALLATION INSTRUCTION EMA/MS 403.220.
THE DETAILS RELATING TO FOUNDATION RAILS, COMPENSATION PLATES AND METHOD OF SEC SWITCHBOARD ARE NOT THEN VALID, THEY SHOULD BE MODIFIED TO SUIT THE METHOD OF F

FOUNDATION RAILS ARE NOT PART OF THE SCOPE OF SUPPLY OF THE ELECTRICAL EQUIPMEN MUST BE OBTAINED LOCALLY.

FLOOR FINISH: THE FLOOR FINISH SHOULD BE SUCH THAT IT WILL WITHSTAND THE LOADS THE SPECIFICATIONS. FOR SWITCHGEAR ROOMS A FLOOR FINISH, LOAD BEARING QUALITY, IN COMPLIANCE WITH ZE 45 (RATED COMPRESSIVE STRENGHTH 45N/mm, FLEXURALE TENSIDE GRINDING WEAR 9cm/50cm) IS NECESSARY. THE UPPER SURFACE OF THE FLOOR FINISH OR SCREED SHOULD NOT BE HIGHER THAN THE UPPER SURFACE OF THE FOUNDATION RAILS.

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

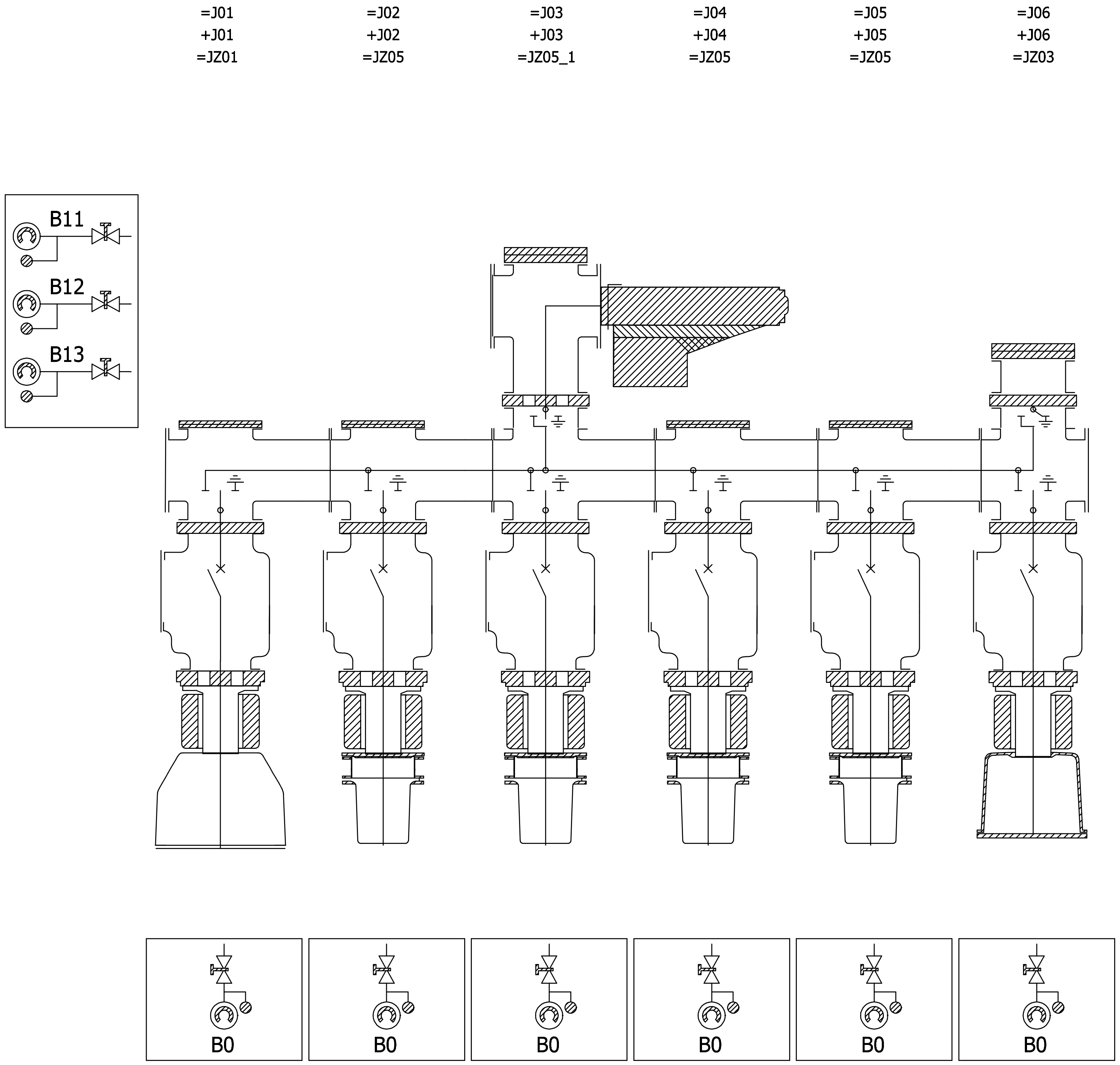
8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
GENERAL INFORMATION
Arrangement drawing

883314
(3) W92210-F2141-S004-B
=JZ00
D =J00
+J00
D7
Sheet 7+
15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



Legend:

Gastight bushing

Gaspermeable bushing

Shut off valve

Pressure gauge indicator with filling valve

Indication of the pressure indicators for the gas chambers (mounting location):

(within section)
B0 Circuit-breaker phase L1,L2,L3

(within end wall)
B11 Busbar 1 phase L1
B12 Busbar 1 phase L2
B13 Busbar 1 phase L3

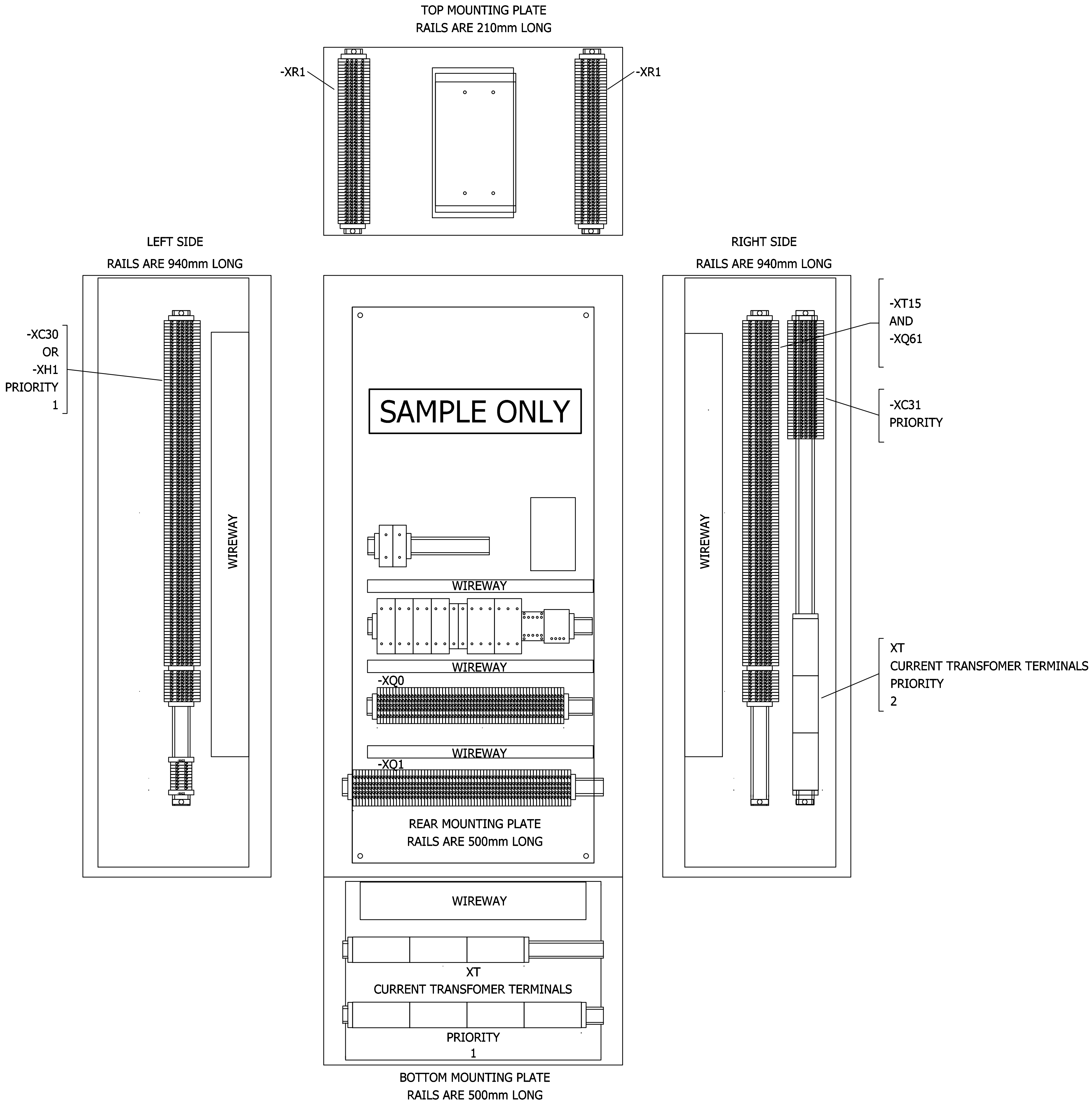
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ00	D =J00
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS		+J00 D8
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		GAS ARRANGEMENT	883314	(3) W92210-F2141-S004-B Sheet 8+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Arrangement drawing		15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

LV COMP. 1200mm



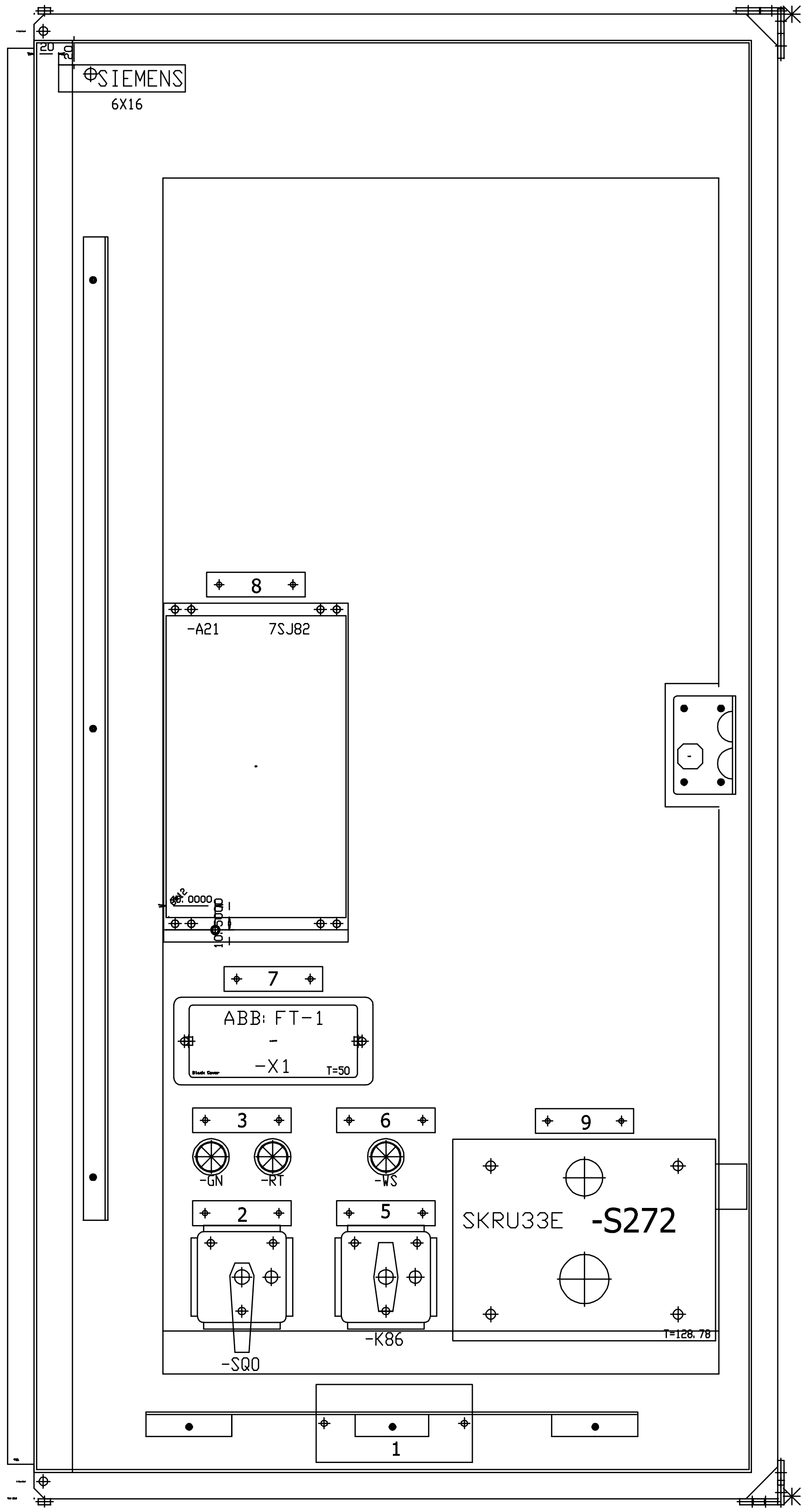
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ00	D	=J00
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS				+J00 D9
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		GENERAL INFORMATION	883314	(3) W92210-F2141-S004-B		Sheet 9+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Arrangement drawing				15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

=J01
=JZ01



Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	MAIN A			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	5	LOCKOUT RELAY			5
1	6	LOCKOUT RELAY	HEALTHY		6
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9	KEY INTERLOCK	CB CONTROL		6
1	10				

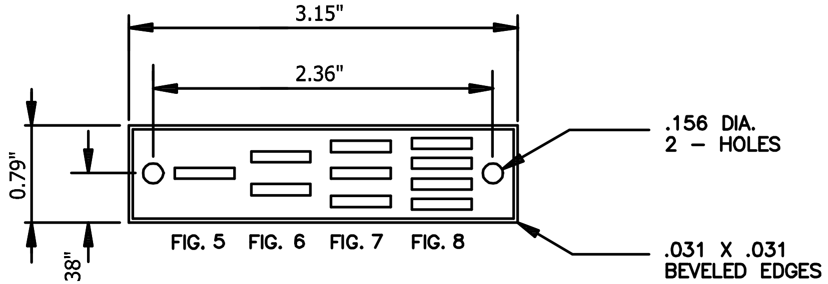


FIG. 5 FIG. 6 FIG. 7 FIG. 8

BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS

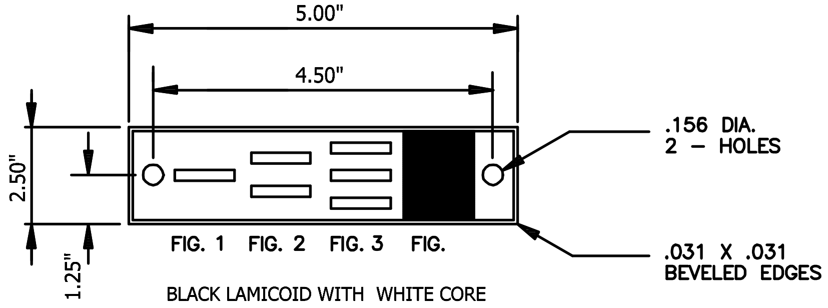


FIG. 1 FIG. 2 FIG. 3 FIG.

BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

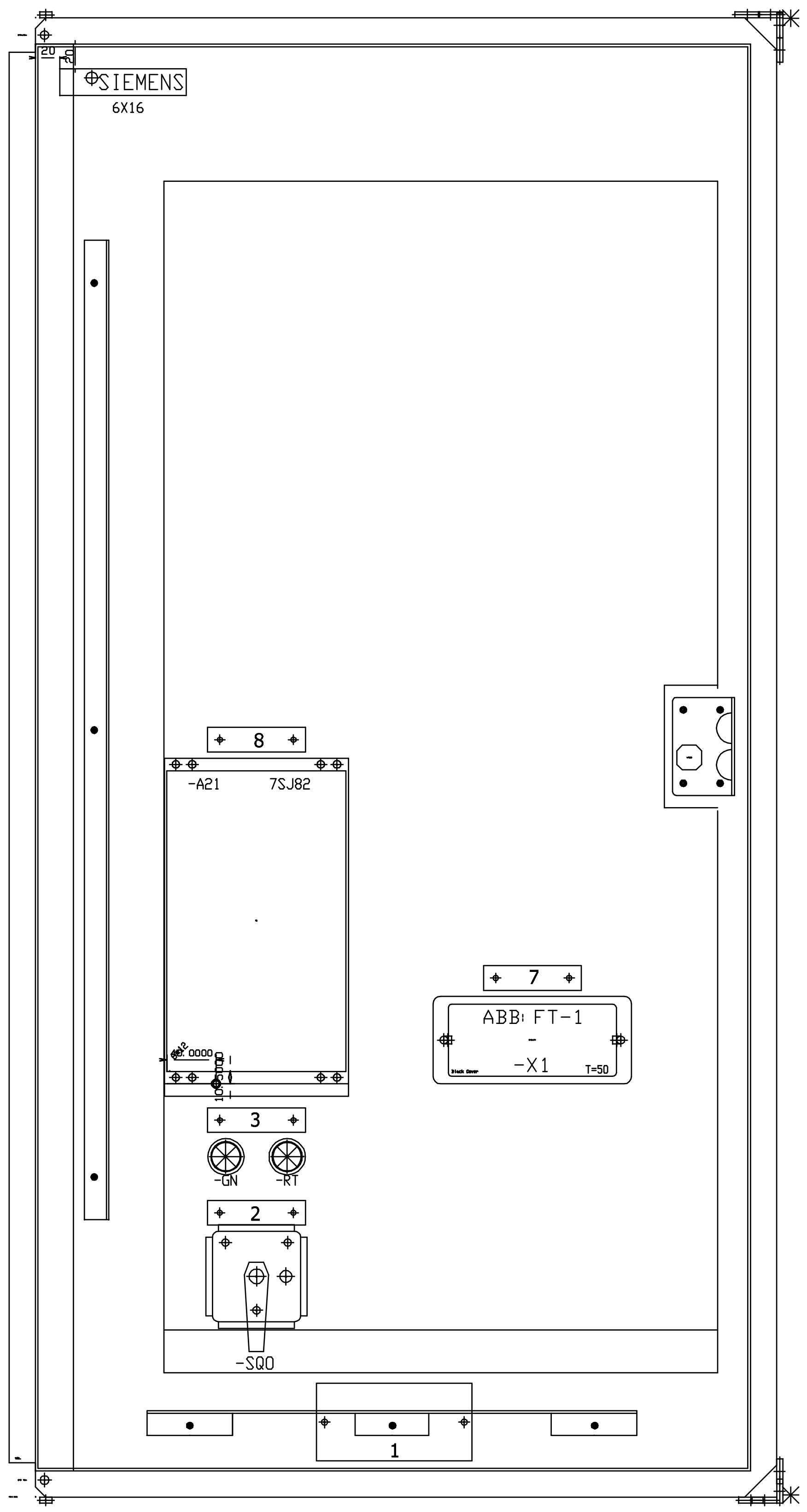
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ00	D	=J00
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS			+J00
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		DOOR LAYOUT	883314	(3) W92210-F2141-S004-B	D10
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Arrangement drawing			Sheet 10+ 15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 11

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

=J02
=JZ05



Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	TRX NO. 1B			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	4				
1	5				
1	6				
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9				
1	10				

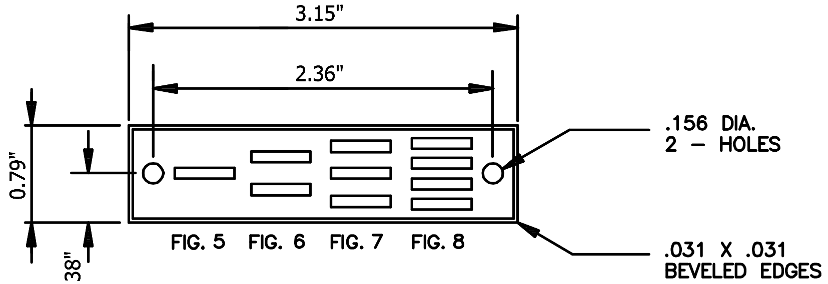


FIG. 5 FIG. 6 FIG. 7 FIG. 8

BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS

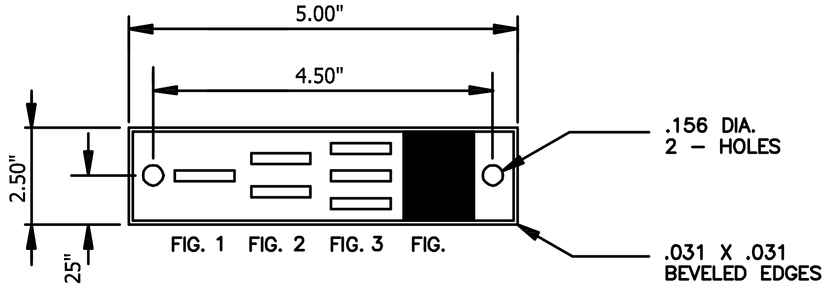


FIG. 1 FIG. 2 FIG. 3 FIG.

BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

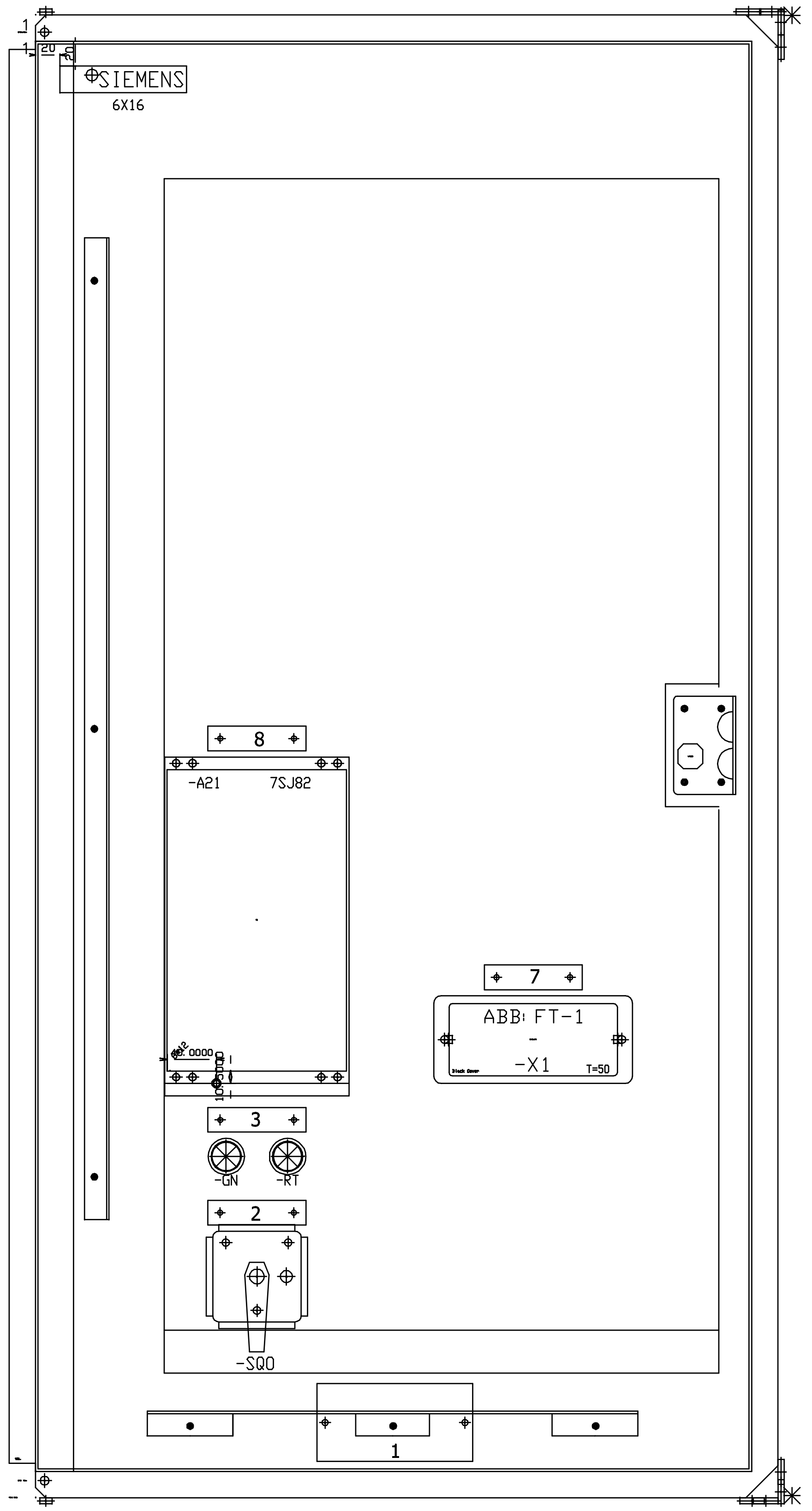
CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

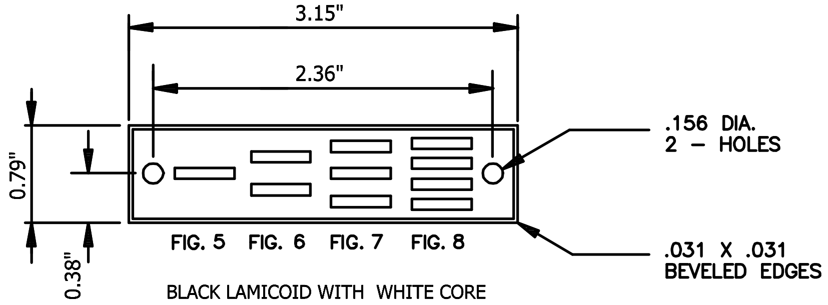
8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
DOOR LAYOUT
Arrangement drawing

=JZ00
D
=J00
+J00
D11
883314
(3) W92210-F2141-S004-B
Sheet 11+
15 Sh.

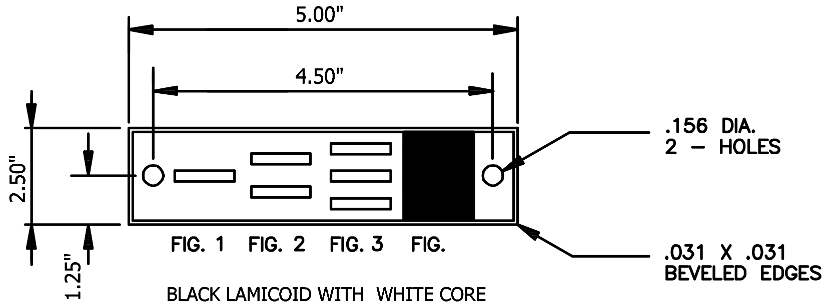
=J03
=JZ05_1



Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	TRX NO. 2			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	4				
1	5				
1	6				
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9				
1	10				



BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS



BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
DOOR LAYOUT
Arrangement drawing

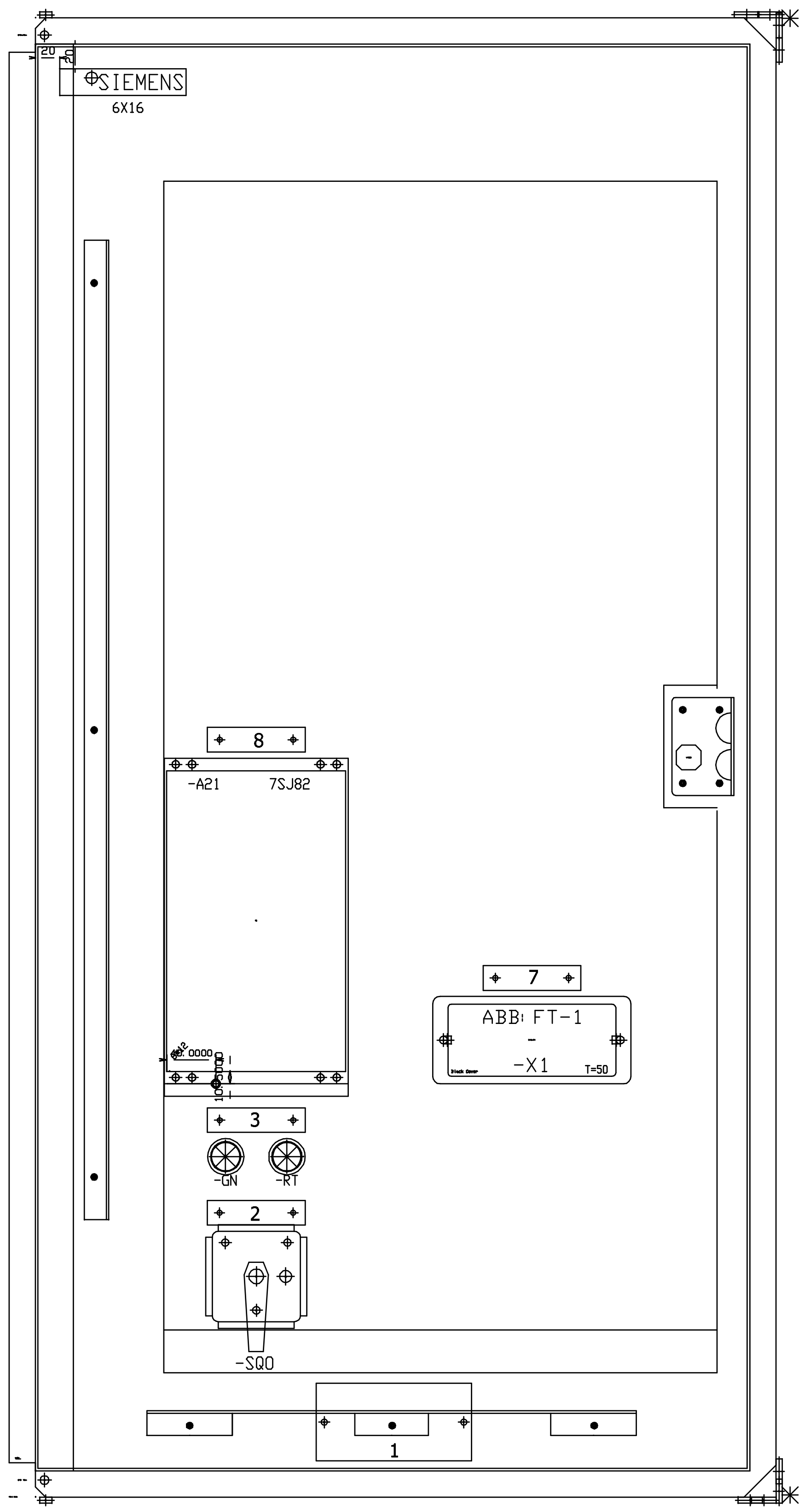
=JZ00
D
=J00
+J00
D12
883314
(3) W92210-F2141-S004-B
Sheet 12+
15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 13

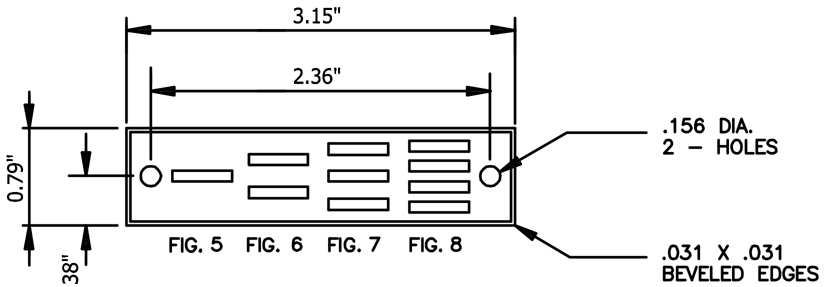
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

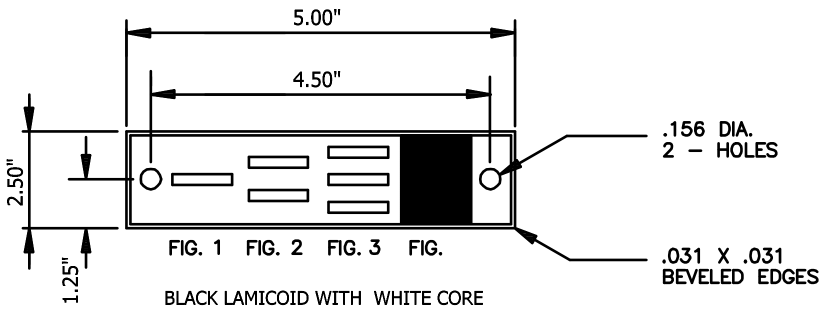
=J04
=JZ05



Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	TRX NO. 1A			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	4				
1	5				
1	6				
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9				
1	10				



BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS



BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
DOOR LAYOUT
Arrangement drawing

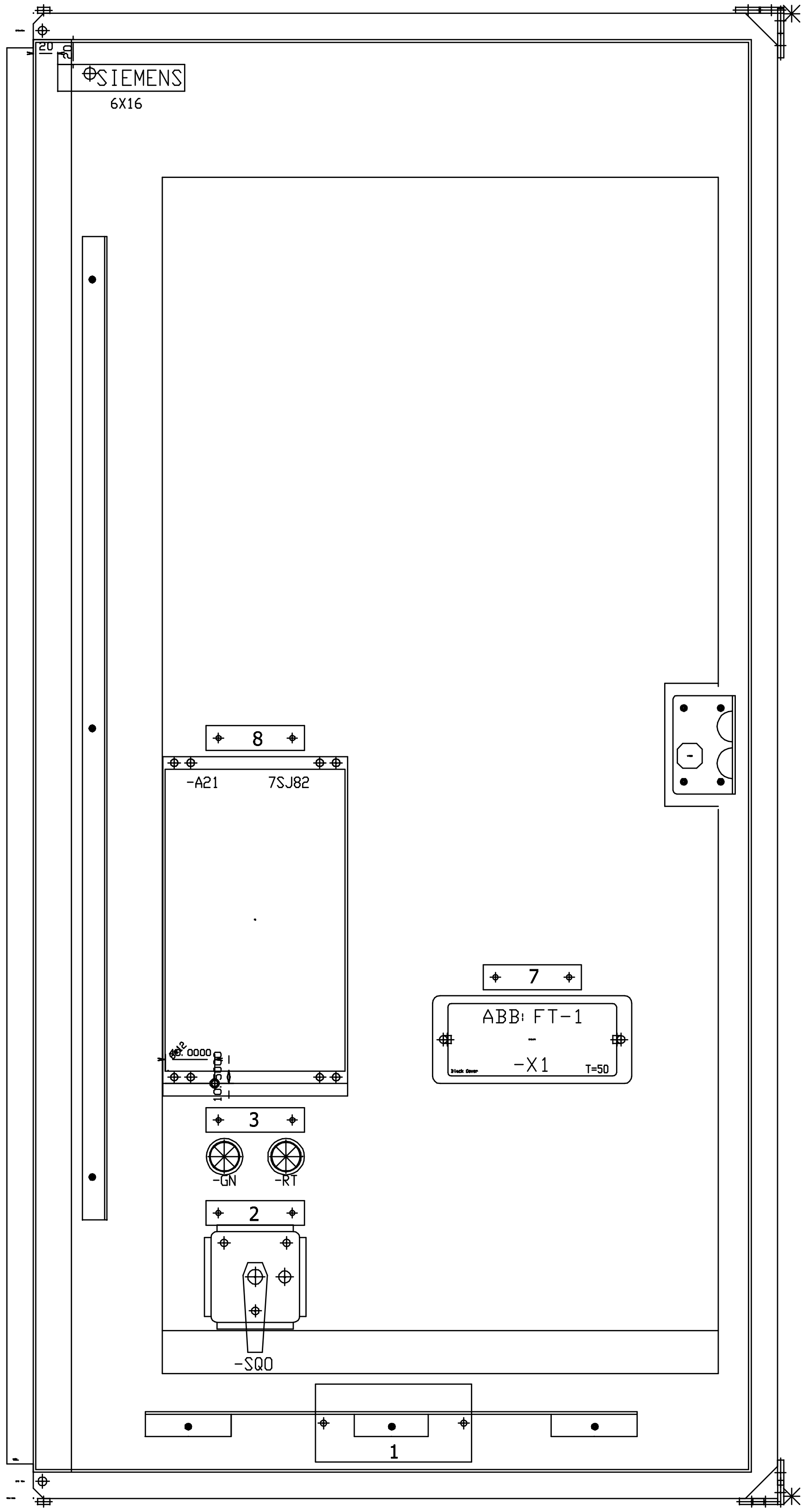
=JZ00
D
=J00
+J00
D13
883314
(3) W92210-F2141-S004-B
Sheet 13+
15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / D / D / 14

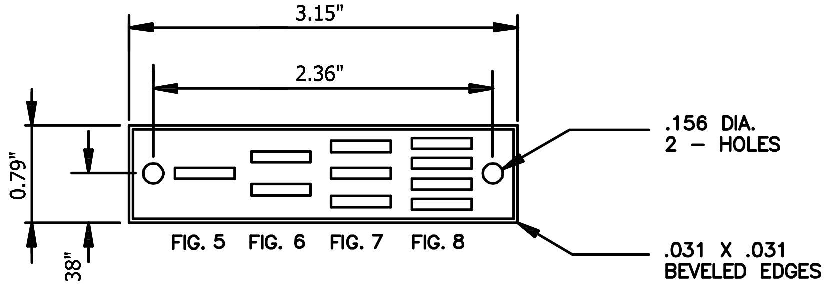
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

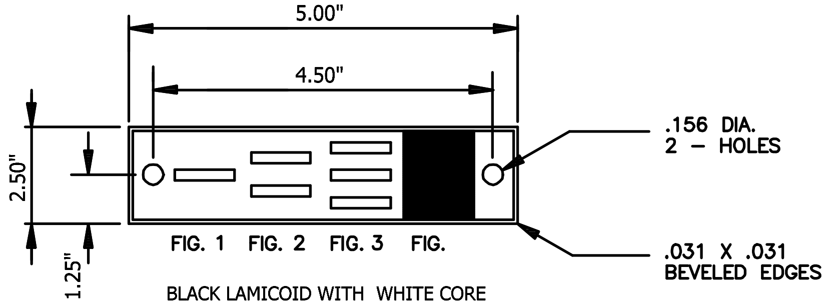
=J05
=JZ05



Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	TRX NO. 1			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	4				
1	5				
1	6				
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9				
1	10				



BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS



BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
DOOR LAYOUT
Arrangement drawing

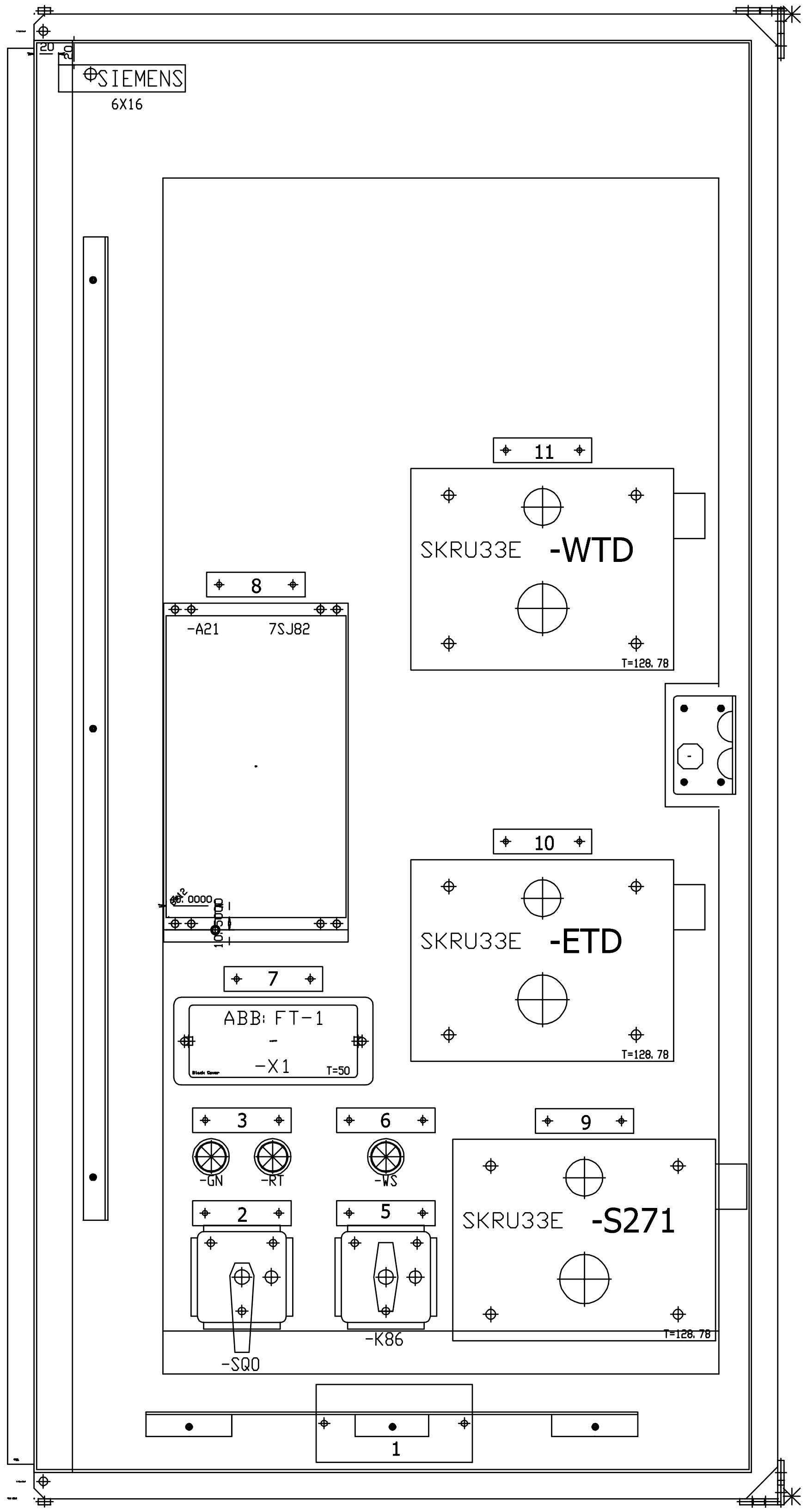
=JZ00
D =J00
+J00
D14
883314
(3) W92210-F2141-S004-B
Sheet 14+
15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J00 / D / D / 15

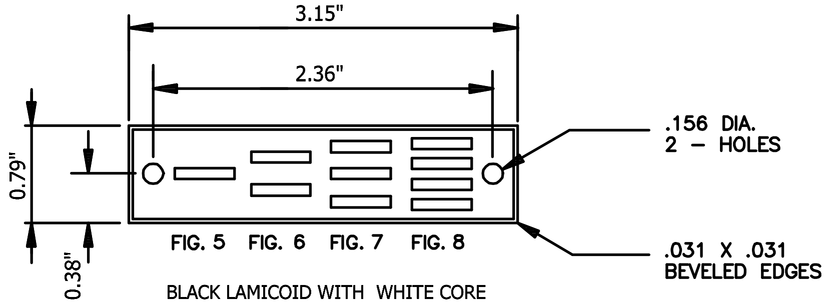
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

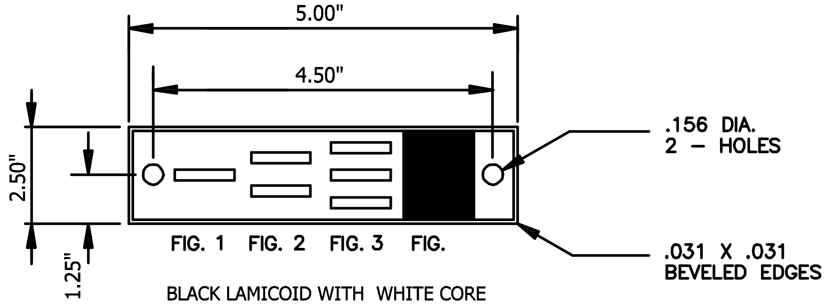
=J06
=JZ03



Qty	Item	Engraving 1 Line 1	Engraving 2 Line 2	Engraving 3 Line 3	Fig.
1	1	TIE FEEDER			1
1	2	CIRCUIT BREAKER	CONTROL SWITCH		6
1	3	CIRCUIT BREAKER	OPEN CLOSED		6
1	5	LOCKOUT RELAY			5
1	6	LOCKOUT RELAY	HEALTHY		6
1	7	TEST SWITCH			5
1	8	MULTIFUNCTION	PROTECTION RELAY		6
1	9	KEY INTERLOCK	CB CONTROL		6
1	10	KEY INTERLOCK	DISCONNECTOR		6
1	11	KEY INTERLOCK	GROUND SWITCH		6



BLACK LAMICOID WITH WHITE CORE
.125 HIGH CHARACTERS



BLACK LAMICOID WITH WHITE CORE
.50 HIGH CHARACTERS

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

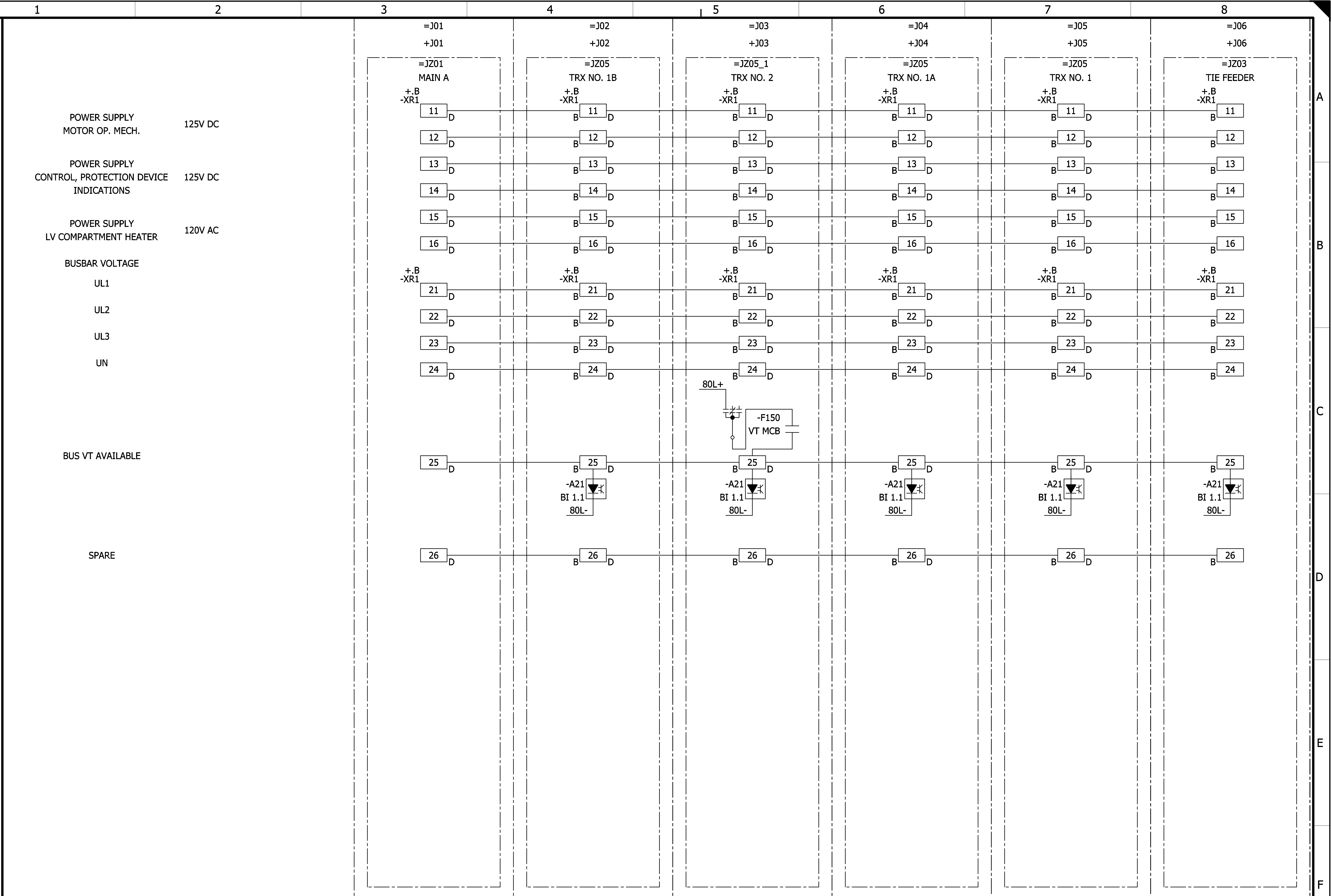
8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
DOOR LAYOUT
Arrangement drawing

=JZ00 D =J00
+J00 D15
883314 (3) W92210-F2141-S004-B
Sheet 15-
15 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / S / G / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



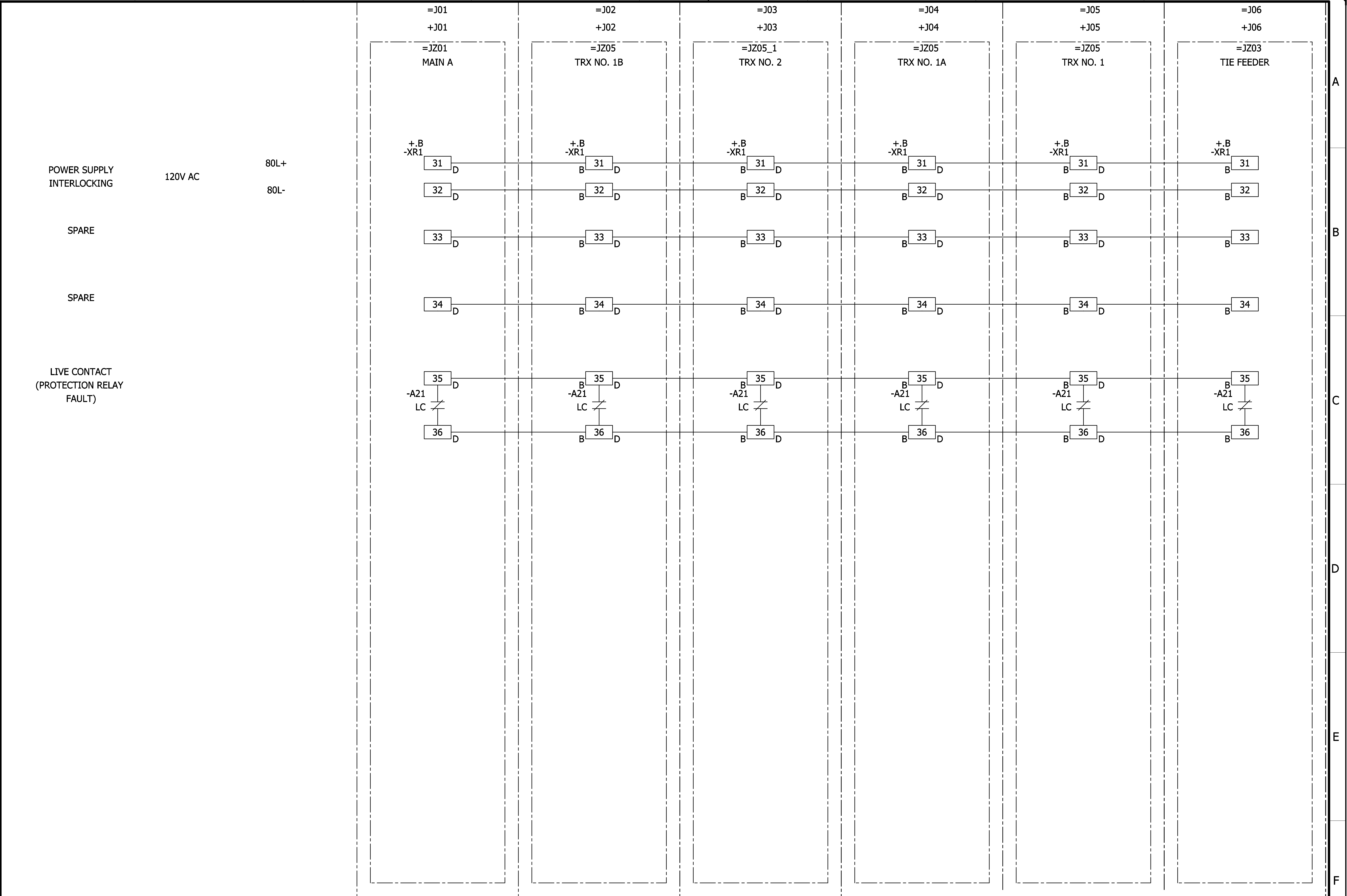
ALL UNIDENTIFIED WIRES SIS AWG 12 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ00	S	=J00
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		GENERAL DOCUMENTS		+J00	G1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		BUS WIRE DIAGRAM	883314	(3) W92210-F2141-S006-B	Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / S / G / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 12 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

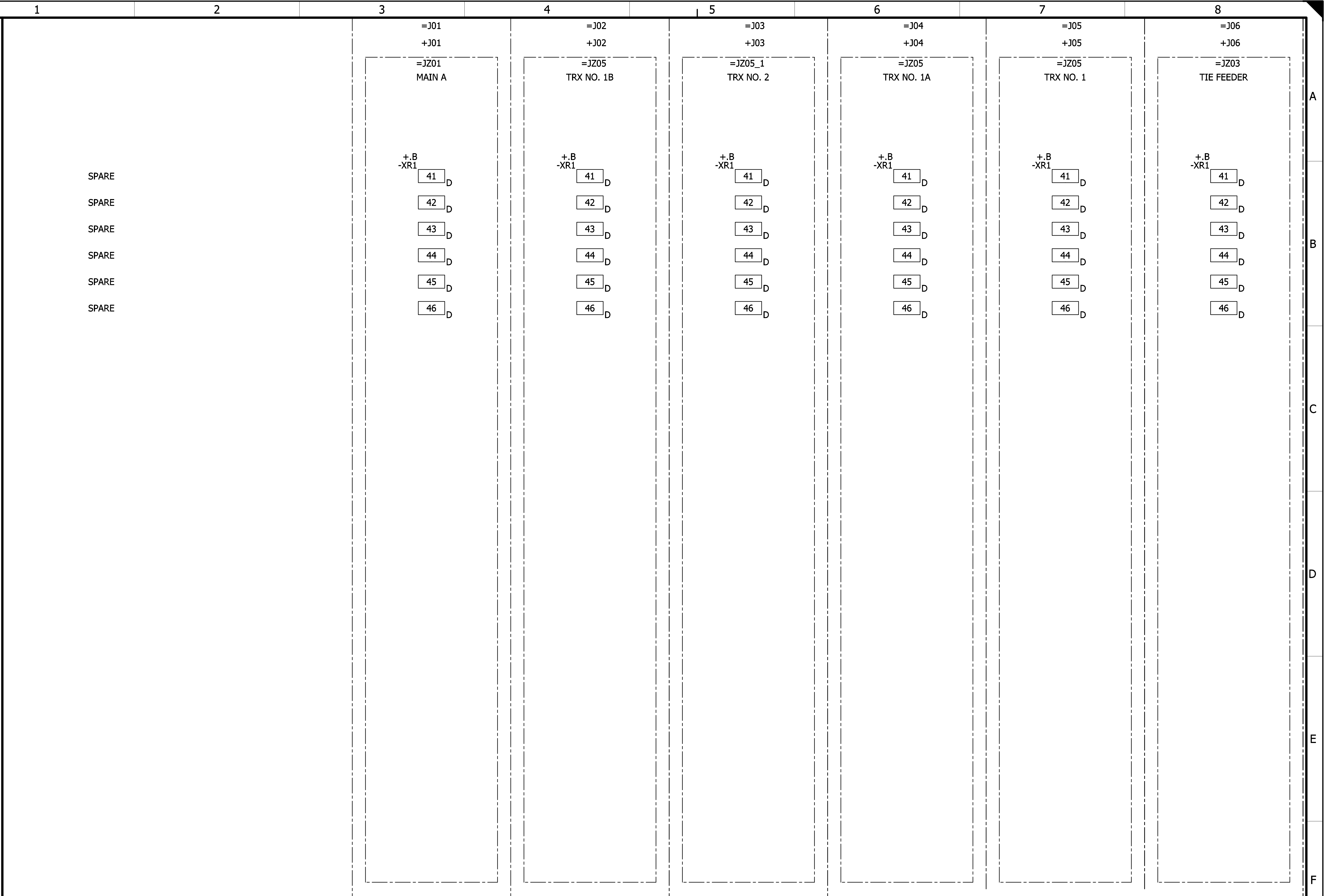
8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
BUS WIRE DIAGRAM
Circuit diagram

=JZ00
S
=J00
+J00
G2
883314
(3) W92210-F2141-S006-B
Sheet 2+
4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J00 / S / G / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 12 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

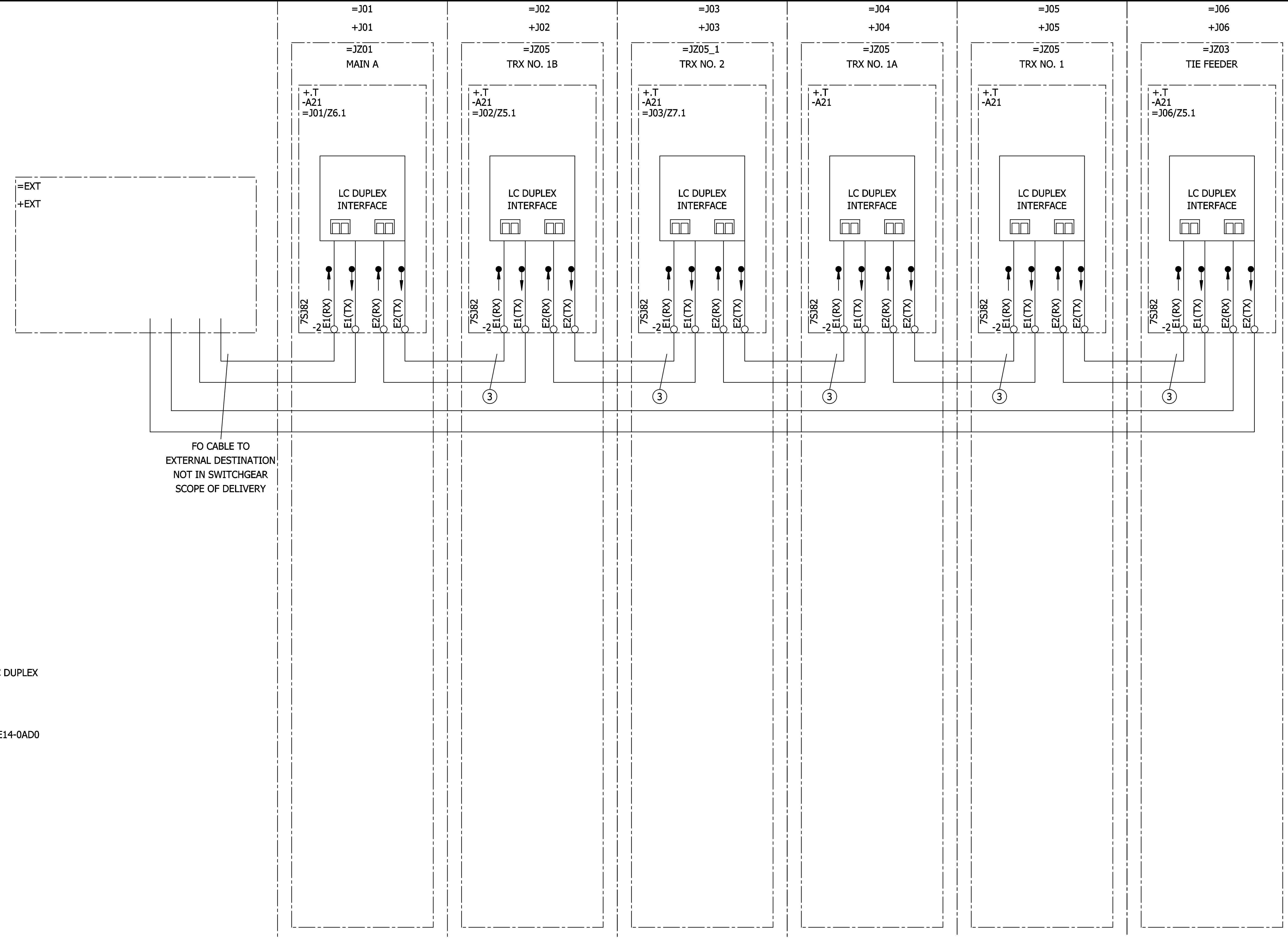
8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
BUS WIRE DIAGRAM
Circuit diagram

=JZ00
S
=J00
+J00
G3
883314
(3) W92210-F2141-S006-B
Sheet 3+
4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J00 / S / G / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



FO CABLE TO
EXTERNAL DESTINATION
NOT IN SWITCHGEAR
SCOPE OF DELIVERY

FIBER OPTIC DUPLEX
DATA LINE

③ 3m
6XV8100-0BE14-0AD0

ALL UNIDENTIFIED WIRES SIS AWG 12 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
GENERAL DOCUMENTS
BUS WIRE DIAGRAM
Circuit diagram

=JZ00
S =J00
+J00
G4
883314
(3) W92210-F2141-S006-B
Sheet 4-
4 Sh.

Siemens AG

Energy Management - Medium Voltage & Systems

Circuit diagram

for

Purchaser	CRUM ELECTRIC SUPPLY COMPANY INC.
User	COLORADO DEPARTMENT OF TRANSPORT
Plant	VENTILATION BUILDING EAST
Plant section	8DA10 25kV SWITCHGEAR MAIN A
Typical	=JZ01
Project reference number	
Date of issue	08-27-15
Customer document number	

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

SIEMENS AG

Archive: =J01 / A / / / 1

Project: 883314

Documentation identifier A / =J01 / / 1

Manufacturer document number (3) W92210-F2141-S011-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J01 / A / A / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
A	=J01 +J01	/1	(3) W92210-F2141-S011-B	1-	1	08-27-15	8DA10 25kV SWITCHGEAR MAIN A COVER SHEET Cover sheet	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A1	(3) W92210-F2141-S012-B	1+	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A2	(3) W92210-F2141-S012-B	2+	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A3	(3) W92210-F2141-S012-B	3+	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J01 +J01	A4	(3) W92210-F2141-S012-B	4-	4	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	G1	(3) W92210-F2141-S015-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	G2	(3) W92210-F2141-S015-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M1	(3) W92210-F2141-S015-B	1+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M2	(3) W92210-F2141-S015-B	2+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M3	(3) W92210-F2141-S015-B	3+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M4	(3) W92210-F2141-S015-B	4+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M5	(3) W92210-F2141-S015-B	5+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M6	(3) W92210-F2141-S015-B	6+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M7	(3) W92210-F2141-S015-B	7+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
TABLE OF DOCUMENTS
List of documents

=JZ01 A =J01
+J01 A1

883314 (3) W92210-F2141-S012-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J01 / A / A / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
S	=J01 +J01	M8	(3) W92210-F2141-S015-B	8+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M9	(3) W92210-F2141-S015-B	9+	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A INDICATIONS SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	M10	(3) W92210-F2141-S015-B	10-	10	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	S1	(3) W92210-F2141-S015-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	S2	(3) W92210-F2141-S015-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR MAIN A TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z1	(3) W92210-F2141-S015-B	1+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A CIRCUIT BREAKER Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z2	(3) W92210-F2141-S015-B	2+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A THREE POSITION SWITCH Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z3	(3) W92210-F2141-S015-B	3+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A THREE POSITION SWITCH Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z4	(3) W92210-F2141-S015-B	4+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A GAS PRESSURE MONITORING Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z5	(3) W92210-F2141-S015-B	5+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A GAS PRESSURE MONITORING Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z6	(3) W92210-F2141-S015-B	6+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A PROTECTION AND CONTROL DEVICE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z7	(3) W92210-F2141-S015-B	7+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z8	(3) W92210-F2141-S015-B	8+	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J01 +J01	Z9	(3) W92210-F2141-S015-B	9-	9	08-27-15	8DA10 25kV SWITCHGEAR MAIN A SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ01	A	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A				+J01	A2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314	(3) W92210-F2141-S012-B			Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents					4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J01 / A / A / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
V	=J01 +.B	/1	(3) W92210-F2141-S018-B	1+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XR1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/2	(3) W92210-F2141-S018-B	2+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-X90 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/3	(3) W92210-F2141-S018-B	3+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XT1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/4	(3) W92210-F2141-S018-B	4+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XT5 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/5	(3) W92210-F2141-S018-B	5+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/6	(3) W92210-F2141-S018-B	6+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/7	(3) W92210-F2141-S018-B	7+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/8	(3) W92210-F2141-S018-B	8+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/9	(3) W92210-F2141-S018-B	9+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/10	(3) W92210-F2141-S018-B	10+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/11	(3) W92210-F2141-S018-B	11+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/12	(3) W92210-F2141-S018-B	12+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/13	(3) W92210-F2141-S018-B	13+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/14	(3) W92210-F2141-S018-B	14+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
TABLE OF DOCUMENTS
List of documents

=JZ01 A =J01
+J01 A3
883314 (3) W92210-F2141-S012-B
Sheet 3+
4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J01 / A / A / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

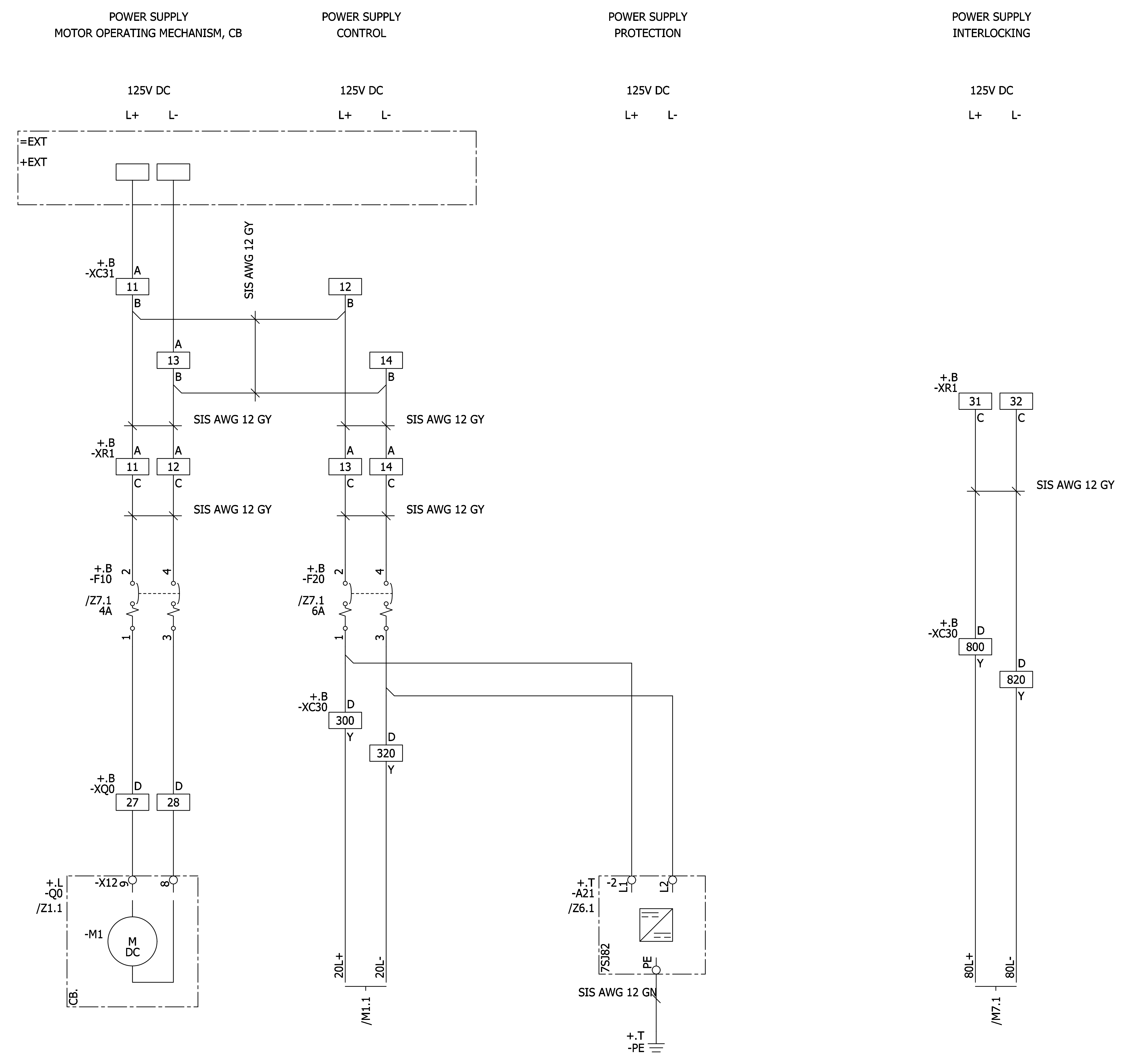
Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
V	=J01 +.B	/15	(3) W92210-F2141-S018-B	15+	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XB11 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J01 +.B	/16	(3) W92210-F2141-S018-B	16-	16	08-27-15	8DA10 25kV SWITCHGEAR MAIN A +.B-XPE Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	A	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	A4
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314	(3) W92210-F2141-S012-B	Sheet 4-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents			4 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / G / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

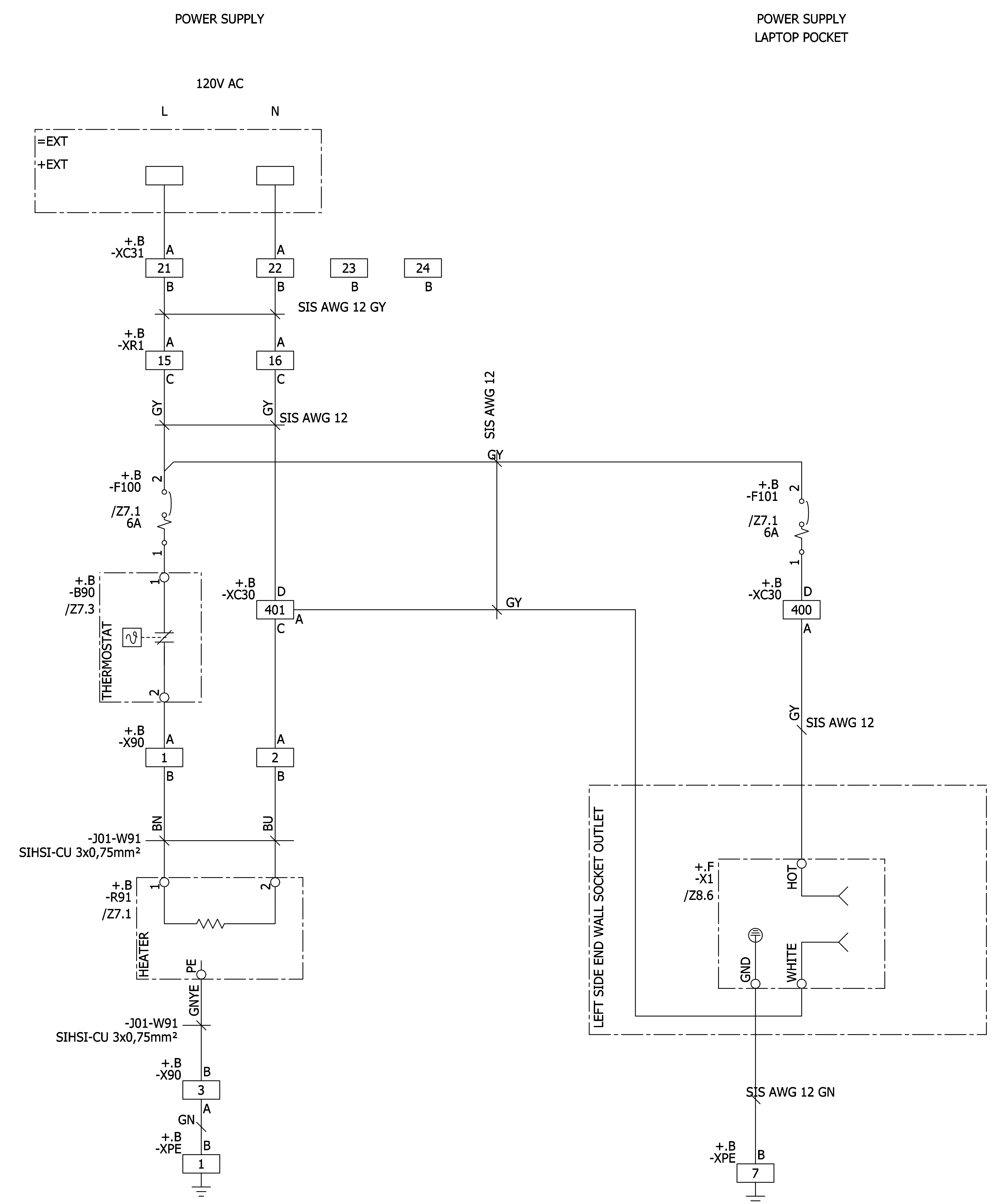
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S =J01
+J01
G1
883314
(3) W92210-F2141-S015-B
Sheet 1+
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / G / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

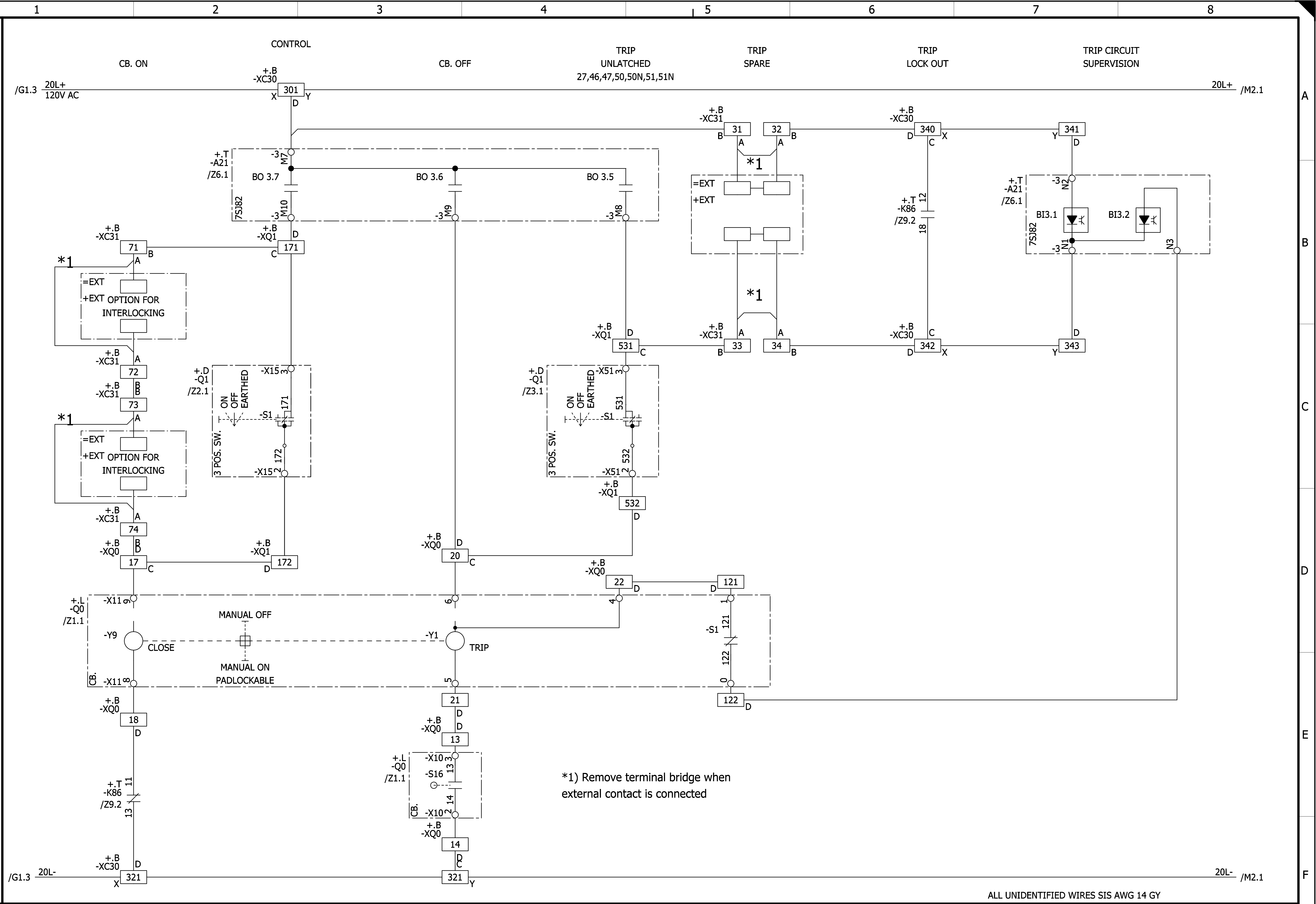
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
G2
883314
(3) W92210-F2141-S015-B
Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

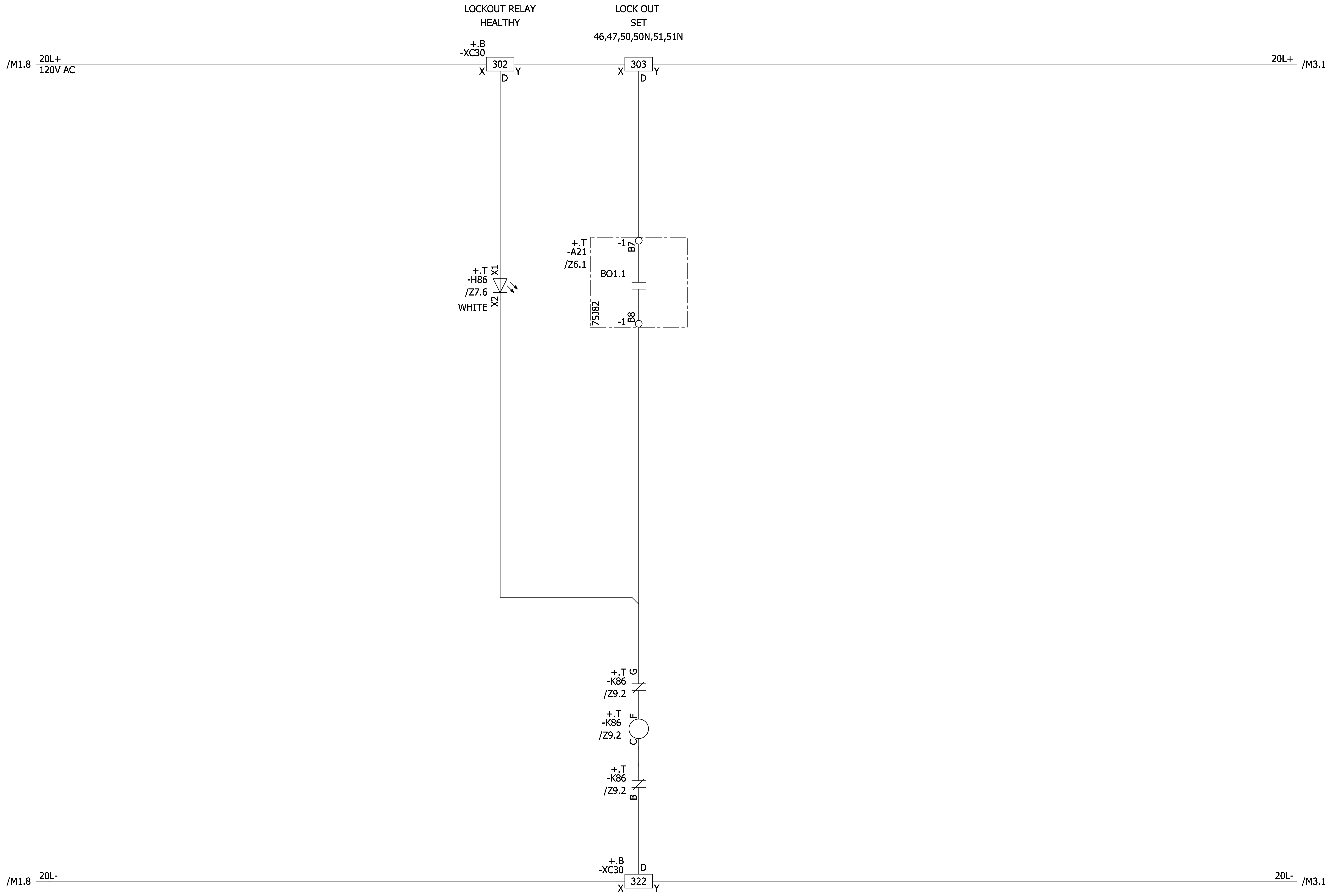


				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	M1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S015-B		Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



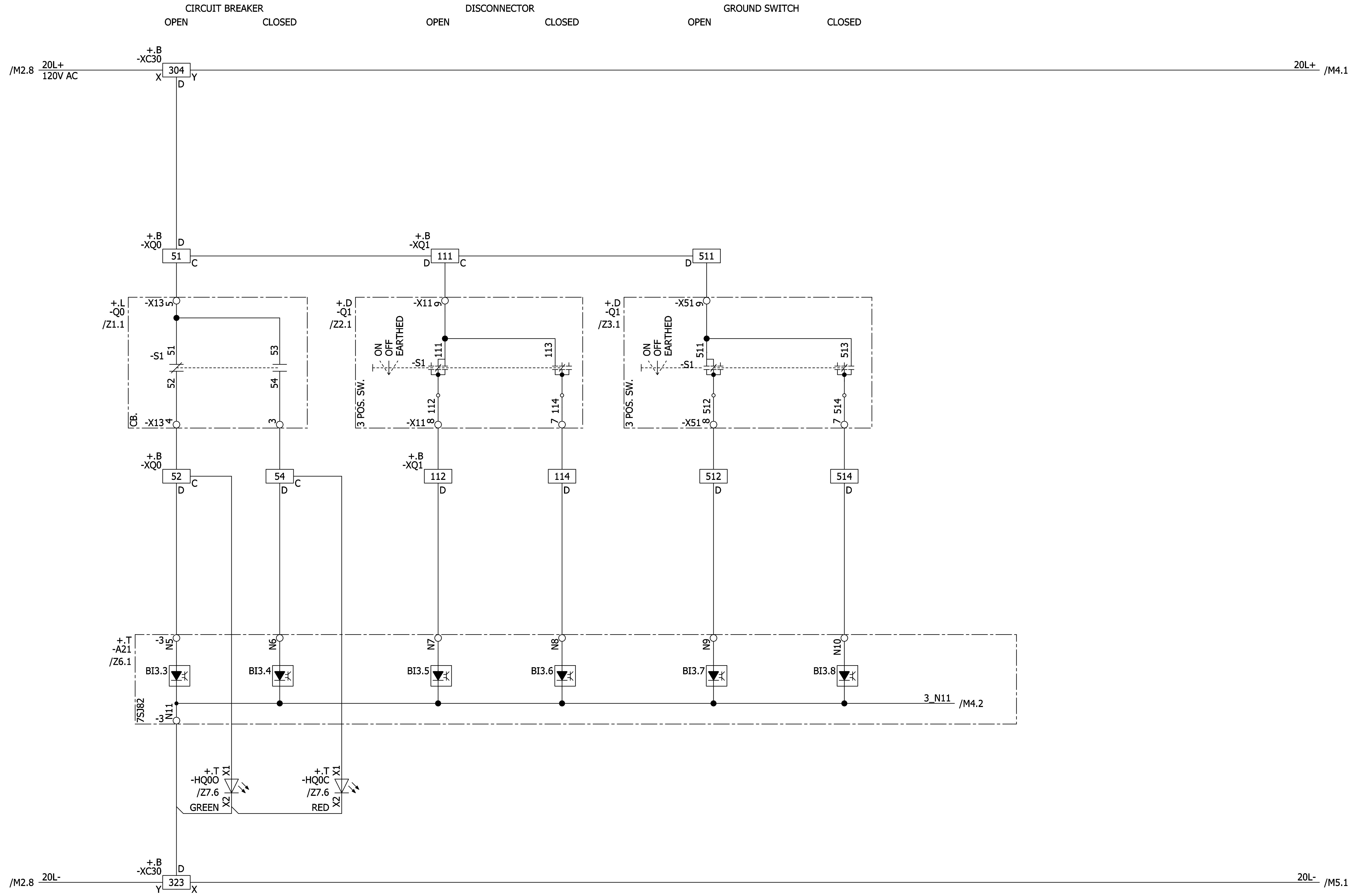
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	M2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S015-B		Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

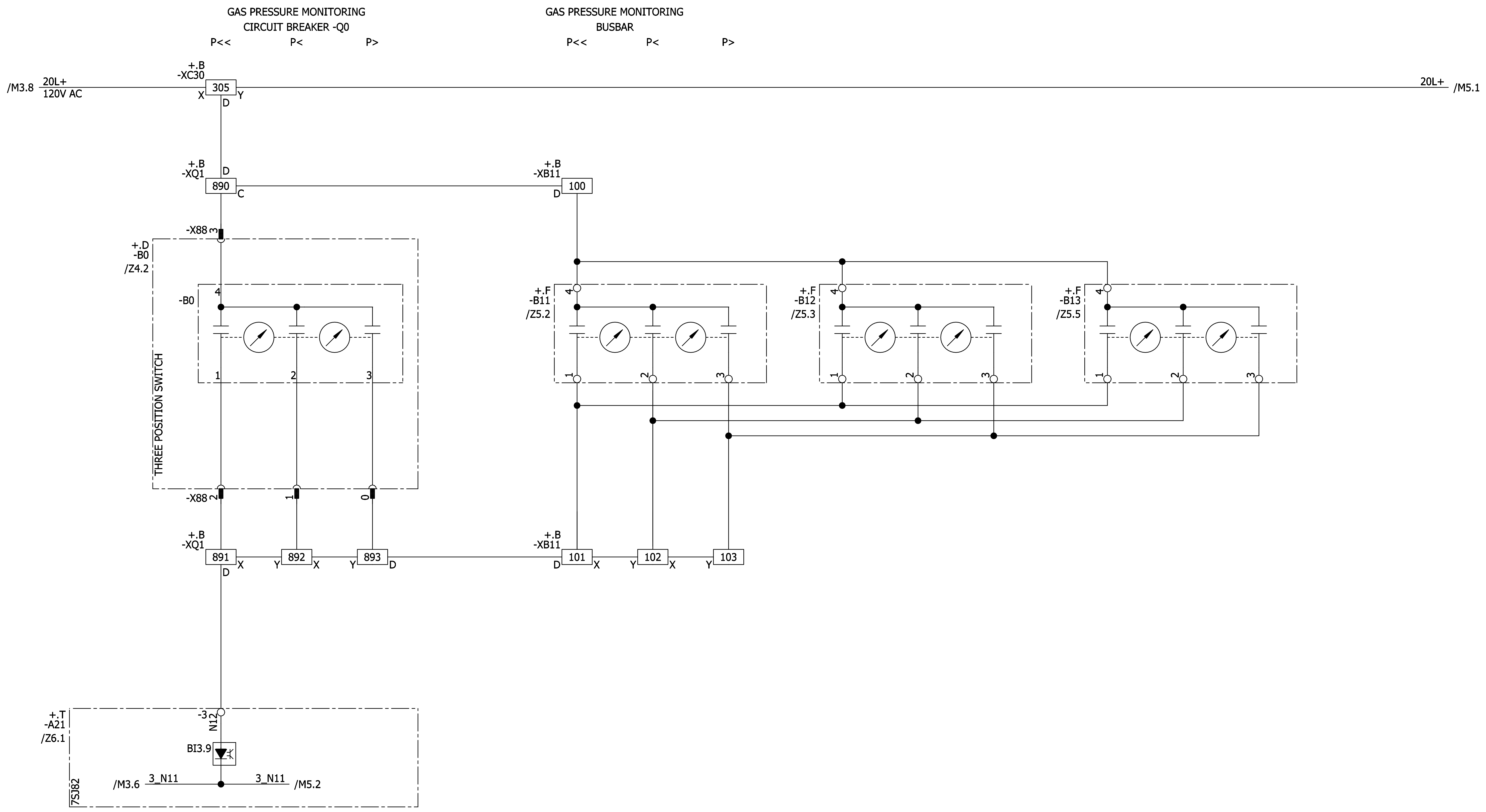
=JZ01 S =J01
+J01
M3

883314
(3) W92210-F2141-S015-B
Sheet 3+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

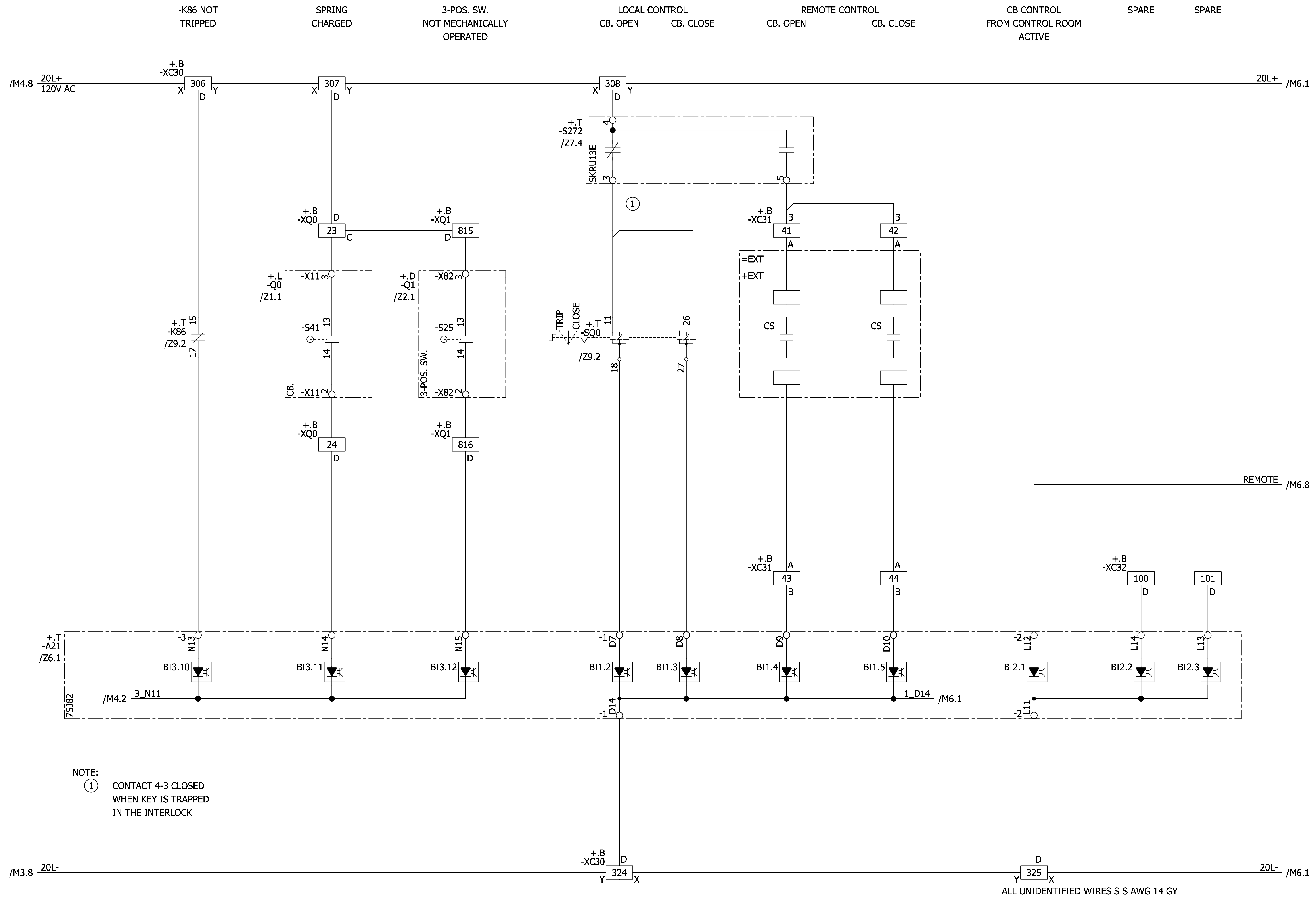
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
M4
883314
(3) W92210-F2141-S015-B
Sheet 4+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



NOTE:
① CONTACT 4-3 CLOSED
WHEN KEY IS TRAPPED
IN THE INTERLOCK

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

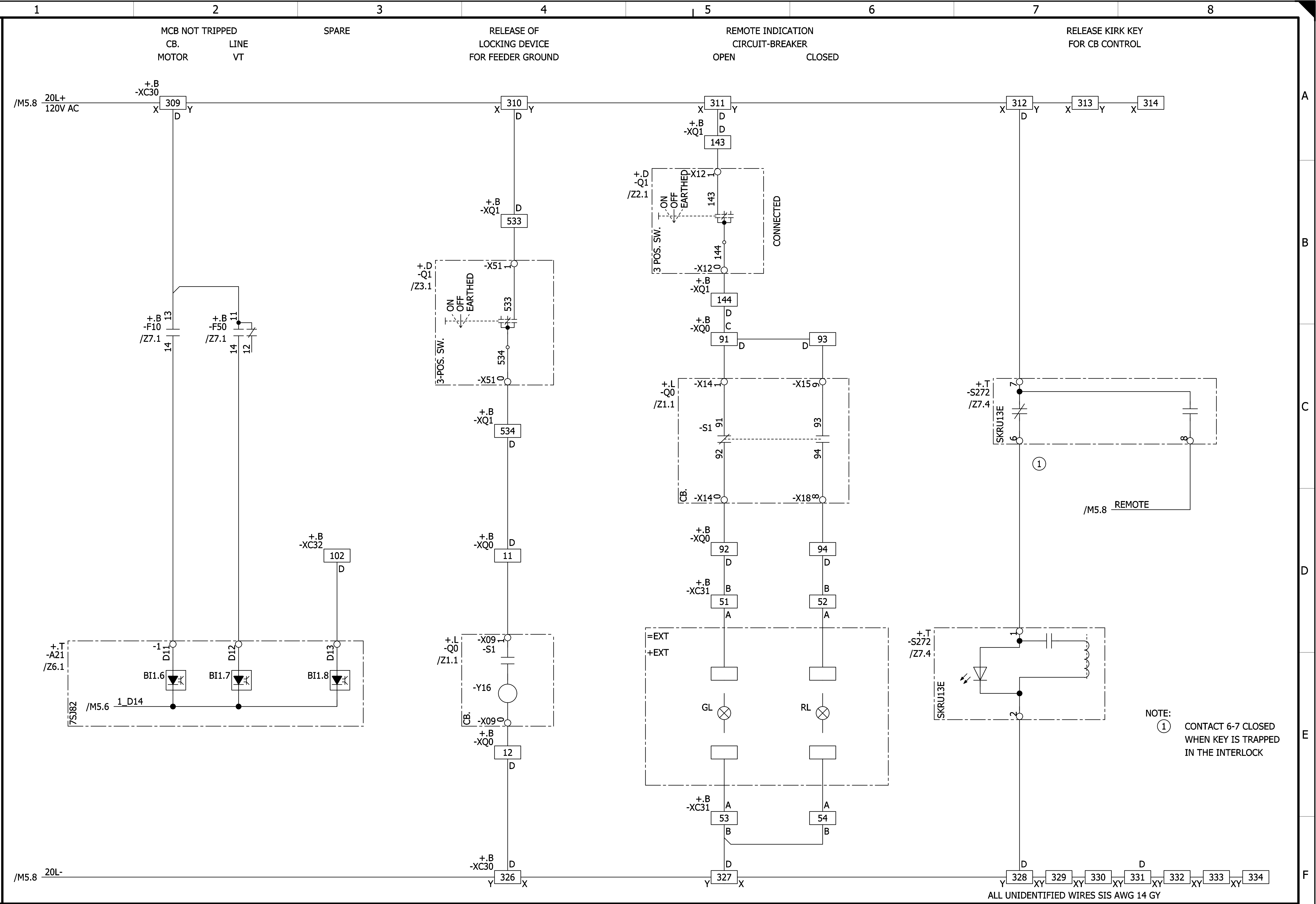
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
M5
883314
(3) W92210-F2141-S015-B
Sheet 5+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

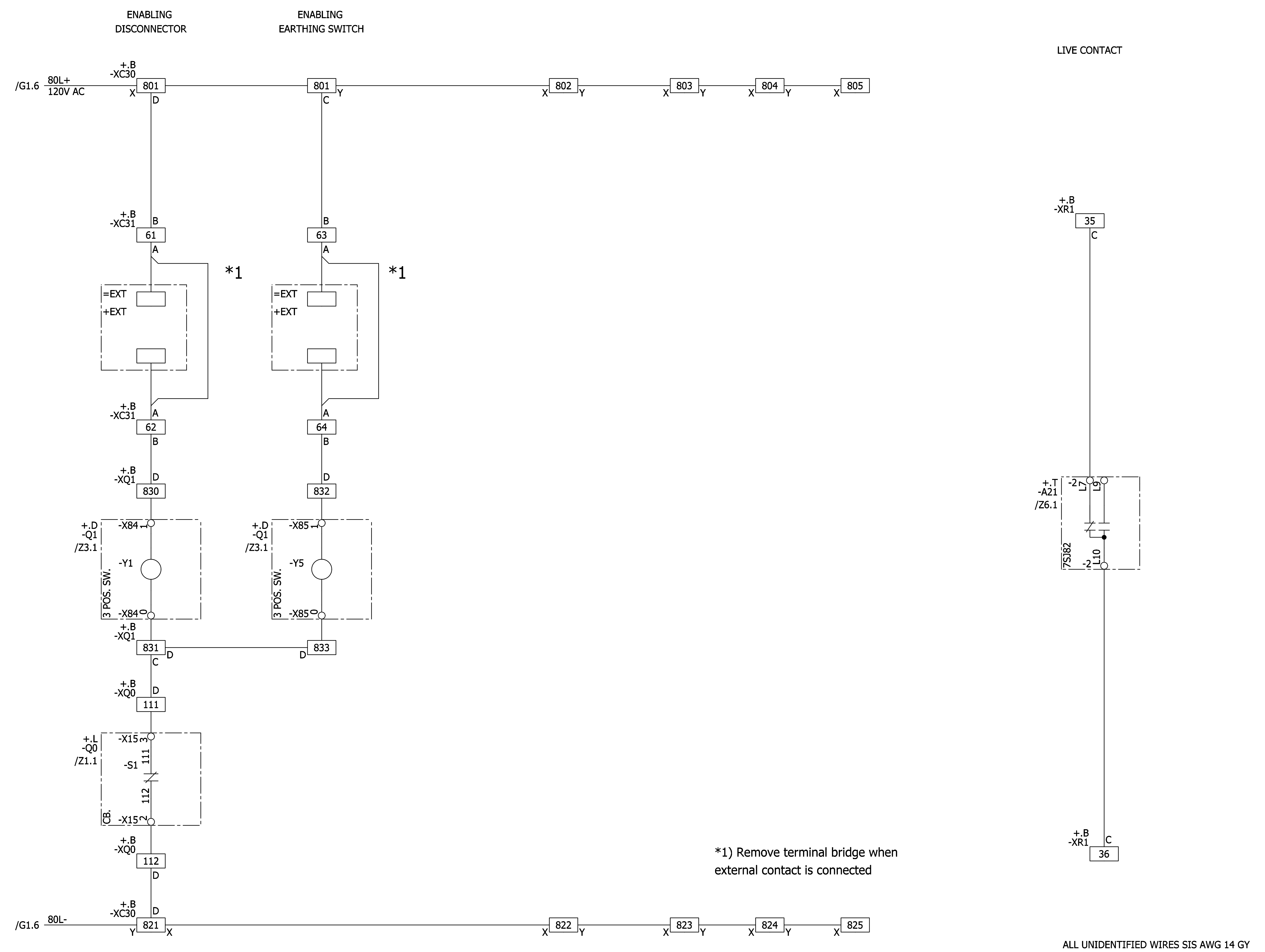
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

883314
(3) W92210-F2141-S015-B
=JZ01
S =J01
+J01
M6
Sheet 6+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



*1) Remove terminal bridge when external contact is connected

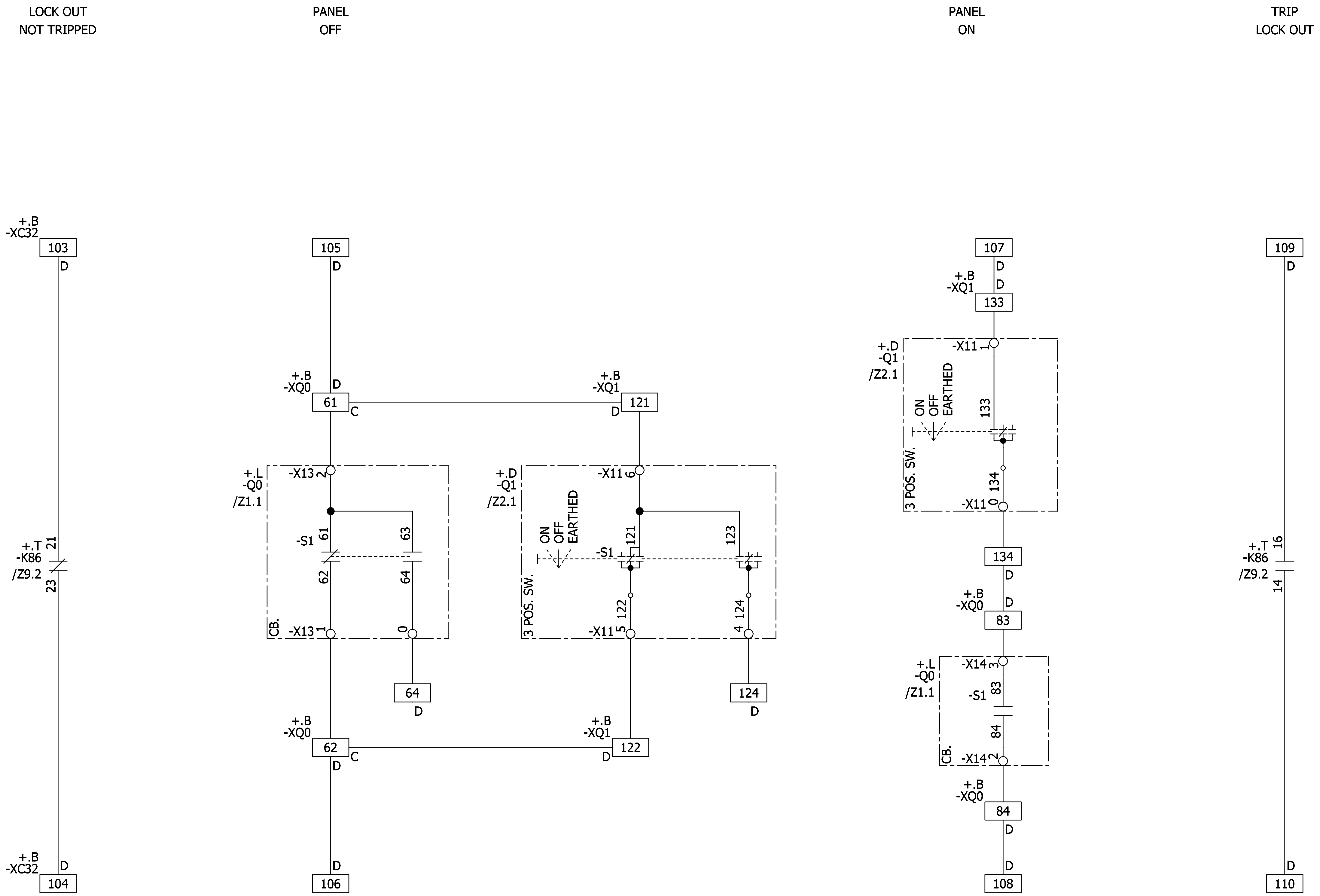
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	M7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S015-B		Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

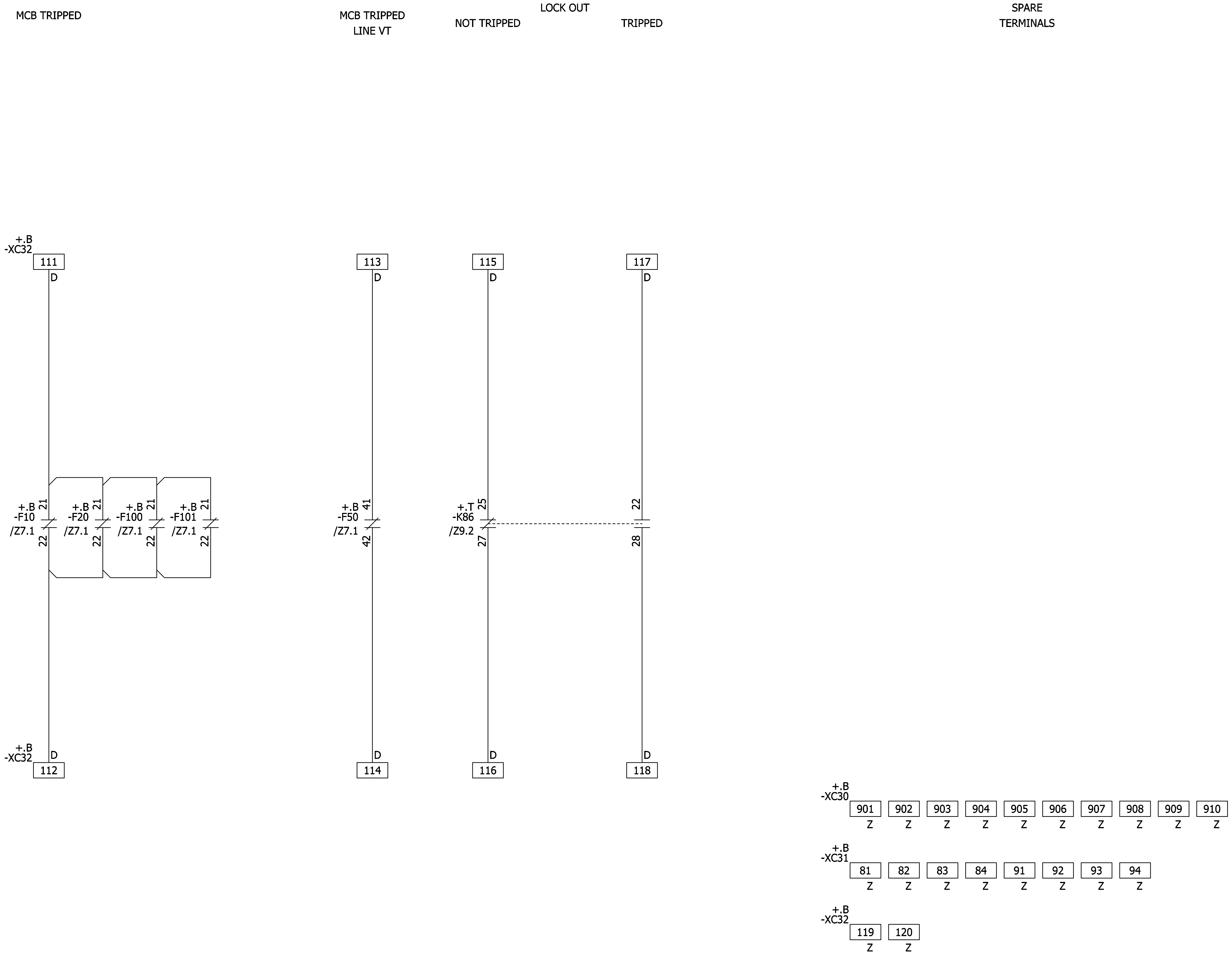
8DA10 25kV SWITCHGEAR
MAIN A
CONTROL SCHEMATIC
Circuit diagram

=JZ01
S
=J01
+J01
M8
883314
(3) W92210-F2141-S015-B
Sheet 8+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / M / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
INDICATIONS SPARE
Circuit diagram

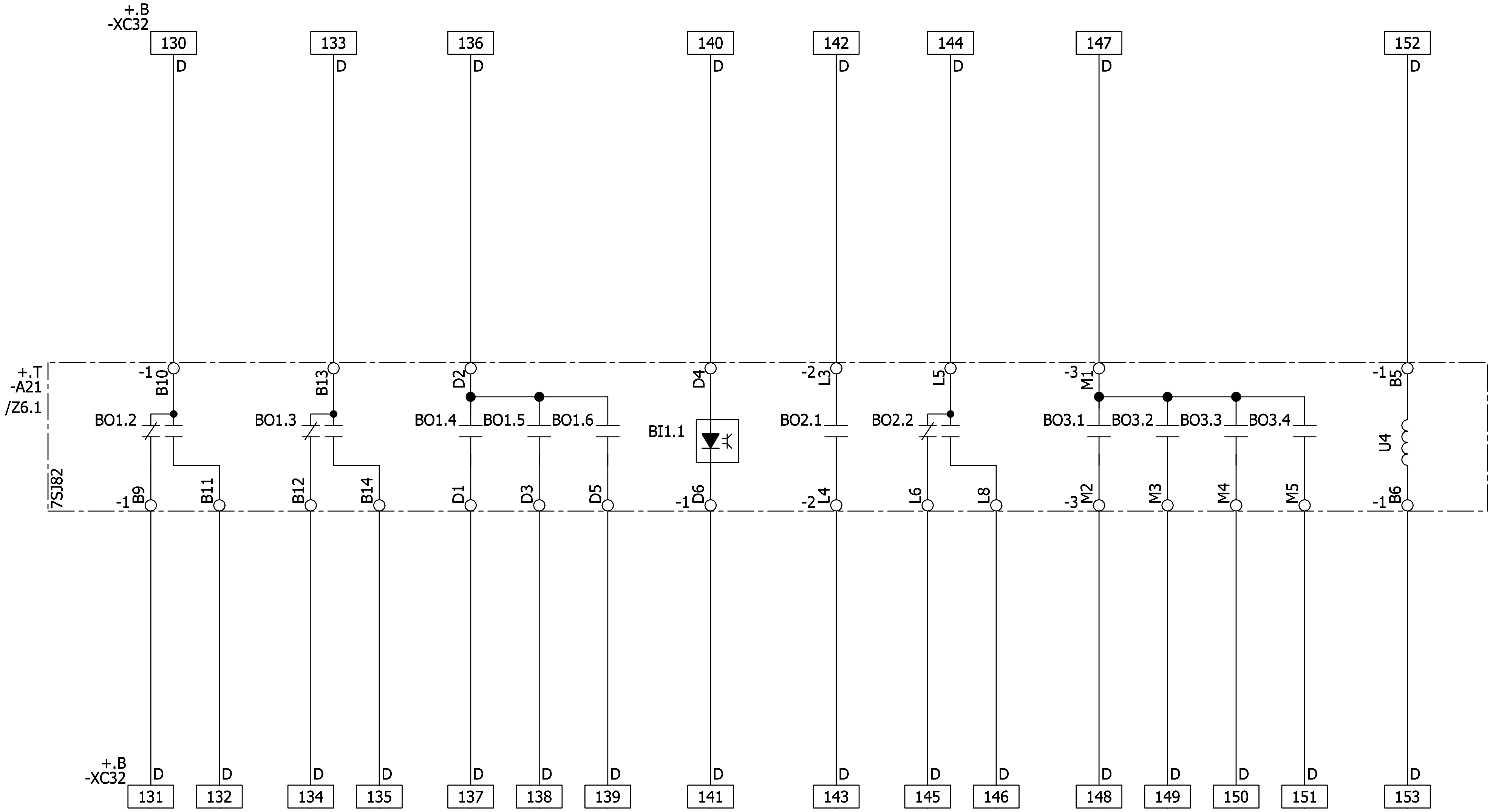
=JZ01
S
=J01
+J01
M9
883314
(3) W92210-F2141-S015-B
Sheet 9+
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / M / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

SPARE



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

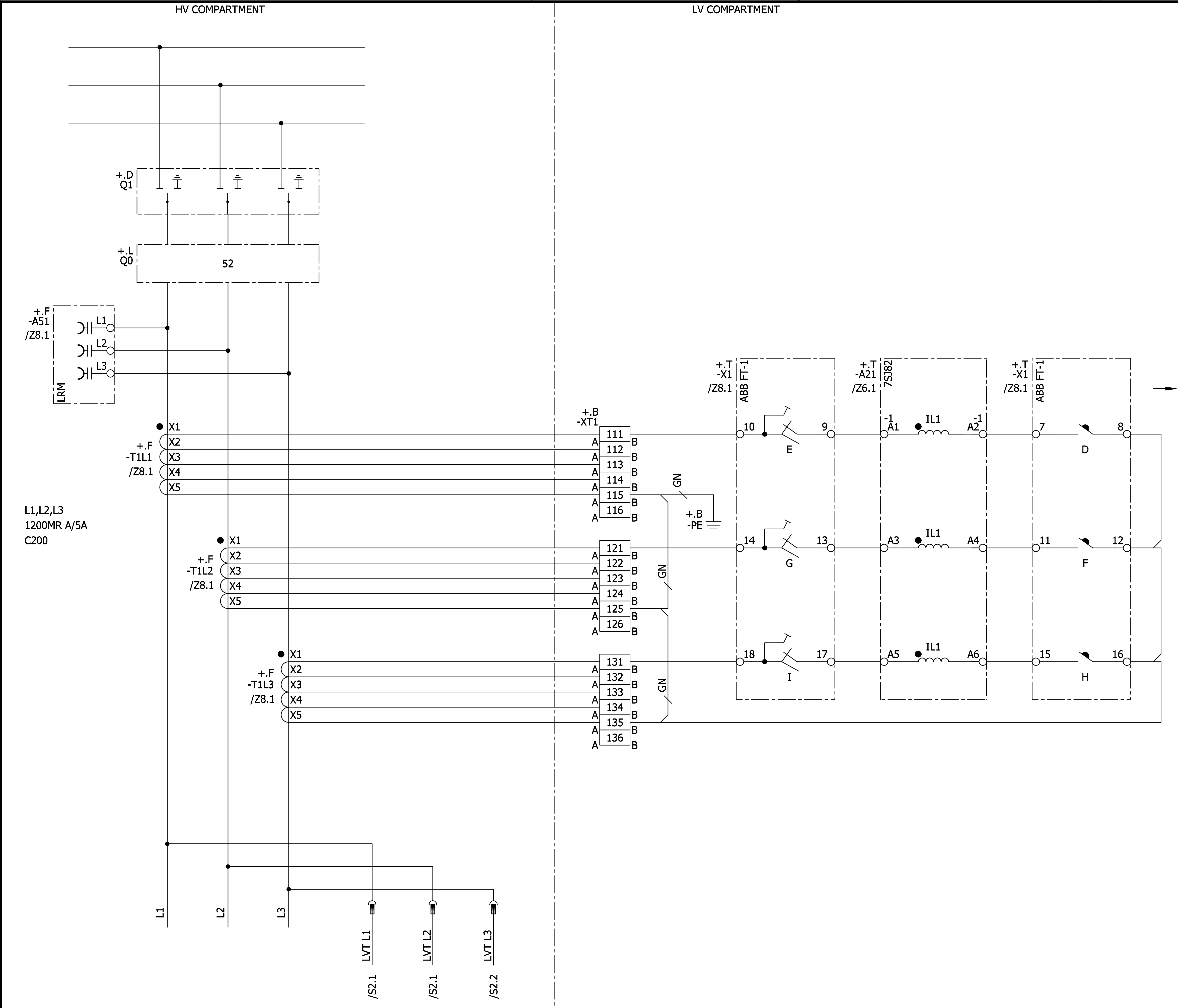
8DA10 25kV SWITCHGEAR
MAIN A
SPARE
Circuit diagram

=JZ01
S
=J01
+J01
M10
883314
(3) W92210-F2141-S015-B
Sheet 10-
10 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / S / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1200 A
MULTI-RATIO CT

CURRENT RATING (A) 1200:5	SECONDARY TAPS
100:5	X2-X3
200:5	X1-X2
300:5	X1-X3
400:5	X4-X5
500:5	X3-X4
600:5	X2-X4
800:5	X1-X4
900:5	X3-X5
1000:5	X2-X5
→ 1200:5	X1-X5

ALL UNIDENTIFIED WIRES SIS AWG 12 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

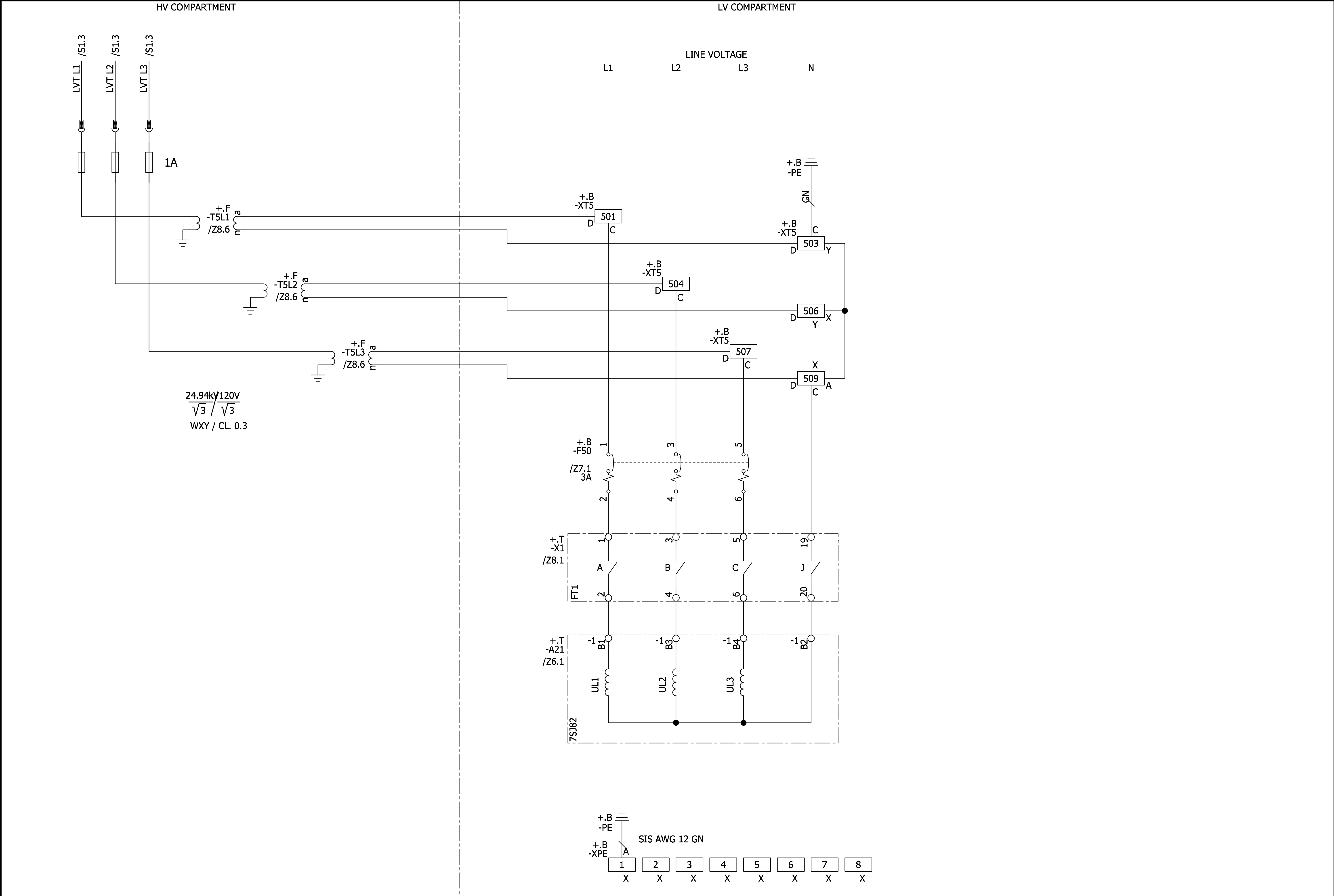
8DA10 25kV SWITCHGEAR
MAIN A
TRANSFORMER CIRCUITS
Circuit diagram

=JZ01
S =J01
+J01
S1
883314
(3) W92210-F2141-S015-B
Sheet 1+
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / S / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

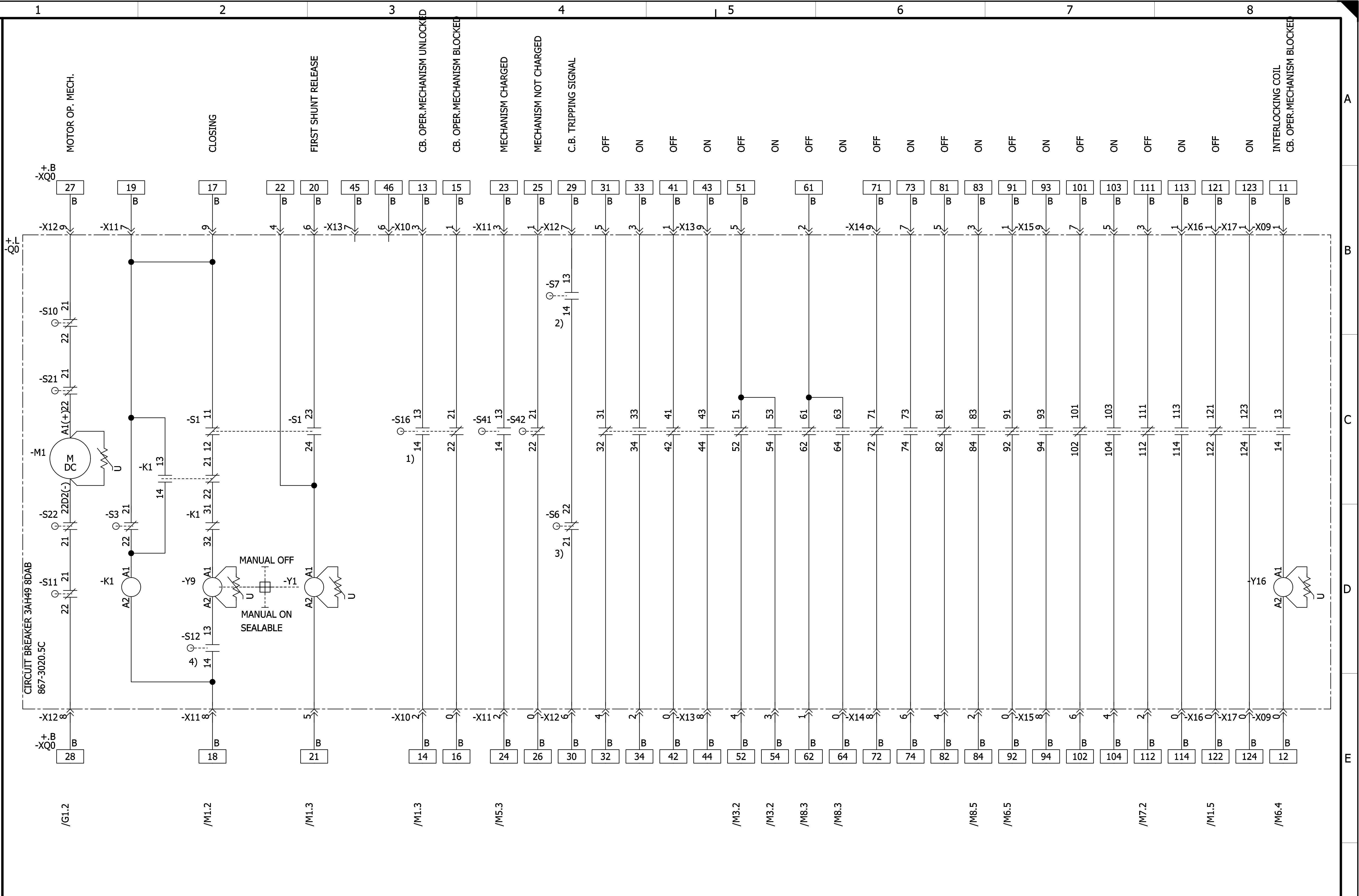
8DA10 25kV SWITCHGEAR
MAIN A
TRANSFORMER CIRCUITS
Circuit diagram

=JZ01 S =J01
+J01 S2
883314 (3) W92210-F2141-S015-B Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) OPERATES WHEN CB. TRIP IS NOT LOCKED OUT

2) OPERATES WHEN MECH. OFF IS NOT PRESSED

3) OPERATES WHEN NO TRIPPING

4) INTERLOCKING OF ELECTRICAL CLOSING OF THE CB IN CASE OF MANUAL OPERATION OF THE THREE-POSITION SWITCH

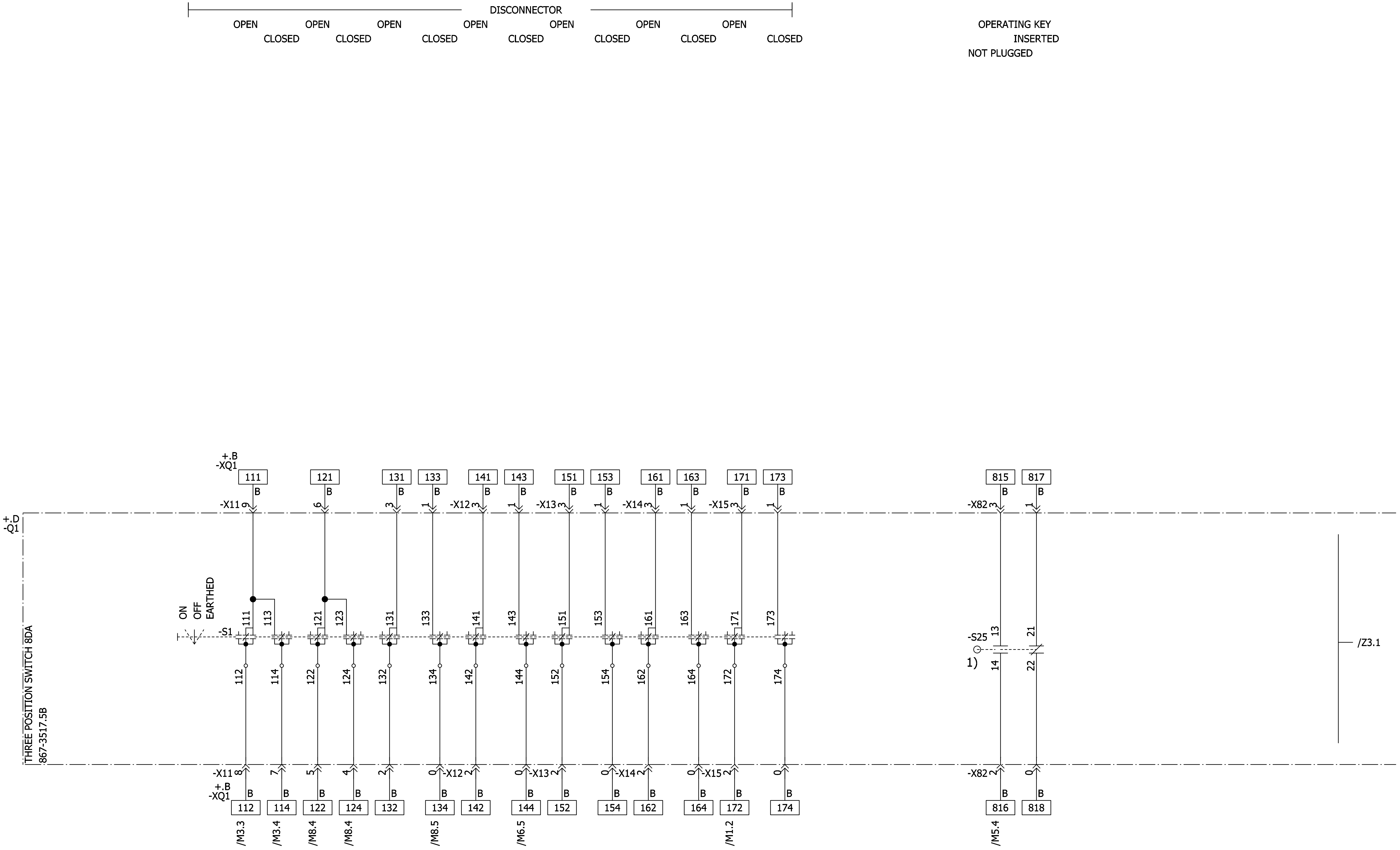
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name								
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CIRCUIT BREAKER	883314	(3) W92210-F2141-S015-B	Z1 Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J01 / S / Z / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) SHOWN WITH LEVER INSERTED

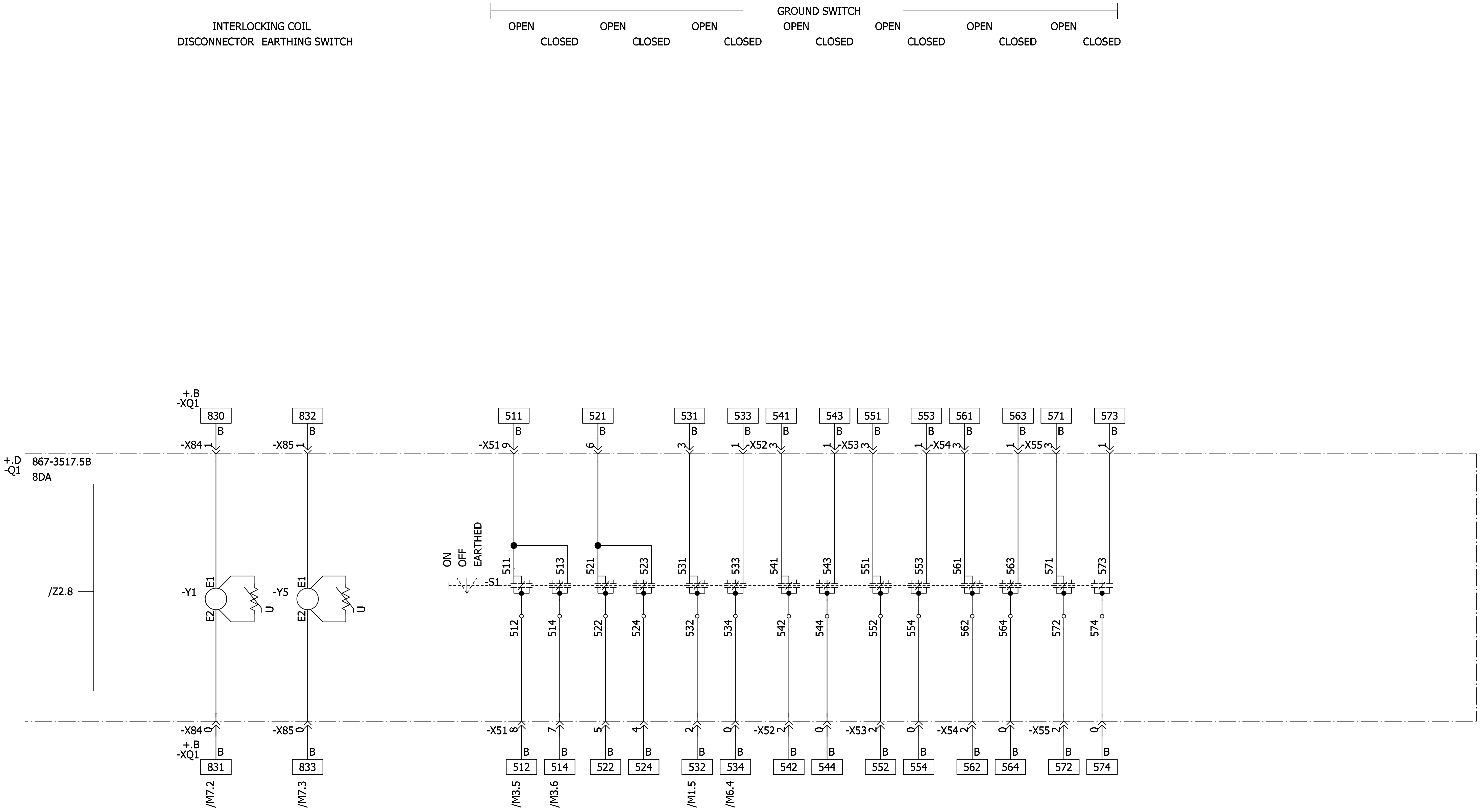
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01 Z2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		THREE POSITION SWITCH	883314	(3) W92210-F2141-S015-B	Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
THREE POSITION SWITCH
Circuit diagram

=JZ01
S
=J01
+J01
Z3
883314
(3) W92210-F2141-S015-B
Sheet 3+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 4

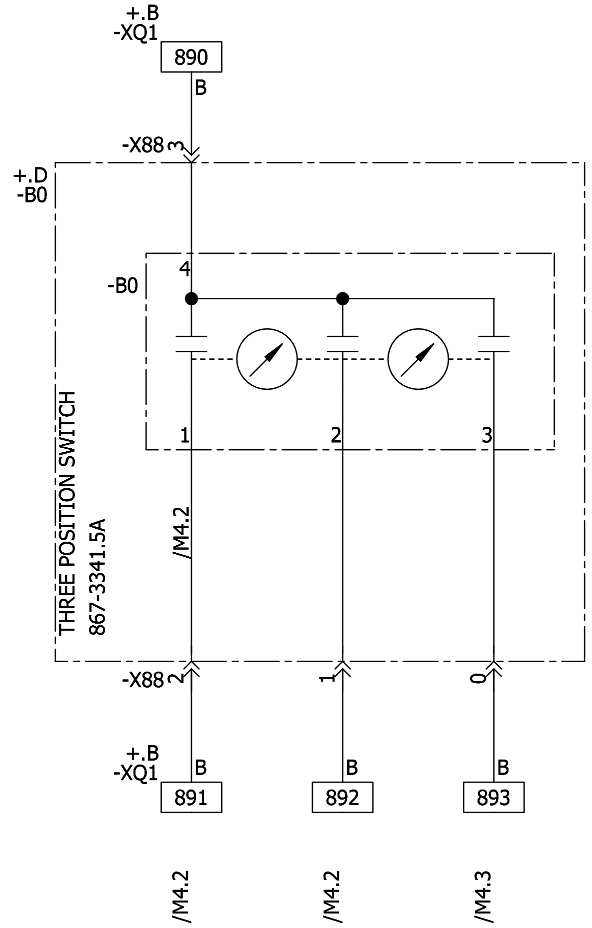
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

GAS PRESSURE MONITORING
CIRCUIT BREAKER -Q0
P<< P< P>

PLEASE NOTE:

MANOMETER WITH 3 ALARM CONTACTS (OPTION)
CONTACT 1: UNDERPRESSURE P<<
CONTACT 2: UNDERPRESSURE P<
CONTACT 3: OVERPRESSURE P>



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	Z4
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		GAS PRESSURE MONITORING	883314	(3) W92210-F2141-S015-B		Sheet 4+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

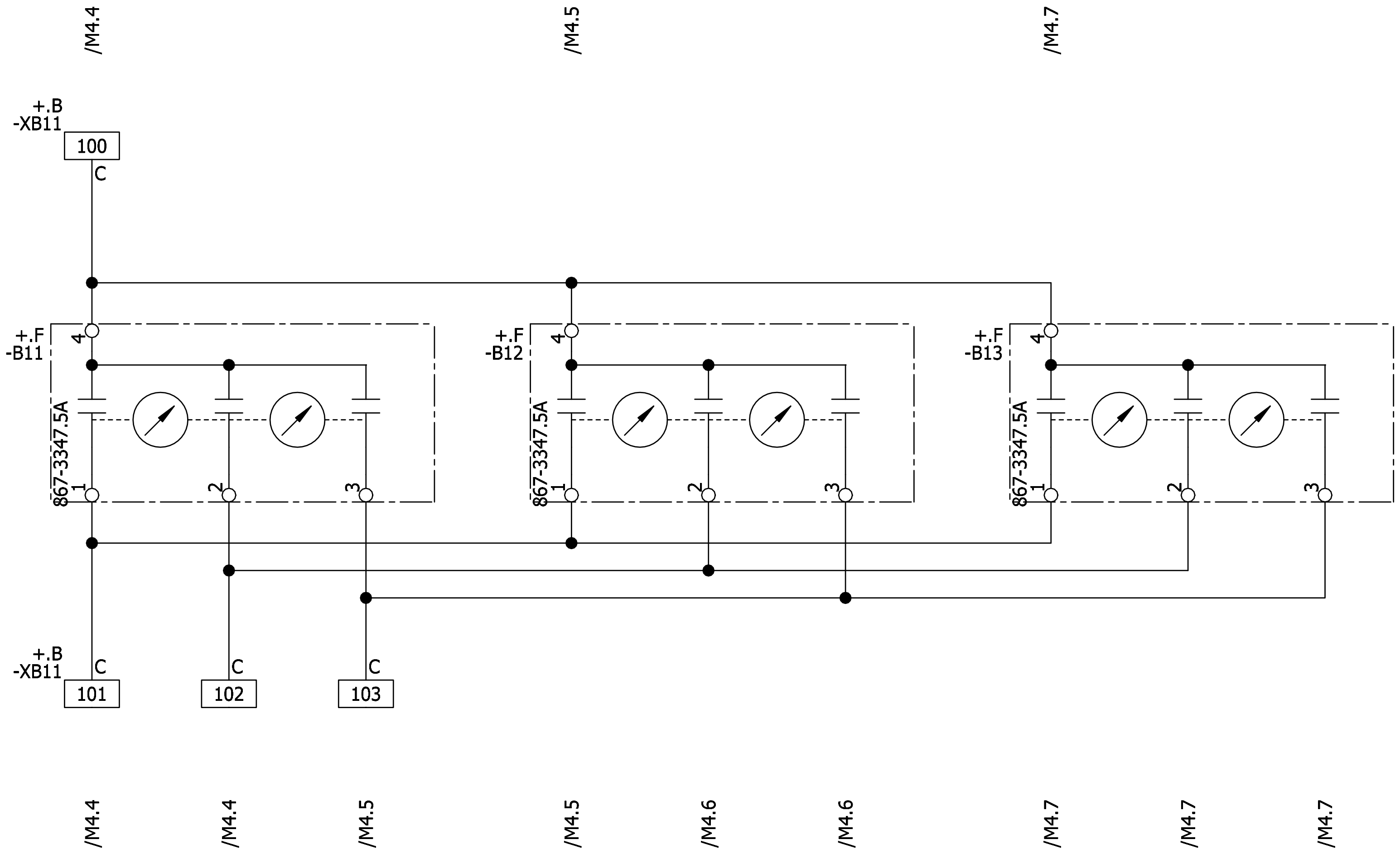
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

GAS PRESSURE MONITORING BUSBAR 1

P<< P< P>

PLEASE NOTE:

MANOMETER WITH 3 ALARM CONTACTS (OPTION)
CONTACT 1: UNDERPRESSURE P<<
CONTACT 2: UNDERPRESSURE P<
CONTACT 3: OVERPRESSURE P>



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date	05-18-15
Drawn	Ten-Thomé
Appr.	Magnuson
Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

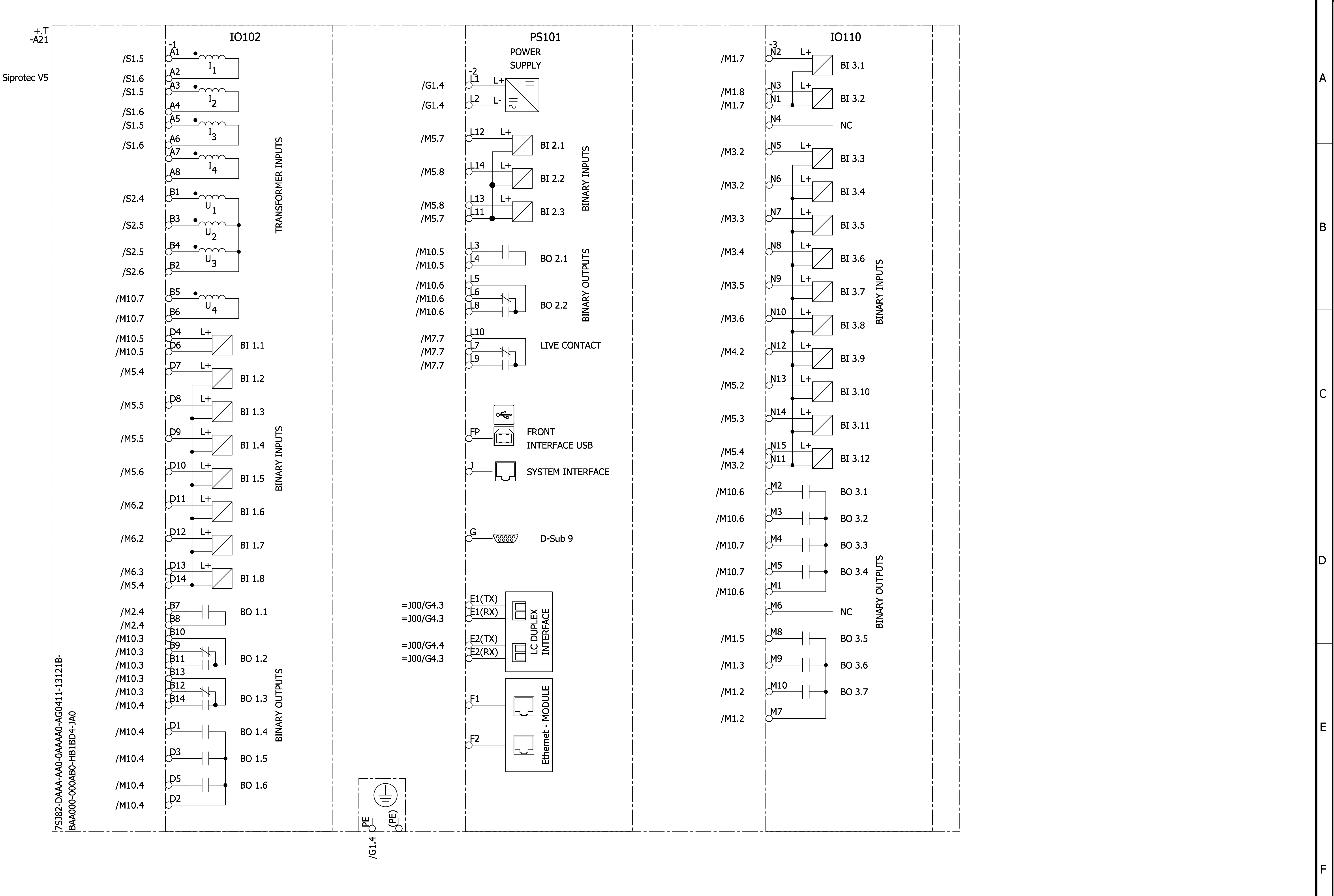
8DA10 25kV SWITCHGEAR
MAIN A
GAS PRESSURE MONITORING
Circuit diagram

=JZ01
S
=J01
+J01
Z5
883314
(3) W92210-F2141-S015-B
Sheet 5+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

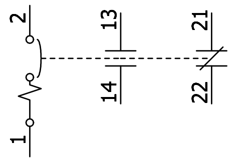


Revision	Modification	Date	Name								
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01 Z6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		PROTECTION AND CONTROL DEVICE	883314	(3) W92210-F2141-S015-B	Sheet 6+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			9 Sh.

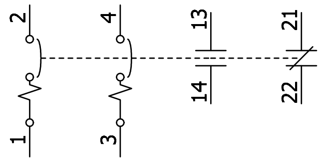
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

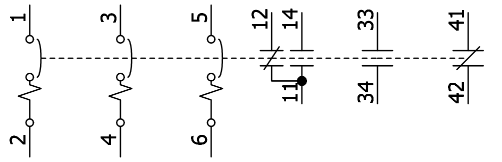
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



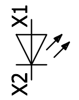
+.B -F100	5SJ4106-7HG41 5ST3010-0HG 1 POLE, 6A	/G2.2		/M9.3
+.B -F101	5SJ4106-7HG41 5ST3010-0HG 1 POLE, 6A	/G2.4		/M9.3



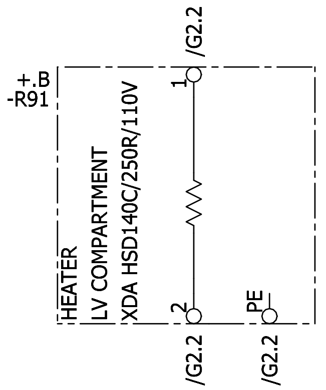
+.B -F10	5SJ4204-7HG41 5ST3010-0HG 2 POLE, 4A	/G1.2	/G1.2	/M6.2	/M9.2
+.B -F20	5SJ4206-7HG41 5ST3010-0HG 2 POLE, 6A	/G1.3	/G1.3		/M9.3

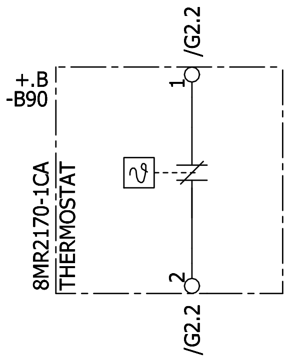


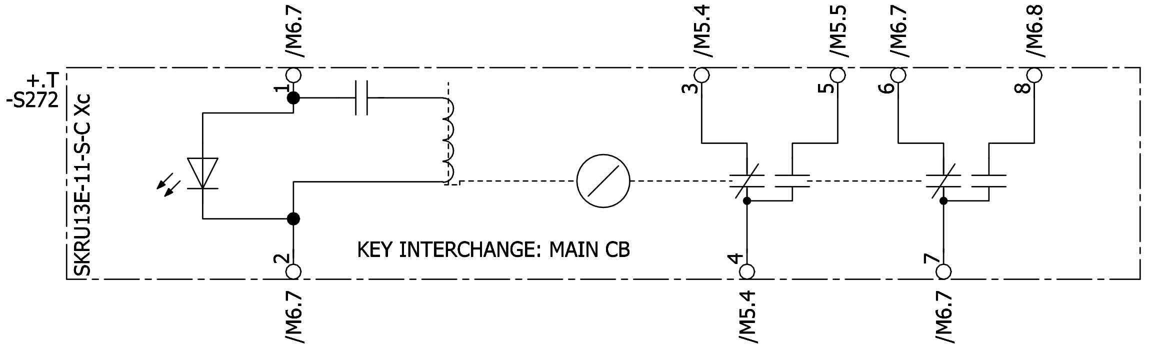
+.B -F50	3RV1611-1DG14 3pol., 3A 3RV1901-1A	/S2.4	/S2.5	/S2.5	/M6.2		/M9.4



+.T -HQ0O	3SB3400-1A CB//OPEN GREEN 3SB3001-6BA40 3SB3901-1DF	/M3.2
+.T -HQ0C	3SB3400-1A CB//CLOSED RED 3SB3001-6BA20 3SB3901-1CF	/M3.3
+.T -H86	3SB3400-1A LOCKOUT HEALTHY WHITE 3SB3001-6BA60 3SB3901-1QF	/M2.4







AUXILARY SWITCH
CIRCUITS 3-4 AND 6-7 ARE NORMALLY CLOSED
AND
CIRCUITS 5-4 AND 8-7 ARE NORMALLY OPEN
WHEN THE KEY IS TRAPPED IN THE INTERLOCK

KIRK KEY INTERLOCK WITH KEY NORMALLY TRAPPED IN LOCK
KEY REMOVABLE WHEN SOLENOID IS ENERGIZED

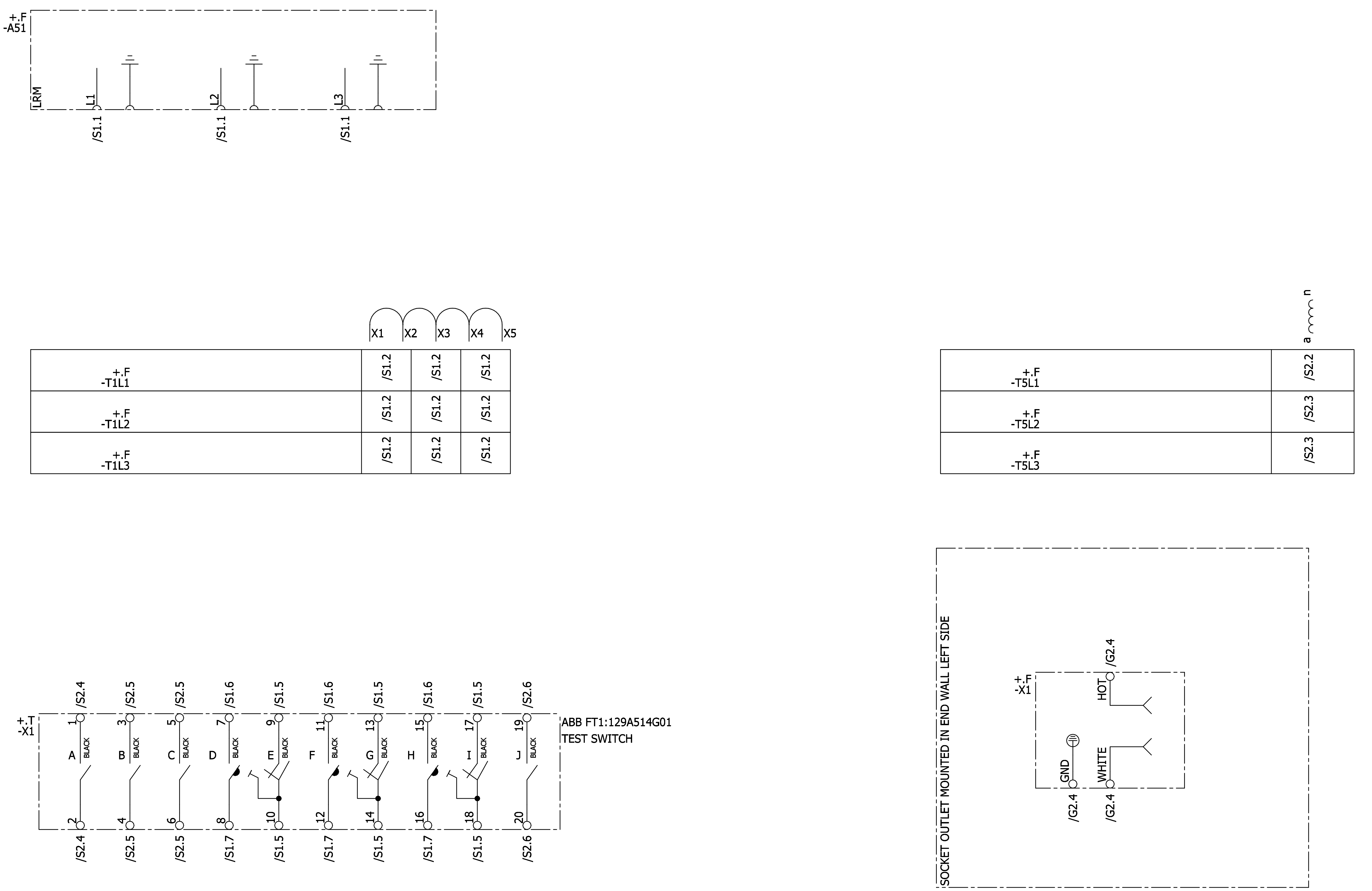
PUSHBUTTON (CLOSE TO ENERGIZE SOLENOID)
SIGNAL LAMP INDICATES WHEN SOLENOID CAN BE ENERGIZED

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S =J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A		+J01	Z7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S015-B	Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	S	=J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A			+J01	Z8
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S015-B		Sheet 8+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J01 / S / Z / 9

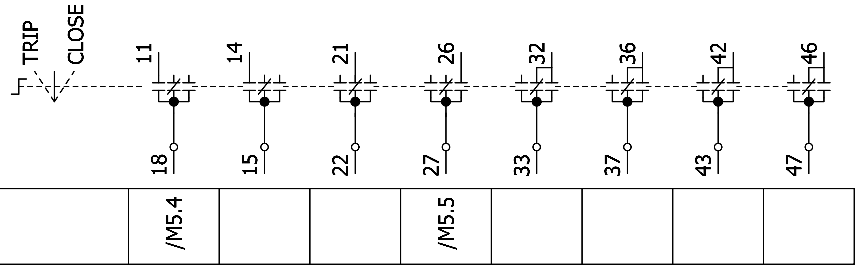
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

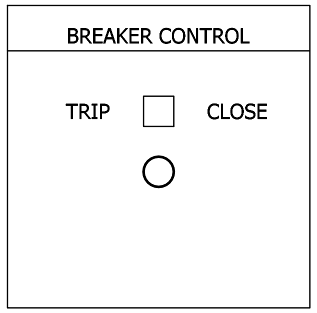
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

nat =NORMAL AFTER TRIP

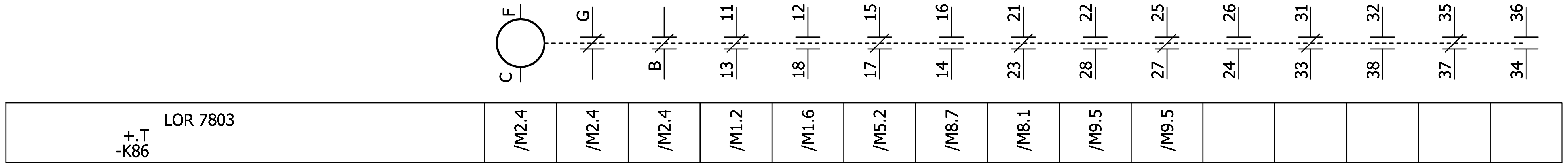
nac =NORMAL AFTER CLOSE

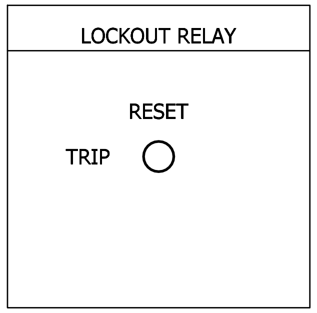
DECK	CONTACTS	POS			
		TRIP	nat	nac	CLOSE
1	11 — 18	X			
	14 — 15	X			
2	21 — 22		X	X	
	26 — 27				X
3	32 — 33			X	X
	36 — 37			X	X
4	42 — 43			X	X
	46 — 47			X	X





DECK	CONTACTS	POSITION	
		TRIP	RESET
I	B — C		X
	F — G		X
1	11 — 13		X
	12 — 18	X	
	15 — 17		X
	16 — 14	X	
2	21 — 23		X
	22 — 28	X	
	25 — 27		X
	26 — 24	X	
3	31 — 33		X
	32 — 38	X	
	35 — 37		X
	36 — 34	X	





Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
SECONDARY EQUIPMENT
Circuit diagram

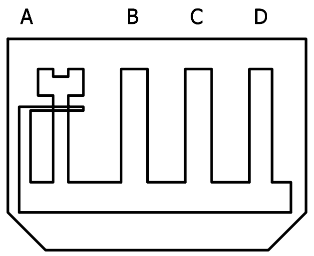
=JZ01 S =J01
+J01
Z9
883314
(3) W92210-F2141-S015-B
Sheet 9-
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBKLP2-13
Archive: =J01 / V / / / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				



Cable connection to termination

A ☐ B ☐ C ☐ D ☐

Terminal	Terminal block type	Wire type
11-46	UPCV3K	
	PLUG PC 4/6-STF-7,62	
	UPCV3K-F BEFORE AND AFTER EACH BLOCK OF 6 UPCV3K TERMINALS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 24

-XR1

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Termination B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
-XC31 :11 B	○	11	=J00/G1.3		-F10 :2	=J02 +.B -XR1 :11 B
-XC31 :13 B	○	12	=J00/G1.3		-F10 :4	=J02 +.B -XR1 :12 B
-XC31 :12 B	○	13	=J00/G1.3		-F20 :2	=J02 +.B -XR1 :13 B
-XC31 :14 B	○	14	=J00/G1.3		-F20 :4	=J02 +.B -XR1 :14 B
-XC31 :21 B	○	15	=J00/G1.3		-F100 :2	=J02 +.B -XR1 :15 B
-XC31 :22 B	○	16	=J00/G1.3		-XC30 :401 D	=J02 +.B -XR1 :16 B
	○	21	=J00/G1.3			=J02 +.B -XR1 :21 B
	○	22	=J00/G1.3			=J02 +.B -XR1 :22 B
	○	23	=J00/G1.3			=J02 +.B -XR1 :23 B
	○	24	=J00/G1.3			=J02 +.B -XR1 :24 B
	○	25	=J00/G1.3			=J02 +.B -XR1 :25 B
	○	26	=J00/G1.3			=J02 +.B -XR1 :26 B
	○	31	=J00/G2.3		-XC30 :800 D	=J02 +.B -XR1 :31 B
	○	32	=J00/G2.3		-XC30 :820 D	=J02 +.B -XR1 :32 B
	○	33	=J00/G2.3			=J02 +.B -XR1 :33 B
	○	34	=J00/G2.3			=J02 +.B -XR1 :34 B
	○	35	=J00/G2.3		+.T -A21-2 :L7	=J02 +.B -XR1 :35 B
	○	36	=J00/G2.3		+.T -A21-2 :L10	=J02 +.B -XR1 :36 B
	○	41	=J00/G3.3			
	○	42	=J00/G3.3			
	○	43	=J00/G3.3			
	○	44	=J00/G3.3			
	○	45	=J00/G3.3			
	○	46	=J00/G3.3			

Screen bus →	A Cable clamp	⌒	Cover
N-bus	B Screen bus	—×—	Insulation plate
PE-PEN-bus	C Screwed cable gland	—××—	Higher level insulation plate
Used cores total	D Plug housing	◉	Test socket
Continued on sheet	E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name			
				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XR1
Connection table

=JZ01 V =J01 +.B

883314 (3) W92210-F2141-S018-B

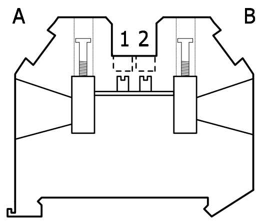
/1
Sheet 1+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11-UT
Archive: =J01 / V / / / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1	-J01-W91	SIHSI-CU 3x0,75mm²		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				



1 = Plug-in bridge left
2 = Plug-in bridge right

Cable connection to termination A B

Terminal	Terminal block type	Wire type
1-3	UT 4	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BN														
BU														
GNYE														
3														

-X90

1 2 JUMPER

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation	
-B90	:2	○ ▫ ▫ ○	1	/G2.2	-R91	:1
-XC30	:401 C	○ ▫ ▫ ○	2	/G2.2	-R91	:2
-XPE	:1 B	○ ▫ ▫ ○	3	/G2.2	-R91	:PE

Screen bus →	A Cable clamp	Cover
N-bus	B Screen bus	Insulation plate
PE-PEN-bus	C Screwed cable gland	Higher level insulation plate
Used cores total	D Plug housing	Test socket
Continued on sheet	E Insulated	Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-X90
Connection table

=JZ01 V =J01 +.B
883314
(3) W92210-F2141-S018-B
/2
Sheet 2+
16 Sh.

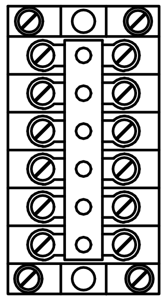
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
111-136	LJK:1506SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 18

Termination A Destination Item designation				Terminal strip -XT1 Link	Term.-no.	Cross-ref.	Termination B Destination Item designation			
+.F	-T1L1	:X1			111	/S1.4		+.T	-X1	:10
+.F	-T1L1	:X2			112	/S1.4				
+.F	-T1L1	:X3			113	/S1.4				
+.F	-T1L1	:X4			114	/S1.4				
+.F	-T1L1	:X5			115	/S1.4			-XT1	:125 B
							=J01	+.B	-PE	
			⌒		116	/S1.4				
+.F	-T1L2	:X1			121	/S1.4		+.T	-X1	:14
+.F	-T1L2	:X2			122	/S1.4				
+.F	-T1L2	:X3			123	/S1.4				
+.F	-T1L2	:X4			124	/S1.4				
+.F	-T1L2	:X5			125	/S1.4			-XT1	:115 B
									-XT1	:135 B
			⌒		126	/S1.4				
+.F	-T1L3	:X1			131	/S1.4		+.T	-X1	:18
+.F	-T1L3	:X2			132	/S1.4				
+.F	-T1L3	:X3			133	/S1.4				
+.F	-T1L3	:X4			134	/S1.4				
+.F	-T1L3	:X5			135	/S1.4			-XT1	:125 B
								+.T	-X1	:16
			⌒		136	/S1.4				

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒ Cover
✕ Insulation plate
⋇ Higher level insulation plate
◉ Test socket
○⌐○ Disconnector

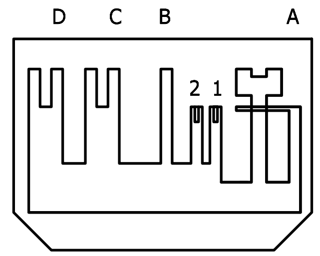
Revision	Modification	Date	Name						
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 V =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	+.B /3
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J01+.B-XT1	883314 (3) W92210-F2141-S018-B Sheet 3+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Connection table	16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
501-509	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 6

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination D Destination Item designation	Termination C Destination Item designation	Slot B Destination Item designation		Terminal strip Link JUMPER	2	1	Term.-no.	Cross-ref.		Termination A Destination Item designation
				-XT5						
+.F -T5L1 :a	-F50 :1			●	□	□	501	/S2.4	⊖	
+.F -T5L1 :n	=J01 +.B -PE			●	■	□	503	/S2.6	⊖	
+.F -T5L2 :a	-F50 :3			●	□	□	504	/S2.5	⊖	
+.F -T5L2 :n				●	■	□	506	/S2.6	⊖	
+.F -T5L3 :a	-F50 :5			●	□	□	507	/S2.5	⊖	
+.F -T5L3 :n	+.T -X1 :19			●	■	□	509	/S2.6	⊖	

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	✕	Insulation plate
C Screwed cable gland	✕✕	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XT5
Connection table

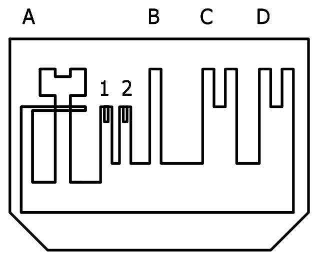
=JZ01
V
=J01
+.B
/4
883314
(3) W92210-F2141-S018-B
Sheet 4+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 58

Cable connection to termination

A B C D

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XC30					
	1 2 JUMPER					
	1	300	/G1.3			-F20 :1
	1	301	/M1.2			+.T -A21-3 :M7
	1	302	/M2.4			+.T -H86 :X1
	1	303	/M2.4			+.T -A21-1 :B7
	1	304	/M3.2			-XQ0 :51 D
	1	305	/M4.2			-XQ1 :890 D
	1	306	/M5.2			+.T -K86 :15
	1	307	/M5.3			-XQ0 :23 D
	1	308	/M5.4			+.T -S272 :4
	1	309	/M6.2			-F10 :13
	1	310	/M6.4			-XQ1 :533 D
	1	311	/M6.5			-XQ1 :143 D
	1	312	/M6.7			+.T -S272 :7
	1	313	/M6.7			
	1	314	/M6.8			
	2	320	/G1.3			-F20 :3
	2	321	/M1.2		-XQ0 :14 D	+.T -K86 :13
	2	322	/M2.4			+.T -K86 :B
	2	323	/M3.2			+.T -A21-3 :N11
	2	324	/M5.4			+.T -A21-1 :D14
	2	325	/M5.7			+.T -A21-2 :L11
	2	326	/M6.4			-XQ0 :12 D
	2	327	/M6.5			-XC31 :53 B
	2	328	/M6.7			+.T -S272 :2
	2	329	/M6.7			
	2	330	/M6.7			
	2	331	/M6.8			
	2	332	/M6.8			
	2	333	/M6.8			
	2	334	/M6.8			
	1	340	/M1.6		+.T -K86 :12	-XC31 :32 B
	1	341	/M1.7			+.T -A21-3 :N2
	2	342	/M1.6		+.T -K86 :18	-XC31 :34 B
	2	343	/M1.7			+.T -A21-3 :N1
+.F -X1 :HOT		400	/G2.4			-F101 :1
+.F -X1 :WHITE		401	/G2.2		-X90 :2 A	-XR1 :16 C
	1	800	/G1.6			-XR1 :31 C
	1	801	/M7.2		-XC31 :63 B	-XC31 :61 B
	1	802	/M7.4			
	1	803	/M7.5			

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover	
B Screen bus	✕	Insulation plate	
C Screwed cable gland	✕✕	Higher level insulation plate	
D Plug housing	◉	Test socket	
E Insulated	○⌐○	Disconnector	

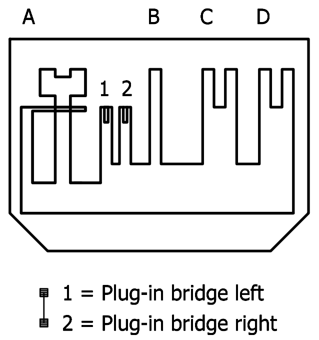
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by				
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01	V =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A		+.B /5
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J01+.B-XC30	883314	(3) W92210-F2141-S018-B
								Connection table		Sheet 5+ 16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal: 300-910
Terminal block type: VBSTB 4-FS
Wire type:
FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 58

Cable connection to termination
A B C D

1	2	3	4	5	6	7	8	9

-XC30

Termination A Destination Item designation	Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	■	□	●	804	/M7.5			
	■	□	●	805	/M7.6			
	□	■	●	820	/G1.6			-XR1 :32 C
	□	■	●	821	/M7.2			-XQ0 :112 D
	□	■	●	822	/M7.4			
	□	■	●	823	/M7.5			
	□	■	●	824	/M7.5			
	□	■	●	825	/M7.6			
	□	□	●	901	/M9.7			
	□	□	●	902	/M9.7			
	□	□	●	903	/M9.7			
	□	□	●	904	/M9.7			
	□	□	●	905	/M9.7			
	□	□	●	906	/M9.8			
	□	□	●	907	/M9.8			
	□	□	●	908	/M9.8			
	□	□	●	909	/M9.8			
	□	□	●	910	/M9.8			

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp — ⌒ — Cover
B Screen bus — ✕ — Insulation plate
C Screwed cable gland — ✕✕ — Higher level insulation plate
D Plug housing — ◉ — Test socket
E Insulated — o⌐o — Disconnector

Revision	Modification	Date	Name							
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 V =J01	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	+.B	/6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J01+.B-XC30	883314 (3) W92210-F2141-S018-B	Sheet 6+
				Norm		Orig./Prep.for/Prep.by		Connection table		16 Sh.

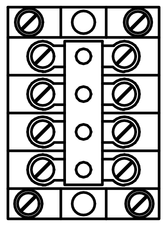
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation				Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation		
				-XC31					
=EXT	+EXT				11	/G1.2		-XR1	:11 A
								-XC31	:12 B
					12	/G1.3		-XR1	:13 A
								-XC31	:11 B
=EXT	+EXT				13	/G1.2		-XR1	:12 A
								-XC31	:14 B
					14	/G1.3		-XR1	:14 A
								-XC31	:13 B
=EXT	+EXT				21	/G2.2		-XR1	:15 A
=EXT	+EXT				22	/G2.2		-XR1	:16 A
					23	/G2.2			
					24	/G2.3			
		-XC31	:32 A		31	/M1.5	+.T	-A21-3	:M7
=EXT	+EXT								
		-XC31	:31 A		32	/M1.5		-XC30	:340 D
=EXT	+EXT								
		-XC31	:34 A		33	/M1.5		-XQ1	:531 C
=EXT	+EXT								
		-XC31	:33 A		34	/M1.5		-XC30	:342 D
=EXT	+EXT								
=EXT	+EXT				41	/M5.5		-XC31	:42 B
							+.T	-S272	:5
=EXT	+EXT				42	/M5.6		-XC31	:41 B
=EXT	+EXT				43	/M5.5	+.T	-A21-1	:D9
=EXT	+EXT				44	/M5.6	+.T	-A21-1	:D10
=EXT	+EXT				51	/M6.5		-XQ0	:92 D
=EXT	+EXT				52	/M6.6		-XQ0	:94 D
=EXT	+EXT				53	/M6.5		-XC31	:54 B
								-XC30	:327 D
=EXT	+EXT				54	/M6.6		-XC31	:53 B
		-XC31	:62 A		61	/M7.2		-XC30	:801 D
=EXT	+EXT								
		-XC31	:61 A		62	/M7.2		-XQ1	:830 D
=EXT	+EXT								
		-XC31	:64 A		63	/M7.3		-XC30	:801 C
=EXT	+EXT								
		-XC31	:63 A		64	/M7.3		-XQ1	:832 D
=EXT	+EXT								
		-XC31	:72 A		71	/M1.2		-XQ1	:171 C
=EXT	+EXT								

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒ Cover
–×– Insulation plate
–××– Higher level insulation plate
◉ Test socket
○⌐○ Disconnector

Revision	Modification	Date	Name						
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 V =J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A	+.B /7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J01+.B-XC31	Sheet 7+
				Norm		Orig./Prep.for/Prep.by		Connection table	883314 (3) W92210-F2141-S018-B 16 Sh.

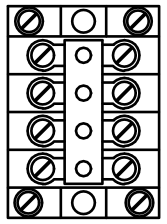
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J01 / V / / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A B

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation
		-XC31				
-XC31 :71 A			72	/M1.2		-XC31 :73 B
=EXT +EXT						
-XC31 :74 A			73	/M1.2		-XC31 :72 B
=EXT +EXT						
-XC31 :73 A	⌒		74	/M1.2		-XQ0 :17 D
=EXT +EXT						
			81	/M9.7		
			82	/M9.7		
			83	/M9.7		
	⌒		84	/M9.7		
			91	/M9.7		
			92	/M9.8		
			93	/M9.8		
	⌒		94	/M9.8		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
✕	Insulation plate
✕✕	Higher level insulation plate
◉	Test socket
⊶	Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC31
Connection table

=JZ01 V =J01 +.B /8
883314 (3) W92210-F2141-S018-B Sheet 8+ 16 Sh.

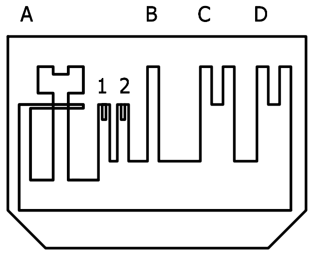
CopyRight (C) Siemens AG 2015 All Rights Reserved

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 45

Cable connection to termination

A B C D

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XC32					
	1 2 JUMPER					
	⊖ □ □ ●	100	/M5.8			+.T -A21-2 :L14
	⊖ □ □ ●	101	/M5.8			+.T -A21-2 :L13
	⊖ □ □ ●	102	/M6.3			+.T -A21-1 :D13
	⊖ □ □ ●	103	/M8.1			+.T -K86 :21
	⊖ □ □ ●	104	/M8.1			+.T -K86 :23
	⊖ □ □ ●	105	/M8.3			-XQ0 :61 D
	⊖ □ □ ●	106	/M8.3			-XQ0 :62 D
	⊖ □ □ ●	107	/M8.5			-XQ1 :133 D
	⊖ □ □ ●	108	/M8.5			-XQ0 :84 D
	⊖ □ □ ●	109	/M8.7			+.T -K86 :16
	⊖ □ □ ●	110	/M8.7			+.T -K86 :14
	⊖ □ □ ●	111	/M9.2			-F10 :21
	⊖ □ □ ●	112	/M9.2			-F10 :22
	⊖ □ □ ●	113	/M9.4			-F50 :41
	⊖ □ □ ●	114	/M9.4			-F50 :42
	⊖ □ □ ●	115	/M9.5			+.T -K86 :25
	⊖ □ □ ●	116	/M9.5			+.T -K86 :27
	⊖ □ □ ●	117	/M9.5			+.T -K86 :22
	⊖ □ □ ●	118	/M9.5			+.T -K86 :28
	⊖ □ □ ●	119	/M9.7			
	⊖ □ □ ●	120	/M9.7			
	⊖ □ □ ●	130	/M10.3			+.T -A21-1 :B10
	⊖ □ □ ●	131	/M10.3			+.T -A21-1 :B9
	⊖ □ □ ●	132	/M10.3			+.T -A21-1 :B11
	⊖ □ □ ●	133	/M10.3			+.T -A21-1 :B13
	⊖ □ □ ●	134	/M10.3			+.T -A21-1 :B12
	⊖ □ □ ●	135	/M10.4			+.T -A21-1 :B14
	⊖ □ □ ●	136	/M10.4			+.T -A21-1 :D2
	⊖ □ □ ●	137	/M10.4			+.T -A21-1 :D1
	⊖ □ □ ●	138	/M10.4			+.T -A21-1 :D3
	⊖ □ □ ●	139	/M10.4			+.T -A21-1 :D5
	⊖ □ □ ●	140	/M10.5			+.T -A21-1 :D4
	⊖ □ □ ●	141	/M10.5			+.T -A21-1 :D6
	⊖ □ □ ●	142	/M10.5			+.T -A21-2 :L3
	⊖ □ □ ●	143	/M10.5			+.T -A21-2 :L4
	⊖ □ □ ●	144	/M10.6			+.T -A21-2 :L5
	⊖ □ □ ●	145	/M10.6			+.T -A21-2 :L6
	⊖ □ □ ●	146	/M10.6			+.T -A21-2 :L8
	⊖ □ □ ●	147	/M10.6			+.T -A21-3 :M1
	⊖ □ □ ●	148	/M10.6			+.T -A21-3 :M2

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp — Cover
B Screen bus — Insulation plate
C Screwed cable gland — Higher level insulation plate
D Plug housing ◉ Test socket
E Insulated — Disconnector

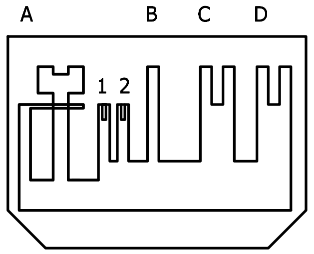
Revision	Modification	Date	Name							
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ01 V	=J01
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		MAIN A		+.B /9
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J01+.B-XC32	883314 (3) W92210-F2141-S018-B	Sheet 9+
				Norm		Orig./Prep.for/Prep.by		Connection table		16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 45

Cable connection to termination

A B C D

Cable connection to termination 1	2	3	4	5	6	7	8	9	Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										-XC32					
										1 2 JUMPER					
										⊖ □ □ ● — —	149	/M10.6			+.T -A21-3 :M3
										⊖ □ □ ● — —	150	/M10.7			+.T -A21-3 :M4
										⊖ □ □ ● — —	151	/M10.7			+.T -A21-3 :M5
										⊖ □ □ ● — —	152	/M10.7			+.T -A21-1 :B5
										⊖ □ □ ● — —	153	/M10.7			+.T -A21-1 :B6

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover	
B Screen bus	—×—	Insulation plate	
C Screwed cable gland	—××—	Higher level insulation plate	
D Plug housing	◉	Test socket	
E Insulated	○⁄○	Disconnector	

Revision	Modification	Date	Name			
				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

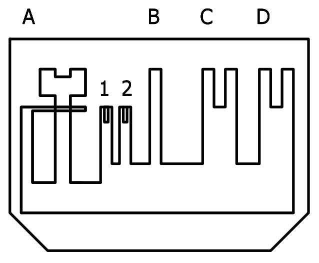
Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XC32
Connection table

=JZ01 V =J01 +.B /10
883314 (3) W92210-F2141-S018-B
Sheet 10+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / 11

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

-XQ0

1 2 JUMPER

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖ ☐ ☐ ●	11	/M6.4	+.L -Q0-X09 :1		-XQ1 :534 D
	⊖ ☐ ☐ ●	12	/M6.4	+.L -Q0-X09 :0		-XC30 :326 D
	⊖ ☐ ☐ ●	13	/M1.3	+.L -Q0-X10 :3		-XQ0 :21 D
	⊖ ☐ ☐ ●	14	/M1.3	+.L -Q0-X10 :2		-XC30 :321 C
	⊖ ☐ ☐ ●	15	/Z1.3	+.L -Q0-X10 :1		
	⊖ ☐ ☐ ●	16	/Z1.3	+.L -Q0-X10 :0		
	⊖ ☐ ☐ ●	17	/M1.2	+.L -Q0-X11 :9	-XQ1 :172 D	-XC31 :74 B
	⊖ ☐ ☐ ●	18	/M1.2	+.L -Q0-X11 :8		+.T -K86 :11
	⊖ ☐ ☐ ●	19	/Z1.1	+.L -Q0-X11 :7		
	⊖ ☐ ☐ ●	20	/M1.3	+.L -Q0-X11 :6	-XQ1 :532 D	+.T -A21-3 :M9
	⊖ ☐ ☐ ●	21	/M1.3	+.L -Q0-X11 :5		-XQ0 :13 D
	⊖ ☐ ☐ ●	22	/M1.4	+.L -Q0-X11 :4		-XQ0 :121 D
	⊖ ☐ ☐ ●	23	/M5.3	+.L -Q0-X11 :3	-XQ1 :815 D	-XC30 :307 D
	⊖ ☐ ☐ ●	24	/M5.3	+.L -Q0-X11 :2		+.T -A21-3 :N14
	⊖ ☐ ☐ ●	25	/Z1.4	+.L -Q0-X11 :1		
	⊖ ☐ ☐ ●	26	/Z1.4	+.L -Q0-X11 :0		
	⊖ ☐ ☐ ●	27	/G1.2	+.L -Q0-X12 :9		-F10 :1
	⊖ ☐ ☐ ●	28	/G1.2	+.L -Q0-X12 :8		-F10 :3
	⊖ ☐ ☐ ●	29	/Z1.4	+.L -Q0-X12 :7		
	⊖ ☐ ☐ ●	30	/Z1.4	+.L -Q0-X12 :6		
	⊖ ☐ ☐ ●	31	/Z1.4	+.L -Q0-X12 :5		
	⊖ ☐ ☐ ●	32	/Z1.4	+.L -Q0-X12 :4		
	⊖ ☐ ☐ ●	33	/Z1.4	+.L -Q0-X12 :3		
	⊖ ☐ ☐ ●	34	/Z1.4	+.L -Q0-X12 :2		
	⊖ ☐ ☐ ●	41	/Z1.5	+.L -Q0-X12 :1		
	⊖ ☐ ☐ ●	42	/Z1.5	+.L -Q0-X12 :0		
	⊖ ☐ ☐ ●	43	/Z1.5	+.L -Q0-X13 :9		
	⊖ ☐ ☐ ●	44	/Z1.5	+.L -Q0-X13 :8		
	⊖ ☐ ☐ ●	45	/Z1.3	+.L -Q0-X13 :7		
	⊖ ☐ ☐ ●	46	/Z1.3	+.L -Q0-X13 :6		
	⊖ ☐ ☐ ●	51	/M3.2	+.L -Q0-X13 :5	-XQ1 :111 D	-XC30 :304 D
	⊖ ☐ ☐ ●	52	/M3.2	+.L -Q0-X13 :4	+.T -HQ0O :X1	+.T -A21-3 :N5
	⊖ ☐ ☐ ●	54	/M3.2	+.L -Q0-X13 :3	+.T -HQ0C :X1	+.T -A21-3 :N6
	⊖ ☐ ☐ ●	61	/M8.3	+.L -Q0-X13 :2	-XQ1 :121 D	-XC32 :105 D
	⊖ ☐ ☐ ●	62	/M8.3	+.L -Q0-X13 :1	-XQ1 :122 D	-XC32 :106 D
	⊖ ☐ ☐ ●	64	/M8.3	+.L -Q0-X13 :0		
	⊖ ☐ ☐ ●	71	/Z1.6	+.L -Q0-X14 :9		
	⊖ ☐ ☐ ●	72	/Z1.6	+.L -Q0-X14 :8		
	⊖ ☐ ☐ ●	73	/Z1.6	+.L -Q0-X14 :7		
	⊖ ☐ ☐ ●	74	/Z1.6	+.L -Q0-X14 :6		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp — Cover
B Screen bus — Insulation plate
C Screwed cable gland — Higher level insulation plate
D Plug housing — Test socket
E Insulated — Disconnector

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ0
Connection table

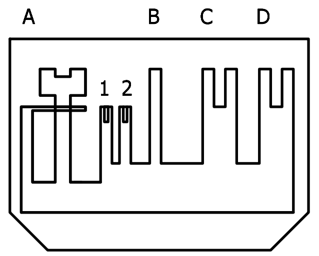
=JZ01 V =J01
+.B
883314
(3) W92210-F2141-S018-B
/11
Sheet 11+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 12

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A B C D

Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
-XQ0					
1 2 JUMPER					
⊖ □ □ ●	81	/Z1.6	+.L -Q0-X14 :5		
⊖ □ □ ●	82	/Z1.6	+.L -Q0-X14 :4		
⊖ □ □ ●	83	/M8.5	+.L -Q0-X14 :3		-XQ1 :134 D
⊖ □ □ ●	84	/M8.5	+.L -Q0-X14 :2		-XC32 :108 D
⊖ □ □ ●	91	/M6.5	+.L -Q0-X14 :1	-XQ1 :144 D	-XQ0 :93 D
⊖ □ □ ●	92	/M6.5	+.L -Q0-X14 :0		-XC31 :51 B
⊖ □ □ ●	93	/M6.6	+.L -Q0-X15 :9		-XQ0 :91 D
⊖ □ □ ●	94	/M6.6	+.L -Q0-X15 :8		-XC31 :52 B
⊖ □ □ ●	101	/Z1.7	+.L -Q0-X15 :7		
⊖ □ □ ●	102	/Z1.7	+.L -Q0-X15 :6		
⊖ □ □ ●	103	/Z1.7	+.L -Q0-X15 :5		
⊖ □ □ ●	104	/Z1.7	+.L -Q0-X15 :4		
⊖ □ □ ●	111	/M7.2	+.L -Q0-X15 :3		-XQ1 :831 C
⊖ □ □ ●	112	/M7.2	+.L -Q0-X15 :2		-XC30 :821 D
⊖ □ □ ●	113	/Z1.8	+.L -Q0-X15 :1		
⊖ □ □ ●	114	/Z1.8	+.L -Q0-X15 :0		
⊖ □ □ ●	121	/M1.5	+.L -Q0-X16 :1		-XQ0 :22 D
⊖ □ □ ●	122	/M1.5	+.L -Q0-X16 :0		+.T -A21-3 :N3
⊖ □ □ ●	123	/Z1.8	+.L -Q0-X17 :1		
⊖ □ □ ●	124	/Z1.8	+.L -Q0-X17 :0		

Termination A Destination Item designation

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp — Cover
B Screen bus — Insulation plate
C Screwed cable gland — Higher level insulation plate
D Plug housing ◉ Test socket
E Insulated — Disconnector

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ0
Connection table

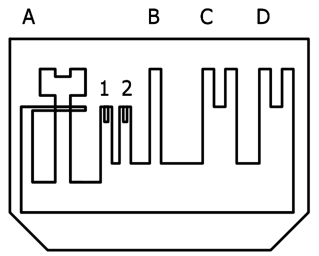
=JZ01 V =J01
+.B /12
883314
(3) W92210-F2141-S018-B
Sheet 12+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 13

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XQ1					
	1 2 JUMPER					
	⊖ □ □ ● — —	111	/M3.3	+.D -Q1-X11 :9	-XQ1 :511 D	-XQ0 :51 C
	⊖ □ □ ● — —	112	/M3.3	+.D -Q1-X11 :8		+.T -A21-3 :N7
	⊖ □ □ ● — —	114	/M3.4	+.D -Q1-X11 :7		+.T -A21-3 :N8
	⊖ □ □ ● — —	121	/M8.4	+.D -Q1-X11 :6		-XQ0 :61 C
	⊖ □ □ ● — —	122	/M8.4	+.D -Q1-X11 :5		-XQ0 :62 C
	⊖ □ □ ● — —	124	/M8.4	+.D -Q1-X11 :4		
	⊖ □ □ ● — —	131	/Z2.3	+.D -Q1-X11 :3		
	⊖ □ □ ● — —	132	/Z2.3	+.D -Q1-X11 :2		
	⊖ □ □ ● — —	133	/M8.5	+.D -Q1-X11 :1		-XC32 :107 D
	⊖ □ □ ● — —	134	/M8.5	+.D -Q1-X11 :0		-XQ0 :83 D
	⊖ □ □ ● — —	141	/Z2.3	+.D -Q1-X12 :3		
	⊖ □ □ ● — —	142	/Z2.3	+.D -Q1-X12 :2		
	⊖ □ □ ● — —	143	/M6.5	+.D -Q1-X12 :1		-XC30 :311 D
	⊖ □ □ ● — —	144	/M6.5	+.D -Q1-X12 :0		-XQ0 :91 C
	⊖ □ □ ● — —	151	/Z2.4	+.D -Q1-X13 :3		
	⊖ □ □ ● — —	152	/Z2.4	+.D -Q1-X13 :2		
	⊖ □ □ ● — —	153	/Z2.4	+.D -Q1-X13 :1		
	⊖ □ □ ● — —	154	/Z2.4	+.D -Q1-X13 :0		
	⊖ □ □ ● — —	161	/Z2.4	+.D -Q1-X14 :3		
	⊖ □ □ ● — —	162	/Z2.4	+.D -Q1-X14 :2		
	⊖ □ □ ● — —	163	/Z2.5	+.D -Q1-X14 :1		
	⊖ □ □ ● — —	164	/Z2.5	+.D -Q1-X14 :0		
	⊖ □ □ ● — —	171	/M1.2	+.D -Q1-X15 :3	-XC31 :71 B	+.T -A21-3 :M10
	⊖ □ □ ● — —	172	/M1.2	+.D -Q1-X15 :2		-XQ0 :17 C
	⊖ □ □ ● — —	173	/Z2.5	+.D -Q1-X15 :1		
	⊖ □ □ ● — —	174	/Z2.5	+.D -Q1-X15 :0		
	⊖ □ □ ● — —	511	/M3.5	+.D -Q1-X51 :9		-XQ1 :111 C
	⊖ □ □ ● — —	512	/M3.5	+.D -Q1-X51 :8		+.T -A21-3 :N9
	⊖ □ □ ● — —	514	/M3.6	+.D -Q1-X51 :7		+.T -A21-3 :N10
	⊖ □ □ ● — —	521	/Z3.4	+.D -Q1-X51 :6		
	⊖ □ □ ● — —	522	/Z3.4	+.D -Q1-X51 :5		
	⊖ □ □ ● — —	524	/Z3.4	+.D -Q1-X51 :4		
	⊖ □ □ ● — —	531	/M1.5	+.D -Q1-X51 :3	-XC31 :33 B	+.T -A21-3 :M8
	⊖ □ □ ● — —	532	/M1.5	+.D -Q1-X51 :2		-XQ0 :20 C
	⊖ □ □ ● — —	533	/M6.4	+.D -Q1-X51 :1		-XC30 :310 D
	⊖ □ □ ● — —	534	/M6.4	+.D -Q1-X51 :0		-XQ0 :11 D
	⊖ □ □ ● — —	541	/Z3.5	+.D -Q1-X52 :3		
	⊖ □ □ ● — —	542	/Z3.5	+.D -Q1-X52 :2		
	⊖ □ □ ● — —	543	/Z3.5	+.D -Q1-X52 :1		
	⊖ □ □ ● — —	544	/Z3.5	+.D -Q1-X52 :0		

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	─✕─	Insulation plate
C Screwed cable gland	─✕✕─	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⁄○	Disconnector

Revision	Modification	Date	Name	Norm	
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ1
Connection table

883314

=JZ01

V

=J01
+.B

(3) W92210-F2141-S018-B

/13
Sheet 13+
16 Sh.

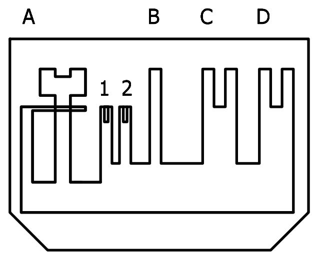
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 14

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

CopyRight (C) Siemens AG 2015 All Rights Reserved

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

-XQ1

Termination A Destination Item designation	Link 1	Link 2	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	□	□	551	/Z3.5	+.D -Q1-X53 :3		
	□	□	552	/Z3.5	+.D -Q1-X53 :2		
	□	□	553	/Z3.6	+.D -Q1-X53 :1		
	□	□	554	/Z3.6	+.D -Q1-X53 :0		
	□	□	561	/Z3.6	+.D -Q1-X54 :3		
	□	□	562	/Z3.6	+.D -Q1-X54 :2		
	□	□	563	/Z3.6	+.D -Q1-X54 :1		
	□	□	564	/Z3.6	+.D -Q1-X54 :0		
	□	□	571	/Z3.6	+.D -Q1-X55 :3		
	□	□	572	/Z3.6	+.D -Q1-X55 :2		
	□	□	573	/Z3.7	+.D -Q1-X55 :1		
	□	□	574	/Z3.7	+.D -Q1-X55 :0		
	□	□	815	/M5.4	+.D -Q1-X82 :3		-XQ0 :23 C
	□	□	816	/M5.4	+.D -Q1-X82 :2		+.T -A21-3 :N15
	□	□	817	/Z2.7	+.D -Q1-X82 :1		
	□	□	818	/Z2.7	+.D -Q1-X82 :0		
	□	□	830	/M7.2	+.D -Q1-X84 :1		-XC31 :62 B
	□	□	831	/M7.2	+.D -Q1-X84 :0	-XQ0 :111 D	-XQ1 :833 D
	□	□	832	/M7.3	+.D -Q1-X85 :1		-XC31 :64 B
	□	□	833	/M7.3	+.D -Q1-X85 :0		-XQ1 :831 D
	□	□	890	/M4.2	+.D -B0-X88 :3	-XB11 :100 D	-XC30 :305 D
	■	□	891	/M4.2	+.D -B0-X88 :2		+.T -A21-3 :N12
	■	□	892	/M4.2	+.D -B0-X88 :1		
	■	□	893	/M4.3	+.D -B0-X88 :0		-XB11 :101 D

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

Cover
Insulation plate
Higher level insulation plate
Test socket
Disconnector

Revision	Modification	Date	Name	Norm	
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XQ1
Connection table

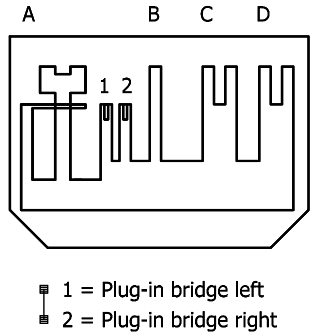
=JZ01
V
=J01
+.B
/14
883314
(3) W92210-F2141-S018-B
Sheet 14+
16 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J01 / V / / / 15

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
100-103	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 4

Cable connection to termination

A ☐ B ☐ C ☐ D ☐

1	2	3	4	5	6	7	8	9

-XB11

Termination A Destination Item designation		Link 1	Link 2		Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	⊖	☐	☐	●	100	/M4.4		+.F -B11 :4	-XQ1 :890 C
	⊖	■	☐	●	101	/M4.4		+.F -B11 :1	-XQ1 :893 D
	⊖	■	☐	●	102	/M4.4		+.F -B11 :2	
	⊖	■	☐	●	103	/M4.5			

1 2 JUMPER

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

Cover
Insulation plate
Higher level insulation plate
Test socket
Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XB11
Connection table

883314
(3) W92210-F2141-S018-B

=JZ01 V =J01
+.B
/15
Sheet 15+
16 Sh.

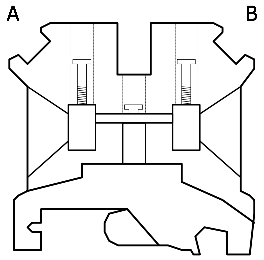
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11
Archive: =J01 / V / / / 16

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
1-8	UT 4-PE	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 8

Termination A Destination Item designation	Link	Term.-no.	Cross-ref.	Termination B Destination Item designation
	-XPE			
=J01 +.B -PE	○	1	/G2.2	-X90 :3 A
	○	2	/S2.5	
	○	3	/S2.5	
	○	4	/S2.5	
	○	5	/S2.5	
	○	6	/S2.5	
	○	7	/G2.4	+.F -X1 :GND
	○	8	/S2.6	

Screen bus →	A Cable clamp	Cover
N-bus	B Screen bus	Insulation plate
PE-PEN-bus	C Screwed cable gland	Higher level insulation plate
Used cores total	D Plug housing	Test socket
Continued on sheet	E Insulated	Disconnector

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
MAIN A
=J01+.B-XPE
Connection table

=JZ01 V =J01 +.B /16
883314 (3) W92210-F2141-S018-B
Sheet 16-
16 Sh.

Siemens AG

Energy Management - Medium Voltage & Systems

Circuit diagram

for

Purchaser CRUM ELECTRIC SUPPLY COMPANY INC.

User COLORADO DEPARTMENT OF TRANSPORT

Plant VENTILATION BUILDING EAST

Plant section 8DA10 25kV SWITCHGEAR
TRX NO. 1B

Typical =JZ05

Project reference number

Date of issue 08-27-15

Customer document number

A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM
Revision	Modification	Date	Name

SIEMENS AG

Archive: =J02 / A / / / 1

Project: 883314

Documentation identifier A / =J02 / / 1

Manufacturer document number (3) W92210-F2141-S021-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J02 / A / A / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
A	=J02 +J02	/1	(3) W92210-F2141-S021-B	1-	1	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B COVER SHEET Cover sheet	EM MS O GIS SWF PR OP SEN FFM
A	=J02 +J02	A1	(3) W92210-F2141-S022-B	1+	3	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J02 +J02	A2	(3) W92210-F2141-S022-B	2+	3	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
A	=J02 +J02	A3	(3) W92210-F2141-S022-B	3-	3	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B TABLE OF DOCUMENTS List of documents	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	G1	(3) W92210-F2141-S025-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	G2	(3) W92210-F2141-S025-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M1	(3) W92210-F2141-S025-B	1+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M2	(3) W92210-F2141-S025-B	2+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M3	(3) W92210-F2141-S025-B	3+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M4	(3) W92210-F2141-S025-B	4+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M5	(3) W92210-F2141-S025-B	5+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M6	(3) W92210-F2141-S025-B	6+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M7	(3) W92210-F2141-S025-B	7+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CONTROL SCHEMATIC Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	M8	(3) W92210-F2141-S025-B	8+	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B INDICATIONS SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ05	A	=J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B			+J02	A1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314	(3) W92210-F2141-S022-B		Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents				3 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBINH2
Archive: =J02 / A / A / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation			Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
S	=J02 +J02	M9	(3) W92210-F2141-S025-B	9-	9	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B SPARE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	S1	(3) W92210-F2141-S025-B	1+	2	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	S2	(3) W92210-F2141-S025-B	2-	2	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B TRANSFORMER CIRCUITS Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z1	(3) W92210-F2141-S025-B	1+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B CIRCUIT BREAKER Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z2	(3) W92210-F2141-S025-B	2+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B THREE POSITION SWITCH -Q1 Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z3	(3) W92210-F2141-S025-B	3+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B THREE POSITION SWITCH -Q1 Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z4	(3) W92210-F2141-S025-B	4+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B GAS PRESSURE MONITORING Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z5	(3) W92210-F2141-S025-B	5+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B PROTECTION AND CONTROL DEVICE Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z6	(3) W92210-F2141-S025-B	6+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z7	(3) W92210-F2141-S025-B	7+	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
S	=J02 +J02	Z8	(3) W92210-F2141-S025-B	8-	8	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B SECONDARY EQUIPMENT Circuit diagram	EM MS O GIS SWF PR OP SEN FFM
V	=J02 +.B	/1	(3) W92210-F2141-S028-B	1+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XR1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J02 +.B	/2	(3) W92210-F2141-S028-B	2+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-X90 Connection table	EM MS O GIS SWF PR OP SEN FFM
V	=J02 +.B	/3	(3) W92210-F2141-S028-B	3+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XT1 Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05 A =J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B	+J02 A2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		TABLE OF DOCUMENTS	883314 (3) W92210-F2141-S022-B Sheet 2+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		List of documents	3 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBINH2
Archive: =J02 / A / A / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

Designation	Manufacturer document number Customer document number	Sheet	Sheets	Date	Description	Prepared by
V =J02 /4 +.B	(3) W92210-F2141-S028-B	4+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /5 +.B	(3) W92210-F2141-S028-B	5+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XC30 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /6 +.B	(3) W92210-F2141-S028-B	6+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /7 +.B	(3) W92210-F2141-S028-B	7+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XC31 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /8 +.B	(3) W92210-F2141-S028-B	8+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /9 +.B	(3) W92210-F2141-S028-B	9+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XC32 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /10 +.B	(3) W92210-F2141-S028-B	10+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /11 +.B	(3) W92210-F2141-S028-B	11+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XQ0 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /12 +.B	(3) W92210-F2141-S028-B	12+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /13 +.B	(3) W92210-F2141-S028-B	13+	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XQ1 Connection table	EM MS O GIS SWF PR OP SEN FFM
V =J02 /14 +.B	(3) W92210-F2141-S028-B	14-	14	08-27-15	8DA10 25kV SWITCHGEAR TRX NO. 1B +.B-XPE Connection table	EM MS O GIS SWF PR OP SEN FFM

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT	
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST	
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by	

Siemens AG

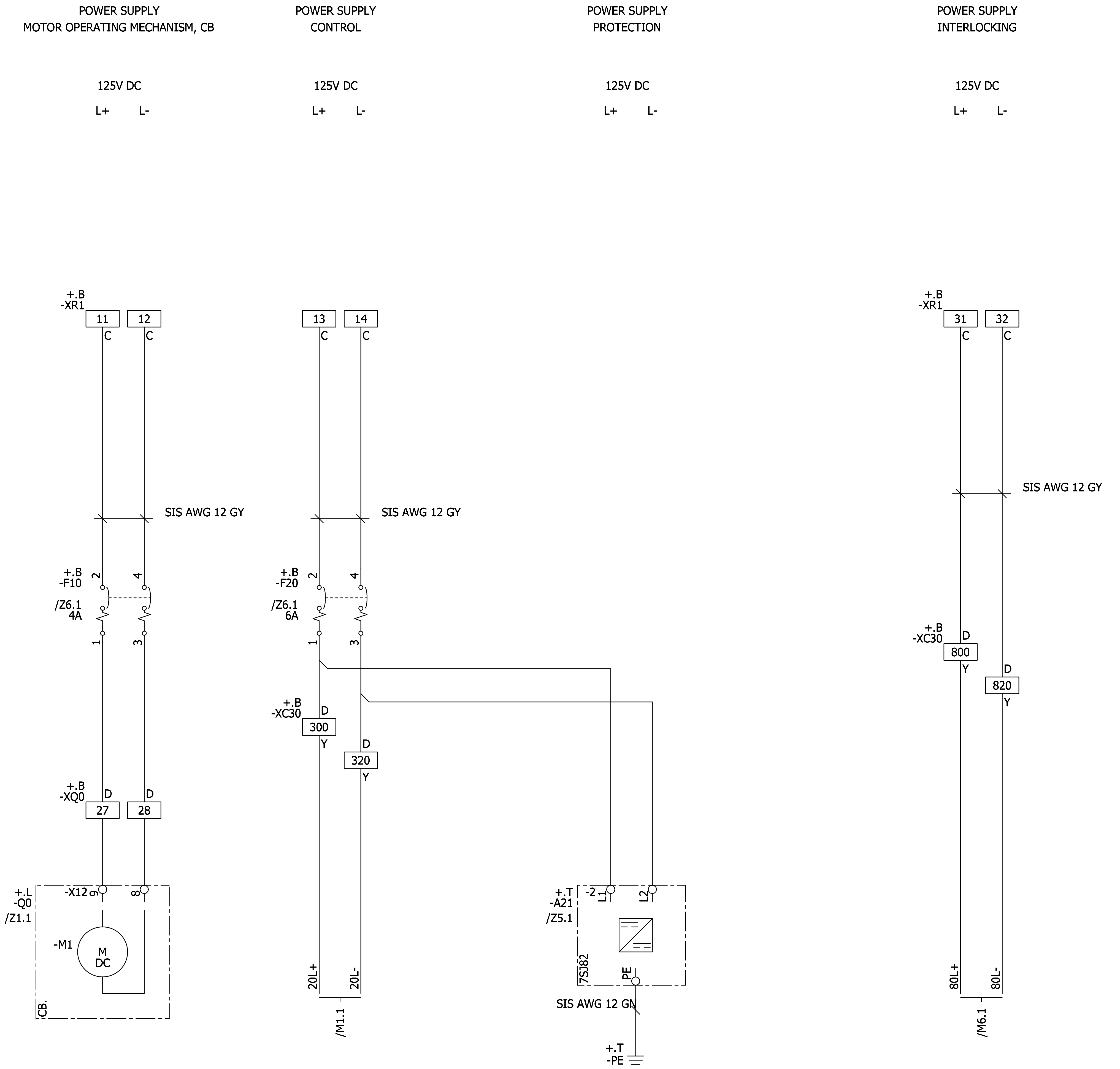
8DA10 25kV SWITCHGEAR
TRX NO. 1B
TABLE OF DOCUMENTS
List of documents

=JZ05 A =J02
+J02 A3
883314 (3) W92210-F2141-S022-B
Sheet 3-
3 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
Archive: =J02 / S / G / 1 FBSTP2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



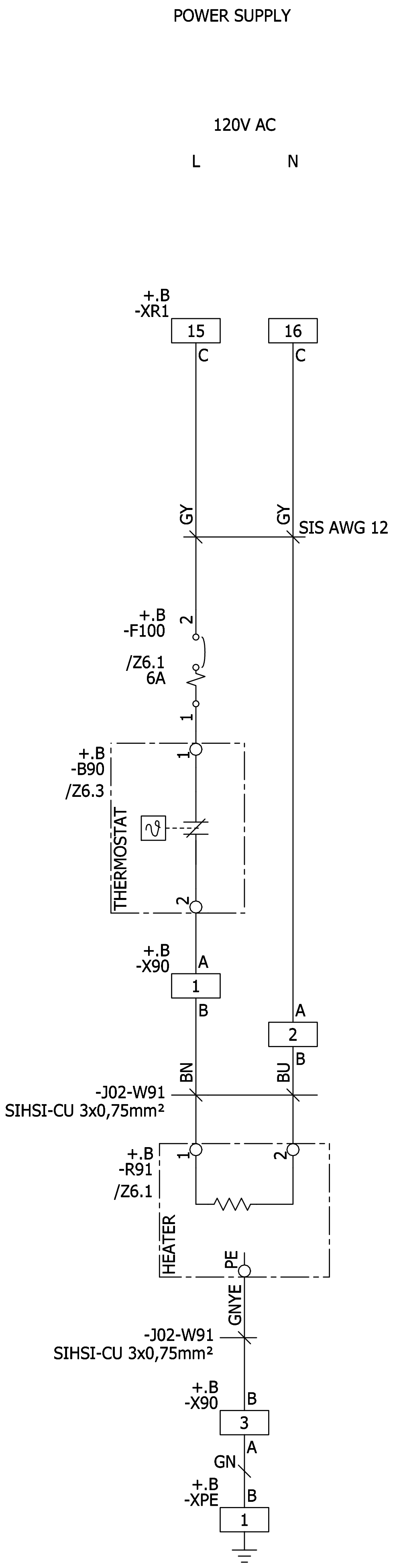
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ05	S	=J02	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B				+J02	G1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S025-B			Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram					2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / G / 2

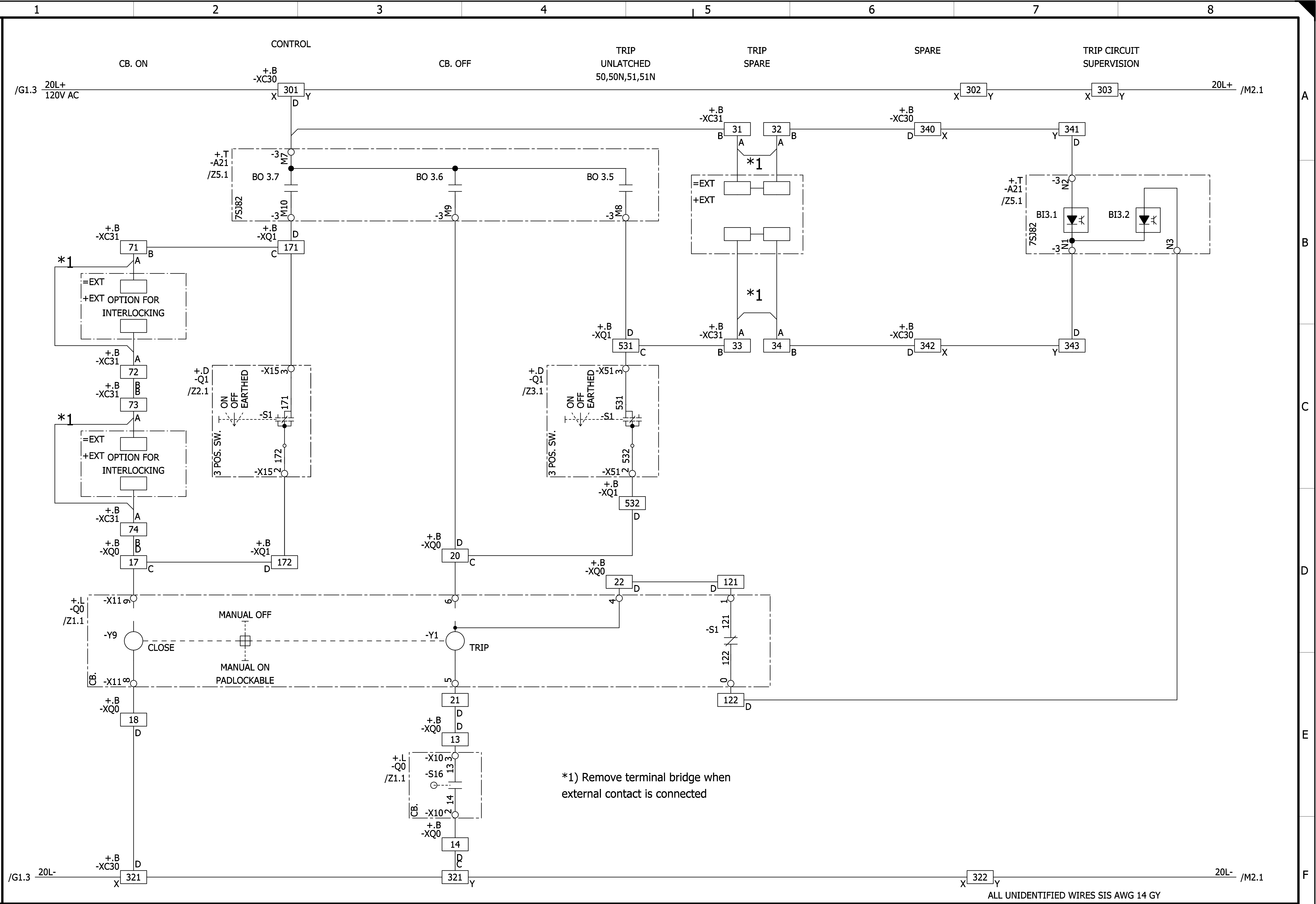
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ05	S	=J02	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B				+J02	G2
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S025-B			Sheet 2-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram					2 Sh.



ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

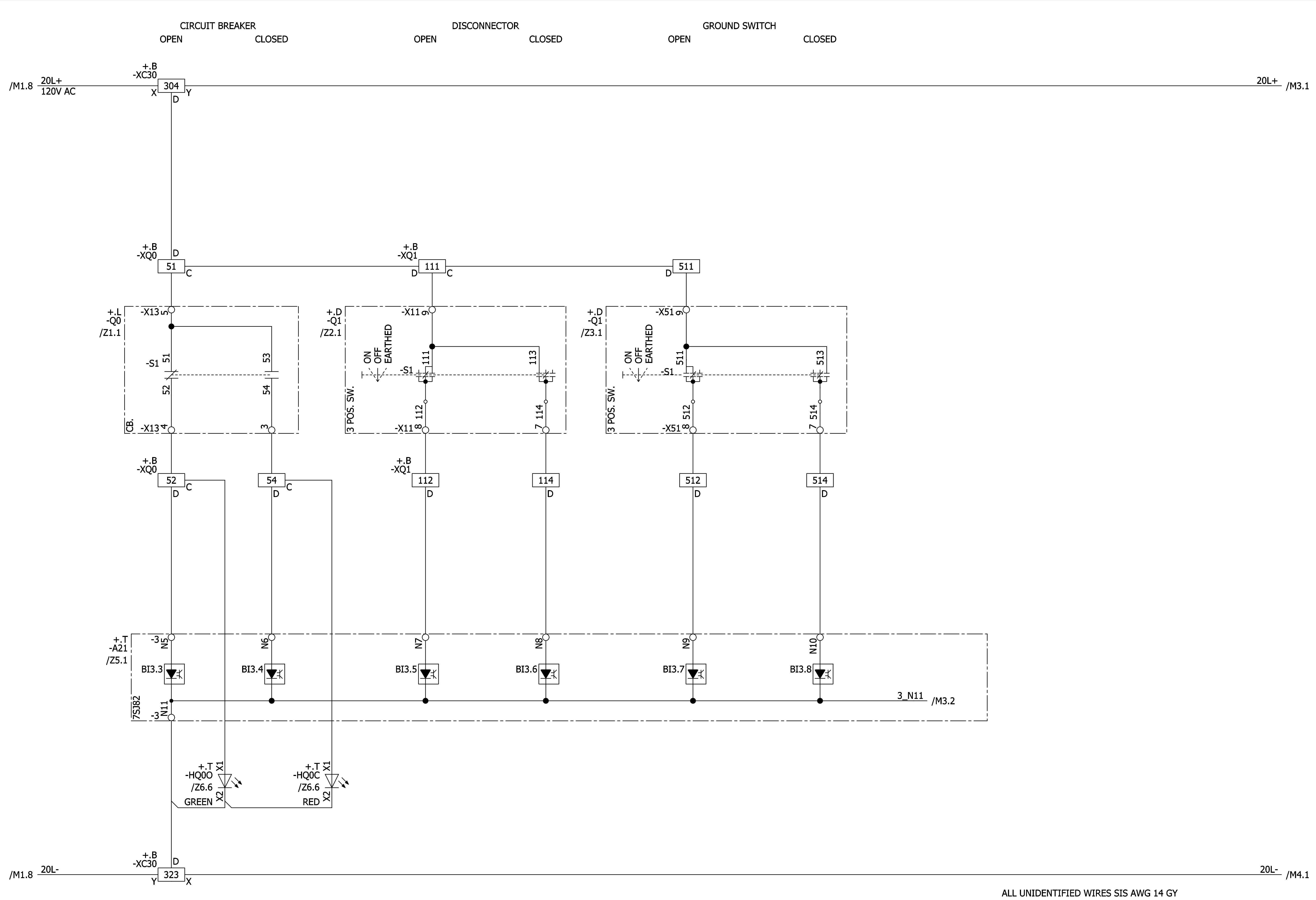
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05	S =J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B		+J02 M1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S025-B Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram		9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

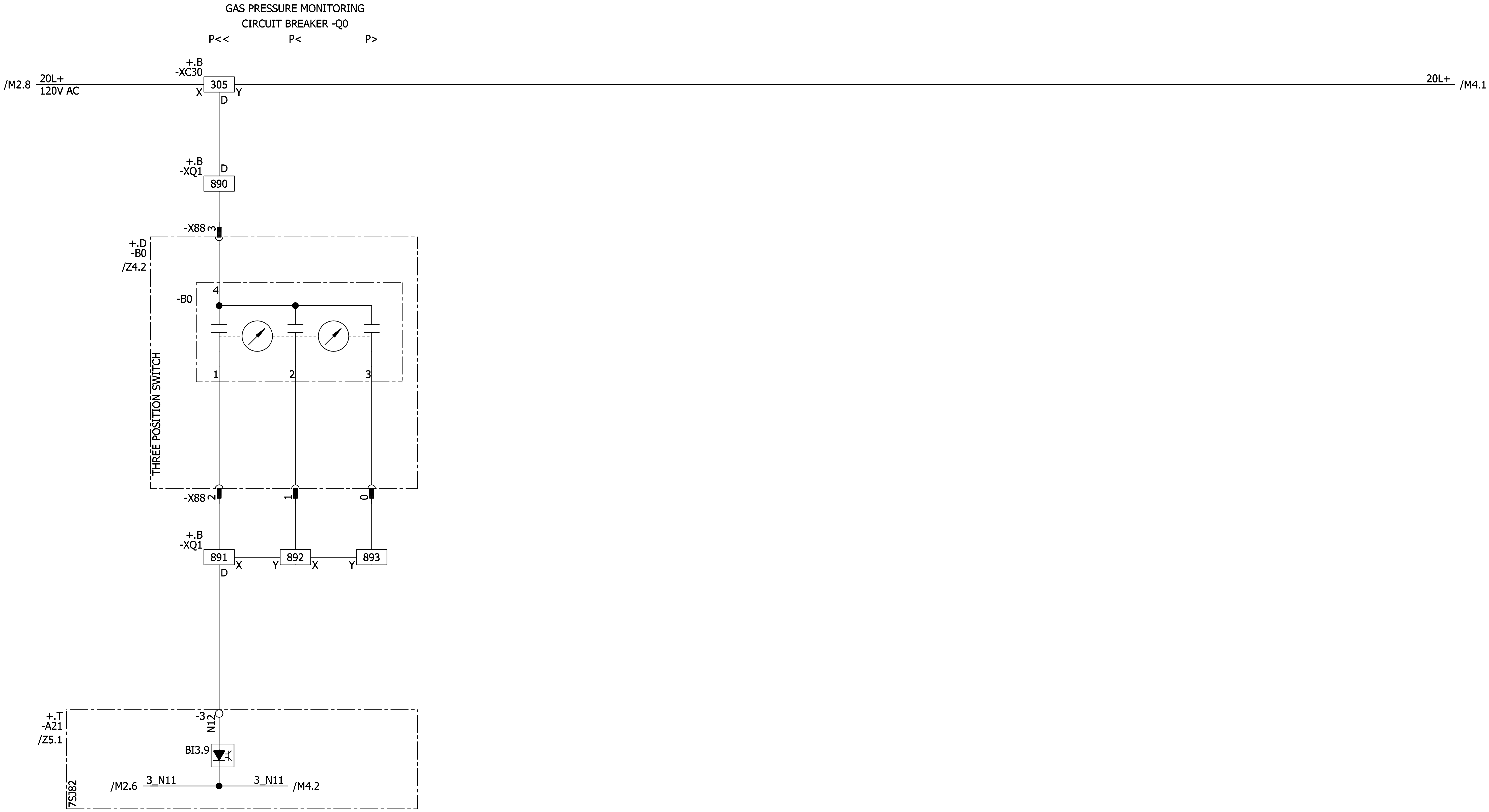
8DA10 25kV SWITCHGEAR
TRX NO. 1B
CONTROL SCHEMATIC
Circuit diagram

=JZ05
S
=J02
+J02
M2
883314
(3) W92210-F2141-S025-B
Sheet 2+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

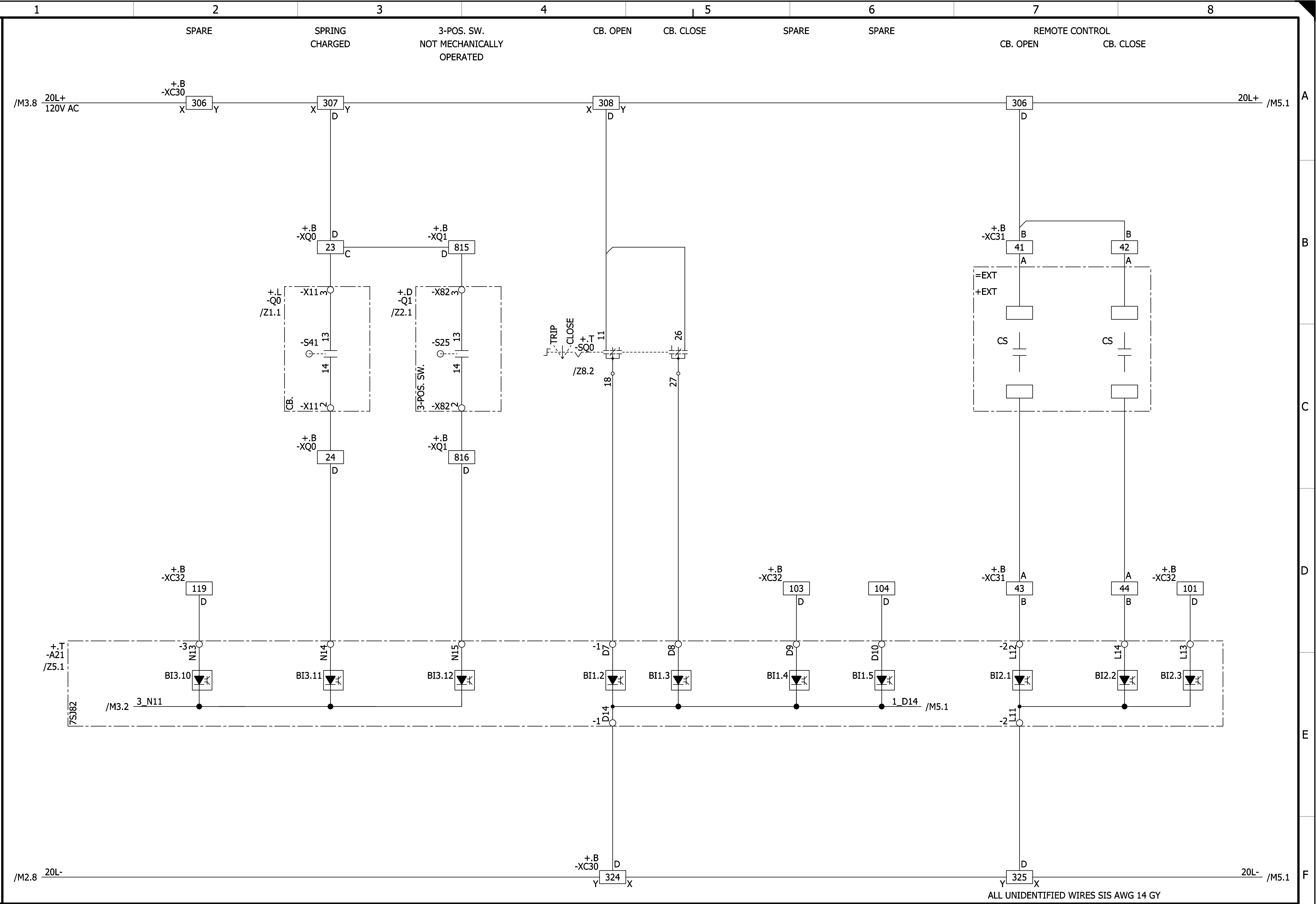
8DA10 25kV SWITCHGEAR
TRX NO. 1B
CONTROL SCHEMATIC
Circuit diagram

=JZ05
S
=J02
+J02
M3
883314
(3) W92210-F2141-S025-B
Sheet 3+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

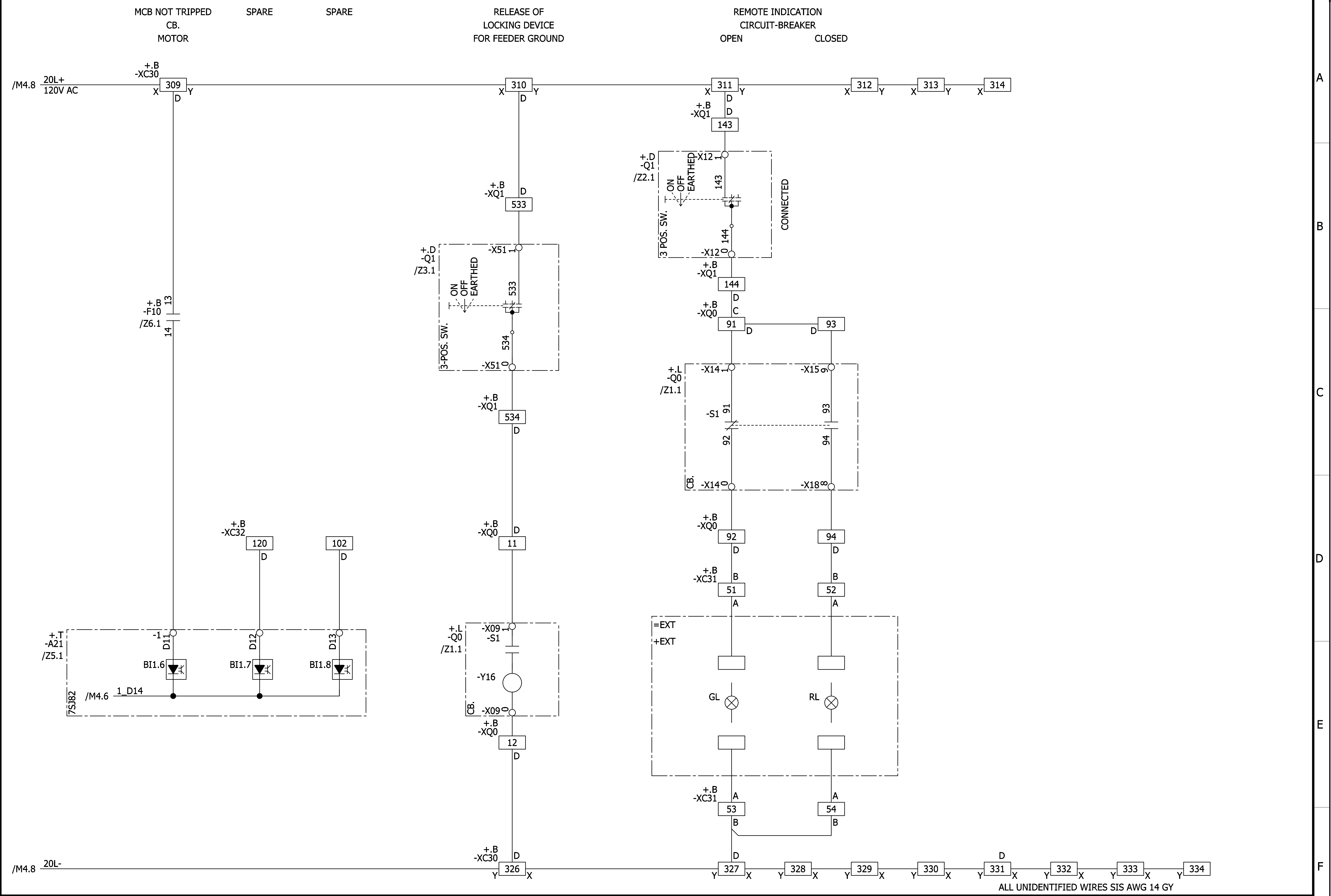
8DA10 25kV SWITCHGEAR
TRX NO. 1B
CONTROL SCHEMATIC
Circuit diagram

=JZ05 S =J02
+J02
M4
883314 (3) W92210-F2141-S025-B
Sheet 4+
9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J02 / S / M / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

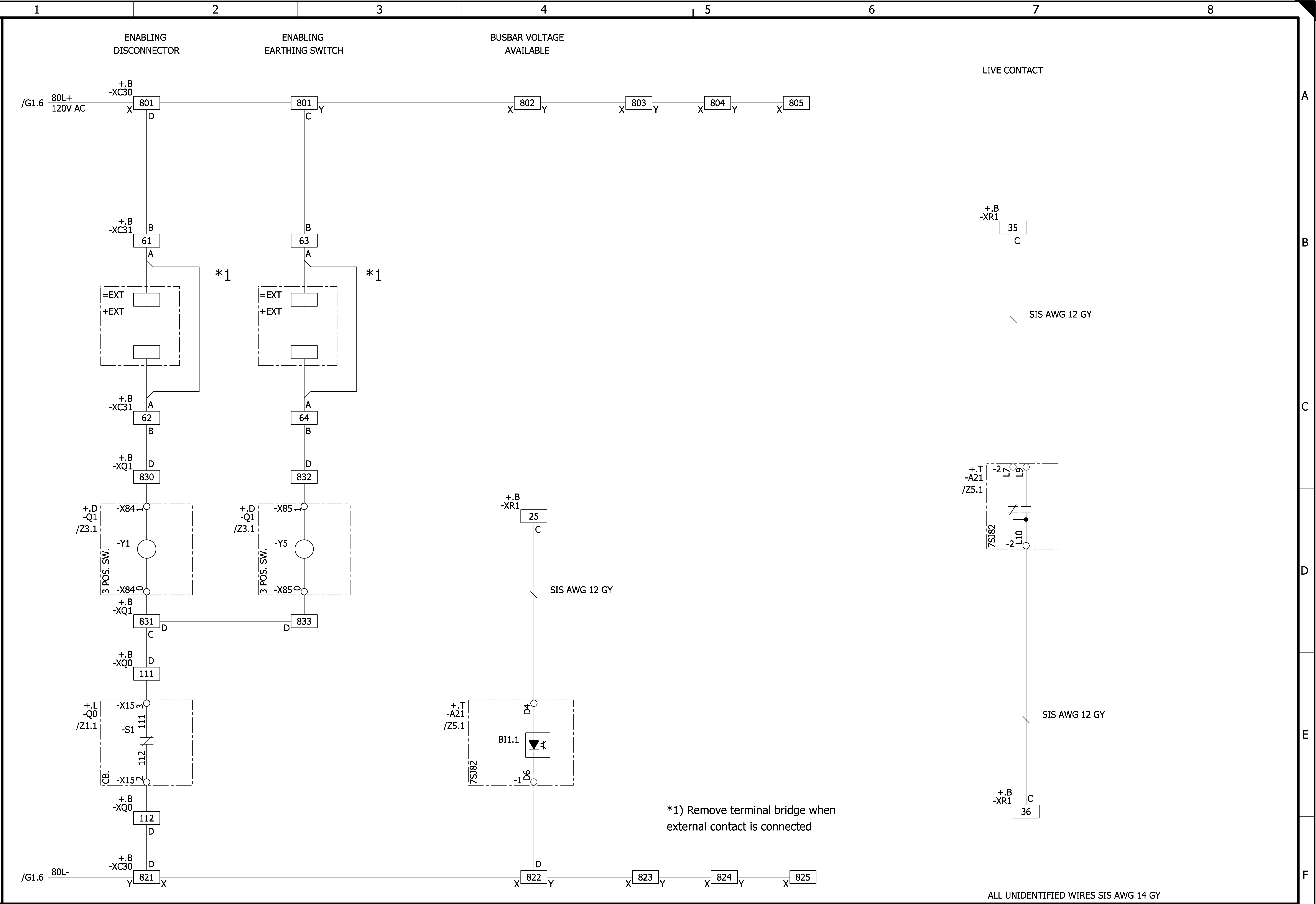


Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by				
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05	S =J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B		+J02 M5
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314	(3) W92210-F2141-S025-B Sheet 5+
								Circuit diagram		9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J02 / S / M / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



*1) Remove terminal bridge when external contact is connected

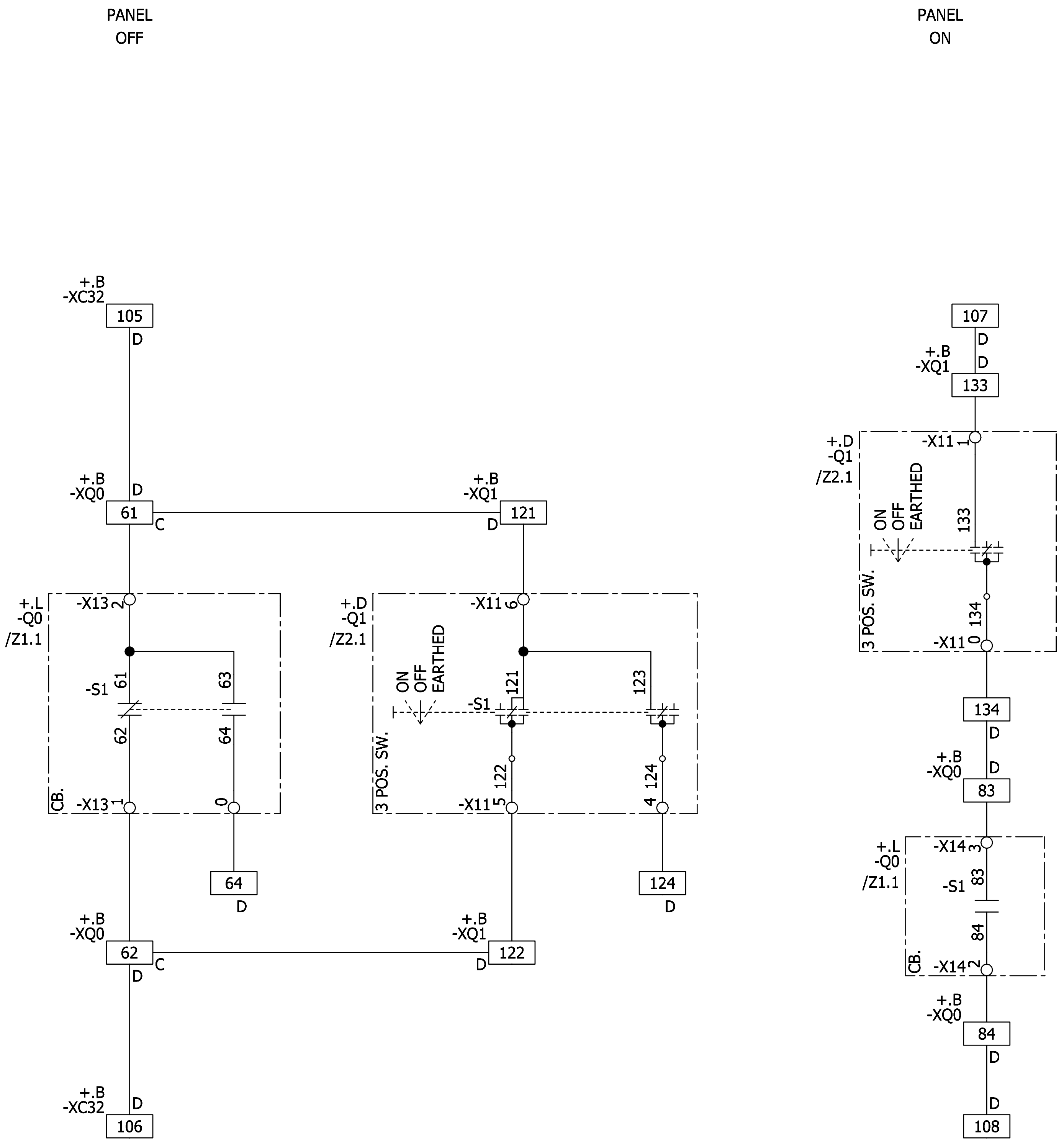
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05 S =J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B	+J02 M6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CONTROL SCHEMATIC	883314 (3) W92210-F2141-S025-B Sheet 6+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram	9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
CONTROL SCHEMATIC
Circuit diagram

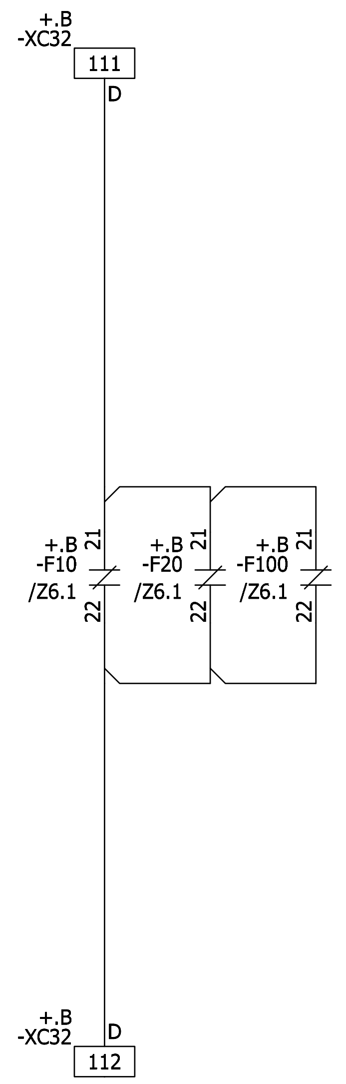
=JZ05 S =J02
+J02
M7
883314
(3) W92210-F2141-S025-B
Sheet 7+
9 Sh.

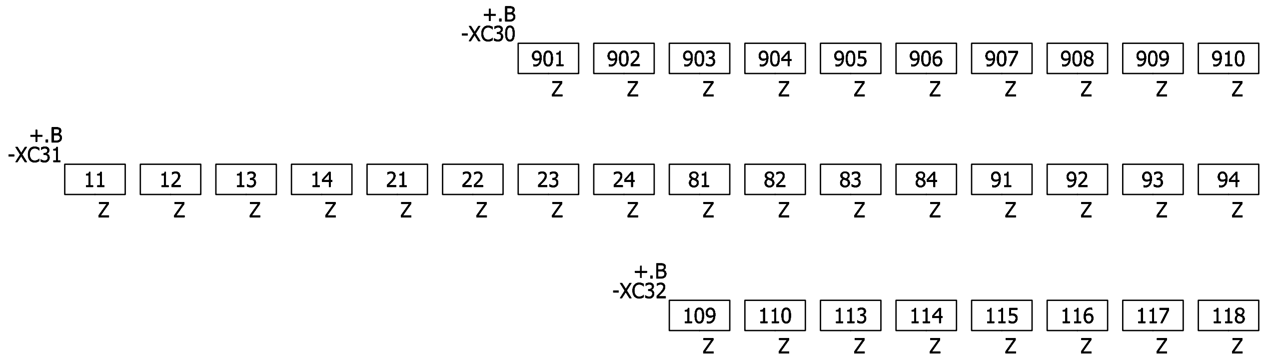
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

MCB TRIPPED





ALL UNIDENTIFIED WIRES SIS AWG 14 GY

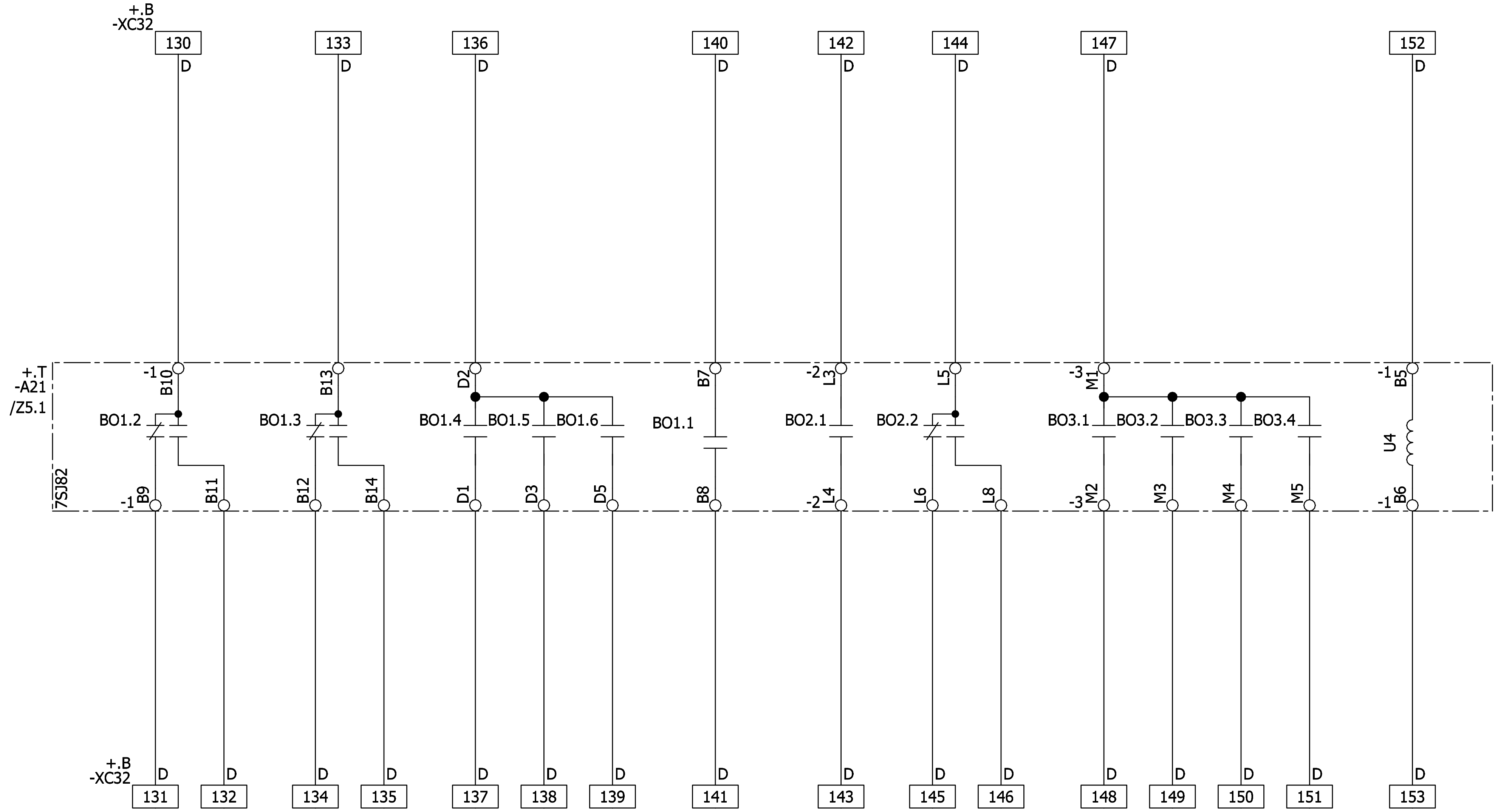
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		S	=J02	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B	=JZ05		+J02	M8
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		INDICATIONS SPARE	883314	(3) W92210-F2141-S025-B		Sheet 8+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				9 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / M / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

SPARE



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
SPARE
Circuit diagram

=JZ05 S =J02
+J02
M9
883314
(3) W92210-F2141-S025-B
Sheet 9-
9 Sh.

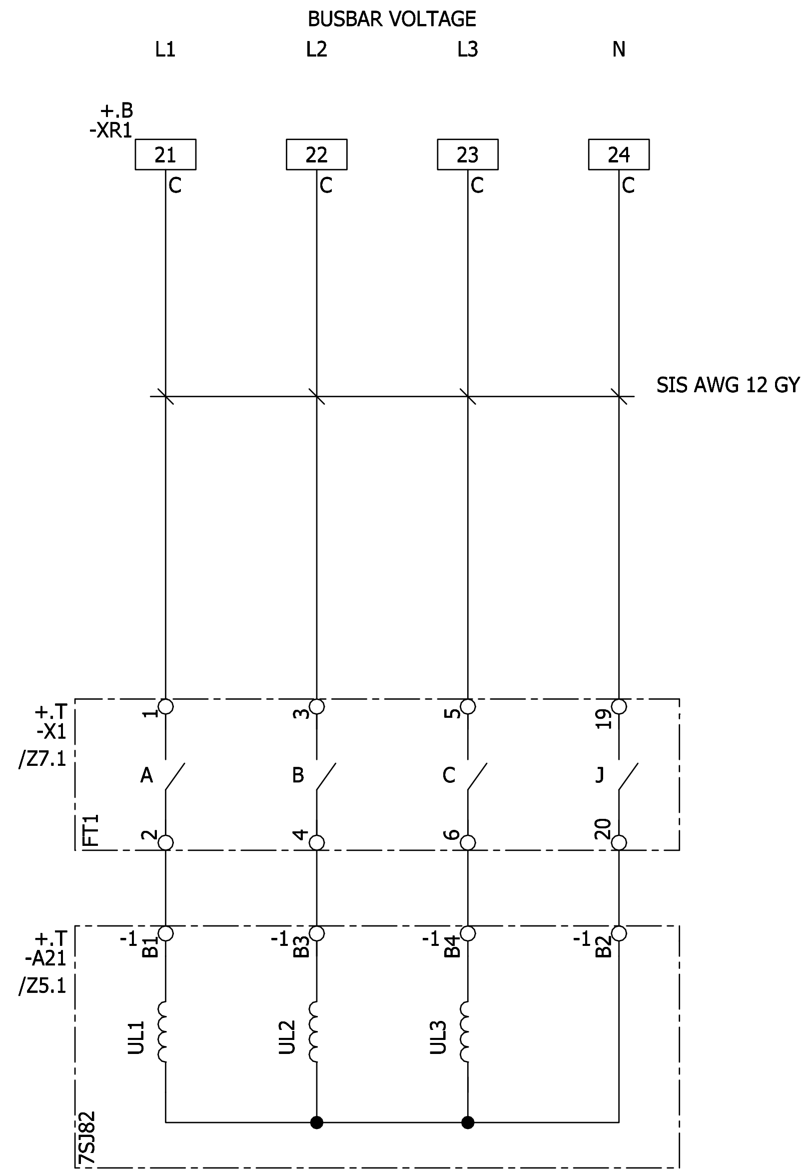
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / S / 1

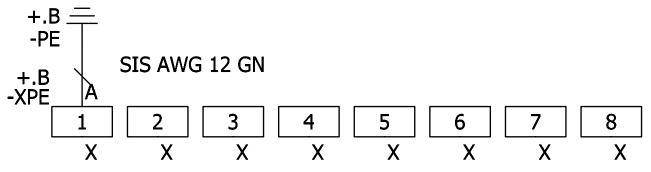
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

HV COMPARTMENT

LV COMPARTMENT





ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
Revision	Modification	Date	Name	Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

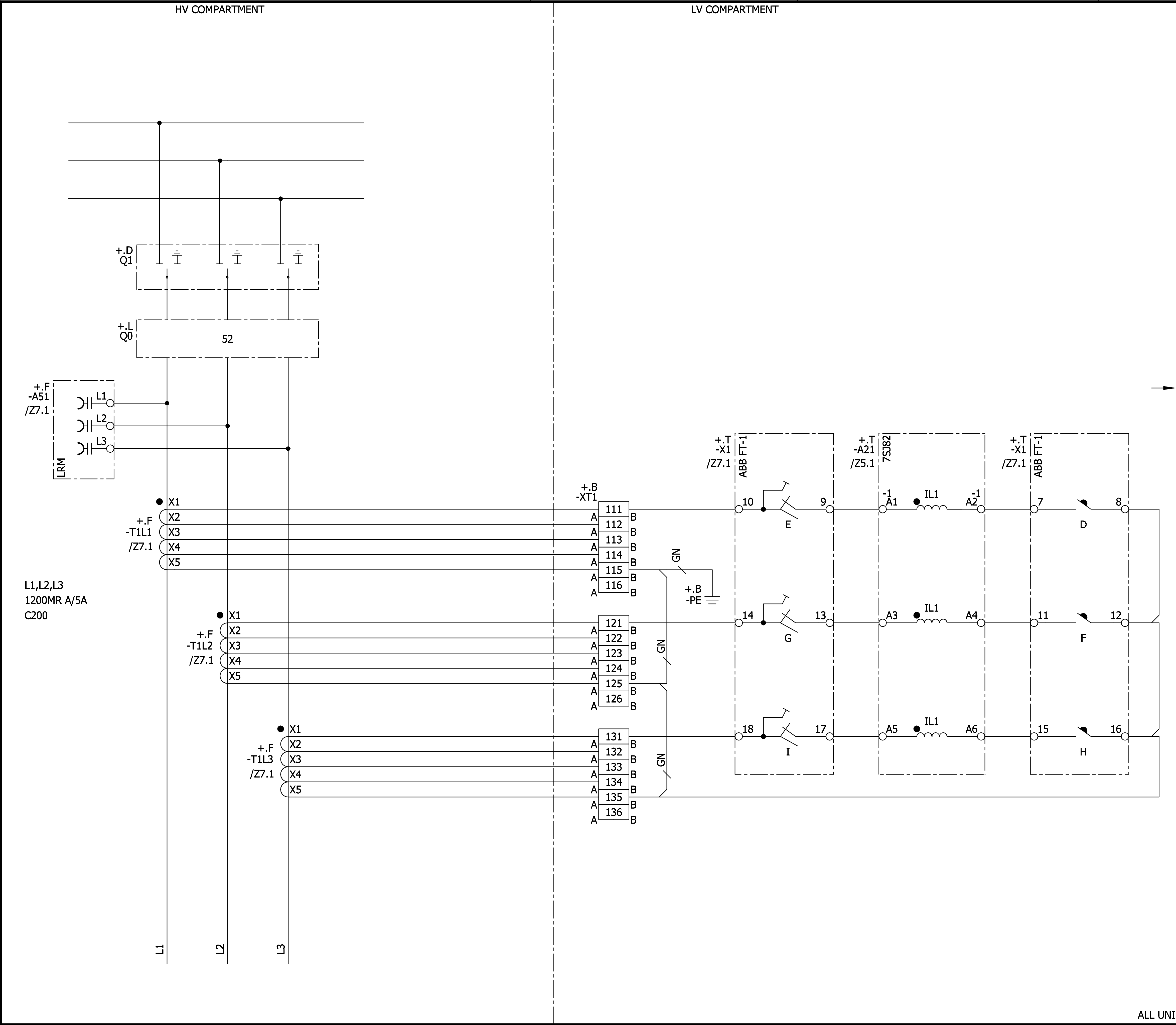
8DA10 25kV SWITCHGEAR
TRX NO. 1B
TRANSFORMER CIRCUITS
Circuit diagram

=JZ05
S
=J02
+J02
S1
883314
(3) W92210-F2141-S025-B
Sheet 1+
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / S / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1200 A
MULTI-RATIO CT

CURRENT RATING (A) 1200:5	SECONDARY TAPS
100:5	X2-X3
200:5	X1-X2
300:5	X1-X3
400:5	X4-X5
500:5	X3-X4
600:5	X2-X4
800:5	X1-X4
900:5	X3-X5
1000:5	X2-X5
→ 1200:5	X1-X5

ALL UNIDENTIFIED WIRES SIS AWG 12 GY

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

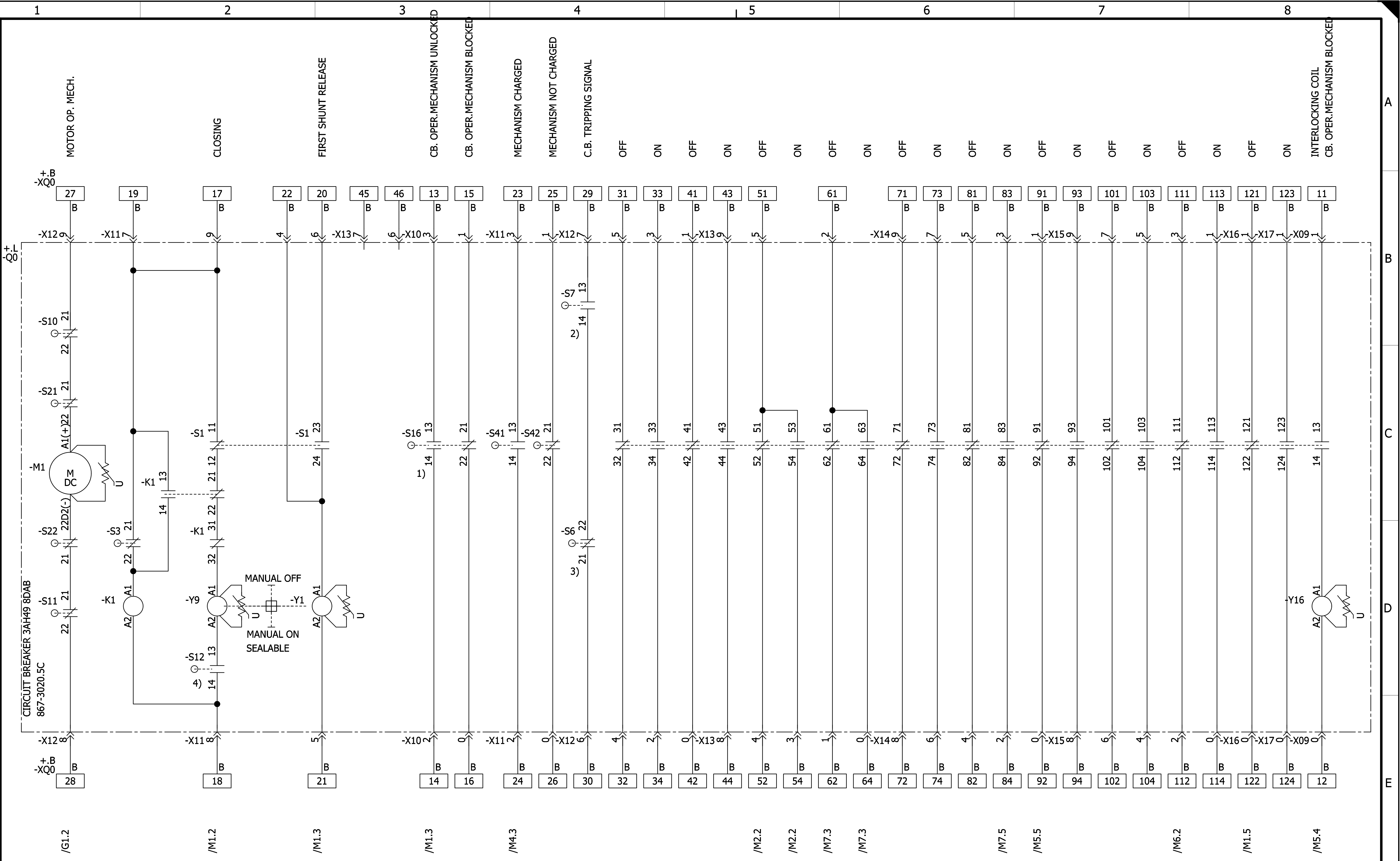
8DA10 25kV SWITCHGEAR
TRX NO. 1B
TRANSFORMER CIRCUITS
Circuit diagram

=JZ05
S
=J02
+J02
S2
883314
(3) W92210-F2141-S025-B
Sheet 2-
2 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15 FBSTP2
Archive: =J02 / S / Z / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



1) OPERATES WHEN CB. TRIP IS NOT LOCKED OUT

2) OPERATES WHEN MECH. OFF IS NOT PRESSED

3) OPERATES WHEN NO TRIPPING

4) INTERLOCKING OF ELECTRICAL CLOSING OF THE CB IN CASE OF MANUAL OPERATION OF THE THREE-POSITION SWITCH

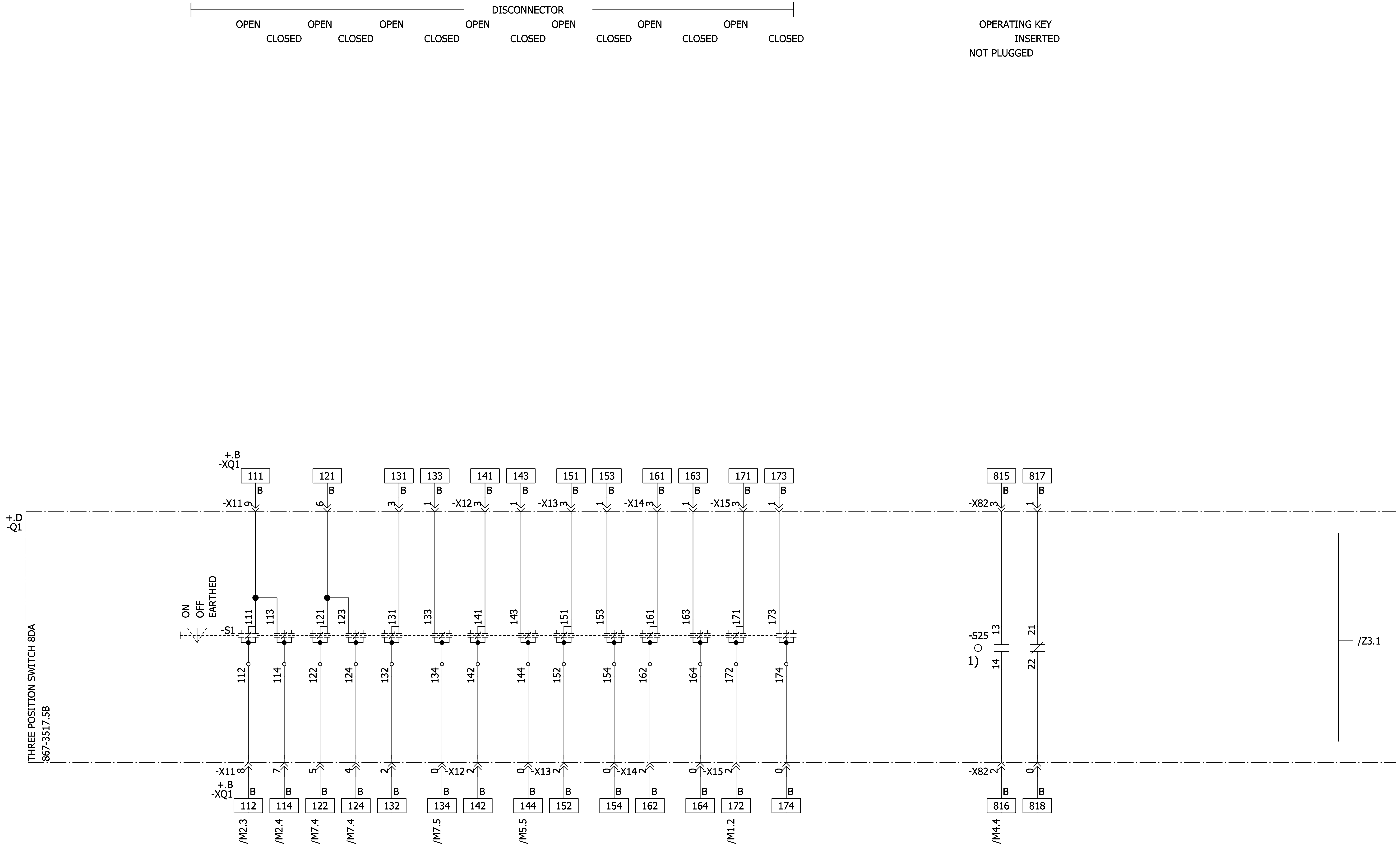
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05	S	=J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B			+J02 Z1
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		CIRCUIT BREAKER	883314	(3) W92210-F2141-S025-B	Sheet 1+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram			8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / Z / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:



1) SHOWN WITH LEVER INSERTED

ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT	
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST	
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by	

Siemens AG

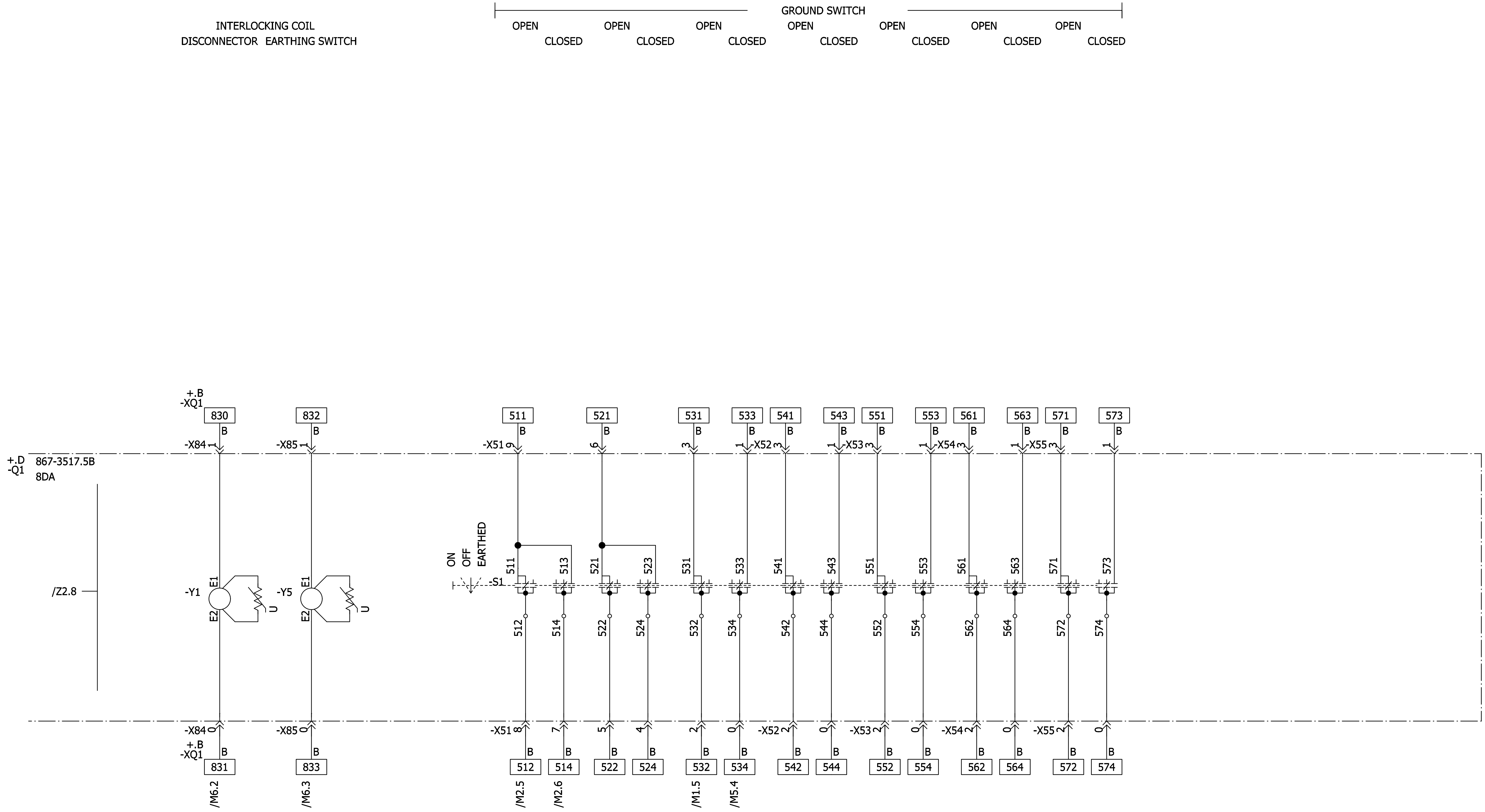
8DA10 25kV SWITCHGEAR
TRX NO. 1B
THREE POSITION SWITCH -Q1
Circuit diagram

=JZ05	S	=J02	
		+J02	Z2
883314	(3) W92210-F2141-S025-B		Sheet 2+
			8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / Z / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



ALL UNIDENTIFIED WIRES SIS AWG 14 GY

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
THREE POSITION SWITCH -Q1
Circuit diagram

=JZ05
S
=J02
+J02
Z3
883314
(3) W92210-F2141-S025-B
Sheet 3+
8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / Z / 4

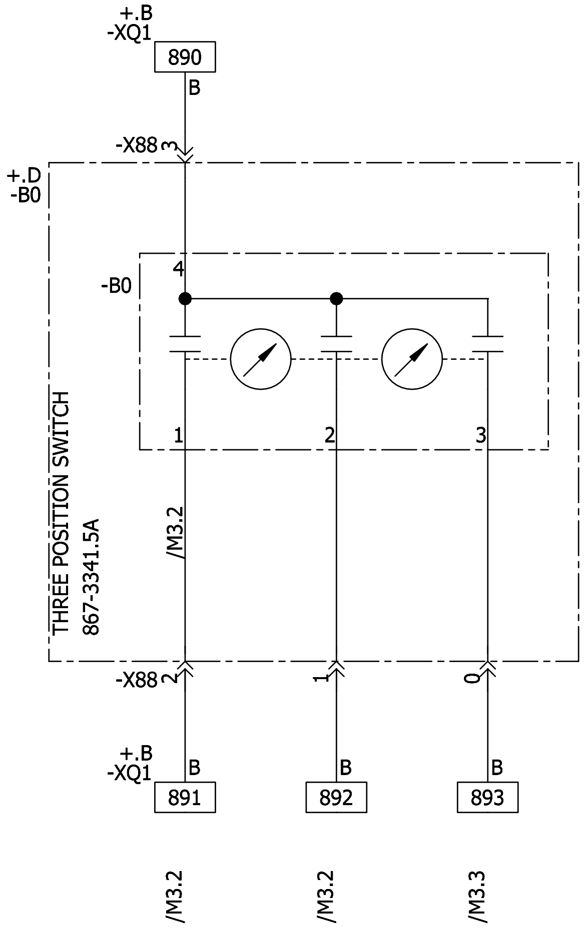
Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

GAS PRESSURE MONITORING
CIRCUIT BREAKER -Q0
P<< P< P>

PLEASE NOTE:

MANOMETER WITH 3 ALARM CONTACTS (OPTION)
CONTACT 1: UNDERPRESSURE P<<
CONTACT 2: UNDERPRESSURE P<
CONTACT 3: OVERPRESSURE P>



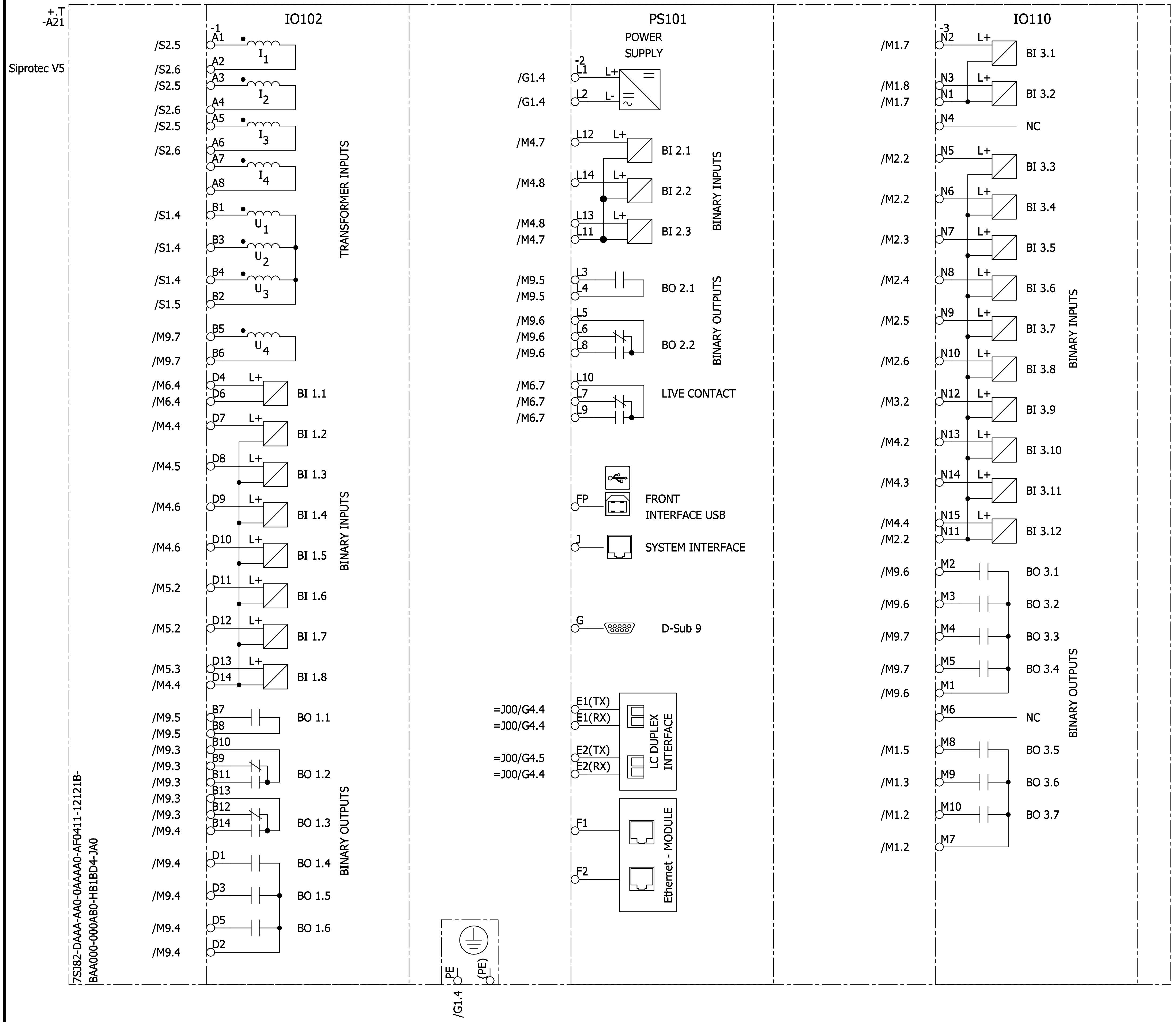
ALL UNIDENTIFIED WIRES SIS AWG 14 GY

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05	S	=J02	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B			+J02	Z4
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		GAS PRESSURE MONITORING	883314	(3) W92210-F2141-S025-B		Sheet 4+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				8 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / Z / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
PROTECTION AND CONTROL DEVICE
Circuit diagram

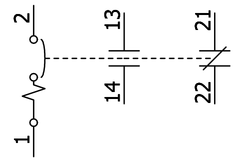
=JZ05 S =J02
+J02
883314
(3) W92210-F2141-S025-B

Z5
Sheet 5+
8 Sh.

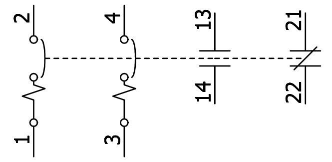
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / Z / 6

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

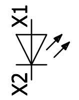
Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:



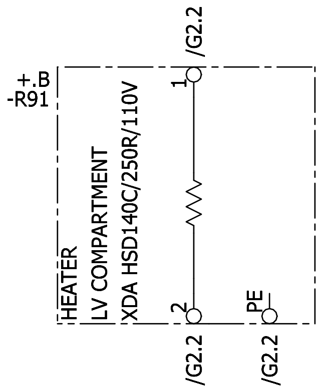
+.B -F100 5SJ4106-7HG41 5ST3010-0HG 1 POLE, 6A	/G2.2		/M8.5

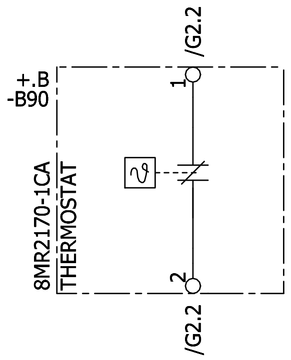


+.B -F10 5SJ4204-7HG41 5ST3010-0HG 2 POLE, 4A	/G1.2	/G1.2	/M5.2	/M8.4
+.B -F20 5SJ4206-7HG41 5ST3010-0HG 2 POLE, 6A	/G1.3	/G1.3		/M8.4



+.T -HQ0O 3SB3400-1A CB//OPEN GREEN 3SB3001-6BA40 3SB3901-1DF	/M2.2
+.T -HQ0C 3SB3400-1A CB//CLOSED RED 3SB3001-6BA20 3SB3901-1CF	/M2.3



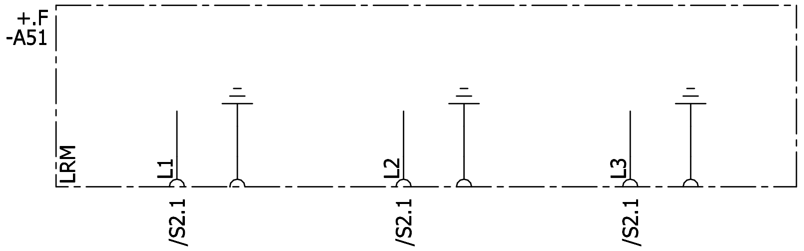


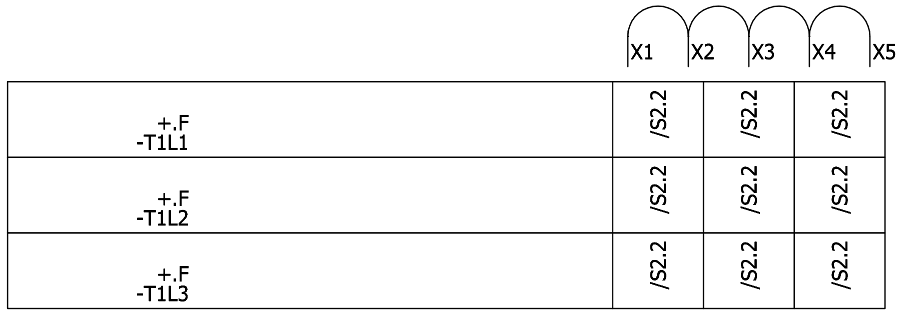
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05	S	=J02	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B			+J02	Z6
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S025-B		Sheet 6+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram				8 Sh.

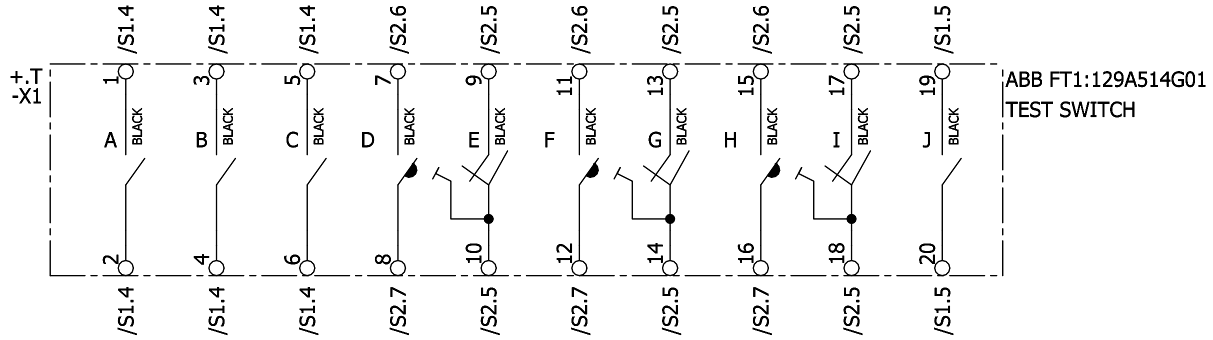
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBSTP2
Archive: =J02 / S / Z / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:





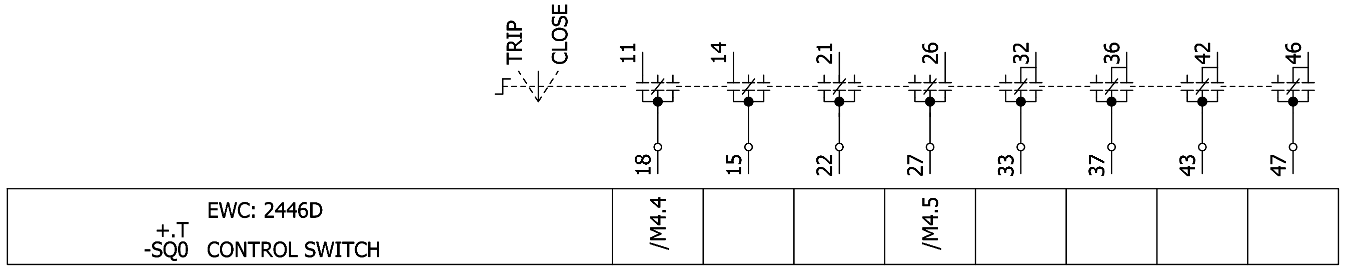


				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR		=JZ05	S	=J02	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B				+J02	Z7
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		SECONDARY EQUIPMENT	883314	(3) W92210-F2141-S025-B			Sheet 7+
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Circuit diagram					8 Sh.

nat =NORMAL AFTER TRIP

nac =NORMAL AFTER CLOSE

DECK	CONTACTS	POS TRIP	nat	nac	CLOSE
1	11 —┤├——┤├— 18	X			
	14 —┤├——┤├— 15	X			
2	21 —┤├——┤├— 22		X	X	
	26 —┤├——┤├— 27				X
3	32 —┤├——┤├— 33			X	X
	36 —┤├——┤├— 37			X	X
4	42 —┤├——┤├— 43			X	X
	46 —┤├——┤├— 47			X	X



BREAKER CONTROL

TRIP ☐ CLOSE

○

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
SECONDARY EQUIPMENT
Circuit diagram

=JZ05 S =J02
+J02
Z8

883314 (3) W92210-F2141-S025-B

Sheet 8-
8 Sh.

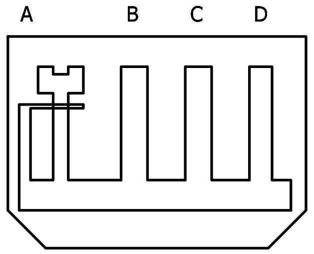
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13
Archive: =J02 / V / / / 1

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

1	2	3	4	5	6	7	8	9	10	11	12	13	14



Cable connection to termination

A B C D

Terminal	Terminal block type	Wire type
11-46	UPCV3K	
	PLUG PC 4/6-STF-7,62	
	UPCV3K-F BEFORE AND AFTER EACH BLOCK OF 6 UPCV3K TERMINALS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 24

Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XR1					
	○	11	=J00/G1.4	=J01 +.B -XR1 :11 D	-F10 :2	=J03 +.B -XR1 :11 B
	○	12	=J00/G1.4	=J01 +.B -XR1 :12 D	-F10 :4	=J03 +.B -XR1 :12 B
	○	13	=J00/G1.4	=J01 +.B -XR1 :13 D	-F20 :2	=J03 +.B -XR1 :13 B
	○	14	=J00/G1.4	=J01 +.B -XR1 :14 D	-F20 :4	=J03 +.B -XR1 :14 B
	○	15	=J00/G1.4	=J01 +.B -XR1 :15 D	-F100 :2	=J03 +.B -XR1 :15 B
	○	16	=J00/G1.4	=J01 +.B -XR1 :16 D	-X90 :2 A	=J03 +.B -XR1 :16 B
	○	21	=J00/G1.4	=J01 +.B -XR1 :21 D	+.T -X1 :1	=J03 +.B -XR1 :21 B
	○	22	=J00/G1.4	=J01 +.B -XR1 :22 D	+.T -X1 :3	=J03 +.B -XR1 :22 B
	○	23	=J00/G1.4	=J01 +.B -XR1 :23 D	+.T -X1 :5	=J03 +.B -XR1 :23 B
	○	24	=J00/G1.4	=J01 +.B -XR1 :24 D	+.T -X1 :19	=J03 +.B -XR1 :24 B
	○	25	=J00/G1.4	=J01 +.B -XR1 :25 D	+.T -A21-1 :D4	=J03 +.B -XR1 :25 B
	○	26	=J00/G1.4	=J01 +.B -XR1 :26 D		=J03 +.B -XR1 :26 B
	○	31	=J00/G2.4	=J01 +.B -XR1 :31 D	-XC30 :800 D	=J03 +.B -XR1 :31 B
	○	32	=J00/G2.4	=J01 +.B -XR1 :32 D	-XC30 :820 D	=J03 +.B -XR1 :32 B
	○	33	=J00/G2.4	=J01 +.B -XR1 :33 D		=J03 +.B -XR1 :33 B
	○	34	=J00/G2.4	=J01 +.B -XR1 :34 D		=J03 +.B -XR1 :34 B
	○	35	=J00/G2.4	=J01 +.B -XR1 :35 D	+.T -A21-2 :L7	=J03 +.B -XR1 :35 B
	○	36	=J00/G2.4	=J01 +.B -XR1 :36 D	+.T -A21-2 :L10	=J03 +.B -XR1 :36 B
	○	41	=J00/G3.4			
	○	42	=J00/G3.4			
	○	43	=J00/G3.4			
	○	44	=J00/G3.4			
	○	45	=J00/G3.4			
	○	46	=J00/G3.4			

Screen bus →	A Cable clamp ⌒	Cover
N-bus	B Screen bus ⨯	Insulation plate
PE-PEN-bus	C Screwed cable gland ⨯⨯	Higher level insulation plate
Used cores total	D Plug housing ◉	Test socket
Continued on sheet	E Insulated ○⁄○	Disconnector

Revision	Modification	Date	Name			
				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XR1
Connection table

=JZ05 V =J02 +.B /1

883314 (3) W92210-F2141-S028-B

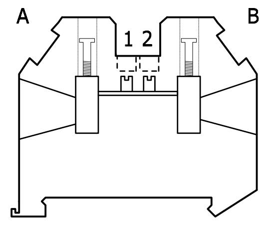
Sheet 1+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11-UT
Archive: =J02 / V / / / 2

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1	-J02-W91	SIHSI-CU 3x0,75mm²		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				



1 = Plug-in bridge left
2 = Plug-in bridge right

Cable connection to termination A ☐ B ☐

Terminal	Terminal block type	Wire type
1-3	UT 4	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation	
																	-X90 1 2 JUMPER				
BN															-B90	:2	○ □ □ ○	1	/G2.2	-R91	:1
BU															-XR1	:16 C	○ □ □ ○	2	/G2.2	-R91	:2
GNYE															-XPE	:1 B	○ □ □ ○	3	/G2.2	-R91	:PE

Screen bus	→	A Cable clamp	⌒	Cover
N-bus		B Screen bus	—✕—	Insulation plate
PE-PEN-bus		C Screwed cable gland	—✕✕—	Higher level insulation plate
Used cores total	3	D Plug housing	◉	Test socket
Continued on sheet		E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name
A	CERTIFIED	06-30-15	BM
B	IFC	08-27-15	BM

Date 05-18-15
Drawn Ten-Thomé
Appr. Magnuson
Norm
Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-X90
Connection table

883314
(3) W92210-F2141-S028-B

=JZ05 V =J02 +.B
/2
Sheet 2+
14 Sh.

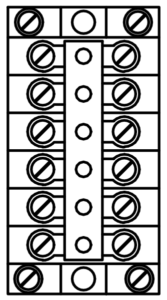
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J02 / V / / / 3

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination
A
B

Terminal	Terminal block type	Wire type
111-136	LJK:1506SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 18

Termination A Destination Item designation			Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation			
			-XT1						
+.F	-T1L1	:X1		111	/S2.4		+.T	-X1	:10
+.F	-T1L1	:X2		112	/S2.4				
+.F	-T1L1	:X3		113	/S2.4				
+.F	-T1L1	:X4		114	/S2.4				
+.F	-T1L1	:X5		115	/S2.4			-XT1	:125 B
						=J02	+.B	-PE	
				116	/S2.4				
+.F	-T1L2	:X1		121	/S2.4		+.T	-X1	:14
+.F	-T1L2	:X2		122	/S2.4				
+.F	-T1L2	:X3		123	/S2.4				
+.F	-T1L2	:X4		124	/S2.4				
+.F	-T1L2	:X5		125	/S2.4			-XT1	:115 B
								-XT1	:135 B
				126	/S2.4				
+.F	-T1L3	:X1		131	/S2.4		+.T	-X1	:18
+.F	-T1L3	:X2		132	/S2.4				
+.F	-T1L3	:X3		133	/S2.4				
+.F	-T1L3	:X4		134	/S2.4				
+.F	-T1L3	:X5		135	/S2.4			-XT1	:125 B
							+.T	-X1	:16
				136	/S2.4				

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
—×—	Insulation plate
—××—	Higher level insulation plate
◉	Test socket
○⌐○	Disconnector

Revision	Modification	Date	Name			
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XT1
Connection table

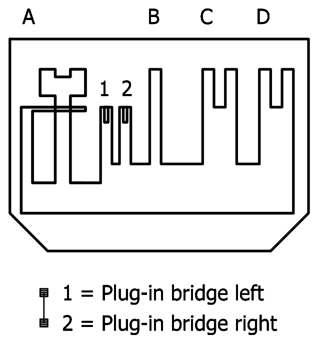
=JZ05 V =J02
+.B
/3
883314
(3) W92210-F2141-S028-B
Sheet 3+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 4

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 56

Cable connection to termination

A B C D

Termination A Destination Item designation	Link 1	Link 2	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XC30						
	1	2 JUMPER					
	■	□	300	/G1.3			-F20 :1
	■	□	301	/M1.2			+.T -A21-3 :M7
	■	□	302	/M1.7			
	■	□	303	/M1.7			
	■	□	304	/M2.2			-XQ0 :51 D
	■	□	305	/M3.2			-XQ1 :890 D
	■	□	306	/M4.2			-XC31 :41 B
	■	□	307	/M4.3			-XQ0 :23 D
	■	□	308	/M4.4			+.T -SQ0 :11
	■	□	309	/M5.2			-F10 :13
	■	□	310	/M5.4			-XQ1 :533 D
	■	□	311	/M5.5			-XQ1 :143 D
	■	□	312	/M5.6			
	■	□	313	/M5.6			
	■	□	314	/M5.7			
	□	■	320	/G1.3			-F20 :3
	□	■	321	/M1.2		-XQ0 :14 D	-XQ0 :18 D
	□	■	322	/M1.7			
	□	■	323	/M2.2			+.T -A21-3 :N11
	□	■	324	/M4.4			+.T -A21-1 :D14
	□	■	325	/M4.7			+.T -A21-2 :L11
	□	■	326	/M5.4			-XQ0 :12 D
	□	■	327	/M5.5			-XC31 :53 B
	□	■	328	/M5.6			
	□	■	329	/M5.6			
	□	■	330	/M5.6			
	□	■	331	/M5.7			
	□	■	332	/M5.7			
	□	■	333	/M5.8			
	□	■	334	/M5.8			
	■	□	340	/M1.6			-XC31 :32 B
	■	□	341	/M1.7			+.T -A21-3 :N2
	□	■	342	/M1.6			-XC31 :34 B
	□	■	343	/M1.7			+.T -A21-3 :N1
	■	□	800	/G1.6			-XR1 :31 C
	■	□	801	/M6.2		-XC31 :63 B	-XC31 :61 B
	■	□	802	/M6.4			
	■	□	803	/M6.5			
	■	□	804	/M6.5			
	■	□	805	/M6.6			

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	✕	Insulation plate
C Screwed cable gland	✕✕	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○○	Disconnector

Revision	Modification	Date	Name	Norm		
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Orig./Prep.for/Prep.by		

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XC30
Connection table

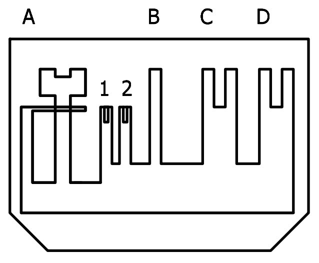
=JZ05 V =J02 +.B /4
883314 (3) W92210-F2141-S028-B
Sheet 4+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 5

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
300-910	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 56

Cable connection to termination

A ☐ B ◸ C ◹ D ◿

Link 1	Link 2	Term.-no.	Cross-ref.	Termination D Destination Item designation
		-XC30		
1	2	JUMPER		
□	▣	820	/G1.6	-XR1 :32 C
□	▣	821	/M6.2	-XQ0 :112 D
□	▣	822	/M6.4	+.T -A21-1 :D6
□	▣	823	/M6.5	
□	▣	824	/M6.5	
□	▣	825	/M6.6	
□	□	901	/M8.7	
□	□	902	/M8.7	
□	□	903	/M8.7	
□	□	904	/M8.7	
□	□	905	/M8.7	
□	□	906	/M8.8	
□	□	907	/M8.8	
□	□	908	/M8.8	
□	□	909	/M8.8	
□	□	910	/M8.8	

Termination A Destination Item designation

Slot B Destination Item designation

Termination C Destination Item designation

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

⌒	Cover
—✕—	Insulation plate
—✕✕—	Higher level insulation plate
◉	Test socket
○⌐○	Disconnector

Revision	Modification	Date	Name	Norm	
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

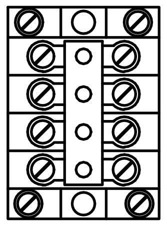
Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XC30
Connection table

=JZ05 V =J02
+.B
/5
883314
(3) W92210-F2141-S028-B
Sheet 5+
14 Sh.

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ◤

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation
			-XC31		
			11	/M8.5	
			12	/M8.6	
			13	/M8.6	
	⌒		14	/M8.6	
			21	/M8.6	
			22	/M8.6	
			23	/M8.7	
	⌒		24	/M8.7	
-XC31 :32 A			31	/M1.5	+.T -A21-3 :M7
=EXT +EXT					
-XC31 :31 A			32	/M1.5	-XC30 :340 D
=EXT +EXT					
-XC31 :34 A			33	/M1.5	-XQ1 :531 C
=EXT +EXT					
-XC31 :33 A	⌒		34	/M1.5	-XC30 :342 D
=EXT +EXT					
=EXT +EXT		●	41	/M4.7	-XC30 :306 D
=EXT +EXT		●	42	/M4.8	
=EXT +EXT			43	/M4.7	+.T -A21-2 :L12
=EXT +EXT	⌒		44	/M4.8	+.T -A21-2 :L14
=EXT +EXT			51	/M5.5	-XQ0 :92 D
=EXT +EXT			52	/M5.6	-XQ0 :94 D
=EXT +EXT			53	/M5.5	-XC31 :54 B
					-XC30 :327 D
=EXT +EXT	⌒		54	/M5.6	-XC31 :53 B
-XC31 :62 A			61	/M6.2	-XC30 :801 D
=EXT +EXT					
-XC31 :61 A			62	/M6.2	-XQ1 :830 D
=EXT +EXT					
-XC31 :64 A			63	/M6.3	-XC30 :801 C
=EXT +EXT					
-XC31 :63 A	⌒		64	/M6.3	-XQ1 :832 D
=EXT +EXT					
-XC31 :72 A			71	/M1.2	-XQ1 :171 C
=EXT +EXT					
-XC31 :71 A			72	/M1.2	-XC31 :73 B
=EXT +EXT					
-XC31 :74 A			73	/M1.2	-XC31 :72 B
=EXT +EXT					

Screen bus	
N-bus	
PE-PEN-bus	
Used cores total	
Continued on sheet	

- ⌒ Cover
- ⨯ Insulation plate
- ⨯⨯ Higher level insulation plate
- ◉ Test socket
- ⊸ Disconnector

Revision	Modification	Date	Name				
				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT	
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST	
				Norm		Orig./Prep.for/Prep.by	

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XC31
Connection table

=JZ05 V =J02 +.B /6
883314 (3) W92210-F2141-S028-B
Sheet 6+
14 Sh.

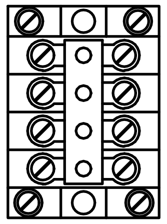
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11_URTKSP
Archive: =J02 / V / / / 7

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination
A
B

Terminal	Terminal block type	Wire type
11-94	LJK:1504SC	
	+ 2 DIN-RAIL MOUNTING ADAPTER LJK:DIN_R-1 PER BLOCK	
	(NOT TO BE PREPARED BY PHOENIX - SUPPLIED BY OTHERS)	
	NOTE:REMOVE SHORTING BAR	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 36

Termination A Destination Item designation		Terminal strip Link	Term.-no.	Cross-ref.		Termination B Destination Item designation
		-XC31				
-XC31 :73 A	⌒		74	/M1.2		-XQ0 :17 D
=EXT +EXT						
			81	/M8.7		
			82	/M8.7		
			83	/M8.7		
	⌒		84	/M8.8		
			91	/M8.8		
			92	/M8.8		
			93	/M8.8		
	⌒		94	/M8.8		

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

⌒	Cover
⊹	Insulation plate
⊹⊹	Higher level insulation plate
◉	Test socket
⚬⟋⚬	Disconnector

Revision	Modification	Date	Name	Norm	
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XC31
Connection table

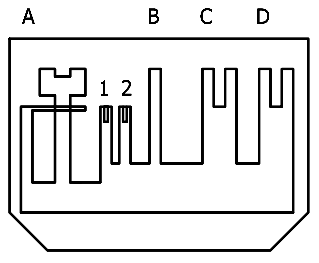
=JZ05 V =J02
+.B
883314
(3) W92210-F2141-S028-B
/7
Sheet 7+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 8

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
101-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 44

Cable connection to termination
A B C D

Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Termination A Destination Item designation	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
-XC32								
□	□	●	101	/M4.8				+.T -A21-2 :L13
□	□	●	102	/M5.3				+.T -A21-1 :D13
□	□	●	103	/M4.6				+.T -A21-1 :D9
□	□	●	104	/M4.6				+.T -A21-1 :D10
□	□	●	105	/M7.3				-XQ0 :61 D
□	□	●	106	/M7.3				-XQ0 :62 D
□	□	●	107	/M7.5				-XQ1 :133 D
□	□	●	108	/M7.5				-XQ0 :84 D
□	□	●	109	/M8.7				
□	□	●	110	/M8.7				
□	□	●	111	/M8.4				-F10 :21
□	□	●	112	/M8.4				-F10 :22
□	□	●	113	/M8.7				
□	□	●	114	/M8.8				
□	□	●	115	/M8.8				
□	□	●	116	/M8.8				
□	□	●	117	/M8.8				
□	□	●	118	/M8.8				
□	□	●	119	/M4.2				+.T -A21-3 :N13
□	□	●	120	/M5.2				+.T -A21-1 :D12
□	□	●	130	/M9.3				+.T -A21-1 :B10
□	□	●	131	/M9.3				+.T -A21-1 :B9
□	□	●	132	/M9.3				+.T -A21-1 :B11
□	□	●	133	/M9.3				+.T -A21-1 :B13
□	□	●	134	/M9.3				+.T -A21-1 :B12
□	□	●	135	/M9.4				+.T -A21-1 :B14
□	□	●	136	/M9.4				+.T -A21-1 :D2
□	□	●	137	/M9.4				+.T -A21-1 :D1
□	□	●	138	/M9.4				+.T -A21-1 :D3
□	□	●	139	/M9.4				+.T -A21-1 :D5
□	□	●	140	/M9.5				+.T -A21-1 :B7
□	□	●	141	/M9.5				+.T -A21-1 :B8
□	□	●	142	/M9.5				+.T -A21-2 :L3
□	□	●	143	/M9.5				+.T -A21-2 :L4
□	□	●	144	/M9.6				+.T -A21-2 :L5
□	□	●	145	/M9.6				+.T -A21-2 :L6
□	□	●	146	/M9.6				+.T -A21-2 :L8
□	□	●	147	/M9.6				+.T -A21-3 :M1
□	□	●	148	/M9.6				+.T -A21-3 :M2
□	□	●	149	/M9.6				+.T -A21-3 :M3

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A	Cable clamp	⌒	Cover
B	Screen bus	✕	Insulation plate
C	Screwed cable gland	✕✕	Higher level insulation plate
D	Plug housing	◉	Test socket
E	Insulated	○⌐○	Disconnector

CopyRight (C) Siemens AG 2015 All Rights Reserved

Revision	Modification	Date	Name		
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XC32
Connection table

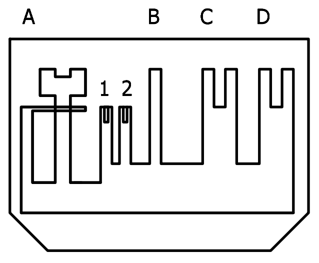
=JZ05
V
=J02
+.B
/8
883314
(3) W92210-F2141-S028-B
Sheet 8+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 9

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
101-153	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 44

Cable connection to termination

A ☐ B ☐ C ☐ D ☐

Cable connection 1	2	3	4	5	6	7	8	9	Termination A Destination Item designation		Terminal strip -XC32 Link 1 2 JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										⊖	□ □ ● — —	150	/M9.7			+.T -A21-3 :M4
										⊖	□ □ ● — —	151	/M9.7			+.T -A21-3 :M5
										⊖	□ □ ● — —	152	/M9.7			+.T -A21-1 :B5
										⊖	□ □ ● — —	153	/M9.7			+.T -A21-1 :B6

Screen bus
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

⌒ Cover
–✕– Insulation plate
–✕✕– Higher level insulation plate
◉ Test socket
○⌐○ Disconnector

CopyRight (C) Siemens AG 2015 All Rights Reserved

Revision	Modification	Date	Name			
A	CERTIFIED	06-30-15	BM	Date	05-18-15	
B	IFC	08-27-15	BM	Drawn	Ten-Thomé	
				Appr.	Magnuson	
				Norm		Orig./Prep.for/Prep.by

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XC32
Connection table

=JZ05 V =J02 +.B /9

883314 (3) W92210-F2141-S028-B

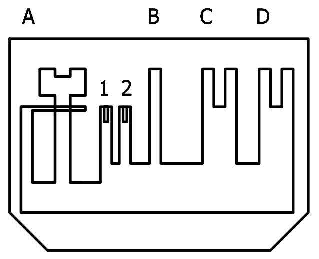
Sheet 9+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 10

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library1: PTD_M2_CoC_E_ansi
Symbol library2: PTD_M2_CoC_E
Symbol library3:
Symbol library4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9	Termination A Destination Item designation	Link 1	Link 2	JUMPER	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
										⊖ □	□	●	11	/M5.4	+.L -Q0-X09 :1		-XQ1 :534 D
										⊖ □	□	●	12	/M5.4	+.L -Q0-X09 :0		-XC30 :326 D
										⊖ □	□	●	13	/M1.3	+.L -Q0-X10 :3		-XQ0 :21 D
										⊖ □	□	●	14	/M1.3	+.L -Q0-X10 :2		-XC30 :321 C
										⊖ □	□	●	15	/Z1.3	+.L -Q0-X10 :1		
										⊖ □	□	●	16	/Z1.3	+.L -Q0-X10 :0		
										⊖ □	□	●	17	/M1.2	+.L -Q0-X11 :9	-XQ1 :172 D	-XC31 :74 B
										⊖ □	□	●	18	/M1.2	+.L -Q0-X11 :8		-XC30 :321 D
										⊖ □	□	●	19	/Z1.1	+.L -Q0-X11 :7		
										⊖ □	□	●	20	/M1.3	+.L -Q0-X11 :6	-XQ1 :532 D	+.T -A21-3 :M9
										⊖ □	□	●	21	/M1.3	+.L -Q0-X11 :5		-XQ0 :13 D
										⊖ □	□	●	22	/M1.4	+.L -Q0-X11 :4		-XQ0 :121 D
										⊖ □	□	●	23	/M4.3	+.L -Q0-X11 :3	-XQ1 :815 D	-XC30 :307 D
										⊖ □	□	●	24	/M4.3	+.L -Q0-X11 :2		+.T -A21-3 :N14
										⊖ □	□	●	25	/Z1.4	+.L -Q0-X11 :1		
										⊖ □	□	●	26	/Z1.4	+.L -Q0-X11 :0		
										⊖ □	□	●	27	/G1.2	+.L -Q0-X12 :9		-F10 :1
										⊖ □	□	●	28	/G1.2	+.L -Q0-X12 :8		-F10 :3
										⊖ □	□	●	29	/Z1.4	+.L -Q0-X12 :7		
										⊖ □	□	●	30	/Z1.4	+.L -Q0-X12 :6		
										⊖ □	□	●	31	/Z1.4	+.L -Q0-X12 :5		
										⊖ □	□	●	32	/Z1.4	+.L -Q0-X12 :4		
										⊖ □	□	●	33	/Z1.4	+.L -Q0-X12 :3		
										⊖ □	□	●	34	/Z1.4	+.L -Q0-X12 :2		
										⊖ □	□	●	41	/Z1.5	+.L -Q0-X12 :1		
										⊖ □	□	●	42	/Z1.5	+.L -Q0-X12 :0		
										⊖ □	□	●	43	/Z1.5	+.L -Q0-X13 :9		
										⊖ □	□	●	44	/Z1.5	+.L -Q0-X13 :8		
										⊖ □	□	●	45	/Z1.3	+.L -Q0-X13 :7		
										⊖ □	□	●	46	/Z1.3	+.L -Q0-X13 :6		
										⊖ □	□	●	51	/M2.2	+.L -Q0-X13 :5	-XQ1 :111 D	-XC30 :304 D
										⊖ □	□	●	52	/M2.2	+.L -Q0-X13 :4	+.T -HQ0O :X1	+.T -A21-3 :N5
										⊖ □	□	●	54	/M2.2	+.L -Q0-X13 :3	+.T -HQ0C :X1	+.T -A21-3 :N6
										⊖ □	□	●	61	/M7.3	+.L -Q0-X13 :2	-XQ1 :121 D	-XC32 :105 D
										⊖ □	□	●	62	/M7.3	+.L -Q0-X13 :1	-XQ1 :122 D	-XC32 :106 D
										⊖ □	□	●	64	/M7.3	+.L -Q0-X13 :0		
										⊖ □	□	●	71	/Z1.6	+.L -Q0-X14 :9		
										⊖ □	□	●	72	/Z1.6	+.L -Q0-X14 :8		
										⊖ □	□	●	73	/Z1.6	+.L -Q0-X14 :7		
										⊖ □	□	●	74	/Z1.6	+.L -Q0-X14 :6		

Terminal strip: -XQ0

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	—✕—	Insulation plate
C Screwed cable gland	—✕✕—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⁄○	Disconnector

Revision	Modification	Date	Name	Norm	Orig./Prep.for/Prep.by
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XQ0
Connection table

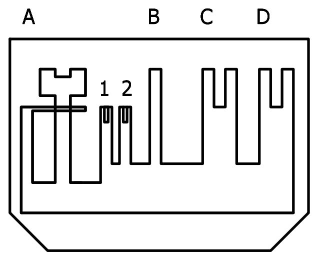
=JZ05 V =J02
+.B /10
883314 (3) W92210-F2141-S028-B
Sheet 10+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 11

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
11-124	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 60

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
	-XQ0					
	1 2 JUMPER					
	⊖ □ □ ●	81	/Z1.6	+.L -Q0-X14 :5		
	⊖ □ □ ●	82	/Z1.6	+.L -Q0-X14 :4		
	⊖ □ □ ●	83	/M7.5	+.L -Q0-X14 :3		-XQ1 :134 D
	⊖ □ □ ●	84	/M7.5	+.L -Q0-X14 :2		-XC32 :108 D
	⊖ □ □ ●	91	/M5.5	+.L -Q0-X14 :1	-XQ1 :144 D	-XQ0 :93 D
	⊖ □ □ ●	92	/M5.5	+.L -Q0-X14 :0		-XC31 :51 B
	⊖ □ □ ●	93	/M5.6	+.L -Q0-X15 :9		-XQ0 :91 D
	⊖ □ □ ●	94	/M5.6	+.L -Q0-X15 :8		-XC31 :52 B
	⊖ □ □ ●	101	/Z1.7	+.L -Q0-X15 :7		
	⊖ □ □ ●	102	/Z1.7	+.L -Q0-X15 :6		
	⊖ □ □ ●	103	/Z1.7	+.L -Q0-X15 :5		
	⊖ □ □ ●	104	/Z1.7	+.L -Q0-X15 :4		
	⊖ □ □ ●	111	/M6.2	+.L -Q0-X15 :3		-XQ1 :831 C
	⊖ □ □ ●	112	/M6.2	+.L -Q0-X15 :2		-XC30 :821 D
	⊖ □ □ ●	113	/Z1.8	+.L -Q0-X15 :1		
	⊖ □ □ ●	114	/Z1.8	+.L -Q0-X15 :0		
	⊖ □ □ ●	121	/M1.5	+.L -Q0-X16 :1		-XQ0 :22 D
	⊖ □ □ ●	122	/M1.5	+.L -Q0-X16 :0		+.T -A21-3 :N3
	⊖ □ □ ●	123	/Z1.8	+.L -Q0-X17 :1		
	⊖ □ □ ●	124	/Z1.8	+.L -Q0-X17 :0		

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp
B Screen bus
C Screwed cable gland
D Plug housing
E Insulated

Cover
Insulation plate
Higher level insulation plate
Test socket
Disconnector

Revision	Modification	Date	Name			
				Date	05-18-15	
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	
B	IFC	08-27-15	BM	Appr.	Magnuson	
				Norm		

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XQ0
Connection table

=JZ05 V =J02 +.B /11

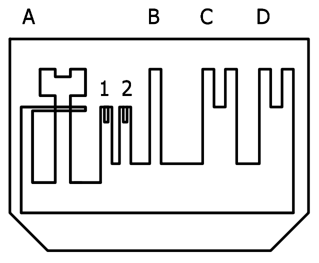
883314 (3) W92210-F2141-S028-B

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / 12

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A B C D

Link	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
-XQ1					
1 2 JUMPER					
⊖ □ □ ●	111	/M2.3	+.D -Q1-X11 :9	-XQ1 :511 D	-XQ0 :51 C
⊖ □ □ ●	112	/M2.3	+.D -Q1-X11 :8		+.T -A21-3 :N7
⊖ □ □ ●	114	/M2.4	+.D -Q1-X11 :7		+.T -A21-3 :N8
⊖ □ □ ●	121	/M7.4	+.D -Q1-X11 :6		-XQ0 :61 C
⊖ □ □ ●	122	/M7.4	+.D -Q1-X11 :5		-XQ0 :62 C
⊖ □ □ ●	124	/M7.4	+.D -Q1-X11 :4		
⊖ □ □ ●	131	/Z2.3	+.D -Q1-X11 :3		
⊖ □ □ ●	132	/Z2.3	+.D -Q1-X11 :2		
⊖ □ □ ●	133	/M7.5	+.D -Q1-X11 :1		-XC32 :107 D
⊖ □ □ ●	134	/M7.5	+.D -Q1-X11 :0		-XQ0 :83 D
⊖ □ □ ●	141	/Z2.3	+.D -Q1-X12 :3		
⊖ □ □ ●	142	/Z2.3	+.D -Q1-X12 :2		
⊖ □ □ ●	143	/M5.5	+.D -Q1-X12 :1		-XC30 :311 D
⊖ □ □ ●	144	/M5.5	+.D -Q1-X12 :0		-XQ0 :91 C
⊖ □ □ ●	151	/Z2.4	+.D -Q1-X13 :3		
⊖ □ □ ●	152	/Z2.4	+.D -Q1-X13 :2		
⊖ □ □ ●	153	/Z2.4	+.D -Q1-X13 :1		
⊖ □ □ ●	154	/Z2.4	+.D -Q1-X13 :0		
⊖ □ □ ●	161	/Z2.4	+.D -Q1-X14 :3		
⊖ □ □ ●	162	/Z2.4	+.D -Q1-X14 :2		
⊖ □ □ ●	163	/Z2.5	+.D -Q1-X14 :1		
⊖ □ □ ●	164	/Z2.5	+.D -Q1-X14 :0		
⊖ □ □ ●	171	/M1.2	+.D -Q1-X15 :3	-XC31 :71 B	+.T -A21-3 :M10
⊖ □ □ ●	172	/M1.2	+.D -Q1-X15 :2		-XQ0 :17 C
⊖ □ □ ●	173	/Z2.5	+.D -Q1-X15 :1		
⊖ □ □ ●	174	/Z2.5	+.D -Q1-X15 :0		
⊖ □ □ ●	511	/M2.5	+.D -Q1-X51 :9		-XQ1 :111 C
⊖ □ □ ●	512	/M2.5	+.D -Q1-X51 :8		+.T -A21-3 :N9
⊖ □ □ ●	514	/M2.6	+.D -Q1-X51 :7		+.T -A21-3 :N10
⊖ □ □ ●	521	/Z3.4	+.D -Q1-X51 :6		
⊖ □ □ ●	522	/Z3.4	+.D -Q1-X51 :5		
⊖ □ □ ●	524	/Z3.4	+.D -Q1-X51 :4		
⊖ □ □ ●	531	/M1.5	+.D -Q1-X51 :3	-XC31 :33 B	+.T -A21-3 :M8
⊖ □ □ ●	532	/M1.5	+.D -Q1-X51 :2		-XQ0 :20 C
⊖ □ □ ●	533	/M5.4	+.D -Q1-X51 :1		-XC30 :310 D
⊖ □ □ ●	534	/M5.4	+.D -Q1-X51 :0		-XQ0 :11 D
⊖ □ □ ●	541	/Z3.5	+.D -Q1-X52 :3		
⊖ □ □ ●	542	/Z3.5	+.D -Q1-X52 :2		
⊖ □ □ ●	543	/Z3.5	+.D -Q1-X52 :1		
⊖ □ □ ●	544	/Z3.5	+.D -Q1-X52 :0		

Termination A Destination Item designation

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover
B Screen bus	—×—	Insulation plate
C Screwed cable gland	—××—	Higher level insulation plate
D Plug housing	◉	Test socket
E Insulated	○⌐○	Disconnector

Revision	Modification	Date	Name		
				Date	05-18-15
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé
B	IFC	08-27-15	BM	Appr.	Magnuson
				Norm	

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XQ1
Connection table

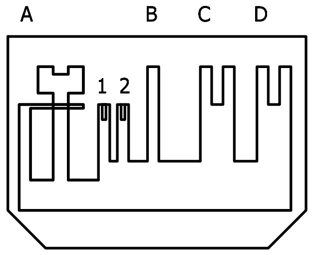
=JZ05 V =J02 +.B /12
883314 (3) W92210-F2141-S028-B
Sheet 12+
14 Sh.

ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-13-VBSTB4
Archive: =J02 / V / / / 13

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				



1 = Plug-in bridge left
2 = Plug-in bridge right

Terminal	Terminal block type	Wire type
111-893	VBSTB 4-FS	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 64

Cable connection to termination

A B C D

1	2	3	4	5	6	7	8	9

Termination A Destination Item designation

Terminal strip -XQ1

Link (1 2 JUMPER)	Term.-no.	Cross-ref.	Slot B Destination Item designation	Termination C Destination Item designation	Termination D Destination Item designation
⊖ □ □ ●	551	/Z3.5	+.D -Q1-X53 :3		
⊖ □ □ ●	552	/Z3.5	+.D -Q1-X53 :2		
⊖ □ □ ●	553	/Z3.6	+.D -Q1-X53 :1		
⊖ □ □ ●	554	/Z3.6	+.D -Q1-X53 :0		
⊖ □ □ ●	561	/Z3.6	+.D -Q1-X54 :3		
⊖ □ □ ●	562	/Z3.6	+.D -Q1-X54 :2		
⊖ □ □ ●	563	/Z3.6	+.D -Q1-X54 :1		
⊖ □ □ ●	564	/Z3.6	+.D -Q1-X54 :0		
⊖ □ □ ●	571	/Z3.6	+.D -Q1-X55 :3		
⊖ □ □ ●	572	/Z3.6	+.D -Q1-X55 :2		
⊖ □ □ ●	573	/Z3.7	+.D -Q1-X55 :1		
⊖ □ □ ●	574	/Z3.7	+.D -Q1-X55 :0		
⊖ □ □ ●	815	/M4.4	+.D -Q1-X82 :3		-XQ0 :23 C
⊖ □ □ ●	816	/M4.4	+.D -Q1-X82 :2		+.T -A21-3 :N15
⊖ □ □ ●	817	/Z2.7	+.D -Q1-X82 :1		
⊖ □ □ ●	818	/Z2.7	+.D -Q1-X82 :0		
⊖ □ □ ●	830	/M6.2	+.D -Q1-X84 :1		-XC31 :62 B
⊖ □ □ ●	831	/M6.2	+.D -Q1-X84 :0	-XQ0 :111 D	-XQ1 :833 D
⊖ □ □ ●	832	/M6.3	+.D -Q1-X85 :1		-XC31 :64 B
⊖ □ □ ●	833	/M6.3	+.D -Q1-X85 :0		-XQ1 :831 D
⊖ □ □ ●	890	/M3.2	+.D -B0-X88 :3		-XC30 :305 D
⊖ ■ □ ●	891	/M3.2	+.D -B0-X88 :2		+.T -A21-3 :N12
⊖ ■ □ ●	892	/M3.2	+.D -B0-X88 :1		
⊖ ■ □ ●	893	/M3.3	+.D -B0-X88 :0		

Screen bus →
N-bus
PE-PEN-bus
Used cores total
Continued on sheet

A Cable clamp	⌒	Cover	
B Screen bus	—✕—	Insulation plate	
C Screwed cable gland	—✕✕—	Higher level insulation plate	
D Plug housing	◉	Test socket	
E Insulated	○⌐○	Disconnector	

Revision	Modification	Date	Name	Norm	
A	CERTIFIED	06-30-15	BM	Date	05-18-15
B	IFC	08-27-15	BM	Drawn	Ten-Thomé
				Appr.	Magnuson

CRUM ELECTRIC SUPPLY COMPANY INC.
COLORADO DEPARTMENT OF TRANSPORT
VENTILATION BUILDING EAST
Orig./Prep.for/Prep.by

Siemens AG

8DA10 25kV SWITCHGEAR
TRX NO. 1B
=J02+.B-XQ1
Connection table

=JZ05
V
=J02
+.B
/13
883314
(3) W92210-F2141-S028-B
Sheet 13+
14 Sh.

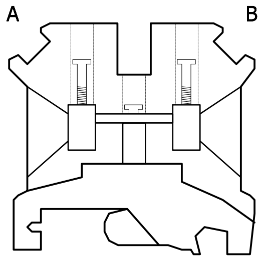
ELCAD-Version 7.3.2 SP3
Last used: 28.08.15
FBKLP2-11
Archive: =J02 / V / / / 14

Translate file A: A_COC_EN
Translate file B: leer1
Translate file C: C_FB_EN.etr, 04-11-24
Translate file D: leer2

Project: I:/ELCAD.73/ANSI/883314.pro
Symbol library 1: PTD_M2_CoC_E_ansi
Symbol library 2: PTD_M2_CoC_E
Symbol library 3:
Symbol library 4:

	Cable designation	Type, no.of cores, cross sec.	Destination, equipment code	Level
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



Cable connection to termination A ☐ B ◤

Terminal	Terminal block type	Wire type
	USLKG 5	
		FOR DETAILS SEE CIRCUIT DIAGRAM

No. of Terminals (in total) : 8

Termination A Destination Item designation	Terminal strip Link	Term.-no.	Cross-ref.	Termination B Destination Item designation
	-XPE			
=J02 +.B -PE	○	1	/G2.2	-X90 :3 A
	○	2	/S1.7	
	○	3	/S1.7	
	○	4	/S1.7	
	○	5	/S1.8	
	○	6	/S1.8	
	○	7	/S1.8	
	○	8	/S1.8	

Screen bus →	A Cable clamp	⌒	Cover
N-bus	B Screen bus	⨯	Insulation plate
PE-PEN-bus	C Screwed cable gland	⨯⨯	Higher level insulation plate
Used cores total	D Plug housing	◉	Test socket
Continued on sheet	E Insulated	○⌐○	Disconnector

				Date	05-18-15	CRUM ELECTRIC SUPPLY COMPANY INC.	Siemens AG	8DA10 25kV SWITCHGEAR	=JZ05 V =J02
A	CERTIFIED	06-30-15	BM	Drawn	Ten-Thomé	COLORADO DEPARTMENT OF TRANSPORT		TRX NO. 1B	+.B /14
B	IFC	08-27-15	BM	Appr.	Magnuson	VENTILATION BUILDING EAST		=J02+.B-XPE	883314 (3) W92210-F2141-S028-B Sheet 14-
Revision	Modification	Date	Name	Norm		Orig./Prep.for/Prep.by		Connection table	14 Sh.

SIEMENS

Energy Management

Prüfbescheinigung / Test Certificate

Kunde / Customer: **CRUM ELECTRIC SUPPLY COMPANY INC**	Auftrags-Nr. / Fact.ref.no.: **883314**	HptPos. / Main item: **000010**

BZ-Nr. / Order item: **0003637056, 0030160911 –** **CDOT - EAST BUILDING / US –** **MV GIS 24.9 KV - EAST BUILDING**	Stück / Quantity: **1**	Schaltanlage / Switchgear: **8DA10** **6 Feld(er)/Panel(s)** **6 x LS**

Die Schaltanlage entspricht gemäß IEC 62271-200 folgender IAC Klassifikation / The switchgear conforms to the following IAC classification in accordance with IEC 62271-200:	ANSI 2B 25kA 0,5s

Die Schaltanlage entspricht nachstehenden Bestimmungen und wurde erfolgreich in unserem Prüffeld stückgeprüft:	The switchgear meets the specifications stated below and has been successfully routine-tested at our test field:

IEC 62271-200

§ 7.1	Wechselspannungsprüfung mit 70 kV, 1 min	Power frequency voltage test with 70 kV, 1 min
§ 7.2	Spannungsprüfung an Hilfsstromkreisen mit 1 kV, 1 s	Dielectric test of auxiliary circuits with 1 kV, 1 s
§ 7.3	Widerstandsmessung der Hauptstromkreise	Measurement of the resistance of the main circuit
§ 7.4	Dichtheitsprüfung der gasgefüllten Schotträume	Tightness test of gas-filled compartments
§ 7.5	Konstruktions- und Sichtkontrollen	Design and visual checks
§ 7.101	Teilentladungsprüfung	Partial discharge test
§ 7.102	Mechanische Funktionsprüfungen	Mechanical function test
§ 7.103	Druckprüfung der gasgefüllten Schotträume	Pressure test of gas-filled compartments
§ 7.104	Prüfung der Hilfseinrichtungen Kontrolle der Verdrahtung	Test of auxiliary devices Verification of the correct wiring
§ 7.106	Messung des Gaszustandes nach Füllung	Measurement of gas condition after filling

Datum / Date: 2015-11-13	Hr. / Mr.: Fr. / Mrs.: Thomas Krause Gültig ohne Unterschrift / Valid without signature

* Je nach Feldvariante sind einzelne Prüfungen nicht erforderlich
* Depending on the panel version, some of these tests are not necessary

Einzelfeldprüfung 8DA/B	**Seriennummern / serial numbers single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J01** **883314-000060/001**	**Becker, Frank**	**2015-11-05**

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060114

Vakuumröhren – Vacuum Interruptor

Phase **Phase**	**Seriennummer** **Serial - No.**
L1	**883314/+J01/085093055**
L2	**883314/+J01/085093058**
L3	**883314/+J01/085093076**

Stromwandler – Current Transformer

Einbauort **Location**	**Phase** **Phase**	**Seriennummer** **Serial - No.**
Poltragplatte unten 1, Lower pole baseplate 1	**L1**	**80197897**
Poltragplatte unten 1, Lower pole baseplate 1	**L2**	**80197893**
Poltragplatte unten 1, Lower pole baseplate 1	**L3**	**80197895**

Spannungswandler – Voltage Transformer

Einbauort **Location**	**Phase** **Phase**	**Seriennummer** **Serial - No.**
-		

Schutzgeräte – Protective Relais
BM1510000556

Motorsteuerungen – Motor Control Units

Einbauort **Location**	**Seriennummer** **Serial - No.**
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	+J02 883314-000070/001	Becker, Frank	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060113

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883314/+J02/085093065
L2	883314/+J02/085093064
L3	883314/+J02/085093073

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197896
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197899
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197898

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000553

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	+J03 883314-000080/001	Becker, Frank	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060118

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883314/+J03/085093351
L2	883314/+J03/085093056
L3	883314/+J03/085093074

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197885
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197891
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197882

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000558

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	+J04 883314-000090/001	Becker, Frank	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060115

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883314/+J04/085093354
L2	883314/+J04/085093353
L3	883314/+J04/085093352

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197889
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197886
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197884

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000554

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	+J05 883314-000100/001	Becker, Frank	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060116

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883314/+J05/085093349
L2	883314/+J05/085093356
L3	883314/+J05/085093355

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197887
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197892
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197894

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000557

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J06** **883314-000110/001**	**Becker, Frank**	**2015-11-05**

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker

3AH49/00060117

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883314/+J06/085093347
L2	883314/+J06/085093348
L3	883314/+J06/085093350

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197888
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197890
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197883

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais

-

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J01** **883314-000060/001**	**Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	046					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	7,2 mm	L2 :	7,0 mm	L3 :	6,6 mm
Kontaktkraft Contakt pressure	L1:	3166 N	L2 :	3161 N	L3 :	3163 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,7 mm		Klinkenüberdeckung Latch overlap	6 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3.8 mV	L2 :	3.6 mV	L3 :	3.6 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	1,9 mV	L2 :	1,8 mV	L3 :	2,2 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,6 pF	L2 :	9,7 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	360 ° / - °	L2 :	360 ° / - °	L3 :	360 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J02** **883314-000070/001**	**Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	048					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6,5 mm	L2 :	7,0 mm	L3 :	6,5 mm
Kontaktkraft Contakt pressure	L1:	3165 N	L2 :	3168 N	L3 :	3166 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,7 mm		Klinkenüberdeckung Latch overlap	6 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	58,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3,5 mV	L2 :	3,6 mV	L3 :	3,6 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	1,9 mV	L2 :	2,0 mV	L3 :	2,0 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,7 pF	L2 :	9,6 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	360 ° / - °	L2 :	360 ° / - °	L3 :	360 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J03** **883314-000080/001**	**Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	010					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	7,0 mm	L2 :	6,5 mm	L3 :	6,8 mm
Kontaktkraft Contakt pressure	L1:	3159 N	L2 :	3161 N	L3 :	3163 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,6 mm			Klinkenüberdeckung Latch overlap	8 mm	
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3,6 mV	L2 :	3,2 mV	L3 :	3,5 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	1,9 mV	L2 :	1,6 mV	L3 :	2,2 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,7 pF	L2 :	9,7 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	360 ° / - °	L2 :	360 ° / - °	L3 :	360 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no. **883314-000010**	Feld-Nr. / Panel-no. Serien-Nr. / Serial No. **+J04** **883314-000090/001**	Prüfer, Datum / Inspector, Date **Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	023					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6,8 mm	L2 :	6,6 mm	L3 :	7,1 mm
Kontaktkraft Contakt pressure	L1:	3170 N	L2 :	3163 N	L3 :	3166 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,7 mm		Klinkenüberdeckung Latch overlap	8 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	60,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3,5 mV	L2 :	3,5 mV	L3 :	3,6 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2,0 mV	L2 :	1,9 mV	L3 :	2,0 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,7 pF	L2 :	9,7 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	360 ° / - °	L2 :	360 ° / - °	L3 :	360 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	Measuring values single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J05** **883314-000100/001**	**Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	011					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6,5 mm	L2 :	7,1 mm	L3 :	7,1 mm
Kontaktkraft Contakt pressure	L1:	3173 N	L2 :	3167 N	L3 :	3164 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,6 mm		Klinkenüberdeckung Latch overlap	8 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3,6 mV	L2 :	3,4 mV	L3 :	3,7 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2,0 mV	L2 :	2,0 mV	L3 :	2,2 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,6 pF	L2 :	9,7 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	360 ° / - °	L2 :	360 ° / - °	L3 :	360 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883314-000010	**+J06** **883314-000110/001**	**Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	040					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6,8 mm	L2 :	6,9 mm	L3 :	6,6 mm
Kontaktkraft Contakt pressure	L1:	3164 N	L2 :	3166 N	L3 :	3169 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,5 mm		Klinkenüberdeckung Latch overlap	8 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3,7 mV	L2 :	3,6 mV	L3 :	3,8 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	1,9 mV	L2 :	1,7 mV	L3 :	2,1 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,6 pF	L2 :	9,7 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	360 ° / - °	L2 :	360 ° / - °	L3 :	360 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883314	**+J01**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060114	Inspector:	Becker

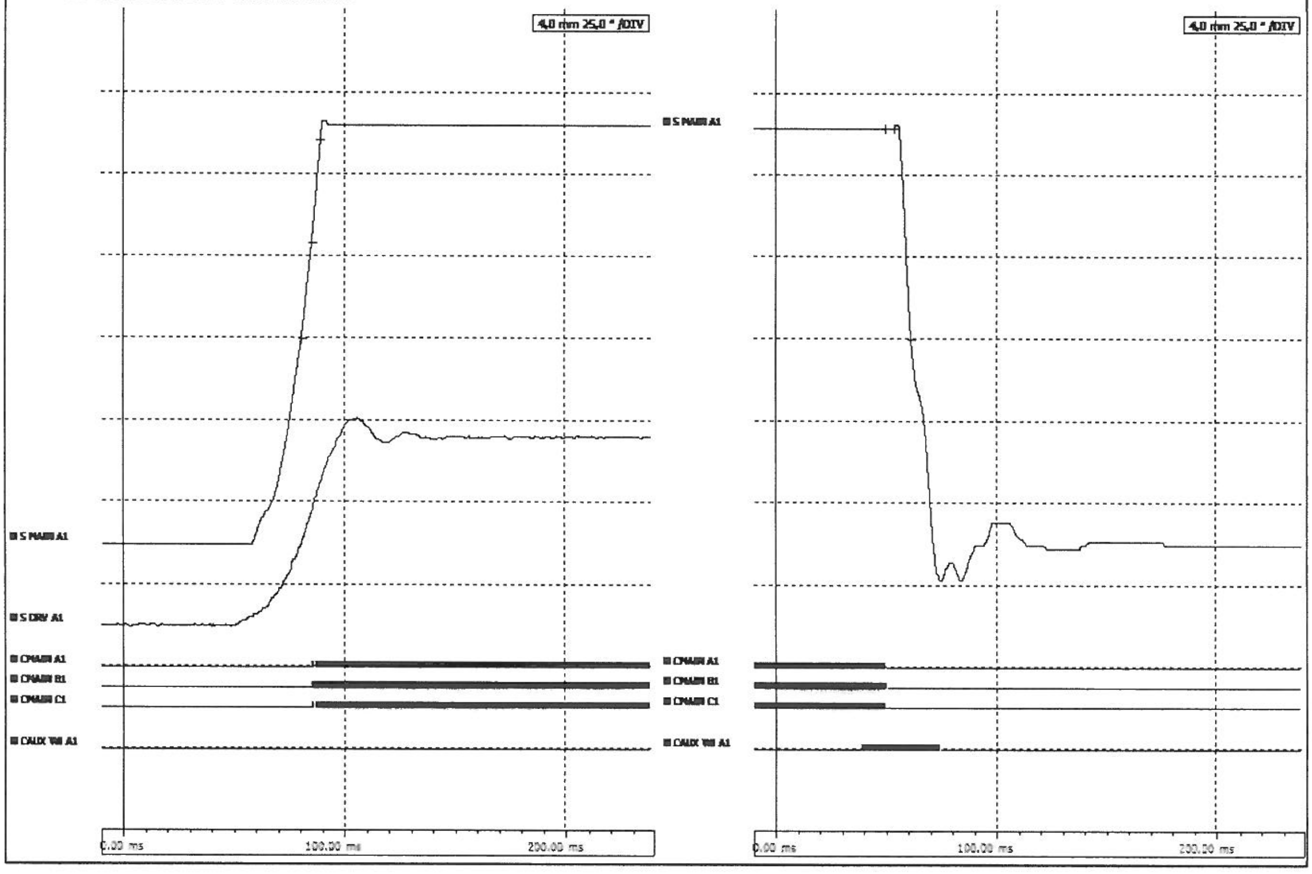
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,11	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,32	m/s	1,10 - 1,80	m/s
Close operation time	te	85,50	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	49,70	ms	45,00 - 65,00	ms
Passing contact time		37,30	ms	8,00 - 200,00	ms
Contact travel		20,40	mm	18,00 - 22,00	mm
max. over swing		1,70	mm	0,00 - 3,00	mm
max. forward swing		1,10	mm	0,00 - 4,00	mm
Contact sysnchronism		0,10	ms	< 2,00	ms

Close operation	L1		L2		L3		**Tolerances**	
Contact bounce time	1,60	ms	0,80	ms	1,60	ms	<= 7,00	ms
Single contact bounce	0,10	ms	0,30	ms	0,10	ms	<= 2,00	ms
No. of bounces	1	times	1	times	1	times	<= 3	times

Open operation	L1		L2		L3		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883314	**+J03**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060118	Inspector:	Becker

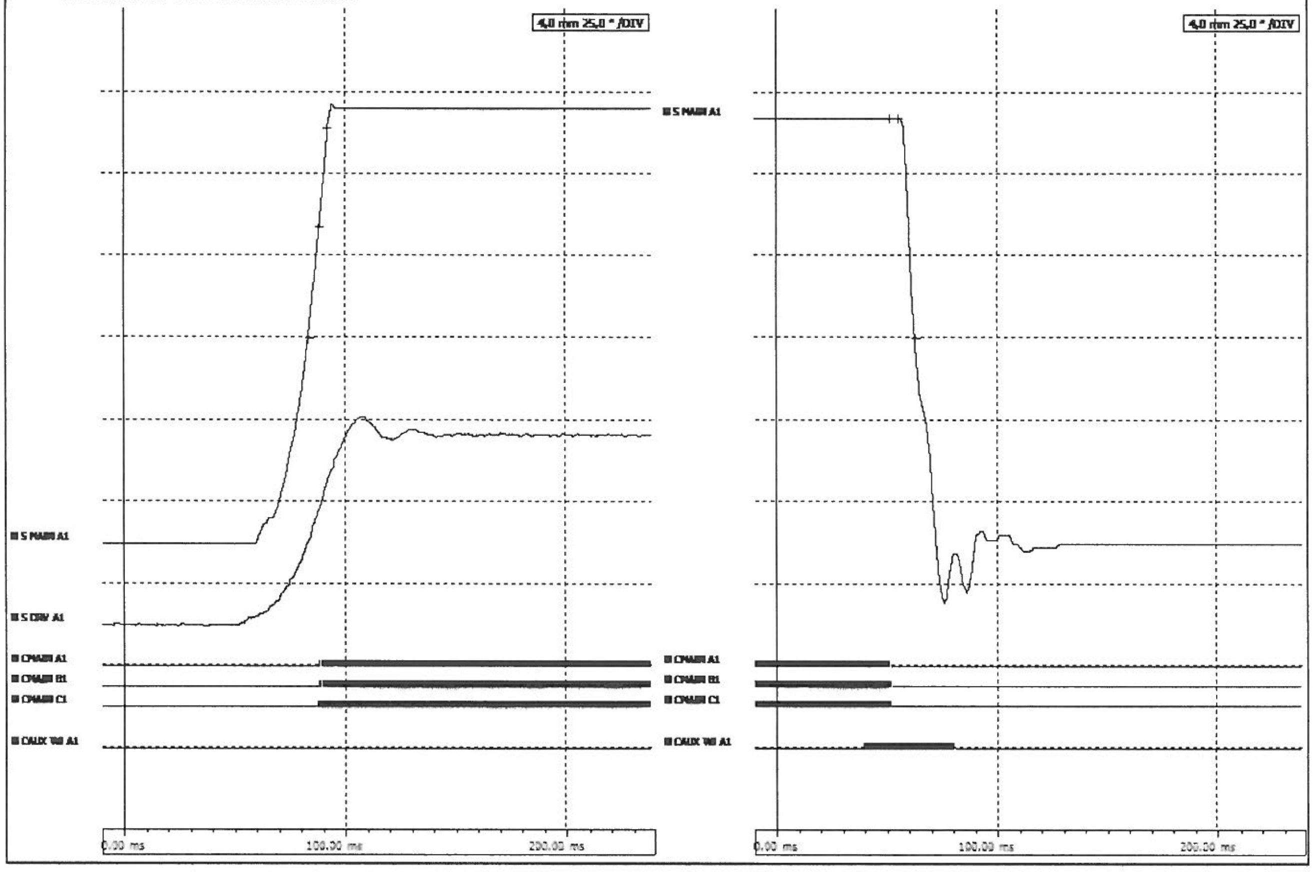
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,14	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,45	m/s	1,10 - 1,80	m/s
Close operation time	te	88,70	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	51,60	ms	45,00 - 65,00	ms
Passing contact time		44,60	ms	8,00 - 200,00	ms
Contact travel		21,20	mm	18,00 - 22,00	mm
max. over swing		2,90	mm	0,00 - 3,00	mm
max. forward swing		0,60	mm	0,00 - 4,00	mm
Contact sysnchronism		0,50	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,70	ms	1,70	ms	1,50	ms	<= 7,00	ms
Single contact bounce	0,20	ms	0,20	ms	0,30	ms	<= 2,00	ms
No. of bounces	1	times	1	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS
Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883314	**+J04**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060115	Inspector:	Becker

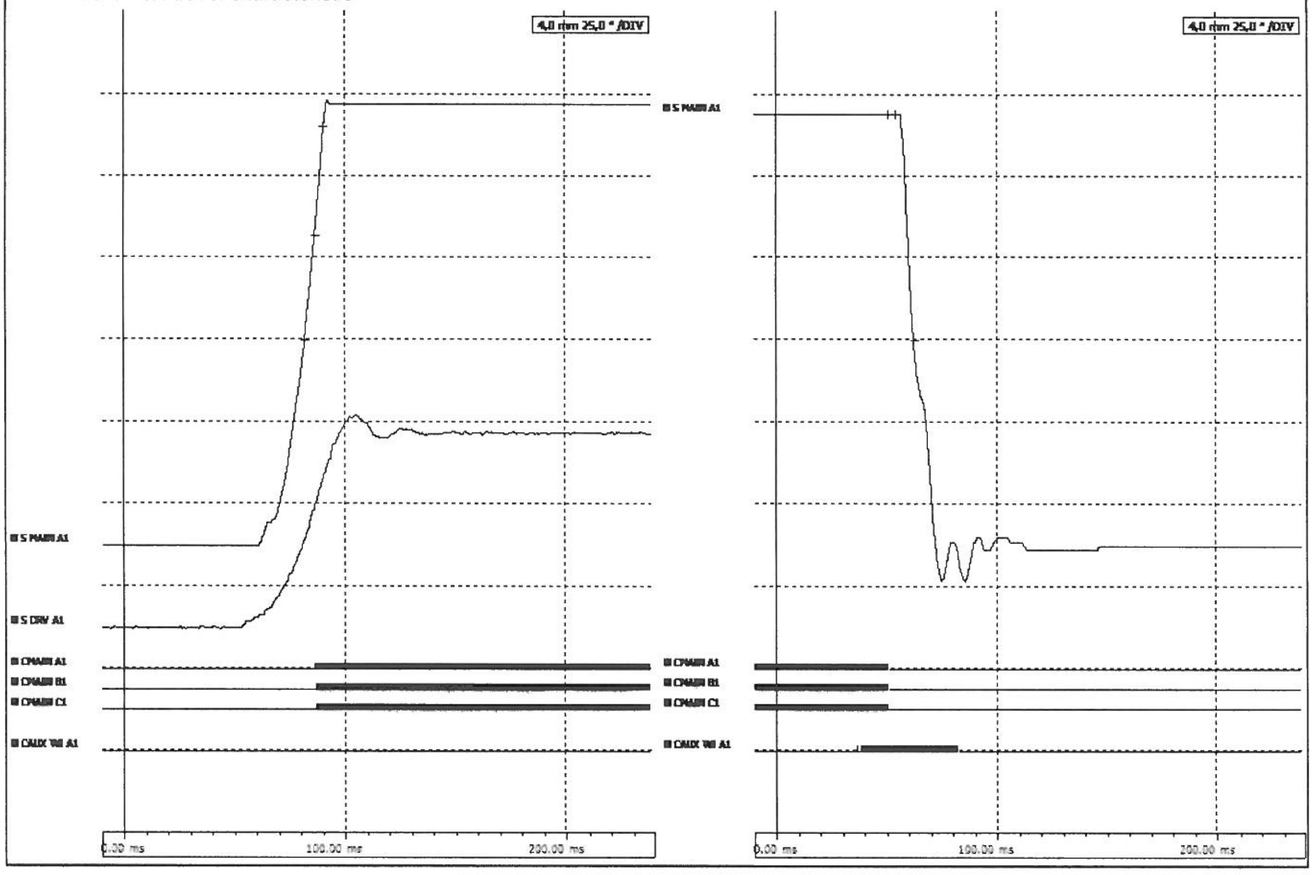
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,21	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,43	m/s	1,10 - 1,80	m/s
Close operation time	te	86,80	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	50,80	ms	45,00 - 65,00	ms
Passing contact time		47,50	ms	8,00 - 200,00	ms
Contact travel		21,50	mm	18,00 - 22,00	mm
max. over swing		1,70	mm	0,00 - 3,00	mm
max. forward swing		0,40	mm	0,00 - 4,00	mm
Contact sysnchronism		0,20	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,60	ms	0,60	ms	1,60	ms	<= 7,00	ms
Single contact bounce	0,20	ms	0,20	ms	0,30	ms	<= 2,00	ms
No. of bounces	1	times	1	times	2	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883314	**+J05**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060116	Inspector:	Becker

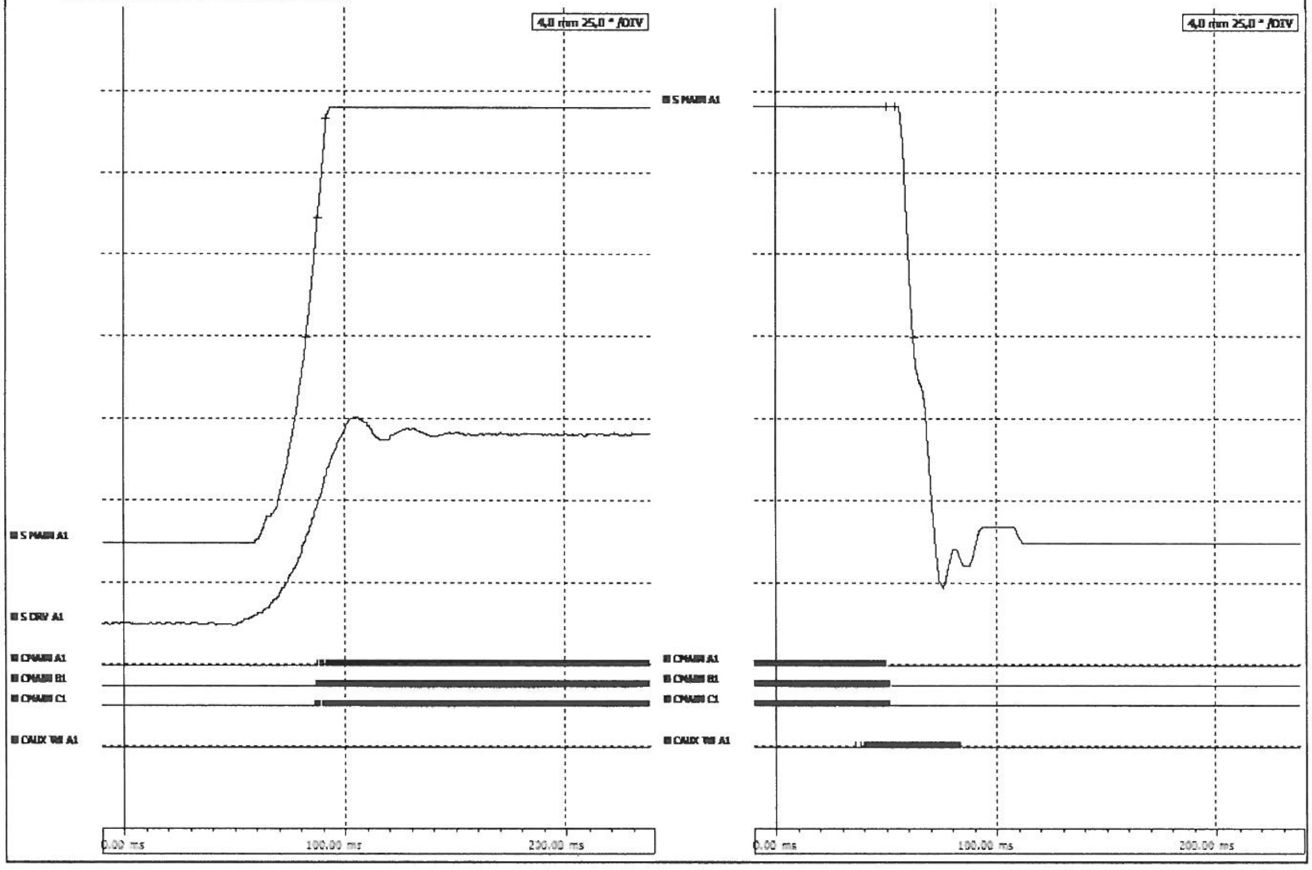
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,16	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,43	m/s	1,10 - 1,80	m/s
Close operation time	te	88,20	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	50,70	ms	45,00 - 65,00	ms
Passing contact time		48,40	ms	8,00 - 200,00	ms
Contact travel		21,20	mm	18,00 - 22,00	mm
max. over swing		2,20	mm	0,00 - 3,00	mm
max. forward swing		0,80	mm	0,00 - 4,00	mm
Contact sysnchronism		1,40	ms	< 2,00	ms

Close operation	L1		L2		L3		**Tolerances**	
Contact bounce time	4,00	ms	0,70	ms	3,20	ms	<= 7,00	ms
Single contact bounce	0,60	ms	0,20	ms	0,30	ms	<= 2,00	ms
No. of bounces	2	times	1	times	1	times	<= 3	times

Open operation	L1		L2		L3		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS
Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883314	**+J06**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060117	Inspector:	Becker

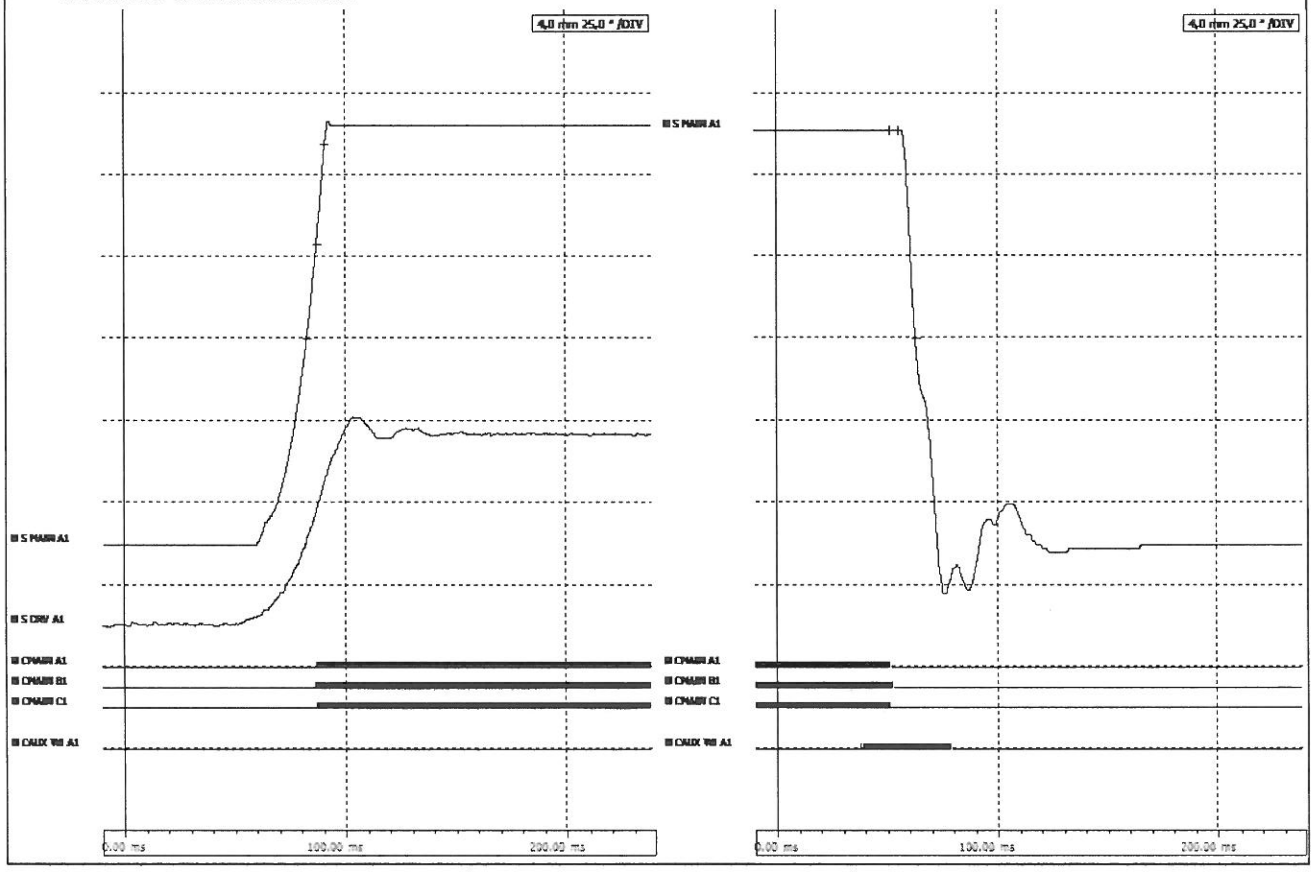
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,14	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,37	m/s	1,10 - 1,80	m/s
Close operation time	te	87,30	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	51,70	ms	45,00 - 65,00	ms
Passing contact time		44,10	ms	8,00 - 200,00	ms
Contact travel		20,40	mm	18,00 - 22,00	mm
max. over swing		2,40	mm	0,00 - 3,00	mm
max. forward swing		1,90	mm	0,00 - 4,00	mm
Contact sysnchronism		0,50	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,70	ms	0,00	ms	0,60	ms	<= 7,00	ms
Single contact bounce	0,10	ms	0,00	ms	0,10	ms	<= 2,00	ms
No. of bounces	1	times	0	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



IC LMV MS O GIS

Seite: 1/1

Anlage 2 zu Arbeitsanweisung 3-07-03-810-006
Annexure 2 to working instruction 3-07-03-810-006

Messblatt HS/TE - Prüfung
Measuring form HV/PD - test

Ausgabe: 06/15

Auftrags-Nr. / factory No	Feld-Nr. / panel	Prüfer / Inspector
883314	+J01/+J02/+J03	Müller,A. 10.11.2015

Spannungsfall / voltage drop

Messung mit 100 A DC / measurement with 100 Amp DC

	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	
Phase / phase	+J01/+J02	+J02/+J03					
L1	10.6	11.1					[mV]
L2	11.2	11.0					[mV]
L3	10.8	11.1					[mV]

Gasmessung / gas measurement

Taupunkt / dew point T< -25°C; Gasqualität / gas quality G>97%

	Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels	
	+J01		+J02		+J03							
Gasraum / gas compartment	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]
Leistungsschalter / circuit breaker	-39	99.9	-41	99.2	-42	99.2						
Trenner 1 / disconnector 1	/	/	/	/	/	/						
Trenner 2 / disconnector 2	/	/	/	/	/	/						
SS-Raum / Busbar room	L1		L2		L3		L1		L2		L3	

Nennstehwechselspannung / rated power frequency withstand voltage

Prüfer / Inspector
Cermak,M. 10.11.2015

U_r : 27 kV

Leiter / Erde; Phase / Earth; tested with 70 kV

offene Schaltstrecke / open interruiter tested with 70 kV

offene Trennstrecke / open isolating distance tested with 80 kV

Teilentladungs-Messung in pC / partial discharge measurement in pC

	L1	L2	L3	
1.1 x U_r	3	3	3	max. Meßwert / setpoint ≤ 20 pC
1.1 x $U_r / \sqrt{3}$	2	2	2	max. Meßwert / setpoint ≤ 3 pC
kV	/	/	/	TE- Aussetzspannung / PD-extinction voltage

Spannungsanzeige / voltage indication

	L1 (0.1 - 0.45 x U_b)	*L2* (0.1 - 0.45 x U_b)	*L3* (0.1 - 0.45 x U_b)
LRM Modul: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	7.1	7.3	7.6
Capdis/VOIS: Volle Pfeilanzeige (full arrow)	/	/	/
Capdis/VOIS*: Volle Pfeilanzeige (full arrow)	/	/	/
LRM Modul*: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	/	/	/

Anpassungsmodul CAPDIS:
Adaptable module CAPDIS :

/ pF

**(Zusätzlicher Abgriff / additonal connection)*

Überprüfung der Spannungsanzeige bei Betriebspannung Ub (gemäß IEC 61243-5)
*Check of voltage indication at operating voltage **Ub** (acc. to IEC 61243-5)*

IC LMV MS O GIS

Seite: 1/1

Anlage 2 zu Arbeitsanweisung 3-07-03-810-006
Annexure 2 to working instruction 3-07-03-810-006

Messblatt HS/TE - Prüfung
Measuring form HV/PD - test

Ausgabe: 06/15

Auftrags-Nr. / factory No	Feld-Nr. / panel	Prüfer / Inspector
883314	+J04/+J05/+J06	Lembke 05.11.2015

Spannungsfall / voltage drop

Messung mit 100 A DC / measurement with 100 Amp DC

	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	
Phase / phase	+J04/+J05	+J05/+J06					
L1	11.3	11.5					[mV]
L2	11.3	11.6					[mV]
L3	11.3	11.5					[mV]

Gasmessung / gas measurement

Taupunkt / dew point T< -25°C; Gasqualität / gas quality G>97%

	Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels	
	+J04		+J05		+J06							
Gasraum / gas compartment	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]
Leistungsschalter / circuit breaker	-35	99.0	-36	99.6	-35	99.8						
Trenner 1 / disconnector 1	/	/	/	/	/	/						
Trenner 2 / disconnector 2	/	/	/	/	/	/						
SS-Raum / Busbar room	L1		L2		L3		L1		L2		L3	

Nennstehwechselspannung / rated power frequency withstand voltage

Prüfer / Inspector
Lech 05.11.2015

U_r: 27 kV

Leiter / Erde; Phase / Earth; tested with 70 kV

offene Schaltstrecke / open interruiter tested with 70 kV

offene Trennstrecke / open isolating distance tested with / kV

Teilentladungs-Messung in pC / partial discharge measurement in pC

	L1	L2	L3	
1.1 x U_r	2	2	2	max. Meßwert / setpoint ≤ 20 pC
1.1 x U_r / √3	2	2	2	max. Meßwert / setpoint ≤ 3 pC
kV	/	/	/	TE- Aussetzspannung / PD-extinction voltage

Spannungsanzeige / voltage indication

	L1 (0.1 - 0.45 x U_b)	***L2*** (0.1 - 0.45 x U_b)	***L3*** (0.1 - 0.45 x U_b)
LRM Modul: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	7.4	7.2	7.2
Capdis/VOIS: Volle Pfeilanzeige (full arrow)	/	/	/
Capdis/VOIS*: Volle Pfeilanzeige (full arrow)	/	/	/
LRM Modul*: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	/	/	/
(Zusätzlicher Abgriff / additonal connection)	*Anpassungsmodul CAPDIS:* *Adaptable module CAPDIS:*		
Überprüfung der Spannungsanzeige bei Betriebspannung Ub (gemäß IEC 61243-5) *Check of voltage indication at operating voltage Ub (acc. to IEC 61243-5)*	/ pF		

PRÜFPROTOKOLL
[ROUTINE TEST REPORT]

AUSGABEDATUM: **07.11.2015**
[DATE OF ISSUE]
GEPRÜFT VON: **Mr.BASARAN**
[TESTED BY]
ABNAHME DURCH:
[ACCEPTED BY]
TEST ERGEBNISS: **BESTANDEN**
[TEST RESULT] [PASSED]

PROJEKT
[PROJECT]

Kunde: SIEMENS AG Schaltanlagenwerk
[Customer]
Bestellnummer: 0040038835 Pos.: 10
[Purchase order]
Vertragsnummer: 883314-05
[Contract number]
Fertigungsnummer/Stückzahl: 1512776 / 3
[Job number / Units]
Datum: 15.10.2015
[Date of test]

SPANNUNGSWANDLER
[VOLTAGE TRANSFORMER]

Typ: ZIESS40.5SIASS6PS2
[Type]
Übersetzung: 24940:V3/120:V3
[Ratio]
Seriennummer: 15/12776 01..03
[Serial number]
Stückzahl: 3
[Quantity]
Anwendungsnorm: IEEE C57.13
[Applicated standard]

DURCHGEFÜHRTE PRÜFUNGEN
[CARRIED OUT TESTS]

1. Prüfung der Anschlußbezeichnungen: ☑
[1. Verification of terminal markings]
2. Wechselspannungprüfungen an Primärwicklungen: ☑
[2. Power-freq withstand test on primary winding]
3. Teilentladungsmessung: ☑
[3. Partial discharge measurement]
4. Wechselspannungprüfungen an Sekundärwicklungen: ☑
[4. Power-freq withstand test on secondary windings]
5. Wechselspannungprüfungen zwischenTeilwicklungen: ☐
[5. Power-freq withstand test between sections]
6. Bestimmung von Meßabweichungen: ☑
[6. Determination of errors]
7. Zusätzlich berechnete Genauigkeit: ☐
[7. Additional calculated accuracy]

Notiz
[NOTES]

WANDLERSPECIFIKATIONEN
[VOLTAGE TRANSFORMER SPECIFICATION]

Typ: [Type]	ZIESS40.5SIASS6PS2
Übersetzung: [Ratio]	24940:V3/120:V3
Isolationsniveau: [Insulation level]	25,5/40/125 kV
Bemessungsfrequenz: [Rated frequency]	60 Hz
Spannungsfaktor: [Voltage factor]	1.9*Un 8h

WICKLUNGSPECIFIKATIONEN
[WINDING SPECIFICATION]

Sekundäranschlüsse: [Secondary terminals]	x1 x2
Übersetzung: [Winding ratio]	24940:V3/120:V3
Klasse / Bürde: [Class / Burden]	0.3XWY

SN: 15/12776 01

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings] 3kV, 60Hz; 1Min **BESTANDEN** [PASSED]

Auf Primärwicklung: [On primary winding] 40,0kV, 250Hz, 29s **BESTANDEN** [PASSED]

Teilentladungsmessung: [Partial discharge test] siehe Tabelle [see table] **BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
31,0	< 3 *
18,0	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 25 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,07	+3,4	+0,21	+2,6
100	+0,08	+3,2	+0,21	+2,6
90	+0,08	+3,2	+0,21	+2,6

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 12,5 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,13	+2,5		
100	+0,13	+2,5		
90	+0,13	+2,4		

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 75 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,24	+0,9		
100	-0,24	+0,8		
90	-0,24	+0,8		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: [Markings verification] **BESTANDEN** [PASSED]

SN: 15/12776 02

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: 3kV, 60Hz; 1Min **BESTANDEN**
[On secondary windings] [PASSED]

Auf Primärwicklung: 40,0kV, 250Hz, 29s **BESTANDEN**
[On primary winding] [PASSED]

Teilentladungsmessung: siehe Tabelle **BESTANDEN**
[Partial discharge test] [see table] [PASSED]

*** BGL**

U[kV]	PD[pC]
31,0	< 3 *
18,0	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: x1 x2
[Terminals]

Übersetzung: 24940:V3/120:V3
[Ratio]

Klasse / Bürde: 0.3 / 25 VA
[Class / Burden]

Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	+0,03	+2,3	+0,17	+1,9
100	+0,04	+2,0	+0,17	+1,9
90	+0,04	+1,9	+0,17	+1,8

Anschlüsse: x1 x2
[Terminals]

Übersetzung: 24940:V3/120:V3
[Ratio]

Klasse / Bürde: 0.3 / 12,5 VA
[Class / Burden]

Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	+0,09	+1,6		
100	+0,09	+1,6		
90	+0,09	+1,5		

Anschlüsse: x1 x2
[Terminals]

Übersetzung: 24940:V3/120:V3
[Ratio]

Klasse / Bürde: 0.3 / 75 VA
[Class / Burden]

Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	-0,25	+0,5		
100	-0,25	+0,5		
90	-0,25	+0,5		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: **BESTANDEN**
[Markings verification] [PASSED]

SN: 15/12776 03

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings]	3kV, 60Hz; 1Min	**BESTANDEN** [PASSED]
Auf Primärwicklung: [On primary winding]	40,0kV, 250Hz, 29s	**BESTANDEN** [PASSED]
Teilentladungsmessung: [Partial discharge test]	siehe Tabelle [see table]	**BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
31,0	< 3 *
18,0	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 25 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	-0,05	-0,3	+0,14	+0,4
100	-0,03	-0,4	+0,14	+0,3
90	-0,03	-0,4	+0,14	+0,3

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 12,5 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	+0,05	+0,1		
100	+0,06	+0,1		
90	+0,06	+0,0		

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 75 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	-0,26	+0,6		
100	-0,25	+0,6		
90	-0,26	+0,7		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: **BESTANDEN**
[Markings verification] [PASSED]

ABKÜRZUNGEN UND DEFINITIONEN
[ABBREVIATION AND DEFINITION]

PF	Power factor [Power factor]
Un	Bemessungsspannung [Rated voltage]
Um	Systemspannung [System voltage]
Ut	Prüfspannung [Test voltage]
Uinc	TE Einsatzspannung [PD inception voltage]
Uext	TE Löschspannung [PD extinction voltage]
V3	Wurzel von 3 [Sqare root of 3]
P	Spannungsfehler [Percentage voltage error]
D	Winkelfehler [Phase displacement error]
PD	Teilentladung [Partial discharge]
BGL	Grundstörungspegel bei Teilentladungsmessung [Partial discharge basic ground level]

SIEMENS AG

Prüfprotokoll / Test Report
Stromwandler / Current Transformer

Besteller	Client	Siemens AG EM MS P GIS
Bestellnummer	Client order No	40038834 M.Schiller
Typ	Type	4MC4_90LZI
Auftr.-Nr.	Order No	80590090.010
Fabr.-Nr.	Serial No	80197882...99
Eigentumsnummer	Ownership number	883314-05
Zusatzdaten / Additional data:		-5°C<=Tamb<=55°C RF 1.33
Norm	Standard	IEEE C57.13 - 2008
Frequenz	Frequency	60 Hz
Iso.-Pegel	Ins. Level	0,66 / 4 / -- kV
Ith		25 kA, 3 s

Klemmen / Terminals	**Klasse / Class**	**Leistung / Power**	**Übersetzung / Ratio**
X1...X5	C 200	RF 1.33	1200/5@MR

Dieses Dokument ist ohne Unterschrift verbindlich.
This document is valid without signature.
30.10.2015

Genauigkeitsprüfung
Determination Of Errors

Fabriknummer Serial No	Klemmen Terminals	k_r	S / VA	100 % I_r	
				RCF	*TCF*
80197882	X1-X5	1200/5	<1	1,00015	0,999966
	X1-X4	800/5	<1	1,00027	0,99999
	X1-X3	300/5	<1	1,001	1,00026
	X1-X2	200/5	<1	1,00185	1,00073
80197883	X1-X5	1200/5	<1	1,00021	0,999977
	X1-X4	800/5	<1	1,00035	1,00001
	X1-X3	300/5	<1	1,00124	1,00038
	X1-X2	200/5	<1	1,00221	1,00096
80197884	X1-X5	1200/5	<1	1,00014	0,999943
	X1-X4	800/5	<1	1,00028	0,999994
	X1-X3	300/5	<1	1,00102	1,00026
	X1-X2	200/5	<1	1,00186	1,00075
80197885	X1-X5	1200/5	<1	1,00016	0,999935
	X1-X4	800/5	<1	1,0003	0,999966
	X1-X3	300/5	<1	1,00118	1,0003
	X1-X2	200/5	<1	1,00214	1,00085
80197886	X1-X5	1200/5	<1	1,0003	1,00011
	X1-X4	800/5	<1	1,0004	1,00012
	X1-X3	300/5	<1	1,00113	1,00037
	X1-X2	200/5	<1	1,00199	1,00085
80197887	X1-X5	1200/5	<1	1,00026	1,00003
	X1-X4	800/5	<1	1,0004	1,00007
	X1-X3	300/5	<1	1,00124	1,00039
	X1-X2	200/5	<1	1,00219	1,00093
80197888	X1-X5	1200/5	<1	1,00018	0,999986
	X1-X4	800/5	<1	1,00029	1,00001
	X1-X3	300/5	<1	1,00101	1,00025
	X1-X2	200/5	<1	1,00184	1,00067
80197889	X1-X5	1200/5	<1	1,00018	0,999986
	X1-X4	800/5	<1	1,00029	1,00001
	X1-X3	300/5	<1	1,00103	1,00027
	X1-X2	200/5	<1	1,00188	1,00073
80197890	X1-X5	1200/5	<1	1,00028	1,00008
	X1-X4	800/5	<1	1,00038	1,0001
	X1-X3	300/5	<1	1,00107	1,00028
	X1-X2	200/5	<1	1,00189	1,00069
80197891	X1-X5	1200/5	<1	1,0002	1,00001
	X1-X4	800/5	<1	1,00032	1,00004
	X1-X3	300/5	<1	1,00103	1,00029
	X1-X2	200/5	<1	1,00187	1,00077
80197892	X1-X5	1200/5	<1	1,0002	1,00002
	X1-X4	800/5	<1	1,00032	1,00005
	X1-X3	300/5	<1	1,00096	1,00023
	X1-X2	200/5	<1	1,00178	1,00067
80197893	X1-X5	1200/5	<1	1,00033	1,00001
	X1-X4	800/5	<1	1,00054	1,00007
	X1-X3	300/5	<1	1,00166	1,00054
	X1-X2	200/5	<1	1,00291	1,00136

Fabriknummer **Serial No**	**Klemmen** **Terminals**	k_r	*S* / **VA**	**100 %** I_r	
				RCF	*TCF*
80197894	X1-X5	1200/5	<1	1,00012	0,99994
	X1-X4	800/5	<1	1,00026	0,999983
	X1-X3	300/5	<1	1,00098	1,00025
	X1-X2	200/5	<1	1,0018	1,0007
80197895	X1-X5	1200/5	<1	1,00028	0,999912
	X1-X4	800/5	<1	1,00046	0,999937
	X1-X3	300/5	<1	1,00187	1,00057
	X1-X2	200/5	<1	1,00325	1,00145
80197896	X1-X5	1200/5	<1	1,00016	0,999955
	X1-X4	800/5	<1	1,00027	0,999967
	X1-X3	300/5	<1	1,00107	1,00025
	X1-X2	200/5	<1	1,00197	1,00076
80197897	X1-X5	1200/5	<1	1,00016	0,999968
	X1-X4	800/5	<1	1,00029	1,00001
	X1-X3	300/5	<1	1,001	1,00026
	X1-X2	200/5	<1	1,00182	1,00071
80197898	X1-X5	1200/5	<1	1,00021	0,999902
	X1-X4	800/5	<1	1,00042	0,999973
	X1-X3	300/5	<1	1,00158	1,00048
	X1-X2	200/5	<1	1,00278	1,00127
80197899	X1-X5	1200/5	<1	1,00031	1,00001
	X1-X4	800/5	<1	1,00048	1,00004
	X1-X3	300/5	<1	1,0016	1,00052
	X1-X2	200/5	<1	1,00279	1,00128

Messdatum / Measuring date: 19.10.2015

Magnetisierungscharakteristik
Excitation Characteristics

Fabriknummer **Serial No**	**Klasse** **Class**	**Klemmen** **Terminals**	E_{ALF} / **V**	$I_{e\,ALF}$ / **A**	$I_{e\,measured}$ / **mA**
80197882	C 200	X1-X5	218	10	63,3
80197883	C 200	X1-X5	218	10	61,7
80197884	C 200	X1-X5	218	10	63,8
80197885	C 200	X1-X5	218	10	64,5
80197886	C 200	X1-X5	218	10	64,5
80197887	C 200	X1-X5	218	10	61,9
80197888	C 200	X1-X5	218	10	63,3
80197889	C 200	X1-X5	218	10	64,5
80197890	C 200	X1-X5	218	10	62,9
80197891	C 200	X1-X5	218	10	63,9
80197892	C 200	X1-X5	218	10	59,9
80197893	C 200	X1-X5	218	10	62,6
80197894	C 200	X1-X5	218	10	63,5
80197895	C 200	X1-X5	218	10	79,8
80197896	C 200	X1-X5	218	10	67
80197897	C 200	X1-X5	218	10	60,9
80197898	C 200	X1-X5	218	10	62,4
80197899	C 200	X1-X5	218	10	60,2

Isolationsprüfung
High Voltage Power-Frequency Withstand Test

Fabr.-Nr. / Serial No: 80197882...99

Wicklungsprüfung Separate source withstand test		4 kV 50 Hz, 1,2 min	Erfolgreich Passed
Windungsprüfung/Offenspannung Inter-turn overvoltage test			Erfolgreich Passed

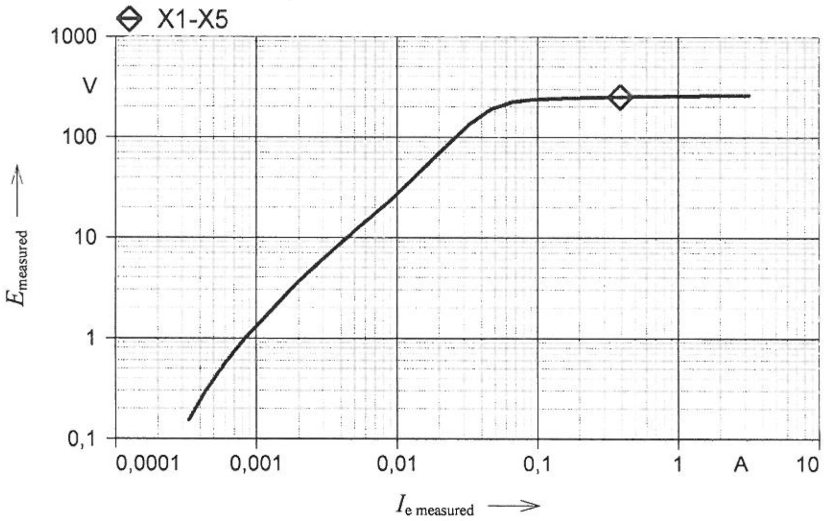
Widerstandsmessung
Measured Resistances

R_{ct} korrigiert auf / corrected to 75 °C

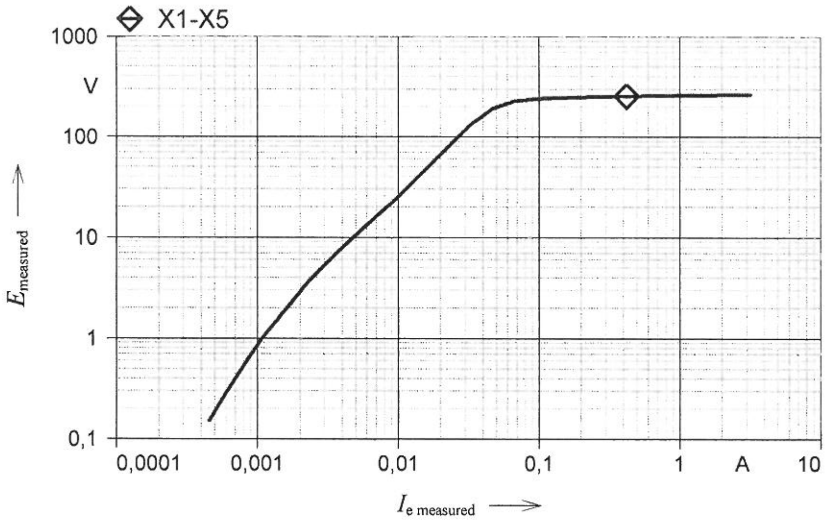
Fabriknummer Serial No	**R_{ct} / Ω**			
	X1-X5	**X1-X4**	**X1-X3**	**X1-X2**
80197882	0,324	0,225	0,105	0,0807
80197883	0,323	0,225	0,105	0,0808
80197884	0,323	0,225	0,105	0,0808
80197885	0,323	0,224	0,105	0,0807
80197886	0,324	0,225	0,105	0,0811
80197887	0,324	0,225	0,105	0,0812
80197888	0,324	0,225	0,105	0,0808
80197889	0,325	0,226	0,105	0,0811
80197890	0,324	0,225	0,105	0,0809
80197891	0,325	0,225	0,105	0,0811
80197892	0,327	0,227	0,105	0,0814
80197893	0,327	0,227	0,105	0,0814
80197894	0,324	0,225	0,105	0,0813
80197895	0,325	0,226	0,105	0,0814
80197896	0,322	0,224	0,105	0,0809
80197897	0,323	0,224	0,105	0,0809
80197898	0,323	0,224	0,105	0,0808
80197899	0,324	0,225	0,105	0,0812

Gemessene Magnetisierungskurven
Measured Excitation Curves

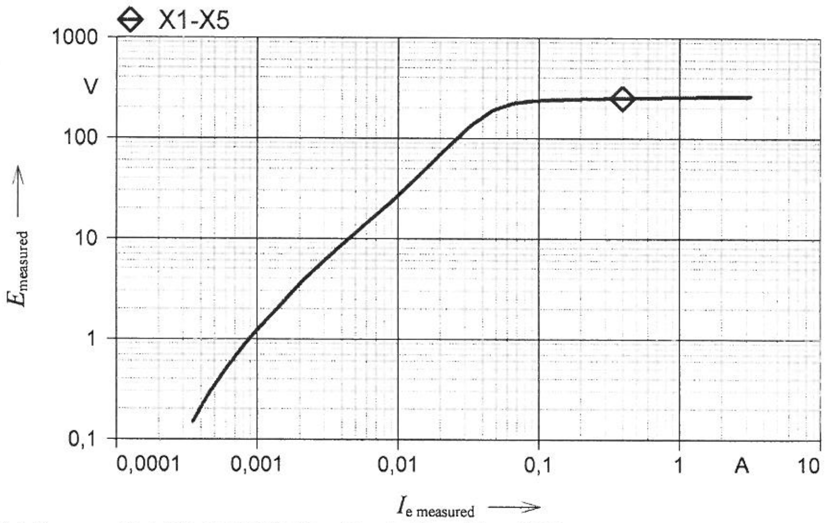
Fabriknummer/Serial No 80197882, Kern/Core 1, Klasse/Class C 200



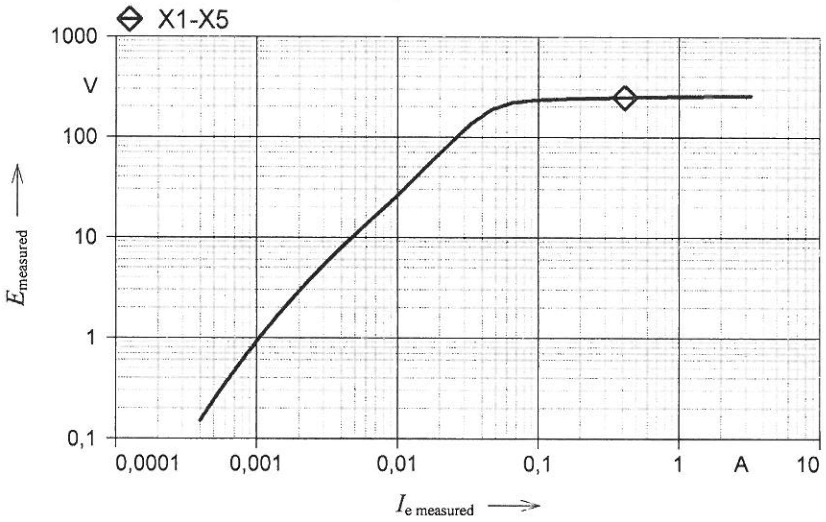
Fabriknummer/Serial No 80197883, Kern/Core 1, Klasse/Class C 200



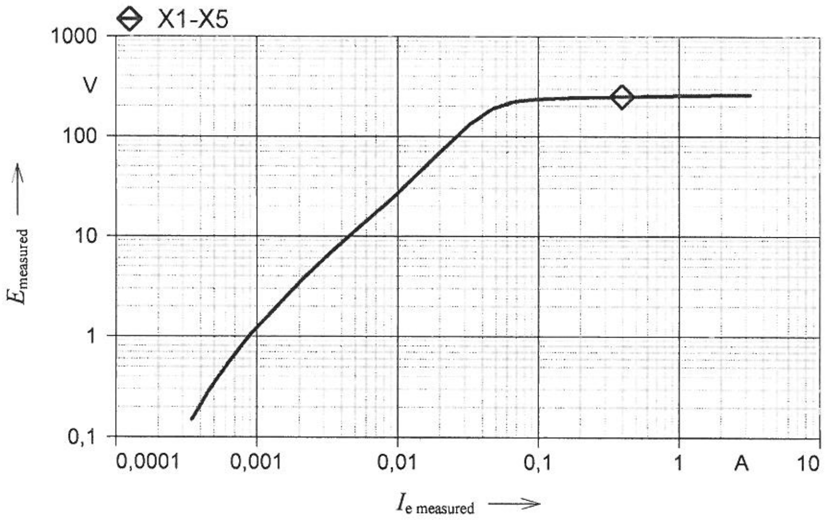
Fabriknummer/Serial No 80197884, Kern/Core 1, Klasse/Class C 200



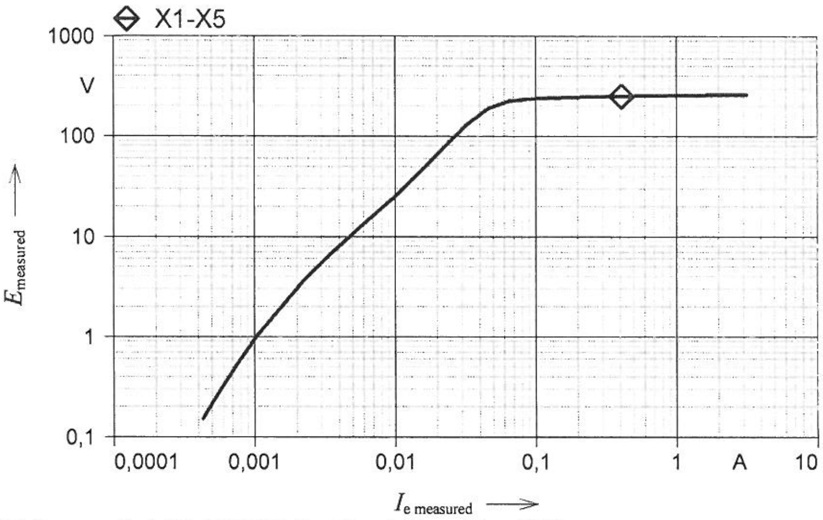
Fabriknummer/Serial No 80197885, Kern/Core 1, Klasse/Class C 200



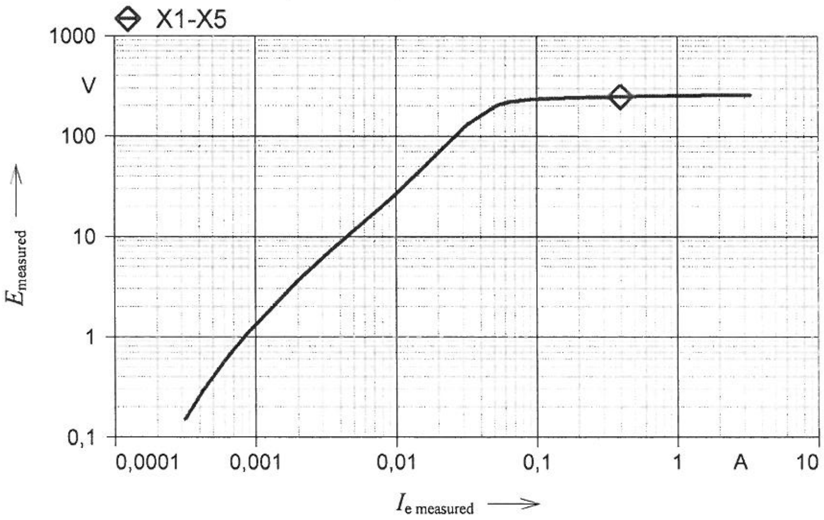
Fabriknummer/Serial No 80197886, Kern/Core 1, Klasse/Class C 200



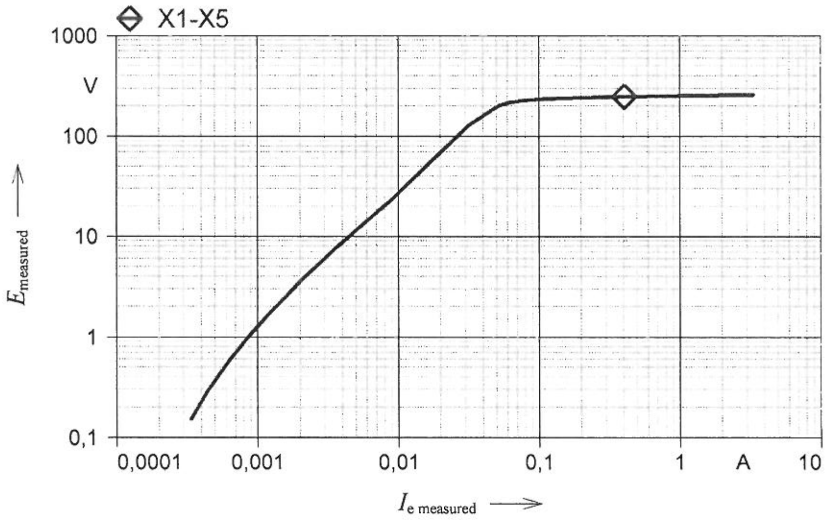
Fabriknummer/Serial No 80197887, Kern/Core 1, Klasse/Class C 200



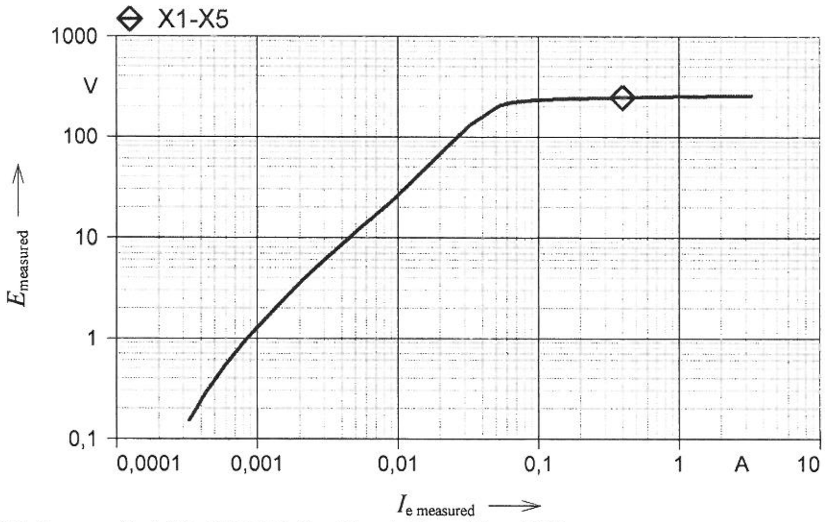
Fabriknummer/Serial No 80197888, Kern/Core 1, Klasse/Class C 200



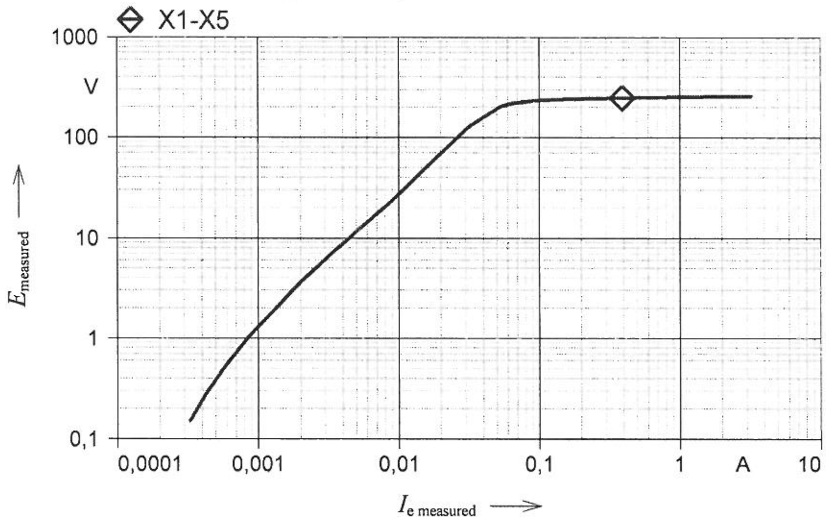
Fabriknummer/Serial No 80197889, Kern/Core 1, Klasse/Class C 200



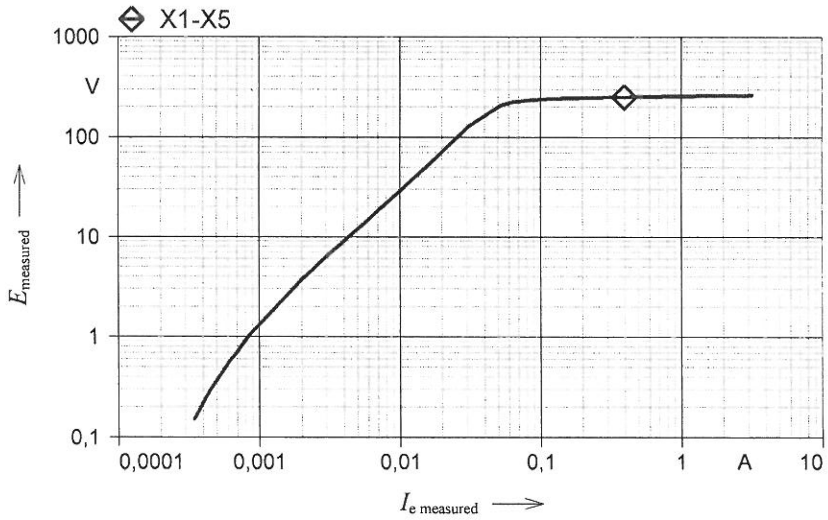
Fabriknummer/Serial No 80197890, Kern/Core 1, Klasse/Class C 200



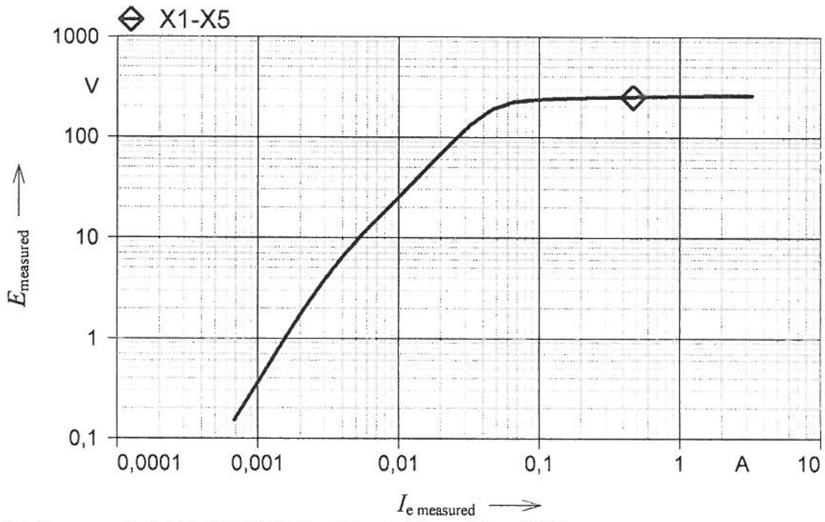
Fabriknummer/Serial No 80197891, Kern/Core 1, Klasse/Class C 200



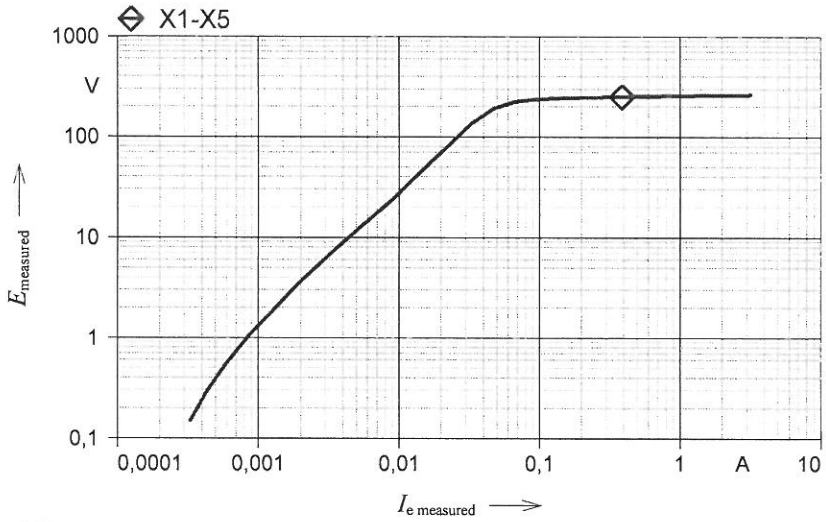
Fabriknummer/Serial No 80197892, Kern/Core 1, Klasse/Class C 200



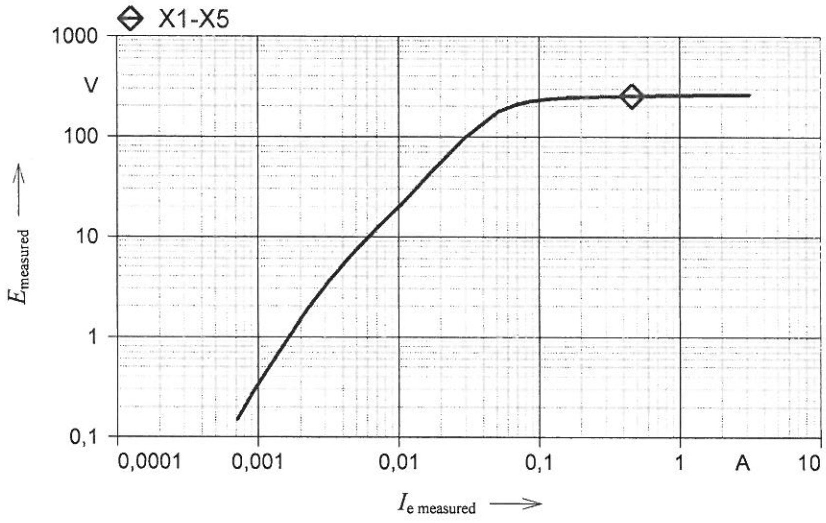
Fabriknummer/Serial No 80197893, Kern/Core 1, Klasse/Class C 200



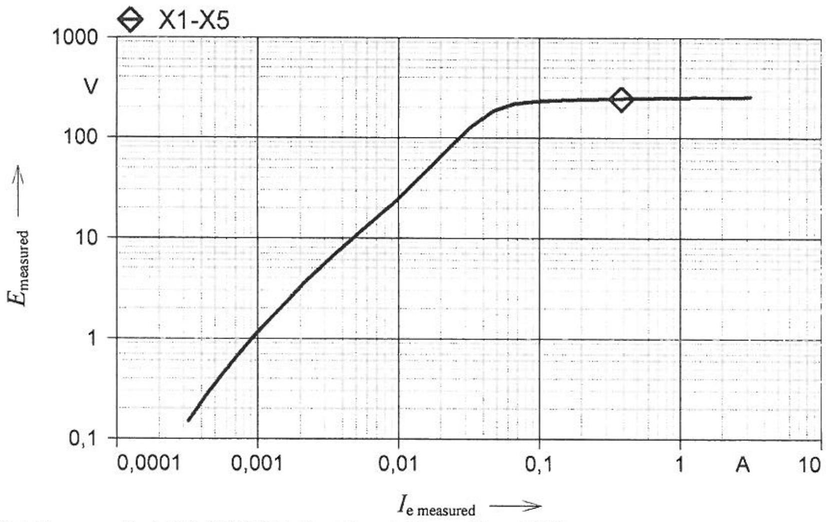
Fabriknummer/Serial No 80197894, Kern/Core 1, Klasse/Class C 200



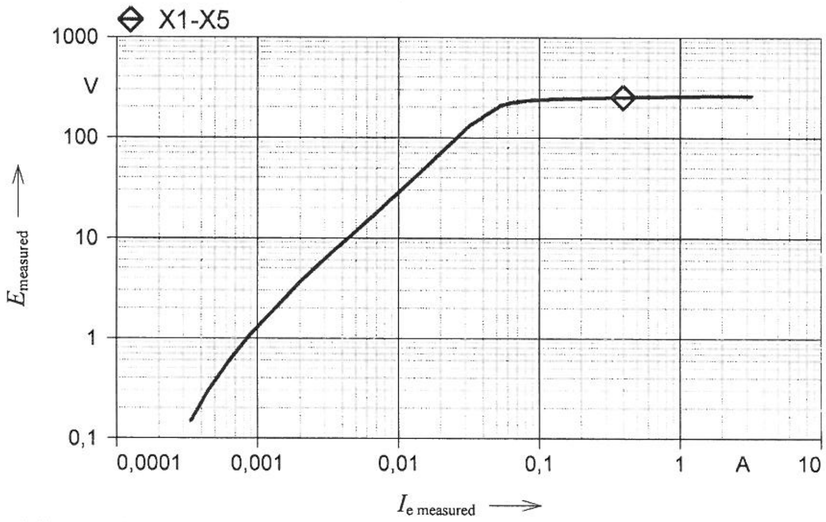
Fabriknummer/Serial No 80197895, Kern/Core 1, Klasse/Class C 200



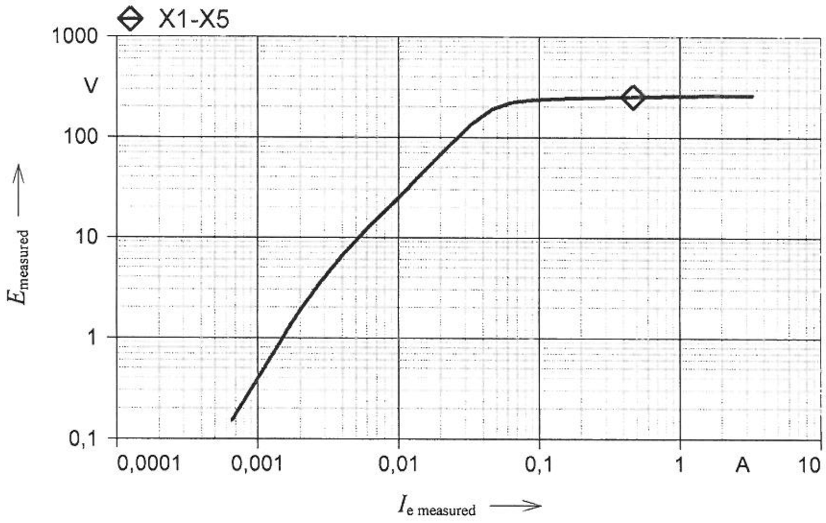
Fabriknummer/Serial No 80197896, Kern/Core 1, Klasse/Class C 200



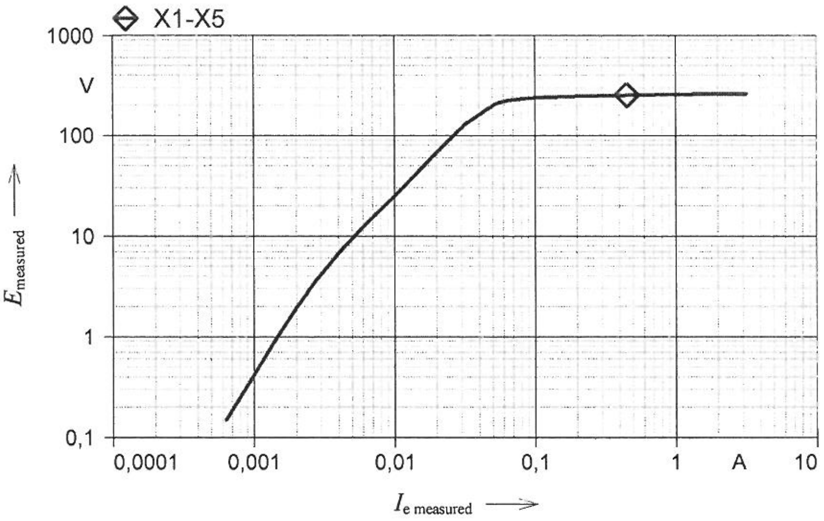
Fabriknummer/Serial No 80197897, Kern/Core 1, Klasse/Class C 200



Fabriknummer/Serial No 80197898, Kern/Core 1, Klasse/Class C 200



Fabriknummer/Serial No 80197899, Kern/Core 1, Klasse/Class C 200



Prüfung der Anschlussbezeichnungen und der Polarität
Verification of Terminal Markings and Polarity

Erfolgreich / Passed

SIEMENS

Energy Management

Prüfbescheinigung / Test Certificate

Kunde / Customer:	Auftrags-Nr. / Fact.ref.no.:	HptPos. / Main item:
CRUM ELECTRIC SUPPLY COMPANY INC	**883597**	**000020**

BZ-Nr. / Order item:	Stück / Quantity:	Schaltanlage / Switchgear:
0003637056, 0030160911 – **CDOT - WEST BUILDING / US –** **MV GIS 24.9 KV - WEST BUILDING**	**1**	**8DA10** **6 Feld(er)/Panel(s)** **6 x LS**

Die Schaltanlage entspricht gemäß IEC 62271-200 folgender IAC Klassifikation / The switchgear conforms to the following IAC classification in accordance with IEC 62271-200:	ANSI 2B 25kA 0,5s

Die Schaltanlage entspricht nachstehenden Bestimmungen und wurde erfolgreich in unserem Prüffeld stückgeprüft:	The switchgear meets the specifications stated below and has been successfully routine-tested at our test field:

IEC 62271-200

§ 7.1	Wechselspannungsprüfung mit 70 kV, 1 min	Power frequency voltage test with 70 kV, 1 min
§ 7.2	Spannungsprüfung an Hilfsstromkreisen mit 1 kV, 1 s	Dielectric test of auxiliary circuits with 1 kV, 1 s
§ 7.3	Widerstandsmessung der Hauptstromkreise	Measurement of the resistance of the main circuit
§ 7.4	Dichtheitsprüfung der gasgefüllten Schotträume	Tightness test of gas-filled compartments
§ 7.5	Konstruktions- und Sichtkontrollen	Design and visual checks
§ 7.101	Teilentladungsprüfung	Partial discharge test
§ 7.102	Mechanische Funktionsprüfungen	Mechanical function test
§ 7.103	Druckprüfung der gasgefüllten Schotträume	Pressure test of gas-filled compartments
§ 7.104	Prüfung der Hilfseinrichtungen Kontrolle der Verdrahtung	Test of auxiliary devices Verification of the correct wiring
§ 7.106	Messung des Gaszustandes nach Füllung	Measurement of gas condition after filling

Datum / Date: 2015-11-13	Hr. / Mr.: Fr. / Mrs.: Thomas Krause Gültig ohne Unterschrift / Valid without signature

* Je nach Feldvariante sind einzelne Prüfungen nicht erforderlich
* Depending on the panel version, some of these tests are not necessary

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	+J01 883597-000080/001	Becker, Frank	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060110

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883597/+J01/085093326
L2	883597/+J01/085093345
L3	883597/+J01/085093346

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197947
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197952
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197950

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1010000562

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J02 883597-000090/001**	**Oehler, Martin**	**2015-11-05**

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060111

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883597/+J02/085093323
L2	883597/+J02/085093324
L3	883597/+J02/085093325

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197953
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197942
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197951

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000560

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	+J03 883597-000100/001	Oehler, Martin	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060109

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883597/+J03/085093320
L2	883597/+J03/085093321
L3	883597/+J03/085093322

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197943
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197941
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197944

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000555

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J04** **883597-000110/001**	**Oehler, Martin**	**2015-11-05**

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060108

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883597/+J04/085093317
L2	883597/+J04/085093318
L3	883597/+J04/085093319

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197945
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197946
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197948

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000559

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	**Seriennummern / serial numbers single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J05** **883597-000120/001**	**Oehler, Martin**	**2015-11-05**

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060107

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883597/+J05/085093314
L2	883597/+J05/085093315
L3	883597/+J05/085093316

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197937
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197938
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197949

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000561

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Einzelfeldprüfung 8DA/B	Seriennummern / serial numbers single panel test 8DA/B

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	+J06 883597-000130/001	Oehler, Martin	2015-11-05

Seriennummern / Serial numbers

Leistungsschalter – Circuit Breaker
3AH49/00060112

Vakuumröhren – Vacuum Interruptor

Phase Phase	Seriennummer Serial - No.
L1	883597/+J06/085093311
L2	883597/+J06/085093312
L3	883597/+J06/085093313

Stromwandler – Current Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
Poltragplatte unten 1, Lower pole baseplate 1	L1	80197936
Poltragplatte unten 1, Lower pole baseplate 1	L2	80197939
Poltragplatte unten 1, Lower pole baseplate 1	L3	80197940

Spannungswandler – Voltage Transformer

Einbauort Location	Phase Phase	Seriennummer Serial - No.
-		

Schutzgeräte – Protective Relais
BM1510000563

Motorsteuerungen – Motor Control Units

Einbauort Location	Seriennummer Serial - No.
-	

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no. **883597-000020**	Feld-Nr. / Panel-no. Serien-Nr. / Serial No. **+J01** **883597-000080/001**	Prüfer, Datum / Inspector, Date **Becker, Frank**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	010					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6,5 mm	L2 :	6,7 mm	L3 :	7,1 mm
Kontaktkraft Contakt pressure	L1:	3162 N	L2 :	3160 N	L3 :	3157 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0,6 mm		Klinkenüberdeckung Latch overlap	6 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59,0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70,0 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140,0 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3.7 mV	L2 :	3.5 mV	L3 :	3.6 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2.2 mV	L2 :	2.2 mV	L3 :	2.4 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9,7 pF	L2 :	9,7 pF	L3 :	9,7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	0 ° / - °	L2 :	0 ° / - °	L3 :	0 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J02** **883597-000090/001**	**Oehler, Martin**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	52					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6.7 mm	L2 :	7.0 mm	L3 :	7.3 mm
Kontaktkraft Contakt pressure	L1:	3160 N	L2 :	3170 N	L3 :	3160 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0.5 mm		Klinkenüberdeckung Latch overlap	8 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59.0 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3.4 mV	L2 :	3.5 mV	L3 :	3.3 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2.1 mV	L2 :	1.9 mV	L3 :	2.1 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9.3 pF	L2 :	9.7 pF	L3 :	9.3 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	0 ° / - °	L2 :	0 ° / - °	L3 :	0 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J03** **883597-000100/001**	**Oehler, Martin**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	21					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	7.3 mm	L2 :	6.6 mm	L3 :	7.2 mm
Kontaktkraft Contakt pressure	L1:	3160 N	L2 :	3170 N	L3 :	3180 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0.5 mm		Klinkenüberdeckung Latch overlap	8 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	59.1 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3.3 mV	L2 :	3.4 mV	L3 :	3.2 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2.2 mV	L2 :	2.2 mV	L3 :	2.2 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9.7 pF	L2 :	9.7 pF	L3 :	9.7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	0 ° / - °	L2 :	0 ° / - °	L3 :	0 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no. **883597-000020**	Feld-Nr. / Panel-no. Serien-Nr. / Serial No. **+J04** **883597-000110/001**	Prüfer, Datum / Inspector, Date **Oehler, Martin**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	21					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	7.4 mm	L2 :	7.3 mm	L3 :	7.2 mm
Kontaktkraft Contakt pressure	L1:	3180 N	L2 :	3150 N	L3 :	3180 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0.4 mm		Klinkenüberdeckung Latch overlap	7 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	58.6 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3.3 mV	L2 :	3.3 mV	L3 :	3.3 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2.0 mV	L2 :	1.9 mV	L3 :	2.1 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9.8 pF	L2 :	9.7 pF	L3 :	9.7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	0 ° / - °	L2 :	0 ° / - °	L3 :	0 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J05** **883597-000120/001**	**Oehler, Martin**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	56					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6.7 mm	L2 :	7.2 mm	L3 :	7.4 mm
Kontaktkraft Contakt pressure	L1:	3150 N	L2 :	3190 N	L3 :	3160 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0.3 mm		Klinkenüberdeckung Latch overlap	7 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	58.1 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	3.6 mV	L2 :	3.4 mV	L3 :	3.3 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	2.0 mV	L2 :	2.1 mV	L3 :	2.0 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9.7 pF	L2 :	9.7 pF	L3 :	9.7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	0 ° / - °	L2 :	0 ° / - °	L3 :	0 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

Messblatt Einzelfeldprüfung 8DA/B	**Measuring values single panel test 8DA/B**

Auftrags- Nr. / Order-no.	Feld-Nr. / Panel-no. Serien-Nr. / Serial No.	Prüfer, Datum / Inspector, Date	
883597-000020	**+J06** **883597-000130/001**	**Oehler, Martin**	**2015-11-05**

Zählerstand nach Dauerschaltung Counter after switching operations	64					
Überhub nach Dauerschaltung Overtravel after switching operations	L1:	6.7 mm	L2 :	7.2 mm	L3 :	6.7 mm
Kontaktkraft Contakt pressure	L1:	3150 N	L2 :	3160 N	L3 :	3180 N
Abstand Rolle - Kurvenscheibe Distance roll - cam disk	0.3 mm		Klinkenüberdeckung Latch overlap	8 mm		
Schaltwinkel an der LS-Welle Switching angle CB driving shaft	58.4 °					
Unterspannungsauslösung Under voltage trip	-Y1:	70 V DC / - V AC	-Y2 :	- V DC / - V AC		
	-Y7:	- V DC / - V AC				
Überpannungsauslösung Over voltage trip	-Y1:	140 V DC / - V AC	-Y2 :	- V DC / - V AC		

Spannungsfall bei 100 A DC / Voltage drop at 100 A DC

Leistungsschalter- / Hochführungstrecke Circuit breaker- / Bus riser distance	L1:	4.0 mV	L2 :	3.9 mV	L3 :	3.8 mV
Trennerstrecke -Q1 Isolator distance –Q1	L1:	1.9 mV	L2 :	2.1 mV	L3 :	1.9 mV
Trennerstrecke -Q2 Isolator distance -Q2	L1:	- mV	L2 :	- mV	L3 :	- mV

Kapazität / Capacity

Kapazität Poltragplatte Capacity pole support plate	L1:	9.7 pF	L2 :	9.7 pF	L3 :	9.7 pF
Sollwerte / Nominal values :	HO system: 11.0 ± 2.0 pF / LRM system: 10.0 ± 2.0 pF / G2 vac. tube: 6.5 ± 1.0 pF					
Sonstiges Others	L1:	- pF	L2 :	- pF	L3 :	- pF

Stromwandler / Current Transformer
Primary injection test

Polarität Stromwandler Polarity Transformer	L1:	0 ° / - °	L2 :	0 ° / - °	L3 :	0 ° / - °
Übersetzungsverhältnis gem. Ü-Plan Transformer ratio acc. single-line diagram	L1:	☒ / ☐	L2 :	☒ / ☐	L3 :	☒ / ☐
Sollwerte / Nominal values :	Nahe/ near 0° / 360° (P1/P2 oder K1/K2)					
Sollwerte / Nominal values :	Nahe /near 180° (P2/P1 oder K2/K1)					

SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883597	**+J01**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060110	Inspector:	Becker

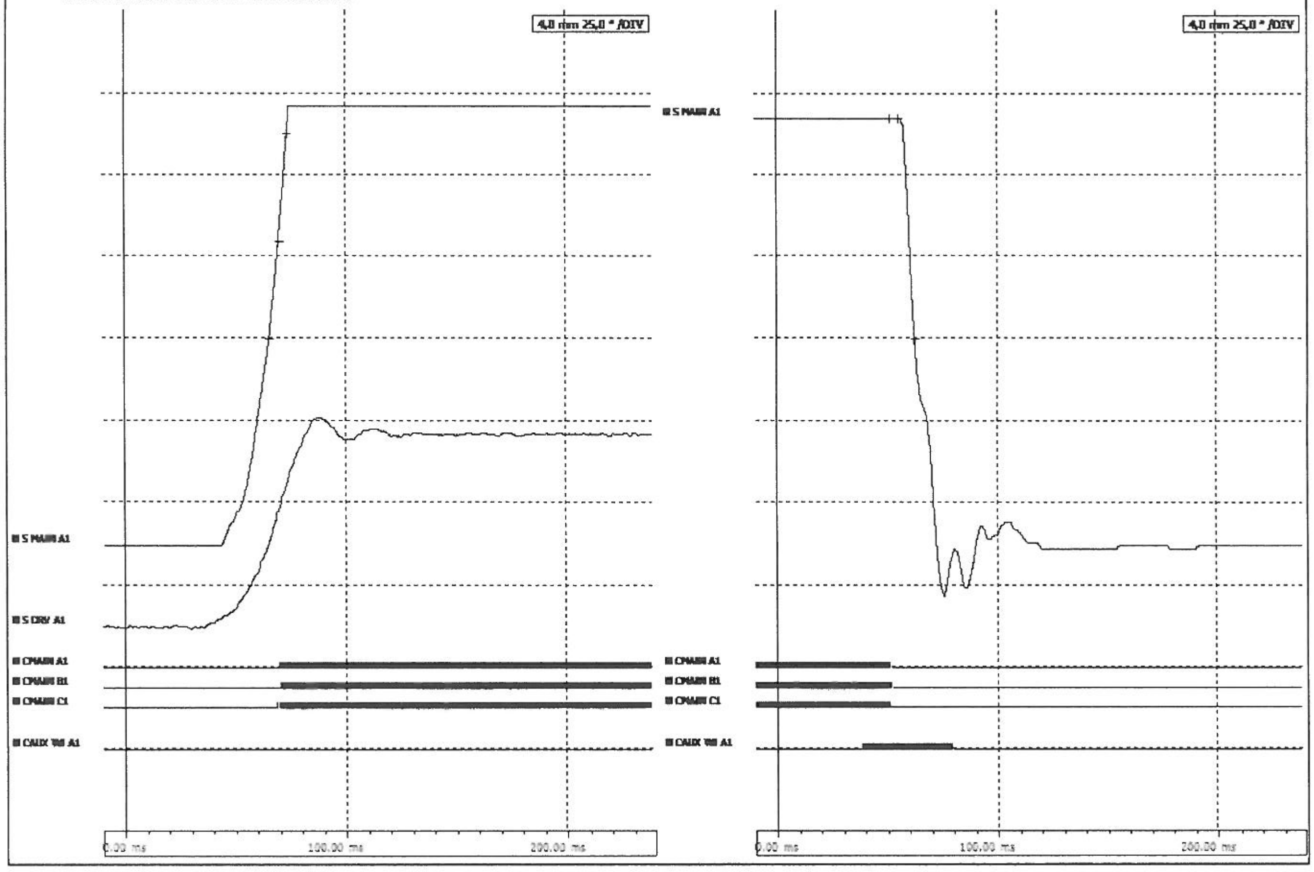
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,19	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,52	m/s	1,10 - 1,80	m/s
Close operation time	te	69,90	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	51,70	ms	45,00 - 65,00	ms
Passing contact time		43,20	ms	8,00 - 200,00	ms
Contact travel		21,40	mm	18,00 - 22,00	mm
max. over swing		2,60	mm	0,00 - 3,00	mm
max. forward swing		1,10	mm	0,00 - 4,00	mm
Contact sysnchronism		0,90	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,00	ms	0,80	ms	0,80	ms	<= 7,00	ms
Single contact bounce	0,00	ms	0,30	ms	0,30	ms	<= 2,00	ms
No. of bounces	0	times	1	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883597	**+J02**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060111	Inspector:	Oehler

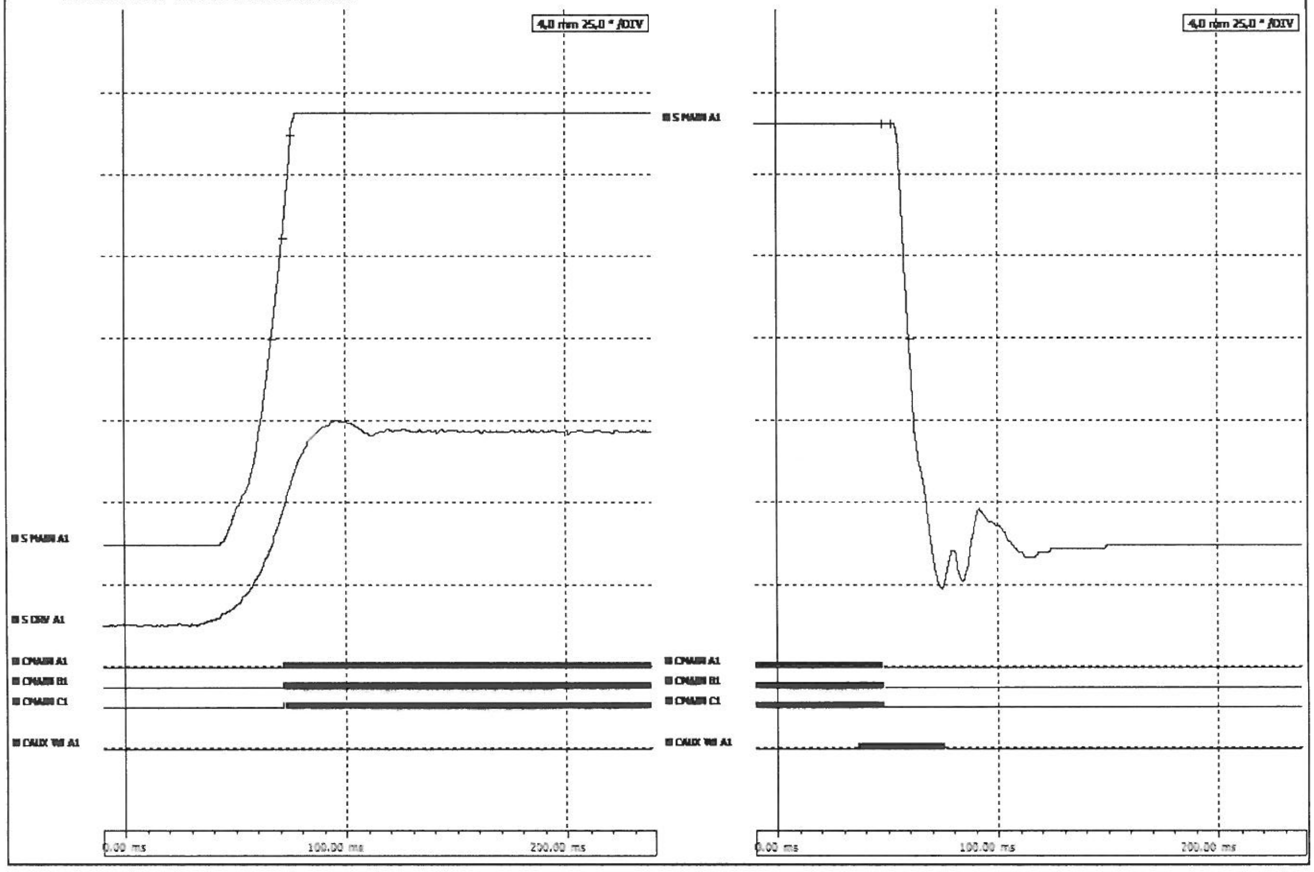
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,10	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,28	m/s	1,10 - 1,80	m/s
Close operation time	te	71,80	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	47,90	ms	45,00 - 65,00	ms
Passing contact time		39,80	ms	8,00 - 200,00	ms
Contact travel		21,00	mm	18,00 - 22,00	mm
max. over swing		2,20	mm	0,00 - 3,00	mm
max. forward swing		1,70	mm	0,00 - 4,00	mm
Contact sysnchronism		0,10	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,70	ms	1,70	ms	0,80	ms	<= 7,00	ms
Single contact bounce	0,20	ms	0,20	ms	0,20	ms	<= 2,00	ms
No. of bounces	1	times	2	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883597	**+J03**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060109	Inspector:	Oehler

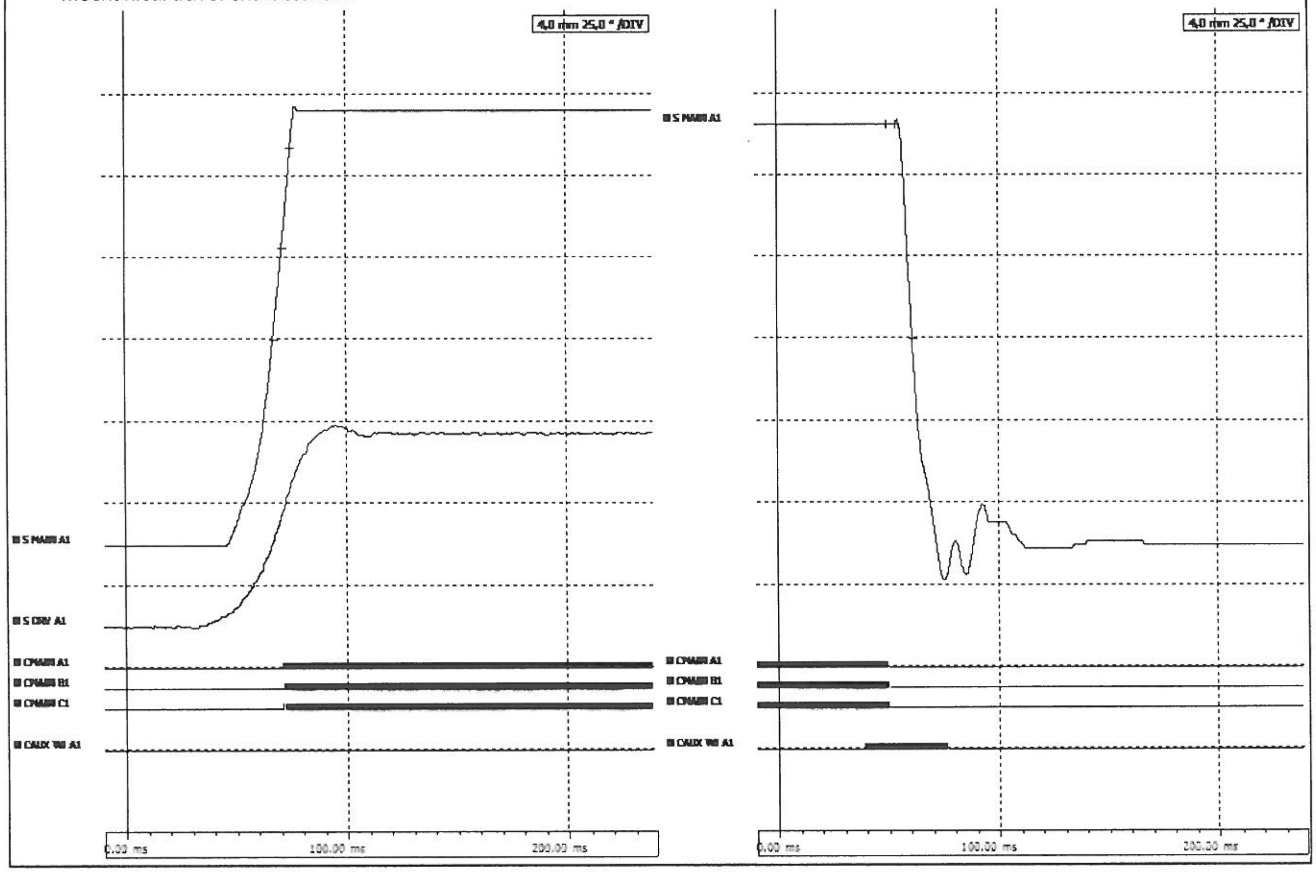
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,16	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,37	m/s	1,10 - 1,80	m/s
Close operation time	te	71,30	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	49,70	ms	45,00 - 65,00	ms
Passing contact time		40,90	ms	8,00 - 200,00	ms
Contact travel		21,20	mm	18,00 - 22,00	mm
max. over swing		1,70	mm	0,00 - 3,00	mm
max. forward swing		1,90	mm	0,00 - 4,00	mm
Contact sysnchronism		0,50	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,70	ms	0,60	ms	0,80	ms	<= 7,00	ms
Single contact bounce	0,30	ms	0,20	ms	0,30	ms	<= 2,00	ms
No. of bounces	1	times	1	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS

Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883597	**+J04**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060108	Inspector:	Oehler

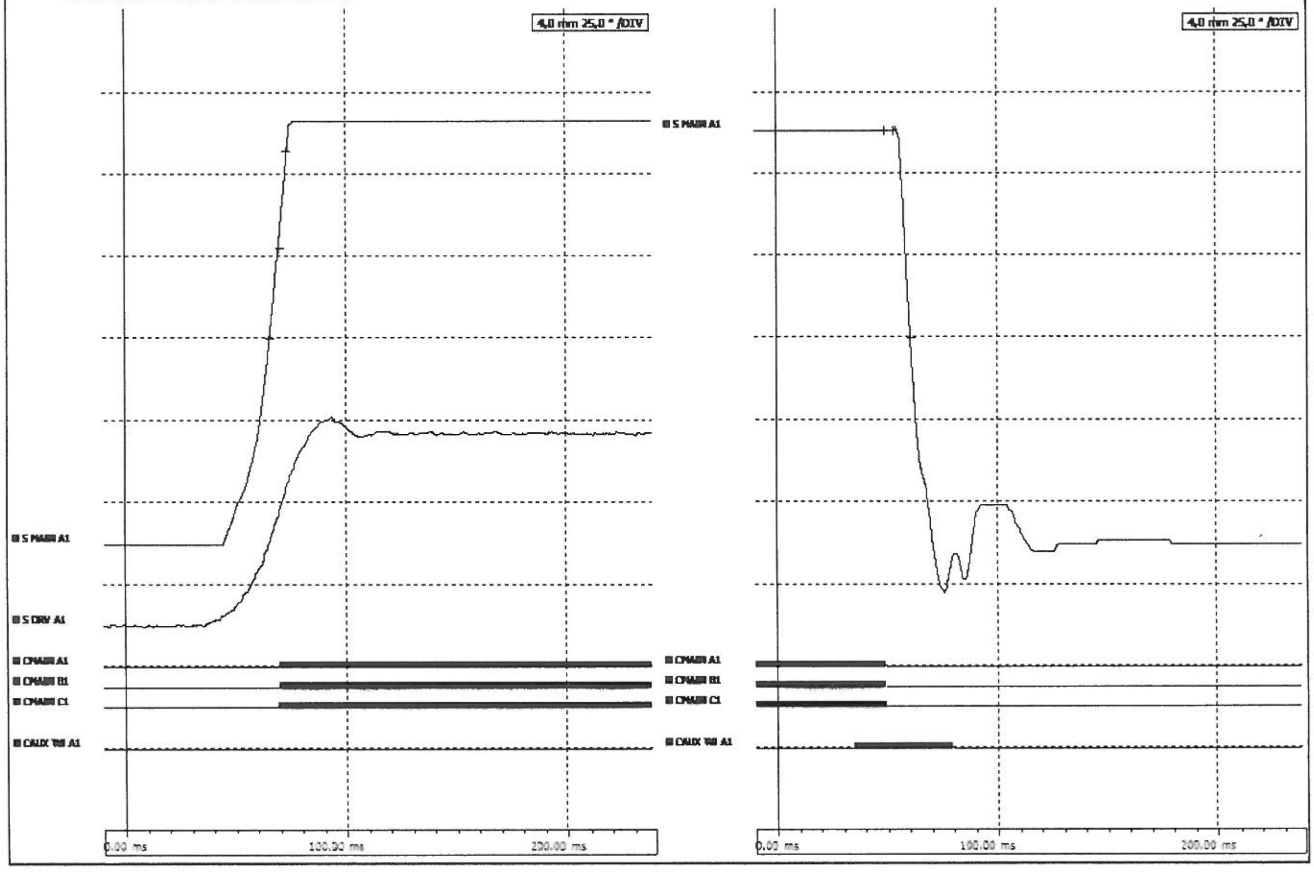
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,13	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,33	m/s	1,10 - 1,80	m/s
Close operation time	te	69,80	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	49,30	ms	45,00 - 65,00	ms
Passing contact time		44,50	ms	8,00 - 200,00	ms
Contact travel		20,60	mm	18,00 - 22,00	mm
max. over swing		2,40	mm	0,00 - 3,00	mm
max. forward swing		1,80	mm	0,00 - 4,00	mm
Contact sysnchronism		0,40	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,00	ms	0,80	ms	0,70	ms	<= 7,00	ms
Single contact bounce	0,00	ms	0,20	ms	0,30	ms	<= 2,00	ms
No. of bounces	0	times	1	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS	Page: 1/1
Annexure 8 to working instruction 3-3810-004 Measured-data log for single-panel-test	Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883597	**+J05**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060107	Inspector:	Oehler

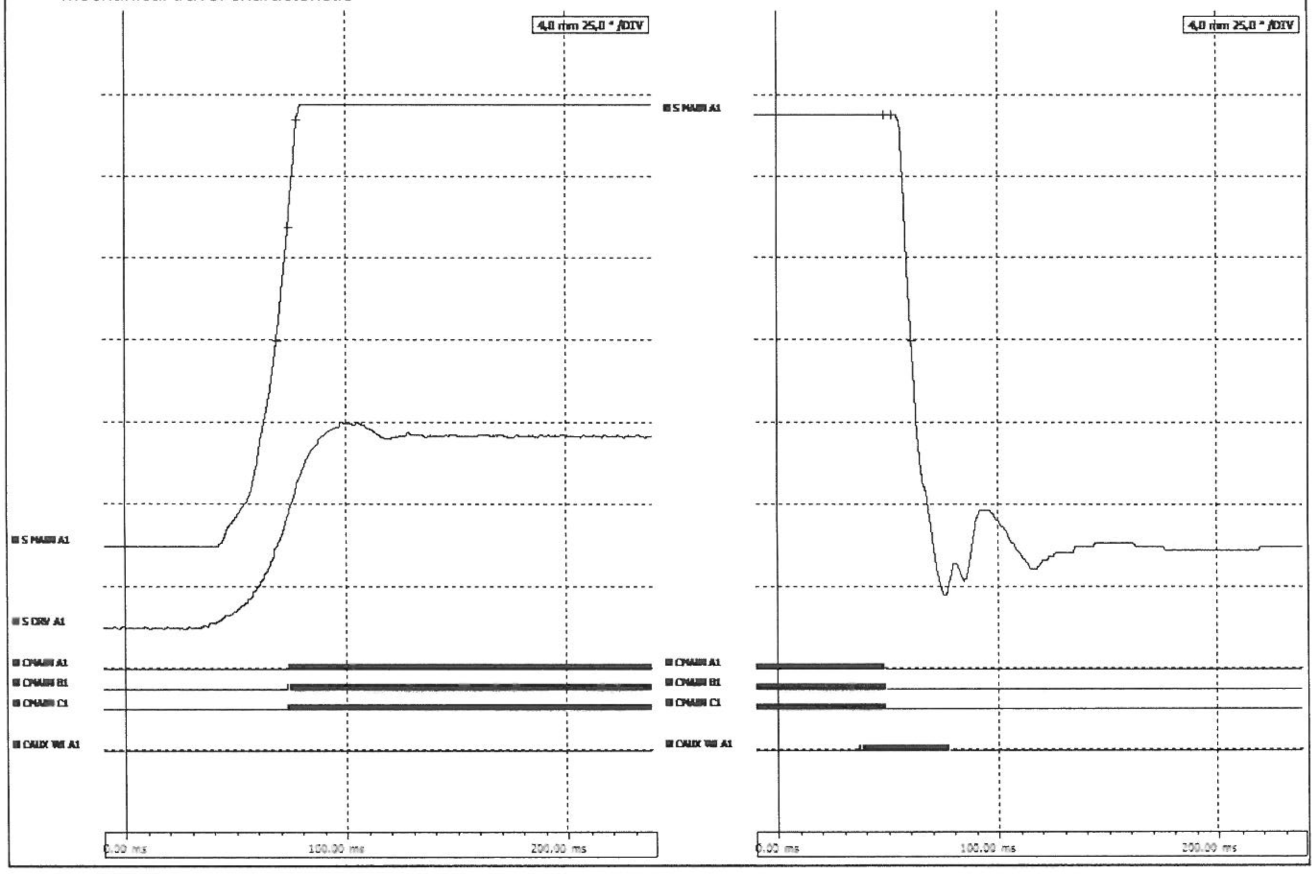
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,17	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,28	m/s	1,10 - 1,80	m/s
Close operation time	te	74,10	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	48,50	ms	45,00 - 65,00	ms
Passing contact time		42,60	ms	8,00 - 200,00	ms
Contact travel		21,50	mm	18,00 - 22,00	mm
max. over swing		2,40	mm	0,00 - 3,00	mm
max. forward swing		1,70	mm	0,00 - 4,00	mm
Contact sysnchronism		0,30	ms	< 2,00	ms

Close operation	**L1**		**L2**		**L3**		**Tolerances**	
Contact bounce time	0,80	ms	0,80	ms	1,60	ms	<= 7,00	ms
Single contact bounce	0,50	ms	0,30	ms	0,20	ms	<= 2,00	ms
No. of bounces	1	times	1	times	1	times	<= 3	times

Open operation	**L1**		**L2**		**L3**		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



SIEMENS
Annexure 8 to working instruction 3-3810-004
Measured-data log for single-panel-test

Page: 1/1
Release: 08/10

Circuit breaker routine test 8DA/DB

Factory No.	Panel No.
883597	**+J06**

Vaccum tube type:	VSG360	Date:	05.11.2015
Circuit breaker mechanism type:	3AH49/00060112	Inspector:	Oehler

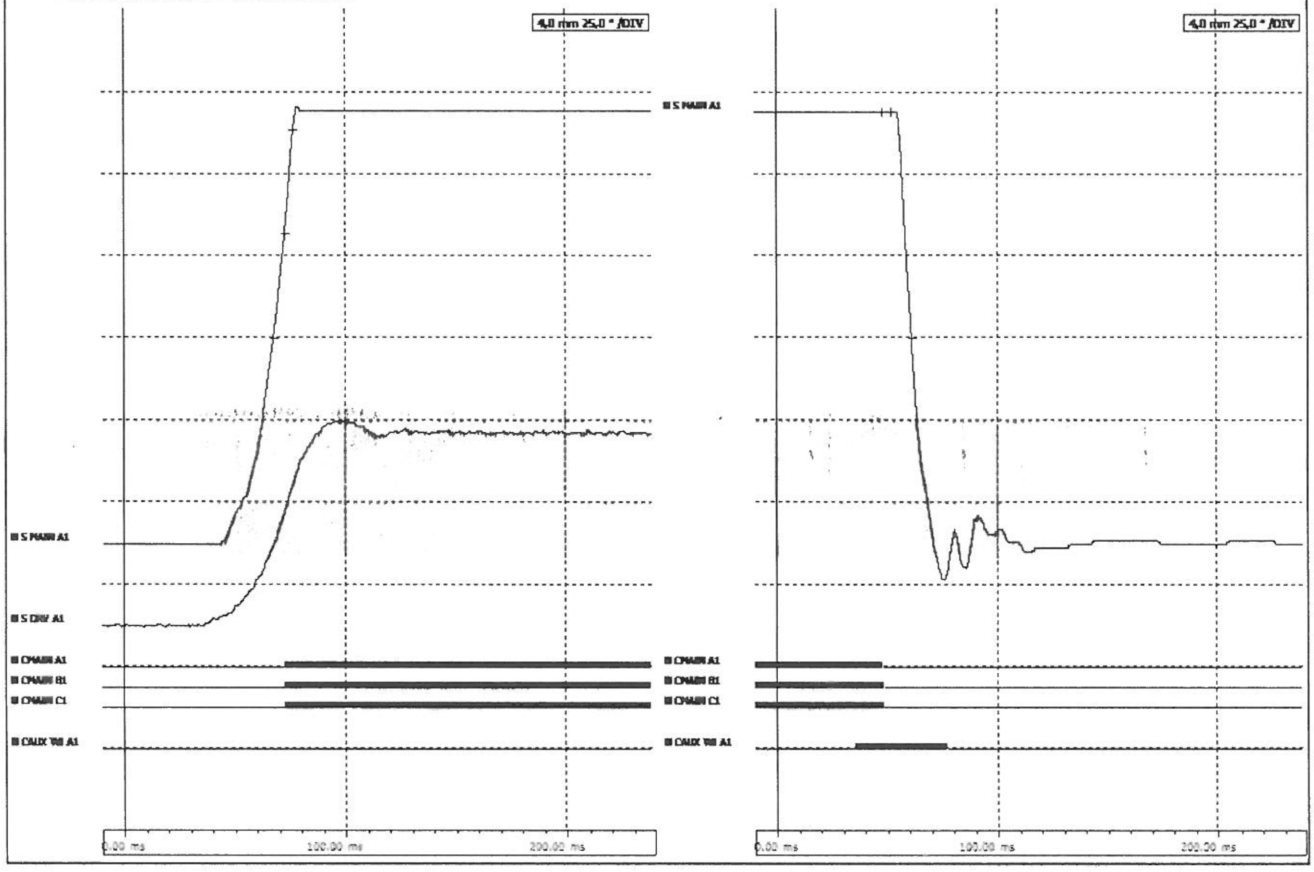
25 Close-open operating cycles	completed	☑
5 Close-open operating cycles at maximum supply voltage	completed	☑
5 Close-open operating cycles at minimum supply voltage	completed	☑

Measurement of operating times				**Tolerances**	
Close operation speed	ve	1,12	m/s	1,10 - 1,70	m/s
Open operation speed	va	1,21	m/s	1,10 - 1,80	m/s
Close operation time	te	72,90	ms	60,00 - 95,00	ms
Open operation time Y1	ta1	48,20	ms	45,00 - 65,00	ms
Passing contact time		44,50	ms	8,00 - 200,00	ms
Contact travel		21,10	mm	18,00 - 22,00	mm
max. over swing		1,70	mm	0,00 - 3,00	mm
max. forward swing		1,40	mm	0,00 - 4,00	mm
Contact sysnchronism		0,20	ms	< 2,00	ms

Close operation	L1		L2		L3		**Tolerances**	
Contact bounce time	0,80	ms	0,70	ms	0,70	ms	<= 7,00	ms
Single contact bounce	0,40	ms	0,10	ms	0,20	ms	<= 2,00	ms
No. of bounces	1	times	1	times	1	times	<= 3	times

Open operation	L1		L2		L3		**Tolerances**	
No. of bounces	0	times	0	times	0	times	<= 0	times

Mechanical travel characteristic



IC LMV MS O GIS

Seite: 1/1

Anlage 2 zu Arbeitsanweisung 3-07-03-810-006
Annexure 2 to working instruction 3-07-03-810-006

Messblatt HS/TE - Prüfung
Measuring form HV/PD - test

Ausgabe: 06/15

Auftrags-Nr. / factory No	Feld-Nr. / panel	Prüfer / Inspector
883597	+J01/+J02/+J03	Lembke 06.11.2015

Spannungsfall / voltage drop

Messung mit 100 A DC / measurement with 100 Amp DC

	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	
Phase / phase	+J01/+J02	+J02/+J03					
L1	10.3	10.9					[mV]
L2	10.5	10.9					[mV]
L3	11.6	11.1					[mV]

Gasmessung / gas measurement

Taupunkt / dew point T< -25°C; Gasqualität / gas quality G>97%

	Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels	
	+J01		+J02		+J03							
Gasraum / gas compartment	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]
Leistungsschalter / circuit breaker	-41	99.5	-45	99.3	-44	98.8						
Trenner 1 / disconnector 1	/	/	/	/	/	/						
Trenner 2 / disconnector 2	/	/	/	/	/	/						
SS-Raum / Busbar room	L1		L2		L3		L1		L2		L3	

Nennstehwechselspannung / rated power frequency withstand voltage

Prüfer / Inspector
Müller, A. 06.11.2015

U$_r$: 27 kV

Leiter / Erde; Phase / Earth;	tested with 70	kV
offene Schaltstrecke / open interruiter	tested with 70	kV
offene Trennstrecke / open isolating distance	tested with 80	kV

Teilentladungs-Messung in pC / partial discharge measurement in pC

	L1	L2	L3	
1.1 x U_r	3	3	3	max. Meßwert / setpoint ≤ 20 pC
1.1 x $U_r / \sqrt{3}$	3	3	3	max. Meßwert / setpoint ≤ 3 pC
kV	/	/	/	TE- Aussetzspannung / PD-extinction voltage

Spannungsanzeige / voltage indication	***L1*** (0.1 - 0.45 x U_b)	***L2*** (0.1 - 0.45 x U_b)	***L3*** (0.1 - 0.45 x U_b)
LRM Modul: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	6.9	7.0	7.0
Capdis/VOIS: Volle Pfeilanzeige (full arrow)	/	/	/
Capdis/VOIS*: Volle Pfeilanzeige (full arrow)	/	/	/
LRM Modul*: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	/	/	/

**(Zusätzlicher Abgriff / additonal connection)*

Anpassungsmodul CAPDIS:
Adaptable module CAPDIS :

/ pF

Überprüfung der Spannungsanzeige bei Betriebsspannung U**b** (gemäß IEC 61243-5)
*Check of voltage indication at operating voltage U**b** (acc. to IEC 61243-5)*

IC LMV MS O GIS

Anlage 2 zu Arbeitsanweisung 3-07-03-810-006
Annexure 2 to working instruction 3-07-03-810-006

Messblatt HS/TE - Prüfung
Measuring form HV/PD - test

Seite: 1/1

Ausgabe: 06/15

Auftrags-Nr. / factory No	Feld-Nr. / panel	Prüfer / Inspector
883597	+J04/+J05/+J06	Müller 10.11.2015

Spannungsfall / voltage drop

Messung mit 100 A DC / measurement with 100 Amp DC

	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	Felder / panels	
Phase / phase	+J04/+J05	+J05/+J06					
L1	10.7	10.6					[mV]
L2	10.8	10.1					[mV]
L3	11.1	10.1					[mV]

Gasmessung / gas measurement

Taupunkt / dew point T< -25°C; Gasqualität / gas quality G>97%

	Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels		Felder / panels	
	+J04		+J05		+J06							
Gasraum / gas compartment	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]	T [°C]	G [%]
Leistungsschalter / circuit breaker	-48	99.2	-48	99.9	-37	99.9						
Trenner 1 / disconnector 1	/	/	/	/	/	/						
Trenner 2 / disconnector 2	/	/	/	/	/	/						
SS-Raum / Busbar room	L1		L2		L3		L1		L2		L3	

Nennstehwechselspannung / rated power frequency withstand voltage

Prüfer / Inspector
Lüdecke 11.11.2015

U_r : 27 kV

Leiter / Erde; Phase / Earth; tested with 70 kV

offene Schaltstrecke / open interruiter tested with 70 kV

offene Trennstrecke / open isolating distance tested with 80 kV

Teilentladungs-Messung in pC / partial discharge measurement in pC

	L1	L2	L3	
1.1 x U_r	2	2	2	max. Meßwert / setpoint ≤ 20 pC
1.1 x U_r / √3	2	2	2	max. Meßwert / setpoint ≤ 3 pC
kV	/	/	/	TE- Aussetzspannung / PD-extinction voltage

Spannungsanzeige / voltage indication

	L1 (0.1 - 0.45 x U_b)	***L2*** (0.1 - 0.45 x U_b)	***L3*** (0.1 - 0.45 x U_b)
LRM Modul: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	7.4	7.4	7.3
Capdis/VOIS: Volle Pfeilanzeige (full arrow)	/	/	/
Capdis/VOIS*: Volle Pfeilanzeige (full arrow)	/	/	/
LRM Modul*: Funktion (1x blinken pro Sekunde) bei / function (1x blink / sec)	/	/	/

(Zusätzlicher Abgriff / additonal connection)

Anpassungsmodul CAPDIS:
Adaptable module CAPDIS :

Überprüfung der Spannungsanzeige bei Betriebspannung U**b** (gemäß IEC 61243-5)
*Check of voltage indication at operating voltage U**b** (acc. to IEC 61243-5)*

/ pF

PRÜFPROTOKOLL
[ROUTINE TEST REPORT]

AUSGABEDATUM: 07.11.2015
[DATE OF ISSUE]

GEPRÜFT VON: Mr.BASARAN
[TESTED BY]

ABNAHME DURCH:
[ACCEPTED BY]

TEST ERGEBNISS: BESTANDEN
[TEST RESULT] [PASSED]

PROJEKT
[PROJECT]

Kunde: SIEMENS AG Schaltanlagenwerk
[Customer]

Bestellnummer: 0040038838 Pos.: 10
[Purchase order]

Vertragsnummer: 883597-05
[Contract number]

Fertigungsnummer/Stückzahl: 1512777 / 3
[Job number / Units]

Datum: 18.10.2015
[Date of test]

SPANNUNGSWANDLER
[VOLTAGE TRANSFORMER]

Typ: 4MU4 FUSE ZEK
[Type]

Übersetzung: 24940:V3/120:V3
[Ratio]

Seriennummer: 15/12777 01..03
[Serial number]

Stückzahl: 3
[Quantity]

Anwendungsnorm: IEEE C57.13
[Applicated standard]

DURCHGEFÜHRTE PRÜFUNGEN
[CARRIED OUT TESTS]

1. Prüfung der Anschlußbezeichnungen: ☑
[1. Verification of terminal markings]

2. Wechselspannungprüfungen an Primärwicklungen: ☑
[2. Power-freq withstand test on primary winding]

3. Teilentladungsmessung: ☑
[3. Partial discharge measurement]

4. Wechselspannungprüfungen an Sekundärwicklungen: ☑
[4. Power-freq withstand test on secondary windings]

5. Wechselspannungprüfungen zwischenTeilwicklungen: ☐
[5. Power-freq withstand test between sections]

6. Bestimmung von Meßabweichungen: ☑
[6. Determination of errors]

7. Zusätzlich berechnete Genauigkeit: ☐
[7. Additional calculated accuracy]

Notiz
[NOTES]

WANDLERSPECIFIKATIONEN
[VOLTAGE TRANSFORMER SPECIFICATION]

Typ: [Type]	4MU4 FUSE ZEK
Übersetzung: [Ratio]	24940:V3/120:V3
Isolationsniveau: [Insulation level]	25,5/40/125 kV
Bemessungsfrequenz: [Rated frequency]	60 Hz
Spannungsfaktor: [Voltage factor]	1.9*Un 8h

WICKLUNGSPECIFIKATIONEN
[WINDING SPECIFICATION]

Sekundäranschlüsse: [Secondary terminals]	x1 x2
Übersetzung: [Winding ratio]	24940:V3/120:V3
Klasse / Bürde: [Class / Burden]	0.3XWY

SN: 15/12777 01

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings]	3kV, 60Hz; 1Min	**BESTANDEN** [PASSED]
Auf Primärwicklung: [On primary winding]	40,0kV, 250Hz, 29s	**BESTANDEN** [PASSED]
Teilentladungsmessung: [Partial discharge test]	siehe Tabelle [see table]	**BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
31,0	< 3 *
18,0	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: [Terminals]	x1 x2
Übersetzung: [Ratio]	24940:V3/120:V3
Klasse / Bürde: [Class / Burden]	0.3 / 25 VA
Klassifizierung: [Determination of errors]	**BESTANDEN** [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,03	+3,8	+0,14	+2,5
100	+0,05	+3,7	+0,14	+2,5
90	+0,06	+3,6	+0,14	+2,4

Anschlüsse: [Terminals]	x1 x2
Übersetzung: [Ratio]	24940:V3/120:V3
Klasse / Bürde: [Class / Burden]	0.3 / 12,5 VA
Klassifizierung: [Determination of errors]	**BESTANDEN** [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,06	+2,2		
100	+0,06	+2,1		
90	+0,07	+2,1		

Anschlüsse: [Terminals]	x1 x2
Übersetzung: [Ratio]	24940:V3/120:V3
Klasse / Bürde: [Class / Burden]	0.3 / 75 VA
Klassifizierung: [Determination of errors]	**BESTANDEN** [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,26	+0,6		
100	-0,26	+0,6		
90	-0,25	+0,7		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: [Markings verification]	**BESTANDEN** [PASSED]

SN: 15/12777 02

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings]	3kV, 60Hz; 1Min	**BESTANDEN** [PASSED]
Auf Primärwicklung: [On primary winding]	40,0kV, 250Hz, 29s	**BESTANDEN** [PASSED]
Teilentladungsmessung: [Partial discharge test]	siehe Tabelle [see table]	**BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
31,0	< 3 *
18,0	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 25 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	+0,01	+0,2	+0,16	+0,5
100	+0,03	+0,2	+0,16	+0,5
90	+0,03	+0,2	+0,16	+0,5

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 12,5 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	+0,09	+0,4		
100	+0,09	+0,4		
90	+0,09	+0,4		

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 75 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	P[%]	D[min]	P[%]	D[min]
110	-0,26	+0,1		
100	-0,27	+0,1		
90	-0,25	-1,3		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: **BESTANDEN**
[Markings verification] [PASSED]

SN: 15/12777 03

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings] 3kV, 60Hz; 1Min **BESTANDEN** [PASSED]

Auf Primärwicklung: [On primary winding] 40,0kV, 250Hz, 29s **BESTANDEN** [PASSED]

Teilentladungsmessung: [Partial discharge test] siehe Tabelle [see table] **BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
31,0	< 3 *
18,0	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 25 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,02	+2,0	+0,13	+1,1
100	+0,04	+2,0	+0,13	+1,0
90	+0,04	+1,9	+0,13	+1,0

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 12,5 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,06	+0,9		
100	+0,06	+0,9		
90	+0,07	+0,8		

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 75 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,26	-0,2		
100	-0,25	-0,3		
90	-0,25	-0,3		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: [Markings verification] **BESTANDEN** [PASSED]

ABKÜRZUNGEN UND DEFINITIONEN
[ABBREVIATION AND DEFINITION]

PF	Power factor [Power factor]
Un	Bemessungsspannung [Rated voltage]
Um	Systemspannung [System voltage]
Ut	Prüfspannung [Test voltage]
Uinc	TE Einsatzspannung [PD inception voltage]
Uext	TE Löschspannung [PD extinction voltage]
V3	Wurzel von 3 [Sqare root of 3]
P	Spannungsfehler [Percentage voltage error]
D	Winkelfehler [Phase displacement error]
PD	Teilentladung [Partial discharge]
BGL	Grundstörungspegel bei Teilentladungsmessung [Partial discharge basic ground level]

SIEMENS

ZELISKO, Z/IN INSTRUMENT TRANSFORMERS

PRÜFPROTOKOLL
[ROUTINE TEST REPORT]

AUSGABEDATUM: **07.11.2015**
[DATE OF ISSUE]
GEPRÜFT VON: **Mr.KUDU**
[TESTED BY]
ABNAHME DURCH:
[ACCEPTED BY]
TEST ERGEBNISS: **BESTANDEN**
[TEST RESULT] [PASSED]

PROJEKT
[PROJECT]

Kunde: SIEMENS AG Schaltanlagenwerk
[Customer]
Bestellnummer: 0040038841 Pos.: 10
[Purchase order]
Vertragsnummer: 883597-05
[Contract number]
Fertigungsnummer/Stückzahl: 1512778 / 3
[Job number / Units]
Datum: 09.10.2015
[Date of test]

SPANNUNGSWANDLER
[VOLTAGE TRANSFORMER]

Typ: 4MU3 FUSE
[Type]
Übersetzung: 24940:V3/120:V3
[Ratio]
Seriennummer: 15/12778 01..03
[Serial number]
Stückzahl: 3
[Quantity]
Anwendungsnorm: IEEE C57.13
[Applicated standard]

DURCHGEFÜHRTE PRÜFUNGEN
[CARRIED OUT TESTS]

1. Prüfung der Anschlußbezeichnungen: ☑
[1. Verification of terminal markings]
2. Wechselspannungprüfungen an Primärwicklungen: ☑
[2. Power-freq withstand test on primary winding]
3. Teilentladungsmessung: ☑
[3. Partial discharge measurement]
4. Wechselspannungprüfungen an Sekundärwicklungen: ☑
[4. Power-freq withstand test on secondary windings]
5. Wechselspannungprüfungen zwischenTeilwicklungen: ☐
[5. Power-freq withstand test between sections]
6. Bestimmung von Meßabweichungen: ☑
[6. Determination of errors]
7. Zusätzlich berechnete Genauigkeit: ☐
[7. Additional calculated accuracy]

Notiz
[NOTES]

WANDLERSPECIFIKATIONEN
[VOLTAGE TRANSFORMER SPECIFICATION]

Typ: [Type]	4MU3 FUSE
Übersetzung: [Ratio]	24940:V3/120:V3
Isolationsniveau: [Insulation level]	25,5/40/125 kV
Bemessungsfrequenz: [Rated frequency]	60 Hz
Spannungsfaktor: [Voltage factor]	1.9*Un 8h

WICKLUNGSPECIFIKATIONEN
[WINDING SPECIFICATION]

Sekundäranschlüsse: [Secondary terminals]	x1 x2
Übersetzung: [Winding ratio]	24940:V3/120:V3
Klasse / Bürde: [Class / Burden]	0.3WXY

SN: 15/12778 01

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: 3kV, 60Hz; 1Min **BESTANDEN**
[On secondary windings] [PASSED]

Auf Primärwicklung: 40,0kV, 150Hz, 48s **BESTANDEN**
[On primary winding] [PASSED]

Teilentladungsmessung: siehe Tabelle **BESTANDEN**
[Partial discharge test] [see table] [PASSED]

*** BGL**

U[kV]	PD[pC]
30,6	< 3 *
19,5	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: x1 x2
[Terminals]

Übersetzung: 24940:V3/120:V3
[Ratio]

Klasse / Bürde: 0.3 / 12,5 VA
[Class / Burden]

Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,05	+0,4	+0,14	+0,5
100	+0,07	+0,4	+0,14	+0,5
90	+0,07	+0,3	+0,14	+0,4

Anschlüsse: x1 x2
[Terminals]

Übersetzung: 24940:V3/120:V3
[Ratio]

Klasse / Bürde: 0.3 / 25 VA
[Class / Burden]

Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,04	-0,3		
100	-0,03	-0,3		
90	-0,03	-0,3		

Anschlüsse: x1 x2
[Terminals]

Übersetzung: 24940:V3/120:V3
[Ratio]

Klasse / Bürde: 0.3 / 75 VA
[Class / Burden]

Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,26	-1,6		
100	-0,26	-1,5		
90	-0,24	-1,4		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: **BESTANDEN**
[Markings verification] [PASSED]

PRÜFPROTOKOLL
[ROUTINE TEST REPORT]

SN: 15/12778 02

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings]	3kV, 60Hz; 1Min	**BESTANDEN** [PASSED]
Auf Primärwicklung: [On primary winding]	40,0kV, 150Hz, 48s	**BESTANDEN** [PASSED]
Teilentladungsmessung: [Partial discharge test]	siehe Tabelle [see table]	**BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
30,6	< 3 *
19,5	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 12,5 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,02	-0,1	+0,14	+0,3
100	+0,04	-0,2	+0,14	+0,2
90	+0,04	-0,2	+0,14	+0,2

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 25 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,03	-0,5		
100	-0,03	-0,5		
90	-0,03	-0,6		

Anschlüsse: [Terminals] x1 x2

Übersetzung: [Ratio] 24940:V3/120:V3

Klasse / Bürde: [Class / Burden] 0.3 / 75 VA

Klassifizierung: [Determination of errors] **BESTANDEN** [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,27	-1,6		
100	-0,27	-1,6		
90	-0,27	-1,6		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: [Markings verification] **BESTANDEN** [PASSED]

SN: 15/12778 03

HOCHSPANNUNGSPRÜFUNG
[DIELECTRIC TEST]

Auf Sekundärwicklungs: [On secondary windings]	3kV, 60Hz; 1Min	**BESTANDEN** [PASSED]
Auf Primärwicklung: [On primary winding]	40,0kV, 150Hz, 48s	**BESTANDEN** [PASSED]
Teilentladungsmessung: [Partial discharge test]	siehe Tabelle [see table]	**BESTANDEN** [PASSED]

*** BGL**

U[kV]	PD[pC]
30,6	6
19,5	< 3 *

GENAUIGKEITSPRÜFUNG
[ACCURACY TEST]

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 12,5 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	12,5 VA; PF 0,10		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,03	+0,2	+0,12	+1,0
100	-0,01	+0,1	+0,12	+1,0
90	-0,01	+0,1	+0,13	+0,9

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 25 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	25 VA; PF 0,70		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	+0,06	+0,6		
100	+0,06	+0,5		
90	+0,06	+0,5		

Anschlüsse: x1 x2
[Terminals]
Übersetzung: 24940:V3/120:V3
[Ratio]
Klasse / Bürde: 0.3 / 75 VA
[Class / Burden]
Klassifizierung: **BESTANDEN**
[Determination of errors] [PASSED]

	75 VA; PF 0,85		0 VA; PF 0,00	
Un[%]	**P[%]**	**D[min]**	**P[%]**	**D[min]**
110	-0,26	-1,7		
100	-0,26	-1,8		
90	-0,26	-1,8		

PRÜFUNG DER ANSCHLUSSBEZEICHNUNGEN
[VERIFICATION OF TERMINAL MARKINGS]

Anschliessenprüfung: **BESTANDEN**
[Markings verification] [PASSED]

ABKÜRZUNGEN UND DEFINITIONEN
[ABBREVIATION AND DEFINITION]

PF	Power factor [Power factor]
Un	Bemessungsspannung [Rated voltage]
Um	Systemspannung [System voltage]
Ut	Prüfspannung [Test voltage]
Uinc	TE Einsatzspannung [PD inception voltage]
Uext	TE Löschspannung [PD extinction voltage]
V3	Wurzel von 3 [Sqare root of 3]
P	Spannungsfehler [Percentage voltage error]
D	Winkelfehler [Phase displacement error]
PD	Teilentladung [Partial discharge]
BGL	Grundstörungspegel bei Teilentladungsmessung [Partial discharge basic ground level]

SIEMENS AG

Prüfprotokoll / Test Report
Stromwandler / Current Transformer

Besteller	Client	Siemens AG EM MS P GIS
Bestellnummer	Client order No	40038836 M.Schiller
Typ	Type	4MC4_90LZI
Auftr.-Nr.	Order No	80590074.010
Fabr.-Nr.	Serial No	80197936...53
Eigentumsnummer	Ownership number	883597-05
Zusatzdaten / Additional data:		-5°C<=Tamb<=55°C RF 1.33
Norm	Standard	IEEE C57.13 - 2008
Frequenz	Frequency	60 Hz
Iso.-Pegel	Ins. Level	0,66 / 4 / -- kV
Ith		25 kA, 3 s

Klemmen / Terminals	**Klasse / Class**	**Leistung / Power**	**Übersetzung / Ratio**
X1...X5	C 200	RF 1.33	1200/5@MR

Dieses Dokument ist ohne Unterschrift verbindlich.
This document is valid without signature.
15.10.2015

Fabriknummer Serial No	**Klemmen Terminals**	k_r	S / VA	**100 % I_r**	
				RCF	*TCF*
80197948	X1-X5	1200/5	<1	1,0001	0,999907
	X1-X4	800/5	<1	1,00026	0,99998
	X1-X3	300/5	<1	1,00115	1,00044
	X1-X2	200/5	<1	1,00216	1,00114
80197949	X1-X5	1200/5	<1	1,00012	0,999929
	X1-X4	800/5	<1	1,0003	1,00001
	X1-X3	300/5	<1	1,00117	1,00045
	X1-X2	200/5	<1	1,00219	1,00113
80197950	X1-X5	1200/5	<1	1,00012	0,999923
	X1-X4	800/5	<1	1,00029	0,999992
	X1-X3	300/5	<1	1,00121	1,00046
	X1-X2	200/5	<1	1,00227	1,00119
80197951	X1-X5	1200/5	<1	1,00023	1,00004
	X1-X4	800/5	<1	1,00036	1,00007
	X1-X3	300/5	<1	1,0013	1,00061
	X1-X2	200/5	<1	1,00239	1,00145
80197952	X1-X5	1200/5	<1	1,00012	0,999911
	X1-X4	800/5	<1	1,00029	0,999976
	X1-X3	300/5	<1	1,00109	1,00023
	X1-X2	200/5	<1	1,00205	1,00072
80197953	X1-X5	1200/5	<1	1,00012	0,999921
	X1-X4	800/5	<1	1,0003	1,00001
	X1-X3	300/5	<1	1,00126	1,00056
	X1-X2	200/5	<1	1,00233	1,00134

Messdatum / Measuring date: 14.10.2015

Magnetisierungscharakteristik
Excitation Characteristics

Fabriknummer Serial No	**Klasse Class**	**Klemmen Terminals**	E_{ALF} / V	$I_{e\,ALF}$ / A	$I_{e\,measured}$ / mA
80197936	C 200	X1-X5	214	10	297
80197937	C 200	X1-X5	214	10	111
80197938	C 200	X1-X5	214	10	119
80197939	C 200	X1-X5	214	10	119
80197940	C 200	X1-X5	214	10	138
80197941	C 200	X1-X5	214	10	139
80197942	C 200	X1-X5	214	10	110
80197943	C 200	X1-X5	214	10	100
80197944	C 200	X1-X5	214	10	206
80197945	C 200	X1-X5	214	10	102
80197946	C 200	X1-X5	214	10	107
80197947	C 200	X1-X5	214	10	108
80197948	C 200	X1-X5	214	10	126
80197949	C 200	X1-X5	214	10	131
80197950	C 200	X1-X5	214	10	113
80197951	C 200	X1-X5	214	10	103
80197952	C 200	X1-X5	214	10	154
80197953	C 200	X1-X5	214	10	107

Isolationsprüfung
High Voltage Power-Frequency Withstand Test

Fabr.-Nr. / Serial No: 80197936...53

Wicklungsprüfung Separate source withstand test		4 kV 50 Hz, 1,2 min	Erfolgreich Passed
Windungsprüfung/Offenspannung Inter-turn overvoltage test			Erfolgreich Passed

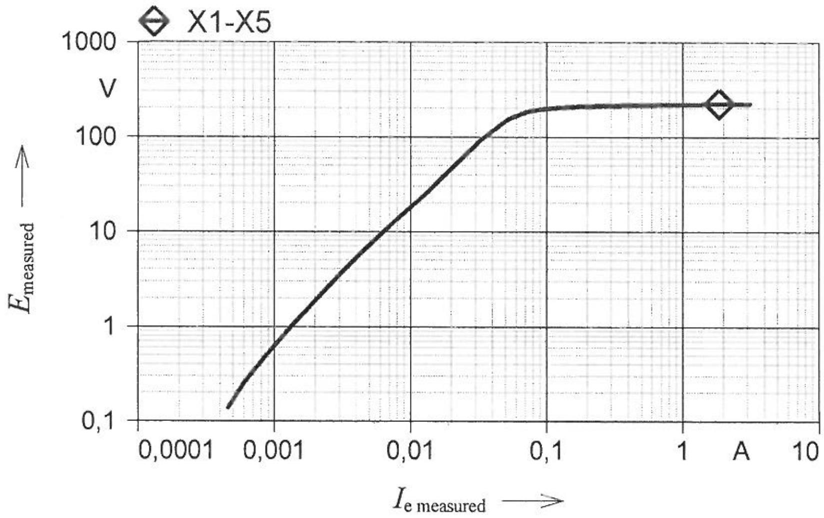
Widerstandsmessung
Measured Resistances

R_{ct} korrigiert auf / corrected to 75 °C

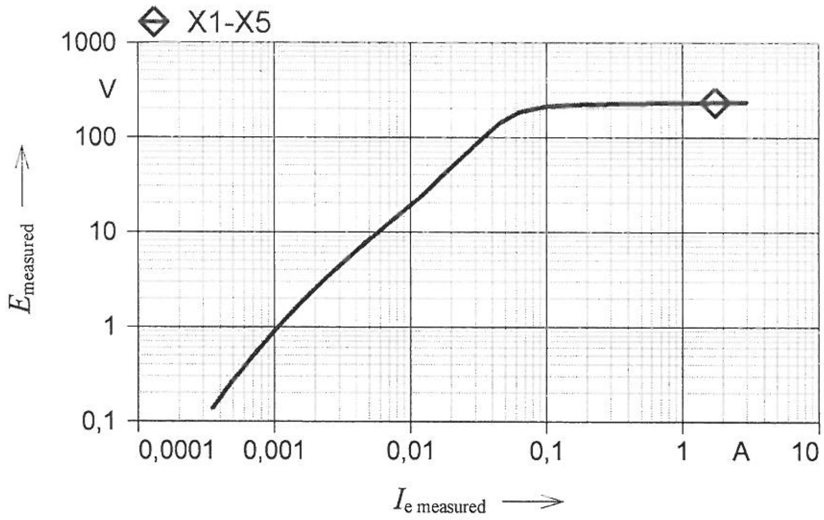
Fabriknummer Serial No	**R_{ct} / Ω**			
	X1-X5	**X1-X4**	**X1-X3**	**X1-X2**
80197936	0,251	0,176	0,0867	0,069
80197937	0,251	0,177	0,0877	0,0694
80197938	0,252	0,177	0,0876	0,0692
80197939	0,251	0,177	0,0876	0,0696
80197940	0,254	0,179	0,0876	0,0694
80197941	0,252	0,178	0,088	0,0695
80197942	0,253	0,178	0,0875	0,0696
80197943	0,255	0,179	0,0878	0,0698
80197944	0,254	0,179	0,0878	0,0697
80197945	0,253	0,178	0,0874	0,0692
80197946	0,253	0,178	0,0877	0,0693
80197947	0,252	0,177	0,0874	0,0692
80197948	0,251	0,177	0,0872	0,069
80197949	0,252	0,177	0,0875	0,0692
80197950	0,253	0,178	0,0881	0,0699
80197951	0,252	0,178	0,0878	0,0697
80197952	0,253	0,178	0,088	0,0699
80197953	0,252	0,178	0,0875	0,0692

Gemessene Magnetisierungskurven
Measured Excitation Curves

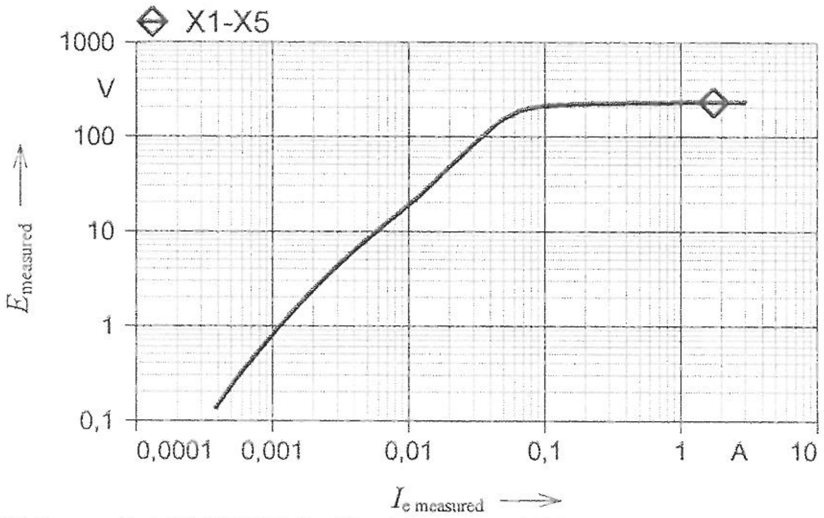
Fabriknummer/Serial No 80197936, Kern/Core 1, Klasse/Class C 200



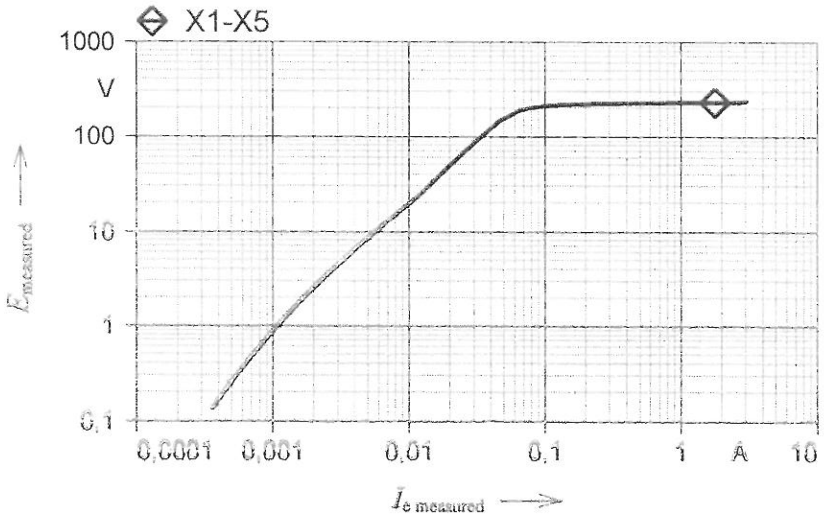
Fabriknummer/Serial No 80197937, Kern/Core 1, Klasse/Class C 200



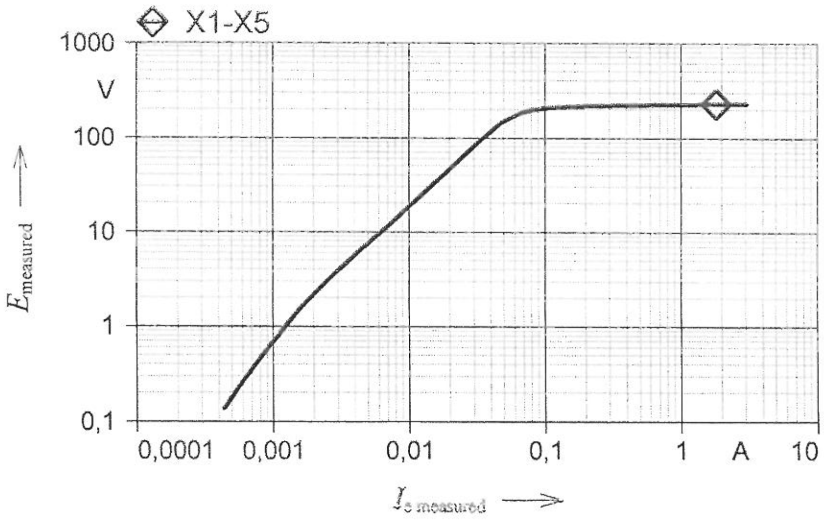
Fabriknummer/Serial No 80197938, Kern/Core 1, Klasse/Class C 200



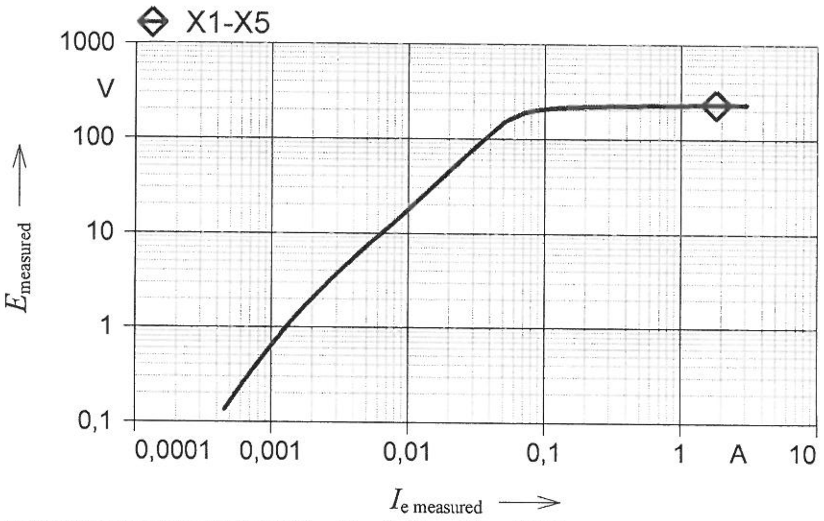
Fabriknummer/Serial No 80197939, Kern/Core 1, Klasse/Class C 200



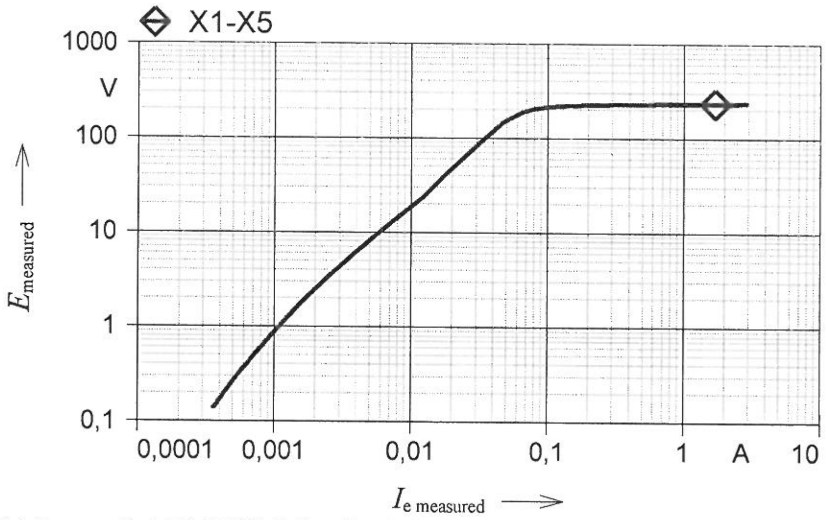
Fabriknummer/Serial No 80197940, Kern/Core 1, Klasse/Class C 200



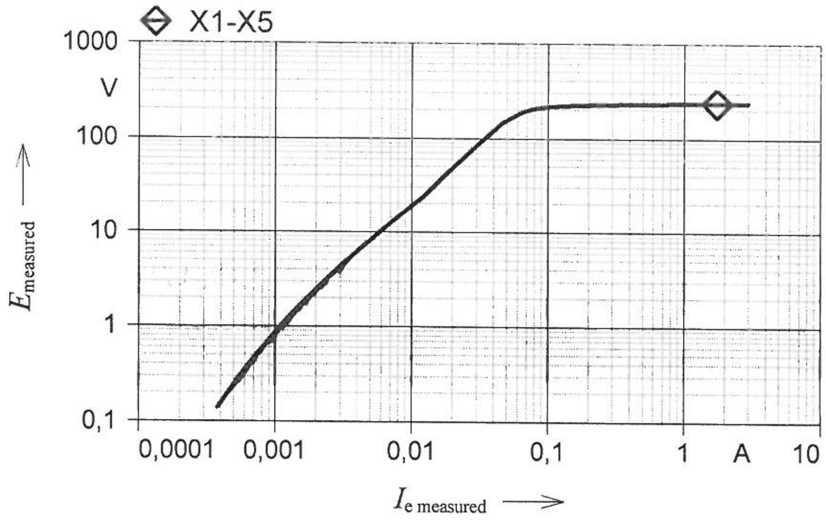
Fabriknummer/Serial No 80197941, Kern/Core 1, Klasse/Class C 200



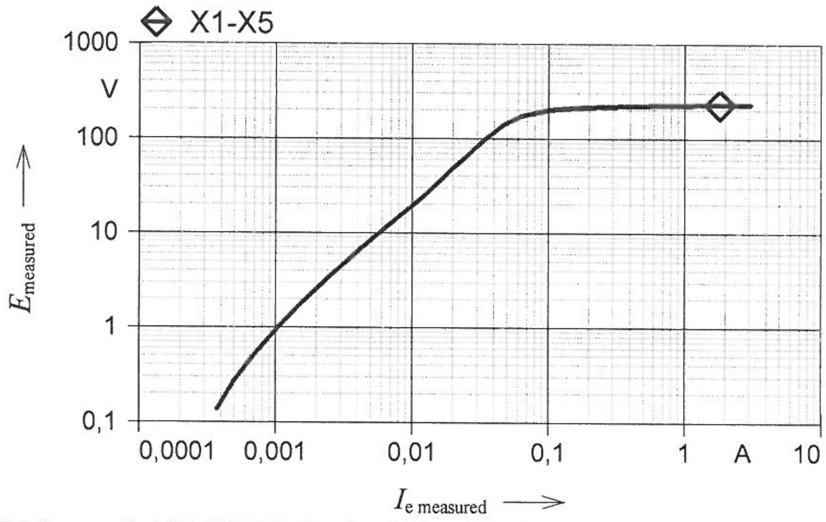
Fabriknummer/Serial No 80197942, Kern/Core 1, Klasse/Class C 200



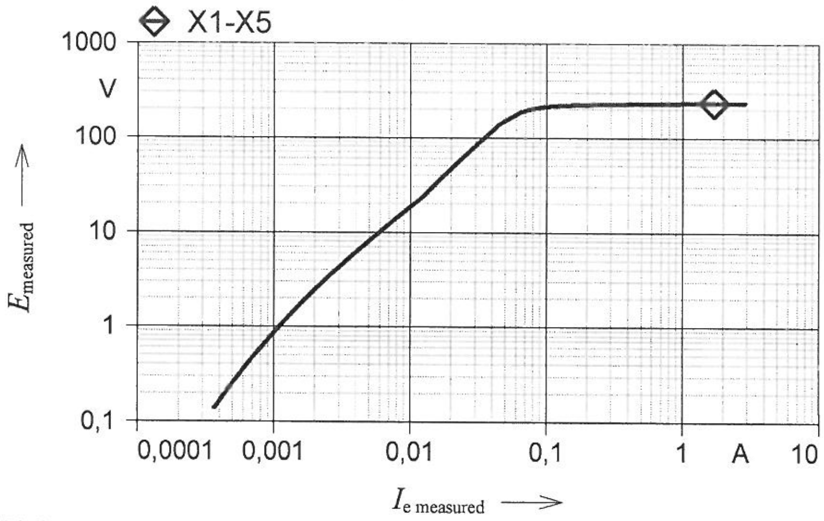
Fabriknummer/Serial No 80197943, Kern/Core 1, Klasse/Class C 200



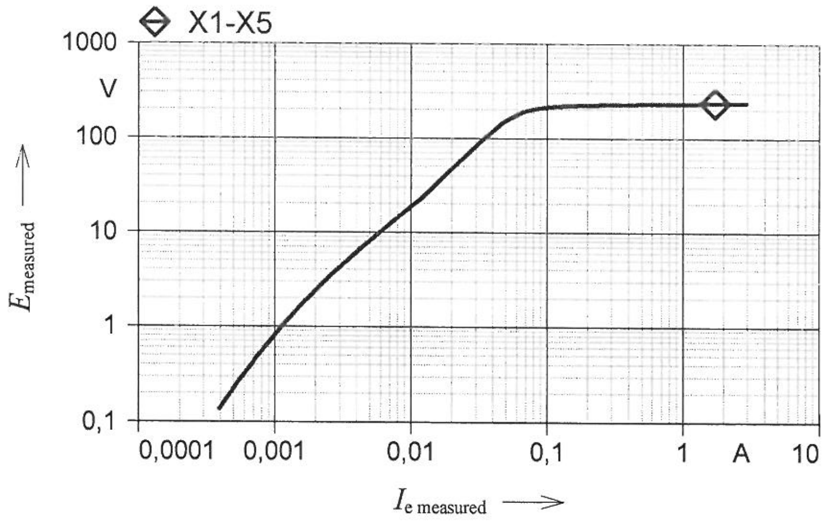
Fabriknummer/Serial No 80197944, Kern/Core 1, Klasse/Class C 200



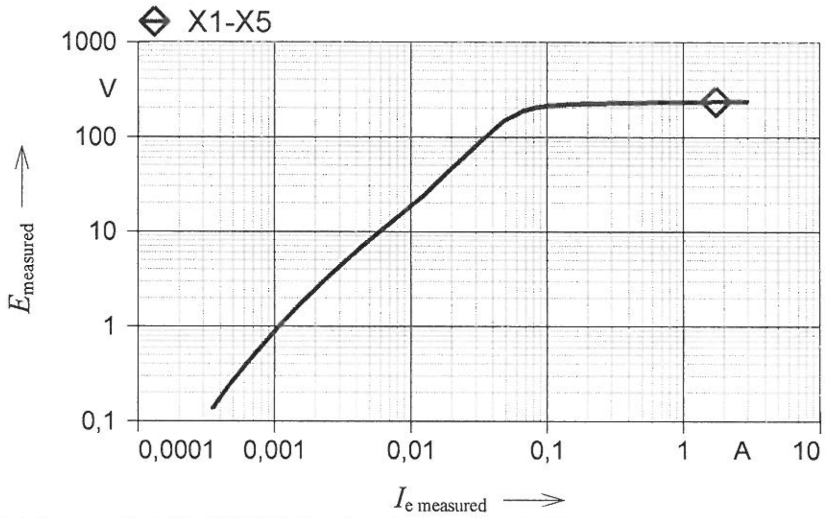
Fabriknummer/Serial No 80197945, Kern/Core 1, Klasse/Class C 200



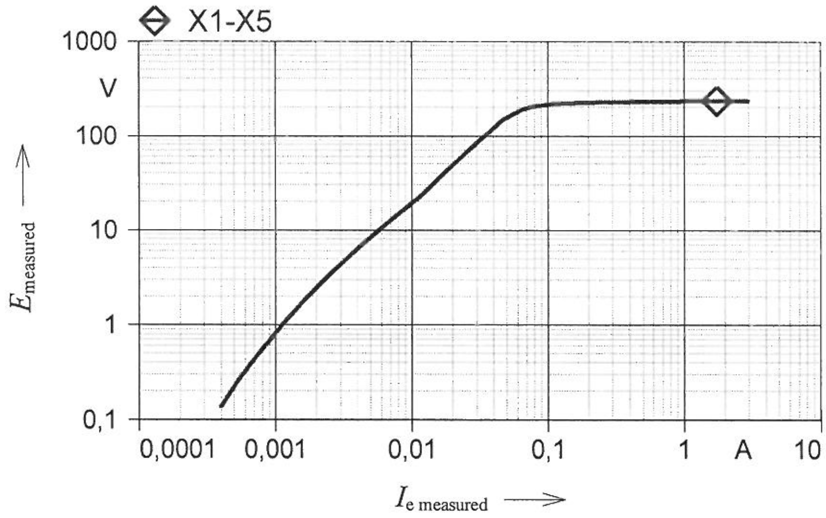
Fabriknummer/Serial No 80197946, Kern/Core 1, Klasse/Class C 200



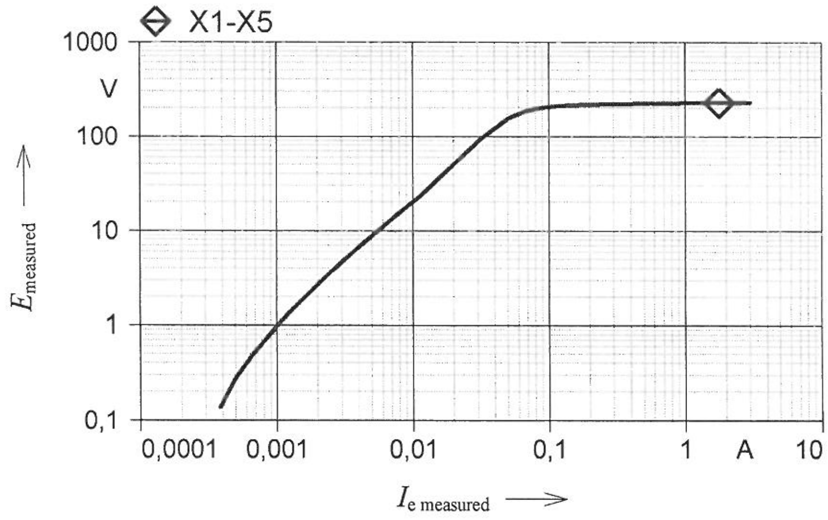
Fabriknummer/Serial No 80197950, Kern/Core 1, Klasse/Class C 200



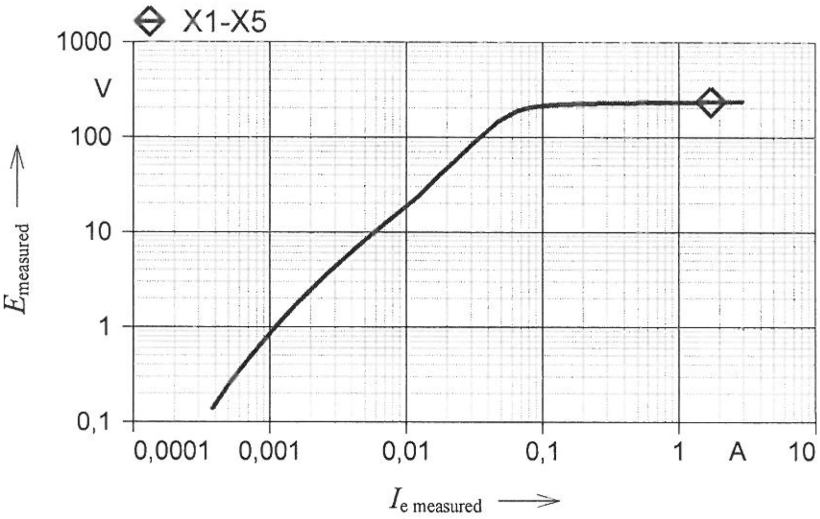
Fabriknummer/Serial No 80197951, Kern/Core 1, Klasse/Class C 200



Fabriknummer/Serial No 80197952, Kern/Core 1, Klasse/Class C 200



Fabriknummer/Serial No 80197953, Kern/Core 1, Klasse/Class C 200



Prüfung der Anschlussbezeichnungen und der Polarität
Verification of Terminal Markings and Polarity

Erfolgreich / Passed

EMERSON
Network Power

Emerson Network Power
Electrical Reliability Services, Inc.
7100 Broadway, Suite 7e
Denver, CO 80221
T (303) 427-8809
F (303) 427-4080
www.electricalreliability.com

September 27, 2016

Sturgeon Electric Co
12150 E 112th Ave
Henderson, CO 80640-9116

Attention: Mr. Tyler Clark

Subject: Siemens Relay Testing at Eisenhower Tunnel
Project No. 3237613

Dear Mr. Clark:

Thank you for the opportunity to provide services for you during this project. Our comprehensive report and recommendations are attached. They detail the work we performed, results obtained and provide recommendations for any corrective actions. Please let us know if you have any questions or need additional information.

As an independent third party electrical testing, maintenance and engineering services firm and full member of the InterNational Electrical Testing Association (NETA), Electrical Reliability Services prides itself in the quality of our services and skills of our people. Thanks again for the opportunity to provide you with electrical testing services. If there is anything more we can do for you, please don't hesitate to contact us.

Sincerely,

Electrical Reliability Services, Inc.

Dennis L Salzmann
Service Center Manager

Colorado Department Of Transportation
Siemens Relay Testing at Eisenhower Tunnel

Emerson Network Power | Electrical Reliability Services

Submitted: September 27, 2016

Purchase Order No. 791243
Project No. 3237613

Prepared for:

Sturgeon Electric Co
12150 E 112th Ave
Henderson, CO 80640-9116

Project Leader:

Daniel A Schroeder

Approved by:

Dennis Salzmann
Area Manager

Table of Contents

1. SUMMARY

1.1 This project was initiated by Mr. Tyler Clark with Sturgeon Electric Co. All testing was performed by Electrical Reliability Services Field Engineer Daniel A Schroeder between August 30, 2016 and September 1, 2016.

1.2 Acceptance tests and inspections help determine if electrical equipment is suitable for use.

1.3 This project involved testing of protective relays.

1.4 Please refer to Section 5 for complete details regarding comments, deficiencies and recommendations.

2. OBJECTIVES

2.1 The new electrical equipment and components as defined in Section 3 of this report have been inspected and tested to help assure that each component meets manufacturer's and industry standards.

2.2 Evaluating the performance of new equipment prior to energization is considered the most important test the equipment ever receives. These tests often reveal hidden defects, design or installation errors or in-transit damage, which can lead to serious system malfunction and down time.

2.3 This initial testing provides a database for future maintenance system analysis and equipment modification. These test results, when compared with the results from future periodic maintenance tests, can be indicative of life expectancy and thus provide a continuing monitor of reliability throughout the life of the equipment.

3. SERVICE DESCRIPTION

3.1 Acceptance testing of the following protective relays:

- 12 - Overcurrent Protection Relays, Siemens 7SJ82

4. PROCEDURES

The following procedures were followed in the performance of this project:

4.1 Protective Relays - Microprocessor Based

4.1.1 Visual and Mechanical Inspection

.1 Record model number, style number, serial number, firmware revision, software revision, and rated control voltage.

.2 Verify operation of light-emitting diodes, display, and targets.

.3 Verify that the frame is grounded in accordance with manufacturer's instructions.

.4 Set the relay in accordance with the client-provided settings.

4.1.2 Electrical Test

.1 Check functional operation of each element used in the protection scheme.

.2 Check operation of all active digital inputs.

.3 Check all output contacts.

.4 Check all internal logic functions used in the protection scheme.

5. RESULTS: COMMENTS, DEFICIENCIES AND RECOMMENDATIONS

5.1 Based on the results of the inspections and tests performed, the equipment included in this project (see detailed test data in Appendix) is considered serviceable.

6. APPENDIX

APPENDIX

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51207871 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (East)
RELAY ID: Main A RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000564
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: Main A OPERATED EQUIP: Main A
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 08/31/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

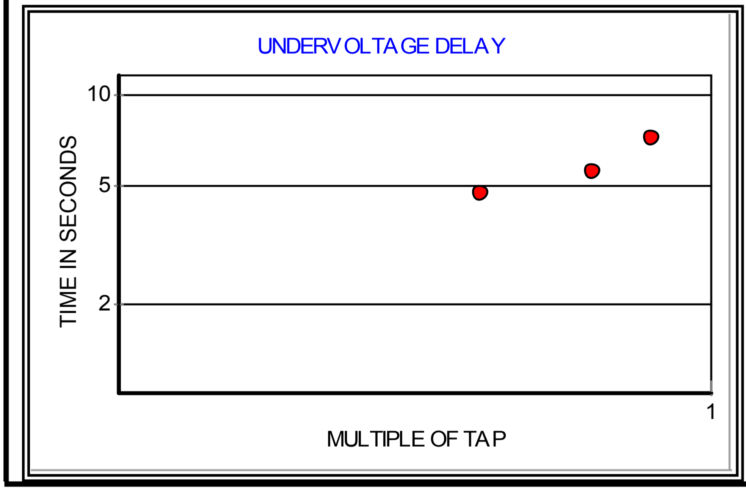
s27_PU= 96 s27_TD= 1.00 s27_PU_FACTOR= 0.90

Relay Test Results for: UNDERVOLTAGE PICKUP

PICKUP VOLTS	IDEAL	%ERROR	OK?
49.384	49.883	-1.00	PASS

Relay Test Results for: UNDERVOLTAGE DELAY

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
0.63	31.426	427.88	7.131	7.898	-9.71	PASS
0.40	19.953	332.05	5.534	5.721	-3.27	PASS
0.17	8.316	279.08	4.651	4.690	-0.82	PASS



EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51209574 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (East)
RELAY ID: Tie Feeder RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000556
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: Tie Feeder OPERATED EQUIP: Tie Feeder
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 08/31/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.375	6.250	2.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.57	0.326	0.300	8.70	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.38	0.323	0.300	7.67	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.75	0.329	0.300	9.70	PASS

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51216814 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (East)
RELAY ID: TRX No 1 RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000558
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 1 OPERATED EQUIP: TRX No 1
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 08/31/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.75	0.329	0.300	9.70	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.66	0.328	0.300	9.23	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.60	0.327	0.300	8.90	PASS

Relay Test Results

Lib Routine: 7SJ51205315 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (East)
RELAY ID: TRX No 1A RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000554
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 1A OPERATED EQUIP: TRX No 1A
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 08/31/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.58	0.326	0.300	8.80	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.55	0.326	0.300	8.60	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.73	0.329	0.300	9.60	PASS

Relay Test Results

Lib Routine: 7SJ51226049 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (East)
RELAY ID: TRX No 1B RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000557
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 1B OPERATED EQUIP: TRX No 1B
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 08/31/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.312	6.250	1.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.73	0.329	0.300	9.63	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.57	0.326	0.300	8.73	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.71	0.328	0.300	9.50	PASS

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51226566 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (East)
RELAY ID: TRX No 2 RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000553
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 2 OPERATED EQUIP: TRX No 2
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 08/31/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.73	0.329	0.300	9.60	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.50	0.325	0.300	8.33	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.54	0.326	0.300	8.57	PASS

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine:	7SJ51228602	**AF/AL:**	AL
Lib Version:	0	**Pass/Fail:**	PASS

Relay Data:

CUSTOMER:	Sturgeon Electric Company	JOB NO:	3237613
SITE:	Eisenhower Tunnel	SITE ADDRESS:	MP 215.35
LOCATION:	Eisenhower Tunnel Switchgear (West)	PANEL:	8DA10 25kV
RELAY ID:	Main A	RELAY FUNCTION:	MF
RELAY PN:	7SJ82	RELAY SN:	
RELAY MFG:	SIEMENS	RELAY TYPE:	7SJ82
WIRING ID:		TAG NO:	
PROTECTED EQUIP:	Main A	OPERATED EQUIP:	Main A
TECHNICIAN:	Danny Schroeder	TECHNICIAN PHONE:	720-387-1527
TEST EQUIP ASSET NO:	40-01478	TEST EQUIP CAL DATE:	2/5/2016
TEST DATE:	09/01/2016	TRIP TEST:	
RETEST DATE:	08/31/2019	PHASE OUT:	
NOTES:			

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

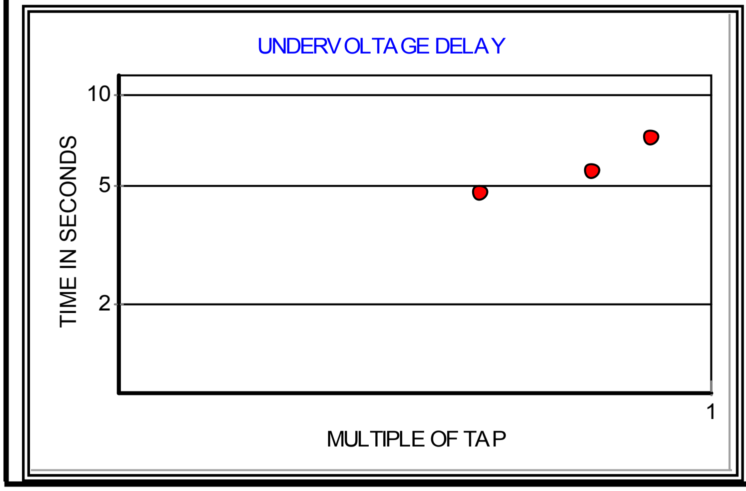
s27_PU= 96 s27_TD= 1.00 s27_PU_FACTOR= 0.90

Relay Test Results for: UNDERVOLTAGE PICKUP

PICKUP VOLTS	IDEAL	%ERROR	OK?
49.384	49.883	-1.00	PASS

Relay Test Results for: UNDERVOLTAGE DELAY

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
0.63	31.426	428.17	7.136	7.898	-9.65	PASS
0.40	19.953	332.47	5.541	5.721	-3.14	PASS
0.17	8.316	279.25	4.654	4.690	-0.76	PASS



Relay Test Results

Lib Routine: 7SJ51204206 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (West)
RELAY ID: Tie Feeder RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000562
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: Tie Feeder OPERATED EQUIP: Tie Feeder
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 09/01/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.79	0.330	0.300	9.93	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.46	0.324	0.300	8.13	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.61	0.327	0.300	8.93	PASS

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51217233 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO:
3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel PANEL: 8DA10 25kV
Switchgear (West)
RELAY ID: TRX No 1 RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000560
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 1 OPERATED EQUIP: TRX No 1
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 09/01/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.57	0.326	0.300	8.73	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.61	0.327	0.300	8.93	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.66	0.328	0.300	9.20	PASS

Relay Test Results

Lib Routine: 7SJ51230432 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO: 3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel Switchgear (West) PANEL: 8DA10 25kV
RELAY ID: TRX No 1A RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000561
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 1A OPERATED EQUIP: TRX No 1A
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 09/01/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.57	0.326	0.300	8.70	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.68	0.328	0.300	9.33	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.46	0.324	0.300	8.10	PASS

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51207892 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO: 3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel Switchgear (West) PANEL: 8DA10 25kV
RELAY ID: TRX No 1B RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000559
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 1B OPERATED EQUIP: TRX No 1B
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 09/01/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.73	0.329	0.300	9.60	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.67	0.328	0.300	9.27	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.79	0.330	0.300	9.93	PASS

EMERSON
Network Power
Electrical Reliability Services

Relay Test Results

Lib Routine: 7SJ51230653 **AF/AL:** AL

Lib Version: 0 **Pass/Fail:** PASS

Relay Data:

CUSTOMER: Sturgeon Electric CompanyJOB NO: 3237613
SITE: Eisenhower Tunnel SITE ADDRESS: MP 215.35
LOCATION: Eisenhower Tunnel Switchgear (West) PANEL: 8DA10 25kV
RELAY ID: TRX No 2 RELAY FUNCTION: MF
RELAY PN: 7SJ82 RELAY SN: BM1510000555
RELAY MFG: SIEMENS RELAY TYPE: 7SJ82
WIRING ID: TAG NO:
PROTECTED EQUIP: TRX No 2 OPERATED EQUIP: TRX No 2
TECHNICIAN: Danny Schroeder TECHNICIAN PHONE: 720-387-1527
TEST EQUIP ASSET NO: 40-01478 TEST EQUIP CAL DATE: 2/5/2016
TEST DATE: 09/01/2016 TRIP TEST:
RETEST DATE: 08/31/2019 PHASE OUT:
NOTES:

Global Defines:

Routine Notes:

Relay Settings Used for Testing:

s50_51_T1_PU= 6.25 s50_51_T1_TD= 0.30

Relay Test Results for: PHASE OVERCURRENT PICKUP

PHASE	PICKUP CURRENT	IDEAL	%ERROR	OK?
A-N	6.250	6.250	0.00	PASS
B-N	6.312	6.250	1.00	PASS
C-N	6.250	6.250	0.00	PASS

Relay Test Results for: PHASE OVERCURRENT DELAY

PHASE OVERCURRENT DELAY (PHASE A-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.64	0.327	0.300	9.10	PASS

PHASE OVERCURRENT DELAY (PHASE B-N)

MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.64	0.327	0.300	9.13	PASS

PHASE OVERCURRENT DELAY (PHASE C-N)

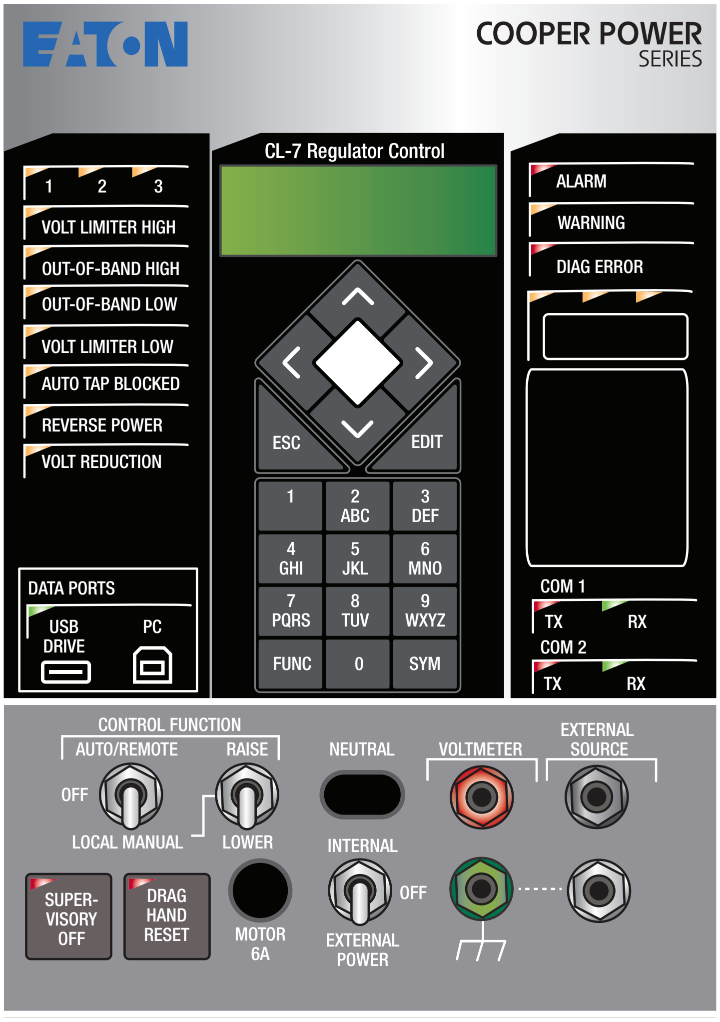
MULTIPLE	VALUE	TIME(CY)	TIME(SEC)	IDEAL	%ERROR	OK?
1.05	6.562	19.55	0.326	0.300	8.63	PASS

Voltage Regulators
MN225003EN

Effective June 2016
Supersedes June 2015

COOPER POWER
SERIES

CL-7 voltage regulator control installation, operation, and maintenance instructions



Powering Business Worldwide

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

The information, recommendations, descriptions and safety notations in this document are based on Eaton Corporation's ("Eaton") experience and judgment and may not cover all contingencies. If further information is required, an Eaton sales office should be consulted. Sale of the product shown in this literature is subject to the terms and conditions outlined in appropriate Eaton selling policies or other contractual agreement between Eaton and the purchaser.

THERE ARE NO UNDERSTANDINGS, AGREEMENTS, WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OTHER THAN THOSE SPECIFICALLY SET OUT IN ANY EXISTING CONTRACT BETWEEN THE PARTIES. ANY SUCH CONTRACT STATES THE ENTIRE OBLIGATION OF EATON. THE CONTENTS OF THIS DOCUMENT SHALL NOT BECOME PART OF OR MODIFY ANY CONTRACT BETWEEN THE PARTIES.

In no event will Eaton be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or other-wise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein. The information contained in this manual is subject to change without notice.

Contents

Safety for life

Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment, and support our "Safety For Life" mission.

Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as arc flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER

Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

WARNING

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage. G101.0

WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

WARNING

Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

Product information

Introduction

This document describes the operation and maintenance instructions for the CL-7 Voltage Regulator Control for Eaton's Cooper Power™ series voltage regulators. Refer to *Service Information MN225008EN (S225-10-30) VR-32 Voltage Regulator with Quik-Drive™ Tap-Changer Installation, Operation, and Maintenance Instructions* for installation and operation information on Eaton's Cooper Power series Voltage Regulator.

Read this manual first

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment. Read and understand the manual detailing the installation and operation of the regulator used with this control.

Additional information

These instructions cannot cover all details or variations in the equipment, procedures, or processes described nor provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, please contact your Eaton representative.

Acceptance and initial inspection

This product is completely assembled, tested, and inspected at the factory. It is carefully calibrated, adjusted, and in good condition when accepted by the carrier for shipment.

Upon receipt, inspect the carton for signs of damage. Unpack the control and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and storage

Be careful during handling and storage of equipment to minimize the possibility of damage.

⚠ CAUTION

Lifting hazard. A complete control box assembly with control can weight in excess of 50 lbs. Proper lifting techniques and team lifts should be employed in order to avoid personal injury.

Standards

Eaton's regulators are designed and tested in accordance with the following standards:

- IEEE Std C37.90.1™-2012 Standard
- IEEE Std C37.90.2™-2004 Standard
- IEEE Std C57.13™-2008 Standard
- IEEE Std C57.15™-2009 Standard
- IEEE Std C57.91™-2011 Standard
- IEEE Std C57.131™-2012 Standard
- EN 50081-2
- EN 61000-4
- IEC 60068-2
- IEC 60214-1
- IEC 60255-5

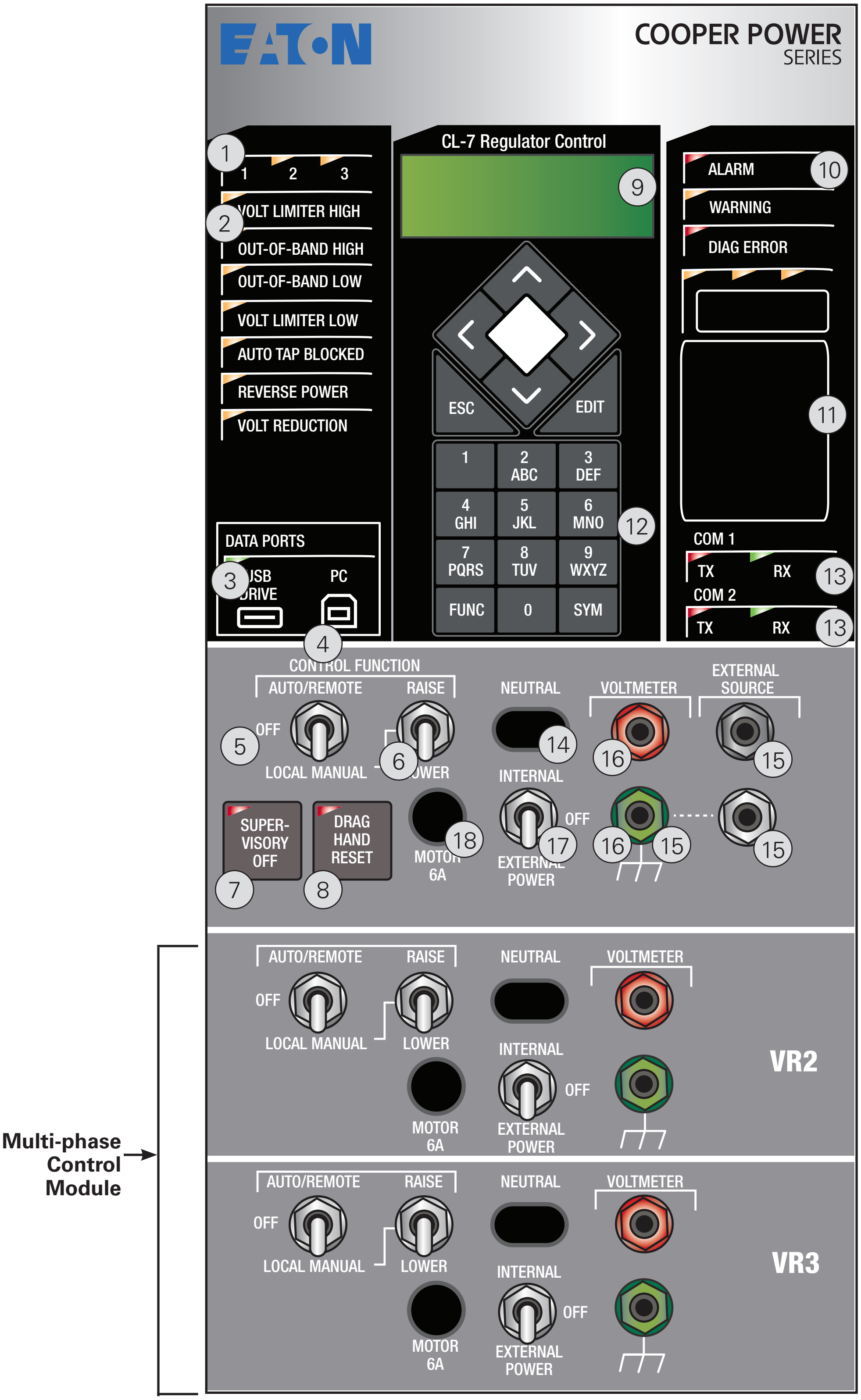
Quality standards

ISO 9001 Certified Quality Management System.

Description

The CL-7 voltage regulator control from Eaton's Cooper Power series incorporates the latest in digital technology to provide accurate, rapid, and dependable control of a step-voltage regulator. Utilizing surface-mount technology and low-power electronics, the CL-7 control is CE (Commonwealth Europe) compliant. The nameplate located on the control box defines the power circuit.

The CL-7 control provides the first of its kind single- or multi-phase voltage regulation utilizing a single control platform. During every step of develop, focus was placed on producing a control to meet the growing demand for smart grid ready features and for flexibility to meet the needs of the future. While great effort was put into enhancing its features, the CL-7 control remains true to its roots by maintaining the ease of use of its predecessor CL controls. The control features the same look and feel of the earlier controls and whenever possible, the same function codes were utilized. The CL-7 control allows keypad programming, Metering-PLUS™ status inquiries, USB memory device uploading and downloading, and multiple communication ports with user-selectable DNP3 or IEC 60870-5 protocol. Additional communications protocol options are also available upon request. LED indicators provide instant information on alarm, communications, and regulation condition status. A four-line display provides detailed information and further simplifies programming. In addition, the CL-7 control is highly configurable and ready for use in applications where either digital or analog SCADA is required.



1	Multi-phase Active Display LEDs
2	Status Indicators
3	USB Drive Data Port and LED
4	USB Type B PC Data Port
5	Control Function Switch
6	Manual Raise/Lower Switch
7	Supervisory Off Switch
8	Drag-Hand Reset Switch
9	4 X 20 Character LCD
10	Alarm and Warning Indicators
11	Hot Key Descriptions
12	Multi-Use Keypad: Numeric Keys, Function Keys, Short-Cut Keys
13	Communications Indicators–Tx and Rx LEDs
14	Redundant LED Neutral Light
15	External Source Terminals with Ground
16	Voltmeter Terminals
17	Power Switch
18	Motor Fuse

Figure 1-1. Control panel layout.

Section 1: Control front panel

Lower panel (grey)

The lower (lineman's) section of the front panel contains components and features used to operate the voltage regulator. This section is similar to that of other controls in Eaton's Cooper Power series CL line. Refer to Figure 1-2.

Power switch

In the External position, the control and tap-changer motor are powered from an external source connected to the external source terminals (120 Vac standard, 240 Vac as indicated by decal). In the Internal position, the control and motor are powered from the regulator. In the Off position, no power is delivered to either the control or the motor.

Control function switch

In the AUTO/REMOTE position, the tap-changer motor can be controlled by either the front panel (auto) or remotely by SCADA. In the OFF position, manual and automatic operation and remote motor control are inhibited. In the LOCAL MANUAL position, automatic operation and remote motor control are inhibited and the tap-changer may be raised or lowered locally by momentarily toggling the RAISE/LOWER switch.

Manual raise/lower switch

This switch allows the operator to manually raise or lower the tap-changer motor when the control switch is set to LOCAL MANUAL.

Supervisory off switch

This is a momentary switch used only to inhibit digital communications. When the LED in the top left corner of the switch is not illuminated, SCADA has full capabilities. When the LED is illuminated, SCADA may only read the control database.

Drag-hand reset switch

This is a momentary switch that operates a solenoid in the Position Indicator to move the drag hands to the present tap position.

Neutral light

This is an indication that the tap-changer is in the neutral position. See the **Control Installation: Determining Neutral Position** section of this manual for more detailed guidance on determining when the regulator is in the neutral position.

⚠ WARNING

Explosion Hazard. Bypass a regulator with the line energized only if the position indicator, the neutral light, and the control tap position indicate neutral and the voltage measured between the source and load bushings using an approved voltmeter is zero. If both neutral indicators do not indicate neutral or there is a voltage between the source and load bushings, the line should be de-energized to avoid shorting part of the series winding and resultant high circulating current. Failure to comply can result in death or personal injury and equipment damage. VR-T206.0

Voltmeter Terminals

These terminals allow the connection of a voltmeter to measure the potential sensed by the control between the load (L) bushing and the source load (SL) bushing of the regulator. There are two terminals: a red positive and a green ground.

Fuse

The motor fuse is a 125 V, 6 A, fast-blow fuse.

External source terminals

CAUTION

Equipment damage. Be mindful of polarity when using an external source. Polarity reversal will result in control damage. VR-T201.0

Providing 120 Vac to these terminals powers the control and tap-changer motor. Controls wired for an external source of 220–240 Vac have a decal specifying “240” at the terminals. Caution should be taken when connecting external voltage to the terminals. The voltage should be checked to insure the polarity is correct. The black terminal is the hot terminal, the white is the neutral terminal, and the green, which is directly connected to the chassis, is the external supply ground.

Consult the **Connecting Power to External Source Terminals** section of this manual before applying external power to the control.

CAUTION

Equipment damage. Only a true ac power supply is to be used to energize the control externally. Do not use a dc-to-ac voltage inverter. Failure to comply can cause excessive harmonics to be generated and result in damage to the control. VR-T204.1

Connecting power to external source terminals

120 Vac applications to an Eaton's Cooper Power series 120 V control

Option 1:

The control box assembly is connected to earth ground to provide protection to operations personnel. This is a typical field application where the control is mounted on a grounded regulator tank or dropped down a pole with the control box grounded properly.

Since the control is configured for 120 Vac, a 1:1 isolation transformer must be used to isolate the supply voltage. This isolation transformer must isolate both the neutral and line on the secondary side. Also, the neutral and ground on the secondary side should not be bonded or connected. To check isolation from earth ground, check the continuity of each lead on the isolation transformer with respect to ground (G). Check this before connecting the leads to the control panel. See Figure 1-2.

The control panel assembly is grounded through the tank or a separate grounding strap. Earth ground of the isolation transformer is not connected to the control. The only source of earth ground reference on secondary of the isolation transformer is through the control box connection to ground.

Option 2:

The control box assembly is floating. This is a typical shop or lab application where the control is mounted on an ungrounded regulator tank or sitting on a workbench.

The 120 Vac external source must be completely isolated. In most cases an isolation transformer is needed. This isolation transformer must isolate both the neutral and line on the secondary side. Also, the neutral and ground on the secondary side should not be bonded or connected. To check isolation from earth ground, check the continuity of each lead on the isolation transformer with respect to ground (G). Check this before connecting the leads to the control panel. See Figure 1-3.

In this case, the ground of the isolation transformer is connected to the green terminal post on the CL-7 control. In this configuration, the only source of earth ground reference on the secondary side of the isolation transformer is through the control box connection to the isolation transformer ground.

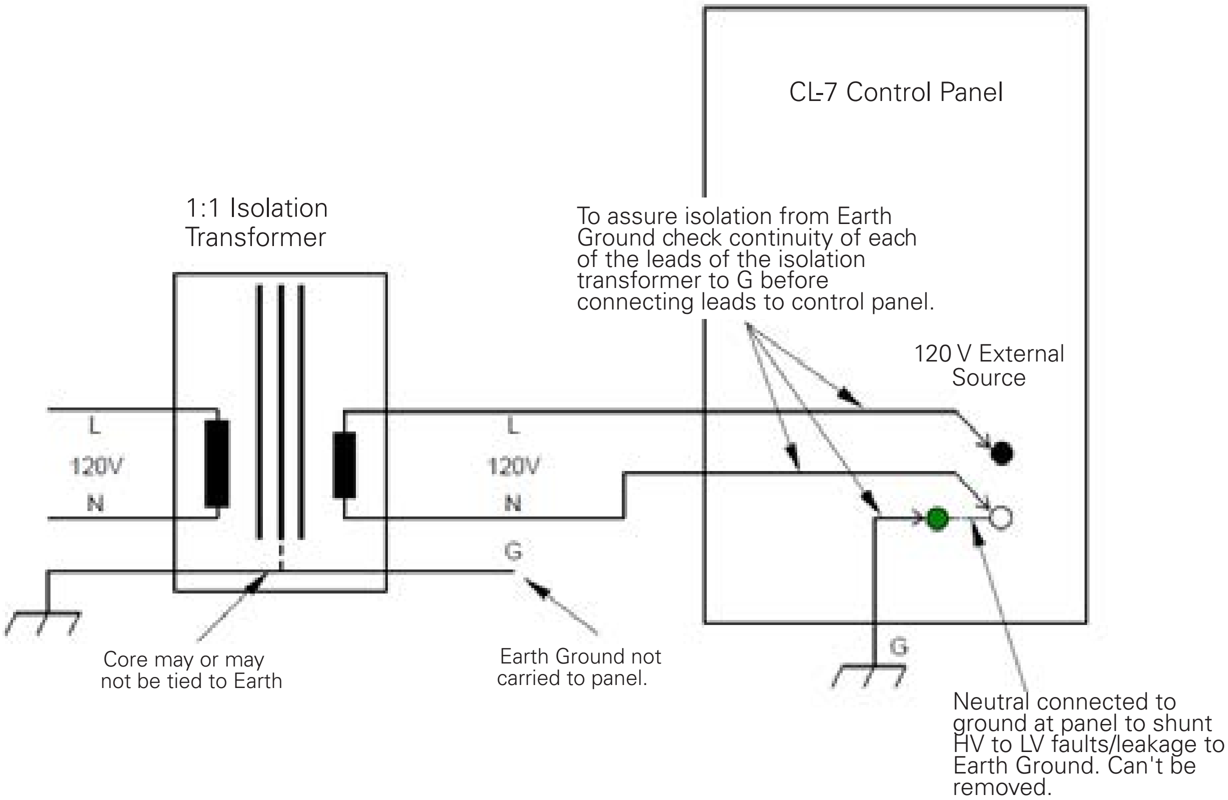


Figure 1-2. 120 Vac Application with Eaton's Cooper Power series 120 V Control - Option 1.

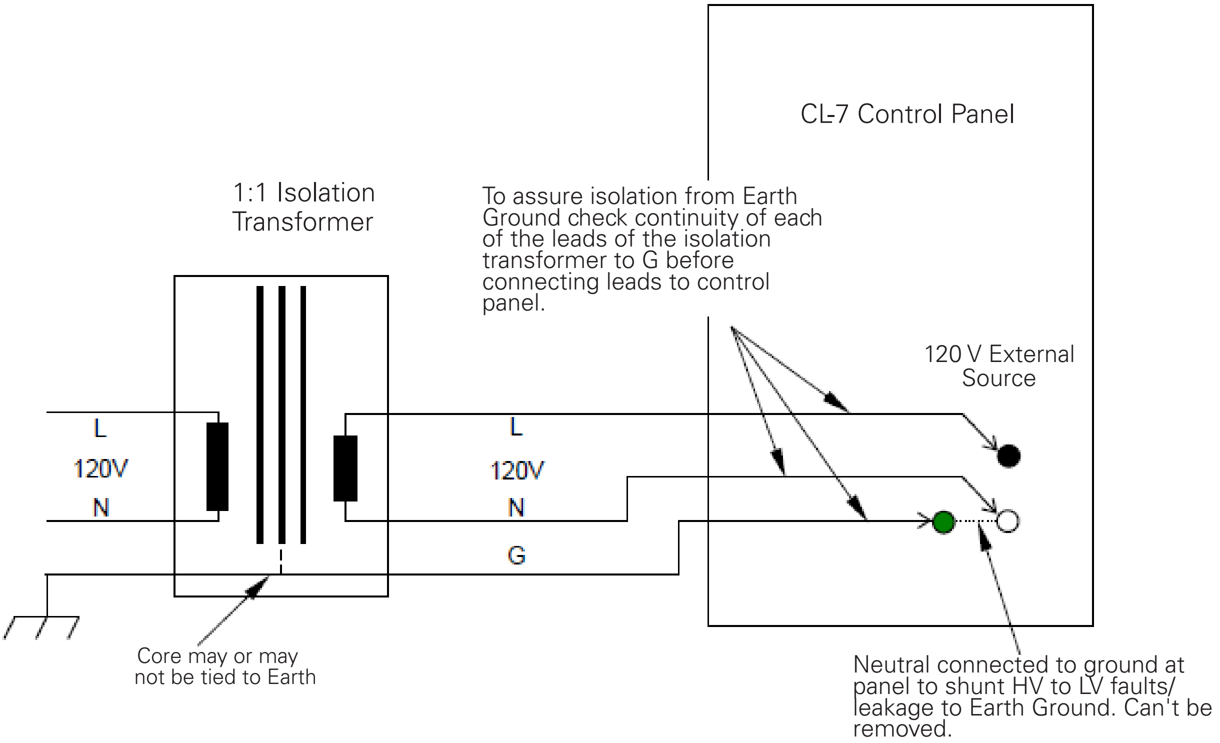


Figure 1-3. 120 Vac Application with Eaton's Cooper Power series 120 V Control - Option 2.

240 Vac applications to an Eaton's Cooper Power series 120 V control

Option 1:

The control box assembly/panel is connected to earth ground to provide protection to operations personnel. This is a typical field application where the control is mounted on a grounded regulator tank or dropped down a pole with the control box grounded properly.

Since the control is configured for 120 Vac, a 2:1 isolation transformer must be used to step and isolate the supply voltage. This isolation transformer must isolate both the neutral and line on the secondary side. Also, the neutral and ground on the secondary side should not be bonded or connected. To check isolation from earth ground, check the continuity of each lead on the isolation transformer with respect to ground (G). Check this before connecting the leads to the control panel. See Figure 1-4.

The control panel assembly is grounded through the tank or a separate grounding strap. Earth ground of the isolation transformer is not connected to the control. The only source of earth ground reference on secondary of the isolation transformer is through the control box connection to ground.

Option 2:

The control box assembly is floating. This is a typical shop or lab application when the control is mounted on an ungrounded regulator tank or setting on a workbench.

Since the control is configured for 120 Vac, a 2:1 isolation transformer must be used to step and isolate the supply voltage. This isolation transformer must isolate both the neutral and line on the secondary side. Also, the neutral and ground on the secondary side should not be bonded or connected. To check isolation from earth ground, check the continuity of each lead on the isolation transformer with respect to ground (G). Check this before connecting the leads to the control panel. See Figure 1-5.

In this case the ground of the isolation transformer is connected to the green terminal post on the CL-7 control. In this configuration, the only source of earth ground reference on the secondary side of the isolation transformer is through the control box connection to the isolation transformer ground.

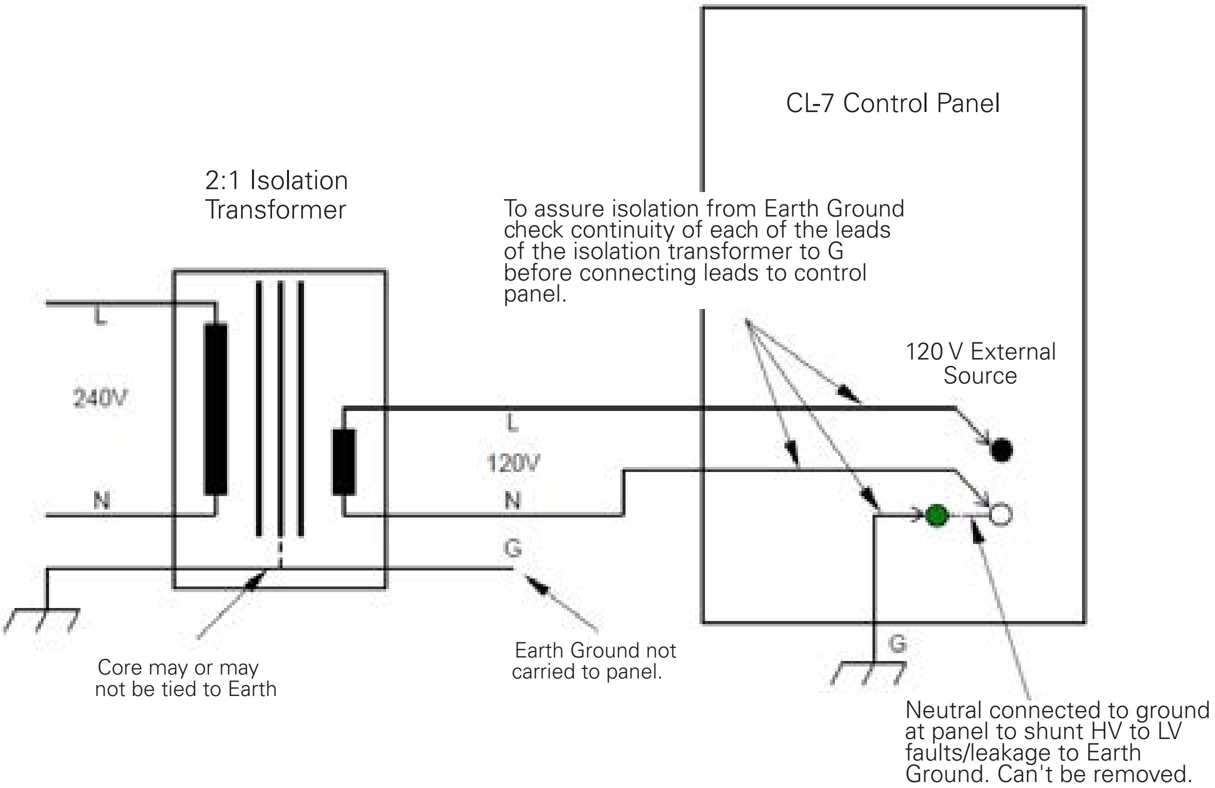


Figure 1-4. 240 Vac Application with Eaton's Cooper Power series 120 V Control - Option 1.

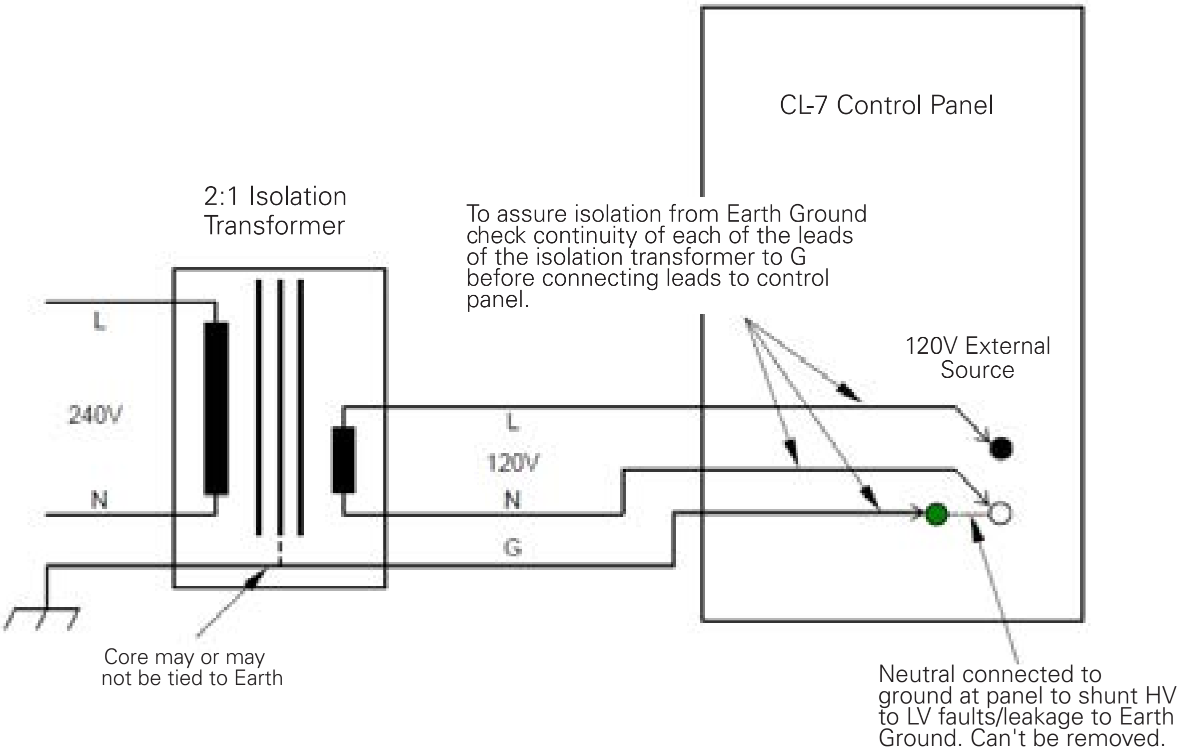


Figure 1-5. 240 Vac Application with Eaton's Cooper Power series 120 V Control - Option 2.

240 Vac applications to and Eaton's Cooper Power series 240 V control

Option 1:

The control box assembly/panel is connected to earth ground to provide protection to operations personnel. This is a typical field application where the control is mounted on a grounded regulator tank or dropped down a pole with the control box grounded properly.

The 240 Vac control cabinet from Eaton's Cooper Power series utilizes a 240 Vac to 120 Vac (2:1) auto transformer inside the control cabinet on the back panel. This transformer steps down the 240 Vac external supply to provide 120 Vac to the control panel. Inside the CL-7 control, the neutral and ground are connected in several locations. Care should be taken when applying external power.

The 240 Vac external source must be completely isolated. In most cases an isolation transformer is needed. This isolation transformer must isolate both the neutral and line on the secondary side. Also, the neutral and ground on the secondary side should not be bonded or connected. To check isolation from earth ground, check the continuity of each lead on the isolation transformer with respect to ground (G). Check this before connecting the leads to the control panel. See Figure 1-6.

The control panel assembly is grounded through the tank or a separate grounding strap. Earth ground of the isolation transformer is not connected to the control. The only source of earth ground reference on the secondary side of the isolation transformer is through the control box connection to ground.

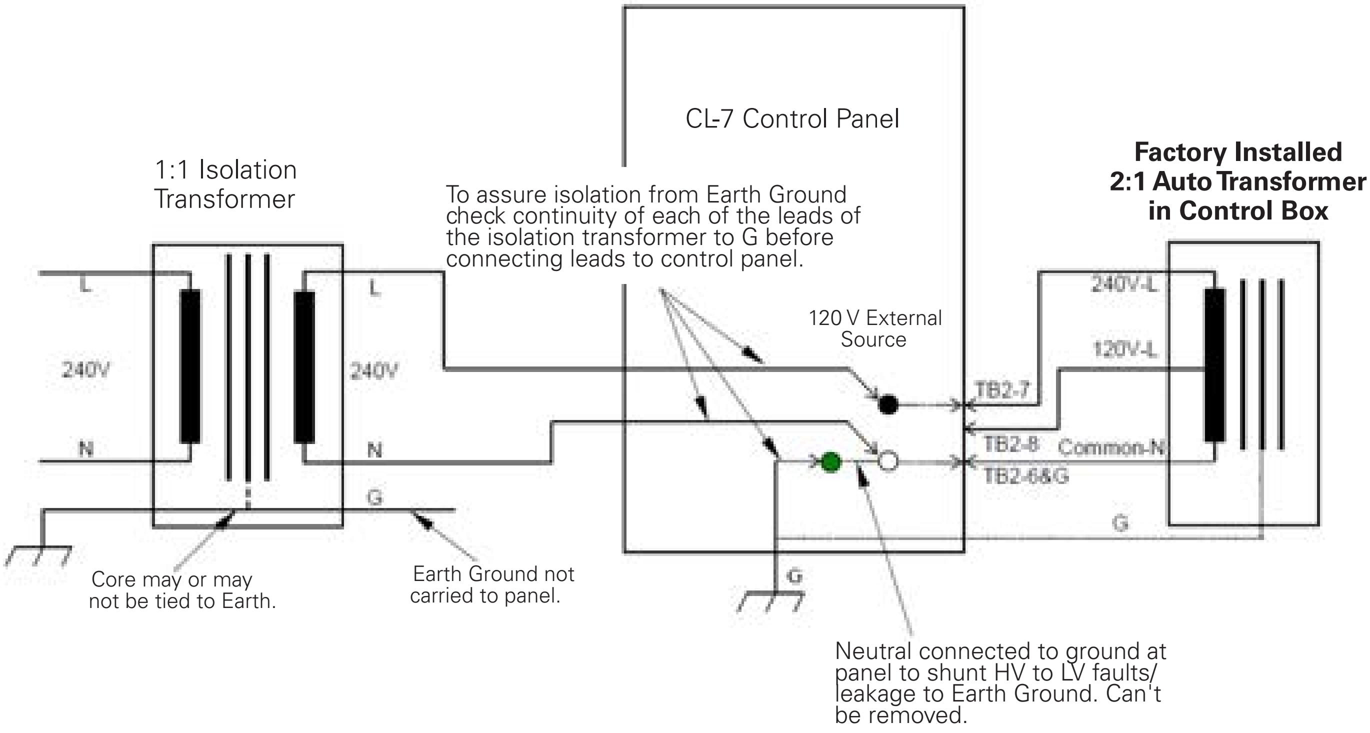
Option 2:

The control box assembly is floating. This is a typical shop or lab application where the control is mounted on an ungrounded regulator tank or sitting on a workbench.

Eaton's Cooper Power series offers an optional control configuration that accepts 240 Vac external power. In this configuration, a 240 Vac to 120 Vac (2:1) auto transformer is installed inside the control cabinet on the back panel. This transformer steps down the 240 Vac external supply to provide 120 Vac to the control panel. Inside the CL-7 control, the neutral and ground are connected in several locations.

The 240 Vac external source must be completely isolated. In most cases an isolation transformer is needed. This isolation transformer must isolate both the neutral and line on the secondary side. Also, the neutral and ground on the secondary side should not be bonded or connected. To check isolation from earth ground, check the continuity of each lead on the isolation transformer with respect to ground (G). Check this before connecting the leads to the control panel. See Figure 1-7.

In this case, the ground of the isolation transformer is connected to the green terminal post on the CL-7 control. In this configuration, the only source of earth ground reference on the secondary side of the isolation transformer is through the control box connection to the isolation transformer ground.



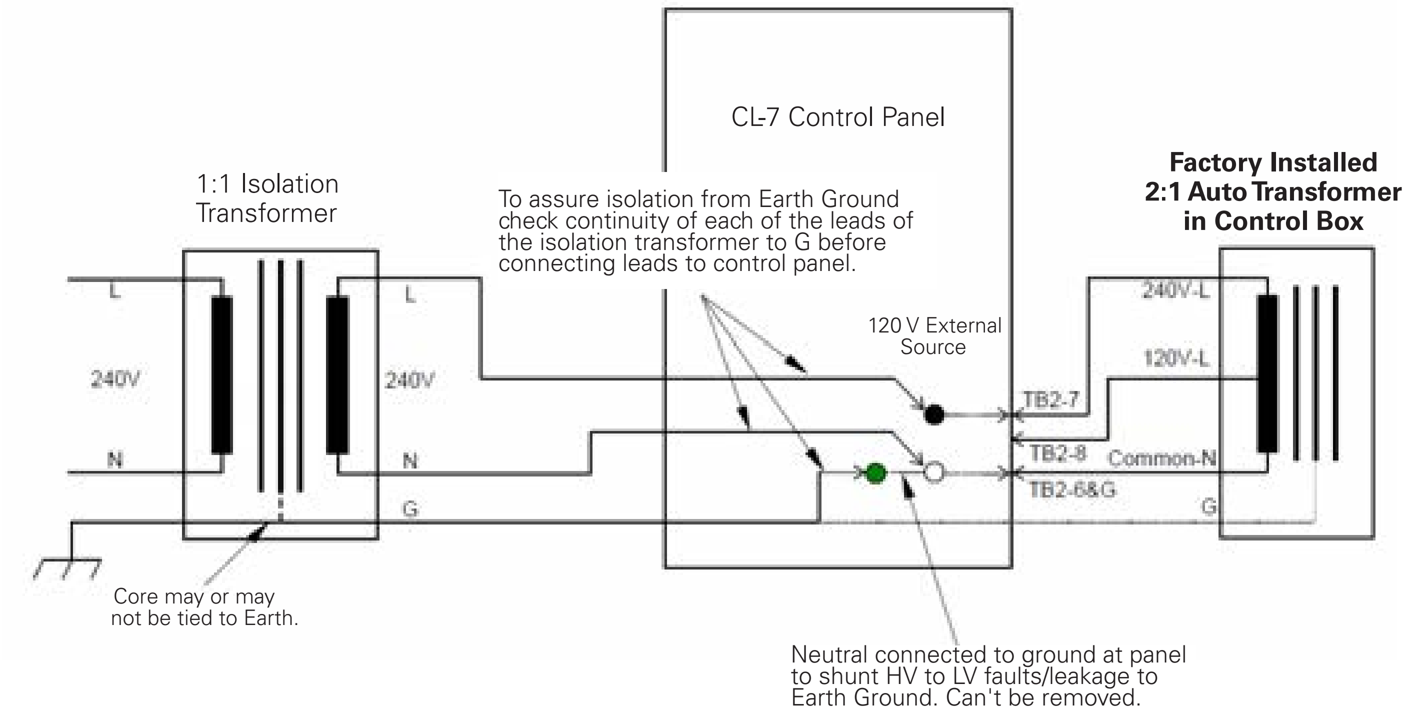
To assure isolation from Earth Ground check continuity of each of the leads of the isolation transformer to G before connecting leads to control panel.

Core may or may not be tied to Earth.

Earth Ground not carried to panel.

Neutral connected to ground at panel to shunt HV to LV faults/ leakage to Earth Ground. Can't be removed.

Figure 1-6. 240 Vac Application with Eaton's Cooper Power series 240 V Control - Option 1.



To assure isolation from Earth Ground check continuity of each of the leads of the isolation transformer to G before connecting leads to control panel.

Core may or may not be tied to Earth.

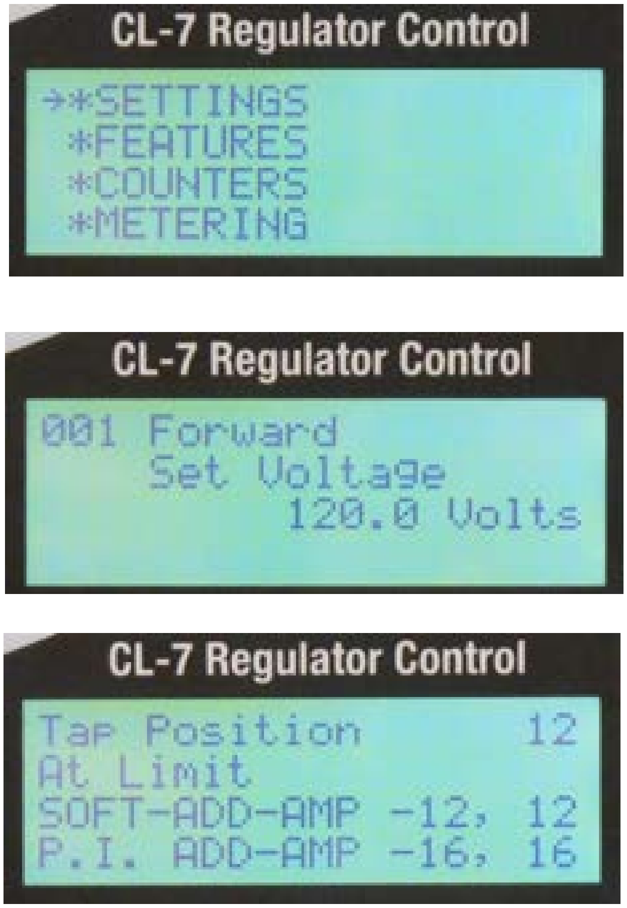
Neutral connected to ground at panel to shunt HV to LV faults/leakage to Earth Ground. Can't be removed.

Figure 1-7. 240 Vac Application with Eaton's Cooper Power series 240 V Control - Option 2.

Upper panel (black)

Display

The display is a back-lit LCD that will display information in four lines of twenty characters and in four different languages: English, French, Portuguese, and Spanish. See Figure 1-8.



```
CL-7 Regulator Control
→*SETTINGS
 *FEATURES
 *COUNTERS
 *METERING
```

```
CL-7 Regulator Control
001 Forward
    Set Voltage
          120.0 Volts
```

```
CL-7 Regulator Control
Tap Position      12
At Limit
SOFT-ADD-AMP -12, 12
P.I. ADD-AMP -16, 16
```

Figure 1-8. Main Menu, Forward Direction, and Metering-PLUS Tap Position screens.

The CL-7 control utilizes a nested menu structure, items are structured with a main menu and then one, two, three, or four sub-menus. The final submenu in any of the menus contains the control parameters. The main menu is the default display; refer to Table 5-2 for the complete nested menu. When a menu is displayed, the current menu item is indicated by a cursor arrow (→) on the display screen. Parameter values appear on the LCD, right justified, with a decimal point shown as necessary.

Note: Only four line items appear on the display at one time. Moving the cursor down from the fourth line will shift the line items up one item at a time.

LCD display contrast

The LCD display panel contrast is adjustable. Press and hold the **FUNC** key, then press the scroll up arrow key to increase or the scroll down arrow key to decrease contrast.

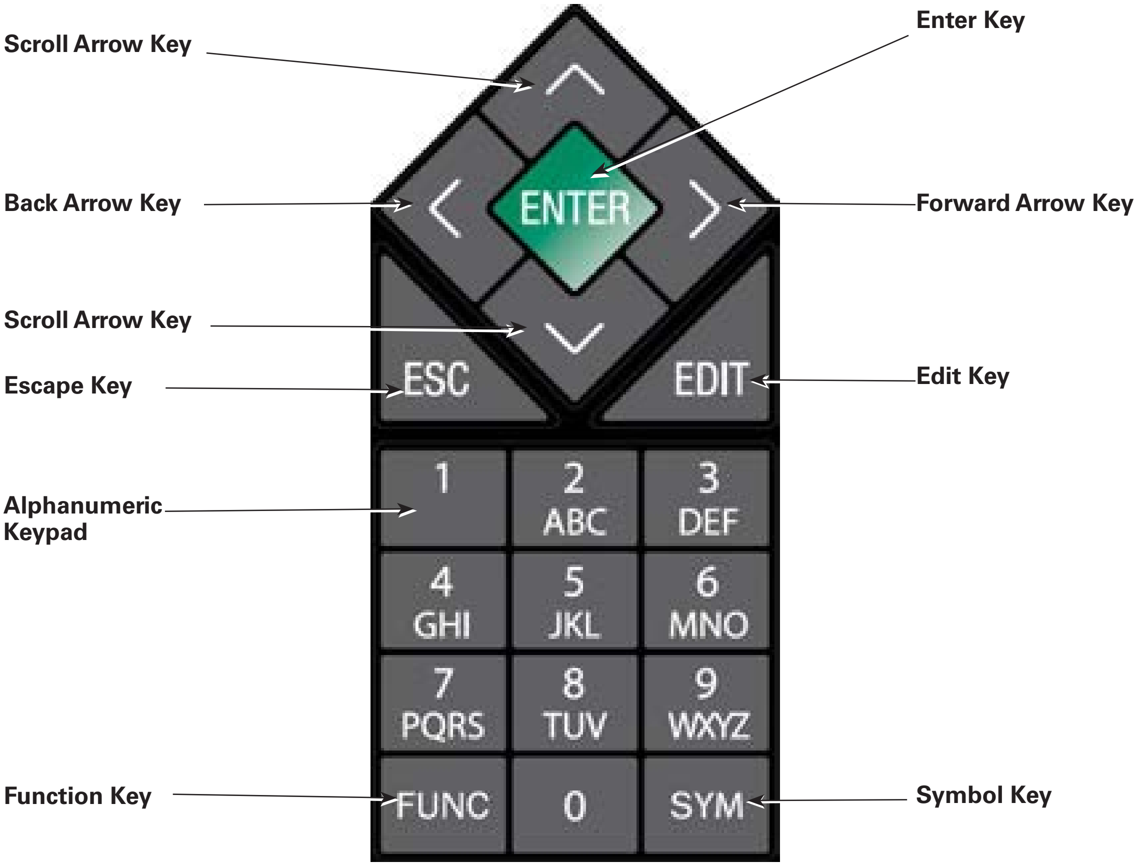


Figure 1-9. Alphanumeric, scrollable keypad with user-definable Metering-PLUS and shortcut options.

Keypad

The front panel interface for the CL-7 control uses a 19-key touchpad with a cell-phone style alphanumeric keypad, arrow keys, a symbol key and four keys used to access and edit control parameters. Refer to Figure 1-9. The keypad allows for three modes of interface with the nested menu structure: alphanumeric keys, short-cut hot-keys, and scroll keys.

Parameter access and editing

Use function codes to quickly read and edit control parameters. To display a parameter on the LCD using a function code (FC), press function (**FUNC**), key in the FC number and then press **ENTER**. For security, certain parameters, as noted in Table 4-1, can only be accessed via the function code method. Also, certain parameters and data, such as alarms, configurable logic and profiler data, can only be accessed using ProView™ NXG interface software.

See Table 5-2 for a list of the functions grouped by menu level and Table 5-3 for a numerical listing of function codes.

Alphanumeric and symbol keys

After pressing the **FUNC** or **EDIT** keys, the alphanumeric keypad is enabled to enter function code numbers or parameter information. When the alphanumeric keying is complete, pressing **ENTER** will complete the process and enable hot-key functionality (see section below).

The alpha characters, used to enter passwords and identification information, are accessed by pressing the keys multiple times to scroll through the letters available for each key. Capitalization of a letter is accomplished by pressing an up or down arrow key while the letter is active on the screen.

Symbols (#, /, ? and !) can be entered by repeatedly pressing the **SYM** key to scroll through the characters.

Short-cut hot-keys

The keypad can be configured to create shortcut access to a variety of commonly used Metering-PLUS, menu and parameter displays. Keys mapped to support the Metering-PLUS feature provide, with one touch, commonly used diagnostic data. Refer to the Advanced Features: Metering-PLUS section of this manual for more information. Mapping can also provide one-button access to top-level nested items, some function codes, and enabling of configurable logic.

The default keypad map corresponds to that of the predecessor CL-6 control. A slide out panel (see Figure 1-10) provides a key-code for the key assignments. Two additional pre-programmed key maps can be selected or a custom keypad map can be created. Keypad mapping is available through the nested menu path MENU SYSTEM > Hot Keys or by using FC 944. A custom keypad map can only be created using ProView NXG software.

Options available in the User Defined mapping are CL Exclusive and CL Exclusive w/ Confirm. CL is configurable logic. These options allow for one-button activation of functionality created in configurable logic. Configurable logic inputs are available that correspond to the user-defined key assignments. After programming configurable logic and assigning a control key to activate the logic, a single key press (or key press and then a confirming key press) is all that is required to active the functionality of the logic. See *Service Information MN225015EN, CL-7 Regulator Control ProView NXG Software Programming Guide* for more information on this feature and creating configurable logic.

Slide-out panels are available for the alternate pre-programmed keypad assignments or a user-defined custom panel can be created.

The following options are available when creating a custom keypad map:

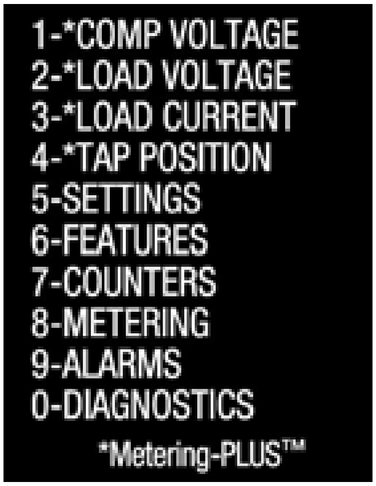
- Comp Voltage Metering-PLUS
- Load Voltage Metering-PLUS
- Load Current Metering-PLUS
- Tap Position Metering-PLUS
- USB Memory Drive
- SETTINGS Menu
- FEATURES Menu
- SEQUENCE OF EVENTS Log
- METERING Menu
- ALARMS Menu
- COUNTERS Menu
- COMMUNICATIONS Menu
- System Calendar and Clock FC 50
- DIAGNOSTICS Menu
- Security Access
- Total Operations FC 0
- Forward Set Voltage FC 1
- Forward Band Width FC 2
- Forward Time Delay FC 3
- Forward Line Drop Compensation Resistance FC 4
- Forward Line Drop Compensation Reactance FC 5
- Load Voltage FC 6
- Source Voltage FC 7
- Comp Voltage FC 8
- Load Current FC 9
- CL Exclusive
- CL Exclusive w/Confirm

Scroll arrow keys

Use the arrow keys to move up or down between menu levels, scroll through parameter options when editing parameters, change the case of letters and change numerical values from positive to negative. When the multi-phase option is active on the control, the right arrow key can also be used to change the display between the connected regulators.

The ENTER and Escape (ESC) keys are used like the arrow keys to enter the menu structure or move between menu levels. ENTER is used to access submenus. ESC is used to step back or exit submenus. Repeated pressing of the ESC key will return the display screen to the top level main menu.

The LCD displays only four menu items at one time. For nested menu levels that contain more than 4 items, the arrow keys are used to move the cursor down from the fourth line and then shift the menu items up one item at a time. After reaching the last item, the menu will scroll to the top item.



1-*COMP VOLTAGE
2-*LOAD VOLTAGE
3-*LOAD CURRENT
4-*TAP POSITION
5-SETTINGS
6-FEATURES
7-COUNTERS
8-METERING
9-ALARMS
0-DIAGNOSTICS
*Metering-PLUS™

Figure 1-10. Standard keypad hot-key assignments.

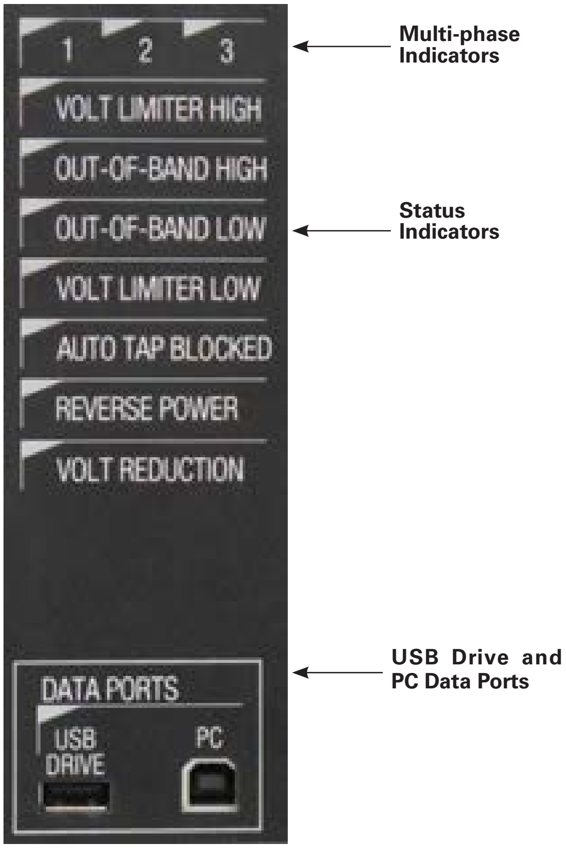


Figure 1-11. Status Indicators and USB Ports.

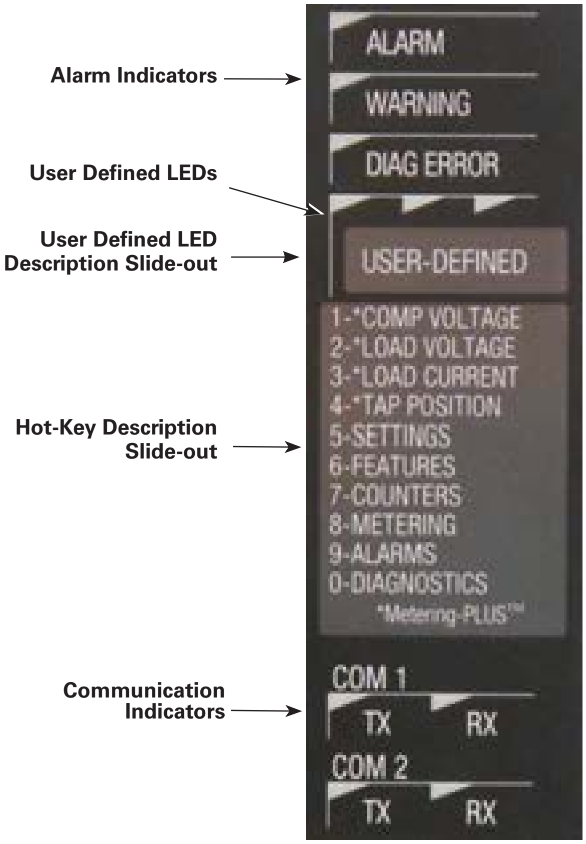


Figure 1-12. Alarm, communication indicators and slide-out hot-key map.

Indicator LEDs

Multi-phase indicators

These LEDs provide an indication of which connected voltage regulator is active for the parameter displayed on the LCD screen and for the Status Indicator LEDs. Pressing the right arrow key will scroll through the LEDs. They are active and used only for multi-phase functionality. Refer to Figure 1-11.

Status indicators

These LEDs indicate regulation conditions: Voltage Limiter High, Out-of-Band High, Out-of-Band Low, Voltage Limiter Low, Tapping Blocked, Reverse Power, and Voltage Reduction. Refer to Figure 1-11. Refer to the Control Operation, Control Features, and Advanced Features sections of this manual for more information.

Alarm indicators

These LEDs indicate an Alarm, Warning, user-defined condition, or a diagnostic error. See Figure 1-12.

Communications indicators

These LEDs illuminated to indicate transmit (Tx) and receive (Rx) activity when the transfer of information is taking place through the communications ports on the side of the control. See Figure 1-12.

Data ports

USB drive

The USB Drive data port accepts any USB 2.0 compatible memory device that is formatted with the FAT32 file system. It is used to download data logs and to load and save standard and custom configurations. See Figure 1-11. USB functionality can be accessed in the top-level menu item USB MEMORY DRIVE or directly using FC 950 through FC 953. See the Advanced Features: USB Memory Drive section of this manual for more information. The LED above the port illuminates to indicate an active connection between the control and USB memory Drive.

PC

The PC data port is a USB type B port that interfaces local communication between the control and a PC using a standard USB type A to B printer cable. See Figure 1-11. The primary purpose of this port is for communications between a control and a PC loaded with ProView NXG interface software.

Hot-key mapping

This slide out card provides information about the hot key mapping assignments. See Figure 1-12.

Section 2: Control installation

⚠ WARNING

Hazardous Voltage. To protect personnel from surges while operating the control, follow these control enclosure grounding procedures: a) If the enclosure is attached to the regulator tank or is remote from the tank but only accessible with a ladder, connect the enclosure to the regulator-to-ground rod conductor; b) If the enclosure is accessible by personnel standing on the ground, connect the enclosure directly to a ground mat and ground rod. Failure to comply can result in severe personal injury or death. VR-T202.0

⚠ WARNING

Hazardous Voltage. The control box must be solidly earth grounded. Failure to comply can cause severe personal injury and equipment damage. VR-T203.0

CAUTION

Equipment damage. Only an ac power supply is to be used to energize the control externally. Do not use a dc-to-ac voltage inverter. Failure to comply can cause excessive harmonics to be generated and result in damage to the front panel. VR-T204.1

CAUTION

Equipment damage. Be mindful of polarity when using an external source. Polarity reversal will result in control damage. VR-T201.0

Mounting the control

The CL-7 regulator control in a control box can be mounted on the regulator tank or at a point remote from the unit. Rubber-covered cable of various lengths is available for interconnection between the control and the regulator.

Mounting a multi-phase control

As with the single-phase control, the multi-phase control can be mounted on one of the regulator tanks or on a separate mounting point remote from the regulators. An individual control cable will be connected between the junction box of each regulator and the control box.

Placing the control into service

Refer to the appropriate regulator manual, as indicated on the regulator nameplate for specific information on regulator installation (see Figure 3-4). Refer to Tables 2-1 and 2-2 for control specifications and metering accuracy.

When energizing the control from an external source, use only a 120 Vac source, unless the control was configured for 240 Vac, as indicated by a decal adjacent to the terminals.

Table 2-1. Control Specifications

Description	Specifications
Physical Size*	
Height	
Single-phase Model	292 mm (11.5")
Multi-phase Model	445 mm (17.5")
Width	201 mm (7.9")
Depth	98 mm (3.9")
Weight*	
Single-phase Model	3.4 kg (7.5 lbs)
Multi-phase Model	5.9 kg (12.9 lbs)
Burden @ 120 V	4 VA
Operating Temperature Range	-40 °C to +85 °C
Control System Accuracy	±1%

* Information provided for base units. Additional features will add to weight and dimension.

† Accuracy is based on full scale of 127 Vac and 0.800 A.

Table 2-2. Metering Accuracy

Load Voltage and Differential/Source Voltage

For a full range of 147 Vac at 45-65 Hz accuracy is ± 5% under all conditions.* †

The control will withstand up to 147 V without damage or loss of calibration.

Current Input/Output

For a full range of 0-0.800 A at 45-65 Hz accuracy is ±0.5% under all conditions.**

The control will withstand the short-circuit rating of the regulator without damage or loss of calibration.

Calculated Values, kVA, kW, kvar

Accuracy within 1% under all conditions.*

Harmonic Analysis, Current and Voltage Harmonics

All harmonics metered values shall be computed and displayed with error not to exceed ±3% under nominal conditions.

* Basic accuracy of the device, excluding PT and CT errors.

** 0.5% on range of 0-0.0800 A (±0.5%)(0.800 A) = ±0.004 A

† 0.5% on full scale 147 Vac: (0.5%) (147 Vac) = 0.735 Vac

Setting the control for service

The control must be properly programmed for service. Controls that come pre-installed at the factory on a voltage regulator will be set up for operation on that regulator. For controls that are retrofit onto a regulator, programming must be performed before the unit can be put into service. Refer to the Initial Control Programming section of this manual for more information.

The control must be energized to be programmed. Apply 120 Vac, or other voltage as indicated by the decal on the control, to the external source terminals; ensure the ground wire is connected to the ground terminal; and place the power switch in the external position. Alternately, the regulator may be energized at line potential and the power switch placed in the Internal position.

When power is applied to the control, the self-test routine will commence and the LCD display will activate, followed by a **PASS** message. Check the date and time displayed and reset if necessary. If a failure or diagnostic error message is displayed, refer to the **Troubleshooting** section of this manual.

Setting the control for multi-phase service

When programming a control for multi-phase operation, there are a number of settings that configure the control for operation and a number that configure the control to function with the connected voltage regulators. It is important to identify the pertinent settings for the individual regulators and enter each setting into the control appropriately. Refer to the **Multi-phase Voltage Regulation** section of this manual and *Bulletin B225-13018 CL-7 Multi-phase Control Reference* for guidance on programming the control for multi-phase operation.

Operational check

Pre-installation check

The CL-7 control has the facilities for either manual or automatic operation of the tap-changer, using either the internal source of power (the regulator) or an external source. To perform an operational check of the control before installing the regulator, follow these steps.

Note: For use with a non-Eaton's Cooper Power series voltage regulator, refer to the manufacturer’s manual for equipment specific information.

1. Open **V1** (and **V6**, if present) knife switch(es) located on back panel of control enclosure.
2. Place POWER switch in **OFF** position and CONTROL FUNCTION switch in **OFF** position.
3. Connect a variable 120 Vac 50/60 Hz source to EXTERNAL SOURCE terminals. Controls wired for an external source of 220–240 Vac have a decal specifying “240” at the terminals. Verify proper polarity.
4. Place POWER switch in **EXTERNAL** position.
5. Move CONTROL FUNCTION switch to **LOCAL MANUAL**, press and hold **RAISE/LOWER** momentary toggle switch. Allow tap-changer to operate to **8 L**, the 5% buck position. Verify tap position indication (TPI) is registering properly by pressing **Metering-PLUS Tap Position** key or viewing FC 12.
6. Raise and hold the **RAISE/LOWER** momentary toggle switch. Allow tap-changer to operate to **8 R**, the 5% boost position.
7. Place CONTROL FUNCTION switch in the **AUTO/REMOTE** position.
8. Increase the variable voltage source until applied voltage is out-of-band. Note that the **OUT-OF-BAND HIGH** LED on the front panel will come on. After the time delay period, the control will issue a lower-tap-change signal. Verify tap position indication (TPI) is registering properly by pressing the **Metering-PLUS Tap Position** key or viewing FC 12 and comparing the reading to the tap position indicator on the regulator junction box.
9. Decrease the variable voltage source until applied voltage is out of band. Note that the **OUT-OF-BAND LOW** LED on the front panel will come on. After the time delay period, the control will issue a raise-tap-change signal. Verify tap position indication (TPI) is registering properly by pressing the **Metering-PLUS Tap Position** key or viewing FC 12 and comparing the reading to the tap position indicator on the regulator junction box.
10. Place the CONTROL FUNCTION switch in the **LOCAL MANUAL** position and manually return the tap-changer to neutral. When on neutral, the **NEUTRAL** light will illuminate continuously and position indicator will point to zero.
11. Place CONTROL FUNCTION switch in **OFF** position.
12. Depress the DRAG HAND Reset momentary switch and release; the position indicator drag hands will reset to indicating hand.
13. Turn POWER switch to **OFF** and disconnect power supply from EXTERNAL SOURCE terminals.

In-service check

With the control programmed for basic operation, perform an operational check of manual and automatic operation.

1. Press the **Metering-PLUS Comp Voltage** key to display compensated voltage and both band edges on the LCD panel.
2. Place the CONTROL FUNCTION switch in **LOCAL MANUAL** position.
3. Toggle the **RAISE/LOWER** switch up to activate a raise operation. Allow tap-changer to operate for enough steps to take voltage out of band. Note that the **OUT-OF-BAND HIGH** LED on the front panel will come on.
4. Place the CONTROL FUNCTION switch in the **AUTO/REMOTE** position. After the time delay period, the control should cause the regulator to step down to the top band edge. This will display on the LCD panel.

   Example: 120 V and a 2 V bandwidth = 121 V top band edge.
5. After voltage is brought in-band and tap changing has stopped, move the CONTROL FUNCTION switch to the **LOCAL MANUAL** position.
6. Toggle the **RAISE/LOWER** switch down to activate a lower operation. Allow tap-changer to operate for enough steps to take voltage out of band. Note that the **OUT-OF-BAND LOW** LED on the front panel will come on.

7. Place the CONTROL FUNCTION switch in the **AUTO/REMOTE** position. After the time delay period, the control should cause the regulator to step up to the lower band edge. This will display on the LCD panel.

   Example: 120 V and a 2 V bandwidth = 119 V lower band edge.

Control bench testing

When applying external voltage to a CL-7 control, disconnected from the control box back panel, follow these steps:

1. Place a jumper between positions **7** and **8** of the disconnect plug on the wiring harness of the control.
2. Place a second jumper between positions 6 and terminal G of the disconnected plug. There are two G terminals on the harness plug. The jumper would be placed into the G closest to terminal 6.
3. Connect the external source to the external source post on the front of the control. Connect the hot lead to the black terminal post, the neutral to the white post, and the ground to the green terminal post. See the detailed instructions for applying power to the external source terminals in Section 1 of this manual.

Note: For a multi-phase control, this method will only enable powering of the main control. It is recommended to install the control into a control box to fully power a multi-phase control using the external source terminals.

Field calibration check

To check the calibration of the control, compare the voltage that the control reports on the display to the voltage measured at the test terminals.

Note: Field calibration checks are only an indication of calibration and are not as precise as the procedure described in the **Troubleshooting** section of this manual.

1. Connect an accurate true-RMS responding voltmeter to the voltmeter terminals.
2. Use the keypad to access FC 47 parameter. Key in:

   FUNC, *47,* **ENTER.**

   Or access via the menu: **FEATURES > Calibration > Voltage Calibration**.
3. Under ideal conditions, the displayed voltage of the control will match the voltage of the voltmeter. Realistically, the voltages may be slightly different because:

   A. The metering and operation is based upon the RMS value of the fundamental power line frequency. Thus, the metered values exclude the influences of harmonic voltages which are probably present on the line. A true RMS meter, however, will include these harmonic voltages in its calculations of the RMS voltage. This does not present a problem with either metering device, since each device uses a different approach to metering.

   B. The calibration of the voltmeter being used for measurement is probably not exact. Even a very good meter with a basic accuracy of 0.5% could be in error by as much as 0.6 V (out of 120 V) and still be considered to be "in calibration." The control is calibrated using a conditioned power supply and reference voltmeters which are periodically calibration-checked, traceable to the National Bureau of Standards.

Note: The control firmware is designed to perform ratio correction. Through the use of the ratio-correction transformer (RCT) located on the back panel, the voltage brought to the control is usually corrected to the 120 V base voltage. However, there are some ratings in which this voltage is not fully corrected by the RCT. Refer to the regulator nameplate for specific information for that regulator. Table 3-3 gives a general indication of these voltages.

When mounting the CL-7 control into an existing enclosure, the existing enclosure may not have an RCT installed. In this case the voltage measured on the voltmeter terminals may not match the voltage read on the control.

Whatever voltage results from dividing the nominal system voltage, FC 43, by the overall PT ratio, FC 44, is considered by the control to be the nominal voltage. Therefore, when that voltage appears at the input of the control, 120 V will be reported as the output voltage, FC 6, whether the nominal is actually 120 V or not. Likewise, the compensated voltage, FC 8, and input voltage, FC 7, will be scaled accordingly. If the regulator is equipped and programmed for reverse power operation, the compensated voltage will be correct even during reverse power conditions.

Also note that the base voltage can be set to a 240 V base using FC 148. When this is done, all secondary voltage displays will also be scaled to correspond to the 240 V base. Despite the displays however, the control itself is still powered using an approximate 120 V input.

The load voltage, FC 10; source voltage, FC 11; and calculated parameters such as the kVA, kW, and kvar, are not scaled similarly to FC 6 and FC 8. Instead, they reflect the true value of line voltage.

Note: The voltage measured at the test terminals during reverse power flow is the new source voltage at the load bushing of the regulator.

Removal from service

Refer to the appropriate regulator manual as indicated on the regulator nameplate for further information.

Determining neutral position

⚠ DANGER

Explosion Hazard. During bypass switching, the regulator must be in the neutral position. Prior to bypass switching: 1) The regulator must be placed in the neutral position; 2) Tap-changer operation must be disabled during the bypass switching. If the regulator is in any other position, part of the series winding will be shorted when the bypass switch is closed, resulting in high circulating current. Failure to comply will result in death or severe personal injury and equipment damage. VR-T205.0

⚠ WARNING

Explosion Hazard. Bypass a regulator with the line energized only if the position indicator, the neutral light, and the control tap position indicate neutral and the voltage measured between the source and load bushings using an approved voltmeter is zero. If both neutral indicators do not indicate neutral or there is a voltage between the source and load bushings, the line should be de-energized to avoid shorting part of the series winding and resultant high circulating current. Failure to comply can result in death or personal injury and equipment damage. VR-T206.0

Return the regulator to neutral. Only a regulator in the neutral position can be safely removed from service without interrupting load continuity. It is recommended to use four (4) methods to determine the neutral condition.

⚠ WARNING

Explosion Hazard. Always use the CONTROL FUNCTION switch (labeled AUTO/REMOTE, OFF, LOCAL MANUAL, and RAISE and LOWER) to operate the regulator, not the power switch. Failure to comply can result in the tap-changer stepping off of neutral immediately upon being energized, causing personal injury and equipment damage. VR-T207.0

⚠ WARNING

Explosion Hazard. To stop the regulator on the neutral position, the CONTROL FUNCTION switch should be returned to OFF during the switching operation from positions 1R or 1L to position neutral. Switching to OFF prior to reaching the neutral position prevents overshoot. Failure to comply can result in death or severe personal injury and equipment damage. VR-T208.0

Return the regulator to neutral

1. Use the Raise/Lower switch to bring the regulator to the neutral position.
2. When in neutral, the Neutral light will be continuously and brightly lit on the control front panel and the position indicator will point to zero.
3. Verify the neutral position of the regulator using four methods.
   A. Verify that the neutral indicator light on the control is indicating the neutral position. Neutral is indicated only when the light is continuously and brightly illuminated.
   B. Verify the tap position on the control indicates neutral by using the Metering-PLUS key or FC 12. When in neutral, the display will show "0" (zero).
   C. Verify that the position indicator on the regulator is in the neutral position. The indicator should point straight up to either zero or N for Neutral.
   D. Using an approved voltmeter, verify that there is no voltage difference between the source and load bushings.

⚠ WARNING

Explosion Hazard. After placing the regulator in the neutral position for bypass switching, always disable the motor to prevent a tap change during bypassing which can result in the tap-changer stepping off of neutral. Failure to comply can cause death or severe personal injury and equipment damage. VR-T209.0

4. When the regulator has been placed in the neutral position, but prior to bypassing, additional safety actions must be taken to disable the tap-changer motor and ensure that the tap-changer will not inadvertently switch to an off-neutral position. This can be accomplished by doing the following:
   A. Place the CONTROL FUNCTION switch in the **OFF** position.
   B. Remove the motor fuse.
   C. Place the control POWER switch in the **OFF** position.
   D. Open **V1**, knife switch (and **V6** if present) located on the control back panel.

Removal of control

The control may be removed from the regulator with the regulator energized. Record settings, etc., to facilitate replacement of the control.

To open the control, unscrew the captive knob(s) on the left side of the panel. This allows the control to swing open on its hinges. With the control open, the back panel is readily accessible. The design of the control enclosure, back panel, and control enables easy replacement of the control, leaving the back panel, control enclosure, and cable intact. To remove the control, proceed as follows:

⚠ WARNING

Flashover Hazard. Push the C shorting switch closed before attempting to remove the front panel. Failure to comply can open the regulator CT circuit, producing a flashover in the control, causing personal injury and equipment damage. VR-T210.0

1. Push closed the current shorting switch C. This shorts out the secondary of the regulator CT.

Note: Regulators shipped with a quick-disconnect cable contain a solid-state CT monitoring circuit in the junction box. This device automatically places a burden on the CT anytime the CT circuit is opened. For consistency and redundancy, it is recommended that the CT shorting switch be used whenever it is present on the back panel.

2. Pull open disconnect switch **V1** (and **V6** if present). This de-energizes terminal board **TB3** (or **TB2** if present).
3. Disconnect the control from the back panel at **TB3** (or **TB2** if present), located at the bottom of the back panel.
4. Disconnect the control ground lead from the back panel.

The control can now be lifted off its hinges. Care should be taken to prevent damage to a control while in transit and/or storage.

Replacement of control

⚠ WARNING

Flashover Hazard. Do not pull open the current shorting switch C until the TB3 (or TB2 if present) connection is completed. Failure to comply can open the regulator CT secondary and cause a flashover in the control, causing personal injury and equipment damage. VR-T211.0

To place a control into the control enclosure, follow the procedure outlined below:

1. Engage control on enclosure hinges.
2. Connect control ground lead to back panel.
3. Reconnect control to back panel at **TB3** (or **TB2** if present), located at the bottom of back panel.
4. Push closed the disconnect switch **V1** (and **V6** if present).
5. Pull open the current shorting switch C.
6. Close the control and tighten locking screw(s).

Section 3: Initial control programming

This section explains each step for properly completing initial control programming settings on a CL-7 voltage regulator control and back panel. Check the System Line Voltage rating on the regulator nameplate. Refer to the regulator service manual as identified on the regulator nameplate for additional information on the regulator.

This section covers standard set-up procedures for controls, including control replacement. Refer to **Programming and Reconfiguring for Different Voltage Systems**, in this section of this manual, when installing/replacing the CL-7 control and reconfiguring the regulator for a different voltage system.

1. Start with all switches on the control front panel turned **OFF**.
2. There are two options for powering the control: internal power or external power. Select one method and follow the appropriate step.

   A. Internal Power

   Turn POWER switch to **INTERNAL** from the **OFF** position.

   B. External Power

   Apply external source to the EXTERNAL SOURCE binding posts: hot lead to black, top binding post; neutral lead to white, bottom binding post; ground to green ground binding post. See detailed instructions for applying power to the external source terminals in Section 1 of this manual.

   Turn POWER switch to **EXTERNAL** from the **OFF** position.

Basic programming

Complete the steps in Table 3-1 to program the control for basic operation. Continue with the steps in Table 3-2 to then program the control for additional features or control replacement. For each item, check each value and verify or change as appropriate.

Note: After turning on the control and the LCD displays **PASS**, press **ESC** for further keypad use.

Step-by-step instructions are included in Tables 3-1 and 3-2. The Instructions column lists keys to press (i.e.; ENTER, Edit, 7, etc.). Also, italicized instructions denote a choice or an entry; Value denotes a desired value entered via the numeric keypads; and following each "Scroll" is an italicized list of alternatives that appear in the display, within that function code. Scroll through the list until the desired alternative is selected, and then press Enter.

Perform a Demand Master Reset (FC 38) after completing the initial control programming to reset to present demand values.

Note: Go to FC 941 to change the language setting.

Table 3-1. Programming for Basic Operations

Function Code	Description	Instructions
99	Security Function	FUNC, 99, ENTER, Password *Admin* (default), ENTER
1	Forward Set Voltage	FUNC, 1, ENTER, EDIT, *Value*, ENTER
2	Forward Bandwidth	FUNC, 2, ENTER, EDIT, *Value*, ENTER
3	Forward Time Delay	FUNC, 3, ENTER, EDIT, *Value*, ENTER
4	Forward Line Drop Comp. Resistance	FUNC, 4, ENTER, EDIT, *Value*, ENTER
5	Forward Line Drop Comp. Reactance	FUNC, 5, ENTER, EDIT, *Value*, ENTER
40	Control Identification	FUNC, 40, ENTER, EDIT, *I. D. number*, ENTER
41	Regulator Configuration	FUNC, 41, ENTER, EDIT, Scroll - *Wye*; *Delta Lagging*; *Delta Leading*, ENTER
42	Control Operating Mode	FUNC, 42, ENTER, EDIT, Scroll - *Sequential*; *Time Integrating*; *Voltage Averaging*, ENTER
43	System Line Voltage	FUNC, 43, ENTER, EDIT, *Value*, ENTER
44	Overall PT Ratio	FUNC, 44, ENTER, EDIT, *Value*, ENTER
44	Internal PT Ratio	FUNC 44, Down Arrow, EDIT, *Value*, ENTER
45	C.T. Primary Rating	FUNC, 45, ENTER, EDIT, *Value*, ENTER
46	Demand Time Interval	FUNC, 46, ENTER, EDIT, *Value*, ENTER
49	Tap-Changer Type	FUNC, 49, ENTER, EDIT, Scroll - *Cooper QD8*; *Cooper QD5*; *Cooper QD3*; *Cooper Spring Drive*; *Cooper Direct Drive*; *Siemens*; *General Electric*; *Howard*; *LTC-Reinhausen*, *ITB*, *Toshiba*, *User-Defined*, ENTER
50	Calendar/Clock	FUNC, 50, ENTER, EDIT, *Month*, *Day*, *Year*, *Hour*, *Minute*, ENTER
140	Regulator Type	FUNC, 140, ENTER, EDIT, Scroll - *Type A*; *Type B*; *Type C*; *Type D*, ENTER
144	P.I. ADD-AMP™ High Limit	FUNC, 144, ENTER, EDIT, *Value*, ENTER
145	P.I. ADD-AMP Low Limit	FUNC, 145, ENTER, EDIT, *Value*, ENTER
146	Vin PT Configuration	FUNC, 146, ENTER, EDIT, Scroll - *Vdiff without RCT1*; *Vin*, Vdiff with RCT2, ENTER
69	Auto Operation Blocking Status	FUNC, 69, ENTER, EDIT, Scroll - *Normal*; *Blocked*, ENTER
148	Nominal Sec Load voltage	FUNC, 141, ENTER, EDIT, Scroll - *120*, *240*, *System Line Voltage* ENTER
141	Regulator Identification	FUNC, 141, ENTER, EDIT, *Value*, ENTER

Table 3-1. Programming for Basic Operations (continued)

Function Code	Description	Instructions
Requirements for Reverse Sensing Mode without IDPTs		
039	Source Voltage Calculation	FUNC, 39, ENTER, EDIT Scroll - *On*; *Off*, ENTER
Required for Reverse Sensing Modes		
051	Reverse Set Voltage	FUNC, 51, ENTER, EDIT, *Value*, ENTER
052	Reverse Bandwidth	FUNC, 52, ENTER, EDIT, *Value*, ENTER
053	Reverse Time Delay	FUNC, 53, ENTER, EDIT, *Value*, ENTER
054	Reverse Line Drop Comp. Resistance	FUNC, 54, ENTER, EDIT, *Value*, ENTER
055	Reverse Line Drop Comp. Reactance	FUNC, 55, ENTER, EDIT, *Value*, ENTER
056	Reverse Sensing Mode	FUNC, 56, ENTER, EDIT, Scroll - *Locked Forward*; *Locked Reverse*; *Reverse Idle*; *Bi-directional; Neutral Idle; Co-generation; React Bi-directional, Bias Bi-directional, Bias Co-generation,* ENTER
Required for Voltage Reduction Mode		
070	Voltage Reduction Mode	FUNC, 70, ENTER, EDIT, Scroll - *Off*; *Local/Digital Remote*; *Remote/Latch*; *Remote/Pulse*, ENTER
072	Local/Digital Reduction Value	FUNC, 72, ENTER, EDIT, *Value*, ENTER
073	Remote #1 Value	FUNC, 73, ENTER, EDIT, *Value*, ENTER
074	Remote #2 Value	FUNC, 74, ENTER, EDIT, *Value*, ENTER
075	Remote #3 Value	FUNC, 75, ENTER, EDIT, *Value*, ENTER
076	# of Pulse Reduction Steps	FUNC, 76, ENTER, EDIT, *Value*, ENTER
077	% of Voltage Red Per Pulse Step	FUNC, 77, ENTER, EDIT, *Value*, ENTER
Required for Voltage Limit Mode		
080	Voltage Limit Mode	FUNC, 80, ENTER, EDIT, Scroll - *Off*; *High Limit Only*; *High/Low Limits*, ENTER
081	High Voltage Limit	FUNC, 81 ENTER, EDIT, *Value*, ENTER
082	Low Voltage Limit	FUNC, 82, ENTER, EDIT, *Value*, ENTER

Multi-phase programming

When programming a control for multi-phase operation, there are a number of setting that configure the control for operation and a number that configure the control to function with the connected voltage regulators. It is important to identify the pertinent settings applying to the individual regulators and to the control and enter them correctly. Refer to the **Multi-phase Voltage Regulation** section of this manual and *Bulletin B225-13018 CL-7 Multi-phase Control Reference* for guidance on programming the control for multi-phase operation.

All of the basic control and regulator operational information in this manual applies to controls and regulators whether they are in a single- or multi-phase configuration. When in the multi-phase configuration, the multi-phase LEDs (marked 1, 2 and 3), see Figure 3-1, can be used to identify to which of the regulators the parameters apply. When programming the multi-phase control, pay attention to the LEDs to insure that the parameters are being entered for the correct regulator. Pressing the forward arrow will cycle the display through each of the connected regulators.

Figure 3-1. Multi-phase LEDs and Forward Arrow.

Programming and reconfiguring for different voltage systems

Reconfiguring a voltage regulator for a new system voltage requires more than just programming the control. System voltage changes will require control programming, ratio correction transformer (RCT) connection changes and in some cases, a change in the control winding (PT) tap connection inside the regulator tank through the hand-hole cover.

Refer to the regulator nameplate voltage chart for information on programming and reconfiguring the regulator. The Internal PT Ratio, RCT connection and Overall PT Ratio can be found for common system Load Voltages. If the desired system voltage is not show on the nameplate, refer to the section **Allowable System Voltages and Calculation of Overall PT Ratio.** Instructions for setting Regulator Configuration (FC 41) can be found in the **Determination of Leading or Lagging in Delta-Connected Regulators** section of this manual.

⚠ WARNING

Explosion Hazard. Bypass a regulator with the line energized only if the position indicator, the neutral light, and the control tap position indicate neutral and the voltage measured between the source and load bushings using an approved voltmeter is zero. If both neutral indicators do not indicate neutral or there is a voltage between the source and load bushings, the line should be de-energized to avoid shorting part of the series winding and resultant high circulating current. Failure to comply can result in death or personal injury and equipment damage. VR-T206.1

Steps for changing system voltage

1. Remove the nameplates from the unit and move the pins to the desired Load Volts.
2. Refer to the nameplate; if the Control Winding Taps must be changed the voltage regulator must be de-energize. Refer to the section **Removal from Service** in *Service Information MN225008EN (S225-10-30) VR-32 Voltage Regulator with Quik-Drive Tap-Changer Installation, Operation and Maintenance Instructions* for detailed instructions.
3. Open the hand-hole cover and reconfigure the control winding connections on the terminal board on top of the tap changer.
   - A. Move the PT tap connection (E tap) to the correct position. The terminal is bladed and should easily pull off and then slide onto the new connection point (E1, E2 or E3).
   - B. If the regulator is equipped with an internal differential PT (IDPT) there will be a reference to a P tap on the nameplate for the control winding tap. Reconnect the P tap as required (P1, P2 or P3).
4. Replace and secure the hand-hole cover.

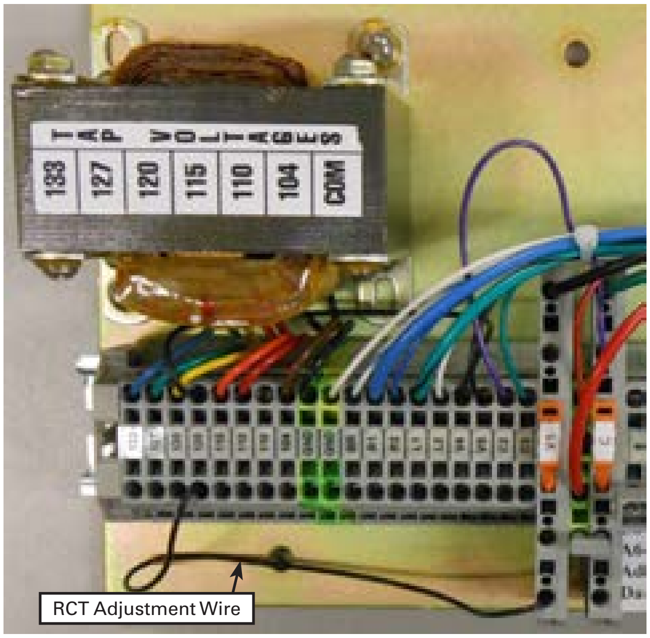


Figure 3-2. Ratio correction transformer showing wire for voltage adjustment.

5. The control should be powered down for the next step. To do so:
   - A. Move the CONTROL FUNCTION switch to OFF
   - B. Move the POWER switch to OFF.
   - C. On the back panel, Open the V1 and V6 (if present) switches and close the C switch (see Figure 3-2).
6. Connect the RCT as required for the desired system voltage.
   - A. Standard Short Back Panel – Move the single black wire connected below TB3 to the correct RCT connection point (see figure 3-2)
   - B. Full Back Panel – Move the looped tagged black wire connected on the left side of the RCT terminal board.
   - C. IDPT RCT – If there is a second RCT for the IDPT, move the looped tagged white/brown wire connected on the left side of the RCT2 terminal board.
7. Power the control for programming:
   - A. Internal Power – If the regulator is connected to system power, close the V1 and V6 (if present) switches and open the C switch and move the POWER switch to INTERNAL.
   - B. External Power – See the section **Connecting Power to External Source Terminals** in this manual. Once power has been connected, move the POWER switch to INTERNAL.

8. Program the control as required for the new system voltage:
   - A. Set FC 41 to for the system configuration (Wye, Delta Leading, Delta Lagging).
   - B. Set FC 43 to the desired Load Volts.
   - C. Set FC 44 to the Overall Pot. Ratio as shown on the nameplate for the corresponding Load Volts or as determined for voltages other than shown on the nameplate.
   - D. Set FC 44↓ to the Internal PT Ratio as shown on the nameplate for the corresponding Load Volts or as determined for voltages other than shown on the nameplate.
9. Complete any other programming as required. Refer to Tables 3-1 and 3-2 for guidance on typical settings.

Allowable system voltages and calculation of overall PT ratio

If the system voltage is other than those listed on the nameplate, it can be determined if there is sufficient ratio correction available from the control winding (internal PT) taps and the Ratio Correction Transformer (RCT) taps to allow the CL-7 control and motor to function properly. The general guideline is that the overall PT ratio is sufficient if the voltage delivered to the control for the nominal voltage conditions is in the range of 115–125 V.

To determine the voltage delivered to the control, use the following procedure:

1. Calculate the desired PT ratio.

   Desired PT Ratio = Desired system voltage ÷ 120 V
2. Choose the internal PT ratio on the nameplate closest to the desired PT Ratio.
3. Calculate the actual voltage at the output of the internal PT.

   Internal PT Output Voltage = Desired system voltage ÷ Selected Internal PT Ratio
4. Choose the RCT tap (133, 127, 120, 115, 110, 104) closest to the internal PT output voltage.
5. Given the RCT input tap, use Table 3-3 to determine the RCT ratio.
6. Calculate the control input voltage.

   Control Input Voltage = Internal PT Output Voltage ÷ (RCT Ratio)
7. Calculate the overall PT ratio.

   Overall PT Ratio = Internal PT Ratio x (RCT Ratio)

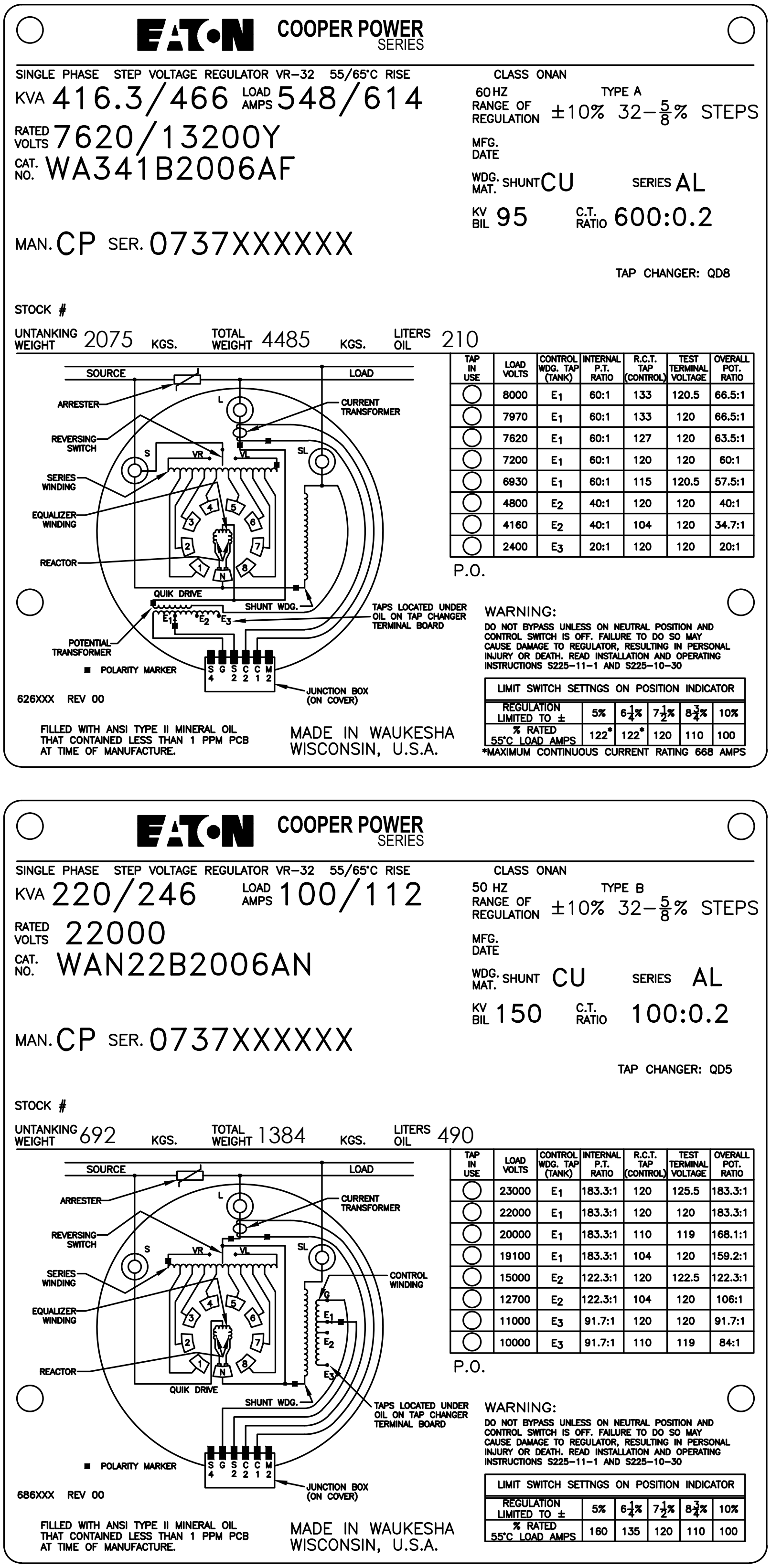
EXAMPLE: If a 60 Hz, 7620 V regulator is to be used on a system with a nominal voltage of 2500 V, the following is determined:

1. 2500 V ÷ 120 V = 20.8
2. Choose 20:1 for the internal PT ratio.
3. Internal PT output voltage = 2500 V ÷ 20 = 125 V
4. Best RCT input tap is 127.
5. RCT ratio is 1.058.
6. Control input V = 125 ÷ 1.058 = 118 V

   This is within allowable range.
7. Overall PT ratio = 20 x 1.058 = 21.2:1

Table 3-3. RCT Ratios

RCT Input Tap	RCT Ratio
133	1.108
127	1.058
120	1.000
115	0.958
110	0.917
104	0.867



COOPER POWER
SERIES

SINGLE PHASE STEP VOLTAGE REGULATOR VR-32 55/65°C RISE
CLASS ONAN
KVA 416.3/466 LOAD AMPS 548/614
60 HZ TYPE A
RANGE OF REGULATION ±10% 32-$\frac{5}{8}$% STEPS
RATED VOLTS 7620/13200Y
MFG. DATE
CAT. NO. WA341B2006AF
WDG. MAT. SHUNT CU SERIES AL
KV BIL 95 C.T. RATIO 600:0.2
MAN. CP SER. 0737XXXXXX
TAP CHANGER: QD8
STOCK #
UNTANKING WEIGHT 2075 KGS. TOTAL WEIGHT 4485 KGS. LITERS OIL 210

TAP IN USE	LOAD VOLTS	CONTROL WDG. TAP (TANK)	INTERNAL P.T. RATIO	R.C.T. TAP (CONTROL)	TEST TERMINAL VOLTAGE	OVERALL POT. RATIO
○	8000	E_1	60:1	133	120.5	66.5:1
○	7970	E_1	60:1	133	120	66.5:1
○	7620	E_1	60:1	127	120	63.5:1
○	7200	E_1	60:1	120	120	60:1
○	6930	E_1	60:1	115	120.5	57.5:1
○	4800	E_2	40:1	120	120	40:1
○	4160	E_2	40:1	104	120	34.7:1
○	2400	E_3	20:1	120	120	20:1

P.O.

WARNING:
DO NOT BYPASS UNLESS ON NEUTRAL POSITION AND CONTROL SWITCH IS OFF. FAILURE TO DO SO MAY CAUSE DAMAGE TO REGULATOR, RESULTING IN PERSONAL INJURY OR DEATH. READ INSTALLATION AND OPERATING INSTRUCTIONS S225-11-1 AND S225-10-30

LIMIT SWITCH SETTNGS ON POSITION INDICATOR					
REGULATION LIMITED TO ±	5%	6$\frac{1}{4}$%	7$\frac{1}{2}$%	8$\frac{3}{4}$%	10%
% RATED 55°C LOAD AMPS	122*	122*	120	110	100

*MAXIMUM CONTINUOUS CURRENT RATING 668 AMPS

626XXX REV 00

FILLED WITH ANSI TYPE II MINERAL OIL THAT CONTAINED LESS THAN 1 PPM PCB AT TIME OF MANUFACTURE.

MADE IN WAUKESHA
WISCONSIN, U.S.A.

COOPER POWER
SERIES

SINGLE PHASE STEP VOLTAGE REGULATOR VR-32 55/65°C RISE
CLASS ONAN
KVA 220/246 LOAD AMPS 100/112
50 HZ TYPE B
RANGE OF REGULATION ±10% 32-$\frac{5}{8}$% STEPS
RATED VOLTS 22000
MFG. DATE
CAT. NO. WAN22B2006AN
WDG. MAT. SHUNT CU SERIES AL
KV BIL 150 C.T. RATIO 100:0.2
MAN. CP SER. 0737XXXXXX
TAP CHANGER: QD5
STOCK #
UNTANKING WEIGHT 692 KGS. TOTAL WEIGHT 1384 KGS. LITERS OIL 490

TAP IN USE	LOAD VOLTS	CONTROL WDG. TAP (TANK)	INTERNAL P.T. RATIO	R.C.T. TAP (CONTROL)	TEST TERMINAL VOLTAGE	OVERALL POT. RATIO
○	23000	E_1	183.3:1	120	125.5	183.3:1
○	22000	E_1	183.3:1	120	120	183.3:1
○	20000	E_1	183.3:1	110	119	168.1:1
○	19100	E_1	183.3:1	104	120	159.2:1
○	15000	E_2	122.3:1	120	122.5	122.3:1
○	12700	E_2	122.3:1	104	120	106:1
○	11000	E_3	91.7:1	120	120	91.7:1
○	10000	E_3	91.7:1	110	119	84:1

P.O.

WARNING:
DO NOT BYPASS UNLESS ON NEUTRAL POSITION AND CONTROL SWITCH IS OFF. FAILURE TO DO SO MAY CAUSE DAMAGE TO REGULATOR, RESULTING IN PERSONAL INJURY OR DEATH. READ INSTALLATION AND OPERATING INSTRUCTIONS S225-11-1 AND S225-10-30

LIMIT SWITCH SETTNGS ON POSITION INDICATOR					
REGULATION LIMITED TO ±	5%	6$\frac{1}{4}$%	7$\frac{1}{2}$%	8$\frac{3}{4}$%	10%
% RATED 55°C LOAD AMPS	160	135	120	110	100

686XXX REV 00

FILLED WITH ANSI TYPE II MINERAL OIL THAT CONTAINED LESS THAN 1 PPM PCB AT TIME OF MANUFACTURE.

MADE IN WAUKESHA
WISCONSIN, U.S.A.

Figure 3-4. Nameplates, 60 Hz regulator and 50 Hz regulator shown.

Determination of leading or lagging in delta-connected regulators

For a regulator to operate properly when connected phase to phase, it is necessary for the control to be programmed with the correct regulator configuration in FC 41. It must be determined whether it is connected leading or lagging. The control aids the operator in making this determination.

1. Regulator must be installed.
2. POWER switch must be set to **INTERNAL**.
3. **V1** knife switch (and **V6**, if present) must be closed.
4. Knife switch C must be open. Current must be flowing.
5. CONTROL FUNCTION switch may be in any position (**AUTO/REMOTE-OFF-LOCAL MANUAL**).
6. For regulator #1, set FC 41 to Delta Lagging and record the Power Factor, FC 13.
7. For the same regulator, set FC 41 to Delta Leading and record the Power Factor.
8. Repeat steps 6 and 7 for each regulator in the bank.
9. For each regulator, one of the two power factor values will be reasonable and the other will be unreasonable.
10. Set the Regulator Configuration (FC 41) to the value which produced the reasonable power factor. See Table 3-4.

For one regulator: Set FC 41 to the value which produced the reasonable power factor.

For two regulators in open delta: See the example in Table 3-4. In an open delta connection, one of the regulators will always be leading and the other lagging. The reasonable power factor for each regulator should be very close to the typical power factor of the system. In this example, regulator #1 is the lagging unit and regulator #2 is the leading unit.

For three regulators in closed delta: In closed delta, all three regulators are either leading or lagging, depending on how they are connected relative to generator phase rotation. Set FC 41 of all three regulators to the value which produced the reasonable power factor.

Table 3-4. Sample Power Factor Values for Regulators Connected in Open Delta Configuration

	Recorded Power Factor (FC 13)	
Configuration (FC 41)	**Reg. #1**	**Reg. #2**
Delta Lagging	0.94*	-0.77
Delta Leading	0.17	0.93*

* Reasonable power factor values.

Section 4: Control operation

Automatic operation

In the automatic mode of operation, the POWER switch will be set on **INTERNAL** and the CONTROL FUNCTION switch will be placed on **AUTO/REMOTE**. The regulator is assumed energized from the primary circuit. If the sequential mode of operation (the standard mode set at FC 42) is selected, the control response on Eaton's Cooper Power series voltage regulator is as follows:

1. As the primary voltage moves to a level which represents an out-of-band condition, the sensing voltage will correspondingly reflect the same results on the 120 V (or 240 V) base. Assuming the voltage dropped low, a lower than normal signal will appear at the printed circuit board input terminals.
2. The signal is transformed and converted into a digital format for use by the microprocessor.
3. The microprocessor, recognizing the voltage condition as low and out-of-band, issues an output which activates the Out-of-Band Low indicator and starts an internal timer, which is equivalent to the time-delay setting.
4. During the time-out period, the voltage is continually sensed and sampled. Should the voltage momentarily move into band, the Out-of-Band Low indicator is deactivated and the timer is reset.
5. At the end of the time-delay period, the microprocessor issues an output which causes the raise triac to be activated.
6. The tap-changer motor begins to turn as a result of triac closure, and a cam on the tap-changer closes the raise holding switch. The holding switch now provides an alternate source for the motor current, which passes through the input terminals on the circuit board.
7. The microprocessor now recognizes that current is flowing in the holding switch circuit. The raise triac is deactivated.
8. As a result of the triac being deactivated, the motor current is now carried solely by the holding switch circuit. When the motor rotation is complete, the holding switch opens as a result of the cam action and the motor stops.
9. The microprocessor recognizes that the tap change is now complete by detecting that motor current is no longer flowing. The operations counter and tap position indication are incremented. A 2-second pause then occurs, allowing the sensing voltage to stabilize after motor operation.
10. At the end of this pause, if the voltage is still out-of-band, another output is issued to reactivate the raise triac, thus starting another tap change sequence. If the voltage is in-band, the **OUT-OF-BAND LOW** indicator is turned off and the time-delay timer is reset.

This sequence is altered slightly if the voltage-averaging or time-integrating mode of operation are selected. These characteristics are described in **Control Operating Modes** in this section of the manual.

Manual operation

In the manual mode of operation, the POWER switch can be set on either **INTERNAL** or **EXTERNAL** and the control switch will be placed on **LOCAL MANUAL**. If the external position is chosen, an external source must be applied to the terminals on the control. This should be a nominal 120 Vac source (or other ac voltage as indicated by a decal) and should not be a direct current to alternating current (dc-to-ac) inverter.

Operation of the momentary toggle **RAISE/LOWER** switch applies power through the position indicator limit switch contacts directly to the tap-changer motor. As the tap-changer motor cam rotates, the holding switch is closed, as described above in the **Automatic Operation** section. This holding-switch current is sensed by the circuit board, and the operations counter and tap position indicator are appropriately updated.

Tap change operation will continue as long as the **RAISE/LOWER** switch is held in either the raise or lower position and the ADD-AMP™ limit switch is not activated to open the circuit.

Self-test

There are three events which trigger the self-test routine: the initial control power-up, operator entry of self-test mode using FC 91, or detection of a firmware problem. Refer to the **Troubleshooting** section of this manual for more information on control self-test.

Security system

The security (password) system implemented on the CL-7 control is structured into four levels. This permits selective access to the various parameters as dictated by the active security level. Most function codes may be read (accessed) at the View level, the base (unsecured) level. The security level required to change or reset each parameter is listed in Table 4-1. The security access codes for levels 1, 2, and 3 have been programmed into the control at the factory. These codes may be changed by the user according to Table 4-1. A secure password may consist of any combination of letters, numbers, and special characters which include the following requirements:

- A minimum of five and maximum of 10 non-blank characters.
- A minimum of 5 letters
- At least one upper case letter.
- At least one special character (#, /, ? or !)
- A letter in the first and last position.

Access into the system is accomplished by entering the appropriate security code at FC 99.The user has the option of overriding (inhibiting) one or more levels of security by choosing the appropriate Security Override Code at FC 92. Choices at FC 92 are View (no override), override Operate level, override Modify and Operate levels, and override the Operate, Modify, and Admin levels.

The values of the three security codes, FC 96, FC 97, and FC 98, may be read only at the Admin level.

IMPORTANT

If the Admin security password is changed and forgotten, it cannot be retrieved. This is to meet international security guidelines which prohibit back-door access to security passwords. In order to reset a lost Admin password, the control must be returned to the factory for reprogramming.

Remote security override

The remote security override feature allows for a temporary override of control security through SCADA. This can be used in cases where local operators are not provided with passwords, but are required to make local changes using the HMI.

Two function code settings configure and enable the feature either through HMI or SCADA, but the feature can only be activated by sending an analog value (Operate=1, Modify=2, Admin=3) through SCADA to override the present security level to the level specified. The remote override timer is set at FC 199 to specify the length of the override in hours and the feature is enables at FC 199↓.

Once the override is activated, it will continue for the duration specified by the remote override timer and then revert back to the previous security level. The timer information is stored in non-volatile memory enabling the override to continue after a power cycle unless the timer has expired while power was off. If the timer is changed when the override is in place, the timeout period will restart.

If the user enters a valid password from the front panel while the remote security override is enabled, the control will use the entered password and the remote security override feature will be disabled.

Table 4-1. Security Codes

Security Level	Accessible at Function Code	Factory-Programmed Code	Functions Available at the Active Code
View	No Code Required	No Code Required	Read all parameters except security (FC 96, FC 97, & FC 98)
Operate	96	Operate	Read all parameters as described above,and reset all demand metering and tap position maximum and minimum values and date/times
Modify	97	Modify	Read all parameters as described above, reset all demand meter and tap position maximum and minimum values and date/times, and change any operational or setup parameter
Admin	98	Admin	Read, reset, or change any parameter

Basic control operations

Set voltage

The set voltage is the voltage level to which the control will regulate on the 120 V or 240 V base. Since the control performs ratio correction in the firmware, this value will typically be set for 120.0 V/240.0, unless it is desired to operate at a voltage level higher or lower than nominal. For proper operation, the ratio-correcting transformer, located on the back panel of the control enclosure, must also be set for the correct tap as shown on the regulator nameplate.

Bandwidth

The bandwidth is defined as that total voltage range, around the set voltage, which the control will consider as a satisfied condition. As an example, a 2 V bandwidth on a 120 V set voltage means the time delay timer will not activate until the voltage is below 119 V or above 121 V. When the voltage is in-band, the band edge indicators are off and the timer (time delay) is off. Selection of a small bandwidth will cause more tap changes to occur, but will provide a more tightly regulated line. Conversely, a larger bandwidth results in fewer tap changes, but at the expense of better regulation. Selection of the bandwidth and time-delay settings should be made recognizing the interdependence of these two parameters.

Time delay

The time delay is the period of time (in seconds) that the control waits from when the voltage first goes out-of-band to the time when a tap change is issued. If a rapid response is required, a shorter setting should be used. If several devices on the same line are to be coordinated (cascaded), different time-delay settings will be required to allow the devices to operate in the desired sequence. Proceeding from the source, each device should have a longer time delay than the preceding device. A minimum 15-second difference between regulators located on the same phase on the same feeder is recommended. The delay allows the upstream device to perform its operations prior to the downstream device reacting. The time-delay setting of a voltage-minimizing, activated capacitor control should be set the same as a regulator control. Alternate time delays are available with the voltage limiter feature. Refer to the **Voltage Limiter** section of this manual.

Line drop compensation, resistance and reactance settings

Quite often regulators are installed some distance from the theoretical load center (the location at which the voltage is to be regulated). This means the load will not be served at the desired voltage level due to the losses (voltage drop) on the line between the regulator and the load. Furthermore, as the load increases, line losses also increase, causing the lowest voltage condition to occur during the time of heaviest loading.

To provide the regulator with the capability to regulate at a projected load center, the control has line-drop-compensation elements within it. This circuitry usually consists of a current transformer (CT), which produces a current proportional to the load current, and resistive (R) and reactive (X) elements through which this current flows. As the load increases, the resulting CT current flowing through these elements produces voltage drops, which simulate the voltage drops on the primary line.

Within the control, the input current is sampled and is used in a computer algorithm which calculates the respective resistive and reactive voltage drops based upon the line-drop-compensation values programmed into the control at FC 4 and FC 5 (or FC 54 and FC 55 for reverse power flow conditions). This is an accurate and economical means of developing the compensated voltage.

To select the proper R and X values, the user must know several factors about the line being regulated.

Regulator configuration

The control is designed to operate on wye (star)-connected and delta-connected regulators. Regulators connected line-to-ground (wye) develop potentials and currents suitable for direct implementation in the control. Regulators connected line-to-line (delta) develop a potential-to-current phase shift which is dependent upon whether the regulator is defined as leading or lagging. The phase shift must be known by the control to permit accurate calculations for correct operation. This is accomplished by entering the proper option at FC 41: Wye, Delta Lagging, or Delta Leading. See **Determination of Leading or Lagging in Delta-Connected Regulators** in Section 3 of this manual for more information on setting this parameter.

Control operating modes

The CL-7 control supports three modes in which the control responds to out-of-band conditions, permitting use of the mode that best fits the application. The three modes are Sequential, Time Integrating, and Voltage Averaging. The mode setting can be selected by scrolling within FC 42 or through **Settings > Configuration** in the menu structure.

Sequential mode

This is the standard mode of response. When the load voltage goes out-of-band, the time-delay circuit is activated. At the end of the time delay, a tap change is initiated. After each tap change, a 2-second pause occurs to permit the control to sample the voltage again. This sequence continues until the voltage is brought into band, at which time the timing circuit is reset. Whenever the voltage goes in-band, the timer is reset.

Time-integrating mode

When the load voltage goes out-of-band, the time-delay circuit is activated. At the end of the time-out, a tap change is initiated. After each tap change, a 2-second pause occurs to permit the control to sample the voltage again. If the voltage is still out-of-band, another tap change is performed. This sequence continues until the voltage is brought into band. When the voltage goes in-band, the timer is decremented at the rate of 1.1 seconds for every second elapsed, until it reaches zero.

Voltage-averaging mode

When the load voltage goes out-of-band, the time-delay circuit is activated. During this time-delay period, the microprocessor monitors and averages the instantaneous load voltage. It then computes the number of tap changes required to bring the average voltage back to the set voltage level. When the time-delay period is complete, the computed number of tap changes are performed without any delay between them, up to a maximum of five consecutive tap changes, to avoid an accumulative error. The timer is not reset on voltage excursions in-band unless the voltage stays in-band for at least ten continuous seconds. An error-averaging characteristic is inherent with the voltage-averaging mode.

Note: To permit sufficient time for the microprocessor to average the voltage, the time-delay period must be 30 seconds or longer. If the time delay is set for less than 30 seconds, the control ignores the setting and uses 30 seconds.

System line voltage

The control performs ratio correction in the firmware, and, consequently, the primary voltage must be entered for the control to perform this calculation. This value is simply the nominal single-phase voltage supplied across the L and SL terminals. Regulators shipped from the factory are set for the voltage indicated by the pin on the nameplate, and this value is programmed into the control. If the regulator is installed on any other system voltage, this system voltage must be entered for proper operation.

Overall PT ratio

Since the control performs ratio correction in the firmware, the PT ratio for the voltage-sensing supply is required for the control to perform the calculation. The ratio to be programmed in the control is the Overall PT Ratio, which is a combination of the ratios of the PT in the tank and the RCT. For standard voltages shown on the regulator nameplate an Overall PT Ratio is listed. The Overall PT Ratio, which corresponds to the regulator's rated voltage, is set by the factory. If the regulator is installed on any other system voltage, the corresponding Overall PT Ratio is also required and must be determined. See the section Allowable System Voltages and Calculation of Overall PT Ratio for more information.

The voltage from the RCT is normally corrected to 120 V. However, when this voltage is other than 120 V, the control will calibrate the input voltage to a 120 V (or 240 V when FC 148 is set to 240 Volts) base and 120 V (or 240 V) will be displayed at FC 6. The voltage test terminals will continue to show the voltage as applied to the control from the RCT.

Internal PT ratio

The CL-7 control does not require a ratio correction transformer (RCT) for the internal differential PT (IDPT). If a regulator design includes an IDPT, but does not have a second RCT, the control is able to use the Internal PT ratio to determine the differential and source-side voltage. In order for this to work, the Internal PT ratio must be entered at FC 44↓ and the Vin PT Configuration (FC 146) must be set to Vdiff without RCT2.

Current transformer primary rating

The control is designed for 200 mA as the rated CT current and will meter to 800 mA with no loss of accuracy. Ratio correction is performed by the firmware, and, consequently, the CT primary rating must be entered. The CT primary rating is available on the regulator nameplate.

EXAMPLE: If a CT ratio 400/0.2 is indicated on the nameplate, then 400 must be entered at FC 45.

Delta-connected (line-to-line connected) regulators

When a regulator is connected line-to-line, the phase angle of the line current is 30 degrees displaced from the voltage impressed across the regulator. After setting the Regulator Configuration, FC 41, the correct relationship between the voltage and current is established. Setting the regulator Configuration to the incorrect delta value (lagging instead of leading, or vice versa), the phase angle will be in error 60 degrees.

See the section **Determination of Leading or Lagging in Delta-Connected Regulators** for information on selecting the correct setting. Below are considerations concerning delta-connected regulators:

- The basic decision-making of the control when line-drop compensation is not used is not affected by the phase angle; therefore, operation will be correct even if FC 41 is set to either of the two incorrect values. This is true for forward and reverse operation.
- If line-drop compensation is used, the scaling of the R and X values is controlled by FC 41; therefore, it is important to correctly set FC 41 for the compensated voltage to be correctly determined.
- The following metering parameters will be correct only if the Regulator Configuration is correctly set: power factor, kVA, kW, kvar, demand kVA, demand kW, and demand kvar.

Note: The kVA, kW, kvar, demand kVA, demand kW, and demand kvar use the line-to-line voltage; therefore, they display the value at the regulator not on any one feeder. To determine the total three-phase value of any one of these parameters, each regulator value must be divided by $\sqrt{3}$ (1.732) before adding the three together.

Section 5: Control programming

Use the keypad to program the control. A Quik-Start™ setup is given for programming for basic regulation. Refer to the **Control Front Panel** section of this manual for information on using the front panel.

Note: After turning on the control and the LCD displays **PASS**, press **ESC** for further keypad use.

Control functions with corresponding control function codes are accessed via the keypad. The menu system is structured with a main menu, and sub-menu levels, the last of which is the parameter. The parameters and other text information are displayed on the LCD screen.

Refer to Table 5-2 for the nested menu of functions and parameters.

Refer to Table 5-3 for a numerical listing of function codes (FC) and corresponding menu and parameter information.

Multiple menu items with the same function code are allowed; the first menu item listed is then the main function called up when that function code is entered at the keypad. Access multiple menu items within the same function code with the ↑↓ scrolling keys.

Quik-Start setup

Refer to Table 5-1 for a quick start up for basic regulation. Please note the following Function Code information when using the Quik-Start settings.

99 Security Password must be entered before changes can be made to parameters.

39 Source Voltage Calculation must be set to On for reverse power flow operation if a source-side calculation is to be used instead of an internal differential potential transformer to determine source-side voltage.

140 Regulator Type must be set for Type A (Straight Design), Type B (Inverted Design), Type C (Type TX for regulators rated at 2.5 kV and greater than 875 A), or Type D (Type AX for regulators rated at 5.0 or 7.53 kV and greater than 875 A) when FC 39 is on.

41 Regulator Configuration must be programmed when a control change-out is required.

43 System Line Voltage must be programmed when a control change-out is required.

44 Overall PT Ratio must be programmed when a control change-out is required.

45 CT Primary Rating must be programmed when a control change-out is required.

49 Tap-Changer Type must be programmed when a control change-out is required.

50 Calendar/Clock must be programmed when a control change-out is required or if power has been lost for more than four (4) days.

69 Blocking Status must be set to Normal for the regulator to operate in the automatic mode.

TABLE 5-1 Quik-Start Set-Up for Basic Regulation

Function Code	Description	Instructions
Security		
099	Security	FUNC, 99, ENTER, *Password* (Admin), ENTER
Forward Settings		
001	Forward Set Voltage	FUNC, 1, ENTER, EDIT, *Value*, ENTER
002	Forward Bandwidth	FUNC, 2, ENTER, EDIT, *Value*, ENTER
003	Forward Time Delay	FUNC, 3, ENTER, EDIT, *Value*, ENTER
004	Forward Line Drip Comp. Resistance	FUNC, 4, ENTER, EDIT, *Value*, ENTER
005	Forward Line Drip Comp. Reactance	FUNC, 5, ENTER, EDIT, *Value*, ENTER
Reverse Settings		
056	Reverse Sensing Mode	FUNC, 56, ENTER, Scroll - Locked Forward; Locked Reverse; Reverse Idle; Bi-Directional; Neutral Idle; Co-generation; React Bi-directional; Bias Bi-Directional, Bias Co-generation, ENTER
039	Source Voltage Calculation	FUNC, 39, ENTER, EDIT, Scroll - *On or Off,* ENTER
140	Regulator Type	FUNC, 140, ENTER, EDIT, Scroll - *Type A; Type B; Type C; Type D,* ENTER
044	Internal PT Ratio	FUNC, 44, ENTER, Down Arrow, EDIT, Value, ENTER
146	Vin PT Configuration	FUNC, 146, ENTER, EDIT, Scroll - Vdiff without RCT2; Vin Mode; Vdiff with RCT2, ENTER
051	Reverse Set Voltage	FUNC, 51, ENTER, EDIT, *Value,* ENTER
052	Reverse Bandwidth	FUNC, 52, ENTER, EDIT, *Value,* ENTER
053	Reverse Time Delay	FUNC, 53, ENTER, EDIT, *Value,* ENTER
054	Reverse Line Drip Comp. Resistance	FUNC, 54, ENTER, EDIT, *Value,* ENTER
055	Reverse Line Drip Comp. Reactance	FUNC, 55, ENTER, EDIT, *Value,* ENTER
Configurations		
041	Regulator Configuration	FUNC, 41, ENTER, EDIT, Scroll - *Wye; Delta Lagging; Delta Leading,* ENTER
042	Control Operation Mode	FUNC, 42, ENTER, EDIT, Scroll - *Sequential; Time-Integrating; Voltage-Averaging,* ENTER
043	System Line Voltage	FUNC, 43, ENTER, EDIT, *Value,* ENTER
044	Overall PT Ratio	FUNC, 44, ENTER, EDIT, *Value,* ENTER
045	C.T. Primary Rating	FUNC, 45, ENTER, EDIT, *Value,* ENTER
049	Tap-Changer Type	FUNC, 49, ENTER, EDIT, Scroll - *Cooper QD8; Cooper QD5; Cooper QD3; Cooper Spring Drive; Cooper Direct Drive; Siemens; General Electric; Howard; LTC-Reinhausen, ITB; Toshiba; User-Defined,* ENTER
050	System Calendar and Clock	FUNC, 50, ENTER, EDIT, *Month, Day, Year, Hour, Minute,* ENTER
069	Auto Operation Blocking Status	FUNC, 69, ENTER, EDIT, Scroll - Normal; Blocked, ENTER
Voltage Reduction		
070	Voltage Reduction Mode	FUNC, 70, ENTER, EDIT, *Scroll - Off; Local/Digital Remote; Remote/Latch, Remote/Pulse,* ENTER
072	Local/Digital Reduction Value	FUNC, 72, ENTER, EDIT, *Value,* ENTER
073	Remote #1 Value	FUNC, 73, ENTER, EDIT, *Value,* ENTER
074	Remote #2 Value	FUNC, 74, ENTER, EDIT, *Value*, ENTER
075	Remote #3 Value	FUNC, 75, ENTER, EDIT, *Value*, ENTER
076	# of Pulse Reduction Steps	FUNC, 76, ENTER, EDIT, *Value*, ENTER
077	% of Voltage Red Per Pulse Step	FUNC, 77, ENTER, EDIT, *Value*, ENTER
Voltage Limiter		
080	Voltage Limiter Mode	FUNC, 80, ENTER, EDIT, Scroll - Off; *High Limit Only; High/Low Limit; IVVC High Limit Only; IVVC High/Low Limits,* ENTER
081	High Voltage Limit	FUNC, 81, ENTER, EDIT, *Value*, ENTER
082	Low Voltage Limit	FUNC, 82, ENTER, EDIT, *Value*, ENTER

Function menu

Refer to Table 5-2 for the nested menu structure: Main Menu, Sub-Menus, and Parameter

TABLE 5-2 Function Menu

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*SETTINGS	*Forward Direction			Forward Set Voltage	001
				Forward Bandwidth	002
				Forward Time Delay	003
				Fwd Line Drop Comp. Resistance	004
				Fwd Line Drop Comp. Reactance	005
	*Reverse Direction			Reverse Set Voltage	051
				Reverse Bandwidth	052
				Reverse Time Delay	053
				Rev Line Drop Comp. Resistance	054
				Rev Line Drop Comp. Reactance	055
	*Configuration			Control Identification	040
				Regulator Type	140
				Tap Changer Type	049
				Regulator Configuration	041
				Control Operating Mode	042
				System Line Voltage	043
				Overall P.T. Ratio	044
				Internal P.T. Ratio	044
				C.T. Primary Rating	045
				Rated Load Current	045
				% C.T. Rating Level 4	045
				% C.T. Rating Level 3	045
				% C.T. Rating Level 2	045
				% C.T. Rating Level 1	045
				Demand Time Interval	046
				P.I. ADD-AMP High Limit	144
				P.I. ADD-AMP Low Limit	145
				Vin P.T. Configuration	146
				TPI Sense Method	147
				Neutral Sync Retry Count	147
				Motor Power Source Selection	147
				Nominal Sec Load Voltage	148
				Regulator Identification	141
				Serial Number	142

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*SETTINGS (Cont.)	*Calendar/Clock			System Calendar and Clock	050
				UTC Time Zone	050
				Date Format	942
				Time Format	943
	_Multi-Phase Config			Multi-Phase Feature	200
				Multi-Phase Mode	201
				Multi-Phase VRs Configured	202
				Multi-Phase Lead Regulator	203
				VR1 Tap Wait Timer	204
				VR2 Tap Wait Timer	204
				VR3 Tap Wait Timer	204
				Multi-Phase Retry Count	205
				Multi-Phase Retry Delay	206
				Multi-Phase Total Deviation	207
				Timer To Max Deviation Mode	208
				Timer To Alt Mode	209
				Max Deviation Alt Mode	210
				Sequencing Interval	211
*FEATURES	*Auto-Block Status			Auto Operation Blocking Status	069
				Block Before Remote Tap	169
	*Reverse Power Mode			Reverse Sensing Mode	056
				Reverse Current Sense Threshold	057
				Bias Co-Gen Alt Mode	058
	*Source Side Voltage Calc			Source Voltage Calculation	039
	*Voltage Limiter			Voltage Limiter Mode	080
				High Voltage Limit	081
				Low Voltage Limit	082
				Voltage Limiter Fast Resp. Delay	083
				Voltage Limiter Delay	084
				Time Between Taps	085
	*Voltage Reduction			Voltage Reduction Mode	070
				Reduction In Effect	071
				Local/Digital Reduction Value	072
				Remote #1 Value	073
				Remote #2 Value	074
				Remote #3 Value	075
				# of Pulse Reduction Steps	076
				% of Voltage Red Per Pulse Step	077
				Present Voltage Reduction Step	078

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*FEATURES (Cont.)	*Tap To Neutral			Tap To Neutral	170
	*Tap To Target			Tap to Target	171
				Target Tap Position	172
	*SOFT-ADD-AMP			SOFT-ADD-AMP Limits	079
				SOFT-ADD-AMP High Limit	175
				SOFT-ADD-AMP Low Limit	176
	*Alternate Config	*Alternate Config Mode		Alternate Config Mode	450
				Alternate Config Selection	452
				Alternate Config State	451
		*Alternate Configuration 1		Forward Set Voltage	460
				Forward Bandwidth	461
				Forward Time Delay	462
				Fwd Line Drop Comp. Resistance	463
				Fwd Line Drop Comp. Reactance	464
				Reverse Set Voltage	465
				Reverse Bandwidth	466
				Reverse Time Delay	467
				Rev Line Drop Comp. Resistance	468
				Rev Line Drop Comp. Reactance	469
				Control Operating Mode	470
				Reverse Sensing Mode	471
				Reverse Current Sense Threshold	472
				Auto Operation Blocking Status	473
				Voltage Reduction Mode	474
				Local/Digital Reduction Value	475
				Remote #1 Value	476
				Remote #2 Value	477
				Remote #3 Value	478
				# of Pulse Reduction Steps	479
				% of Voltage Red Per Pulse Step	480
				Present Voltage Reduction Step	481
				SOFT-ADD-AMP Limits	182
				SOFT-ADD-AMP High Limit	483
				SOFT-ADD-AMP Low Limit	484
				Voltage Limiter Mode	485
				High Voltage Limit	486
				Low Voltage Limit	487
				Voltage Limiter Fast Resp. Delay	488
				Voltage Limiter Delay	489
				Time Between Taps	490
				Tap To Neutral	491

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*FEATURES (Cont.)	*Alternate Config (Cont.)	*Alternate Configuration 2		Forward Set Voltage	500
				Forward Bandwidth	501
				Forward Time Delay	502
				Fwd Line Drop Comp. Resistance	503
				Fwd Line Drop Comp. Reactance	504
				Reverse Set Voltage	505
				Reverse Bandwidth	506
				Reverse Time Delay	507
				Rev Line Drop Comp. Resistance	508
				Rev Line Drop Comp. Reactance	509
				Control Operating Mode	510
				Reverse Sensing Mode	511
				Reverse Current Sense Threshold	512
				Auto Operation Blocking Status	513
				Voltage Reduction Mode	514
				Local/Digital Reduction Value	515
				Remote #1 Value	516
				Remote #2 Value	517
				Remote #3 Value	518
				# of Pulse Reduction Steps	519
				% of Voltage Red Per Pulse Step	520
				Present Voltage Reduction Step	521
				SOFT-ADD-AMP Limits	522
				SOFT-ADD-AMP High Limit	523
				SOFT-ADD-AMP Low Limit	524
				Voltage Limiter Mode	525
				High Voltage Limit	526
				Low Voltage Limit	527
				Voltage Limiter Fast Resp. Delay	528
				Voltage Limiter Delay	529
				Time Between Taps	530
				Tap To Neutral	531

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*FEATURES (Cont.)	*Alternate Config (Cont.)	*Alternate Configuration 3		Forward Set Voltage	550
				Forward Bandwidth	551
				Forward Time Delay	552
				Fwd Line Drop Comp. Resistance	553
				Fwd Line Drop Comp. Reactance	554
				Reverse Set Voltage	555
				Reverse Bandwidth	556
				Reverse Time Delay	557
				Rev Line Drop Comp. Resistance	558
				Rev Line Drop Comp. Reactance	559
				Control Operating Mode	560
				Reverse Sensing Mode	561
				Reverse Current Sense Threshold	562
				Auto Operation Blocking Status	563
				Voltage Reduction Mode	564
				Local/Digital Reduction Value	565
				Remote #1 Value	566
				Remote #2 Value	567
				Remote #3 Value	568
				# of Pulse Reduction Steps	569
				% of Voltage Red Per Pulse Step	570
				Present Voltage Reduction Step	571
				SOFT-ADD-AMP Limits	572
				SOFT-ADD-AMP High Limit	573
				SOFT-ADD-AMP Low Limit	574
				Voltage Limiter Mode	575
				High Voltage Limit	576
				Low Voltage Limit	577
				Voltage Limiter Fast Resp. Delay	578
				Voltage Limiter Delay	579
				Time Between Taps	580
				Tap To Neutral	581

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*FEATURES (Cont.)	*Leader/Follower			Leader/Follower	410
				Leader/Follower State	411
				L/F Mode	412
				Leader/Follower Designation	413
				Follower Devices Configured	414
				Leader/Follower Tap Wait Timer	415
				Leader/Follower Timeout	416
				Leader/Follower Retry Delay	417
				Leader/Follower Retries	418
				Leader/Follower Monitor	420
				L/F Average Comp Volt Secondary	421
				Max Deviation	422
				Timer To Alt Mode	423
				Timer To Max Deviation Mode	424
				Max Deviation Alt Mode	425
	*Calibration			Voltage Calibration	047
				Current Calibration	048
				Reset Calibration	150
	*Fault Detection			Fault Detect Enabled	640
				Fault Detect In Effect	641
				Reset All Fault Detect Durations	642
				Fault Detect Level1 Threshold	645
				Fault Detect Level1 Recovery	646
				Fault Level1 Threshold Timer	647
				Fault Level1 Recovery Timer	648
				Duration of Last Level1	649
				Duration of Longest Level1	649
				Fault Detect Level2 Threshold	650
				Fault Detect Level2 Recovery	651
				Fault Level2 Threshold Timer	652
				Fault Level2 Recovery Timer	653
				Duration of Last Level2	654
				Duration of Longest Level2	654
				Fault Detect Level3 Threshold	655
				Fault Detect Level3 Recovery	656
				Fault Level3 Threshold Timer	657
				Fault Level3 Recovery Timer	658
				Duration of Last Level3	659
				Duration of Longest Level3	659

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*FEATURES (Cont.)	*Voltage Sag Monitoring			Voltage Sag Monitoring	600
				Level1 Threshold	601
				Level1 Recovery	602
				Level1 Threshold Timer Value	602
				Level1 Recovery Timer Value	604
				Duration of Last Level1	605
				Duration of Longest Level1	606
				Level2 Threshold	611
				Level2 Recovery	612
				Level2 Threshold Timer Value	613
				Level2 Recovery Timer Value	614
				Duration of Last Level2	615
				Duration of Longest Level2	616
				Level3 Threshold	621
				Level3 Recovery	622
				Level3 Threshold Timer Value	623
				Level3 Recovery Timer Value	624
				Duration of Last Level3	625
				Duration of Longest Level3	626
				Voltage Sag In Effect	631
				Reset All Volt Sag Durations	632
	*User Inputs			User Defined HMI Func1 Activate	700
				User Defined HMI Func2 Activate	701
				User Defined HMI Func3 Activate	702
				User Defined HMI Func4 Activate	703
	*Auto Tap Dead Phase			Auto Tap Dead Phase mode	220
				Tap Dead Phase	221
				Delay Timer	222
	_Battery			Battery Voltage and Current	190
				Test Battery	191
				Battery Test Results	191
				Automatic Battery Test	192
*COUNTERS	*Operations Counter			Total Operations	000
				Last Counter Change	100
				Enable Interval Counters	107
				Last 24 Hours Operations	101
				Last 30 Days Operations	102
				Current Month Operations	103
				Last Month Operations	104
				Current Year Operations	105
				Last Year Operations	106

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*METERING	*Instantaneous			Load Voltage Secondary	006
				Source Voltage Secondary	007
				Compensated Volt. Secondary	008
				Load Current Primary	009
				Load Voltage Primary kV	010
				Source Voltage Primary kV	011
				Present Tap Position	012
				Percent Regulation	112
				Power Factor	013
				kVA Load	014
				kW Load	015
				kvar Load	016
				Line Frequency	017
				Voltage THD	018
				Voltage 2nd-15th Harmonic	018
				Current THD	019
				Current 2nd-15th Harmonic	019
				Energy kW-h Forward	125
				Energy kW-h Reverse	125
				Energy kvar-h Forward	126
				Energy kvar-h Reverse	126
				Phase Angle	130
				Load Current Real	131
				Load Current Reactive	131
				Average Load Volt. Secondary	132
				Average Source Volt. Secondary	132
				Average Comp Volt. Secondary	132
				Average Load Current Primary	132
				Average Present Tap Position	132
				Average Maximum Tap Position	132
				Average Minimum Tap Position	132
				Total kVA Load	133
				Total kW Load	133
				Total kvar Load	133
				Motor Voltage	139
				Load Voltage Secondary (L-N)	750
				Load Voltage Secondary (L-L)	751
				Source Voltage Secondary (L-N)	752
				Source Voltage Secondary (L-L)	753

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*METERING (Cont.)	*Instantaneous (Cont.)			Load Voltage Primary (L-N)	754
				Load Voltage Primary (L-L)	755
				Source Voltage Primary (L-N)	756
				Source Voltage Primary (L-L)	757
				Load Voltage Angle (L-N)	760
				Load Voltage Angle (L-L)	761
				Source Voltage Angle (L-N)	762
				Source Voltage Angle (L-L)	763
	*Forward Demand			Forward Load Voltage High	020
				Forward Load Voltage Low	020
				Forward Load Voltage Present	020
				Fwd Compensated Voltage High	021
				Fwd Compensated Voltage Low	021
				Fwd Compensated Voltage Present	021
				Forward Load Current High	022
				Forward Load Current Low	022
				Forward Load Current Present	022
				Power Factor at Max Forward kVA	023
				Power Factor at Min Forward kVA	023
				Forward kVA Load High	024
				Forward kVA Load Low	024
				Forward kVA Load Present	024
				Forward kW Load High	025
				Forward kW Load Low	025
				Forward kW Load Present	025
				Forward kvar Load High	026
				Forward kvar Load Low	026
				Forward kvar Load Present	026
				Fwd Load Current Real High	134
				Fwd Load Current Real Low	134
				Fwd Load Current Real Present	134
				Fwd Load Current Reactive High	134
				Fwd Load Current Reactive Low	134
				Fwd Load Current Reactive Present	134
				Maximum Tap Position	027
				Maximum Percent Regulation	127
				Minimum Tap Position	028
				Minimum Percent Regulation	128
				Forward Source Voltage High	029
				Forward Source Voltage Low	029
				Forward Source Voltage Present	029

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*METERING (Cont.)	*Reverse Demand			Reverse Load Voltage High	030
				Reverse Load Voltage Low	030
				Reverse Load Voltage Present	030
				Rev Compensated Voltage High	031
				Rev Compensated Voltage Low	031
				Rev Compensated Voltage Present	031
				Reverse Load Current High	032
				Reverse Load Current Low	032
				Reverse Load Current Present	032
				Power Factor at Max Reverse kVA	033
				Power Factor at Min Reverse kVA	033
				Reverse kVA Load High	034
				Reverse kVA Load Low	034
				Reverse kVA Load Present	034
				Reverse kW Load High	035
				Reverse kW Load Low	035
				Reverse kW Load Present	035
				Reverse kvar Load High	036
				Reverse kvar Load Low	036
				Reverse kvar Load Present	036
				Rev Load Current Real High	135
				Rev Load Current Real Low	135
				Rev Load Current Real Present	135
				Rev Load Current Reactive High	135
				Rev Load Current Reactive Low	135
				Rev Load Current Reactive Present	135
				Reverse Source Voltage High	037
				Reverse Source Voltage Low	037
				Reverse Source Voltage Present	037
	_Master Reset			038 Master Reset	038
*ALARMS	*Alarms Active Unacknowledged			(Unacknowledged Active Alarms)	---
	_Alarms Active Acknowledged			(Acknowledged Active Alarms)	---
*SEQUENCE OF EVENTS				(Events Log)	---

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*COMMUNICATIONS	*Comm Port #1	*Comm Port #1 Configuration		Protocol / Port Type	800
				LoopShare Communications	800
				ProView NXG Session	800
				ProView NXG Address	800
				Ethernet Switch On Comm Port #1	800
		*Serial Configuration		Serial Baud Rate	801
				Serial Parity	801
				Serial CTS Support	801
				Serial Enable Delay	801
				Serial Tx Disable Delay	801
				Serial Echo Mode	801
		*Network Configuration		IP Address	802
				Subnet Mask	802
				Gateway	802
				MAC Address	802
		*DNP3 Basic		DNP RBE Master	810
				DNP IED Slave	810
				DNP IED Slave 2	810
				DNP User Map Selection	810
		*DNP3 Network		DNP Network Protocol Type	811
				DNP Accept From Any IP	811
				DNP Accept From IP Address	811
				DNP Destination Port Number	811
				DNP Listening Port Number	811
				DNP Use Port From Request	811
				DNP Keep Alive Timeout	811
				DNP Keep Alive Retries	811
		*IEC 60870-5-101		IEC101 Link Address	812
				IEC101 Common Address	812
				IEC101 Link Address Size	812
				IEC101 Common Address Size	812
				IEC101 Object Address Size	812
				IEC101 Cause of Transmit Size	812
				8IEC101 Single Command Op Mode	812
				IEC101 Select Before Exec Time	812
				IEC101 User Map Selection	812

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*COMMUNICATIONS (Cont.)	*Comm Port #1 (Cont.)	*IEC 60870-5-104		IEC104 Server Listen Port	813
				IEC104 Common Address	813
				IEC104 Single Command Op Mode	813
				IEC104 Select Before Exec Time	813
				IEC104 Response Timeout (t1)	813
				IEC104 Ack/No Data (t2)	813
				IEC104 Idle Test (t3)	813
				IEC104 Max Transmit (k)	813
				IEC104 Max Receive (w)	813
				IEC104 User Map Selection	813
		*2179		2179 Master Address	815
				2179 Ignore Master Address	815
				2179 Device Address	815
				2179 Select Timeout	815
				2179 User Map Selection	815
		Modbus		Modbus Device Address	816
				Modbus User Map Selection	816
	*Comm Port #2	*Comm Port #2 Configuration		Protocol / Port Type	830
				LoopShare Communications	830
				ProView NXG Session	830
				ProView NXG Address	830
		*Serial Configuration		Serial Baud Rate	831
				Serial Parity	831
				Serial CTS Support	831
				Serial Tx Enable Delay	831
				Serial Tx Disable Delay	831
				Serial Echo Mode	831
		*Network Configuration		IP Address	832
				Subnet Mask	832
				Gateway	832
				MAC Address	832
		*DNP3 Basic		DNP RBE Master	840
				DNP IED Slave	840
				DNP IED Slave 2	840
				DNP User Map Selection	840
		*DNP3 Network		DNP Network Protocol Type	841
				DNP Accept From Any IP	841
				DNP Accept From IP Address	841
				DNP Destination Port Number	841
				DNP Listening Port Number	841

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*COMMUNICATIONS (Cont.)	*Comm Port #2 (cont.)	*DNP3 Network (Cont.)		DNP Use Port From Request	841
				DNP Keep Alive Timeout	841
				DNP Keep Alive Retries	841
		*IEC 60870-5-101		IEC101 Link Address	842
				IEC101 Common Address	842
				IEC101 Link Address Size	842
				IEC101 Common Address Size	842
				IEC101 Object Address Size	842
				IEC101 Cause of Transmit Size	842
				IEC101 Single Command Op Mode	842
				IEC101 Select Before Exec Time	842
				IEC101 User Map Selection	842
		*IEC 60870-5-104		IEC104 Server Listen Port	843
				IEC104 Common Address	843
				IEC104 Single Command Op Mode	843
				IEC104 Select Before Exec Time	843
				IEC104 Response Timeout (t1)	843
				IEC104 Ack/No Data (t2)	843
				IEC104 Idle Test (t3)	843
				IEC104 Max Transmit (k)	843
				IEC104 Max Receive (w)	843
				IEC104 User Map Selection	843
		*IEC 61850		61850 IED Name	844
				61850 Inactivity Timeout	844
				61850 Integrity Report Interval	844
				61850 Request Timeout	844
				61850 MMS Message Size	844
				61850 TPDU Size	844
				61850 Max In Requests	844
				61850 Max Req. Variables	844
		*2179		2179 MasterAddress	845
				2179 IgnoreMaster Address	845
				2179 Device Address	845
				2179 Select Timeout	845
				2179 User Map Selection	845
		_Modbus		Modbus Device Address	846
				Modbus User Map Selection	846
	*LoopShare			LoopShare Comms State	860
				LoopShare Comm Table Assignment	861
				LoopShare Comm Tx Delay	862
				LoopShare Comm Timeout	863

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*COMMUNICATIONS (Cont.)	*I/O Control	*Aux Module 1		Activate Contact Output 1	089
				Activate Contact Output 2	089
				Activate Contact Output 3	089
				Activate Contact Output 4	089
		_Aux Module 2		Activate Contact Output 1	089
				Activate Contact Output 2	089
				Activate Contact Output 3	089
				Activate Contact Output 4	089
	*I/O Status	*Contact Inputs	*Aux Module 1	(Contact status by point)	090
			_Aux Module 2	(Contact status by point)	090
		_Contact Outputs	*Aux Module 1	(Contact status by point)	090
			_Aux Module 2	(Contact status by point)	090
*DIAGNOSTICS	*Test LEDs			No Items	---
	*Control			Firmware Version	920
				Firmware Database Version	921
				FPGA Version	922
				Digital Hardware Revision	923
				BootUtility Version	924
				BootLoader Version	925
				Extended Version	926
				USB Device Connected	088
				Factory Mode	088
				Extended Comms Status	088
				Config. Logic Equation Error	088
				Self-Test	091
				Last Self-Test Results	091
	*Communications			Comm Port #1 Tx Messages	260
				Comm Port #1 Rx Messages	261
				Comm Port #1 Rx Errors	262
				Comm Port # Tx Messages	263
				Comm Port #2 Rx Messages	264
				Comm Port #2 Rx Errors	265
	*Maintenance			Contact Duty Cycle Monitor	333
				PMT™ Mode A State	300
				PMT Mode A Countdown Delay	301
				PMT Mode A Time Delay	302
				PMT Mode A Issue Test	303
				PMT Mode B State	320
				PMT Mode B Countdown Delay	321
				PMT Mode B Time Delay	322
				PMT Mode B Start Time	323

TABLE 5-2 Function Menu (continued)

Level 1 Main Menu	Level 2 Sub-Menu	Level 3 Sub-Menu	Level 4 Sub-Menu	Parameter	Function Code
*DIAGNOSTICS (Cont.)	*Maintenance (Cont.)			PMT Mode B Stop Time	324
				PMT Mode B Max Deviation	325
				PMT Mode B Current Limit	327
				PMT Mode B Issue Test	328
	*Sync Counters			Tap Position Sync Count	110
	_Metering PLUS			Comp Voltage	---
				Load Voltage	---
				Load Current	---
				Tap Position	---
				LF TPI TRG STATUS	---
				Max Deviation	---
				Reg TPI CompV BandE	---
				sV Src Load Comp	---
*MENU SYSTEM	*Security Access			Security Override	092
				Password "Operate"	096
				Password "Modify"	097
				Password "Admin"	098
				Remote Security Override Timer	199
				Remote Security Override Mode	199
	*Language			Language Selection	941
	*Date and Time Format			Date Format	942
				Time Format	943
	_Hot Keys			Key Mapping Selection	944
*USB MEMORY DRIVE				USB Memory Drive Save All Data	950
				USB Memory Drive Save Custom All	950
				USB Memory Drive Save Cust Basic	950
				USB Memory Drive Save Custom Alt	950
				USB Memory Drive Save Custom Adv	950
				USB Memory Drive Save Custom Comm	950
				USB Memory Save Std All	950
				USB Memory Drive Save Std Basic	950
				USB Memory Drive Save Std Alt	950
				USB Memory Drive Save Std Adv	950
				USB Memory Drive Save Std Comm	950
				USB Memory Drive Load Config Data	951
				USB Memory Drive Upgrade Firmware	952
				USB Memory Drive Remove Device	953
_TURN DISPLAY OFF				No Items	---

Function codes

Refer to Table 5-3 for a numerical listing of the function codes. The table accurately represents the display of each function code and identifies the security level for read, edit, and reset, the factory setting, and the low and high limits for keyed in entries. This is followed by a description and, where appropriate, a list of scrolling choices, examples, and related functions and features for each function code.

TABLE 5-3. Function Codes

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>000 Total
Operations
XXXXXX</td><td>---</td><td>View</td><td>Admin</td><td>NA</td><td>0</td><td>0</td><td>999999</td></tr>
<tr><td colspan="8">•On an Eaton's Cooper Power series voltage regulator, the total operations counter is activated by detecting tap-changer motor operation, which is determined by sensing current flow in the holding switch circuit.
•It may also be incremented through operations counter circuitry on non-Eaton's Cooper Power series manufactured tap changers.
•The total operations counter is written into non-volatile memory after every count.
•Access other operations counters at FC 100–FC 107.</td></tr>
<tr><td>001 Forward
Set Voltage
XXX.X Volts</td><td>Volts</td><td>View</td><td>Modify</td><td>NA</td><td>120.0</td><td>100.0</td><td>135.0</td></tr>
<tr><td colspan="8">•The forward set voltage is the voltage level to which the control will regulate, on the 120 V or 240 V base, during forward power flow.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set in terms of the system line voltage. For example, on a 7200 V system, with a desired set voltage 1% above the nominal voltage, the setting would be 7272.</td></tr>
<tr><td>002 Forward
Bandwidth
X.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>2.0</td><td>1.0</td><td>6.0</td></tr>
<tr><td colspan="8">•The bandwidth is defined as the total voltage range, around the set voltage, which the control will consider as a satisfied (in-band) condition, during forward power flow.
•Example: A bandwidth of 3.0 V and a set voltage of 120 V will establish a low edge of 118.5 V and a high edge of 121.5 V.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>003 Forward
Time Delay
XXX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>45</td><td>5</td><td>180</td></tr>
<tr><td colspan="8">•The time delay is the period of time that the control waits, from when the voltage first goes out-of-band to when a tap change is initiated, during forward power flow.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>004 Fwd Line Drop
Comp. Resistance
XX.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>-96.0</td><td>96.0</td></tr>
<tr><td colspan="8">•The resistive line-drop compensation value is used to model the resistive line voltage drop between the regulator and the center of regulation.
•The control uses this parameter, in conjunction with the regulator configuration (FC 41) and the load current, to calculate and regulate to the compensated voltage (displayed at FC 8) during forward power flow.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>005 Fwd Line Drop
Comp. Reactance
XX.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>-96.0</td><td>96.0</td></tr>
<tr><td colspan="8">•The reactive line-drop compensation value is used to model the reactive line drop voltage between the regulator and the center of regulation.
•The control uses this parameter, in conjunction with the regulator configuration (FC 41) and the load current, to calculate and regulate to the compensated voltage (displayed at FC 8) during forward power flow.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>006 Load Voltage
Secondary
XXX.X Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the fundamental RMS voltage, referred to the secondary, which appears at the output (load) terminals of the regulator.
•Since ratio correction is performed by the firmware, this parameter is scaled according to the inputs at FC 43 (System Line Voltage) and FC 44 (Overall PT Ratio)
•During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>007 Source Voltage
Secondary
XXX.X Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the fundamental RMS voltage, referred to the secondary, which appears at the input (source) terminals of the regulator.
•Since ratio correction is performed by the firmware, this parameter is scaled according to the inputs at FC 43 (System Line Voltage) and FC 44 (Internal PT Ratio).
•During forward power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>008 Compensated Volt. Secondary
XXX.X Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the calculated voltage at the center of regulation, referred to the secondary.
•This is based on the resistive compensation setting (FC 4 or FC 54), reactive compensation setting (FC 5 or FC 55), and the load current.
•This is the voltage that the regulator is regulating during either forward or reverse power flow.
•During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>009 Load Current Primary
XXX.X Amps</td><td>Amps</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the fundamental RMS current flowing in the primary circuit.
•This parameter is scaled according to the CT primary rating which is entered at FC 45.
•During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>010 Load Voltage Primary kV
XX.XX kVolts</td><td>KV</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the fundamental RMS voltage, referred to the primary, which appears at the output (load) terminals of the regulator.
•During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>011 Source Voltage Primary kV
XX.XX kVolts</td><td>KV</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the fundamental RMS voltage, referred to the primary, which appears at the input (source) terminals of the regulator.
•Since ratio correction is performed by the firmware, this parameter is scaled according to the inputs at FC 43 (System Line Voltage) and FC 44 (Internal PT ratio).
•During forward power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>012 Present Tap Position
-XX</td><td>Tap</td><td>View</td><td>3</td><td>NA</td><td>NA</td><td>-16</td><td>16</td></tr>
<tr><td colspan="8">•This is the present position of the tap-changer.
•The tap position indication is synchronized at the neutral position, as indicated by the neutral light circuit. Tap positions are displayed from -16 to 16, corresponding to 16 Lower (regulator bucking) to 16 Raise (regulator boosting), respectively.
•See the Control Features: Tap Position section of this manual.
•See Percent Regulation, FC 112.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>013 Power Factor
-X.XXX</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">

- This is the power factor of the primary circuit, as represented by the phase difference between the line current and voltage.
- Lagging current, or inductive loads, are designated by an implied (+) sign, and leading current, or capacitive loads, are designated by a (-) sign. Refer to Figures 5-1 and 5-2.

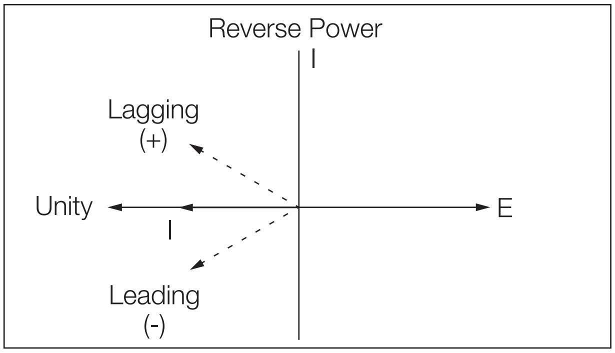


Figure 5-1
Reverse power vector diagram.

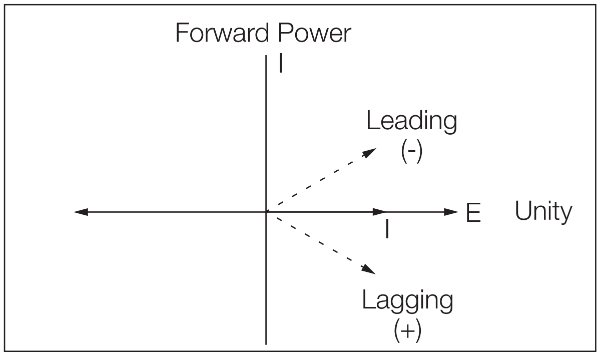


Figure 5-2
Forward power vector diagram.

</td></tr>
<tr><td>014 kVA Load
XXXX.X kVA</td><td>KVA</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">

- This is the total kilovolt-amperes drawn by the load, as calculated by the product of the load-voltage primary kV (FC 10) times the primary load current (FC 9). See Figure 5-3.

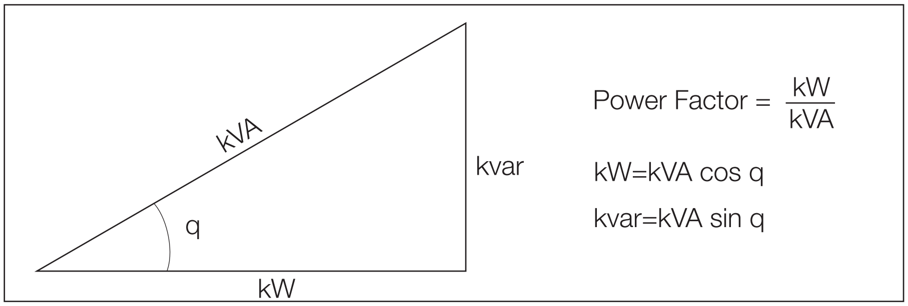


Figure 5-3
Power Triangle.

</td></tr>
<tr><td>015 kW Load
XXXX.X kW</td><td>KW</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">

- This is the total kilowatts (true power) consumed by the load.
- This is calculated by the product of the power factor (FC 13) times the kVA load (FC 14). See Figure 5-3.
- During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.

</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>016 kvar Load
XXXX.X kvar</td><td>Kvar</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the total kilovolt-amperes reactive (reactive power) drawn by the load. The reactive power adds to losses on the line, yet does not do any work. See Figure 5-3.
•During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>017 Line Frequency
XX.XX Hz</td><td>Hz</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the frequency of the power line, as measured by the control.
•The control is capable of operating on systems from 45 to 65 Hz with no loss of accuracy in its measurements.</td></tr>
<tr><td>018 Voltage THD
XX.X %</td><td>%</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The total harmonic distortion (THD) is displayed after entering FC 18.
•The total harmonic distortion is computed as the RSS (square root of the sum of the squares) of the individual harmonic values.
•This is displayed as a percentage of the fundamental RMS voltage.
•Example: 120.0 V of 60 Hz fundamental (power line frequency), with a reading of 0.5 at the 7th harmonic (420 Hz), is 0.6 V RMS.</td></tr>
<tr><td>018 Voltage 2nd Harmonic
XX.X %</td><td>%</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•2nd through 15th harmonic values are displayable.
•Use the arrow keys to scroll through the 2nd through 15th harmonic.</td></tr>
<tr><td>019 Current THD
XX.X %</td><td>%</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The total harmonic distortion is computed as the RSS (square root of the sum of the squares) of the individual harmonic values.
•This is displayed as a percentage of the fundamental RMS voltage.
•Example: 200 A of 60 Hz fundamental (power line frequency), with a reading of 1.9 at the 5th harmonic (300 Hz), is 3.8 A RMS.</td></tr>
<tr><td>019 Current 2nd Harmonic
XX.X %</td><td>%</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The values of the 2nd through 15th harmonic values are displayable.
•Use the arrow keys to scroll through the 2nd through 15th harmonic.</td></tr>
<tr><td>020 Forward Load Voltage High
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the highest secondary output voltage of the regulator since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the highest secondary output voltage is displayed.</td></tr>
<tr><td>020 Forward Load Voltage Low
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the lowest secondary output voltage of the regulator since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the lowest secondary output voltage is displayed.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
020 Forward Load Voltage Present XXX.X Volts	Volts	View	NA	NA	NA	NA	NA
•This is the present reading of secondary output voltage of the regulator, as a demand value, according to the demand time interval at FC 46							
021 Fwd Compensated Voltage High XXX.X Volts MM-DD-YYYY HH:MM:SS	Volts	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the calculated secondary voltage at the center of regulation since the last reset, as a demand value, according to the demand time interval at FC 46. •The forward line-drop compensation settings for resistance and reactance (FC 4 and FC 5) are used in calculating this value. •Date and time of the occurrence of the highest compensated voltage is displayed.							
021 Fwd Compensated Voltage Low XXX.X Volts MM-DD-YYYY HH:MM:SS	Volts	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the calculated secondary voltage at the center of regulation since the last reset, as a demand value, according to the demand time interval at FC 46. •The forward line-drop compensation settings for resistance and reactance (FC 4 and FC 5) are used in calculating this value. •Date and time of the occurrence of the lowest compensated voltage is displayed.							
021 Fwd Compensated Voltage Present XXX.X Volts	Volts	View	NA	NA	NA	NA	NA
•This is the present value of the calculated secondary output voltage of the load center, as a demand value, according to the demand time interval at FC 46. •The forward line-drop compensation settings for resistance and reactance (FC 4 and FC 5) are used in calculating this value.							
022 Forward Load Current High XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the load current since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the highest load current is displayed.							
022 Forward Load Current Low XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the load current since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the lowest load current is displayed.							
022 Forward Load Current Present XXX.X Amps	Amps	View	NA	NA	NA	NA	NA
•This is the present reading of the load current as a demand value, according to the demand time interval at FC 46.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
023 Power Factor at Max Forward kVA X.XXX MM-DD-YYYY HH:MM:SS	---	View	NA	NA	"-----" (Invalid)	NA	NA
•This is the instantaneous power factor of the load at the first occurrence of the maximum kVA demand value, since last reset. •Date and time of the occurrence of the maximum kVA demand value is displayed. •Note: This parameter is associated with the maximum kVA demand; therefore, it cannot be reset independent of that parameter.							
023 Power Factor at Min Forward kVA X.XXX MM-DD-YYYY HH:MM:SS	---	View	NA	NA	"-----" (Invalid)	NA	NA
•This is the instantaneous power factor of the load at the first occurrence of the minimum kVA demand value since last reset. •Date and time of the occurrence of the minimum kVA demand value is displayed. •Note: This parameter is associated with the minimum kVA demand; therefore, it cannot be reset independent of that parameter.							
024 Forward kVA Load High XXXX.X kVA MM-DD-YYYY HH:MM:SS	kVA	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the load kVA since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the highest kVA load is displayed.							
024 Forward kVA Load Low XXXX.X kVA MM-DD-YYYY HH:MM:SS	kVA	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the load kVA since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the lowest kVA load is displayed.							
024 Forward kVA Load Present XXXX.X kVA	kVA	View	NA	NA	NA	NA	NA
•This is the present value of the load kVA, as a demand value, according to the demand time interval at FC 46.							
025 Forward kW Load High XXXX.X kW MM-DD-YYYY HH:MM:SS	kW	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the load kW since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the highest kW load is displayed.							
025 Forward kW Load Low XXXX.X kW MM-DD-YYYY HH:MM:SS	kW	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the load kW since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the lowest kW load is displayed.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
025 Forward kW Load Present XXXX.X kW	kW	View	NA	NA	NA	NA	NA
•This is the present value of the load kW, as a demand value, according to the demand time interval at FC 46.							
026 Forward kvar Load High XXXX.X kvar MM-DD-YYYY HH:MM:SS	kvar	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the load kvar since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of when the highest value occurred is displayed.							
026 Forward kvar Load Low XXXX kvar MM-DD-YYYY HH:MM:SS	kvar	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the load kvar since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of when the lowest value occurred is displayed.							
026 Forward kvar Load Present XXXX.X kvar	kvar	View	NA	NA	NA	NA	NA
•This is the present value of the load kvar, as a demand value, according to the demand time interval at FC 46.							
027 Maximum Tap Position -XX MM-DD-YYYY HH:MM:SS	Tap	View	NA	Operate	Reset*	NA	NA
•This is the highest tap position that the regulator has reached since last reset. •The maximum position and associated date and time can be reset using the ENTER key or via master reset, FC 38. This parameter is not reset by the drag-hand reset switch. •Date and time of the occurrence of the maximum tap position is displayed.							
028 Minimum Tap Position -XX MM-DD-YYYY HH:MM:SS	Tap	View	NA	Operate	Reset*	NA	NA
•This is the lowest tap position that the regulator has reached since last reset. •The minimum position and associated date and time can be reset using the ENTER key or via master reset, FC 38. This parameter is not reset by the drag-hand reset switch. •Date and time of the occurrence of the minimum tap position is displayed.							
029 Forward Source Voltage High XXX.X Volts MM-DD-YYYY HH:MM:SS	Volts	View	NA	Operate	Reset*	NA	NA
•This is the maximum source voltage of the regulator since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the highest source voltage is displayed. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>029 Forward Source Voltage Low
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the minimum source voltage of the regulator since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the lowest source voltage is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>029 Forward Source Voltage Present
XXX.X Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the present value of the source voltage, as a demand value, according to the demand time interval at FC 46.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>030 Reverse Load Voltage High
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the maximum value of the secondary output voltage of the regulator during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the highest load voltage is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>030 Reverse Load Voltage Low
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the minimum value of the secondary output voltage of the regulator during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the lowest load voltage is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>030 Reverse Load Voltage Present
XXX.X Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the present value of the secondary output voltage of the regulator during reverse power flow, as a demand value, according to the demand time interval at FC 46.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
031 Rev Compensated Voltage High XXX.X Volts MM-DD-YYYY HH:MM:SS	Volts	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the calculated secondary voltage at the center of regulation during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46. •The reverse line-drop compensation settings for resistance and reactance (FC 54 and FC 55) are used in calculating this value. •Date and time of the occurrence of the highest compensated voltage is displayed. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
031 Rev Compensated Voltage Low XXX.X Volts MM-DD-YYYY HH:MM:SS	Volts	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the calculated secondary voltage at the load center during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46. •The reverse line-drop compensation settings for resistance and reactance (FC 54 and FC 55) are used in calculating this value. •Date and time of the occurrence of the lowest compensated voltage is displayed. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
031 Rev Compensated Voltage Present XXX.X Volts	Volts	View	NA	NA	NA	NA	NA
•This is the present value of the calculated secondary voltage at the load center during reverse power flow, as a demand value, according to the demand time interval at FC 46. •The reverse line-drop compensation settings for resistance and reactance (FC 54 and FC 55) are used in calculating this value. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
032 Reverse Load Current High XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the load current during reverse power flow since the last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the highest load current is displayed. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
032 Reverse Load Current Low XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•This is the lowest value of the load current during reverse power flow since the last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the lowest load current is displayed. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
032 Reverse Load Current Present XXX.X Amps	Amps	View	NA	NA	NA	NA	NA
•This is the present value of the load current during reverse power flow, as a demand value, according to the demand time interval at FC 46. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
033 Power Factor at Max Reverse kVA X.XXX MM-DD-YYYY HH:MM:SS	---	View	NA	NA	"-----" (Invalid)	NA	NA
•This is the instantaneous power factor of the load at the first occurrence of the maximum kVA demand value since the last reset, during reverse power flow. •Note: This parameter is associated with the maximum kVA demand; therefore, it cannot be reset independent of that parameter. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
033 Power Factor at Min Reverse kVA X.XXX MM-DD-YYYY HH:MM:SS	---	View	NA	NA	"-----" (Invalid)	NA	NA
•This is the instantaneous power factor of the load at the first occurrence of the minimum kVA demand value during reverse power flow since last reset. •Note: This parameter is associated with the minimum kVA demand; therefore, it cannot be reset independent of that parameter. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
034 Reverse kVA Load High XXXX.X kVA MM-DD-YYYY HH:MM:SS	kVA	View	NA	Operate	Reset*	NA	NA
•This is the highest value of the load kVA during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46. •Date and time of the occurrence of the highest kVA load is displayed. •The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>034 Reverse
kVA Load Low
XXXX.X kVA
MM-DD-YYYY HH:MM:SS</td><td>kVA</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the lowest value of the load kVA during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence the lowest kVA load is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>034 Reverse
kVA Load Present
XXXX.X kVA</td><td>kVA</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the present value of the load kVA during reverse power flow, as a demand value, according to the demand time interval at FC 46.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>035 Reverse
kW Load High
XXXX.X kW
MM-DD-YYYY HH:MM:SS</td><td>kW</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the highest value of the load kW during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the highest kW load is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>035 Reverse
kW Load Low
XXXX kW
MM-DD-YYYY HH:MM:SS</td><td>kW</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the lowest value of the load kW during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the lowest kW load is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>035 Reverse
kW Load Present
XXXX.X kW</td><td>kW</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the present value of the load kW during reverse power flow, as a demand value, according to the demand time interval at FC 46.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>036 Reverse
kvar Load High
XXXX.X kvar
MM-DD-YYYY HH:MM:SS</td><td>kvar</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the highest value of the load kvar during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the highest kvar load is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>036 Reverse
kvar Load Low
XXXX.X kvar
MM-DD-YYYY HH:MM:SS</td><td>kvar</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the lowest value of the load kvar during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the lowest kvar load is displayed.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>036 Reverse kvar
Load Present
XXXX.X kvar</td><td>kvar</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the present value of the load kvar during reverse power flow, as a demand value, according to the demand time interval at FC 46.
•The control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>037 Reverse Source
Voltage High
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the highest value of the primary input voltage of the regulator during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the highest source voltage is displayed.</td></tr>
<tr><td>037 Reverse Source
Voltage Low
XXX.X Volts
MM-DD-YYYY HH:MM:SS</td><td>Volts</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the lowest value of the primary input voltage of the regulator during reverse power flow since last reset, as a demand value, according to the demand time interval at FC 46.
•Date and time of the occurrence of the lowest source voltage is displayed.</td></tr>
<tr><td>037 Reverse Source
Voltage Present
XXX.X Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the present value of the primary input voltage of the regulator during reverse power flow, as a demand value, according to the demand time interval at FC 46.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>038 Master Reset</td><td>---</td><td>View</td><td>NA</td><td>Operate</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Only demand metering forward and reverse; maximum and minimum raise and lower; tap position values and associated time/date stamps are reset to their corresponding present demand values at FC 38.
•To reset, press ENTER and then ENTER again to confirm.
•If the present demand value or tap position is in an invalid state, indicated by dashes, the high and low values will also become invalid and will display dashes.
•Individual maximum and minimum values and their date/time stamps (see FC 20–FC 37, FC 127, FC 128, FC 134, and FC 135) may be reset to the present demand value: access the appropriate function code on display, press ENTER and then Enter again to confirm.
•Successful master reset is indicated by the word (Done) appearing on the display.
•See the Control Programming: Special Functions section of this manual.</td></tr>
<tr><td>039 Source Side Voltage Calc.
On</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>On</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The source side voltage is calculated based on tap position and the regulator type (see FC 140).
•Options include: Off; On.
•The source voltage calculation provides accuracy to ±1.5% maximum error.
•When calculated values are used, the LCD will display (CALCULATED).
•If source voltage is sensed, it will take precedence over the calculated voltage.</td></tr>
<tr><td>040 Control Identification
12345</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>12345</td><td>0</td><td>99999</td></tr>
<tr><td colspan="8">•This provision is made for entry of a number to uniquely identify each control.
•The serial number of the control, as shown on the decal on the back of the front panel, is entered at the factory. However, any other number within the limits defined above may be chosen instead.</td></tr>
<tr><td>041 Regulator Configuration
Wye</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>“-----” (Invalid)</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The control is designed to operate on wye-connected or delta-connected three-phase systems. Options include: Wye (star); Delta-lagging; Delta-leading.
•Regulators connected line-to-ground (wye or star) develop potentials and currents suitable for direct implementation in the control.
•Regulators connected line-to-line (delta) develop a potential-to-current phase shift which is dependent upon whether the regulator is defined as leading or lagging. This phase shift must be known by the control to permit accurate calculations for correct operation.
•See the Initial Control Programming section of this manual to determine whether the regulator is leading or lagging.
•Note: See Reference Bulletin R225-10-1 for a discussion of delta connections.</td></tr>
<tr><td>042 Control Operating Mode
Sequential</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Sequential</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This parameter determines the manner in which the control responds to out-of-band conditions.
•The available options are: Sequential; Time Integrating; Voltage Averaging.
•For detailed information, see the Control Operation: Control Operating Modes section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
043 System Line Voltage XXXXX Volts	Volts	View	Modify	NA	“-----” (Invalid)	1200	36000
•The control is designed to operate on primary system voltages from 1200 V to 36000 V. •Ratio correction is performed by the firmware and consequently, the primary voltage must be entered for this calculation. •Example: A regulator installed on a 7200 V system (line-to-neutral) would have 7200 entered. •Example: A regulator installed open or closed delta on an 11000 V system (line-to-line) would have 11000 entered. •Note: The line voltage rating is available on the regulator nameplate and is summarized in Tables 9-1 and 9-2 for most regulator ratings.							
044 Overall P.T. Ratio XXX.X	---	View	Modify	NA	“-----” (Invalid)	10.0	300.0
•The control is designed to operate on primary system voltages from 1200 V to 36000 V. Ratio correction is performed by the firmware, and, consequently, the overall potential transformer (PT) ratio must be entered for this calculation. •Note: The overall PT ratio is available on the regulator nameplate and is summarized in Tables 10-1 and 10-2 for most regulator ratings. •Example: A 13800 V regulator, installed on a 7970 V system, would have 7970 entered at FC 43 and 63.7 entered at FC 44. The control will then define the 125.1 V (output from the back panel ratio correction transformer) as the 120-base voltage, and 120 V is displayed at FC 6. If FC 148 is set to a 240 V base, the control will define the 125.1 V as the 240 V base and 240 V will be displayed at FC 6.							
044 Internal P.T. Ratio XXX.X	---	View	Modify	NA	“-----” (Invalid)	10.0	300.0
•The internal PT ratio for the applicable system voltage from the nameplate voltage chart. •When a voltage regulator is equipped with an Internal Differential PT (IDPT), but not with second Ratio Correction Transformer (RCT2), the control will use the internal PT ratio to calculate the source voltage from the IDPT voltage input. •While FC 146 Vin P.T. Configuration is set to Vdiff with RCT2, the text (INVALID VIN CONFIG) will be displayed when attempting to edit this parameter.							
045 C.T. Primary Rating XXXX Amps	Amps	View	Modify	NA	“-----” (Invalid)	25	4000
•The control is designed for 200 mA as the rated current transformer (CT) output current, and will meter to 800 mA with no loss of accuracy. •Ratio correction is performed by the firmware and consequently the CT primary rating must be entered. The CT primary rating is available on the regulator nameplate. •Example: A 7620 V, 328 A regulator (250 kVA) would have a C.T. rating of 400:0.2 and therefore, 400 is entered.							
045 Rated Load Current XXXX Amps	Amps	View	Modify	NA	“-----” (Invalid)	25	4000
•This is the 55 °C rated load current of the regulator. This information can be found on the unit nameplate.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>045 % C.T. Rating
Level 4
XXX %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>100</td><td>100</td><td>160</td></tr>
<tr><td colspan="8">•Adaptive ADD-AMP Level 4 setting found in the Limit Switch Settings chart on the nameplate at the 5% Level.
•SOFT-ADD-AMP (FC 70) must be set to Adaptive to activate this feature.</td></tr>
<tr><td>045 % C.T. Rating
Level 3
XXX %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>100</td><td>100</td><td>160</td></tr>
<tr><td colspan="8">•Adaptive ADD-AMP Level 3 setting found in the Limit Switch Settings chart on the nameplate at the 6 1/4% Level.
•SOFT-ADD-AMP (FC 79) must be set to Adaptive to activate this feature.</td></tr>
<tr><td>045 % C.T. Rating
Level 2
XXX %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>100</td><td>100</td><td>160</td></tr>
<tr><td colspan="8">•Adaptive ADD-AMP Level 2 setting found in the Limit Switch Settings chart on the nameplate at the 7 1/2% Level.
•SOFT-ADD-AMP (FC 79) must be set to Adaptive to activate this feature.</td></tr>
<tr><td>045 % C.T. Rating
Level 1
XXX %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>100</td><td>100</td><td>160</td></tr>
<tr><td colspan="8">•Adaptive ADD-AMP Level 1 setting found in the Limit Switch Settings chart on the nameplate at the 8 3/4% Level.
•SOFT-ADD-AMP (FC 79) must be set to Adaptive to activate this feature.</td></tr>
<tr><td>046 Demand Time
Interval
XX.X Minutes</td><td>Minutes</td><td>View</td><td>Modify</td><td>NA</td><td>15.0</td><td>0.1</td><td>60.0</td></tr>
<tr><td colspan="8">•This is the time period during which the demand integral is performed for all demand metering readings.
•Demand readings represent the values which produce actual heating effects in electrical equipment and do not respond to the continuous fluctuations which occur on the line.</td></tr>
<tr><td>047 Voltage
Calibration
XXX.X Volts</td><td>Volts</td><td>View</td><td>Admin</td><td>NA</td><td>See Note</td><td>110.0</td><td>130.0</td></tr>
<tr><td colspan="8">•The voltage which the control actually measures is displayed at FC 47. In the example given in FC 44 description, FC 47 would indicate 125.1 V when FC 6 indicated 120 V.
•To calibrate, this value is compared to a reference voltmeter and if different, is changed to display the correct value.
•Note: A default calibration factor is programmed into non-volatile memory at the factory; adjustments should not be necessary in the field.
•See the Troubleshooting: Control Calibration section of this manual.
•In addition to the low and high limits, the user must enter a value that is within 5% of the displayed value.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>048 Current Calibration
XXX.X mAmps</td><td>MilliAmp</td><td>View</td><td>Admin</td><td>NA</td><td>See Note</td><td>100.0</td><td>400.0</td></tr>
<tr><td colspan="8">•The current which the control actually measures in mA, is displayed at FC 48.
•The control is designed for 200 mA as the rated CT secondary output current and will meter to 800 mA with no loss of accuracy.
•To calibrate, this value is compared to a reference ammeter and, if different, is changed to display the correct value.
•Note: A default calibration factor is programmed into non-volatile memory at the factory; adjustments should not be necessary.
•See the Troubleshooting: Control Calibration section of this manual.
•In addition to the low and high limits, the user must enter a value that is within 5% of the displayed value.</td></tr>
<tr><td>049 Tap Changer Type
Cooper QD8</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>“-----”
(Invalid)</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This function code identifies the tap-changer type. Changing this function code changes the control’s sampling rate to accommodate varying tap-changer types.
•Options include: Eaton's Cooper Power series QD8; Eaton's Cooper Power series QD5; Eaton's Cooper Power series QD3; Eaton's Cooper Power series Spring Drive; Eaton's Cooper Power series Direct Drive; Siemens; General Electric; Howard; LTC Reinhausen; ITB, Toshiba, User Defined.</td></tr>
<tr><td>050 System Calendar and Clock
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>See Note</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Editing is always in the format MM-DD-YYYY and with the 24 Hour clock.
•Note: The default is Jan. 1, 1970.
•Refer to the Control Features: Calendar/Clock section of this manual for more information.</td></tr>
<tr><td>050 UTC Time Zone
GMT-05:00</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Used to set the time zone with respect to Greenwich Mean Time. The options include: GMT-12:00 to GMT-01:00; Greenwich Mean Time; GMT+01:00 to GMT+13:00.
•This cannot be edited via the keypad; use of ProView NXG interface software is required for editing.</td></tr>
<tr><td>051 Reverse Set Voltage
XXX.X Volts</td><td>Volts</td><td>View</td><td>Modify</td><td>NA</td><td>120.0</td><td>100.0</td><td>135.0</td></tr>
<tr><td colspan="8">•The set voltage is the voltage level to which the control will regulate on the 120 V or 240 V base during reverse power flow.
•See FC 1 and the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set in terms of the system line voltage. For example, on a 7200 V system, with a desired set voltage 1% above the nominal voltage, the setting would be 7272.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>052 Reverse
Bandwidth
X.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>2.0</td><td>1.0</td><td>6.0</td></tr>
<tr><td colspan="8">•The bandwidth is defined as that total voltage range, around the set voltage, which the control will consider as a satisfied (in-band) condition during reverse power flow.
•Example: A bandwidth of 3.0 V and a set voltage of 120.0 V will establish a low limit of 118.5 V and a high limit of 121.5 V.
•See FC 2 and the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>053 Reverse
Time Delay
XXX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>45</td><td>5</td><td>180</td></tr>
<tr><td colspan="8">•The time delay is the period of time (in seconds) that the control waits, from the time when the voltage first goes out-of-band to the time when a tap change is initiated during reverse power flow.
•See FC 3 and the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>054 Rev Line Drop
Comp. Resistance
XX.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>-96.0</td><td>96.0</td></tr>
<tr><td colspan="8">•The resistive line-drop compensation value is used to model the resistive line voltage drop between the regulator and the center of regulation.
•The control uses this parameter, in conjunction with the regular configuration (FC 41) and the load current, to calculate and regulate to the compensated voltage (displayed at FC 8) during the reverse power flow.
•See FC 4 and the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>055 Rev Line Drop
Comp. Reactance
XX.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>-96.0</td><td>96.0</td></tr>
<tr><td colspan="8">•The reactive line-drop compensation value is used to model the reactive line drop voltage between the regulator and the center of regulation.
•The control uses this parameter, in conjunction with the regulator configuration (FC 41) and the load current, to calculate and regulate to the compensated voltage (displayed at FC 8) during the reverse power flow.
•See FC 5 and the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>056 Reverse Sensing Mode
Locked Forward</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Locked Forward</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The control offers nine different response characteristics for reverse power flow operation. See Reverse power operation in Section 6 for more information on the reverse sensing modes.
•Options include: Locked Forward; Locked Reverse; Reverse Idle; Bi-directional; Neutral Idle; Co-generation; Reactive Bi-directional; Bias Bi-directional; Bias Co-Generation.
•The current threshold set at FC 57 must be exceeded for some modes to function.
•See the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>057 Reverse Current Sense Threshold
X %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>5</td></tr>
<tr><td colspan="8">•This is the current threshold at which the control recognizes current flow direction. Below the threshold, the current flow is considered to be indeterminate.
•This threshold is programmable as a percentage of the rated CT primary rating.
•Example: A 328 A regulator utilizing a CT with a 400 A primary rating and with a 3% threshold value would have a threshold of 12 A.
•The metering of the control switches on a fixed 1% threshold, independent of FC 57.
•See the Control Features: Reverse Power Operation section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>058 Bias Co-Gen Alt Mode
Locked Reverse</td><td>---</td><td>View</td><td>Operate</td><td>NA</td><td>Locked Reverse</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This setting is used in conjunction with the Reverse Sensing Mode (FC 56) of Bias Co-Generation only. The setting goes into effect when operating in that mode and when the control determines that a reversal of current has occurred on the system that is due to a switching operation, a true reversal of power. Under these circumstances, the control will revert to the mode of operation specified in this setting.
•Options include: Locked Reverse; Neutral Idle.</td></tr>
<tr><td>069 Auto Operation Blocking Status
Normal</td><td>---</td><td>0</td><td>Modify</td><td>NA</td><td>Normal</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This feature enables blocking of automatic operation locally and via SCADA communications.
•Options include: Normal; Blocked.
•Normal refers to normal automatic operation. Blocked refers to a state when automatic operation is inhibited.
•Example: This function can be used to perform a desired amount of voltage reduction and then disable the tap-changer (inhibit additional operations) for an indefinite time period.
•If FC 69 has been set to Blocked using SCADA, the operator may override the SCADA system by changing FC 69 from Blocked to Normal.
•Refer to the Control Features: SCADA section of this manual for additional information concerning the SCADA interaction with the control.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>070 Voltage Reduction Mode
Off</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Off</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The control has three voltage reduction modes available. Options include: Off; Local/Digital Remote; Remote/Latch; Remote/Pulse.
•Refer to the Control Features: Voltage Reduction section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>071 Reduction In Effect
XX.X %</td><td>%</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the percentage of voltage reduction currently active.
•See the Control Features: Voltage Reduction section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>072 Local/Digital Reduction Value
XX.X %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>0.0</td><td>10.0</td></tr>
<tr><td colspan="8">•Voltage reduction can be enabled by setting FC 70 to Local/Digital Remote and entering a value at FC 72 either locally through the keypad or remotely using SCADA.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>073 Remote #1 Value
XX.X %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>0.0</td><td>10.0</td></tr>
<tr><td colspan="8">•Three levels of remotely latched voltage reduction are available. These voltage reduction values are activated when FC 70 is set to Remote/Latch and the appropriate input terminals are latched.
•This programs the percentage of voltage reduction for Remote/Latch level #1.
•See the Control Features: Analog SCADA section of this manual for more information.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>074 Remote #2 Value
XX.X %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>0.0</td><td>10.0</td></tr>
<tr><td colspan="8">•See information for FC 73.
•This programs the percentage of voltage reduction for Remote/Latch level #2.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>075 Remote #3 Value
XX.X %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>0.0</td><td>10.0</td></tr>
<tr><td colspan="8">•See information for FC 73.
•This programs the percentage of voltage reduction for Remote/Latch level #3.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>076 # of Pulse Reduction Steps
XX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>0</td><td>0</td><td>10</td></tr>
<tr><td colspan="8">•Up to ten steps of remotely activated voltage reduction are available. The voltage reduction steps are activated when FC 70 is set to Remote/Pulse and a momentary pulse is applied to the appropriate input terminal.
•FC 76 defines the number of steps selected for pulsed voltage reduction. The percentage of voltage reduction of each step is defined at FC 77.
•See the Control Features: Analog SCADA section of this manual for more information.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>077 % of Voltage Red Per Pulse Step
XX.X %</td><td>%</td><td>View</td><td>Modify</td><td>NA</td><td>0.0</td><td>0.0</td><td>10.0</td></tr>
<tr><td colspan="8">•This defines the percentage of voltage reduction which will be applied for each step of pulsed voltage reduction selected at FC 76.
•See the Control Features: Analog SCADA section of this manual for more information.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>078 Present Voltage Reduction Step
XX</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Displays the current step when Remote/Pulse voltage reduction is active.
•If alternate configuration is active, the fourth LCD line displays which one is active, i.e. (ALT CONFIG 1).</td></tr>
<tr><td>079 SOFT-ADD-AMP Limits
Off</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Off</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This parameter enables the Soft ADD-AMP feature. Options include: Off; On; Remote Override; Cfg Logic Active; Adaptive.
•See the Control Features: Soft ADD-AMP section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>080 Voltage Limiter Mode
Off</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Off</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The control has voltage-limiting capabilities for both high-voltage and low-voltage conditions. Options include: Off; High limit only; High/low limits; IVVC High Limit Only; IVVC High/Low Limits.
•See the Control Features: Voltage Limiter section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1)</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>081 High Voltage
Limit
XXX.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>130.0</td><td>120.0</td><td>135.0</td></tr>
<tr><td colspan="8">•The high voltage limit for Voltage Limiter.
•When the voltage-limiting function is activated (FC 80), the control will prevent the output voltage of the regulator from exceeding this value.
•See the Control Features: Voltage Limiter section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>082 Low Voltage
Limit
XXX.X Volts</td><td>Volts/%</td><td>View</td><td>Modify</td><td>NA</td><td>105.0</td><td>105.0</td><td>120.0</td></tr>
<tr><td colspan="8">•The low voltage limit for Voltage Limiter.
•When the voltage-limiting function is activated (FC 80 high and low limit active), the control will prevent the output voltage of the regulator from dropping below this value.
•See the Control Features: Voltage Limiter section of this manual.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).
•If FC 148 Nominal Load Voltage is set to 240 Volts, limits are expanded (doubled).
•If FC 148 is set to System Line Voltage, this setting must be set as a percentage of the set voltage.</td></tr>
<tr><td>083 Voltage Limiter
Fast Resp. Delay
XX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>3</td><td>1</td><td>60</td></tr>
<tr><td colspan="8">•When the load voltage reaches the Voltage Limiter limits plus 3 volts, this is the period of time the control will delay before reacting to bring the load voltage back within the Voltage Limiter limits.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1)</td></tr>
<tr><td>084 Voltage Limiter
Delay
XX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>10</td><td>1</td><td>60</td></tr>
<tr><td colspan="8">•The period of time the control will delay before reacting to bring the load voltage back within the Voltage Limiter limits.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>085 Time Between
Taps
XX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>0</td><td>0</td><td>10</td></tr>
<tr><td colspan="8">•For Voltage Limiter, the delay between completing a tapping operation and sending the signal for the next tapping operation when Voltage Limiter limits have been exceeded.
•If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).</td></tr>
<tr><td>088 USB Device
Connected
0</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Provides a display of 0 when a USB memory device is not connected and 1 when a USB memory device is connected.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
088 Factory Access Mode Disabled	---	View	Modify	NA	Disabled	NA	NA
•This function is used to diagnose the control when an extended communications module is in use. •Available options include: Disabled; Enabled.							
088 Extended Comms Status 0x0 (RUNNING OK)	---	View	NA	NA	NA	NA	NA
•Provides the status of an extended communications card. •(NOT AVAILABLE) indication is displayed if the extended communications card is not present. •(RUNNING OK) indication is displayed if the extended communications card is present and operating properly. •(FAILURE)-0x0 indication is displayed if the extended communications card is present and indicating a failure code.							
088 Config. Logic Equation Error X	---	View	NA	NA	NA	NA	NA
•Provide a display of 0 when there are no configurable logic errors and 1 when one or more configurable logic errors exist.							
089 Activate Contact Output 1 X	---	View	Modify	NA	NA	0	1
•Enables activation of discrete output contact 1. •If value is 0, it can be changed to 1 and then back 0. •If value is 1 because its activation is being driven by a logic equation, attempting to change it to 0 will display (CANNOT OVERRIDE).							
089 Activate Contact Output 2 X	---	View	Modify	NA	NA	0	1
•See description of Activate Contact Output 1.							
089 Activate Contact Output 3 X	---	View	Modify	NA	NA	0	1
•See description of Activate Contact Output 1.							
089 Activate Contact Output 4 X	---	View	Modify	NA	NA	0	1
•See description of Activate Contact Output 1.							
090 CI1 = Inactive CI2 = Inactive CI3 = Inactive CI4 = Inactive	---	View	NA	NA	NA	NA	NA
•Provides a status of the auxiliary input contacts and will display the status as Inactive or Active.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>090 CO1 = Inactive
CO2 = Inactive
CO3 = Inactive
CO4 = Inactive</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Provides a status of the auxiliary output contacts and will display the status as Inactive or Active.</td></tr>
<tr><td>091 Self-Test</td><td>---</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Access this parameter to initiate a self-test.
•While on the Self-Test screen press ENTER and then ENTER again to confirm. Results are displayed when the self-test is complete. Press Escape for further keypad use.
•Refer to Power-Up/Reset Conditions in this section of the manual for more information.</td></tr>
<tr><td>091 Last Self-Test Results
0xXXXXXXXX</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This display is entered at the FC 91 Self-Test screen by pressing the down arrow before activating the self-test. This information is primarily intended to be used as a means of transmitting diagnostic error codes through SCADA. This same information can be viewed at FC 95 in a readable format.
•The display for this parameter is a 32-bit value displayed in hexadecimal format. The value corresponds to the results of the FC 91 self-test.
•To decipher the hexadecimal value, convert the hex number to a binary number. Each digit of the binary number will correspond to a bit in the chart below. For example, a hex number of 208 would correspond to a binary number of 0000000001000001000. Reading the binary number from right to left provide a 1 at bit 3 (the forth digit) and bit 9 (the 10th digit). These bits correspond to diagnostic errors of "VR1 Input Voltage Missing" and "VR1 No Neutral Sync Signal".
•0x00000001 – bit 0, Non-Volatile Setting (CRC error at system startup)
•0x00000002 – bit 1, Frequency Detection
•0x00000004 – bit 2, Data Acquisition
•0000000008 – bit 3, VR1 Input Voltage Missing
•0x00000010 – bit 4, VR2 Input Voltage Missing
•0x00000020 – bit 5, VR3 Input Voltage Missing
•0000000040 – bit 6, VR1 OUTPUT VOLTAGE MISSING
•0x00000080 – bit 7, VR2 Output Voltage Missing
•0x00000100 – bit 8, VR3 Output Voltage Missing
•0x00000200 – bit 9, VR1 No Neutral Sync Signal
•0x00000400 – bit 10, VR2 No Neutral Sync Signal
•0x00000800 – bit 11, VR3 No Neutral Sync Signal
•0x00001000 – bit 12, Clock Needs Setting
•0x00002000 – bit 13, Factory Calibration Required
•0x00004000 – bit 14, Configuration Values Required
•0x00008000 – bit 15, Battery Test
•0x00010000 – bit 16, VR1 Motor Trouble
•0x00020000 – bit 17, VR3 Motor Trouble
•0x00040000 – bit 18, VR3 Motor Trouble</td></tr>
<tr><td>092 Security Override
View</td><td>---</td><td>View</td><td>Admin</td><td>NA</td><td>View</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the control security override parameter. Options for security override are: View; Operate; Modify; Admin.
•Entering the Admin level security code at FC 99 will permit the security parameters to be modified.
•See the Control Operation: Security System section of this manual.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
(095) Self-Test Complete xx-xx-xxxx x:xx:xxa (Pass)	---	View	NA	NA	NA	NA	NA
•This function code will display the results of the last self-test.							
096 Password "Operate" XXXXXXXXXX	---	Admin	Admin	NA	Operate	NA	NA
•The alphanumeric security code for the Operate security level is displayed here. •Entry of the Admin level security code at FC 99 enables viewing and editing of this password. •Entry of this alphanumeric code at FC 99 permits the user to change/reset parameters marked as Operate level security (i.e. demand and tap position readings). •See the Control Operation: Security System section of this manual.							
097 Password "Modify" XXXXXXXXXX	---	Admin	Admin	NA	Modify	NA	NA
•The alphanumeric security code for the Modify security level is displayed here. •Entry of the Admin level security code at FC 99 enables viewing and editing of this password. •Entry of this alphanumeric code at FC 99 permits the user to change/reset parameters marked as Modify level security (i.e. control settings, configuration, and clock) and Operate level security (i.e. demand and tap position readings). •See the Control Operation: Security System section of this manual.							
098 Password "Admin" XXXXXXXXXX	---	Admin	Admin	NA	Admin	NA	NA
•The alphanumeric security code for the Admin security level is displayed here. •Entry of the Admin level security code at FC 99 enables viewing and editing of this password. •Entry of this alphanumeric code at FC 99 permits the user to change/reset any parameter. •Note: If the level Admin code is changed by the user, the new value should be recorded and kept in a safe place. If lost, security codes can be retrieved with a USB memory device and ProView NXG software, with the ProView NXG software via a PC directly connected to the control, or with the remote communications system. •See the Control Operation: Security System section of this manual.							
099 Enter Password ----------	---	Admin	Admin	NA	Admin	NA	NA
•This is the function code used to access the menu location where security codes are entered for access to the system. •Scrolling to this level is not allowed. •See the Control Operation: Security System section of this manual.							
100 Last Counter Change XXXXX MM-DD-YYYY HH:MM:SS	---	View	NA	NA	NA	NA	NA
•This displays the time and date since the Total Operations counter (FC 0) was last changed, as well as the quantity of operations entered at the last change.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>101 Last 24 Hours Operations
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Number of operations in last 24 hours (updated hourly and on every tap change).
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>102 Last 30 Days Operations
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Number of operations in last 30 days (updated daily and on every tap change).
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>103 Current Month Operations
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Number of operations since the beginning of the current month (updated on every tap change and reset when the clock’s month changes).
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>104 Last Month Operations
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Number of operations during the last calendar month (updated on every tap change and reset when the clock’s month changes).
•If reset, this counter will remain zero until the month changes.
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>105 Current Year Operations
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Number of operations since January 1st of the current year (updated on every tap change and reset when the clock’s year changes).
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>106 Last Year Operations
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Number of operations during the last calendar year (updated on every tap change and reset when the clock’s year changes).
•If reset, this counter will remain zero until the year changes.
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>107 Enable Interval Counters
Enabled</td><td>---</td><td>View</td><td>Admin</td><td>NA</td><td>Enabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is used to enable FC 101 to FC 106. Options include: Enabled; Disabled.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>110 Tap Position
Sync Counter
XXXXX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>Admin</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•A count of the number of times the control tap position indication (TPI) was synchronized either at neutral or when the regulator was able to tap up or down when TPI was at 16R or 16L respectively.
•This counter is reset by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>112 Percent
Regulation
XX.X %</td><td>%</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the actual percentage that the regulator is actively boosting (raising) or bucking (lowering) the input (source) voltage.
•When the regulator output voltage is greater than the input voltage (regulator boosting), the sign is implied (+). When the output voltage is lower than the input voltage, the sign is implied (-).
•Tap position indication is calculated as follows: % regulation = [(output/input) - 1] x 100.
•During reverse power operation, the control requires source voltage from a differential or source potential transformer or from the source voltage calculation (see FC 39) to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
<tr><td>125 Energy kW-h
Forward
XXXX.X kW-h</td><td>KW-h</td><td>View</td><td>NA</td><td>Operate</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the total forward energy, measured in kilowatt hours.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>125 Energy kW-h
Reverse
XXXX.X kW-h</td><td>KW-h</td><td>View</td><td>NA</td><td>Operate</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the total reverse energy, measured in kilowatt hours.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>126 Energy kvar-h
Forward
XXXX.X kvar-h</td><td>Kvar-h</td><td>View</td><td>NA</td><td>Operate</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the total forward energy, measured in kvar.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>126 Energy kvar-h
Reverse
XXXX.X kvar-h</td><td>Kvar-h</td><td>View</td><td>NA</td><td>Operate</td><td>Reset* to 0</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the total reverse energy, measured in kvar.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>127 Maximum Percent
Regulation
XX.X %
MM-DD-YYYY HH:MM:SS</td><td>%</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the highest percentage that the regulator has raised the input voltage since last reset.
•The control requires an input voltage from a differential or source potential transformer to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
128 Minimum Percent Regulation XX.X % MM-DD-YYYY HH:MM:SS	%	View	NA	Operate	Reset*	NA	NA
•This is the highest percentage that the regulator has lowered the input voltage since last reset. •The control requires an input voltage from a differential or source potential transformer to obtain this parameter. Lack of this voltage will result in the parameter displaying dashes.							
130 Phase Angle XXX.X Degrees	Degrees	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the angle by which the sine curve of the voltage in a circuit element leads or lags the sine curve of the current.							
131 Load Current Real XXXX.X Amps	Amps	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the real portion of the load current.							
131 Load Current Reactive XXXX.X Amps	Amps	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the reactive portion of the load current. •The instantaneous metering display of the averaged secondary load voltage when in multi-phase operation.							
132 Average Source Volt. Secondary XXX.X Volts	Volts	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the averaged secondary source voltage when in multi-phase operation.							
132 Average Comp Volt. Secondary XXX.X Volts	Volts	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the averaged secondary compensated voltage for all phases when in multi-phase operation.							
132 Average Load Current Primary XXX.X Volts	Amps	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the averaged primary load current when in multi-phase operation.							
132 Average Present Tap Position XX	---	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the average present tap position for all phases when in multi-phase operation.							
132 Average Maximum Tap Position XX MM-DD-YYYY HH:MM:SS	---	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the average present tap position for all phases when in multi-phase operation. •This is reset to zero by pressing ENTER and then ENTER again to confirm.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>132 Average Minimum Tap Position
XX
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The instantaneous metering display of the average minimum tap position for all phases when in multi-phase operation.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>133 Total kVA Load
XXXX.X kVA</td><td>kVA</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The instantaneous metering display of the sum of the apparent power for all phases when in multi-phase operation.</td></tr>
<tr><td>133 Total kW Load
XXXX.X kW</td><td>kW</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•An instantaneous metering display of the sum of the real power for all phases when in multi-phase operation.</td></tr>
<tr><td>133 Total kvar Load
XXXX.X kvar</td><td>kvar</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•An instantaneous metering display of the sum of the reactive power for all phases when in multi-phase operation.</td></tr>
<tr><td>134 Fwd Load Current Real High
XXX.X Amps
MM-DD-YYYY HH:MM:SS</td><td>Amps</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Demand metering high value for the real portion of the current for forward power flow with date and time of earliest occurrence.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>134 Fwd Load Current Real Low
XXX.X Amps
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Demand metering low value for the real portion of the current for forward power flow with date and time of earliest occurrence.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>134 Fwd Load Current Real Present
XXX.X Amps</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Demand metering present value for the real portion of the current for forward power.</td></tr>
<tr><td>134 Fwd Load Current Reactive High
XXX.X Amps
MM-DD-YYYY HH:MM:SS</td><td>Amps</td><td>View</td><td>NA</td><td>Operate</td><td>Reset*</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Demand metering high value for the reactive portion of the current for forward power flow with date and time of earliest occurrence.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
<tr><td>134 Fwd Load Current Reactive Low
XXX.X Amps
MM-DD-YYYY HH:MM:SS</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Demand metering low value for the reactive portion of the current for forward power flow with date and time of earliest occurrence.
•This is reset to zero by pressing ENTER and then ENTER again to confirm.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
134 Fwd Load Current Reactive Present XXX.X Amps MM-DD-YYYY HH:MM:SS	---	View	NA	NA	NA	NA	NA
•Demand metering present value for the reactive portion of the current for forward power.							
135 Rev Load Current Real High XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•Demand metering high value for the real portion of the current for reverse power flow with date and time of earliest occurrence. •This is reset to zero by pressing ENTER and then ENTER again to confirm.							
135 Rev Load Current Real Low XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•Demand metering low value for the real portion of the current for reverse power flow with date and time of earliest occurrence. •This is reset to zero by pressing ENTER and then ENTER again to confirm.							
135 Rev Load Current Real Present XXX.X Amps	Amps	View	NA	NA	NA	NA	NA
•Demand metering present value for the real portion of the current for reverse power flow.							
135 Rev Load Current Reactive High XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•Demand metering high value for the reactive portion of the current for reverse power flow. •This is reset to zero by pressing ENTER and then ENTER again to confirm.							
135 Rev Load Current Reactive Low XXX.X Amps MM-DD-YYYY HH:MM:SS	Amps	View	NA	Operate	Reset*	NA	NA
•Demand metering low value for the reactive portion of the current for reverse power flow with date and time of earliest occurrence. •This is reset to zero by pressing ENTER and then ENTER again to confirm.							
135 Rev Load Current Reactive Present XXX.X Amps	Amps	View	NA	NA	NA	NA	NA
•Demand metering present value for the reactive portion of the current for reverse power flow.							
139 Motor Voltage XXX.X Amps	Volts	View	NA	NA	NA	NA	NA
•The instantaneous metering display of the motor voltage detected by the control.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>140 Regulator Type
Type B</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>“-----”
(Invalid)</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Regulator type defines the regulator type based on ANSI standards. Options include: Type A; Type B; Type C; Type D.
•Type A – Series regulator design
•Type B – Inverted regulator design
•Type C – Series duplex transformer design or Series TX. Used on Eaton's Cooper Power series voltage regulator with voltage rating of 2.5 kV and current ratings above 875 A.
•Type D – Series duplex auto transformer design or Series AX. Used on Eaton's Cooper Power series voltage regulators with voltage rating of 5.0 kV and 7.62 kV and current rating above 875 A.
•Note: The regulator type is included on Eaton's Cooper Power series nameplates.</td></tr>
<tr><td>141 Regulator Identification
--------------------</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>-----</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•A 20-character alphanumeric identification that can be applied to each regulator controlled.
•For a multi-phase configuration, each regulator can have its own identification.</td></tr>
<tr><td>142 Serial Number
-------</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This function code will display the control serial number. The serial number is also displayed on a smaller sticker near the bottom on the left side of the control.
•This function code is not editable.</td></tr>
<tr><td>144 P.I. ADD-AMP High Limit
XX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>16</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The physical location of the high P.I. limit switch on the position indicator is entered here. The allowable values are 16, 14, 12, 10, or 8.
•This setting is informational only and must be set by the user.</td></tr>
<tr><td>145 P.I. ADD-AMP Low Limit
-XX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>-16</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The physical location of the low P.I. limit switch on the position indicator is entered here. The allowable values are -16, -14, -12, -10, or -8.
•This setting is informational only and must be set by the user.</td></tr>
<tr><td>146 Vin P.T. Configuration
Vdiff without RCT2</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Vdiff w/o RCT2</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This defines the configuration of the PT for the source-side voltage. Options include: Vdiff with RCT2; Vdiff without RCT2; Vin Mode.
•The Vdiff modes are used when the regulator is provided with an internal differential PT (with or without a ratio correction transformer) or if the Source Voltage Calculator (FC 39) is turned on.
•The Vin Mode is selected when an external source PT is supplied by the user to provide the source voltage for the control.
•See the Control Features: Source-Side Voltage section of this manual.</td></tr>
<tr><td>147 TPI Sense Method
Incremental</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Incremental</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Function used for LTC applications. The options are: Incremental; Measured.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
147 Neutral Sync Retry Count X	---	View	Modify	NA	3	0	5
•If the control tap-position indication (TPI) is at 1R or 1L and the control taps toward the neutral position but does not detect neutral, the control will keep the tap-position indication at 1R or 1L and allow attempts to tap down or up to synchronize TPI with the actual tap position. This parameter is the number of allowable attempts to synchronize to neutral.							
147 Motor Power Source Selection V-Sense	---	View	Modify	NA	V-Sense	NA	NA
•The control confirms motor power before a tap command can be initiated. This setting will designate which circuit will be checked to confirm the presence of power for the motor. •The Options are: V-Sense (motor is powered by the sense circuit); V-Motor (motor is powered by the motor circuit).							
148 Nominal Sec Load Voltage 120 Volts	---	View	Modify	NA	120 Volts	NA	NA
•The option to display the control voltage at either a 120 V or 240 V base, or using the system voltage. Options are: 120 volts; 240 volts; System Line Voltage. •When the System Line Voltage setting is selected using the control HMI, it will automatically update the display of all affected settings using the system voltage base. •When the System Line Voltage Setting is selected while changing setting using ProView NXG software, this setting must first be applied to the control. Once it is applied, the affected setting will be set to the default values using the system voltage base. The setting must then be set to the desired values.							
150 Reset Calibration	---	View	Admin	NA	NA	NA	NA
•This function allows for the resetting of voltage and current calibration factors set at FC 47 and FC 48 to the factory defaults.							
169 Block Before Remote Tap Off		View	Modify	NA	Off	NA	NA
•This setting will disable remote tapping operations unless the Auto Operation Blocking Status (FC 69) is set to Blocked. The settings options are: Off; On.							
170 Tap To Neutral Off	---	View	Modify	NA	Off	NA	NA
•This setting will enable the Tap To Neutral Feature. Once the feature is enabled, it can be activated using analog inputs, digital SCADA, or configurable logic. •Options include: Off; On.							
171 Tap To Target Off	---	View	Modify	NA	Off	NA	NA
•This setting will enable the Tap To Target Feature. Once the feature is enabled, it can be activated using analog inputs, digital SCADA, or configurable logic. •Options include: Off; On.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
172 Target Tap Position 0	---	View	Admin	NA	0	-16	16
•When the Tap To Target feature is enabled, this setting identifies the target tap position. •For multi-phase voltage regulators, individual target tap positions can be entered for each phase by scrolling through the phase setting using the right arrow button.							
175 SOFT-ADD-AMP High Limit XX	---	View	Modify	NA	16	NA	NA
•Soft ADD-AMP restricts the range of regulation using firmware logic as opposed to the hardware on the tap position indicator. The high limit is set here. The allowable values are 16, 14, 12, 10, or 8. •If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).							
176 SOFT-ADD-AMP Low Limit -XX	---	View	Modify	NA	-16	NA	NA
•Soft ADD-AMP restricts the range of regulation using firmware logic as opposed to the hardware on the tap position indicator. The low limit is set here. The allowable values are -16, -14, -12, -10, or -8. •If an alternate configuration is active, the fourth LCD line displays which one is active, e.g. (ALT CONFIG 1).							
190 Battery Voltage And Current VBat = XX.XX Volts IBat = -X.XX Amps	Volts, Amps	View	NA	NA	NA	NA	NA
•When a battery is connected to the control and being used to maintain control function, this will display the voltage and current readings of the battery.							
191 Test Battery	---	View	NA	NA	NA	NA	NA
•This parameter initiates a battery test. •Pressing the ENTER key causes the (CONFIRM) message to be displayed on the forth line of LCD. Pressing the ENTER key again initiates the battery testing mode.							
191 Battery Test Results VBat = XX.XX Volts IBat = -X.XX Amps	Volts, Amps	View	NA	NA	NA	NA	NA
•When a battery is connected to the control, this will display the voltage and current readings of the battery found while running the battery test routine.							
192 Automatic Test Battery Disabled	---	View	Modify	NA	Disabled	NA	NA
•When enabled, a battery test will automatically be run within 60 seconds of power-up and then 12 hours after the last battery test. The options are: Disabled; Enabled.							
199 Remote Security Override Timer XX Hours	Hours	View	Admin	NA	0	0	24
•This parameter is the time that the security override will be active once enabled.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>199 Remote Security Override Mode
Disabled</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The security level can be temporarily overridden remotely. This parameter is used to enable or disable the feature. The options are: Disable; Enable.</td></tr>
<tr><td>200 Multi-phase Feature
Off</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Off</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Enables the control for multi-phase operation. The options are: Off; On.</td></tr>
<tr><td>201 Multi-phase Mode
Independent</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Independ.</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Sets the mode of multi-phase operation on the control when the multi-phase mode has been turned on. Options are: Independent; Lead Phase Reg.; Voltage Averaging; Max Deviation Advanced Independent.
•See the Multi-phase Voltage Regulation section of this manual for more information.</td></tr>
<tr><td>202 Multi-phase VRs Configured
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>2</td><td>3</td></tr>
<tr><td colspan="8">•The number of voltage regulators configured for multi-phase operation. The available settings are 2 and 3.</td></tr>
<tr><td>203 Multi-phase Lead Regulator
VR1</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>VR1</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Assigns the lead regulator for certain multi-phase operation modes. The available settings are: VR1; VR2; VR3.
•See the Multi-phase Operation section of this manual for more information.</td></tr>
<tr><td>204 VR1 Tap Wait Timer
XXXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>0</td><td>0</td><td>10000</td></tr>
<tr><td colspan="8">•Sets a VR1 wait timer for use with the Multi-phase modes that require a gang operation (meaning that all tap changers must be on the same position). For ganged tap-changer operation, the tapping operations of the connected regulators must be synchronized if more than one tap-changer type is used. If, for example, the fast Quik-drive is ganged with a slow spring-drive, the control will not be able to keep the voltage regulators on the same position unless the Quik-drive is slowed down to switch at the same time as the spring-drive.</td></tr>
<tr><td>204 VR2 Tap Wait Timer
XXXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>0</td><td>0</td><td>10000</td></tr>
<tr><td colspan="8">•See explanation for FC 204 VR1 Tap Wait Timer.</td></tr>
<tr><td>204 VR3 Tap Wait Timer
XXXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>0</td><td>0</td><td>10000</td></tr>
<tr><td colspan="8">•See explanation for FC 204 VR1 Tap Wait Timer.</td></tr>
<tr><td>205 Multi-phase Retry Count
XX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>3</td><td>1</td><td>10</td></tr>
<tr><td colspan="8">•A count of the number of attempts to resend a tap-change command by the control when a tap-change operation was not sensed in certain multi-phase operating modes.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>206 Multi-phase Retry Delay
XX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>5</td><td>5</td><td>60</td></tr>
<tr><td colspan="8">•The delay between attempts to resend a tap-change command by the control when a tap-change operation was not sensed in certain multi-phase operating modes.</td></tr>
<tr><td>207 Multi-phase Total Deviation
XX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>32</td><td>0</td><td>32</td></tr>
<tr><td colspan="8">•The maximum deviation in tap position between regulators operating in the Max Deviation multi-phase mode.</td></tr>
<tr><td>208 Timer To Max Deviation Mode
XXX Hours</td><td>Hours</td><td>View</td><td>Modify</td><td>NA</td><td>168</td><td>0</td><td>168</td></tr>
<tr><td colspan="8">•Defines the amount of time that the connected regulators will remain in the Max Deviation Alternate Mode before reverting to the standard Max Deviation operation.</td></tr>
<tr><td>209 Timer To Alt Mode
XXXX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>60</td><td>10</td><td>3600</td></tr>
<tr><td colspan="8">•Defines the amount of time that the connected regulators are permitted to remain at the configured Max Deviation value before the control will revert to the Max Deviation Alternate mode of operation.</td></tr>
<tr><td>210 Max Deviation Alt Mode
Ganged Mode</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Off</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The configured fall back mode of operation for a group of connected regulators if they remain at the user configured Max Deviation value for the time defined at FC 209. The options are: Off; Tap To Neutral; Ganged Mode; Historical Tap Pos.
•See the Multi-phase Operation section of this manual for more information on the options.</td></tr>
<tr><td>211 Sequencing Interval
XX Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>5</td><td>0</td><td>60</td></tr>
<tr><td colspan="8">•The sequence interval for the multi-phase display and status LEDs on the control HMI. The LEDs will alternately display the status of each connected device for the specified interval.</td></tr>
<tr><td>220 Auto Tap Dead Phase mode
Disabled</td><td></td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This setting will enable Tap-Dead-Phase functionality for a multi-phase control. Using this function, the control will use power from powered phases to operate the tap changer of dead phases.
•The settings options include: Disabled, Tap To Neutral, Ganged Mode.</td></tr>
<tr><td>221 Tap Dead Phase
Inactive</td><td></td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This will display the operational status of the Auto Tap Dead Phase mode function, either Inactive or Active.</td></tr>
<tr><td>222 Delay Timer
15 Seconds</td><td>Seconds</td><td>View</td><td>Modify</td><td>NA</td><td>15</td><td>1</td><td>180</td></tr>
<tr><td colspan="8">•When a condition occurs that would enable the Auto Tap Dead Phase mode, the activation of the function will be delayed for this period of time.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
260 Com 1 Tx Messages XXXXX	---	View	NA	Operate	Reset* to 0	NA	NA
•Count of Transmitted Messages from Com 1.							
261 Com 1 Rx Messages XXXXX	---	View	NA	Operate	Reset* to 0	NA	NA
•Count of Received Messages from Com 1.							
262 Com 1 Rx Errors XXXXX	---	View	NA	Operate	Reset* to 0	NA	NA
•Count of Receive Errors from Com 1.							
263 Com 2 Tx Messages XXXXX	---	View	NA	Operate	Reset* to 0	NA	NA
•Count of Transmitted Messages from Com 2.							
264 Com 2 Rx Messages XXXXX	---	View	NA	Operate	Reset* to 0	NA	NA
•Count of Received Messages from Com 2.							
265 Com 2 Rx Errors XXXXX	---	View	NA	Operate	Reset* to 0	NA	NA
•Count of Receive Errors from Com 2.							
300 PMT Mode A State Off	---	View	Modify	NA	Off	NA	NA
•The Preventive Maintenance Tapping (PMT) feature Mode A will automatically raise and lower the tap-changer to wipe contact blades. The options include: Off; On.							
301 PMT Mode A Countdown Delay XX Days	Days	View	NA	NA	NA	NA	NA
•This is the time remaining until the next PMT Mode A operation.							
302 PMT Mode A Time Delay XX Days	Days	View	Modify	NA	7	1	99
•This is the user-defined period of time between PMT Mode A operations.							
303 PMT Mode A Issue Test	---	NA	Modify	NA	NA	NA	NA
•The user can force the PMT Mode A operation independent of the time-delay setting. •The test is initiated by pressing ENTER and then ENTER again to confirm the command.							
320 PMT Mode B State Off	---	View	Modify	NA	Off	NA	NA
•The Preventive Maintenance Tapping (PMT) feature Mode B will automatically raise and lower the tap-changer to wipe reversing contact blades. The PMT feature Mode B is turned off or on here. The options include: Off; On.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
321 PMT Mode B Countdown Delay XX Days	Days	View	NA	NA	NA	NA	NA
•This is the time remaining until the next PMT Mode B operation.							
322 PMT Mode B Time Delay XX Days	Days	View	Modify	NA	7	1	99
•This is the user-defined period of time between PMT Mode B operations.							
323 PMT Mode B Start Time MM:SS	---	View	Modify	NA	22:00	00:00	23:59
•When the PMT feature Mode B is turned on (FC 320), operation is enabled only within a specified time period. The starting time is set here.							
324 PMT Mode B Stop Time MM:SS	---	View	Modify	NA	02:00	00:00	23:59
•The PMT Mode B operation is disabled after the stopping time set here.							
325 PMT Mode B Max Deviation XX	---	View	Modify	NA	8	1	16
•This is the maximum number of tap positions beyond neutral for which PMT Mode B is enabled.							
327 PMT Mode B Current Limit XXX %	%	View	Modify	NA	50	0	160
•The PMT Mode B is enabled at or below the current limit setting, defined as a percentage of the CT primary rating.							
328 PMT Mode B Issue Test	---	NA	Modify	NA	NA	NA	NA
•The user can force the PMT Mode B operation independent of the time-delay setting. •The test is initiated by pressing ENTER and then ENTER again to confirm the command.							
333 Contact Duty Cycle Monitor XX.XXX %	%	View	NA	NA	NA	NA	NA
•The contact life Duty Cycle Monitor function represents the amount of life consumed, for the worst-case contact, displayed as a percentage of total life. Individual contact wear levels can be interrogated via the ProView NXG software.							
410 Leader/Follower Off	---	View	Modify	NA	Off	NA	NA
•This will turn On or Off Leader/Follower feature. The options include: Off; On.							
411 Leader/Follower State Not Ready	---	View	NA	NA	NA	NA	NA
•This is the state of the Leader/Follower function. Display include: Ready; Not Ready; Active; Inactive; Unable To Operate; Loss Of Comms; Unknown.							
412 L/F Mode Lead Phase Reg.	---	View	Modify	NA	Lead Phase Reg.	NA	NA
•Designates the mode of operation for the Leader/Follower feature. Options include: Lead Phase Reg.; Volt Averaging Reg.; Max Deviation. •See the section in this manual for more information of the various modes of operation.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
413 Leader/Follower Designation Follower 1	---	View	Modify	NA	Follower 1	NA	NA
•This is the Leader/Follower table designation for each connected regulator. The options include: Leader; Follower 1; Follower 2.							
414 Follower Devices Configured 1	---	View	Modify	NA	1	1	2
•The number of follower devices connected in a Leader/Follower scheme. The allowable options are 1 or 2.							
415 Leader/Follower Tap Wait Timer XXXXX mSec	MilliSec	View	Modify	NA	0	0	10000
•Sets a wait timer for use with Leader/Follower gang operation. Gang operation means that all tap changers must be on the same position. For ganged tap-changer operation, the tapping operations of the connected regulators must be synchronized if more than one tap-changer type is used. If, for example, the fast Quik-drive is ganged with a slow spring-drive, the control will not be able to keep the voltage regulators on the same position unless the Quik-drive is slowed down to switch at the same time as the spring-drive.							
416 Leader/Follower Timeout XX Seconds	Seconds	View	Modify	NA	3	0	60
•The length of time in seconds before the Leader returns to starting tap position if a Follower device does not tap.							
417 Leader/Follower Retry Delay XX Seconds	Seconds	View	Modify	NA	5	5	60
•The length of time in seconds before the leader retries to initiate a tapping operation if an initial attempt failed.							
418 Leader/Follower Retries XX	---	View	Modify	NA	3	1	10
•Designates the maximum number of tap command retries attempted by the Leader when a follower does not tap.							
420 Leader/Follower Monitor Powerup	---	View	NA	NA	NA	NA	NA
•Displays the state of the Leader/Follower scheme. Display options include: Powerup; Initializing; Disabled; Leader Active; Leader Inactive; Feedback Pending; Feedback Received; Feedback Late; Sync Retry Delay; Retry Delay; Unable to Operate; Follower Ready; Follower Tap Issued; Follower Not Ready.							
421 L/F Average Comp Volt Secondary XXX.X Volts	Volts	View	NA	NA	NA	NA	NA
•Displays the average compensated voltage among regulators connected in a Leader/Follower scheme.							
422 Max Deviation XX	---	View	Modify	NA	32	0	32
•The maximum deviation in tap position between regulators operating in the Max Deviation Leader/Follower mode.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
423 Timer To Alt Mode XXXX Seconds	Seconds	View	Modify	NA	60	10	3600
•Defines the amount of time that the connected regulators are permitted to remain at the configured Max Deviation value before the control will revert to the Max Deviation Alternate mode of operation.							
424 Timer To Max Deviation Mode XXX Hours	Hours	View	Modify	NA	168	0	168
•Defines the amount of time that the connected regulators will remain in the Max Deviation Alternate Mode before reverting to the standard Max Deviation operation.							
425 Max Deviation Alt Mode Ganged Mode	---	View	Modify	NA	Ganged Mode	NA	NA
•The configured fall back mode of operation for a group of connected regulators if they remain at the user configured Max Deviation value for the time defined at FC 424. The options are: Off; Tap To Neutral; Ganged Mode; Historical Tap Pos. •See the Leader/Follower Operation section of this manual for more information on the options.							
450 Alternate Config Mode Off	---	View	Modify	NA	Off	NA	NA
•This will turn on Alternate Configurations and designate a mode of operation. The options are: Off; On; ARLH; ARLC; Config Logic. •Selecting "On" will enable the basic Alternate Configuration settings. •Selecting ARLH will enable the Auto-Restore Local Heartbeat function. This function will revert control settings modified through SCADA communications back to original settings when a heartbeat signal is lost or discontinued. •Selecting ARLC will enable the Auto-Restore Local Comms function. This function will revert control settings modified through SCADA communications back to original settings when a communications signal is lost. •Selecting Config Logic will enable Alternate Configuration settings to be enabled or disabled using configurable logic equations.							
451 Alternate Config State Inactive	---	View	NA	NA	NA	NA	NA
•Displays the alternate configuration that is currently active. Display options include: Alt Config 1 Active; Alt Config 2 Active; Alt Config 3 Active; ARLC Active; ARLH Active.							
452 Alternate Config Selection Alt Config 1	---	View	Modify	NA	Off	NA	NA
•Allows for the selection of basic alternate configuration settings when FC 450 is set to “On”. Options include: Alt Config 1; Alt Config 2; Alt Config 3; Config Logic.							
460 Forward Set Voltage XXX.X Volts	Volts	View	Modify	NA	120.0	100.0	135.0
•Forward Set Voltage for Alternate Configuration 1.							
461 Forward Bandwidth X.X Volts	Volts	View	Modify	NA	2.0	1.0	6.0
•Forward Bandwidth for Alternate Configuration 1.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
462 Forward Time Delay XXX Seconds	Seconds	View	Modify	NA	45	5	180
•Forward Time Delay for Alternate Configuration 1.							
463 Fwd Line Drop Comp. Resistance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Forward Line Drop Compensation Resistance for Alternate Configuration 1.							
464 Fwd Line Drop Comp. Reactance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Forward Line Drop Compensation Reactance for Alternate Configuration 1.							
465 Reverse Set Voltage XXX.X Volts	Volts	View	Modify	NA	120.0	100.0	135.0
•Reverse Set Voltage for Alternate Configuration 1.							
466 Reverse Bandwidth X.X Volts	Volts	View	Modify	NA	2.0	1.0	6.0
•Reverse Bandwidth for Alternate Configuration 1.							
467 Reverse Time Delay XXX Seconds	Seconds	View	Modify	NA	45	5	180
•Reverse Time Delay for Alternate Configuration 1.							
468 Rev Line Drop Comp. Resistance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Reverse Line Drop Compensation Resistance for Alternate Configuration 1.							
469 Rev Line Drop Comp. Reactance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Reverse Line Drop Compensation Reactance for Alternate Configuration 1.							
470 Control Operating Mode Sequential	---	View	Modify	NA	Sequential	NA	NA
•The Control Operating Mode for Alternate Configuration 1.							
471 Reverse Sensing Mode Locked Forward	---	View	Modify	NA	Locked Forward	NA	NA
•The Reverse Sensing Mode for Alternate Configuration 1.							
472 Reverse Current Sense Threshold X %	%	View	Modify	NA	1	1	5
•The Reverse Current Sense Threshold for Alternate Configuration 1.							
473 Auto Operation Blocking Status Normal	---	View	Modify	NA	Normal	NA	NA
•The Auto Operation Blocking Status for Alternate Configuration 1.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
474 Voltage Reduction Mode Off	---	View	Modify	NA	Off	NA	NA
•The Voltage Reduction Mode for Alternate Configuration 1.							
475 Local/Digital Reduction Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Local/Digital Reduction Value for Alternate Configuration 1.							
476 Remote #1 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #1 Voltage Reduction Value for Alternate Configuration 1.							
477 Remote #2 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #2 Voltage Reduction Value for Alternate Configuration 1.							
478 Remote #3 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #3 Voltage Reduction Value for Alternate Configuration 1.							
479 # of Pulse Reduction Steps XX	---	View	Modify	NA	0	0	10
•The Remote Pulse Voltage Reduction number of steps for Alternate Configuration 1.							
480 % of Voltage Red Per Pulse Step XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote Pulse Voltage Reduction % per step for Alternate Configuration 1.							
481 Present Voltage Reduction Step XX	---	View	NA	NA	NA	NA	NA
•The Remote Pulse Voltage Reduction Present Voltage Reduction Step for Alternate Configuration 1.							
482 SOFT-ADD-AMP Limits Off	---	View	Modify	NA	Off	NA	NA
•The SOFT-ADD-AMP Limits feature enabled for Alternate Configuration 1.							
483 SOFT-ADD-AMP High Limit XX	---	View	Modify	NA	16	NA	NA
•The SOFT-ADD-AMP High Limit for Alternate Configuration 1.							
484 SOFT-ADD-AMP Low Limit XX	---	View	Modify	NA	-16	NA	NA
•The SOFT-ADD-AMP Low Limit for Alternate Configuration 1.							
485 Voltage Limiter Mode Off	---	View	Modify	NA	Off	NA	NA
•Voltage Limiter Mode enabled for Alternate Configuration 1.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
486 High Voltage Limit XXX.X Volts	Volts	View	Modify	NA	130.0	120.0	135.0
•The Voltage Limiter High Limit for Alternate Configuration 1.							
487 Low Voltage Limit XXX.X Volts	Volts	View	Modify	NA	105.0	105.0	120.0
•The Voltage Limiter Low Limit for Alternate Configuration 1.							
488 Voltage Limiter Fast Resp. Delay XX Seconds	Seconds	View	Modify	NA	3	1	60
•The Voltage Limiter Fast Resp. Delay for Alternate Configuration 1.							
489 Voltage Limiter Delay XX Seconds	Seconds	View	Modify	NA	10	1	60
•The Voltage Limiter Delay for Alternate Configuration 1.							
490 Time Between Taps XX Seconds	Seconds	View	Modify	NA	0	0	10
•The Voltage Limiter Time Between Taps for Alternate Configuration 1.							
491 Tap To Neutral Off	---	View	Modify	NA	Off	NA	NA
•The Tap to Neutral setting for Alternate Configuration 1.							
500 Forward Set Voltage XXX.X Volts	Volts	View	Modify	NA	120.0	100.0	135.0
•Forward Set Voltage for Alternate Configuration 2.							
501 Forward Bandwidth X.X Volts	Volts	View	Modify	NA	2.0	1.0	6.0
•Forward Bandwidth for Alternate Configuration 2.							
502 Forward Time Delay XXX Seconds	Seconds	View	Modify	NA	45	5	180
•Forward Time Delay for Alternate Configuration 2.							
503 Fwd Line Drop Comp. Resistance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Forward Line Drop Compensation Resistance for Alternate Configuration 2.							
504 Fwd Line Drop Comp. Reactance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Forward Line Drop Compensation Reactance for Alternate Configuration 2.							
505 Reverse Set Voltage XXX.X Volts	Volts	View	Modify	NA	120.0	100.0	135.0
•Reverse Set Voltage for Alternate Configuration 2.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
506 Reverse Bandwidth X.X Volts	Volts	View	Modify	NA	2.0	1.0	6.0
•Reverse Bandwidth for Alternate Configuration 2.							
507 Reverse Time Delay XXX Seconds	Seconds	View	Modify	NA	45	5	180
•Reverse Time Delay for Alternate Configuration 2.							
508 Rev Line Drop Comp. Resistance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Reverse Line Drop Compensation Resistance for Alternate Configuration 2.							
509 Rev Line Drop Comp. Reactance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Reverse Line Drop Compensation Reactance for Alternate Configuration 2.							
510 Control Operating Mode Sequential	---	View	Modify	NA	Sequential	NA	NA
•The Control Operating Mode for Alternate Configuration 2.							
511 Reverse Sensing Mode Locked Forward	---	View	Modify	NA	Locked Forward	NA	NA
•The Reverse Sensing Mode for Alternate Configuration 2.							
512 Reverse Current Sense Threshold X %	%	View	Modify	NA	1	1	5
•The Reverse Current Sense Threshold for Alternate Configuration 2.							
513 Auto Operation Blocking Status Normal	---	View	Modify	NA	Normal	NA	NA
•The Auto Operation Blocking Status for Alternate Configuration 2.							
514 Voltage Reduction Mode Off	---	View	Modify	NA	Off	NA	NA
•The Voltage Reduction Mode for Alternate Configuration 2.							
515 Local/Digital Reduction Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Local/Digital Reduction Value for Alternate Configuration 2.							
516 Remote #1 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #1 Voltage Reduction Value for Alternate Configuration 2.							
517 Remote #2 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #2 Voltage Reduction Value for Alternate Configuration 2.							
518 Remote #3 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #3 Voltage Reduction Value for Alternate Configuration 2.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
519 # of Pulse Reduction Steps XX	---	View	Modify	NA	0	0	10
•The Remote Pulse Voltage Reduction number of steps for Alternate Configuration 2.							
520 % of Voltage Red Per Pulse Step XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote Pulse Voltage Reduction % per step for Alternate Configuration 2.							
521 Present Voltage Reduction Step XX	---	View	NA	NA	NA	NA	NA
•The Remote Pulse Voltage Reduction Present Voltage Reduction Step for Alternate Configuration 2.							
522 SOFT-ADD-AMP Limits Off	---	View	Modify	NA	Off	NA	NA
•The SOFT-ADD-AMP Limits feature enabled for Alternate Configuration 2.							
523 SOFT-ADD-AMP High Limit XX	---	View	Modify	NA	16	NA	NA
•The SOFT-ADD-AMP High Limit for Alternate Configuration 2.							
524 SOFT-ADD-AMP Low Limit XX	---	View	Modify	NA	-16	NA	NA
•The SOFT-ADD-AMP Low Limit for Alternate Configuration 2.							
525 Voltage Limiter Mode Off	---	View	Modify	NA	Off	NA	NA
•Voltage Limiter Mode enabled for Alternate Configuration 2.							
526 High Voltage Limit XXX.X Volts	Volts	View	Modify	NA	130.0	120.0	135.0
•The Voltage Limiter High Limit for Alternate Configuration 2.							
527 Low Voltage Limit XXX.X Volts	Volts	View	Modify	NA	105.0	105.0	120.0
•The Voltage Limiter Low Limit for Alternate Configuration 2.							
528 Voltage Limiter Fast Resp. Delay XX Seconds	Seconds	View	Modify	NA	3	1	60
•The Voltage Limiter Fast Resp. Delay for Alternate Configuration 2.							
529 Voltage Limiter Delay XX Seconds	Seconds	View	Modify	NA	10	1	60
•The Voltage Limiter Delay for Alternate Configuration 2.							
530 Time Between Taps XX Seconds	Seconds	View	Modify	NA	0	0	10
•The Voltage Limiter Time Between Taps for Alternate Configuration 2.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
531 Tap To Neutral Off	---	View	Modify	NA	Off	NA	NA
•The Tap to Neutral setting for Alternate Configuration 2.							
550 Forward Set Voltage XXX.X Volts	Volts	View	Modify	NA	120.0	100.0	135.0
•Forward Set Voltage for Alternate Configuration 3.							
551 Forward Bandwidth X.X Volts	Volts	View	Modify	NA	2.0	1.0	6.0
•Forward Bandwidth for Alternate Configuration 3.							
552 Forward Time Delay XXX Seconds	Seconds	View	Modify	NA	45	5	180
•Forward Time Delay for Alternate Configuration 3.							
553 Fwd Line Drop Comp. Resistance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Forward Line Drop Compensation Resistance for Alternate Configuration 3.							
554 Fwd Line Drop Comp. Reactance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Forward Line Drop Compensation Reactance for Alternate Configuration 3.							
555 Reverse Set Voltage XXX.X Volts	Volts	View	Modify	NA	120.0	100.0	135.0
•Reverse Set Voltage for Alternate Configuration 3.							
556 Reverse Bandwidth X.X Volts	Volts	View	Modify	NA	2.0	1.0	6.0
•Reverse Bandwidth for Alternate Configuration 3.							
557 Reverse Time Delay XXX Seconds	Seconds	View	Modify	NA	45	5	180
•Reverse Time Delay for Alternate Configuration 3.							
558 Rev Line Drop Comp. Resistance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Reverse Line Drop Compensation Resistance for Alternate Configuration 3.							
559 Rev Line Drop Comp. Reactance XX.X Volts	Volts	View	Modify	NA	0.0	-96.0	96.0
•Reverse Line Drop Compensation Reactance for Alternate Configuration 3.							
560 Control Operating Mode Sequential	---	View	Modify	NA	Sequential	NA	NA
•The Control Operating Mode for Alternate Configuration 3.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
561 Reverse Sensing Mode Locked Forward	---	View	Modify	NA	Locked Forward	NA	NA
•The Reverse Sensing Mode for Alternate Configuration 3.							
562 Reverse Current Sense Threshold X %	%	View	Modify	NA	1	1	5
•The Reverse Current Sense Threshold for Alternate Configuration 3.							
563 Auto Operation Blocking Status Normal	---	View	Modify	NA	Normal	NA	NA
•The Auto Operation Blocking Status for Alternate Configuration 3.							
564 Voltage Reduction Mode Off	---	View	Modify	NA	Off	NA	NA
•The Voltage Reduction Mode for Alternate Configuration 3.							
565 Local/Digital Reduction Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Local/Digital Reduction Value for Alternate Configuration 3.							
566 Remote #1 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #1 Voltage Reduction Value for Alternate Configuration 3.							
567 Remote #2 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #2 Voltage Reduction Value for Alternate Configuration 3.							
568 Remote #3 Value XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote latch #3 Voltage Reduction Value for Alternate Configuration 3.							
569 # of Pulse Reduction Steps XX	---	View	Modify	NA	0	0	10
•The Remote Pulse Voltage Reduction number of steps for Alternate Configuration 3.							
570 % of Voltage Red Per Pulse Step XX.X %	%	View	Modify	NA	0.0	0.0	10.0
•The Remote Pulse Voltage Reduction % per step for Alternate Configuration 3.							
571 Present Voltage Reduction Step XX	---	View	NA	NA	NA	NA	NA
•The Remote Pulse Voltage Reduction Present Voltage Reduction Step for Alternate Configuration 3.							
572 SOFT-ADD-AMP Limits Off	---	View	Modify	NA	Off	NA	NA
•The SOFT-ADD-AMP Limits feature enabled for Alternate Configuration 3.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
573 SOFT-ADD-AMP High Limit XX	---	View	Modify	NA	16	NA	NA
•The SOFT-ADD-AMP High Limit for Alternate Configuration 3.							
574 SOFT-ADD-AMP Low Limit XX	---	View	Modify	NA	-16	NA	NA
•The SOFT-ADD-AMP Low Limit for Alternate Configuration 3.							
575 Voltage Limiter Mode Off	---	View	Modify	NA	Off	NA	NA
•Voltage Limiter Mode enabled for Alternate Configuration 3.							
576 High Voltage Limit XXX.X Volts	Volts	View	Modify	NA	130.0	120.0	135.0
•The Voltage Limiter High Limit for Alternate Configuration 3.							
577 Low Voltage Limit XXX.X Volts	Volts	View	Modify	NA	105.0	105.0	120.0
•The Voltage Limiter Low Limit for Alternate Configuration 3.							
578 Voltage Limiter Fast Resp. Delay XX Seconds	Seconds	View	Modify	NA	3	1	60
•The Voltage Limiter Fast Resp. Delay for Alternate Configuration 3.							
579 Voltage Limiter Delay XX Seconds	Seconds	View	Modify	NA	10	1	60
•The Voltage Limiter Delay for Alternate Configuration 3.							
580 Time Between Taps XX Seconds	Seconds	View	Modify	NA	0	0	10
•The Voltage Limiter Time Between Taps for Alternate Configuration 3.							
581 Tap To Neutral Off	---	View	Modify	NA	Off	NA	NA
•The Tap to Neutral setting for Alternate Configuration 3.							
600 Voltage Sag Monitoring Off		View	Modify	NA	Off	NA	NA
•This will turn on or turn off the voltage sag monitor feature on the control. •The settings options include: On; Off							
601 Level1 Threshold 70.0 %	%	View	Modify	NA	70.0	50.0	70.0
•The level 1 voltage sag set point given as a percentage Demand Metering value of Forward Load Voltage Present or Reverse Load Voltage Present as applicable. •A voltage sag below this level for the duration of the value of the Level 1 Threshold Timer Value (FC 603) will cause the control to record a Level 1 sag event.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
602 Level1 Recovery 75.0 %	%	View	Modify	NA	75.0	71.0	100.0
•After a level 1 voltage sag has occurred, this is the level at which the voltage is said to have recovered from the sag. This value is given as a percentage Demand Metering value of Forward Load Voltage Present or Reverse Load Voltage Present as applicable. •A voltage recovery above this level for the duration of the value of the Level 1 Recovery Timer Value (FC 604) will cause the control to record a Level 1 recovery event.							
603 Level1 Threshold Timer Value 20 mSec	mSec	View	Modify	NA	20	30000	20
•The minimum time duration that must be met in order to record a Level 1 sag event.							
604 Level1 Recovery Timer Value 20 mSec	mSec	View	Modify	NA	20	30000	20
•The minimum time duration that must be met by a sag recovery in order to record a level 1 sag recovery.							
605 Duration of Last Level1 0 Cycles MM-DD-YYYY HH:MM:SSp	Cycles	View	NA	Operate	NA	NA	NA
•A date and time stamped record of the duration of the last level 1 voltage sag recorded in cycles. •The duration is the time between the point at which a sag event reaches the threshold timer value and the recovery has reached the recovery timer value. •This is reset to 0 and the current date and time by entering the appropriate security level and pressing ENTER.							
606 Duration of Longest Level1 0 Cycles MM-DD-YYYY HH:MM:SSp	Cycles	View	NA	Operate	NA	NA	NA
•A date and time stamped record of the longest duration recorded for the Duration of Last Level1 (FC 605) voltage sag. •This is reset to 0 and the current date and time by entering the appropriate security level and pressing ENTER.							
611 Level2 Threshold 80.0 %	%	View	Modify	NA	80.0	50.0	80.0
•The level 2 voltage sag set point given as a percentage Demand Metering value of Forward Load Voltage Present or Reverse Load Voltage Present as applicable. •A voltage sag below this level for the duration of the value of the Level 2 Threshold Timer Value (FC 613) will cause the control to record a Level 2 sag event.							
612 Level2 Recovery 85.0 %	%	View	Modify	NA	85.0	81.0	100.0
•After a level 2 voltage sag has occurred, this is the level at which the voltage is said to have recovered from the sag. This value is given as a percentage Demand Metering value of Forward Load Voltage Present or Reverse Load Voltage Present as applicable. •A voltage recovery above this level for the duration of the value of the Level 2 Recovery Timer Value (FC 614) will cause the control to record a Level 2 recovery event.							
613 Level2 Threshold Timer Value 500 mSec	mSec	View	Modify	NA	500	20	30000
•The minimum time duration that must be met in order to record a Level 2 sag event.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
614 Level2 Recovery Timer Value 500 mSec	mSec	View	Modify	NA	500	20	30000
•The minimum time duration that must be met by a sag recovery in order to record a level 2 sag recovery.							
615 Duration of Last Level2 0 Cycles MM-DD-YYYY HH:MM:SSp	Cycles	View	NA	Operate	NA	NA	NA
•A date and time stamped record of the duration of the last level 2 voltage sag recorded in cycles. •The duration is the time between the point at which a sag event reaches the threshold timer value and the recovery has reached the recovery timer value. •This is reset to 0 and the current date and time by entering the appropriate security level and pressing ENTER.							
616 Duration of Longest Level2 0 Cycles MM-DD-YYYY HH:MM:SSp	Cycles	View	NA	Operate	NA	NA	NA
•A date and time stamped record of the longest duration recorded for the Duration of Last Level 2 (FC 615) voltage sag. •This is reset to 0 and the current date and time by entering the appropriate security level and pressing ENTER.							
621 Level3 Threshold 90.0 %	%	View	Modify	NA	90.0	50.0	90.0
•The level 3 voltage sag set point given as a percentage Demand Metering value of Forward Load Voltage Present or Reverse Load Voltage Present as applicable. •A voltage sag below this level for the duration of the value of the Level 3 Threshold Timer Value (FC 623) will cause the control to record a Level 3 sag event.							
623 Level3 Threshold Timer Value 10000 mSec	mSec	View	Modify	NA	10000	20	30000
•The minimum time duration that must be met in order to record a Level 3 sag event.							
624 Level3 Recovery Timer Value 10000 mSec	mSec	View	Modify	NA	10000	20	30000
•The minimum time duration that must be met by a sag recovery in order to record a level 3 sag recovery.							
625 Duration of Last Level3 0 Cycles MM-DD-YYYY HH:MM:SSp	Cycles	View	NA	Operate	NA	NA	NA
•A date and time stamped record of the duration of the last level 3 voltage sag recorded in cycles. •The duration is the time between the point at which a sag event reaches the threshold timer value and the recovery has reached the recovery timer value. •This is reset to 0 and the current date and time by entering the appropriate security level and pressing ENTER.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
626 Duration of Longest Level3 0 Cycles MM-DD-YYYY HH:MM:SSp	Cycles	View	NA	Operate	NA	NA	NA
•A date and time stamped record of the longest duration recorded for the Duration of Last Level 3 (FC 625) voltage sag. •This is reset to 0 and the current date and time by entering the appropriate security level and pressing ENTER.							
631 Voltage Sag In Effect None	---	View	NA	NA	NA	NA	NA
•During a voltage sag event, this will display the level attained by the event as Level 1, Level 2, or Level 3.							
632 Reset All Volt Sag Durations	---	View	NA	Operate	NA	NA	NA
•Pressing ENTER after providing the appropriate security level will reset all sag monitor duration records to 0 with the current date and time stamp.							
640 Fault Detect Off	---	View	Modify	NA	Off	NA	NA
•This setting will enable the Fault Detect Feature. •Options include: Off; On.							
641 Fault Detect In Effect None	---	View	NA	NA	NA	NA	NA
•When the control has detected a fault based upon the set Fault Detect parameters, this parameter will display the level of fault detect that is in effect at the moment. •Possible displays: Level 1; Level 2; Level 3.							
642 Reset All Fault Detect Durations	---	View	NA	Admin	NA	NA	NA
•This parameter will reset all Fault Detect longest and latest duration parameters for all three levels of fault detect. After the reset, the duration will display 0 Cycles with the date and time stamp of the reset. •On a multi-phase control it will reset the durations for all phases.							
645 Fault Detect Level1 Threshold 600 Amps	Amps	View	Modify	NA	600	5	16000
•This setting defines the current level which must be exceeded for a Level 1 Fault to be recorded by the control. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							
646 Fault Detect Level1 Recovery 599 Amps	Amps	View	Modify	NA	599	4	16000
•This setting defines the level below which current must fall for a Level 1 Fault Recovery to be recorded. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>647 Fault Level1 Threshold Timer
20 mSec</td><td>mSec</td><td>View</td><td>Modify</td><td>NA</td><td>20</td><td>20</td><td>30000</td></tr>
<tr><td colspan="8">•This setting defines the minimum time duration over which the Level 1 Fault Detect Threshold Current must occur for a fault to be recorded.
•On a multi-phase the right arrow is used to scroll to the setting for each phase.</td></tr>
<tr><td>648 Fault Level1 Recovery Timer
20 mSec</td><td>mSec</td><td>View</td><td>Modify</td><td>NA</td><td>20</td><td>20</td><td>30000</td></tr>
<tr><td colspan="8">•This setting defines the minimum time duration over which the Level 1 Fault Detect Recovery Current must occur for a fault recovery to be recorded.
•On a multi-phase the right arrow is used to scroll to the setting for each phase.</td></tr>
<tr><td>649 Duration of Last Level1
0 Cycles
01/01/1970 12:00:00a</td><td>Cycles</td><td>View</td><td>NA</td><td>Operate</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•A display with date and time stamped of the duration in cycles of the last recorded Level 1 fault since last reset.
•On a multi-phase the right arrow is used to scroll to the display for each phase.</td></tr>
<tr><td>649 Duration of Longest Level1
0 Cycles
01/01/1970 12:00:00a</td><td>Cycles</td><td>View</td><td>NA</td><td>Operate</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•A display with date and time stamped of the duration of the longest recorded Level 1 fault since last reset.
•On a multi-phase the right arrow is used to scroll to the display for each phase.</td></tr>
<tr><td>650 Fault Detect Level2 Threshold
500 Amps</td><td>Amps</td><td>View</td><td>Modify</td><td>NA</td><td>500</td><td>5</td><td>16000</td></tr>
<tr><td colspan="8">•This setting defines the current level which must be exceeded for a Level 2 Fault to be recorded by the control.
•On a multi-phase the right arrow is used to scroll to the setting for each phase.</td></tr>
<tr><td>651 Fault Detect Level2 Recovery
499 Amps</td><td>Amps</td><td>View</td><td>Modify</td><td>NA</td><td>499</td><td>4</td><td>16000</td></tr>
<tr><td colspan="8">•This setting defines the level below which current must fall for a Level 2 Fault Recovery to be recorded.
•On a multi-phase the right arrow is used to scroll to the setting for each phase.</td></tr>
<tr><td>652 Fault Level2 Threshold Timer
500 mSec</td><td>mSec</td><td>View</td><td>Modify</td><td>NA</td><td>500</td><td>20</td><td>30000</td></tr>
<tr><td colspan="8">•This setting defines the minimum time duration over which the Level 2 Fault Detect Threshold Current must occur for a fault to be recorded.
•On a multi-phase the right arrow is used to scroll to the setting for each phase.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
653 Fault Level2 Recovery Timer 500 mSec	mSec	View	Modify	NA	500	20	30000
•This setting defines the minimum time duration over which the Level 2 Fault Detect Recovery Current must occur for a fault recovery to be recorded. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							
654 Duration of Last Level2 0 Cycles 01/01/1970 12:00:00a	Cycles	View	NA	Operate	NA	NA	NA
•A display with date and time stamped of the duration in cycles of the last recorded Level 2 fault since last reset. •On a multi-phase the right arrow is used to scroll to the display for each phase.							
654 Duration of Longest Level2 0 Cycles 01/01/1970 12:00:00a	Cycles	View	NA	Operate	NA	NA	NA
•A display with date and time stamped of the duration of the longest recorded Level 2 fault since last reset. •On a multi-phase the right arrow is used to scroll to the display for each phase.							
655 Fault Detect Level3 Threshold 400 Amps	Amps	View	Modify	NA	400	5	16000
•This setting defines the current level which must be exceeded for a Level 3 Fault to be recorded by the control. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							
656 Fault Detect Level3 Recovery 399 Amps	Amps	View	Modify	NA	399	4	16000
•This setting defines the level below which current must fall for a Level 3 Fault Recovery to be recorded. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							
657 Fault Level3 Threshold Timer 1000 mSec	mSec	View	Modify	NA	1000	20	30000
•This setting defines the minimum time duration over which the Level 3 Fault Detect Threshold Current must occur for a fault to be recorded. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							
658 Fault Level3 Recovery Timer 1000 mSec	mSec	View	Modify	NA	1000	20	30000
•This setting defines the minimum time duration over which the Level 3 Fault Detect Recovery Current must occur for a fault recovery to be recorded. •On a multi-phase the right arrow is used to scroll to the setting for each phase.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
659 Duration of Last Level3 0 Cycles 01/01/1970 12:00:00a	Cycles	View	NA	Operate	NA	NA	NA
•A display with date and time stamped of the duration in cycles of the last recorded Level 3 fault since last reset. •On a multi-phase the right arrow is used to scroll to the display for each phase.							
659 Duration of Longest Level3 0 Cycles 01/01/1970 12:00:00a	Cycles	View	NA	Operate	NA	NA	NA
•A display with date and time stamped of the duration of the longest recorded Level 3 fault since last reset. •On a multi-phase the right arrow is used to scroll to the display for each phase.							
700 User Defined HMI Func1 Activate Off	---	View	Modify	NA	Off	NA	NA
•This is used in conjunction with the configurable logic input User HMI Function 1 ON. •This provides and HMI means of enabling or disabling configurable logic. By setting this to “On”, the configurable logic input User HMI Function 1 ON becomes active. •The settings options include: On; Off							
701 User Defined HMI Func2 Activate Off	---	View	Modify	NA	Off	NA	NA
•This is used in conjunction with the configurable logic input User HMI Function 2 ON. •This provides and HMI means of enabling or disabling configurable logic. By setting this to “On”, the configurable logic input User HMI Function 2 ON becomes active. •The settings options include: On; Off							
702 User Defined HMI Func3 Activate Off	---	View	Modify	NA	Off	NA	NA
•This is used in conjunction with the configurable logic input User HMI Function 3 ON. •This provides and HMI means of enabling or disabling configurable logic. By setting this to “On”, the configurable logic input User HMI Function 3 ON becomes active. •The settings options include: On; Off							
703 User Defined HMI Func4 Activate Off	---	View	Modify	NA	Off	NA	NA
•This is used in conjunction with the configurable logic input User HMI Function 4 ON. •This provides and HMI means of enabling or disabling configurable logic. By setting this to “On”, the configurable logic input User HMI Function 4 ON becomes active. •The settings options include: On; Off							
750 Load Voltage Secondary (L-N) ----- Volts	Volts	View	NA	NA	NA	NA	NA
•This is a Delta Calc instantaneous metering value for the Load Voltage Secondary from Line to Neutral. •On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>751 Load Voltage
Secondary (L-L)
----- Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Load Voltage Secondary from Line to Line.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>752 Source Voltage
Secondary (L-N)
----- Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Source Voltage Secondary from Line to Neutral.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>753 Source Voltage
Secondary (L-L)
----- Volts</td><td>Volts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Source Voltage Secondary from Line to Line.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>754 Load Voltage
Primary (L-N)
----- kVolts</td><td>kVolts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Load Voltage Primary from Line to Neutral.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>755 Load Voltage
Primary (L-L)
----- kVolts</td><td>kVolts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Load Voltage Primary from Line to Line.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>756 Source Voltage
Primary (L-N)
----- kVolts</td><td>kVolts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Source Voltage primary from Line to Neutral.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>757 Source Voltage
Primary (L-L)
----- kVolts</td><td>kVolts</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Source Voltage Primary from Line to Line.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>760 Load Voltage
Angle (L-N)
----- Degrees</td><td>Degrees</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Load Voltage Angle from Line to Neutral.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>761 Load Voltage
Angle (L-L)
----- Degrees</td><td>Degrees</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Load Voltage Angle from Line to Line.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>762 Source Voltage
Angle (L-N)
----- Degrees</td><td>Degrees</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Source Voltage Angle from Line to Neutral.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>763 Source Voltage
Angle (L-L)
----- Degrees</td><td>Degrees</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a Delta Calc instantaneous metering value for the Source Voltage Angle from Line to Line.
•On a multi-phase control, the metering values for each phase can be viewed by scrolling with the right arrow.</td></tr>
<tr><td>800 Protocol / Port
Type
Serial DNP</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Serial DNP</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Protocol and Port setting for Com 1. Not all options are resident on the control, some will require additional hardware to enable. The available protocol options will display according to port type.
•Possible options for a particular configuration include: Disabled; DNP / Serial; DNP / Ethernet; IEC 101 / Serial; ICE 104 / Ethernet; 2179 / Serial; Modbus / Serial; IEC 61850 / Ethernet.</td></tr>
<tr><td>800 LoopShare
Communications
Disabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This will enable or disable LoopShare Communications for Com 1. The options include: Disabled; Enabled.</td></tr>
<tr><td>800 ProView NXG
Session
Disabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This will enable or disable sessions with ProView NXG for Com 1. The options include: Disabled; Enabled.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>800 ProView NXG Address
XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>65519</td><td>0</td><td>65519</td></tr>
<tr><td colspan="8">•The Com 1 address for communications with ProView NXG is set here.</td></tr>
<tr><td>800 Ethernet Switch On Com 1
Disabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This will enable or disable the Ethernet switch when it is available on Com 1. The options include: Disabled; Enabled.</td></tr>
<tr><td>801 Serial Baud Rate
9600 BPS</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>9600 BPS</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the Com 1 Serial Communications Baud Rate setting. The option available are: 300 BPS; 600 BPS; 1200 BPS; 2400 BPS; 4800 BPS; 9600 BPS; 19200 BPS; 38400 BPS; 57600 BPS; 115200 BPS.</td></tr>
<tr><td>801 Serial Parity
None</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>None</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This sets for Com 1 the data parity parameter to be used on the serial communications channel.
•The available options are: None; Odd; Even</td></tr>
<tr><td>801 Serial CTS Support
Disabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This setting determines for Com 1 if CTS/RTS handshaking will be used to control the serial communications channel.
•The available options are: Disabled; Enabled</td></tr>
<tr><td>801 Serial Tx Enable Delay
XXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>5</td><td>0</td><td>3000</td></tr>
<tr><td colspan="8">•For Com 1, when the control is set for transmit control handshaking, a delay may be required between the time when the transmission is enabled to when data is transmitted.
•Example: If the transmit enable were used as a keying device for a transmitter or modem, a “warm-up” period may be necessary before data can be transmitted.
•See Figure 5-4.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

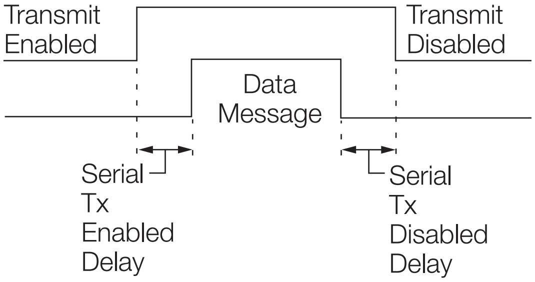
<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>801 Serial Tx Disable Delay XXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>5</td><td>0</td><td>3000</td></tr>
<tr><td colspan="8">•For Com 1, when the control is set for transmit control handshaking, a delay may be required between the time when the data transmission is terminated and the transmit enable signal is disabled.
•See Figure 5-4.


Figure 5-4.
Data transmission from the CL-7 control to the communication system for handshaking applications.</td></tr>
<tr><td>801 Serial Echo Mode Disabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•When serial communications is active, this parameter will enable or disable the echo mode for Com 1.
•Options include: Disabled; Enabled</td></tr>
<tr><td>802 IP Address XXX.XXX.XXX.XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 1 IP Address setting.</td></tr>
<tr><td>802 Subnet Mask XXX.XXX.XXX.XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 1 Subnet Mask setting.</td></tr>
<tr><td>802 Gateway XXX.XXX.XXX.XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 1 Gateway setting.</td></tr>
<tr><td>802 MAC Address XX:XX:XX:XX:XX:XX</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 1 MAC Address setting.</td></tr>
<tr><td>810 DNP RBE Master XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1234</td><td>0</td><td>65519</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the DNP3 device number to be used as the destination for any unsolicited reports by DNP3 events.</td></tr>
<tr><td>810 DNP IED Slave XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>0</td><td>65519</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the DNP3 device number to be assigned to the connected CL-7 control.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
810 DNP IED Slave 2 XXXXX	---	View	Modify	NA	65519	0	65519
•This is the Com 1 setting for the DNP3 device number to be assigned to the connected CL-7 control. •Communications to this address must always use the Default DNP map.							
810 DNP User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active DNP map for Com 1. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
811 DNP Network Protocol Type Listening End Point	---	View	Modify	NA	Listening End Point	NA	NA
•This sets the DNP network type for Com 1. •The available options are: Listening End Point; Dual End Point; UDP.							
811 DNP Accept From Any IP Enabled	---	View	Modify	NA	Enabled	NA	NA
•This is the Com 1 setting that controls whether or not DNP3 requests will be honored from hosts other than the one defined in the next set of fields. •The available options are: Disabled; Enabled							
811 DNP Accept From IP Address XXX.XXX.XXX.XXX	---	View	Modify	NA	NA	NA	NA
•This is the Com 1 setting that allows the user to input a specific IP address from which to accept DNP3 requests. This is also used as the destination IP to establish a connection when a Dual End Point connection is initiated by the control.							
811 DNP Destination Port Number XXXXX	---	View	Modify	NA	20000	1	65535
•This is the Com 1 setting that defines the IP port number to which outgoing DNP3 messages are addressed when a UDP End Point is configured, unless DNP Use Source Port From Request is Enabled. This port number is also used for outgoing TCP connections when a Dual End Point is configured.							
811 DNP Listening Port Number XXXXX	---	View	Modify	NA	20000	1	65535
•This is the Com 1 setting that defines the IP port number that will be monitored for incoming DNP3 requests when a TCP Listening End Point is configured; responses will be sent using the source port from the incoming request.							
811 DNP Use Port From Request Enabled	---	View	Modify	NA	Enabled	NA	NA
•This is the Com 1 setting that enables the control to use the source IP port number from the last request as the destination port number. •The available options are: Disabled; Enabled							
811 DNP Keep Alive Timeout XXXXX Seconds	---	View	Modify	NA	3600	1	65535
•This is the Com 1 setting for the time after which a DNP3 Data Link Layer status request will be sent if no message is received from the master (enter 0 to disable).							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>811 DNP Keep Alive Retries
XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>3</td><td>1</td><td>255</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the number of times the DNP3 Data Link Layer status request will be reattempted before the connection is closed.</td></tr>
<tr><td>812 IEC101 Link Address
XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>0</td><td>See note</td></tr>
<tr><td colspan="8">•This is the Com 1 setting that assigns a unique identifier to the individual slave instance running on the device.
•If Link Address Size is 1, Link Address high value is 255
•If Link Address Size is 2, Link Address high value is 65535</td></tr>
<tr><td>812 IEC101 Common Address
XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>0</td><td>See note</td></tr>
<tr><td colspan="8">•This is the Com 1 setting that identifies the station address, where the station is comprised of all of a device's links.
•If Common Address Size is 1, Common Address high value is 255
•If Common Address Size is 2, Common Address high value is 65535</td></tr>
<tr><td>812 IEC101 Link Address Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the number of octets to be used for the value of the link address.</td></tr>
<tr><td>812 IEC101 Common Address Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the number of octets to be used in the value of the common address.</td></tr>
<tr><td>812 IEC101 Object Address Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the number of octets to be used in the value of the object address.</td></tr>
<tr><td>812 IEC101 Cause of Transmit Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td colspan="8">•This is the Com 1 setting for the number of octets to be used in the cause of transmission indication.</td></tr>
<tr><td>812 IEC101 Single Command Op Mode
SBE</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>SBE</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the Com 1 setting that defines if the control will respond directly (Direct mode) to Single Command Operation commands or if a "select" is required before "execution" (SBE mode).
•The available options are: Direct; SBE.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
812 IEC101 Select Before Exec Time XXXXX mSec	MilliSec	View	Modify	NA	5000	0	65535
•This is the Com 1 setting that determines the amount of time that can elapse between a "select" and "execute" command for Single Command Operations in systems that employ a select-before-execute mode.							
812 IEC101 User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active IEC101 map for Com 1. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
813 IEC104 Server Listen Port XXXXX	---	View	Modify	NA	2404	1	65535
•This is the Com 1 setting for the IP port number that will be monitored for connections.							
813 IEC104 Common Address XXXXX	---	View	Modify	NA	2	1	65535
•This is the Com 1 setting that identifies the station address, where the station is comprised of all of a device's links for Com 1.							
813 IEC104 Single Command Op Mode SBE	---	View	Modify	NA	SBE	NA	NA
•This is the Com 1 setting that defines if the control will respond directly (Direct mode) to Single Command Operation commands or if a "select" is required before "execution" (SBE mode). •The available options are: Direct; SBE.							
813 IEC104 Select Before Exec Time XXXXX mSec	MilliSec	View	Modify	NA	5000	0	65535
•This is the Com 1 setting that determines the amount of time that can elapse between a "select" and "execute" command for Single Command Operations in systems that employ a select-before-execute mode.							
813 IEC104 Response Timeout (t1) XXXXX Seconds	Seconds	View	Modify	NA	15	1	255
•This is the Com 1 setting for the time-out value for the transmission of data or test messages.							
813 IEC104 Ack/No Data (t2) XXXXX Seconds	Seconds	View	Modify	NA	10	1	255
•This is the Com 1 setting for time-out before sending an ACK APDU if no data ACKs are received.							
813 IEC104 Idle Test (t3) XXXXX Seconds	Seconds	View	Modify	NA	20	1	255
•This is the Com 1 setting for the amount of time allowed to lapse before a test APDU is generated.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
813 IEC104 Max Transmit (k) XXXXX	---	View	Modify	NA	12	1	32767
•This is the Com 1 setting for the maximum number of unacknowledged data frames that are allowed to be in transit.							
813 IEC104 Max Receive (w) XXXXX	---	View	Modify	NA	8	1	32767
•This is the Com 1 setting for the maximum number of data frames to wait before acknowledging if no data ACKs are received (w should normally not exceed 2k/3).							
813 IEC104 User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active IEC104 map for Com 1. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
815 2179 Master Address XX	---	View	Modify	NA	0	0	31
•This is the Com 1 setting for the address, from 0 to 31, of the master station controlling and polling the RTU. •Configuration parameters for 2179 are displayed when the protocol is available.							
815 2179 Ignore Master Address Disabled	---	View	Modify	NA	Enabled	NA	NA
•This is the Com 1 setting that allows the device to accept commands and requests from masters other than that listed in the Master Device Address field. •The available options are: Disabled; Enabled.							
815 2179 Device Address XXXX	---	View	Modify	NA	1	0	2047
•This is the Com 1 setting that specifies the address, from 0 to 2047, of the RTU instance on the control.							
815 2179 Select Timeout XXXXXXX mSec	MilliSec	View	Modify	NA	5000	0	3600000
•This is the Com 1 setting that determines the amount of time that can elapse between a "select" and "operate" command for systems that employ select-before-operate commands.							
815 2179 User Map Selection CL-7 Default Event	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active 2179 protocol map for Com 1. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
816 Modbus Device Address XXX	---	View	Modify	NA	1	1	247
•This is the Com 1 setting that specifies the address, from 1 to 247, of the RTU instance on the control. •Configuration parameters for Modbus are displayed when protocol is available.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
816 Modbus User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active Modbus protocol map for Com 1. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
830 Protocol / Port Type Serial DNP	---	View	Modify	NA	Serial DNP	NA	NA
•Protocol and Port setting for Com 2. Not all options are resident on the control, some will require additional hardware to enable. The available protocol options will display according to port type. •Possible options for a particular configuration include: Disabled; DNP / Serial; DNP / Ethernet; IEC 101 / Serial; ICE 104 / Ethernet; 2179 / Serial; Modbus / Serial; IEC 61850 / Ethernet.							
830 LoopShare Communications Disabled	---	View	Modify	NA	Disabled	NA	NA
•This will enable or disable LoopShare Communications for Com 2. The options include: Disabled; Enabled.							
830 ProView NXG Session Disabled	---	View	Modify	NA	Disabled	NA	NA
•This will enable or disable sessions with ProView NXG for Com 2. The options include: Disabled; Enabled.							
830 ProView NXG Address XXXXX	---	View	Modify	NA	65519	0	65519
•The Com 2 address for communications with ProView NXG is set here.							
831 Serial Baud Rate 9600 BPS	---	View	Modify	NA	9600 BPS	NA	NA
•This is the Com 2 Serial Communications Baud Rate setting. The option available are: 300 BPS; 600 BPS; 1200 BPS; 2400 BPS; 4800 BPS; 9600 BPS; 19200 BPS; 38400 BPS; 57600 BPS; 115200 BPS.							
831 Serial Parity None	---	View	Modify	NA	None	NA	NA
•This sets for Com 2 the data parity parameter to be used on the serial communications channel. •The available options are: None; Odd; Even.							
831 Serial CTS Support Disabled	---	View	Modify	NA	Disabled	NA	NA
•This setting determines for Com 2 if CTS/RTS handshaking will be used to control the serial communications channel. •The available options are: Disabled; Enabled.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>831 Serial Tx
Enable Delay
XXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>5</td><td>0</td><td>3000</td></tr>
<tr><td colspan="8">•For Com 2, when the control is set for transmit control handshaking, the user may require a delay between the time when the transmission is enabled to when data is transmitted.
•Example: If the transmit enable were used as a keying device for a transmitter or modem, a “warm-up” period may be necessary before data can be transmitted.
•See Figure 5-5.</td></tr>
<tr><td>831 Serial Tx
Disable Delay
XXXX mSec</td><td>MilliSec</td><td>View</td><td>Modify</td><td>NA</td><td>5</td><td>0</td><td>3000</td></tr>
<tr><td colspan="8">•For Com 2, when the control is set for transmit control handshaking, the user may require a delay between the time when the data transmission is terminated and the transmit enable signal is disabled.
•See Figure 5-5.

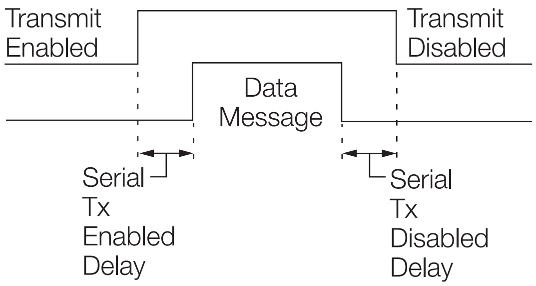



Figure 5-5
Data transmission from the CL-7 control to the communication system for handshaking applications.</td></tr>
<tr><td>831 Serial Echo Mode
Disabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Disabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•When serial communications is active, this parameter will enable or disable the echo mode for Com 2.
•Available options are: Disabled; Enabled.</td></tr>
<tr><td>832 IP Address
XXX.XXX.XXX.XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 2 IP Address setting.</td></tr>
<tr><td>832 Subnet Mask
XXX.XXX.XXX.XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 2 Subnet Mask setting.</td></tr>
<tr><td>832 Gateway
XXX.XXX.XXX.XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 2 Gateway setting.</td></tr>
<tr><td>832 MAC Address
XX:XX:XX:XX:XX:XX</td><td>---</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•The Com 2 MAC Address setting.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
840 DNP RBE Master XXXXX	---	View	Modify	NA	1234	0	65519
•This is the Com 2 setting for the DNP3 device number to be used as the destination for any unsolicited reports generated by DNP3 events.							
840 DNP IED Slave XXXXX	---	View	Modify	NA	1	0	65519
•This is the Com 2 setting for the DNP3 device number to be assigned to the connected CL-7 control.							
840 DNP IED Slave 2 XXXXX	---	View	Modify	NA	65519	0	65519
•This is the Com 2 setting for the DNP3 device number to be assigned to the connected CL-7 control. •Communications to this address must always use the Default DNP map.							
840 DNP User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active DNP map for Com 2. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
841 DNP Network Protocol Type Listening End Point	---	View	Modify	NA	Listening End Point	NA	NA
•This sets the DNP network type for Com 2. •The available options are: Listening End Point; Dual End Point; UDP.							
841 DNP Accept From Any IP Enabled	---	View	Modify	NA	Enabled	NA	NA
•This is the Com 2 setting that controls whether or not DNP3 requests will be honored from hosts other than the one defined in the next set of fields. •The available options are: Disabled; Enabled.							
841 DNP Accept From IP Address XXX.XXX.XXX.XXX	---	View	Modify	NA	NA	NA	NA
•This is the Com 2 setting that allows the user to input a specific IP address from which to accept DNP3 requests. This is also used as the destination IP to establish a connection when a Dual End Point connection is initiated by the control.							
841 DNP Destination Port Number XXXXX	---	View	Modify	NA	20000	1	65535
•This is the Com 2 setting that defines the IP port number to which outgoing DNP3 messages are addressed when a UDP End Point is configured, unless DNP Use Source Port From Request is Enabled. This port number is also used for outgoing TCP connections when a Dual End Point is configured.							
841 DNP Listening Port Number XXXXX	---	View	Modify	NA	20000	1	65535
•This is the Com 2 setting that defines the IP port number that will be monitored for incoming DNP3 requests when a TCP Listening End Point is configured; responses will be sent using the source port from the incoming request.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>841 DNP Use Port
From Request
Enabled</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>Enabled</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is the Com 2 setting that enables the control to use the source IP port number from the last request as the destination port number.
•Available options are: Disabled; Enabled.</td></tr>
<tr><td>841 DNP Keep Alive
Timeout
XXXXX Seconds</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>3600</td><td>1</td><td>65535</td></tr>
<tr><td colspan="8">•This is the Com 2 setting for the time after which a DNP3 Data Link Layer status request will be sent if no message is received from the master (enter 0 to disable).</td></tr>
<tr><td>841 DNP Keep Alive
Retries
XXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>3</td><td>1</td><td>255</td></tr>
<tr><td colspan="8">•This is the Com 2 setting for the number of times the DNP3 Data Link Layer status request will be reattempted before the connection is closed.</td></tr>
<tr><td>842 IEC101 Link
Address
XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>0</td><td>See note</td></tr>
<tr><td colspan="8">•This is the Com 2 setting that assigns a unique identifier to the individual slave instance running on the device.
•If Link Address Size is 1, Link Address high value is 255
•If Link Address Size is 2, Link Address high value is 65535</td></tr>
<tr><td>842 IEC101 Common
Address
XXXXX</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>0</td><td>See note</td></tr>
<tr><td colspan="8">•This is the Com 2 setting that identifies the station address, where the station is comprised of all of a device's links.
•If Common Address Size is 1, Common Address high value is 255
•If Common Address Size is 2, Common Address high value is 65535</td></tr>
<tr><td>842 IEC101 Link
Address Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td colspan="8">•This is the Com 2 setting for the number of octets to be used in the value of the link address.</td></tr>
<tr><td>842 IEC101 Common
Address Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td colspan="8">•This is the Com 2 setting for the number of octets to be used in the value of the common address.</td></tr>
<tr><td>842 IEC101 Object
Address Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td colspan="8">•This is the Com 2 setting for the number of octets to be used in the value of the object address.</td></tr>
<tr><td>842 IEC101 Cause of
Transmit Size
X</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>1</td><td>1</td><td>2</td></tr>
<tr><td colspan="8">•This is the Com 2 setting for the number of octets to be used in the cause of transmission indication.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
842 IEC101 Single Command Op Mode SBE	---	View	Modify	NA	SBE	NA	NA
•This is the Com 2 setting that defines if the control will respond directly (Direct mode) to Single Command Operation commands or if a "select" is required before "execute" (SBE mode). •The available options are: Direct; SBE.							
842 IEC101 Select Before Exec Time XXXXX mSec	MilliSec	View	Modify	NA	5000	0	65535
•This is the Com 2 setting that determines the amount of time that can elapse between a "select" and "execute" command for Single Command Operations in systems that employ a select-before-execute mode.							
842 IEC101 User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active IEC101 map for Com 2. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
843 IEC104 Server Listen Port XXXXX	---	View	Modify	NA	2404	1	65535
•This is the Com 2 setting for the IP port number that will be monitored for connections.							
843 IEC104 Common Address XXXXX	---	View	Modify	NA	2	1	65535
•This is the Com 2 setting that identifies the station address, where the station is comprised of all of a device's links.							
843 IEC104 Single Command Op Mode SBE	---	View	Modify	NA	SBE	NA	NA
•This is the Com 2 setting that defines if the control will respond directly (Direct mode) to Single Command Operation commands or if a "select" is required before "execution" (SBE mode). •The available options are: Direct; SBE.							
843 IEC104 Select Before Exec Time XXXXX mSec	MilliSec	View	Modify	NA	5000	0	65535
•This is the Com 2 setting that determines the amount of time that can elapse between a "select" and "execute" command for Single Command Operations in systems that employ a select-before-execute mode.							
843 IEC104 Response Timeout (t1) XXXXX Seconds	Seconds	View	Modify	NA	15	1	255
•This is the Com 2 setting for the time-out value for the transmission of data or test messages.							
843 IEC104 Ack/No Data (t2) XXXXX Seconds	Seconds	View	Modify	NA	10	1	255
•This is the Com 2 setting for a time-out before sending an ACK APDU if no data ACKs are received.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
843 IEC104 Idle Test (t3) XXXXX Seconds	Seconds	View	Modify	NA	20	1	255
•This is the Com 2 setting for the amount of time allowed to lapse before a test APDU is generated.							
843 IEC104 Max Transmit (k) XXXXX	---	View	Modify	NA	12	1	32767
•This is the Com 2 setting for the maximum number of unacknowledged data frames that are allowed to be in transit.							
843 IEC104 Max Receive (w) XXXXX	---	View	Modify	NA	8	1	32767
•This is the Com 2 setting for the maximum number of data frames to wait before acknowledging if no data ACKS are received (w should normally not exceed 2k/3).							
843 IEC104 User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active IEC104 map for Com 2. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
844 61850 IED Name XXXXXXXXX	---	View	Modify	NA	NA	NA	NA
•This assigns an identifier to the IED in the IEC 61850 environment for Com 2. •Configuration parameters for IEC 61850 are displayed when protocol is available.							
844 61850 Inactivity Timeout XXXXXXX mSec	MilliSec	View	Modify	NA	90000	0	3600000
•This setting defines the time the slave will wait after the last valid data link layer frame is received before resetting the communications link for Com 2.							
844 61850 Integrity Report Interval XXXXXXX mSec	MilliSec	View	Modify	NA	60000	0	3600000
•This sets the time to wait before verifying whether an integrity report is to be sent for Com 2.							
844 61850 Request Timeout XXXXXXX mSec	MilliSec	View	Modify	NA	10000	10000	3600000
•This setting defines the time to wait for the master response to the previous request for Com 2.							
844 61850 MMS Message Size XXXXX	---	View	Modify	NA	8192	2048	32000
•This setting for Com 2 is the maximum number of bytes for the MMS message used to communicate with the master. This setting is negotiated during the association, and whichever MMS message size is smaller, slave or master, is used.							
844 61850 TPDU Size XXXX	---	View	Modify	NA	2048	128	8192
•This sets for Com 2 the size of the packet to be used in the transport layer.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
844 61850 Max In Requests XXXX	---	View	Modify	NA	5	2	15
•This defines for Com 2 the maximum number of incoming requests. This setting is negotiated during the association, and whichever maximum number of incoming requests is smaller, slave or master, is used.							
844 61850 Max Req. Variables XXX	---	View	Modify	NA	32	10	500
•This is the maximum number of variables included in a single request (read, write, report) for Com 2.							
845 2179 Master Address XX	---	View	Modify	NA	0	0	31
•This is the Com 2 setting for master address, from 0 to 31, of the master station controlling and polling the RTU. •Configuration parameters for 2179 are displayed when protocol is available.							
845 2179 Ignore Master Address Disabled	---	View	Modify	NA	Enabled	NA	NA
•This is the Com 2 setting that allows the device to accept commands and requests from masters other than that listed in the Master Device Address field. •Available options are: Disabled; Enabled.							
845 2179 Device Address XXXX	---	View	Modify	NA	1	0	2047
•This is the Com 2 setting that specifies the address, from 0 to 2047, of the RTU instance on the control.							
845 2179 Select Timeout XXXXXXX mSec	MilliSec	View	Modify	NA	5000	0	3600000
•This is the Com 2 setting that determines the amount of time that can elapse between a "select" and "operate" command for systems that employ select-before-operate commands.							
845 2179 User Map Selection CL-7 Default Event	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active 2179 protocol map for Com 2. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							
846 Modbus Device Address XXX	---	View	Modify	NA	1	1	247
•Specifies the address from 1 to 247, of the RTU instance on the control for Com 2. •Configuration parameters for Modbus are displayed when protocol is available.							
846 Modbus User Map Selection CL-7 Default	---	View	Modify	NA	CL-7 Default	NA	NA
•The selection of the active Modbus protocol map for Com 2. The available options are: User 1; User 2; CL-7 Default; CL-7 Default Events; CL-7 Advanced; CL-6 Default; CL-6 Default Events; CL-7 3Ph Default; CL-7 3Ph Default Evt; CL-7 3Ph Advanced.							

TABLE 5-3. Function Codes (continued)

Parameter	Unit of Measure	Security Level			Default Value	Key Entry Limit	
		To Read	To Write	To Reset		Low	High
860 LoopShare Comms State Active	---	View	NA	NA	NA	NA	NA
•This is the state of LoopShare Communications. It will display either Active or Inactive.							
861 LoopShare Comm Table Assignment Passive	---	View	Modify	NA	Passive	NA	NA
•This is the device in the LoopShare Table. The options include: VR1; VR2; VR3; Passive.							
862 LoopShare Comm Tx Delay XXXXX mSec	MilliSec	View	Modify	NA	0	0	10000
•This is the delay between the time a device receives an updated LFDT and when the device passes it along.							
863 LoopShare Comm Timeout XX Seconds	Seconds	View	Modify	NA	3	1	60
•This is the LoopShare communications timeout time.							
920 Firmware Version X.X.X	---	View	NA	NA	NA	NA	NA
•A display of the firmware version currently installed on the control.							
921 Firmware Database Version X	---	View	NA	NA	NA	NA	NA
•A display of the firmware Database version currently installed on the control.							
922 FPGA Version X.X.X	---	View	NA	NA	NA	NA	NA
•A display of the FPGA version currently installed on the control.							
923 Digital Hardware Revision X	---	View	NA	NA	NA	NA	NA
•A display of the Digital Hardware Revision of the control.							
924 BootUtility Version X.X.X	---	View	NA	NA	NA	NA	NA
•A display of the BootUtility version currently installed on the control.							
925 BootLoader Version X.X.X	---	View	NA	NA	NA	NA	NA
•A display of the BootLoader version currently installed on the control.							
926 Extended Comms Version X.XXXX	---	View	NA	NA	NA	NA	NA
•A display of the Extended Comms version currently installed on the control.							
941 Language Selection English	---	View	Modify	NA	English	NA	NA
•This setting allows the user to select the language to display. Options include: English; Spanish; French; Portuguese.							

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>942 Date Format
MM-DD-YYYY</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>MM-DD-YYYY</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This setting allows the user to select how the date format will be displayed.
•Options include: MM-DD-YYYY; DD-MM-YYYY; YYYY-MM-DD.</td></tr>
<tr><td>943 Time Format
12 Hour AM/PM</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>12 Hour AM/PM</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This setting allows the user to select whether time will be displayed on the 12-hour or the 24-hour scale. Options include: 12 Hour AM/PM; 24 Hour.</td></tr>
<tr><td>944 Key Mapping Selection
Cl-7 Advanced</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>CL-7 Advanced</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This setting allows for the selection of one of the preprogrammed keypad mapping configurations or to select the custom user option. The options are: CL-7 Advanced; CL-7 Basic; Standard Platform; Custom User.
•To program the Custom User option, ProView NXG Software must be used.</td></tr>
<tr><td>950 USB Memory Drive
Save All Data</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This is a command to write control data to a USB memory device. Refer to the Advanced Features: USB Memory Device section of this manual.</td></tr>
<tr><td>950 USB Memory Drive
Save Custom All</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves all settings from a control onto a USB memory device. Using the custom option will include the control ID in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive
Save Cust Basic</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as the Basic settings from a control onto a USB memory device. Using the custom option will include the control ID in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive
Save Custom Alt</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as the Alternate Configuration settings from a control onto a USB memory device. Using the custom option will include the control ID in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive
Save Custom Adv</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as the Advanced Features settings from a control onto a USB memory device. Using the custom option will include the control ID in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive
Save Custom Comm</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as Communications settings from a control onto a USB memory device. Using the custom option will include the control ID in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive
Save Std All</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves all settings from a control onto a USB memory device. Using the Standard option will include the word “Standard” in the file name as a default.</td></tr>
</table>

TABLE 5-3. Function Codes (continued)

<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Unit of Measure</th><th colspan="3">Security Level</th><th rowspan="2">Default Value</th><th colspan="2">Key Entry Limit</th></tr>
<tr><th>To Read</th><th>To Write</th><th>To Reset</th><th>Low</th><th>High</th></tr>
<tr><td>950 USB Memory Drive Save Std Basic</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as the Basic settings from a control onto a USB memory device. Using the Standard option will include the word “Standard” in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive Save Std Alt</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as the Alternate Configuration settings from a control onto a USB memory device. Using the Standard option will include the word “Standard” in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive Save Std Adv</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as the Advanced Features settings from a control onto a USB memory device. Using the Standard option will include the word “Standard” in the file name as a default.</td></tr>
<tr><td>950 USB Memory Drive Save Std Comm</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•This command saves the group of settings defined as Communications settings from a control onto a USB memory device. Using the Standard option will include the word “Standard” in the file name as a default.</td></tr>
<tr><td>951 USB Memory Drive Load Config Data</td><td>---</td><td>View</td><td>Modify</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Use this function to load a control settings file from a USB storage device onto a control.
•Pressing ENTER will bring up a list of available settings files. Use of the scroll arrows allows for the selection of the desired file. Pressing ENTER with the desired file on the display will bring up CONFIRM on the display. Pressing ENTER again will load the setting from the file into the control.</td></tr>
<tr><td>952 USB Memory Drive Upgrade Firmware</td><td>---</td><td>View</td><td>Admin</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Use this function to upgrade control firmware.</td></tr>
<tr><td>953 USB Memory Drive Remove Device</td><td>---</td><td>View</td><td>View</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td colspan="8">•Use this function to prepare the control for removal of the USB memory device. Make sure leave the memory device in the control until the green USB Drive LED has gone out.</td></tr>
</table>

Special functions

Use these functions to perform commands through the menu or function code system.

Master reset – FC 38

Initial press reset message

Entering FC 38 or accessing this command via the menu system will cause the LCD to display the following message:

```
038 Master Reset
```

While the Master Reset screen is displayed, pressing the **ESC** key causes the LCD to exit the viewing of this command and to display the previous sub-menu items. Or, pressing the **ENTER** key will request a (CONFIRM) before resetting all demand metering and tap position maximum and minimum values.

```
038 Master Reset


      (CONFIRM)
```

Confirm message

While the (CONFIRM) message is displayed: pressing the **ESC** key causes the LCD to display the initial Master Reset screen; pressing the **ENTER** key causes the execution of the command. Once the command has been executed, it will return to the original Master Rest screen.

Enter security code - FC 99

A security code must be entered to enable parameter editing at the appropriate level. Entering FC 99...

```
Function Code

                 _99
```

...causes the menu system to enter the security code mode:

```

Security Code
             -------
```

This function code does not have an item in the nested-menu system and can only be accessed by using the function code.

Self-test - FC 91

After pressing **FUNC, 91 ENTER** and accessing the FC 91 display, press **ENTER** again to select the option and again to confirm. When the self-test is complete, the LCD displays the Self-Test Complete screen. Press **ESC** for further keypad use.

Test LEDs

Access this under the Diagnostic menu. With the cursor selecting "Test LEDs" press the **ENTER** key and the front panel LEDs will blink three times. The Neutral Light LEDs do not blink.

Turn display off

Access this from the Main Menu (Level 1). With the cursor selecting TURN DISPLAY OFF press the **ENTER** key and the LCD display will turn off. To turn on the LCD display, press any button in the keypad.

Alarms

Use the nested menu to access the lists of acknowledged and unacknowledged system alarms. No security code is needed to display an alarm; a security code is needed to acknowledge an alarm.

- ALARMS > Alarms Active Unacknowledged

  This displays a list of active, unacknowledged system alarms.

- ALARMS > Alarms Active Acknowledged

  This displays a list of active, acknowledged system alarms.

This section covers Alarm displays; for more information on programming alarms, see the Alarms section of *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide*.

If there are no unacknowledged active alarms available, the LCD displays the following message:

```
No Unacknowledged
Active Alarms
```

If there are no acknowledged active alarms available, the LCD displays the following message:

```
No Acknowledged
Active Alarms
```

An actual alarm display example:

```
Supervisory State
Active
01/25/2013 11:35:58a
      (MORE...↓)
```

Status and data alarms

For a complete list and descriptions of the available Status and Data Alarms section of *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide*.

Instantaneous metering and counter quantities

For most Instantaneous Metering quantities, there are two data alarms available: One that can be triggered for a high threshold value and one that can be triggered for a low threshold value. For counter quantities, there will be only one data alarm that will be triggered for a high threshold.

Maintenance quantities

See the **Advanced Features: Duty Cycle Monitor** section of this manual for more information on these alarms.

- Contact Life Level 1 Exceeded
- Contact Life Level 2 Exceeded

Sequence of events (SOE)

Use the Sequence of Events menu item to access a list of events. No security code is needed to display events; a security code is needed to acknowledge an event.

This section covers displaying the SOE; for more information on programming SOE and a complete list of available events, see the Sequence of Events section of *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide*.

The event labels can use 2 LCD lines for a total of up to 40 characters.

If there are no events available, the LCD displays the following message:

```
There Are No Events.
```

An SOE example:

```
VR1 Control Switch
Auto/Remote
01/25/2013 11:35:58a
      (MORE...↓)
```

When accessed through the keypad, only the last 50 events will be displayed. If there are many events (100+) that have not been read via the front panel, it may take a few seconds. While this is occurring the following message, indicating that events are being read, may appear before displaying the latest events:

```
Events...
```

Power-up/reset conditions

When the system first comes up and no error conditions are detected, the LCD displays the following message:

```
Self-Test Complete.
(Date/Time Shown)

        (PASS)
```

If error conditions are detected, the LCD will display error message similar to those that follow:

```
Self-Test Complete.
Factory Calibration
Required!
(ATTENTION...MORE  ↓)
```

```
Self-Test Complete.
Data Acquisition!

 (FAILURE...MORE  ↓)
```

```
Self-Test Complete.
Configuration Value
Required!
(ATTENTION...MORE  ↓)
```

If the "Configuration Value Required!" message appears, refer to **Section 3: Initial Control Programming**. Perform basic programming steps and then initiate a self-test.

```
Self-Test Complete.
Clock Needs Setting!

(ATTENTION...MORE  ↓)
```

```
Self-Test Complete.
VR1 Input Voltage
Missing!
(ATTENTION...MORE  ↓)
```

```
Self-Test Complete.
VR1 Output Voltage
Missing!
 (FAILURE...MORE  ↓)
```

```
Self-Test Complete.
VR1 No Neutral
Sync Signal!
  (ATTENTION...LAST)
```

Consult the troubleshooting section of this manual or contact your Eaton representative for assistance with specific self-test messages.

Indication messages

The fourth line of the LCD is used to provide messages associated with menu mode indications. These indication messages can be defined with up to 20 characters.

Displayed during Self-Test message:

- (PASS)
- (ATTENTION)
- (ATTENTION...MORE↓)
- (ATTENTION...LAST↓)
- (FAILURE)
- (FAILURE...MORE↓)
- (FAILURE...LAST↓)

Displayed when an invalid function code is entered:

- (INVALID FUNCTION)

Displayed when and invalid security code is entered:

- (INVALID SECURITY)

Displayed when a parameter cannot be read, written, or reset because the proper security code has not been entered:

- (IMPROPER SECURITY)

Displayed when setting a password that is too weak:

- (PASSWORD TOO WEAK)

Displayed when edit mode is active:

- (EDIT)
- (CONFIRM) (also displayed to prompt the user when issuing a command from the menu system)

Displayed when a value that has been entered is out the valid range:

- (VALUE TOO HIGH)
- (VALUE TOO LOW)
- (OUT OF RANGE)
- (TIMEOUT)
- (NEG ACKNOWLEDGE)
- (INVALID DATE)
- (INVALID TIME)

Displayed when listing alarms or events:

- (MORE...↓)
- (LAST...↓)

Displayed when an alarm is to be acknowledged or unacknowledged by the user:

- (ACKNOWLEDGE)
- (UNACKNOWLEDGE)

Displayed when accessing USB Memory Drive operations:

- (NO FILES FOUND)
- (READING FILES...)
- (REPLACE FILE)
- (LOADING...)
- (LOAD COMPLETE)
- (LOAD FAILED)
- (SAVING...)
- (SAVE COMPLETE)
- (SAVE FAILED)
- (UPGRADING...)
- (UPGRADE COMPLETE)
- (UPGRADE FAILED)
- (REMOVING...)
- (OK TO REMOVE)
- (REMOVE FAILED)
- (USB NOT CONNECTED)
- (CANCELLING...)
- (CANCEL COMPLETE)

Displayed when indicating that the values for “Load Voltage Secondary” and “Source Voltage Secondary” have been derived by the control:

- (CALCULATED)

Displayed when indicating that alternate configuration is active:

- (ALT CONFIG 1)
- (ALT CONFIG 2)
- (ALT CONFIG 3)

Displayed when indicating that changing Internal PT ratio is not applicable because Vin PT configuration is invalid:

- (INVALID VIN CONFIG)

Displayed when indicating inconsistencies between the neutral signal and Tap Position value entered by the user:

- (TAP AT NEUTRAL)
- (TAP NOT AT NEUTRAL)
- (MEASURED TP ACTIVE)

Displayed when testing the battery:

- (TESTING...)
- (ATTENTION)

Displayed when contact output cannot be overridden:

- (CANNOT OVERRIDE)

Displayed when accessing Extended Comms Status:

- (NOT AVAILABLE)
- (RUNNING OK)
- (FAILURE)

Displayed when accessing Metering PLUS screens for LoopShare:

- (LOOPSHARE INACTIVE)

Displayed when performing a firmware upgrade:

- Do Not Remove Drive (USB Drive)
- Restoring Settings

Metering-PLUS formats

This section covers Metering-PLUS displays; for more information, see the **Advanced Features: Metering PLUS** section of this manual.

Compensated voltage

When the ***Comp Voltage** key is pressed while the control is operating under Forward Power Flow conditions, the LCD displays:

```
Comp Voltage    125.0
Band      119.0-121.0
Using Func        1-5
```

If the control is operating under Reverse Power Flow conditions, the LCD displays:

```
Comp Voltage    115.0
Band      108.0-112.0
Using Func      51-55
```

When operating in the Cogeneration Mode, metering always operates in the *forward* direction **except** that load center voltage is calculated based upon the *reverse* line-drop compensation settings when the fixed 1% reverse metering threshold is exceeded. So, the LCD displays:

```
Comp Voltage    123.0
Band      119.0-121.0
Using Func  1-3,54,55
```

Load voltage

When the ***Load Voltage** key is pressed while the Voltage Limiter Mode = High and Low Limits Active, the LCD displays:

```
Load Voltage    115.0
Limiter   119.0-121.0
```

If Voltage Limiter Mode = Only High Limit, the LCD displays:

```
Load Voltage    115.0
Limiter         121.0
```

If Voltage Limiter Mode = Off, the LCD displays:

```
Load Voltage    115.0
Limiter           Off
```

Load current

When the ***Load Current** key is pressed while the control is operating under Forward Power Flow conditions and automatic tapping is inhibited, the LCD displays:

```
Load Current  600 Fwd
Current Threshold  12
Mode   Locked Forward
Blocked: Cntrl Switch
```

On the first line, “Fwd” corresponds to Forward Power Flow direction. The third line is used to display one of the following operating modes:

- Mode Locked Forward
- Mode Locked Reverse
- Mode Reverse Idle
- Mode Bi-directional
- Mode Neutral Idle
- Mode Cogeneration
- Mode Reactive Bi-directional
- Mode Bias Bi-directional

If automatic operation is blocked, the fourth line displays one of the blocking conditions. See Table 7-1 for a list of blocking conditions and explanations.

If the control is operating under Reverse Power Flow conditions and automatic tapping is not inhibited, the LCD displays the following:

```
Load Current  200 Rev
Current Threshold   2
Mode Bi-directional
```

Tap position

When the *Tap Position key is pressed while the Soft ADD-AMP feature = On, the LCD displays the following:

```
Tap Position        8

SOFT-ADD-AMP  -12, 14
P.I. ADD-AMP  -14, 16
```

If the Soft ADD-AMP feature = On and the present tap position indicates that tap-changer is at a limit, the LCD displays the following:

```
Tap Position     - 12
At Limit
SOFT-ADD-AMP  -12, 14
P.I. ADD-AMP  -14, 16
```

If the Soft ADD-AMP feature = Off and the present tap position indicates that tap-changer is at neutral, the LCD displays the following:

```
Tap Position        0


P.I. ADD-AMP  -14, 16
```

If the Soft ADD-AMP feature = Off and if the tap-changer is at or beyond user-configured P.I. ADD-AMP limits, the LCD displays the following:

```
Tap Position       16
At Limit

P.I. ADD-AMP  -14, 16
```

Section 6: Control features

Calendar/clock

Integral to several functions of the control is an internal real-time calendar/clock. The clock maintains the year, month, day, hour, minute and seconds, within 1 second. The display format is user-selectable (see FC 942 and FC 943). The control time is synchronized to the system frequency when powered by ac. When ac power is lost, the clock maintains time for approximately four (4) days, by using a crystal oscillator and a capacitor as the power source. Twenty minutes on ac power is required to fully charge the capacitor.

The LCD displays the current date and time at the end of the self-test when the front panel is turned on. However, upon power-up after extended loss of power, the control clock time and date will default to midnight, January 1, 1970.

The date and time can be read and set at FC 50. When setting, all of the digits must be entered using the standard 24-hour format (MM/DD/YYYY hh:mm). If an error is made while entering the values, backspace using the left arrow key.

Time zone settings are available. ProView NXG software is required to select a time zone setting; available time zones are all with respect to Greenwich Mean time. The time zone setting can be viewed using FC 50 and pressing the down arrow key once.

Metering

The control has extensive metering capabilities, which are categorized as Instantaneous, Forward Demand, and Reverse Demand.

Instantaneous metering

Instantaneous metering values are refreshed once each second. The information may be accessed using the front panel HMI under the METERING menu. See Table 5-2 for a list of available metering values under this menu. See Table 5-3 in the **Control Programming** section of this manual for more information on the function codes.

Demand metering

The control provides forward and reverse demand metering information for numerous parameters. When applicable, the present value, high value since last reset and low value since last reset are recorded. For the low and high values, the earliest time and date of occurrence are also recorded.

Additionally, the power factor at kVA-high demand and kVA-low demand are recorded. All demand metering values are stored in non-volatile memory separately for forward and reverse power conditions.

Demand metering values may be accessed using the keypad under the METERING menu; see Table 5-2 for a list of available metering values under this menu. See Table 5-3 in the **Control Programming** section of this manual for information on the function codes associated with demand metering.

Demand task operation

The demand metering function is based upon a sliding window concept, or moving integral. The algorithm implemented simulates the response of a thermal demand meter which will reach 90% of its final value after one demand interval in response to a step function input. See Figure 6.1.

The task works like this:

1. For three (3) minutes after a power outage or power reversal, no demands are calculated. This allows the utility system to stabilize from the event which created the outage or power reversal.
2. At three (3) minutes, the present demands (for the appropriate power direction) are set to their corresponding instantaneous value and the integration algorithm begins according to the programmed demand interval at FC 46.
3. At fifteen (15) minutes or at the demand time interval (whichever is longer), the high/low demand values begin to track the present demand, similar to drag hands. All demand values are calculated continuously and, if a change has occurred, the high/low demands are stored in the non-volatile memory every fifteen (15) minutes. This prevents loss of data during a power interruption or outage.

Notice that the provisions are made to reset any demand value individually using the **ENTER** key, or all demand values can be reset simultaneously by entering FC 38. High and low values will be set to their corresponding present demand value, and the dates and times will be set to the present date/time.

Two conditions can cause the present demands to be invalid: The power has just been applied (within the 3-minute freeze period) or the power flow has changed direction. If the control is metering in the forward direction, the reverse present demands will be invalid; if metering in the reverse direction, the forward present demands will be invalid.

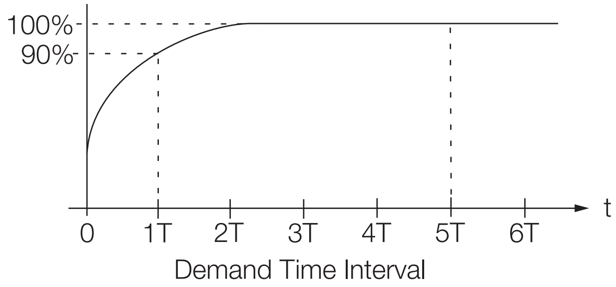


Figure 6-1. Demand time interval response.

Tap position indication (TPI)

The control has the ability to track the position of the tap-changer. The TPI function senses the status of the motor and neutral light circuits and does not require source (input) voltage. The present tap position is stored at FC 12.

EXAMPLES: “8” at FC 12 indicates 8 raise and “-7” indicates 7 lower.

The TPI function is synchronized to the position of the tap-changer by running the regulator to the neutral position. To manually set the present tap position: Access Admin security level; access FC 12; use the **EDIT** key to change to the desired value.

The maximum tap position since last reset (upper drag-hand value of the present tap position) and its date and time are stored at FC 27. The minimum tap position since last reset (lower drag hand value of the present tap position) and its date and time are stored at FC 28.

The TPI drag hand values and dates/times are reset to the present values by the master reset, FC 38, or by resetting each of the values individually. The drag hand reset switch resets the drag hands of the position indicator only, not TPI. All TPI values are stored in non-volatile memory.

The following conditions could occur if the present tap position was manually set incorrectly:

- The present tap position value will go to invalid “---” if the present tap position is 0 (zero, neutral) but no neutral signal is detected. For example, this condition will occur if a replacement control with present tap position set to “0” is installed on a regulator which is not in the neutral position.
- If the TPI function detects a successful upward tap and the prior value of FC 12 was “16”, or a successful downward tap is detected and the prior value of FC 12 was “–16,” the prior value will be maintained.

The display will show a diagnostic error message upon power-up when: (1) the present tap position value prior to power-up is “---” (invalid) and the regulator is not in neutral position; (2) The present tap position prior to power-up is “0” and the regulator is not in the neutral position. [This condition will cause the present tap position value to go to invalid (“----”)]; and (3) During automatic or manual operation the present tap position changes to “0”, but a neutral signal is not received. The **No Neutral Sync** signal is an attention signal, not a failure signal.

The TPI will satisfy the diagnostics routine upon power-up when: (1) The regulator is in neutral and the present tap position is “0”; (2) The present tap position is not “0” and the regulator is not in neutral, including when the tap position is not set correctly; and (3) When the regulator is in neutral and the present tap position is not “0” (TPI will self-correct and reset the tap position).

Source-side voltage

Without a source voltage input, some functions will indicate dashes when displayed. There are three methods for supplying a source-side voltage to the CL-7 control: an Internal Differential Potential Transformer (IDPT), an external source-side PT, or source-side voltage calculation.

Differential voltage

The voltage regulator may be designed and ordered with an Internal Differential PT (IDPT). The IDPT will be included in the schematic on the voltage regulator nameplate and labeled Series Winding Potential Transformer. An IDPT supplies the voltage difference between the source and load bushings of the voltage regulator. This differential voltage is then combined with the load voltage to provide the source-side voltage. When using an IDPT on an Eaton's Cooper Power series voltage regulator, the source voltage accuracy is within ± 1%.

As a standard, a second ratio correction transformer (RCT2) is not supplied on regulators equipped with an IDPT. The control will use the internal PT ratio entered at FC 44↓ and the input voltage from the IDPT to determine the differential voltage between the source and the load bushings. The setting at FC 146 must be set to Vdiff without RCT2 for this configuration.

If an RCT2 is supplied, the Overall PT Ratio entered at FC 44 and the input voltage from the IDPT are used to determine the differential voltage. The setting at FC 146 must be set to Vdiff with RCT2 for this configuration.

External source voltage

An external source-side PT may be connected to the voltage regulator to supply a directly measured source voltage. To use an external source-side PT, the user must change Vin PT Configuration, FC 146, from the default Vdiff without RCT2 to Vin Mode. Using an external source-side PT may be desirable if the voltage regulators are in a closed-delta configuration. In a closed delta, the source voltage and percent regulation will only reflect the true system source values if an external source voltage is used. Voltage regulator performance is not affected by the difference between metering parameters when using an external source PT: the accuracy of the source voltage is dependent upon the accuracy of the PT.

Source-side voltage calculation

The CL-7 control has the ability to calculate the source-side voltage without an IDPT or an external PT. When this feature is turned on at FC 39, the control will use the load voltage from the main PT, the regulator type (Type A, Type B, Type C or Type D), the tap position, and the internal impedance of the regulator to calculate the source-side voltage. This calculated source voltage is accurate to within ±1.5%. Only the regulator type needs to be programmed into the control; the other values are already available.

On the control back panel, when no source or differential PT are present, the connection that would be the input for one of these PTs if they were present is tied to the load-side PT input. When the load and source PT inputs are tied and the values are the same, the control interprets that as meaning that the calculation is required. If the inputs are not tied when there is no source-side PT signal, the control will attempt to read the source-side voltage and will provide an errant value. Often, this value will be in the range of 40 volts. If the source-voltage value is displaying errantly and there is no source PT, check to make sure the source and load PT inputs are tied together.

Reverse power operation

Most voltage regulators are installed in circuits with well-defined power flow from source to load. However, some circuits have interconnections or loops in which the direction of power flow through the regulator may change. For optimum utility system performance, a regulator installed on such a circuit should have the capability of detecting reverse power flow and of sensing and controlling the voltage, regardless of the power flow direction.

The control has full reverse power capabilities. For fully automatic reverse operation, the source voltage must be available to the control. Refer to **Source-Side Voltage** in this section of the manual.

The control offers nine different response characteristics for reverse-power detection and operation. These characteristics are user-selectable by programming the Reverse Sensing Mode (FC 56). The nine modes are Locked Forward, Locked Reverse, Reverse Idle, Bi-directional, Neutral Idle, Co-generation, Reactive Bi-directional, Bias Bi-directional, and Bias Co-generation.

This section will separately explain each mode of operation. Since the control retains the reverse metered demand values separate from the forward metered values, the metering will also be explained for each mode.

In determining power direction, the control senses the real component of the current (except in reactive bi-directional mode), then determines the current direction and magnitude in that direction. When the conditions indicate the power is flowing in reverse, the following parameters assume new values and the control operation is affected accordingly:

Load Voltage	Now sensed from what was previously the source voltage supply.
Source Voltage	Now sensed from what was previously the load voltage supply.
Load Current	In the forward direction, the current is used directly as measured. In the reverse direction, the current is scaled to reflect the ratio difference between the source and load side of the regulator, according to this formula[Q]:

$$\text{Reverse Load Current} = \frac{\begin{pmatrix}\text{Forward}\\ \text{Load}\\ \text{Current}\end{pmatrix}\begin{pmatrix}\text{Source}\\ \text{Voltage}\\ \text{Supply}\end{pmatrix}}{\text{Load Voltage Supply}}$$

[Q] Where source voltage supply and load voltage supply are in the reverse direction.

Based upon the new metered reverse values, the kVA, kW, kvar, and % buck/boost are now calculated.

Locked forward mode

When FC 56 is set for Locked Forward, no source voltage is required. This mode is not intended to be used in applications where reverse power flow is possible.

METERING: Always operates in the forward direction, regardless of power flow direction. If reverse power occurs, the metering functions remain on the normal load side of the regulator—no reverse demand readings will occur.

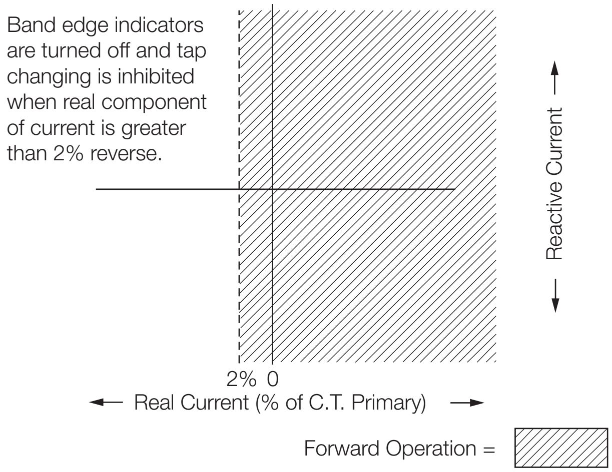


Figure 6-2. Locked forward mode operation.

OPERATION: (Figure 6-2) Always operates in the forward direction using the forward settings at FC 1, FC 2, FC 3, FC 4, and FC 5. This allows operation down to zero current conditions since there is no forward threshold involved. A safeguard has been built into the control to prevent misoperation in the event reverse power flow does occur. If more than 2% (.004 A CT secondary) reverse current occurs, the control idles on the last tap position held and the band edge indicators will turn off. As the current flow returns to a level above this reverse threshold, normal forward operation resumes.

Locked reverse mode

When FC 56 is set for Locked Reverse, source voltage is required, either measured or calculated. This mode is not intended to be used in applications where forward power flow is possible.

METERING: Always operates in the reverse direction, regardless of power flow direction. If forward power occurs, the metering functions remain on the source (S bushing) side of the regulator and no forward demand readings will occur.

OPERATION: (Figure 6-3) Always operates in the reverse direction using the reverse settings at FC 51, FC 52, FC 53, FC 54, and FC 55. This allows operation down to zero current conditions since there is no reverse threshold involved. A safeguard has been built into the control to prevent misoperation in the event forward power flow does occur. If more than 2% (.004 A CT secondary) forward current occurs, the control idles on the last tap position held and the band edge indicators will turn off. As the current flow returns to a level above this forward threshold, normal reverse operation resumes.

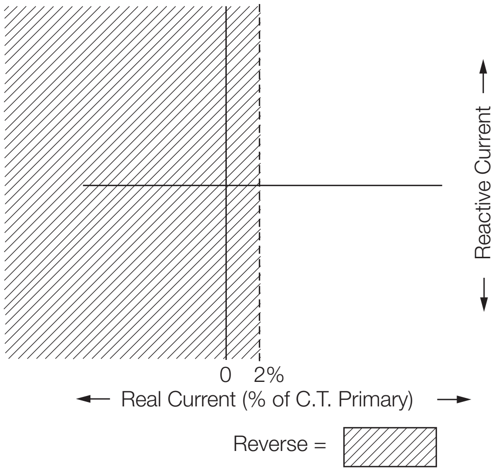


Figure 6-3. Locked reverse mode operation.

Reverse idle mode

When FC 56 is set for Reverse Idle, a source voltage is required, either measured or calculated, for metering only. This mode is recommended for installation where reverse power flow may occur, but a source voltage is not available.

METERING: (Figure 6-4.) A threshold level of 1% (.002 A) of the full load CT secondary current of .200 A is used in setting the power direction. The metering will be forward until the current exceeds the 1% threshold in the reverse direction. At this time, the various parameters use the reverse settings and the Reverse Power indicator turns on. The control continues metering in reverse until the current exceeds the 1% threshold in the forward direction, and then the parameter scaling reverts back to normal and the Reverse Power indicator turns off.

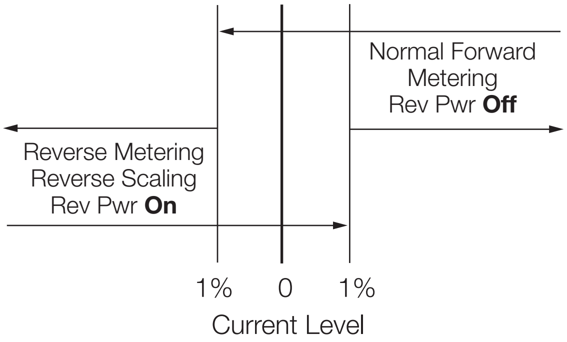


Figure 6-4. Reverse idle metering.

OPERATION: (Figure 6-5.) The threshold for which the control switches operation is programmable at FC 57 over the range 1 to 5% of the rated CT current. When the real component of the current is above this threshold, the control operates in the normal forward direction. When current falls below this threshold, all tap changing is inhibited.

The control idles on the last tap position held before the threshold was crossed. The operational timer (time delay) is reset on any excursion below this threshold, and the band edge indicators turn off.

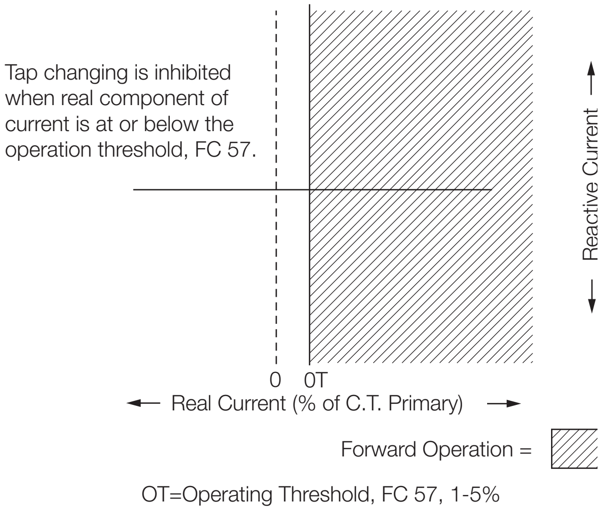


Figure 6-5. Reverse idle mode* operation.

Bi-directional mode

When FC 56 is set for Bi-directional, a source voltage is required, either measured or calculated. This mode is recommended for all installations where reverse power flow may occur except where the source of reverse power is a cogeneration facility or independent power producer.

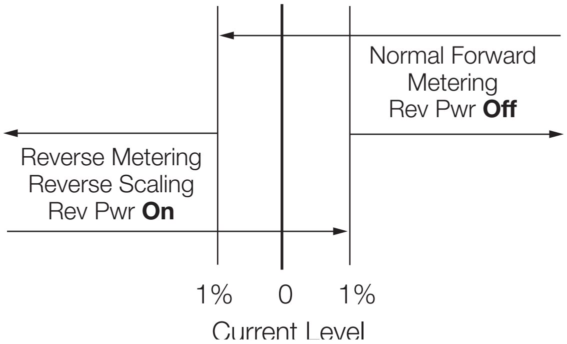


Figure 6-6. Bi-directional, neutral idle and reactive bi-directional metering.

METERING: (Figure 6-6.) A threshold level of 1% (.002 A) of the full load CT secondary current of .200 A is used in setting the power direction. The metering will be forward until the current exceeds the 1% threshold in the reverse direction. At this time, the various parameters use the reverse settings and the Reverse Power indicator turns on. The control continues metering in reverse until the current exceeds the 1% threshold in the forward direction, and then the parameter scaling reverts back to normal and the Reverse Power indicator turns off.

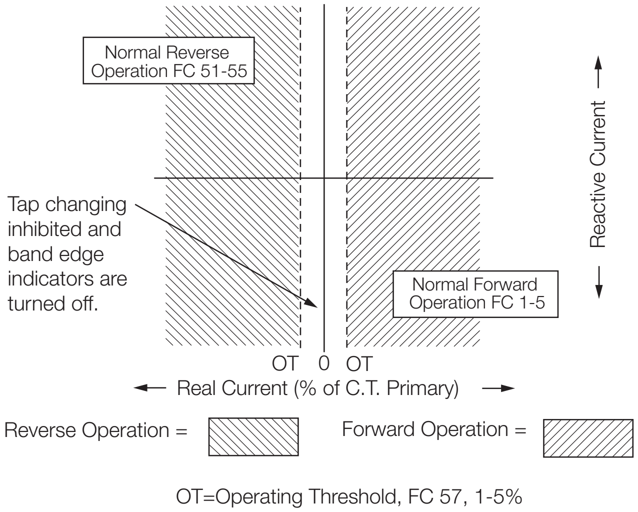


Figure 6-7. Bi-directional mode operation.

---

* Tap changing is inhibited and band edge indicators are turned off.

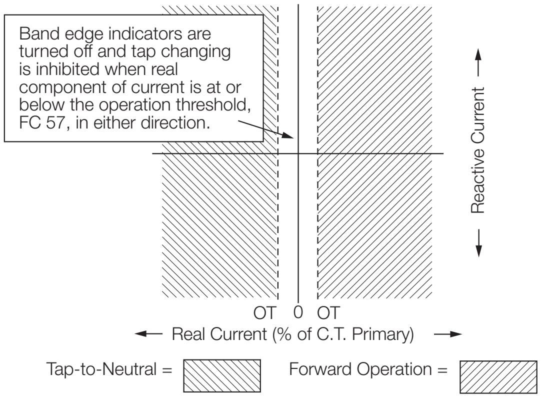
OPERATION: (Figure 6-7.)The control operates in the forward direction whenever the real component of the current is above the operator defined forward threshold (FC 57). The control operates in the reverse direction, using the reverse settings at FC 51, FC 52, FC 53, FC 54, and FC 55, whenever the current is above the operator defined reverse threshold (FC 57). When the current is in the region between the two thresholds, the control idles on the last tap position held before the current fell below the threshold. The operational timer (time delay) is reset on any excursion below the threshold in either direction, and the band edge indicators turn off.

Neutral idle mode

When FC 56 is set to Neutral Idle, a source voltage is required, either measured or calculated.

METERING: (Figure 6-6) A threshold level of 1% (.002 A) of the full load CT secondary current of .200 A is used in setting the power direction. The metering will be forward until the current exceeds the 1% threshold in the reverse direction. At this time, the various parameters use the reverse settings and the Reverse Power indicator turns on. The control continues metering in reverse until the current exceeds the 1% threshold in the forward direction, and then the parameter scaling reverts back to normal and the Reverse Power indicator turns off.

OPERATION: (Figure 6-8) The control operates in the forward direction whenever the real component of the current is above the operation-defined forward threshold (FC 57). When the current exceeds the operator-defined reverse threshold (FC 57) and is held for 10 continuous seconds, the control will tap to neutral. Neutral position is determined using tap position. If the tap position is not valid, neutral is determined using percent regulation (buck and boost). When the current is in the region between the two thresholds, the control idles on the last tap position held before the forward threshold was crossed. While tapping to the neutral position, if the current falls below the reverse threshold, the control continues to tap until neutral position is reached. The operational timer (time delay) is reset on any excursion below the forward threshold, and the band edge indicators turn off.



OT=Operating Threshold, FC 57, 1-5%

Figure 6-8. Neutral idle mode* operation.

* Band edge indicators are turned off.

Cogeneration mode

When FC 56 is set for cogeneration, a source voltage is required, either measured or calculated.

In recent years, there have been a growing number of voltage regulator applications involving cogeneration by utility customers. The cogeneration mode was developed for Eaton's Cooper Power series regulator control to satisfy the specialized needs of these applications. Normally, the desired operation of a regulator installed on a feeder involving cogeneration is to regulate the voltage at the customer substation during times of power flow into the customer site and to regulate the voltage at the regulator (on the same output side) during power flow into the utility grid. This is accomplished by simply not reversing the control sensing input voltage when reverse power is detected and by altering the line-drop compensation settings to account for this change in power flow direction. (See Figure 6-9.)

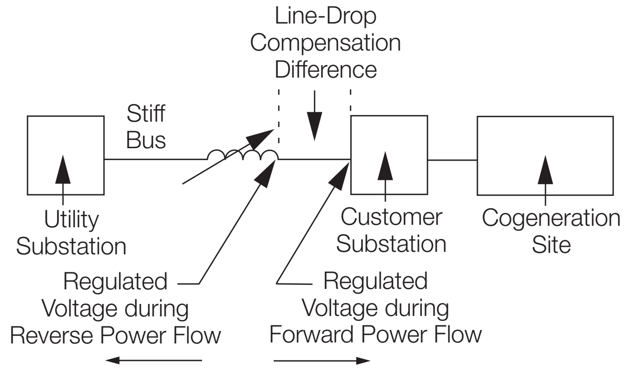


Figure 6-9. Cogeneration regulation points.

METERING: (Figure 6-10.) Always operates in the forward direction except that load center voltage is calculated based upon the reverse line-drop compensation settings (FC 54 and FC 55) when the fixed 1% reverse metering threshold is exceeded. The Reverse Power indicator turns on when this reverse threshold is crossed. The forward line-drop compensation settings (FC 4 and FC 5) are used when the current exceeds the fixed 1% forward metering threshold. The demand values acquired during reverse power flow are stored as reverse metered data, but the values are not scaled (to reflect the other side of the regulator) since the operating direction of the regulator never truly reverses.

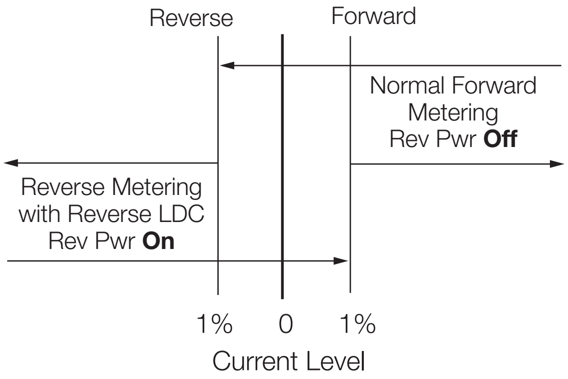


Figure 6-10. Cogeneration metering.

OPERATION: (Figure 6-11.) The control always operates in the forward direction. The control will operate in the forward direction, but will use the reverse settings for set voltage (FC 51), bandwidth (FC 52), time delay (FC 53), and line-drop compensation (FC 54 and FC 55) when the real component of the current is above the fixed 1% reverse metering threshold. The control will continue to use the reverse settings until the real component of the current is above the fixed 1% forward metering threshold. The operational timer (time delay) is not reset on any transitions between the application of forward and reverse line drop compensation settings.

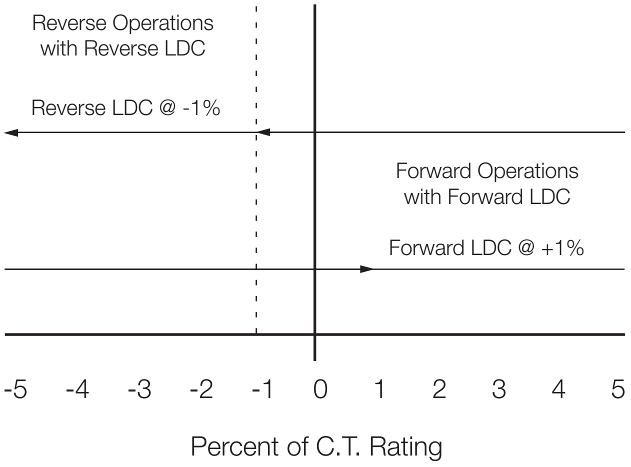


Figure 6-11. Cogeneration mode operation.

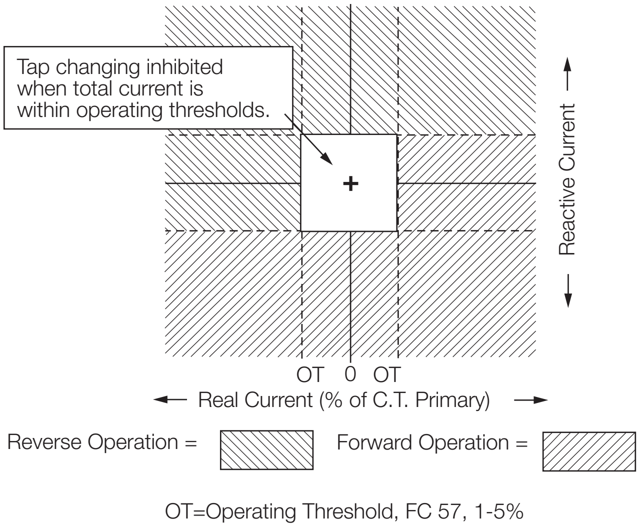
Reactive bi-directional mode

When FC 56 is set for Reactive Bi-directional, source voltage is required, either measured or calculated.

This mode is recommended for installations where reverse power flow may occur and the real component of the current is below the operator-defined threshold (FC 57), except where the source of reverse power is a cogeneration facility or independent power producer.

METERING: (Figure 6-12.) A threshold level of 1% (.002 A) of the full load CT secondary current of .200 A is used in setting the power direction. The metering will be forward until the current exceeds the 1% threshold in the reverse direction. At this time, the various parameters use the reverse settings and the Reverse Power indicator turns on. The control continues metering in reverse until the current exceeds the 1% threshold in the forward direction, then the parameter scaling reverts back to the normal and Reverse Power indicator turns off.

OPERATION: (Figure 6-12.) The control determines which settings (forward/reverse) to use by sensing the real and reactive components of the current. The control operates in the forward direction whenever the magnitude of the reactive component of the current exceeds the operator-defined threshold (FC 57) in the negative direction. The control also operates in the forward direction if the magnitude of the real component of the current exceeds the operator-defined threshold (FC 57) in the positive direction while the magnitude of the reactive component of the current is between the operator-defined thresholds (FC 57). The control operates in the reverse direction using the reverse settings at FC 51, FC 52, FC 53, FC 54, and FC 55 whenever the magnitude of the reactive component of the current exceeds the operator-defined threshold (FC 57) in the positive direction. The control also operates in the reverse direction if the magnitude of the real component of the current exceeds the operator-defined threshold (FC 57) in the negative direction while the magnitude of the reactive component of the current is between the operator-defined thresholds (FC 57).



OT=Operating Threshold, FC 57, 1-5%

Figure 6-12. Reactive bi-directional mode operation.

Bias bi-directional mode

When FC 56 is set for Bias Bi-directional, a source voltage is required, either measured or calculated. This mode is an option for installations where reverse power flow may occur except where the source of reverse power is a cogeneration facility or independent power producer. This mode is similar in operation to the Bi-Directional Mode, but includes a mechanism to enable voltage regulation when current flow is below the current sense threshold and current flow direction cannot be reliable determined because of CT accuracy limitations.

METERING: When current direction is above the current threshold in the forward direction or below it in the reverse direction, metering will be recorded in the direction of current flow. When current flow is under the current thresholds for forward and reverse power, the control will use a mechanism that includes tapping and sampling changes in voltage to look for an out-of-band condition. Metering will be recorded for the current direction last determined by the sampling mechanism to be correct.

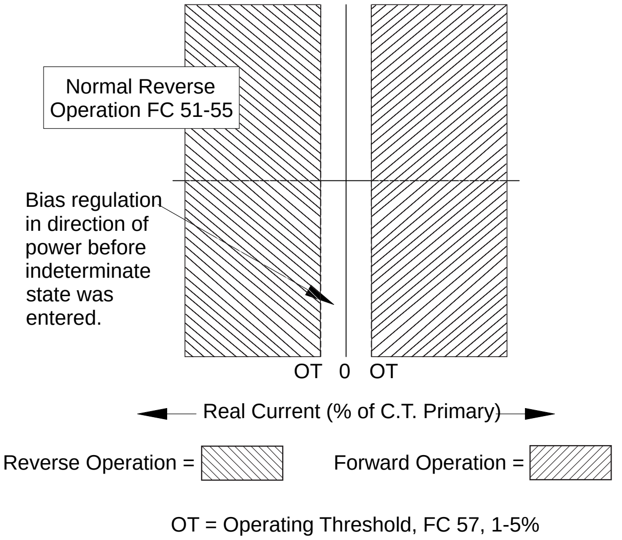


Figure 6-13. Bias bi-directional mode operation.

OPERATION: (Figure 6-13.) In Bias Bi-directional Mode, the control shall function in the power flow direction it was in before entering the indeterminate state. If the control was in the forward power direction before it entered the indeterminate state, it shall use forward settings to determine if it is out of band. If the control was in the reverse power direction before it entered the indeterminate state, it shall use reverse settings to determine if it is out of band.

Any time the control is in the indeterminate state and transitions from an in-band to an out-of-band condition, it will make two quick steps to determine if it is tapping in the correct direction for the flow of power. The two quick steps will be in the appropriate direction based upon the last known power direction.

Note: In the context of this discussion, the quick raise steps would be in the clockwise direction on the position indicator and quick lower steps would be in the counter-clockwise direction.

The control shall confirm it is tapping in the correct direction if any one of following conditions is met:

- Load bushing voltage increases one percent or more of the nominal secondary voltage after two quick raise taps if the control is out of band low and was in the forward direction before it entered the indeterminate state, or
- Load bushing voltage is unchanged or increases less than one percent of the nominal secondary voltage after two quick raise taps if the control is out of band high and was in the reverse direction before it entered the indeterminate state, or
- Load bushing voltage decreases one percent or more of the nominal secondary voltage after two quick lower taps if the control is out of band high and was in the forward direction before it entered the indeterminate state, or
- Load bushing voltage is unchanged or decreases less than one percent of the nominal secondary voltage after two quick lower taps if the control is out of band low and was in the reverse direction before it entered the indeterminate state.

If the control determines the regulator is not tapping in the correct direction after two quick taps, the control shall make two quick taps back to its original position and then make the needed taps in the opposite direction to bring the compensated voltage in band.

When the control is in an indeterminate state and needs to tap, two quick raise taps it will be inhibited if the current tap position is 15 or 16. When the control is in an indeterminate state and needs to tap, two quick lower taps it will be inhibited if the current tap position is -15 or -16.

When the control is in an indeterminate state and needs to tap, two quick raise or lower taps shall be inhibited if control determines that two quick taps will violate any of the following limits:

- Soft ADD-AMP limits
- P.I. ADD-AMP limits
- Leader/Follower Max Deviation limits
- Voltage limiting (i.e. two quick taps will exceed the limits)

Bias Co-Generation mode

When FC 56 is set for Bias Co-Generation, a source voltage is required, either measured or calculated.

The traditional Co-Generation mode of operation assumes that the primary power source is supplied by a utility substation on the source-side, physical S bushing, of the voltage regulator and that this supply is stiff. In this scenario, the co-generation facility is located on the load-side, physical L bushing, of the voltage regulator and the power generated supplements the stiff bus. Voltage regulation will always be in the forward direction, away from the stiff bus toward the co-gen facility. See Figure 6-9.

It is possible however, that a co-gen facility is connected to a loop configured distribution system containing disconnect and tie switches to isolate and recover sections of the system. In this scenario, a true power reversal can occur through the voltage regulator due to a switch reconfiguration. The traditional Co-Generation mode is not able to react to a current reversal due to a switch reconfiguration. If a reversal does occur when the control is set to Co-Gen mode, the regulator would continue to attempt forward voltage regulation and tap changer runaway is likely.

Bias Co-Generation is able to distinguish between reverse power due to co-generation (Figure 6-14) and true reverse power flow due to switch reconfiguration (Figure 6-15).

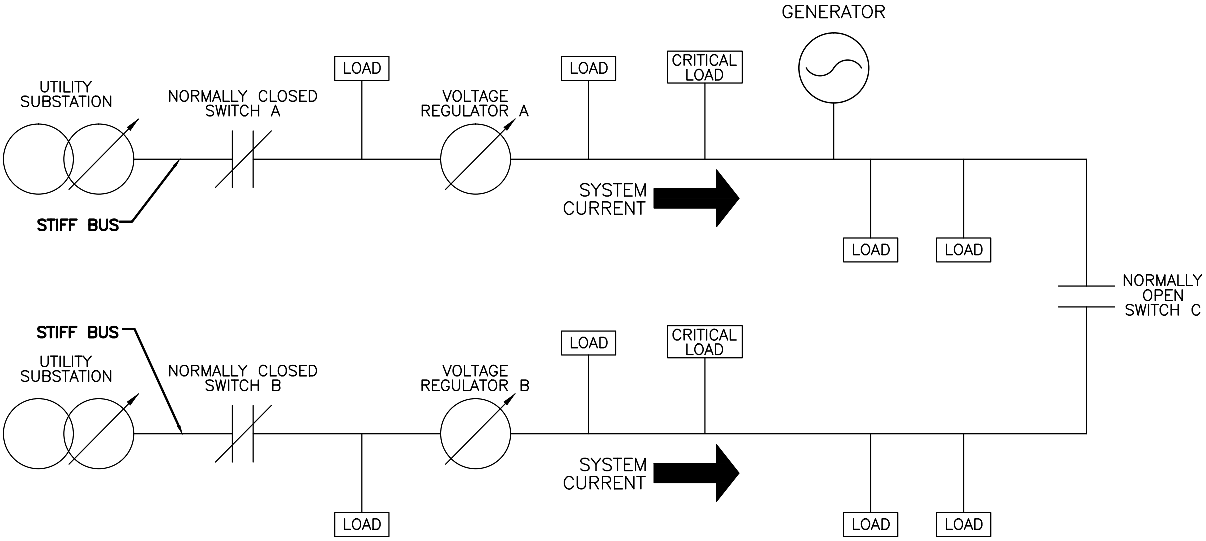


Figure 6-14. Loop configured system with Co-Gen facility. Tie switch is open; stiff bus on the source bushings of the regulators and true current flow from source bushing to load bushing.

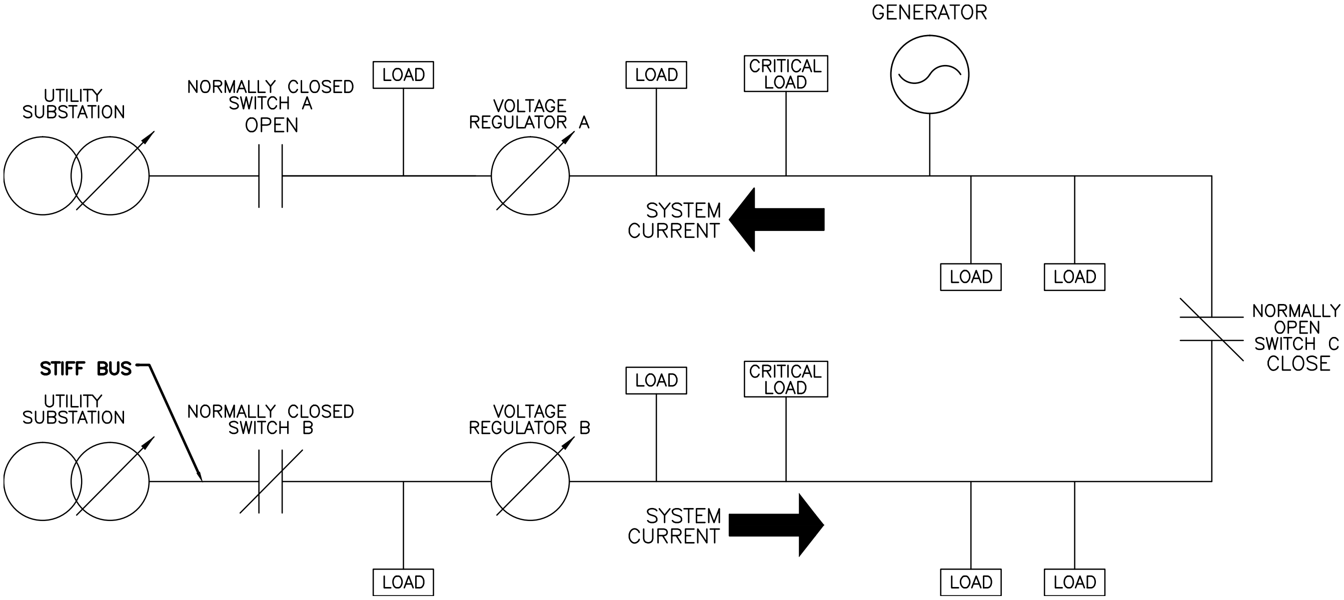


Figure 6-15. Loop configured system with Co-Gen facility. Tie switch is closed. Stiff bus on the load bushing of voltage regulator A with true current flow from load to source. Stiff bus on the source bushing of voltage regulator B with true current flow from source to load.

METERING: In a co-generation environment, when current level is above the Reverse Current Sense Threshold in the forward direction, metering will be recorded for forward current flow. When current flow is below the Reverse Current Sense Threshold in the forward direction, the control will use a test tap strategy and sample changes in voltage to determine a true current flow direction. Metering will be recorded for the current direction last determined by the sampling mechanism to be correct. See Figure 6-16.

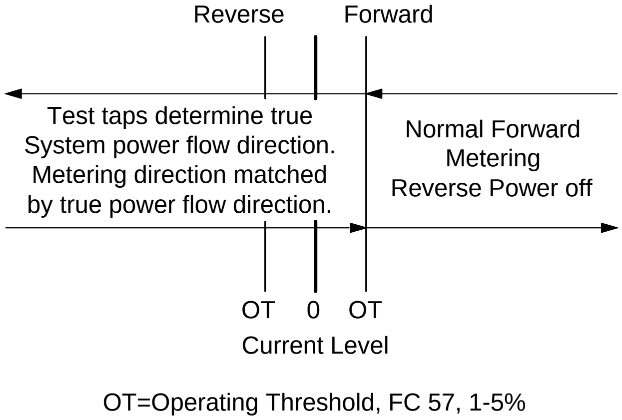


Figure 6-16. Bias Co-Generation Metering.

OPERATION: When the control is set for Bias Co-Generation, if the current flow exceeds the Reverse Current Sense Threshold in the forward direction, the control will regulate voltage as normal for forward current flow. If the current flow drops below the Reverse Current Sense Threshold, the control must determine current direction. To do this, it will use a test tap strategy similar to the Bias Bi-directional mode. The control will utilize two quick test taps and sample changes in voltage. The current flow direction will be indicated by the direction of voltage change seen during the test taps.

If the test tapping and sampling determines a reverse power flow is due to co-generation, the control will perform forward voltage regulation using reverse settings for set voltage (FC 51), bandwidth (FC 52), time delay (FC 53), and line drop compensation (FC 54 and FC 55). If the test tapping and sampling determines that a true current reversal has occurred, the control will begin to operate in an alternate bias co-gen mode as selected by the user. The alternate bias co-gen modes are 1) Locked Reverse and 2) Neutral Idle. In this case, it will also use the basic reverse power settings (FC 51 - FC 55). See Figure 6-17.

Because reverse power through the regulator is possible in a co-generation scenario without a true current flow reversal, the control must continue to use the test tap and sampling strategy to determine current flow whenever the current flow in the forward direction is below the Reverse Current Sense Threshold.

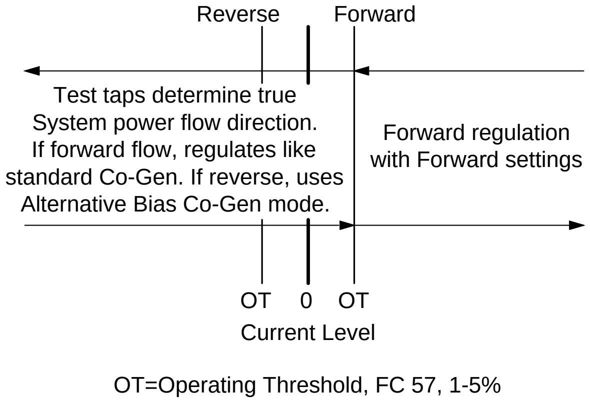


Figure 6-17. Bias Co-Generation Operation.

Multi-phase voltage regulation

The CL-7 voltage regulator control is capable of controlling up to three (3) voltage regulators with the use of a single control. In order to function in a multi-phase configuration, the control must be equipped with a multi-phase module attached to the bottom of the base control. It must also be installed into a control box configured with a back panel and connections for multiple voltage regulators.

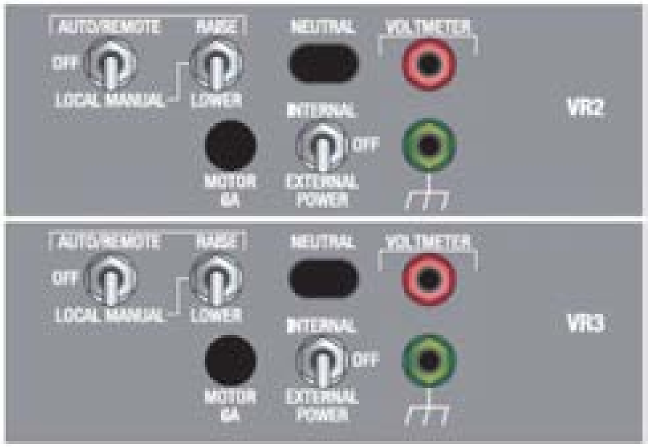


Figure 6-18. Multi-phase module with control switches, a neutral light, motor fuse and terminals for connected second and third regulators.

Multi-phase parameters

Once the control and control box are configured, the multi-phase functionality is turned on using FC 200. Other multi-phase settings are required to designate the mode of operation (FC201), the number connected regulators (FC 202) and designation of a lead regulator (FC 203).

The Multi-phase Mode selection designates how the control will operate the regulators with respect to each other. The settings include:

- Independent – Connected units regulate voltage independently of each other;
- Lead Phase Regulation – Similar to Leader/Follower, the lead regulator determines the tap position for all phases based on conditions on the lead phase;
- Voltage Averaging – All regulators are gang operated and on the same tap position with the control regulating based upon the average load voltage of all connected regulators;
- Max Deviation – All connected regulators regulate independently, but within a sliding window of a maximum deviation of tap positions.
- Advanced Independent - Connected units regulate independent of each other and are also able to operate using individual settings values for Set Voltage, Bandwidth, Time Delay and Line Drop Compensation.

See the *Bulletin B225-13018, CL-7 Multi-phase Control Reference* for detailed information on the multi-phase definitions and settings. Also see *Service Information MN225015EN, CL-7 Regulator Control ProView NXG Software Programming Guide* for additional multi-phase operational and setup information.

Multi-phase control display

The CL-7 control is able to cycle through displays for settings and metering information. When in the multi-phase mode of operation, the LEDs number 1, 2 and 3 are used to designate which regulator information is being displayed on the LCD screen and status LEDs.

Figure 6-19. Multi-phase LEDs designate the regulator active on the display.

Pressing the right arrow button will cycle through the displays for each connected regulator.

When in the multi-phase mode, after the LCD display goes into the power-save mode by powering down, the status LEDs on the control will automatically cycle through to display the status of all connected regulators. The setting for the cycle time is set at FC 211.

Multi-phase regulation settings

When the control is operating in the multi-phase mode, there are a number of settings that are considered to be control settings and still others that are specific to each connected voltage regulator and are considered to be *regulator settings*.

The *control settings* include the following:

- FC 1 to FC 5 and FC 51 to FC 55 – Forward and Reverse Direction Settings (when not in Advance Independent multi-phase mode)
- FC 40 – Control Identification
- FC 42 – Control Operating Mode
- FC 43 – System Line Voltage
- FC 46 – Demand Time Interval
- FC 148 – Nominal Sec Load Voltage
- FC 56 – Reverse Power Mode
- FC 80 – Voltage Limiter and other associated Voltage Limiter function codes
- FC 70 – Voltage Reduction Mode and other associated Voltage Reduction function codes
- FC 170 – Tap To Neutral
- FC 171 – Tap To Target
- FC 79 – Soft ADD-AMP and other associated other Soft ADD-AMP function codes

The *regulator settings* are set individually for each regulator. When entering the settings, scroll through the display for each regulator by pressing the right arrow key. The multi-phase LED with cycle through as the arrow is pressed and will indicate which regulator is active for each specific control parameter.

The regulator settings include:

- FC 1 to FC 5 and FC 51 to FC 55 – Forward and Reverse Direction Settings (when in Advance Independent multi-phase mode)
- FC 140 – Regulator Type
- FC 49 – Tap Changer Type
- FC 41 – Regulator Configuration
- FC 44 – Overall PT Ratio
- FC 44 – Internal PT Ratio
- FC 45 – CT Primary Rating
- FC 45 – Rated Load Current
- FC 45 – % C.T. Rating Level 4
- FC 45 – % C.T. Rating Level 3
- FC 45 – % C.T. Rating Level 2
- FC 45 – % C.T. Rating Level 1
- FC 144 – P.I. ADD-AMP High Limit
- FC 145 – P.I. ADD-AMP Low Limit
- FC 146 – Vin PT Configuration
- FC 141 – Regulator Identification
- FC 39 – Source Voltage Calculation

Auto tap dead phase

An advantage of using the multi-phase control is the Auto Tap Dead Phase feature. This feature enables the operation of the voltage regulator on a dead phase. When power is lost to one phase, power from the other phases can be used to operate the regulator on the dead phase. Enabling this option can be done either on the control HMI using FC 220 through FC 222 or using ProView NXG software.

The Auto Tap Dead Phase options are Tap To Neutral and Ganged Mode. The Tap To Neutral option will tap the dead phase regulator to the neutral position until power is restored. The Ganged Mode will gang operate the regulators, keeping them on the same tap position until power is restored. There is also a delay timer that will delay the operation of the dead phase for a user defined period of time.

Voltage limiter

The voltage limiter feature is used to place both a high and low limit on the output voltage of the regulator. When enabled, it operates in either the forward or reverse directions and has one of the highest priorities of all operating functions. Voltage limiter is overridden only when Auto Operation Blocking Status (FC 69) is set to Blocked, when an operator takes local control or through an interconnected SCADA system. When the voltage limiter IVVC (integrated volt/var control) settings are used, voltage limiter also takes priority over remote SCADA tapping operations. The purpose of the voltage limiter is to protect the consumer from abnormally high or low voltages resulting from:

- Large, rapid changes in transmission voltage
- Abnormal loading of the feeder
- Inaccurate regulator control settings (voltage level, bandwidth, and line-drop compensation)
- Heavy loading by the first customer while there is a leading power factor on the feeder
- Light loading at the first customer with heavy loading on the feeder at the same time

The appropriate high and low limits for the output voltage can be programmed into the control at FC 81 and FC 82, respectively. The feature is then activated by accessing FC 80 and entering the desired operation: Off; High Limit Only; High/Low Limits; IVVC High Limit Only; or IVVC High/Low Limits. If low-voltage limiting only is desired, FC 80 should be set for both high and low limiting and an extreme value programmed into FC 81 for the high limit (e.g.135) to prevent the high limit from activating.

As mentioned earlier, when one of the IVVC voltage limiter settings are selected at FC 80, the voltage limiter settings in the control take priority over SCADA controlled motor operations. IVVC software typically has the ability to enforce voltage limits, but this is not always the case. When IVVC software is not able to impose voltage limiter limits, these setting will impose the limits through the control.

The control has two response sensitivities and the response time for each sensitivity is configurable. If the output voltage exceeds either the high or low limit by 3 V or more, the control samples the voltage for the period time specified at FC 83 and then taps immediately to bring the voltage to the limit value. If the output voltage exceeds either the high or low limit by less than 3 V, the control samples the voltage for the period specified at FC 84 and then taps to bring the voltage to the limit value. The control uses the sequential method of tapping, with a time delay between the completion of one tapping operation and the beginning of the next set at FC 85, when bringing the voltage back to the limit value. Voltage Limiter High and Voltage Limiter Low LEDs on the front panel illuminate to indicate when either limit is active.

To avoid potential cycling of the regulator, set the high-and low-voltage limits at lest two volts above and below the upper and lower bandwidth limits. This will establish a "grey zone" between the high-and low-voltage limits and the upper and lower band edges. When the output voltage is within this "grey zone", the control will not perform any tap changes the would take the output voltage over the limit. If the voltage is directly on the inner edge of the grey zone, the control will allow one tap change to permit the voltage to enter the grey zone by as much as 0.7 V.

Voltage reduction

An ideal application for system load management is at the distribution voltage regulator. Voltage reduction capabilities within the regulator control permit it to trigger the regulator to reduce voltage during situations where power demands surpass the available capacity and where there are extraordinary peak loads. The control offers three modes of voltage reduction: Local/Digital Remote, analog Remote/Latch, and analog Remote/Pulse. All modes operate for forward or reverse power flow conditions. For further information on the Local/Digital Remote mode, see below. Remote/Latch and Remote/Pulse are discussed in the Analog SCADA section starting later in this section.

All voltage reduction modes work by calculating an effective set voltage as follows:

Effective Set Voltage = Set Voltage x [1- (% reduction)]

Example: If the set voltage = 123 V and voltage reduction of 4.6% is active, the regulator will regulate the compensated voltage to 117.3 V, that is, tap down 5.7 V.

While any mode of voltage reduction is in effect, the Voltage Reduction indicator LED on the front panel will be illuminated. Voltage reduction occurs after a time out, as established by the time delay, FC 3 or FC 53, and the Control Operating Mode, FC 42. The percent reduction in effect is displayed at FC 71.

Local/digital remote mode

Voltage reduction can be performed by selecting the Local/Digital Remote mode of operation at FC 70 and then entering into FC 72 the amount of reduction required as a percentage of the set voltage. To turn voltage reduction off, set FC 70 to “Off” or set FC 72 to 0%. The settings may be changed at the front panel (Local) or through digital SCADA (Digital) to achieve the desired voltage reduction.

Soft ADD-AMP feature

This feature (FC 79) allows the user to set the regulator for the Soft ADD-AMP feature locally at the control as well as remotely through SCADA. The Soft ADD-AMP limits can be overridden by a local operator running the tap-changer in manual mode of operation. This is not the case for the "hard" ADD-AMP limit switches on the position indicator face. The Soft ADD-AMP feature can be overridden via digital SCADA if the ADD-AMP mode is set to Remote Override.

In addition to using to the standard Soft ADD-AMP setting using FC 79, Configurable Logic Activate ADD-AMP is available as an advance control feature. It allows the control to sense system and voltage regulator conditions and turn on the Soft ADD-AMP feature in reaction to specified conditions. Configurable Logic Activate ADD-AMP is controlled by the configurable logic capabilities of the CL-7 control which are described in more detail in the Advanced Control Features Section of this manual.

Adaptive ADD-AMP

Adaptive ADD-AMP is a form of the Soft ADD-AMP feature that enables the control to automatically adapt to the load being experienced by the regulator and limit the range of regulation in response. When limiting the range of regulation, the control adapts the voltage regulator current rating to meet changing current demands. The control supports four configurable Adaptive ADD-AMP tap position levels. To enable the feature the following control settings are required:

1. Enter the 55 °C AWR current rating of the regulator at FC 45↓.
2. Enter the % C.T. Rating Levels 1 thorough 4 at FC 45↓. The levels can be found in the lower right corner of the unit nameplate in the chart labeled "Limit Switch Settings on Position Indicator. The levels correspond to the nameplate information as follows:
   - Level 1 – The 8-3/4 % which corresponds to position limits of ±14.
   - Level 2 – The 7-1/2 % which corresponds to position limits of ±12.
   - Level 3 – The 6-1/4 % which corresponds to position limits of ±10.
   - Level 4 – The 5 % which corresponds to position limits of ±8.
3. Set FC 79 SOFT-ADD-AMP Limits to Adaptive.

Supervisory control and data acquisition (SCADA)

With its tap-changer, potential transformer, and current transformer, the regulator is a likely candidate for a Supervisory Control and Data Acquisition system where the utility needs to have centralized voltage control for peak shaving, energy conservation, or other purposes.

Regulators can be connected to Analog SCADA systems where the regulator is controlled by contact closure and the feedback is via a voltage transducer connected to the voltage sensing circuit of the regulator control. The CL-7 control has a number of features which allow it to function well on these types of systems. For details, see **Analog SCADA** in this section.

The CL-6 control is also capable of real-time digital two-way communication. For details, see **Digital SCADA** in this section.

The control is also well suited to the user who does not have a SCADA system but does have a need for detailed information about the bus or feeder loading. For details, see **Data Retrieval and Settings Upload**.

Data retrieval and settings uploading

The CL-7 control is equipped with a USB (type B) PC data port. It allows for temporary connection to a PC. Using ProView NXG software, the connection allows the user to reset all metering and tap position maximum and minimum values, upload settings which are specific to the control I.D. number, and view data. The entire control database may be downloaded.

Analysis of the data allows the user to verify the control settings and analyze the conditions of the feeder as follows:

- At the moment of the downloading (instantaneous metering)
- Maximum and minimum demand values since last reset (time-tagged demand metering)
- The profile of salient parameters (profile recorder)

For more information on connecting to the control and use of ProView NXG software, see *Service Information CL-7 Regulator Control ProView NXG Software Programming Guide*.

Data retrieval and settings uploading can also be performed using a USB memory device and various associated function codes. See the USB Memory Device topic in the Advanced Control Features section of this manual.

Digital SCADA

Refer to the **Advanced Control Features** section for information on communications and physical interface.

Local operator security

Through the communications channel, the SCADA master may read the CL-7 control data points, write to certain data points, or reset certain data points. The technique of writing to a data point is used for performing operations such as changing settings like Set Voltage or Reverse Power Mode, inhibiting automatic operation, or controlling the tap-changer motor, etc. Following is a discussion of the levels of security used to protect the local operator.

Supervisory switch

The CL-7 control is equipped with a Supervisory Off switch. When this switch is not in the off condition (the switch LED is not illuminated), SCADA may perform the normal read, write, and reset activity. When the switch is in the off condition (the switch LED is illuminated), SCADA may only read the database. This affords protection to the local operator at the front panel, while allowing the system operator to maintain surveillance.

Control switch

If the local operator switches the CONTROL FUNCTION switch to either OFF or LOCAL MANUAL, the control internal circuitry prohibits SCADA from controlling the tap-changer motor. Resets and other writes are allowed.

Active control security level

If the local operator changes the control active security level to Operate level or above, or security override is set to override the Operate level or higher, this does not inhibit any SCADA activity. To inhibit SCADA writes and resets, the local operator should turn the Supervisory switch to Off.

Note: A local operator wishing to check automatic operation should check to make sure that the Blocking Status, FC 69, is set to Normal.

Note: Changes to any of the communications parameters take effect immediately.

Analog SCADA

The CL-7 control can be used with Analog SCADA systems. Three general purpose inputs accessed on the control connection terminal board have been programmed by default for use as inputs for voltage reduction, Tap-to-Neutral, and auto-tap blocking. Most back-panel configurations also have provisions for remote motor control and transducer connections.

Discrete voltage reduction

During voltage reduction, the control remains in the automatic mode. Standard, fixed configuration logic programmed into the control assigns General Purpose Input 1 (GPI 1) to be voltage reduction point 1. See Figures 6-6 and 6-7 for the location of the physical connections. This point can be used as point 1 for the Remote/Latch mode of voltage reduction or as the single pulse point for the Remote/Pulse mode of voltage reduction. If a voltage reduction point 2 is desired for Remote/Latch or Remote/Pulse, GPI 2 or GPI 3 can be reassigned or an auxiliary I/O module can be added and a point assigned. A nominal 120 Vac must be supplied to the GPI point(s) to enable analog voltage reduction. For information on configurable Logic, reassignment of GPI points and assignment of auxiliary I/O points to voltage reduction, see *Service Information MN225015EN, CL-7 Regulator Control ProView NXG Software Programming Guide*.

If dry contacts are to be used for analog voltage reduction, the voltage should be obtained at terminal V9 on the terminal board, an example connection is shown in Figure 6-6. This whetting voltage is only available when the control switch is in the Auto/Remote position. If whet contacts are used, the connections should be as shown in Figure 6-7.

The terminal board contacts assigned as GPIs are:

- GPI 1 is assigned to contact point 5.
- GPI 2 is assigned to contact point J.
- GPI 3 is assigned to contact point BR.

Analog remote/latching mode

This feature is set at FC 70. Up to three independent values of voltage reduction are possible. Levels 1, 2, and 3 are programmed at FC 73, FC 74, and FC 75, respectively. Voltage Reduction input 1 activates the voltage reduction programmed at FC 73; Voltage Reduction input 2 activates the voltage reduction programmed at FC 74; and latching both contacts activates the voltage reduction programmed at FC 75. Each of these function codes may be set from 0.1 to 10.0%. Read the section on Discrete Voltage Reduction above for information on the voltage reduction contact points.

Analog remote/pulse mode

This feature is set at FC 70. Voltage Reduction Point 1 is described in the Discrete Voltage Reduction section. The contact is pulsed (momentarily closed) rather than latched closed to activate this feature. Each closure and waiting period between closures is expected to be at least 0.25 seconds in duration.

The number of steps of pulsed reduction, up to 10, is programmed at FC 76. The percent reduction per step is programmed at FC 77. The present voltage reduction step is display at FC 78. Starting at zero percent reduction, every time Voltage Reduction Point 1 is pulsed, one step of reduction is added to the accumulated total. Pulsing to one step higher than the programmed number of steps returns the voltage reduction to zero. If Voltage Reduction Point 2 is assigned to one of the other GPI points or and auxiliary contact point, a pulse to that point returns voltage reduction immediately to zero.

EXAMPLE: If the number of steps is 3 and the percent per step is 1.5%, four successive pulses of voltage reduction will cause the following percentages of reduction: 1.5, 3.0, 4.5, and 0.

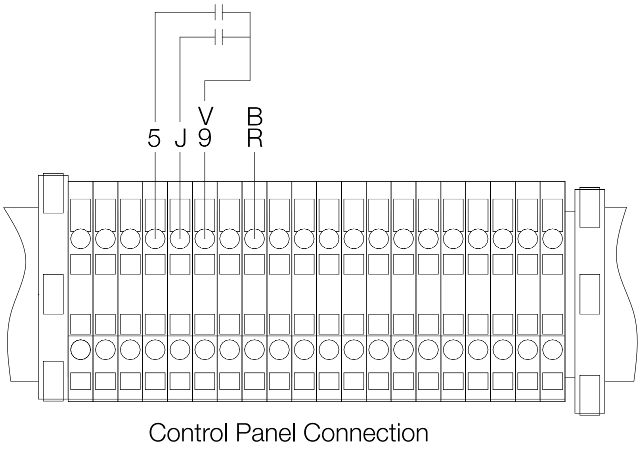


Figure 6-20. Dry contact connections for remote latching and pulse mode with Voltage Reduction Point 2 reassigned to GPI 2.

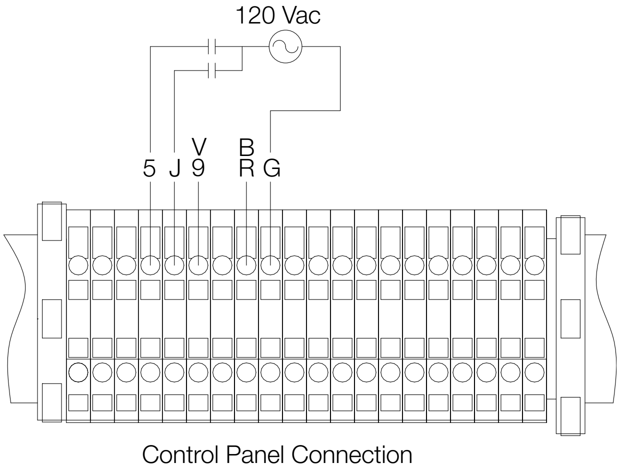


Figure 6-21. Whet contact connections for remote latching and pulse modes with Voltage Reduction Point 2 reassigned to GPI 2.

Tap-to-Neutral

The Tap To Neutral Feature enables a user to tap a voltage regulator to neutral and then maintain that position for as long as desired. During this time, auto operation will be blocked. To utilize the Tap To Neutral feature, two elements are required.

The first required element is to enable Tap To Neutral. Enabling can be done by setting FC 170 on the control to On or by checking a Tap To Neutral box in ProView NXG. The second element required for Tap To Neutral is activation. Tap To Neutral is activated using either an analog input or digital SCADA data point.

As a default, GPI 2 (the J terminal on the control back panel) is used as the analog input to active the feature. Using a relay to close in 120 Vac or ground to the terminal will activate Tap To Neutral.

The digital SCADA point **Configurable Logic Output From SCADA Tap to Neutral Activate** can also be used to activate Tap To Neutral. This digital SCADA point can be found in the default CL-7 DNP map as binary output point 38 (BO-38). In the CL-7 MODBUS default map, the point can be found in Binary Input Registers point 21 (BI-21).

Tap-To-Target

Tap To Target is similar to Tap To Neutral except that with Tap To Target a regulator can be tapped to and held at any tap position until the feature is deactivated. As with Tap To Neutral, the feature must first be enabled and then activated. A third element is also require for Tap To Target and that is the target tap position.

Enabling Tap To Target can be done by setting FC 171 on the control to On or by checking a Tap To Target box in ProView NXG. Tap To Target can be activated using either an analog input or digital SCADA data point, or using configurable logic. The third element, target tap position, can be programmed using FC 172 or entered in the Tap To Neutral dialog box in ProView NXG.

As a default, there are no analog inputs assigned to activate the Tap To Target. An analog input can be assigned using configurable logic in ProView NXG. Assigning one of the General Purpose Inputs, GPI 1, GPI 2, or GPI 3 would provide a means to activate the feature by applying either 120 Vac or grounding the terminal board points on the back panel. The terminal board points are assigned as follows:

- GPI 1 is assigned to terminal 5
- GPI 2 is assigned to terminal J
- GPI 3 is assigned to terminal BR

Making an alternate assignment to a GPI terminal will deactivate its default fixed functionality.

To activate the feature using digital SCADA, use the data point **Configurable Logic Output From SCADA Tap to Target Activate**.

Remote motor control and auto-tap blocking

Standard, fixed configuration logic programmed into the control assigns General Purpose Input 3 (GPI 3) to be the input point for the External Auto Block Active output. Supplying 120 Vac to the point will inhibit auto-operation tapping until it is removed. When the motor is controlled remotely, it is necessary to inhibit automatic operation. As with the analog input points for voltage reduction, a whetting voltage from contact point V9 or a 120 Vac whet contact can be used to activate the auto-tap blocking feature.

Note: GPI 3 is assigned to contact point BR as a default.

To remotely raise or lower the tap-changer, the appropriate set of contacts are momentarily closed. Interposing relays can be used, such that raise and lower contact closure cannot occur simultaneously. See Figure 6-18 for recommended connections on a standard back panel with the TB3 terminal board at the bottom of the control cabinet.

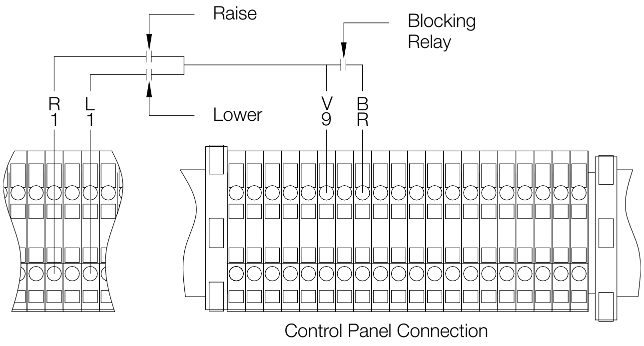


Figure 6-22. Auto-tap blocking and remote motor control connections shown on the standard back panel with a TB3 terminal board.

Alternate configuration

The CL-7 control panel typically operates with one set of configuration settings that are programmed or changed through the keypad or one of the available communications channels using ProView NXG software. Alternate Configuration modes allow the CL-7 control to be programmed with three additional sets of configuration settings that can then be activated at FC 450. Which Alternate Configuration is active can be selected at FC 452. The Alternate Configuration state can be monitored at FC 451 and will display Alt Config 1 Active, Alt Config 2 Active, Alt Config 3 Active, ARLC Active or ALRH Active.

When an Alternate Configuration mode is activated using FC 450, a set of alternate configuration settings will become active and will be used as the basis for the operation of the control. The control parameters included in the set of Alternate Configuration settings can be seen in Table 5-2 under the Alternate Config Section of the FEATURES menu.

Alternate Configuration settings can be entered using two methods: 1) Set the individual Alternate Configuration settings using the control HMI (see Table 5-2 for a list of applicable function codes). 2) Using ProView NXG software, enter the Alternate Configuration settings in the Alternate Configuration Setting dialog box and load the settings using one of the communications channels.

When the control is in the Alternate Configuration mode, the display for each of the affected control parameters will display the statement "(ALT CONFIG X)" at the bottom where X is the number of the active Alternate Configuration set. This will indicate that the alternate configuration setting is active and in use for control operation (see the example below).

```
001 Forward
  Set Voltage
    120.0 Volts
  (ALT CONFIG 1)
```

When the Metering-PLUS Comp Voltage button is pressed, it will display "Alt Config X Active" on the bottom line as shown in the example below.

```
Comp Voltage    120.0
Band      119.0-121.0
Using Func        1-5
Alt Config 1 Active
```

Auto-restore local (ARL)

Two additional functions that can be enabled at FC 450 are Auto-Restore Local Heartbeat (ARLH) and Auto-Restore Local Comms (ARLC). When SCADA communications are being used to modify basic configuration settings, enabling Auto-Restore Local will allow the control to revert control settings modified through SCADA communications back to the original settings programmed into the control. With ARLH, the settings will revert when a heartbeat signal is lost or discontinued. For ARLC, the settings will revert when a communications signal is lost. The settings that are affected by ARL are the same as those listed for Alternate Configurations. When either ARL function is active, FC 451 will display either ARLH Active or ARLC Active.

For more information on setting up ARL with SCADA communications, contact your Eaton representative.

Configurable logic

Alternate Configurations settings can be enabled using Configurable Logic. To enable Alternate Configuration settings using Configurable Logic, the Alternate Configuration setting (FC 450) must be set to Config Logic. Equations must then be created using ProView NXG software which program the conditions under which Alternate Configuration settings will become active. When Alternate Configuration settings are active due to Configurable Logic, the status at FC 451 will display Alt Config 1 Active, Alt Config 2 Active or Alt Config 3 Active.

For more information on enabling Alternate Configuration settings using Configurable Logic, refer to *Service Information MN2258015EN, CL-7 Regulator Control ProView NXG Software Programming Guide* or contact your Eaton representative.

Transducer connections

To monitor the load voltage (forward direction), a transducer, nominal 120 Vac input, may be connected as follows: Connect the transducer hot lead to terminal V4 and its ground lead to a G terminal. A current transducer, 200 mA input, may be connected as follows: Close knife switch C; remove the jumper between C2 and C4; connect the transducer hot lead to C2 and its ground lead to C4; and open knife switch C. Refer to Figures 10-6 and 10-7.

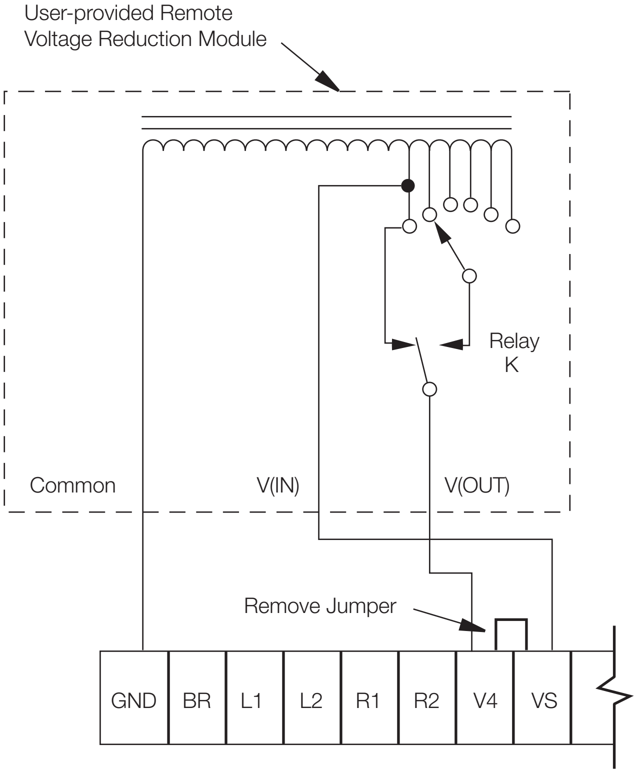


Figure 6-23. Typical user provided "Fooler Voltage" module.

Fooler voltage scheme

Using this method, the voltage sensed by the control is raised, thereby "fooling" the control into reducing the voltage during its normal automatic operation. This method can be used with the CL-7 controls. A VR module, as shown in Figure 6-19, is usually supplied by the Remote Terminal Unit (RTU) manufacturer. The VR module is usually a tapped auto-transformer with a pulse-activated indexing relay. When connected to the control back panel as shown, the voltage sensed by the control is raised as the module is pulsed to higher taps.

Since this method keeps the control in automatic operation, Auto-Inhibiting is not used. An advantage of this method is that it can be applied to many different models of controls from many manufacturers. A disadvantage of this method is that while VR is activated, the measured load voltage is incorrect, as are all other calculated metering values which use the load voltage. To avoid the effects of metering inaccuracy, the Pulse Mode of VR should be used.

Section 7: Advanced control features

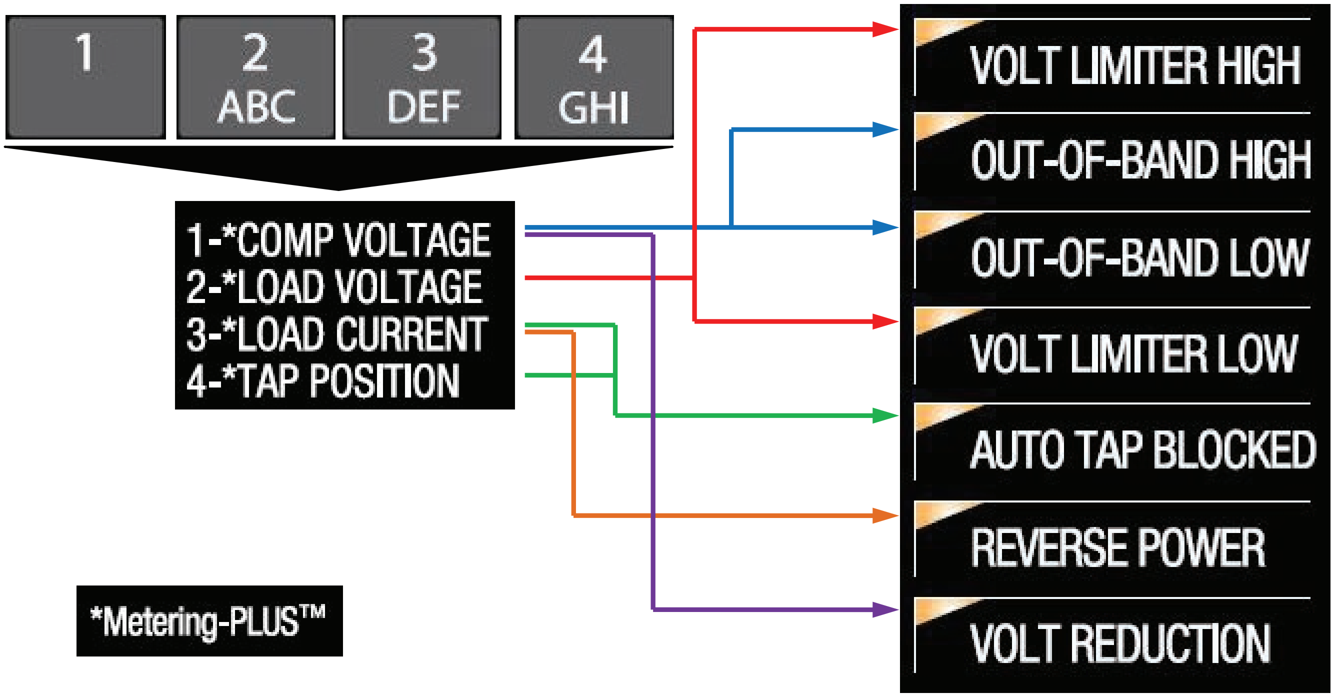


Figure 7-1. Operation analysis using Metering-PLUS feature.

Metering-PLUS feature

The Metering-PLUS feature was designed to allow immediate access to basic control information. On the CL-7 control, the keypad can be configured to assign Hot-Key access to the Metering-PLUS displays. The Hot-Key assignments are shown on the right side of the control. As a default, the CL-7 control is programmed with the Metering-PLUS Comp Voltage, Load Voltage, Load Current and Tap Position screens being assigned as hot-keys to key numbers 1 through 4 respectively.

Compensated voltage

When the **Comp Voltage** key is pressed, the LCD will display the following information.

The first line displays a live representation of the compensated voltage. The compensated voltage is also available at FC 8.

The second line is used to display the in-band compensated voltage range. The voltage range is dependent on four separate parameters: operating mode, metering power direction, set voltage, and bandwidth in the corresponding metering power direction.

The third line specifies the range of configurable function codes that are used to compute the in-band compensated voltage range and the corresponding time delay.

The Out-of-Band High and Out-of-Band Low LEDs are used to indicate an out-of-band condition.

EXAMPLE 1:

```
Comp Voltage    125.0
Band        119.0-121.0
Using Func          1-5
```

- Compensated Voltage = 125.0 V
- Fwd. Set Voltage = 120.0 V
- Fwd. Bandwidth = 2.0 V
- Control experiencing Forward Power Flow as indicated by reference to FC 1-5.

EXAMPLE 2:

```
Comp Voltage    115.0
Band      108.0-112.0
Using Func      51-55
```

- Compensated Voltage = 115.0
- Rev. Set Voltage = 110.0 V
- Rev. Bandwidth = 4.0 V
- Control experiencing Reverse Power Flow as indicated by reference to FC 51-55

EXAMPLE 3:

```
Comp Voltage    123.0
Band      119.0-121.0
Using Func  1-3,54,55
```

- Compensated Voltage = 123.0 V
- Cogeneration Mode as indicated by reference to FC 1-3, 54, 55
- Fwd. Set Voltage = 120.0 V
- Fwd. Bandwidth = 2.0 V
- Control experiencing Reverse Power Flow because of reference to reverse LDC FC 54 and 55

Note: When operating in the Cogeneration Mode, metering always operates in the forward direction except that load center voltage is calculated based upon the line-drop compensation settings when the fixed 1% reverse metering threshold is exceeded.

Load voltage

When the **Load Voltage** key is pressed, the LCD will display the following information:

The first line displays a live representation of the load voltage. The load voltage is also available at FC 6.

The second line displays the voltage limits to be applied by the Voltage-Limiting feature (see FC 80). If a voltage range is displayed, a high and low limit is enabled. A single value implies that only the high limit is active.

The Voltage Limiter High and Voltage Limiter Low LEDs are used to indicate the voltage limiter is active.

EXAMPLE 1:

```
Load Voltage    115.0
Limiter   119.0-121.0
```

- Load Voltage = 115.0 V
- Voltage-Limiting Mode = High and Low Limits Active
- High Voltage Limit = 121.0 V
- Low Voltage Limit = 119.0 V

EXAMPLE 2:

```
Load Voltage    115.0
Limiter         121.0
```

- Load Voltage = 115.0 V
- Voltage-Limiting Mode = Only High Limit Active
- High Voltage Limit = 121.0 V

EXAMPLE 3:

```
Load Voltage    115.0
Limiter Off
```

- Load Voltage = 115.0 V
- Voltage-Limiting Mode = Off

Load current

When the **Load Current** key is pressed, the LCD will display the following information:

The first line displays a live representation of the load current. The load current is also available at FC 9. This line also includes an abbreviation of the power flow direction: "Fwd" corresponds to Forward, "Rev" corresponds to Reverse.

The second line displays the current threshold. This is the point below which the control enters an indeterminate current flow state. See the **Reverse Power Operation** topic in Control Features section of this manual for more information on the current threshold. The current threshold is the product of the CT Primary Rating, and the Reverse Threshold percentage.

Table 7-1. Blocking Condition Priorities

Priority (1=Highest)	Automatic Blocking Condition when…	LCD Display Text (Line 4)
1	Control Function switch is in Off or Local Manual position.	Blocked: Cntrl Switch
2	In Voltage Averaging or Ganged Max Deviation Alt Mode in multi-phase (MP) applications for non-lead phase devices in Lead Phase Regulation.	Blocked: Multiphase
3	A loss of communication occurs for a control working under Max Deviation mode in Leader Follower (L/F) applications.	Blocked: LS Inactive
4	Tap position becomes invalid in certain modes of Leader Follower or Multi-phase applications.	Blocked: Invalid Tap
5	In L/F the designation setting does not match LoopShare Table Assignment setting.	Blocked: MaxDev Confg
6	In L/F for Follower Devices.	Blocked: L/F Follower
7	In L/F for Leader in Unable to Operate state.	Blocked: L/F UTO
8	In L/F for Leader in Inactive State.	Blocked: L/F Inactive
9	In initialization process in MP or L/F applications or when retry count is exhausted if device failed to tap in MP applications.	Blocked: Synching
10	In L/F and tap positions is being determined by the Max Deviation Alt Mode of Historical Tap Pos.	Blocked: Historical
11	Tap-to-Neutral is active.	Blocked: Tap-To-Neutr
12	Blocking is enabled through Configurable Logic or Communications.	Blocked: CL or Comm
13	FC 69 is set to Blocked using keypad, software or SCADA.	Blocked: Func Code 69
14	Reverse power when in Locked Forward mode or forward power when in Locked Reverse mode.	Blocked: Rev Pwr Mode

EXAMPLE: A 328 A regulator utilizing a CT with a 400 A primary rating and a 3% reverse threshold value would yield a 12 A current threshold.

The third line displays the operating mode: Locked Forward, Locked Reverse, Reverse Idle, Bi-directional, Neutral Idle, Co-generation, Reactive Bi-directional or Bias Bi-directional.

If automatic operation is blocked, the fourth line displays the blocking condition. If multiple blocking conditions exist, the blocking condition with the highest precedence will be displayed. Refer to Table 7-1 for the blocking condition priority levels.

EXAMPLE 1:

```
Load Current  600 Fwd
Current Threshold  12
Mode   Locked Forward
Blocked:   CL or Comm
```

- Load Current = 600 A
- Forward Power Flow
- Threshold Current = 12 A
- Locked Forward operating mode
- Auto blocking due to configurable logic condition or SCADA communications

EXAMPLE 2:

```
Load Current  200 Rev
Current Threshold   2
Mode   Bi-directional
```

- Load Current = 200 A
- Reverse Power Flow
- Threshold Current = 2 A
- Bi-directional operating mode
- Automatic tapping is not block

Tap position

When the Tap Position key is pressed, the LCD will display the following information:

The first line displays the present tap position. Neutral tap position is represented as a "0". Tap positions lower than zero are denoted with a negative sign; tap positions above zero do not carry a sign.

The second line is used to indicate when the tap-changer has reached a Soft ADD-AMP limit or a user-configured Position Indicator (P.I.) ADD-AMP limit. In Example 1, the second line is blank because the tap-changer is not at an ADD-AMP limit.

If the Soft ADD-AMP feature is enabled, the third line is used to display the corresponding Soft ADD-AMP limits.

The fourth line is used to display the physical P.I. ADD-AMP settings corresponding to the physical position indicator.

Note: Physical ADD-AMP always takes precedence over soft.

EXAMPLE 1:

```
Tap Position       8

SOFT-ADD-AMP  -12, 14
P.I. ADD-AMP  -14, 16
```

- Present tap position = 8 Raise
- Soft ADD-AMP feature = On
- Soft ADD-AMP feature lower tap limit = -12
- Soft ADD-AMP feature upper tap limit = 14
- P. I. ADD-AMP lower tap limit = -14
- P. I. ADD-AMP upper tap limit = 16

EXAMPLE 2:

```
Tap Position     -12
At Limit
SOFT-ADD-AMP  -12, 14
P.I. ADD-AMP  -14, 16
```

- Present tap position = 12 Lower
- Tap-Changer at ADD-AMP Limit
- Soft ADD-AMP feature = On
- Soft ADD-AMP feature lower tap limit = -12
- Soft ADD-AMP feature upper tap limit = 14
- P. I. ADD-AMP lower tap limit = -14
- P. I. ADD-AMP upper tap limit = 16

EXAMPLE 3:

```
Tap Position       0


P.I. ADD-AMP  -14, 16
```

- Present tap position = Neutral
- Soft ADD-AMP feature = Off
- P. I. ADD-AMP lower tap limit = -14
- P. I. ADD-AMP upper tap limit = 16

EXAMPLE 4:

```
Tap Position      14
At Limit
SOFT-ADD-AMP  -12, 14
P.I. ADD-AMP  -14, 14
```

- Present tap position = 14
- Tap-Changer at ADD-AMP Limit
- Soft ADD-AMP feature = On
- Soft ADD-AMP feature lower tap limit = -12
- Soft ADD-AMP feature upper tap limit = 14
- P. I. ADD-AMP lower tap limit = -14
- P. I. ADD-AMP upper tap limit = 14

Note: Both the Soft ADD-AMP feature and the physical ADD-AMP settings on the Position Indicator will prevent any further lower tap changes. This conclusion is based on the assumption that the P.I. ADD-AMP configuration settings, entered by the user, match the physical position indicator limit settings.

EXAMPLE 5:

```
Tap Position      15
At Limit

P.I. ADD-AMP  -14, 12
```

- Present tap position = 15
- Tap-Changer above ADD-AMP Limit
- Soft ADD-AMP feature = Off
- P. I. ADD-AMP lower tap limit = -14
- P. I. ADD-AMP upper tap limit = 12

Note: User-configured upper "P.I. ADD-AMP" tap limit **does not** match the upper physical tap limit setting on the Position Indicator. Assuming the present tap position is correct, the physical upper P.I. limit switch must be at position 16.

This condition may occur if the user-configured P.I. ADD-AMP limits do not match the physical location of the P.I. ADD-AMP limit switches. In this example, the regulator is at tap position 15, yet the user-configured upper P.I. ADD-AMP limit is 12. The control will advance the tap-changer beyond the user-configured P.I. ADD-AMP limit settings provided the actual mechanical P.I. limit switches do not prevent the operation. If the tap-changer is at, or beyond, either user-configured "P.I. ADD-AMP" limit, **At Limit** will appear on the second line.

Figure 7-2. A USB memory device in the data port.

USB memory device

The CL-7 control has a USB Drive (type A) data port located in the front of the control. This port allows the operator to import settings into the control or to save settings and data from the control. Also, firmware upgrades can be loaded using a USB memory device. Firmware is the software resident in the control that provides processing algorithms and functionality to the hardware. Firmware upgrades are supplied by the factory when revisions are necessary.

USB memory devices are readily available; any USB memory device will work that is USB 2.0 compatible, is formatted with the FAT32 file system, and has at least 250 MB free space.

Using the USB memory device inserted into the Data Port, the operator has the ability to easily transfer information to and from the control. When the USB memory device is properly seated and ready for use, the green LED above the port will illuminate. To properly remove the device, use FC 953 and wait until the green LED goes out.

If a USB device is not inserted and one of the USB functions is accessed, an error message (USB NOT CONNECTED) will appear on the display.

USB memory drive functions

Save all data, FC 950

The Save All Data function saves all of the data within the control (metering data, settings, configuration, etc.) in a file. The default name of the data file will be xxxxxALL.cl7 where the xxxxx corresponds to the control identification number found at FC 40. The name of the file can be modified as desired using the keypad.

EXAMPLE : 12345ALL.cl7
To use the function, insert a USB memory device, access FC 950 and press **ENTER**. The control LCD will display the default file name and the word (CONFIRM). The file name can be edited at this time. Press **ENTER** again to confirm and the save the file using the name displayed. While data is being saved, the LCD will display (SAVING...), and the control will write the data to a file on the device. If a file already exists on the memory device with the same name, the words (REPLACE FILE) will display; press the **ENTER** key to confirm saving over the existing file. Upon completion, the control will display (OK TO REMOVE) indicating that it is safe to remove the card without compromising the data. The green LED above the data port will also go out when it is safe to remove the device.

If the command is completed with errors, a (SAVE FAILED) message is displayed on the fourth line of the LCD. If the command is in progress and is aborted via the ESC key, a (CANCEL COMPLETED) message is displayed on the fourth line of the LCD.

Saving configuration settings, FC 950

There are several options available at FC 950 for saving configuration settings. The options can be access by entering the FC 950 parameter and then scrolling through the options using the up and down arrows on the keypad. The options that exist are:

- Custom and Standard All - Save all settings.
- Custom and Standard Basic - Save the basic control operation and configuration settings only.
- Custom and Standard Alt - Save the Alternate Configuration Settings only.
- Custom and Standard Adv - Save the Advanced Features settings only.
- Custom and Standard Comm - Save the communications settings only.

When the save option is used, a file will be created with the suffix .cl7. The designation ALL, BAS, ALT, ADV and COM will also be added as a default to the settings file name before the .cl7 suffix. It is recommended to keep these designations in place so that the types of setting contained in the file can be identified.

The only difference between custom and standard settings files is that the default name of the file created will contain either the control identification number found at FC 40 or the word "Standard" respectively. When using the custom saving options, the control also allows for editing of the file name.

EXAMPLES: 12345ALL.cl7
StandardBAS.cl7

To use the function, insert a USB memory device, access FC 950 and press the down arrow key to scroll through the save options. Press **ENTER**; this will bring up the default file name with the message (CONFIRM) on the bottom of the screen. For the custom save options, modify the file name if desired. Press **ENTER** to confirm. The LCD will display (SAVING...), and the control will save the configuration data to the memory device. If a file already exists on the memory device with the same name, the words (REPLACE FILE) will display; press the **ENTER** key to confirm saving over the existing file. Upon completion, the control will display (OK TO REMOVE). The USB memory device may be removed after this message is displayed and the green LED light goes out.

If the command is completed with errors, a (SAVE FAILED) message is displayed on the fourth line of the LCD. If the command is in progress and is aborted via the ESC key, a (CANCEL COMPLETED) message is displayed on the fourth line of the LCD.

Loading configuration data, FC 951

Using FC 951 will allow the user to select among the configuration files located on a USB memory device and load the desired file. Any of the stored files with the .cl7 suffix can be selected and loaded.

An Admin level of security is required to perform this operation. After inserting a USB memory device, access FC 951. Press **ENTER**; this will bring up the first file name located on the device. If more than one .cl7 file is located on the device, a (More...↓) will appear on the screen. Use the down arrow to scroll to the desired file for loading. Press **ENTER** again and the control LCD will display (CONFIRM). Press **ENTER** again to confirm and begin loading the file. The LCD will display (LOADING...), and the control will load the configuration data from the memory device. Upon completion, the control will display (LOAD COMPLETE). The USB memory device may be removed after this message is displayed.

If the command is completed with errors, a (LOAD FAILED) message is displayed on the fourth line of the LCD. If the command is in progress and is aborted via the ESC key, a (CANCEL COMPLETE) message is displayed on the fourth line of the LCD.

Remove device, FC 953

It is always recommended that the USB memory device not be removed from the control while the green LED above the port is illuminated. To prepare the control for removal of the device, access FC 953 and press **ENTER**; (CONFIRM) will appear on the display. Pressing **ENTER** again will cause the message (OK TO REMOVE) to display and the green LED to go out. The device may now be safely removed.

Communications

Communicate with the CL-7 control using ProView NXG software or protocols such as DNP3 or IEC 60870. The ProView NXG software, used with a PC, can provide temporary local connection to the control.

Communication ports

There are two physical communications ports and a PC data port (USB type B) on the CL-7 control.

The PC data port is for use as a temporary local communication connection to the control. Connection is made to the PC data port by using a standard USB type A to USB type B cable (standard USB printer cable). When using ProView NXG software, a port configuration has been created to allow for easy connection. Clicking on the connect button will bring up a list of configured ports, click on **Data Ports (USB Direct)** to connect.

The communication ports Com 1 and Com 2 are for use as permanent communication connection to the control. Connection is made by using an optional communication accessory card inserted into the side of the control. A communications base card is also required. The port settings are configured using various function codes which can be found in the COMMUNICATIONS menu. See Tables 5-2 and 5-3 for a list of communication parameters and descriptions.

For more detailed instructions on using ProView NXG software, see *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide.*

For more detailed instruction on communications settings, protocols and capabilities, see *Service Information S225-70-3 CL-7 Regulator Control Communications*.

Protocols

There are two protocols resident in the CL-7 control: DNP3 and IEC 60870. Various other protocols are available, but require additional hardware and must be specified at the time of order. While only one protocol can be selected for a single Com port at a time, the two com ports can be set to different protocols. Both of the protocols are highly configurable.

Configurable logic

Configurable Logic is a powerful tool since it provides the user with the means to configure general logic equations. These logic equations can be used to perform discrete SCADA functions, modify control function, or add communications data points. Configurable Logic must be configured via the digital communications software, ProView NXG software.

Control functions codes can be used to enable configurable logic. See the information contained in Table 5-3 for FC 700-703 more information on this functionality.

See *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide* for more information on programming configurable logic.

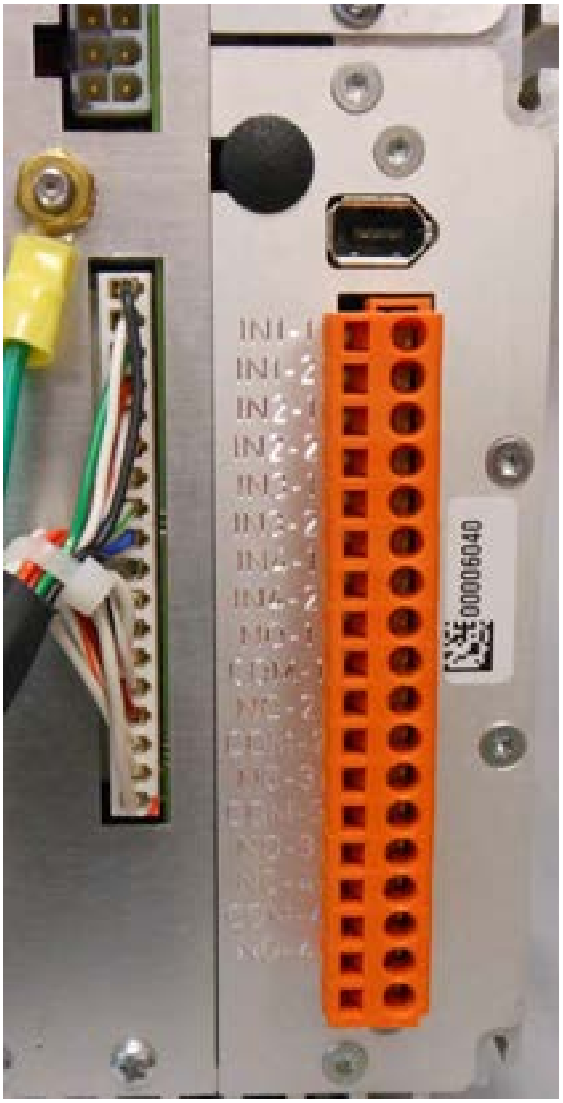


Figure 7-3. Optional I/O contact module connector.

Auxiliary input and output

Up to two auxiliary I/O Modules can be added as options to the CL-7 control (Figure 7-3). The modules enable connection of contact-type input devices (switches, relays) and discrete indicating devices (relays, LEDs, lamps) to the control to effect local discrete inputs and outputs. The I/O module accessories can be used to supplement normal local control and status indicators.

Each contact I/O module option contains four (4) inputs and four (4) outputs. When added to a control, the modules require configuration to assign functionality to the input and output contacts. The module must also be mapped for the control to recognize it. Use ProView NXG software to configure logic and map the module. Refer to *Service Information MN2258015EN, CL-7 Regulator Control ProView NXG Software Programming Guide* for additional information on configuring the control and control logic.

The user can program the CL-7 control to use the discrete input states, as well as other internal logic conditions, to determine the operation of the control. Likewise, the user can program the CL-7 control to toggle the discrete output states based on internal control logic.

The input contacts can be activate using an ac or dc voltage; see Table 7-2, Contact I/O Option Module Input Ratings for more information on input activation limits. A whetting voltage can be supplied from the control; the whetting voltage connection can be made at terminal V9 on the lower terminal board on the back panel. See Figure 7-4 for connection recommendations.

Output contacts 1 and 2 on the Contact I/O outputs are Form A (single-pole normally open) relay contacts; output contacts 3 and 4 are Form C (single-pole, double throw NO/NC) relay contacts. All four outputs are non-latching type. Refer to Table 7-3 Output Ratings for output fusing recommendations.

Note: Latching is defined as an output that retains its status when control power is removed. Non-latching is defined as an output that returns to a default status when control power is removed.

Note: Following a firmware upgrade the Contact I/O module output relays will revert to the de-energized state. Additionally, the Contact I/O module may need to be remapped.

CAUTION

Equipment damage; misoperation. External leads must be shielded and the shield must be grounded at both ends. Terminate each lead with a 320 Vac, 160 Joules metal oxide varistor (MOV), or equivalent, at the remote end. Attach MOVs between the leads and ground. Failure to properly shield and protect leads can result in equipment damage and/ or unintentional operation.

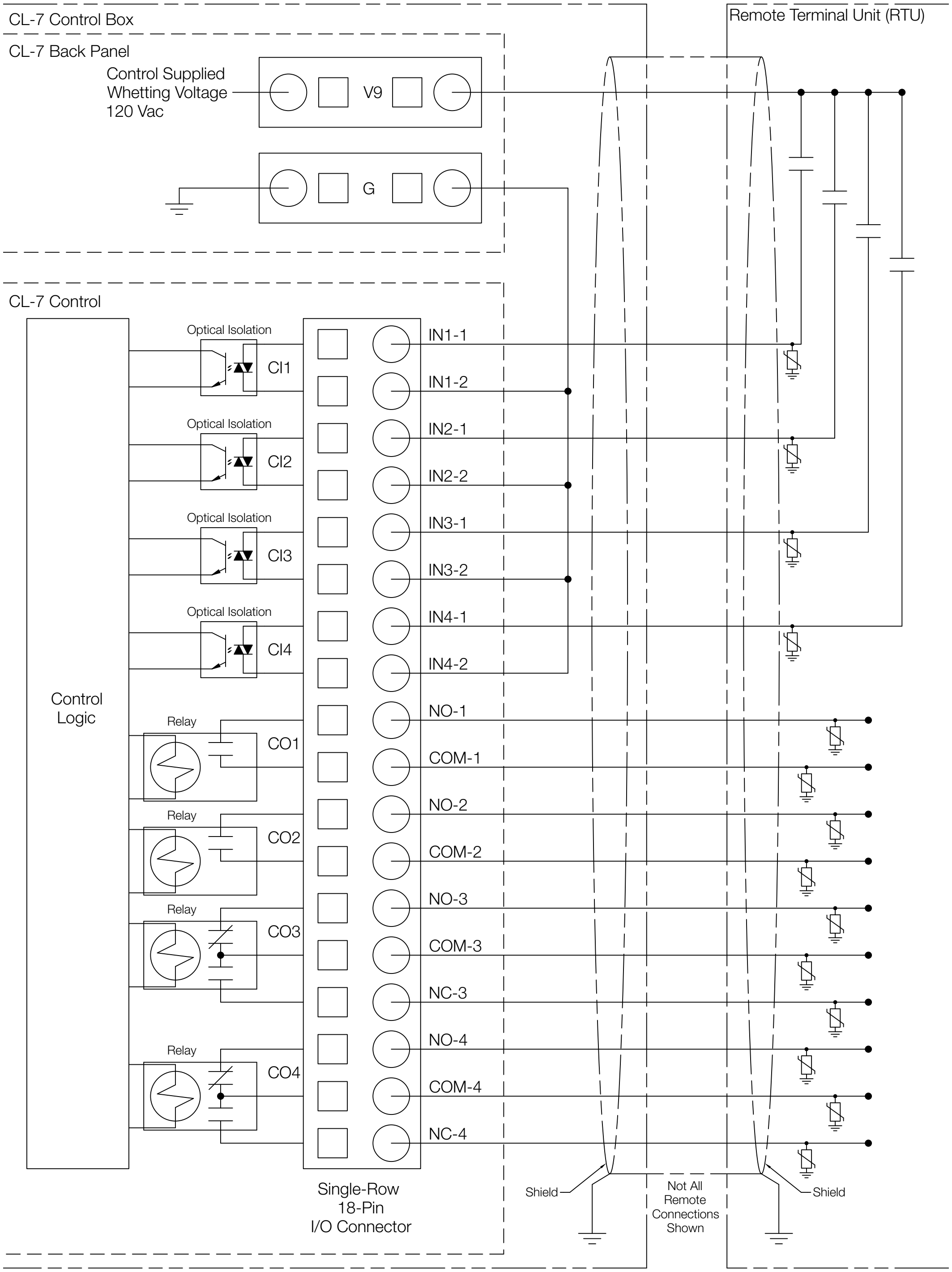


Figure 7-4. Customer connections to Contact I/O Module with shielding and surge protection. (I/O functionality is customizable using the Configurable Logic tool in ProView NXG software.)

Table 7-2. Contact I/O Option Module Input Ratings

Minimum Detection Level:	10 V (ac rms or dc) (50 or 60 Hz) (Using control-supplied whetting Voltage is recommended)
Maximum Applied Voltage:	250 Vac, rms, or 125 Vdc
Nominal Input Loading:	2 mA per input (internally current limited)
Typical Control Response Time:	50 msec (Note: Regulation tasks take priority over input activity.)
Minimum Input Pulse Time:	250 msec
Minimum Transition Time between Pulse Inputs:	250 msec
Input Protection:	Shunting type using MOVs and capacitors. Optical Isolation from input to system. (1500 Vac, rms)
Hi-Pot Capability:	3.150 kV dc for 1 second, from one input set to the next or from one pin to chassis, but not across the two terminals of a single input (due to MOVs).

Table 7-3. Output Ratings

Maximum Switching Voltage:	250 Vac, rms or 125 Vdc
Maximum Switching Loading:	Refer to Figure 21.
Maximum Pickup Time:	8 msec (not including control response time)
Maximum Release Time:	15 msec (not including control response time)
Output Protection:	Shunting type using MOVs and capacitors. 1500 Vac, rms isolation between coil and contacts
Hi-Pot Capability:	3.150 kV dc for 1 second from one output to the next or from one pin to chassis, but not across two terminals of a single output (due to output protection).
Fusing:	Outputs are not internally fuse-protected. Customer-supplied fusing is recommended.

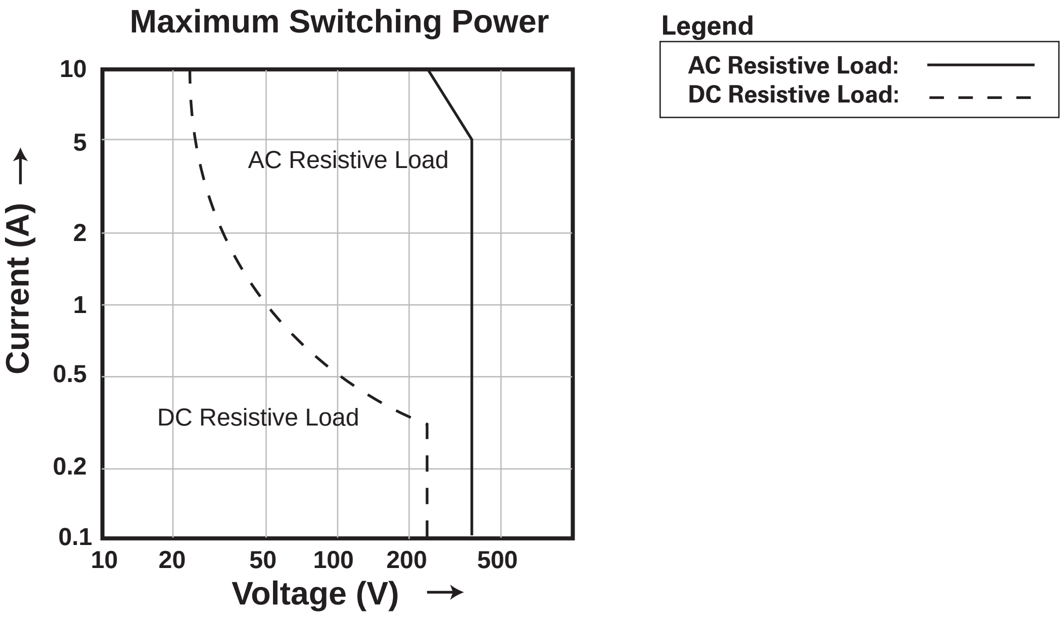


Figure 7-5. Maximum output switching graph.

Alarms

An alarm is a binary (On/Off) flag that is activated when a user-defined condition is true. The status of an alarm can be viewed on the LCD display or through communications, including ProView NXG software. Alarms can only be configured via communications. See *Service Information MN225015EN CL-7 Regulator Control ProView NXG Software Programming Guide* for information on configuring alarms.

The user can define the priority of an alarm to cause the Alarm LED, Warning LED, or no LED to be illuminated. The assigned priority of the alarm also determines the order in which the alarms are viewed via the display.

- Assigning a Priority of 0–50 will cause the Alarm LED to be illuminated when the alarm condition is active.
- Assigning a Priority of 51–100 will cause the Warning LED to be illuminated when the alarm condition is active.
- Assigning a Priority of 101–127 will not cause an LED to be illuminated, but the condition can be viewed on the LCD display or through communications while the alarm condition is active.

A timer can also be set for each alarm. This will allow the alarm to become active only after the alarm condition has existed and the period of time specified by the timer (in seconds) has expired. When an alarm becomes active, it is given the state of Unacknowledged. If the alarm is configured to illuminate an LED, the LED will flash as long as the alarm is Unacknowledged. To acknowledge an alarm the Operate security level is required. After entering the security code, enter Alarms > Alarms Active Unacknowledged using the front-panel menu; the unacknowledged alarms will display. Press the **ENTER** key to display (ACKNOWLEDGE) and **ENTER** again to complete the operation. If the alarm is configured to illuminate an LED and it has been acknowledged, the LED will be on continuously. The alarm will turn off whenever the alarm condition is no longer true.

The control can also record an event or take a profile snapshot whenever an alarm becomes active or inactive. The control contains two types of user-configurable alarms: Status Alarms and Data Alarms.

The **Status Alarm** type is activated based upon the condition of a binary (On/Off) parameter. By default, Status Alarms become active when the parameter is On. The alarm, however, can be inverted so that it becomes active when the parameter is Off. See *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide* for a complete list and definitions of available Status alarms.

EXAMPLE:
Configuring a Supervisory Active Alarm to be inverted with a Priority of 25 will cause the Alarm LED to flash whenever the Supervisory Switch is in the Off position.

The **Data Alarm** type is activated based upon the condition of an analog (numeric) parameter being above or below a threshold value. The operations counters and metering values are available as Data Alarms. See *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide* for a complete list and definitions of available Status alarms.

EXAMPLE: Configuring a Compensated Voltage Low Alarm with a Threshold of 115 V with a Priority of 75 will cause the Warning LED to flash whenever the compensated voltage is below 115 V.

Sequence of events (SOE)

An event is a time-stamped record of an alarm condition or control activity. The CL-7 control is designed to record a sequence of these events; event data is stored in non-volatile memory on the control. The last fifty events can be viewed via the front panel display using the top level nested menu item SEQUENCE OF EVENTS. The last 300+ events can be viewed using ProView NXG software.

Configuring SOE can only be done using software. There are a number of events that are pre-configured on every control. See *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide* for a list of available events and information on configuring SOE functionality.

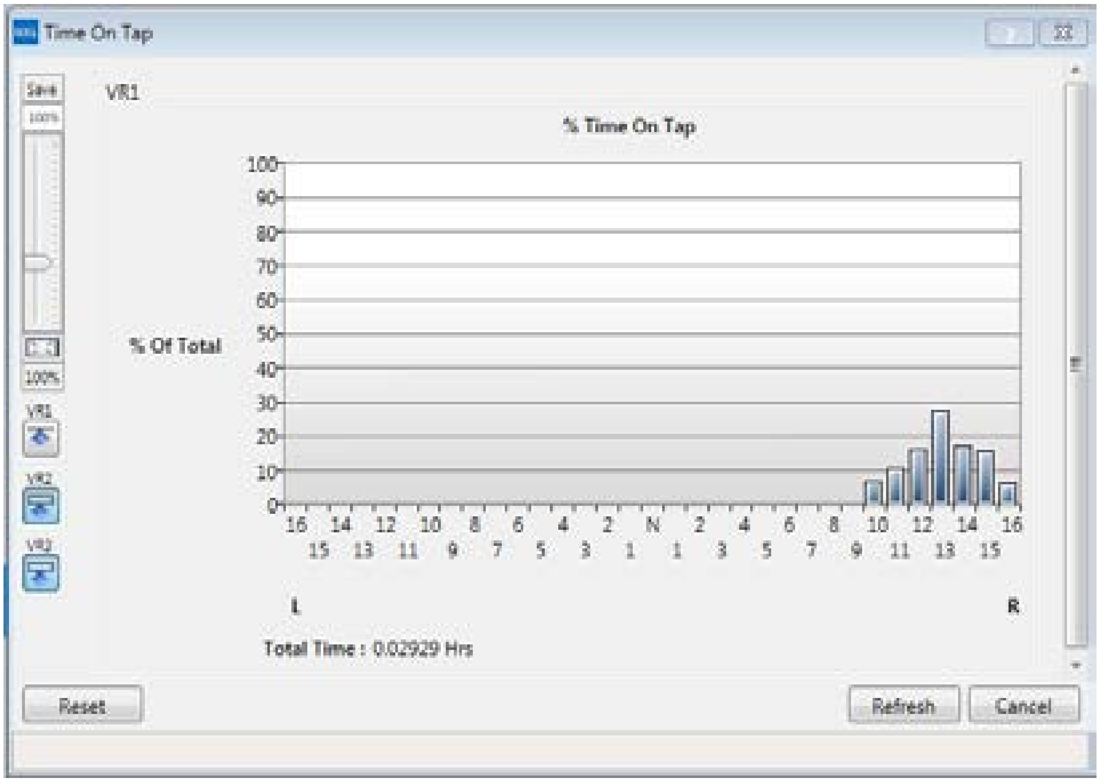
Data profiler

The Data Profiler records the current state of parameters chosen by the user at regular intervals into non-volatile memory. The Data Profiler data can only be viewed using ProView NXG software. Configuring the Data Profiler must also be accomplished using the software. The user can choose to profile as many of the instantaneous and demand (present) parameters as desired. The sampling interval can be set from one (1) minute to one (1) day. The storage capacity for data is limited; the greater the number of parameters chosen and the shorter the sampling interval, the less overall time will pass before the record begins to be overwritten. In the software, a Trend Time will be displayed as the Profiler is configured which will be an estimate of the length of time data can be recorded before the oldest data is overwritten.

See *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide* for a list and description of available Data Profiler items and information on configuring Data Profiler functionality.

TIME-ON-TAP™ feature

The TIME-ON-TAP™ feature logs the percentage of time spent on each tap-changer position. The TIME-ON-TAP data is only viewable using ProView NXG software and is presented in bar graph format; see Figure 7-6.



Total Time : 0.02929 Hrs

Figure 7-6. TIME-ON-TAP sample graph.

Preventive maintenance tapping

Preventive Maintenance Tapping (PMT™) will automatically operate the tap-changer according to user-configured parameters. Under certain operating conditions, load tap-changer contacts can become susceptible to coking. The PMT feature will operate the tap-changer to wipe the contact blades and prevent build-up of carbon. There are two different types of preventive maintenance tapping available: **PMT Mode A** and **PMT Mode B**.

PMT Mode A

When enabled the control monitors tap position and, if it remains on any single tap position for a user-defined period of time (Time Delay, FC 302), the control will automatically raise the tap-changer one position, lower the tap-changer two positions, and then raise the tap-changer one position. When PMT Mode A is performed on a Quik-Drive tap-changer, this entire operation will take approximately one second. The user can monitor how much time is left prior to the maintenance tapping being performed at Countdown Delay, FC 301. To sample how the PMT Mode A functions, the user can use Issue Test, FC 303.

PMT Mode B

When enabled, the control monitors tap position and, if it does not pass through neutral for a user-defined period of time (Time Delay, FC 322), the control will automatically tap through and past neutral one position. This operates and wipes the blades of the reversing switch. It then returns the tap-changer to the original tap position. Due to the possible large fluctuation in voltage while maintenance is being performed, there are more configuration points in PMT Mode B than in Mode A. The user can determine the time of day that PMT Mode B is allowed to operate, so that maintenance can be performed at night. To limit the amount of allowable voltage-swing when performing maintenance, the user can input the maximum deviation. Also, the user can input a current limit so that maintenance is only performed under light load conditions. Additionally, a master slave mode is available so multiple units can act at once to keep the supply balanced for three-phase loads that are sensitive to imbalance. The user can monitor how much time is left prior to the maintenance tapping being performed at Countdown Delay, FC 321. To sample how the PMT Mode B functions, the user can use Issue Test, FC 328.

Duty cycle monitor

The Duty Cycle Monitor calculates the amount of life used for each arcing surface contact on the voltage regulator Quik-Drive tap-changer. The control uses the metering values, such as current, voltage, power factor, and tap position, and a detailed data on the internal design of the voltage regulator to calculate the interrupting current and recovery voltage. This is then related to the test data for the appropriate Quik-Drive tap-changer. The Duty Cycle Monitor functions only on voltage regulators with a Quik-Drive tap-changer.

FC 333 displays the worst-case value of life used, expressed as a percentage, to the third decimal point. This value may be used to generate two different Data Alarms. The first DCM Data Alarm is intended to be configured so that maintenance may be scheduled. The suggested setting is 75%. The second Data Alarm is intended to be set at a higher level, the suggested setting is 90%, in order to notify the user that a service outage due to contact failure may be imminent. For more information on Alarms, see the Alarms topic in this section of the manual.

A detailed percentage of life-used for each arcing contact is also available and can be viewed using ProView NXG software. When replacing a control on an existing voltage regulator, ProView NXG software must be used to enable and configure the Duty Cycle Monitor feature. Configuration values programmed in the software for the specific voltage regulator include the design number and an estimation of the amount of life already used.

Note: Duty Cycle Monitor is active only on Eaton's Cooper Power series regulators with Quik-Drive tap-changers.

Leader/follower scheme

The Leader/Follower Scheme is an electronic scheme designed to coordinate the operation of two or three individual single-phase step voltage regulators. This feature is primarily used by utilities and others needing three-phase voltage regulation within certain parameters.

A fiber optic intelligent loop scheme (LoopShare) is used between controls providing the communications necessary between phases to initialize a tap change and provide positive feedback in maintaining regulation within the desired parameters. The status and settings for LoopShare are found at FC 860 through FC 863. As a result of the communications between all phases, access to certain data from all phases is available at the display of all controls involved and by using ProView NXG software.

If configured as a Leader or Follower device, the CL-7 control can be operated in one of two Ganged modes or a Group Coordinated mode. All configuration and setting values associated with the connected equipment must be configured separately for all connected voltage regulators. Leader/Follower Operation works on the understanding that all equipment connected and run in the Leader/Follower configuration must maintain communications with the operating group.

This scheme can also be used for paralleling substation voltage regulators with a set of power transformers used for increasing capacity and providing a backup for maintaining regulated power. For more details on the various Leader/Follower schemes and configuring the feature, see *Service Information MN2258015EN CL-7 Regulator Control ProView NXG Software Programming Guide.*

Voltage sag monitoring

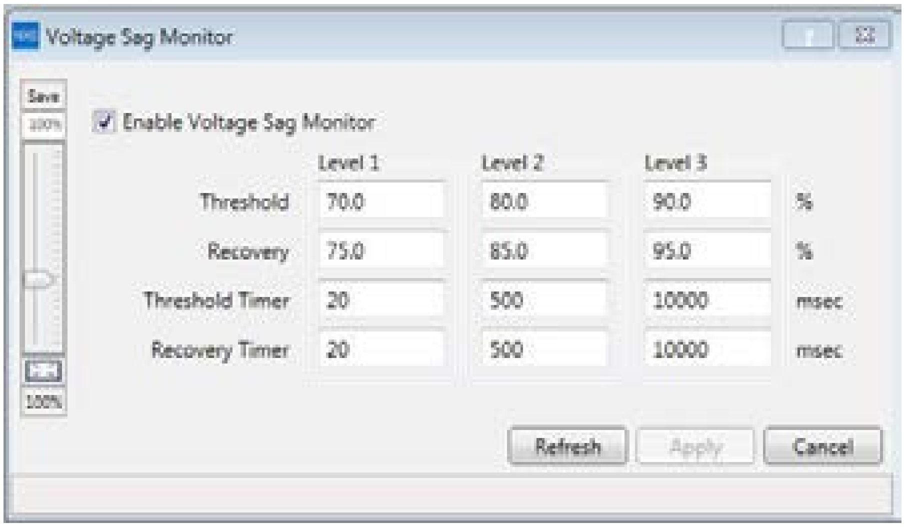
The voltage sag monitor compares the voltage regulator load voltage with a reference value and determines if the load voltage has dropped below a defined threshold level for a defined period of time. The concept is based on the voltage quality curve defined by the Computer Business Equipment Manufacturer's Association (CBEMA), which is meant as a guideline for the kind of voltage deviation that electronic equipment should withstand without failure. This feature as applied to the voltage regulator will be a limited subset of the CBEMA guideline.

With the feature enabled, the control compares the current load voltage against three unique voltage sag set points, with each set point containing both a voltage level (as a percent of the reference voltage) and minimum time duration of the voltage sag. When the control detects that the regulated voltage has fallen below the defined voltage level and stayed below that level for the defined duration, the control records the voltage sag as an event in the sequence of events recorder.

When the load voltage rises above a defined recovery voltage for a defined recovery period of time, the control resets the voltage sag monitor and records another event indicating that the voltage sag has ended. A date and time stamped record of the duration of the last and longest voltage sag for each voltage sag level is also recorded.

The reference voltage used to compare against the regulator load voltage is the Demand Metering value of Forward Load Voltage Present or Reverse Load Voltage Present as applicable.

Voltage sag monitor settings can be found using control nested menu FEATURES > Voltage Sag Monitoring or by accessing FC 600-606, 611-616, 621-262, 631, and 632. The feature can also be programmed and data viewed using ProView NXG software.



☑ Enable Voltage Sag Monitor

	Level 1	Level 2	Level 3	
Threshold	70.0	80.0	90.0	%
Recovery	75.0	85.0	95.0	%
Threshold Timer	20	500	10000	msec
Recovery Timer	20	500	10000	msec

Figure 7-7. Setting the voltage sag monitor using ProView NXG software.

Fault detection

The fault detection feature will compare system load current measure by the voltage regulator with a reference value, and determine if the load current rises above a defined fault current threshold level for a defined period of time.

The Fault Detection feature can be enabled using FC 640 on the control HMI or by checking a box in the Fault Detection dialog box in ProView NXG.

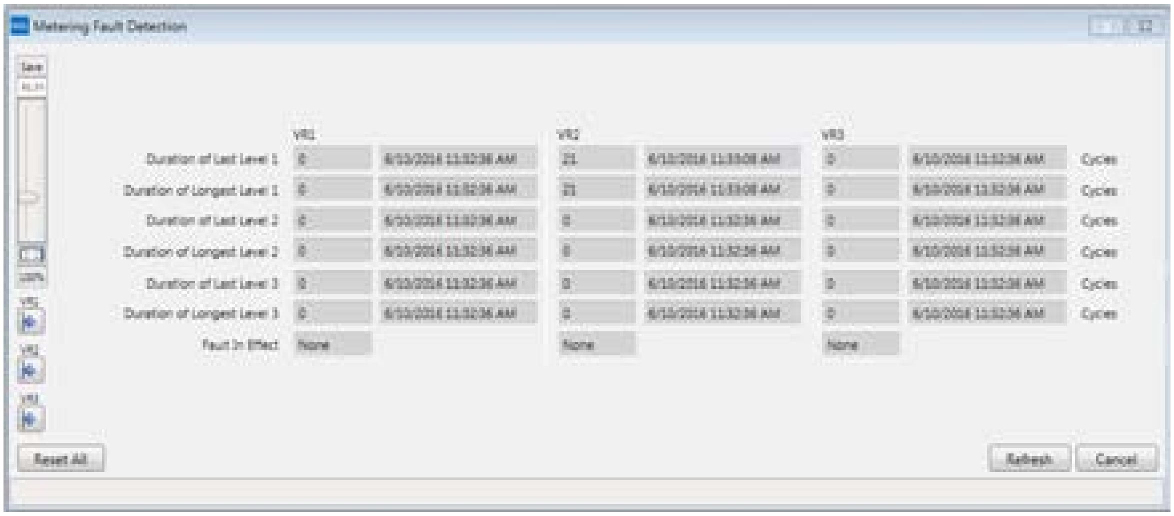
☑ Fault Detect Enable

	Level 1	Level 2	Level 3	
Threshold	600	500	400	Amps
Recovery	599	499	399	Amps
Threshold Timer	20	500	1000	msec
Recovery Timer	20	500	1000	msec

Figure 7-8. Fault Detection settings dialog box.

The Fault Detection feature will enable the control to compare system currents against three unique fault current levels. Each fault current level contain both a current threshold in amps and threshold timer in milliseconds. When the control detects that the system current level has exceeded a defined fault current level and remains above that level for the time period defined by the Threshold Timer, the control will record the fault current as an event in the control's Sequence of Events recorder. When the fault current falls below the defined Recovery current level for the time period defined by the Recovery Timer, the control will reset Fault Detection and record another event indicating that the fault has ended. Fault Detection settings can be made using the dialog box shown above (Figure 7-8) in ProView NXG or through the control HMI using function codes found in the control nested menu **Features > Fault Detection**. There is one set of Fault Detection settings which applies to all three voltage regulators when using a multi-phase control.

It is also possible to record the total time duration of the fault events. The last fault event and longest fault event are recorded with a date and time stamp which can be viewed using the control HMI or in the Metering Fault Detection dialog box (Figure 7-9) in ProView NXG. Fault Detection event recording is available for up to three connected voltage regulators when using a multi-phase control.



	VR1		VR2		VR3		
Duration of Last Level 1	0	6/10/2016 11:32:36 AM	21	6/10/2016 11:33:08 AM	0	6/10/2016 11:32:36 AM	Cycles
Duration of Longest Level 1	0	6/10/2016 11:32:36 AM	21	6/10/2016 11:33:08 AM	0	6/10/2016 11:32:36 AM	Cycles
Duration of Last Level 2	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	Cycles
Duration of Longest Level 2	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	Cycles
Duration of Last Level 3	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	Cycles
Duration of Longest Level 3	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	0	6/10/2016 11:32:36 AM	Cycles
Fault In Effect	None		None		None		

Figure 7-9. Metering Fault Detection dialog box.

Battery options

The CL-7 control may be equipped with a 13 A-Hr, 24 Vdc battery backup. The purpose of the battery backup is to maintain power to the control when system power is lost. The battery is not intended to run the tap-changer.

When the control is equipped with battery backup, the function codes are used to monitor battery function. When the battery is in use, FC 190 will display battery current and voltage values. Use FC 191 to initiate a battery test and display the results. An automatic battery test can be enabled at FC 192 which will run a battery test within 60 seconds of power up of the control and then every 12 hours thereafter.

Battery test results may display a code when the test is not successfully passed. The codes are:

1 – Battery failed test

2 – A battery test was already running

3 – Battery test was blocked

4 – Battery test was not run

5 – Auto battery test disabled.

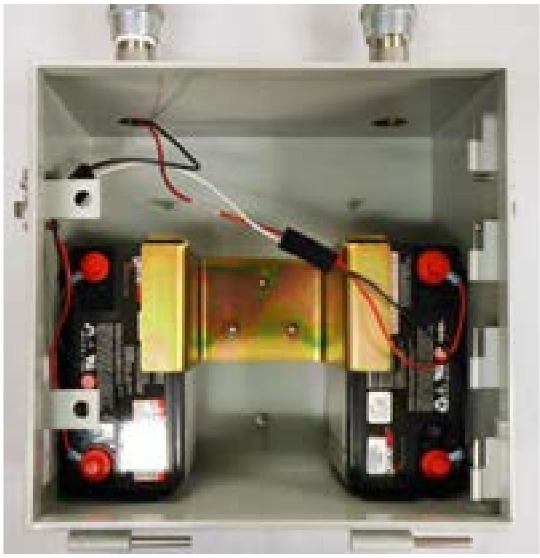


Figure 7-10. Auxiliary control box with backup batteries.

Customer supplied battery power

The CL-7 control can be powered using a substation battery with a voltage of 48 to 125 Vdc. With this option, terminals will be provided on the back panel of the control to connect battery power. The terminals will be connected to the control DC power jumper (see Figure 7-9). If a substation batter option is not provided, the DC power jumper must be in place in order to power the control.

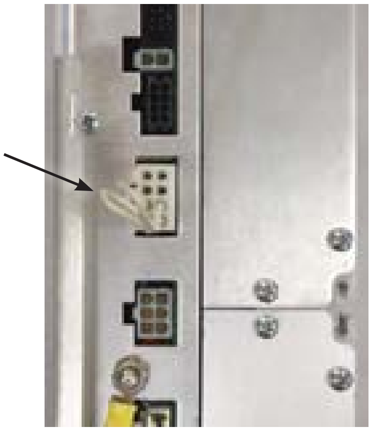


Figure 7-11. DC power jumper in place on side of control. This jumper must be in place to power the control when the substation battery option is not provided.

DC power supply (13.5 Vdc)

An optional 13.5 Vdc power supply is available for the CL-7 control. The power supply is intended to provide an auxiliary source to power communications equipment. The unit has a max output of 1.48 A for 1 second and max power of 14 W continuous and 20 W peak.

Figure 7-10 shows the DC power supply installed in the side of a CL-7 control. Power connections can be made to the orange plug; the top plug is the negative terminal and the bottom plug is the positive terminal.

Figure 7-12. DC power supply (13.5 Vdc) installed in the side of a CL-7 control.

Section 8: Troubleshooting

⚠ WARNING

Hazardous voltage. When troubleshooting energized equipment, protective gear must be worn to avoid personal contact with energized parts. Failure to comply can cause serious injury or death. **VR-T213.0**

When using the CL-7 control with an Eaton's Cooper Power series regulator, refer to *Service Information MN225008EN (S225-10-30) VR-32 Voltage Regulator with Quik-Drive Tap-Changer Installation, Operation, and Maintenance Instructions* for additional information on the regulator operation and maintenance.

External check

Examine the power connections first. For example, verify that the load lead is connected to the load (L) bushing, the source lead is connected to the source (S) bushing and that the source-load lead is connected to the source-load (SL) bushing. Check for other potential problems, such as an open ground connection.

Defining the problem

Determine which of the following categories best describes the malfunction and follow the corresponding steps. Refer to the schematics in the Appendix, Figures 10-1 through 10-8, while diagnosing the problem.

Note: Parameter options accessed via menu or function code are shown in **bold**.

Settings of front panel switches are shown in **bold**.

Keypad directions are shown as follows: press keys as shown in **bold**; enter numbers as shown in italics.

Note: The typical control box will have a single terminal board (TB3) at the bottom of the back panel. Legacy control boxes, CRA control boxes and a very few new units will have two terminal boards, TB1 at the top and TB2 at the bottom. TB3 will include most of the same terminals as found on TB1 and TB2. Troubleshooting principles will apply to any back-panel configuration.

Control panel troubleshooting

No motor power

If the control panel powers up, but the motor will not run, first check the 6 A motor fuse on the control front panel. Remove the fuse from the control and check for continuity across the fuse. Spare fuses are shipped with each control and are located in the control box.

Note: Use only 125 V, 6 amp, fast-blow fuses of the proper current rating. Failure to do so may cause unnecessary fuse operation or insufficient protection of the regulator and control.

No control power

If the control will not power up at all, check the power to the control:

1. With a voltmeter, check the voltage between terminals **VS** and **G**. The voltage should approximate the set voltage. If the voltage is present at terminal **VS**, then the problem is in the control. Replace the control.
2. Check the voltage-disconnect knife switch **V1**, **V6** (if present), and the current shorting knife switch **C** on the back panel in the control enclosure. Close the **V1** and V6 switches if open. Open the CT shorting switch (**C**) if closed.
3. Check the voltage between **V1** and **G**. If the voltage is present at **V1**, then the problem could be in the wiring harness or ratio-correcting transformer. Check for loose connections or burnt wiring. Verify that the ratio-correcting transformer **RCT1** is on the correct tap for the regulated voltage as shown on the nameplate on the control enclosure door.
4. If voltage is not present, then the problem is either in the control cable, junction box connection, or inside of the regulator.

Self-test

The control hardware performs self-diagnostic physical and memory checks. There are two events which force the control into the self-test routine: (1) Power is turned on; (2) Operator entry of the self-test mode (FC 91).

The duration of this test sequence is approximately seven (7) seconds. At completion, the display will indicate **PASS** or display an error message if a problem is found. (See **Diagnostic Error Messages** in the next section of this manual). The messages will remain in the display until the operator presses the **ESC** key or, after 20 minutes, the display will automatically be turned off.

Note: After the self-test and the LCD displays **PASS**, press **ESC** key for further keypad use.

Diagnostic error messages

Upon running the self-test, if an error is detected, a diagnostic error message will be displayed and the red DIAG ERROR LED will illuminate until the self-test is rerun without error.

Note: The most common diagnostic errors can be rectified by changing parameters in the control. Review this section or call an Eaton representative for assistance.

A list of diagnostic error messages and explanations follows.

- Non-Volatile Settings Failed!—The firmware was unable to create, open, read or write the settings file.
- Frequency Detection Failed!—Detected system frequency is below 40 Hz or above 70 Hz.

- No Data Acquisition!—Data failed to be acquired over a 1 second time period (data is acquired every 512 microseconds, if no data is acquired in one second it indicates a problem).
- VR1 (2, 3) Input Voltage Missing!—The detected or measured source voltage secondary is below 40 volts for VR1 (2, 3).
- VR1 (2, 3) Output Voltage Missing!—The detected or measured load voltage secondary is below 40 volts for VR1 (2, 3).
- VR1 (2, 3) No Neutral Sync Signal!—The control tap position is set to neutral, but the neutral signal from the tap changer is not present for VR1 (2, 3).
- Clock Needs Setting!—The clock has lost power and must be reset.
- Factory Calibration Required!—Control calibrations are out of range.
- Configuration Value Required!—Control settings have not been set.
- Battery Test Failed!—The battery has failed and needs replacing.
- VR1 (2, 3) Motor Trouble!—Motor trouble was detected and the motor trouble state was set to true.

No neutral sync signal

CONTROL NOT INSTALLED ON REGULATOR

This most often occurs when powering up a control on a workbench or when a control panel has been installed on a regulator on a tap position other than neutral. The **No Neutral Sync Signal** means the control did not have a neutral signal during the self-test while powering up. This can occur because there is no 120 V signal present on the neutral light input. To confirm this and clear the error message, perform the following:

1. Press ESC.
2. Func, 99, Enter, Admin (default), Enter.
3. Func, 12, Enter.
4. Edit, (some number from one to 16), Enter.
5. Initiate a self-test.

FUNC, *91*, **ENTER**, **ENTER**, **ENTER**.

The **(No Neutral Sync Signal)** message should not reappear.

CONTROL ON REGULATOR

If the control is on a regulator and the **No Neutral Sync Signal** message appears during power up or self-test, or there is no neutral light, check the input signal between terminal **NL** and **G**. If the regulator is in neutral, there should be 120 V at the input. When 120 V is not present at terminal **NL** while on neutral, the neutral light on the control panel will be off.

If there is no neutral light and no neutral light signal at terminal **NL**, verify that the regulator is in neutral. For the regulator to be in neutral, the position indicator should be on neutral and if the regulator is energized there should not be a differential voltage between the source (S) bushing and the load (L) bushing.

When there is no neutral light and the regulator is powered up either by internal or external power, check these input points as follows:

- If there are **TB1** and **TB2** terminal boards, check the voltage between **TB2-NL** and **G**, located on the bottom terminal board on the control assembly back panel:

  If there is no voltage and there is voltage at **TB1-NL**, the problem is in the connections in the wiring harness on the back panel. If there is voltage on **TB2-NL** and no neutral light, the problem is in the control panel.

- **TB3-NL or TB1-NL if present** located on the top terminal board on the control assembly back panel:

  If there is no voltage, the problem can be in the connection at this terminal point, the control cable, the connection in the junction box, or inside the regulator.

- **JBB-NL**, located on the terminal board inside the junction box and **TCB-NL**, located on the tap changer:

  If there is no voltage, the problem is inside the regulator, either with connection point **JBB-NL** under the cover assembly, connection **TCB-NL** on the tap-changer, neutral light switch, or the neutral light actuator segments.

  On the current regulator design, the junction box terminal board consists of automotive-style plug connections. Check that the plugs are firmly installed. Disconnecting the plug on the top will allow for a probe to make contact to check the voltage.

No input voltage

The **Input Voltage Missing** message occurs when no input voltage is sensed or it cannot be calculated. The input voltage is the source voltage from a differential or source potential transformer. This voltage signal can also be calculated by the control if FC 39, Source Voltage Calculation is set to **On**, the regulator type is properly set at FC 140, and the tap position is present at FC 12.

When this message is indicated and the regulator has a differential transformer, check for a voltage between **V6** and **G**, if V6 is present. This voltage will be 0.0 V when the regulator is in neutral. The voltage will increase as the regulator is tapped up. When the regulator is at 16 raise, the voltage will be 11.5 to 12 Vac. If there is no input voltage shown at FC 7, Source Voltage Secondary, and the regulator has a differential transformer, the problem could be in the control, back panel connections, control cable, the junction box, the junction box terminal board under the cover, or the differential PT.

If there is not a differential PT on the regulator, turn FC 39 to **On**. This will supply the calculated voltage signal and when the self-test is rerun, the input voltage diagnostic error message will clear.

Indication messages when using edit key

The following indication messages can occur when using the **Edit** key:

- (**Improper Security**) message will display while attempting an edit function when changes are disabled by the security system. To enable, enter a higher security code at FC 99. To enter the Security Code key in:

  FUNC, *99*, **ENTER**, *Security Code*, **ENTER**.

  Proceed with function code value and setting changes.
- (**VALUE TOO LOW**) means the function value you have entered is below the acceptable limit.
- (**VALUE TOO HIGH**) means the function value you have entered is above the acceptable limit.

For more information, refer to **Indication Messages** in the **Control Programming** section of this manual.

Tap-changer operation troubleshooting

The regulator will not operate manually or automatically

1. Connect a voltmeter between **R1** and **G**. Set the CONTROL FUNCTION switch on **LOCAL MANUAL.**
2. Toggle the **RAISE** switch and measure the voltage between terminals **R1** and **G**. The voltage reading should approximate the set voltage setting.
3. Place the voltmeter hot lead on **L1**, then toggle the **LOWER** switch.
4. Measure the voltage between terminals **L1** and **G**. The voltage reading should approximate the set voltage value.
5. If correct voltage readings are obtained in Steps 2 and 4, the trouble may be in the position indicator, junction box, control cable, or motor capacitor. Refer to the junction box troubleshooting section *Service Information MN225008EN (S225-10-30) VR-32 Voltage Regulator with Quik-Drive Tap-Changer Installation, Operation, and Maintenance Instructions*.
6. If there is no voltage measurement in either Step 2 or 4, make a corresponding measurement (from **R3** to **G** and **L3** to **G**) on lower terminal board **TB2** or **TB3**.
7. If the voltages measured in Step 6 are approximately the set voltage value, then the fault is likely a loose connection or a faulty terminal on the back panel.
8. If Steps 2, 4, and 6 do not provide voltage readings, measure the voltage between **VM** and **G**. The reading should approximate the set voltage value.
9. If Step 8 does not yield a voltage measurement, check the voltage between **V1** and **G** at the voltage disconnect knife switch.

   A. If the set voltage value is approximately obtained, the **V1** disconnect or the ratio-correcting transformer (**RCT1**) of the rear panel signal circuit is probably faulty.

   B. If voltage is not obtained, the trouble is in the control cable, junction box, or regulator tank. Refer to the junction box troubleshooting section of *Service Information MN225008EN (S225-10-30) VR-32 Voltage Regulator with Quik-Drive Tap-Changer Installation, Operation, and Maintenance Instructions*. If the junction box checks are satisfactory, the trouble is in the regulator tank. See *Service Information S225-12-1 QD3 Quik-Drive Voltage Regulator Tap-Changer Manual, S225-12-2 QD5 Quik-Drive Voltage Regulator Tap-Changer Manual*, and *Service Information S225-10-19 Voltage Regulator Quik-Drive T875 Tap-Changer Switch; Operating, Maintenance, Troubleshooting and Parts Replacement Instructions* for troubleshooting methods.

Motor capacitor problem

A problem in the motor capacitor can prevent a regulator from operating manually or automatically. If the motor capacitor is in the control box, it can easily be removed and checked using a voltmeter with a capacitive setting. To check the motor capacitor if it is not accessible, use the following steps:

1. Connect a voltmeter from **R1** to **G**.
2. With the control powered up, place the **CONTROL FUNCTION** switch on **LOCAL MANUAL**.
3. Using the **RAISE/LOWER** switch, give a **raise** signal.
4. The voltmeter reading should approximate the set voltage.
5. With the voltmeter still connected between the **R1** terminal and **G**, give a **lower** signal.
6. The voltmeter should read a capacitive voltage. This voltage could be somewhere between 160 and 190 Vac.
7. A voltage reading between **R1** and **G** of 0 V or a mV reading while giving a lower signal is a sign of a bad capacitor.
8. To double check, place the voltmeter lead between **L1** and **G**.
9. Use the **RAISE/LOWER** switch, and give a **lower** signal.
10. The voltmeter reading should approximate the set voltage.
11. With the voltmeter still connected to between **L1** and **G**, give a **raise** signal.
12. The voltmeter should read a capacitive voltage. This voltage could be somewhere between 160 and 190 Vac.
13. A voltage reading between **L1** and **G** of 0 V or a mV reading while giving a lower signal is a sign of a bad capacitor.
14. If both the raise and lower circuit reads 0 V, or a mV reading, when there should be a capacitive voltage, then the motor capacitor is open. The capacitor will need to be replaced.
15. If 120 Vac is present between **R1** and **G** and **L1** and **G** when no raise or lower signal is provided, it is a sign of a shorted motor or capacitor.

Operation counter does not indicate tap change

If the operation counter does not indicate tap changes, check the following:

1. The voltage signal between **TB3-R1** and **L1** (or **TB2-R3** and **L3** is present) should be approximately 120 Vac when a tap change is made. When this voltage signal is applied, the control panel operation counter will be updated.
2. Measure the voltage at **R1** and **L1** (**R3** and **L3** if present) when the tap-changer is given a command to tap, in manual mode, by the **RAISE/LOWER** toggle switch. If the voltage signal is present, the problem is either in the control connector or the control.
3. If the voltage signal is not present at **R1** and **L1** (**R3** and **L3** if present), the problem could be in the back panel wiring harness connections at **TB1-R1** or **L1** (if they are present), the control cable, junction box connections, or the holding switch on the tap-changer.
4. Check the voltage signal at **TB1-R1** or **L1** (if they are present). If the signal is not present at these points or at **TB3-R1** or **L1**; keep tracing the signal back through the components back into the regulator.

Tap position out-of-sync

If the control loses sync with the position indicators (check FC 12, Present Tap Position), then check:

1. FC 49 Tap-Changer Type against the nameplate on the regulator. The nameplate indicates what type of tap-changer is on Eaton's Cooper Power series regulator. FC 49 must be set for the type of tap-changer (Spring Drive, Direct Drive, QD8, QD5, QD3).

   If the control is installed on a non-Eaton's Cooper Power series regulator, FC 49 should be set to match the manufacturer of the unit.
2. The control box ground—An improperly grounded control box can cause the control to loose tap tracking. The control box must have a solid ground to the ground lug on the side of the box, either from the tank ground pad or earth ground cable.
3. The tap position of the position indicator—When a control is installed on a unit in the field, the correct tap position must be entered in the control to match the position indicator tap position.

Regulator will not tap beyond a certain tap position

If the regulator will not tap beyond a certain tap position, check the limit switch settings on the position indicator. If the limits need to be adjusted, adjust upper and lower limits to allow proper regulation.

If the regulator will not tap beyond a certain position while in automatic operation, but will beyond this position manually, check the Soft ADD-AMP settings are FC 79, FC 175 and FC 176.

If the regulator does not tap beyond tap position 2 in the lower direction or -2 in raise direction, the problem may be the internal tap-changer logic switches. Call your Eaton representative for assistance.

The regulator operates manually but operates incorrectly when set on automatic

Manually run the regulator to the neutral position. Check for voltage between the bottom of the **V1** switch and **G**. This is the sensing circuit supplying voltage from the output of **RCT1** on the rear panel. If this voltage is more than 10% above or below the programmed voltage level setting of the control, then the source is beyond the range of the regulator. An absence of voltage would indicate a wiring problem such as an open somewhere in the control power supply. If these checks are correct, perform the following:

1. If the control will not operate automatically, verify that the band edge indicators are functioning. (These are the **OUT-OF-BAND HIGH** and **OUT-OF-BAND LOW** LEDs located on the front panel.) If they are not functioning, check FC 56, Reverse Sensing Mode. Set it to **Locked Forward** if it is not there already. Retry the automatic mode of operation.
2. Verify that FC 69, Auto Blocking is set to **Normal**. Retry the automatic mode of operation.
3. Measure the voltage from **VS** to **G** on **TB3** (or on the lower terminal board **TB2** if present).

    A. A measurement of approximately the set voltage value between **VS** and **G** indicates that the problem is in the control.

    B. If there is no voltage present between **VS** and **G**, the trouble is in the V1 disconnect or the ratio-correcting transformer of the back-panel circuit. Replace them.

4. Check the holding switch circuit.

    A. Verify that the tap-changer will complete a tap change by placing the **CONTROL FUNCTION** switch to **LOCAL MANUAL** and toggling the **RAISE/LOWER** switch in the desired direction.

    B. If the **RAISE/LOWER** switch must be held in the **RAISE** or **LOWER** position to complete a tap change, the problem is in the holding switch circuit. If the holding switch is not working, a Quik-Drive tap-changer will do multiple taps until the tap change time-out occurs.

    C. Check for voltage between **TB3-HS** and **G** (**TB1-HS** or **TB2-HS** if they are present and **G**). When TB1 and TB2 are present, if voltage is present at **TB1-HS** and not on **TB2-HS**, the problem is in the back panel wiring harness. Replace the orange **HS** lead from **TB1-HS** to **TB2-HS**. If no voltage is present at **TB3-HS** (or **TB1-HS** when present), the problem is in the control cable, junction box cover, or the holding switch (located inside the regulator) itself. Check cable continuity up to the junction box.

    If it appears normal, the problem is the holding switch. Adjust or replace it (see *Service Information S225-12-1 QD3 Quik-Drive Voltage Regulator Tap-Changer Manual, S225-12-2 QD5 Quik-Drive Voltage Regulator Tap-Changer Manual*, and *Service Information S225-10-19 Voltage Regulator Quik-Drive T875 Tap-Changer Switch; Operating, Maintenance, Troubleshooting and Parts Replacement Instructions*. If all appears to be in order, the problem is most likely in the control, not in the holding switch.

Check FC 56, reverse sensing mode

When there is no load current and the regulator will not operate in automatic, check the **C** switch on the back panel. If the **C** switch is closed and FC 56 is set for **Bi-directional**, the regulator will not operate in automatic. The **C** switch should be open for normal operation.

Check FC 69, auto operation blocking status

1. Check the **CONTROL FUNCTION** switch. The switch should be on **AUTO/REMOTE**.
2. Verify that FC 69 is set to **Normal**. To check the FC 69 setting:

    FUNC, *69*, **ENTER**.

3. If not on **Normal** and resetting is blocked by the security feature, enter the security code via the keypad to change the blocking status:

    A. **FUNC**, *99*, **ENTER**; *Admin* (default), **ENTER**.

    B. **FUNC**,*69*, **ENTER**.

    C. **EDIT**, Scroll to **Normal**, **ENTER**.

Check FC 170, Tap-to-Neutral

1. Verify that FC 170 is set to **Off**. To check the FC 170 setting:

    FUNC, *170*, **ENTER**.

2. If not set to **Off** and resetting is blocked by the security feature, enter the security code via the keypad to change the blocking status:

    A. **FUNC**, *99*, **ENTER**; *Admin* (default), **ENTER**.

    B. **FUNC**,*170*, **ENTER**.

    C. **EDIT**, Scroll to **Off**, **ENTER**.

Testing with the voltage limiter ON and a limit value set

CAUTION

Equipment Damage. Be mindful of polarity when using an external source. Polarity reversal will result in control damage. VR-T201.0

When testing a regulator with external power, it is recommended that FC 80, Voltage Limiter Mode be set to **Off**.

When testing in the auto mode with the voltage limiter on, there may be problems getting the regulator to operate in either raise or lower direction if the external voltage is greater than the voltage limit settings.

No band indicators

If the band indicators are not working when the voltage is out-of-band, check the following:

1. Check FC 56, Reverse Sensing Mode. If FC 56 is set to **Lock Forward** and there is reverse power, the indicator will not display and the voltage will not regulate.
2. Check FC 57, Reverse Current Sense Threshold and ***Load Current** (*Metering PLUS). If the load current is less then the reverse threshold current, the indicators will not work and the regulator will not regulate.

3. If the regulator has been serviced and the current transformer circuit was involved, check the polarity of the current transformer. If the polarity is reversed, the band indicators will not display.

Metering troubleshooting

Load voltage secondary (output voltage), does not match the voltmeter test terminal voltage

When the output voltage at FC 6 is several volts different from the voltage at the voltmeter test terminals, verify that the following function code settings are per the nameplate:

1. Verify FC 43, System Line Voltage (Load Voltage) is set per the nameplate value.
2. Verify FC 44, Overall PT Ratio is set per the nameplate.
3. Verify **RCT** Control Tap located on the back panel of the control assembly is set per the nameplate.
4. Verify Control Winding **E** Tap and Differential Transformer P Taps, if present, are set per the nameplate. **E** taps are located on the terminal board on the tap-changer inside the tank. **P** taps may be located on the terminal board on the top of the tap-changer or on the differential potential transformer located on the side channel inside the regulator tank.

When all the settings are set per the nameplate, the regulator is in neutral, and the system line voltage or load voltage matches what is stated on the nameplate, the voltmeter test terminals on the control panel will read the value on the nameplate.

No load current

When there is no load current reading at FC 9, Load Current, Primary, or any of the metering components requiring current as part of the calculation, check the **C** switch on the back panel. The switch should be open. If the **C** is closed, the current transformer is shorted and no current reading is available.

Control calibration

⚠ WARNING

Explosion Hazard. Verify that both the neutral light and the position indicator hand indicate neutral when the tap-changer is physically in the neutral position. Lack of synchronization will cause an indefinite indication of NEUTRAL. Without both indications of neutral, bypassing of the regulator at a later time will not be possible, and the line must be de-energized to avoid shorting part of the series winding. Failure to comply can result in serious personal injury or death and equipment damage. VR-T212.0

CAUTION

Equipment Damage. Be mindful of polarity when using an external source. Polarity reversal will result in control damage. VR-T201.0

All controls are factory-calibrated and should not need to be recalibrated. However, calibration can be performed for both the voltage and current circuits using the steps that follow. The factory calibration can be restored using FC 150.

Voltage calibration

1. Connect an accurate true-RMS-responding voltmeter to the voltmeter terminal. This voltmeter should have a base accuracy of at least 0.1% with calibration traceable to the National Bureau of Standards.
2. Connect a stable 50/60 Hz voltage source (with less than 5% harmonic content) to the External Source terminals.
3. Set the POWER switch to **EXTERNAL**.
4. Adjust the voltage source to provide 120.0 Vac to the control, as read on the reference voltmeter.
5. Before calibration can be performed, Security Level 3 must be activated by entering the proper security code at FC 99, Security Code.

   FUNC, *99*, **ENTER**; *Admin* (default), **Enter**.
6. *Access* FC 47, Voltage Calibration.

   FUNC, *47*, **ENTER**.
7. The display will show the voltage applied to the control. This should correspond to the reading on the reference voltmeter. If the control reading is significantly different, (0.6 volts or more), the calibration can be altered by pressing **EDIT**, keying in the correct voltage as displayed on the reference meter, and pressing **ENTER**. The voltage circuit is now calibrated.

Note: When installing an Eaton's Cooper Power series control on a non-Eaton's Cooper Power series voltage regulator, the control MUST have the calibration process performed. To calibrate the control on the non-Eaton's Cooper Power series regulator the internal power (System Voltage) must be applied.

Current calibration

1. Connect an accurate true-RMS-responding ammeter in series with the current source.
2. Connect a stable 60/50 Hz current source (with less than 5% harmonic content) to the reference ammeter and to the current input terminals **C1** and **C3** on **TB3** (or **TB2** if present) (**C1** is identified by a red wire, and **C3** is identified as the green wire).
3. To power the control, connect a 120 Vac voltage source to the EXTERNAL SOURCE terminals.
4. Place the power switch on **External Power.**
5. Adjust the current source to provide 0.200 A to the control, as read on the reference ammeter.
6. Before calibration can be performed, Security Level 3 must be activated by entering the proper security code at FC 99, Security Code. The default security code is "Admin".

   FUNC, *99*, **ENTER**; *Admin* (default), **ENTER**
7. *Access* FC 48, Current Calibration.

   FUNC, *48*, **ENTER**.
8. The display will show the current applied to the control. This should correspond to the reading on the reference ammeter. If the control reading is significantly different (greater than 0.6 mA error), the calibration can be altered by pressing **EDIT**, then entering the correct current as displayed on the reference meter, followed by **ENTER**. The current circuit is now calibrated.

Section 9: Appendix

Table 9-1. VR-32 Tap Connections and Voltage Levels (60 Hz)

Regulator Voltage Rating 1	Nominal Single Phase Voltage 2	Ratio-Adjusting Data			Test Terminal Voltage ** 6	Overall Potential Ratio ** 7
		Internal Tap* 3	PT Ratio 4	RCT Tap 5		
2500	2500	-	20:1	120	125	20:1
	2400	-	20:1	120	120	20:1
5000	5000	E_1/P_1	40:1	120	125	40:1
	4800	E_1/P_1	40:1	120	120	40:1
	4160	E_1/P_1	40:1	104	120	34.7:1
	2400	E_2/P_2	20:1	120	120	20:1
7620	8000	E_1/P_1	60:1	133	120.5	66.5:1
	7970	E_1/P_1	60:1	133	120	66.5:1
	7620	E_1/P_1	60:1	127	120	63.5:1
	7200	E_1/P_1	60:1	120	120	60:1
	6930	E_1/P_1	60:1	115	120.5	57.5:1
	4800	E_2/P_2	40:1	120	120	40:1
	4160	E_2/P_2	40:1	104	120	34.7:1
	2400	E_3/P_3	20:1	120	120	20:1
13800	13800	E_1/P_1	115:1	120	120	115:1
	13200	E_1/P_1	115:1	115	120	110.2:1
	12470	E_1/P_1	115:1	104	125	99.7:1
	12000	E_1/P_1	115:1	104	125	99.7:1
	7970	E_2/P_2	57.5:1	133	125	63.7:1
	7620	E_2/P_2	57.5:1	133	120	63.7:1
	7200	E_2/P_2	57.5:1	120	120	57.5:1
	6930	E_2/P_2	57.5:1	120	120.5	57.5:1
14400	14400	E_1/P_1	120:1	120	120	120:1
	13800	E_1/P_1	120:1	115	120	115:1
	13200	E_1/P_1	120:1	110	120	110:1
	12000	E_1/P_1	120:1	104	115.5	104:1
	7970	E_2/P_2	60:1	133	120	66.5:1
	7620	E_2/P_2	60:1	127	120	63.5:1
	7200	E_2/P_2	60:1	120	120	60:1
	6930	E_2/P_2	60:1	115	120.5	57.5:1
19920	19920	E_1/P_1	166:1	120	120	166:1
	17200	E_1/P_1	166:1	104	119.5	143.9:1
	16000	E_2/P_2	120:1	133	120.5	133:1
	15242	E_2/P_2	120:1	127	120	127:1
	14400	E_2/P_2	120:1	120	120	120:1
	7960	E_3/P_3	60:1	133	120	66.5:1
	7620	E_3/P_3	60:1	127	120	63.5:1
	7200	E_3/P_3	60:1	120	120	60:1
34500	34500	E_1/P_1	287.5:1	120	120	287.5:1
	19920	E_2/P_2	165.5:1	120	120.5	165.5:1

* P taps are used with E taps only on regulators where an internal differential potential transformer is used in conjunction with the control winding to provide voltage supplies to the control. See nameplate for verification of this type of control supply.

** Test terminal voltage and overall potential ratio may vary slightly from one regulator to another. See the regulator nameplate for determining the exact values.

Table 9-2. VR-32 Tap Connections and Voltage Levels (50 Hz)

Regulator Voltage Rating 1	Nominal Single Phase Voltage 2	Ratio-Adjusting Data			Test Terminal Voltage ** 6	Overall Potential Ratio ** 7
		Internal Tap* 3	PT Ratio 4	RCT Tap 5		
6600	6930	-	55:1	127	119.1	58.2:1
	6600	-	55:1	120	120	55:1
	6350	-	55:1	115	120.5	52.7:1
	6000	-	55:1	110	119	50.4:1
	5500	-	55:1	104	115.4	47.7:1
11000	11600	E_1/P_1	91.7:1	127	119.5	96:1
	11000	E_1/P_1	91.7:1	120	120	91.7:1
	10000	E_1/P_1	91.7:1	110	119	84.1:1
	6930	E_2/P_2	55:1	127	119.1	58.2:1
	6600	E_2/P_2	55:1	120	120	55.1:1
	6350	E_2/P_2	55:1	115	120.5	52.7:1
	6000	E_2/P_2	55:1	110	119	50.4:1
	5500	E_2/P_2	55:1	104	115.4	47.7:1
15000	15000	E_1/P_1	120:1	120	125	120:1
	14400	E_1/P_1	120:1	120	120	120:1
	13800	E_1/P_1	120:1	115	120	115:1
	13200	E_1/P_1	120:1	110	120	110:1
	12000	E_1/P_1	120:1	104	115.4	104:1
	11000	E_2/P_2	92.7:1	120	118.7	91.8:1
	10000	E_2/P_2	92.7:1	110	117.7	84.1:1
	8600	E_3/P_3	72.9:1	120	118	72.9:1
22000	23000	E_1/P_1	183.4:1	127	118.5	194.1:1
	22000	E_1/P_1	183.4:1	120	120	183.4:1
	20000	E_1/P_1	183.4:1	110	119	168.1:1
	19100	E_1/P_1	183.4:1	104	120.2	158.9:1
	15000	E_2/P_2	122.3:1	120	122.6	122.3:1
	12700	E_2/P_2	122.3:1	104	119.8	106:1
	11000	E_3/P_3	91.7:1	120	120	91.7:1
	10000	E_3/P_3	91.7:1	110	119	84.1:1
33000	34500	E_1/P_1	275:1	127	118.5	291:1
	33000	E_1/P_1	275:1	120	120	275:1
	30000	E_1/P_1	275:1	110	119	252.1:1
	22000	E_2/P_2	183.3:1	120	120	183.3:1
	20000	E_2/P_2	183.3:1	110	119	168:1
	11600	E_3/P_3	91.7:1	127	119.5	97:1
	11000	E_3/P_3	91.7:1	120	120	91.7:1
	10000	E_3/P_3	91.7:1	110	119	84.1:1

* P taps are used with E taps only on regulators where an internal differential potential transformer is used in conjunction with the control winding to provide voltage supplies to the control. See nameplate for verification of this type of control supply.

** Test terminal voltage and overall potential ratio may vary slightly from one regulator to another. See the regulator nameplate for determining the exact values.

Table 9-3. ADD-AMP Capabilities of 60 Hz Ratings

		†Load Current Ratings (A)				
		Regulation Range (Wye and Open Delta)				
		±10%	±8.75%	±7.5%	±6.25%	±5%
		Regulation Range (Closed Delta)				
Rated Volts	Rated kVA	±15%	±13.1%	±11.3%	±9.4%	±7.5%
2500	50	200	220	240	270	320
	75	300	330	360	405	480
	100	400	440	480	540	640
	125	500	550	600	668	668
	167	668	668	668	668	668
	250	1000	1000	1000	1000	1000
	333	1332	1332	1332	1332	1332
	416.3	1665	1665	1665	1665	1665
5000	25	50	55	60	68	80
	50	100	110	120	135	160
	100	200	220	240	270	320
	125	250	275	300	338	400
	167	334	367	401	451	534
	250	500	550	600	668	668
	333	668	668	668	668	668
	416.3	833	833	833	833	833
7620*	38.1	50	55	60	68	80
	57.2	75	83	90	101	120
	76.2	100	110	120	135	160
	114.3	150	165	180	203	240
	167	219	241	263	296	350
	250	328	361	394	443	525
	333	438	482	526	591	668
	416.3	548	603	658	668	668
	500	656	668	668	668	668
	667	875	875	875	875	875
	833	1093	1093	1093	1093	1093
13800	69	50	55	60	68	80
	138	100	110	120	135	160
	207	150	165	180	203	240
	276	200	220	240	270	320
	414	300	330	360	405	480
	500	362	398	434	489	579
	552	400	440	480	540	640
	667	483	531	580	652	668
	833	604	664	68	668	668
14400	72	50	55	60	68	80
	144	100	110	120	135	160
	288	200	220	240	270	320
	333	231	254	277	312	370
	416	289	318	347	390	462
	432	300	330	360	405	480
	500	347	382	416	468	555
	576	400	440	480	540	640
	667	463	509	556	625	668
	720	500	550	600	668	668
	833	578	636	668	668	668
19920	100	50.2	55	60	68	80
	200	100.4	110	120	135	160
	333	167	184	200	225	267
	400	200.8	220	240	270	320
	500	250	275	300	338	400
	667	335	369	402	452	536
	833	418	460	502	564	668
	1000	502	552	602	668	668
34500	172.5	50	55	60	68	80
	345	100	110	120	135	160
	517	150	165	180	203	240
	690	200	220	240	270	320

Table 9-4. ADD-AMP Capabilities of 50 Hz Ratings

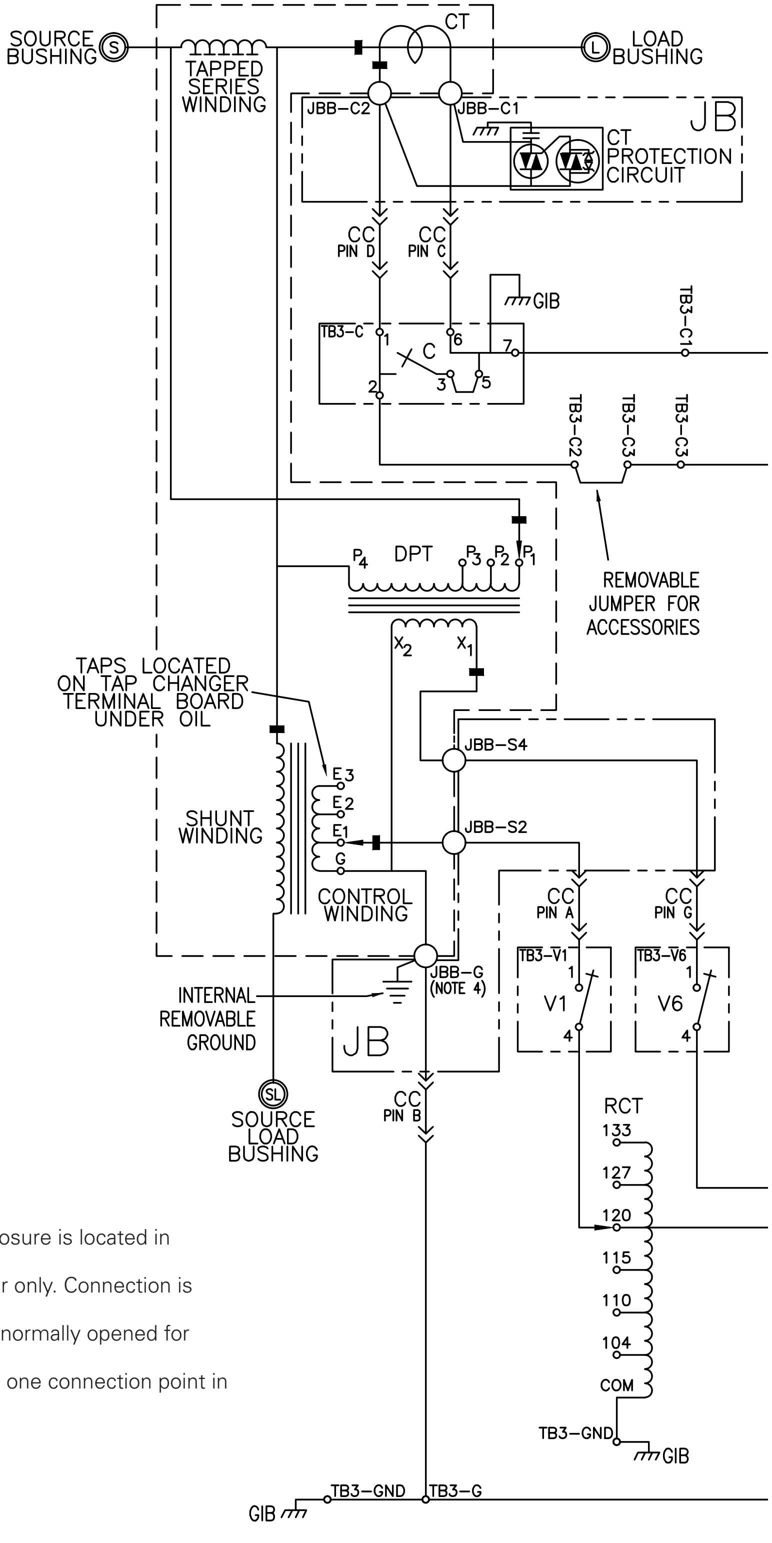
		†Load Current Ratings (A)				
		Regulation Range (Wye and Open Delta)				
		±10%	±8.75%	±7.5%	±6.25%	±5%
		Regulation Range (Closed Delta)				
Rated Volts	Rated kVA	±15%	±13.1%	±11.3%	±9.4%	±7.5%
6600	33	50	55	60	68	80
	66	100	110	120	135	160
	99	150	165	180	203	240
	132	200	220	240	270	320
	198	300	330	360	405	480
	264	400	440	480	540	640
	330	500	550	600	668	668
	396	600	660	668	668	668
11000	55	50	55	60	68	80
	110	100	110	120	135	160
	165	150	165	180	203	240
	220	200	220	240	270	320
	330	300	330	360	405	480
	440	400	440	480	540	640
	550	500	550	600	668	668
	660	600	660	668	668	668
15000	75	50	55	60	68	80
	150	100	110	120	135	160
	225	150	165	180	203	240
	300	200	220	240	270	320
	450	300	330	360	405	480
	600	400	440	480	540	640
	750	500	550	600	668	668
22000	110	50	55	60	68	80
	220	100	110	120	135	160
	330	150	165	180	203	240
	440	200	220	240	270	320
	660	300	330	360	405	480
	880	400	440	480	540	640
33000	165	50	55	60	68	80
	330	100	110	120	135	160
	495	150	165	180	203	240
	333	231	254	277	312	370
	660	200	220	240	270	320

† 55/65 °C rise rating on VR-32 regulators gives an additional 12% increase in capacity if the tap-changer's maximum current rating has not been exceeded. For loading in excess of the above values, please refer to your Eaton representative.

* Regulators are capable of carrying current corresponding to rated kVA when operated at 7200 V.

This page is intentionally left blank.

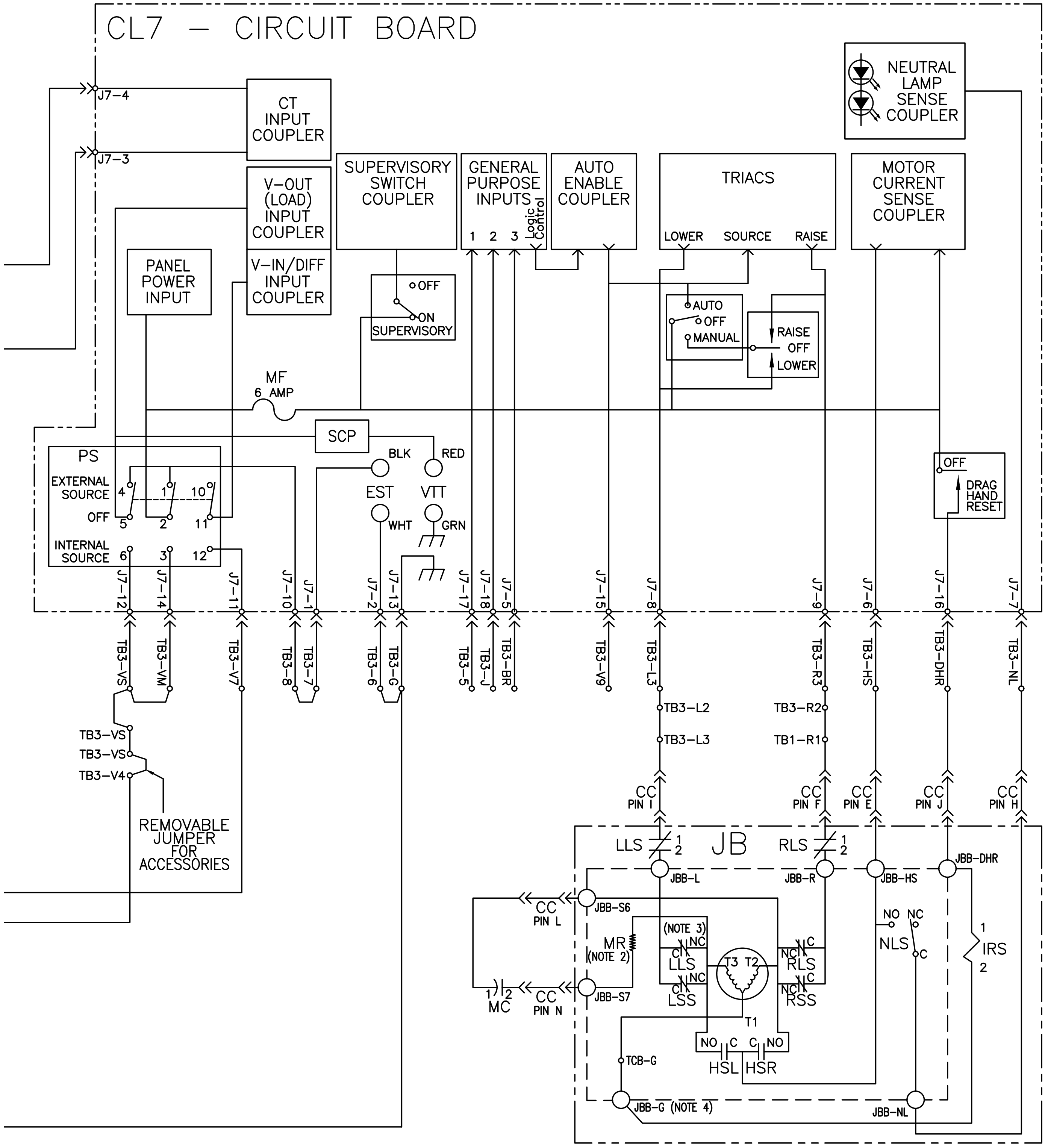
C	CT Shorting Switch
CC	Control Cable
CT	Current Transformer (Toroidal Coil)
DPT	Differential Potential Transformer
DHR	Drag Hand Reset
EST	External Source Terminals
GIB	Ground Integrated into Terminal Board
HSL	Holding Switch Lower
HSR	Holding Switch Raise
IRS	Indicator Reset Solenoid (Position Indicator)
JB	Junction Box on the Regulator Cover
JBB	Junction Box Terminal Board on the Cover
LLS	Lower Limit Switch (Position Indicator)
LLS	Lower Logic Switch (Tap-Changer)
LSS	Lower Safety Switch
MC	Motor Capacitor
MF	Motor Fuse
MR	Motor Resistor
NL	Neutral Light
NLS	Neutral Light Switch
PS	Power Switch
RCT	Ratio Correction Transformer
RLS	Raise Limit Switch (Position Indicator)
RLS	Raise Logic Switch (Tap-Changer)
RSS	Raise Safety Switch
SCP	Short Circuit Protection
TB	Control Terminal Board
TCB	Tap-Changer Terminal Board
V1	PT Voltage Interrupting Switch
V6	DPT Voltage Interrupting Switch
VM	Motor Voltage
VS	Sensing Voltage
VTT	Voltage Test Terminals



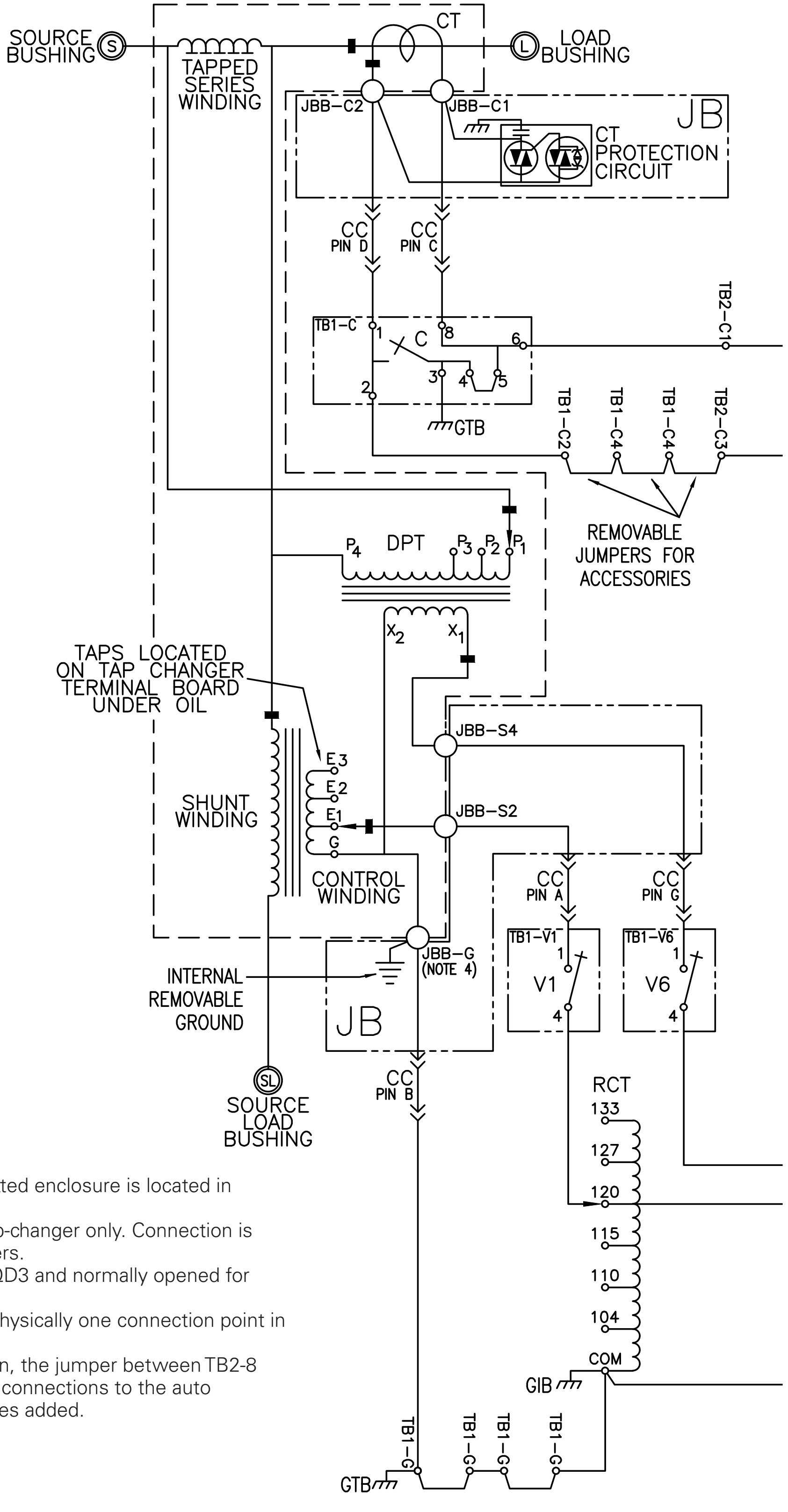
Notes:

1. Portions of schematic shown in dotted enclosure is located in regulator tank.
2. Motor resistor required for QD3 tap-changer only. Connection is direct for QD5 and QD8 tap-changers.
3. This switch is normally closed for QD3 and normally opened for QD5 and QD8 tap-changers.
4. The two JBB-G points shown are physically one connection point in the junction box.

Figure 9-1. Wiring diagram for Type B VR-32 Regulator and CL-7 control with differential potential transformer.


CL7 – CIRCUIT BOARD
J7–4
J7–3
CT INPUT COUPLER
V–OUT (LOAD) INPUT COUPLER
V–IN/DIFF INPUT COUPLER
PANEL POWER INPUT
SUPERVISORY SWITCH COUPLER
OFF
ON
SUPERVISORY
GENERAL PURPOSE INPUTS
1 2 3
Logic Control
AUTO ENABLE COUPLER
TRIACS
LOWER SOURCE RAISE
AUTO
OFF
MANUAL
RAISE
OFF
LOWER
NEUTRAL LAMP SENSE COUPLER
MOTOR CURRENT SENSE COUPLER
MF
6 AMP
SCP
PS
EXTERNAL SOURCE
OFF
INTERNAL SOURCE
4 1 10
5 2 11
6 3 12
BLK
RED
EST
VTT
WHT
GRN
OFF
DRAG HAND RESET
J7–12
J7–14
J7–11
J7–10
J7–1
J7–2
J7–13
J7–17
J7–18
J7–5
J7–15
J7–8
J7–9
J7–6
J7–16
J7–7
TB3–VS
TB3–VM
TB3–V7
TB3–8
TB3–7
TB3–6
TB3–G
TB3–5
TB3–J
TB3–BR
TB3–V9
TB3–L3
TB3–R3
TB3–HS
TB3–DHR
TB3–NL
TB3–L2
TB3–L3
TB3–R2
TB1–R1
TB3–VS
TB3–VS
TB3–V4
REMOVABLE JUMPER FOR ACCESSORIES
CC PIN I
CC PIN F
CC PIN E
CC PIN J
CC PIN H
LLS 1 2
JB
RLS 1 2
JBB–L
JBB–R
JBB–HS
JBB–DHR
CC PIN L
JBB–S6
MR (NOTE 2)
(NOTE 3)
C NC
LLS
C NC
LSS
T3 T2
T1
NC C
RLS
NC C
RSS
NO NC
NLS
C
1
IRS
2
1 2
MC
CC PIN N
JBB–S7
NO C C NO
HSL HSR
TCB–G
JBB–G (NOTE 4)
JBB–NL

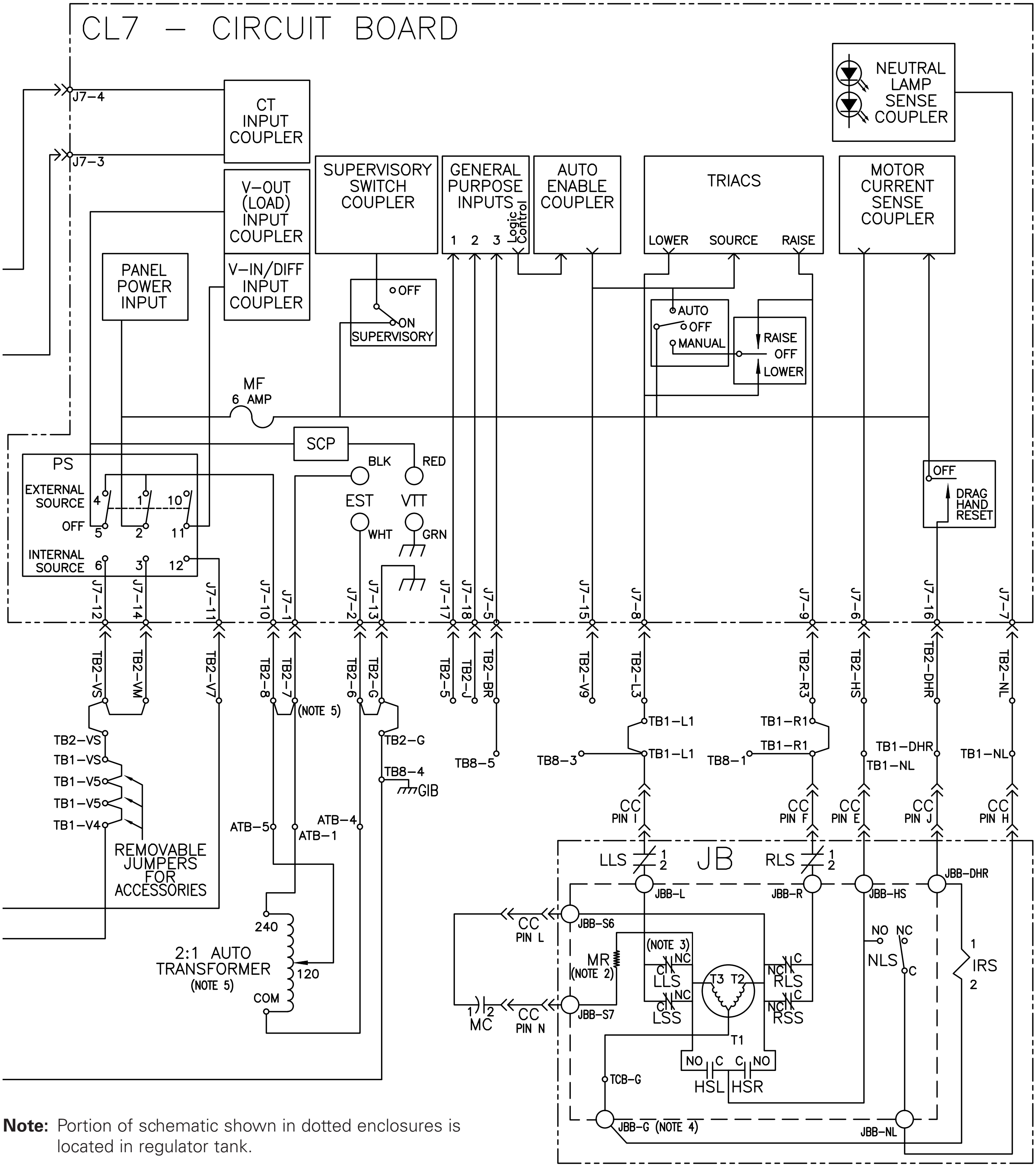
ATB	Auto-Transformer Terminal Board
C	CT Shorting Switch
CC	Control Cable
CT	Current Transformer (Toroidal Coil)
DPT	Differential Potential Transformer
DHR	Drag Hand Reset
EST	External Source Terminals
GIB	Ground Integrated into Terminal Board
GTB	Grounded to Back Panel
HSL	Holding Switch Lower
HSR	Holding Switch Raise
IRS	Indicator Reset Solenoid (Position Indicator)
JB	Junction Box on the Regulator Cover
JBB	Junction Box Terminal Board on the Cover
LLS	Lower Limit Switch (Position Indicator)
LLS	Lower Logic Switch (Tap-Changer)
LSS	Lower Safety Switch
MC	Motor Capacitor
MF	Motor Fuse
MR	Motor Resistor
NL	Neutral Light
NLS	Neutral Light Switch
PS	Power Switch
RCT	Ratio Correction Transformer
RLS	Raise Limit Switch (Position Indicator)
RLS	Raise Logic Switch (Tap-Changer)
RSS	Raise Safety Switch
SCP	Short Circuit Protection
TB	Control Terminal Board
TCB	Tap-Changer Terminal Board
V1	PT Voltage Interrupting Switch
V6	DPT Voltage Interrupting Switch
VM	Motor Voltage
VS	Sensing Voltage
VTT	Voltage Test Terminals



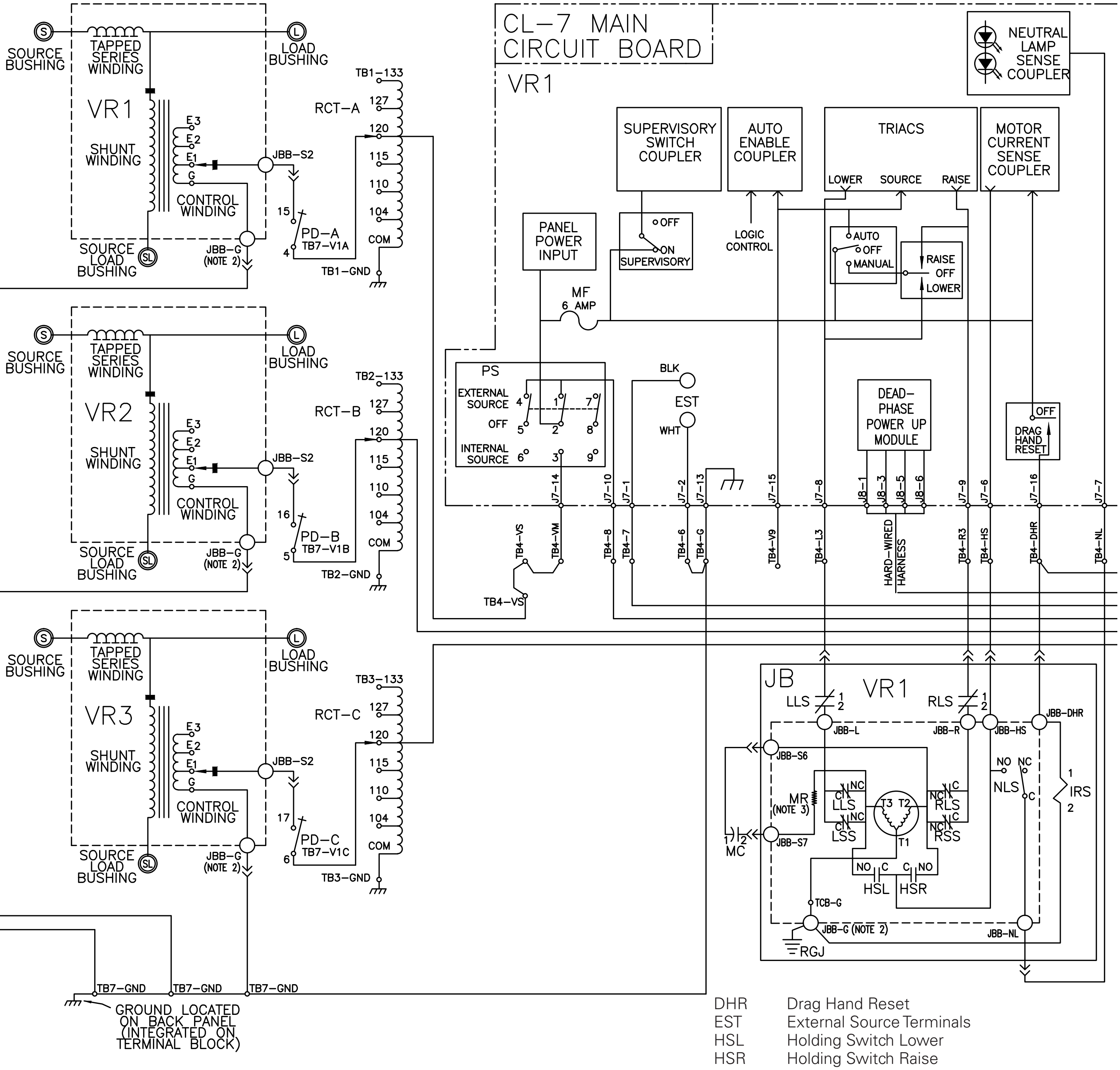
Notes:

1. Portions of schematic shown in dotted enclosure is located in regulator tank.
2. Motor resistor required for QD3 tap-changer only. Connection is direct for QD5 and QD8 tap-changers.
3. This switch is normally closed for QD3 and normally opened for QD5 and QD8 tap-changers.
4. The two JBB-G points shown are physically one connection point in the junction box.
5. For the 240 V external source option, the jumper between TB2-8 and TB2-7 will be removed and the connections to the auto transformer shown with dashed lines added.

Figure 9-2. Wiring diagram for Type B VR-32 Regulator and CL-7 control configures for 240 Vac external power source.



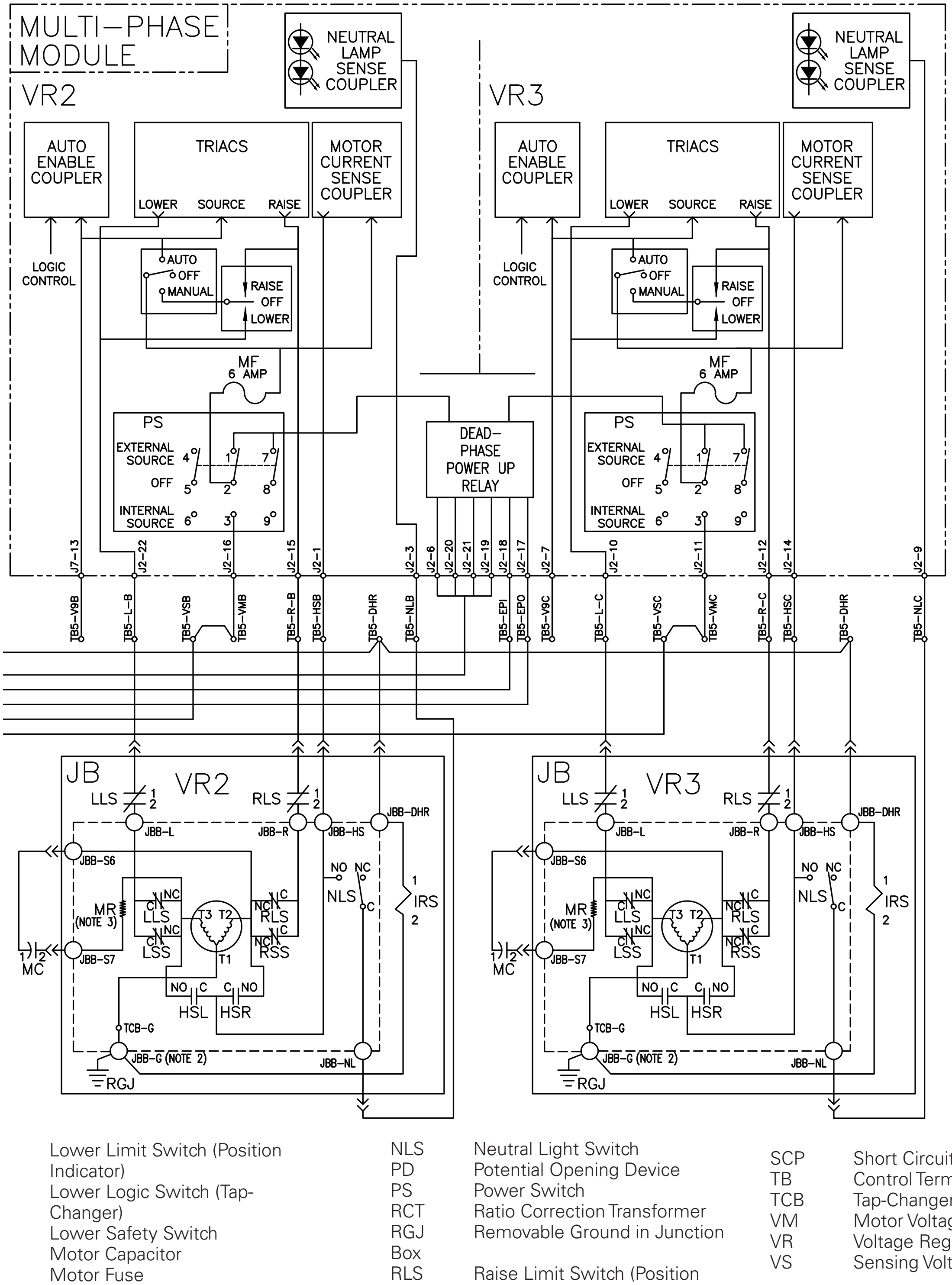
Note: Portion of schematic shown in dotted enclosures is located in regulator tank.



DHR	Drag Hand Reset
EST	External Source Terminals
HSL	Holding Switch Lower
HSR	Holding Switch Raise
IRS	Indicator Reset Solenoid (Position Indicator)
JB	Junction Box on the Regulator Cover
JBB	Junction Box Terminal Board on the Cover

Note: Portion of schematic shown in dotted enclosures is located in regulator tank.

Figure 9-3 Multi-phase motor schematic.



LLS	Lower Limit Switch (Position Indicator)
LLS	Lower Logic Switch (Tap-Changer)
LSS	Lower Safety Switch
MC	Motor Capacitor
MF	Motor Fuse
MR	Motor Resistor
NL	Neutral Light
NLC	Neutral Light Capacitor
NLS	Neutral Light Switch
PD	Potential Opening Device
PS	Power Switch
RCT	Ratio Correction Transformer
RGJ	Removable Ground in Junction Box
RLS	Raise Limit Switch (Position Indicator)
RLS	Raise Logic Switch (Tap-Changer)
RSS	Raise Safety Switch
SCP	Short Circuit Protection
TB	Control Terminal Board
TCB	Tap-Changer Terminal Board
VM	Motor Voltage
VR	Voltage Regulator
VS	Sensing Voltage

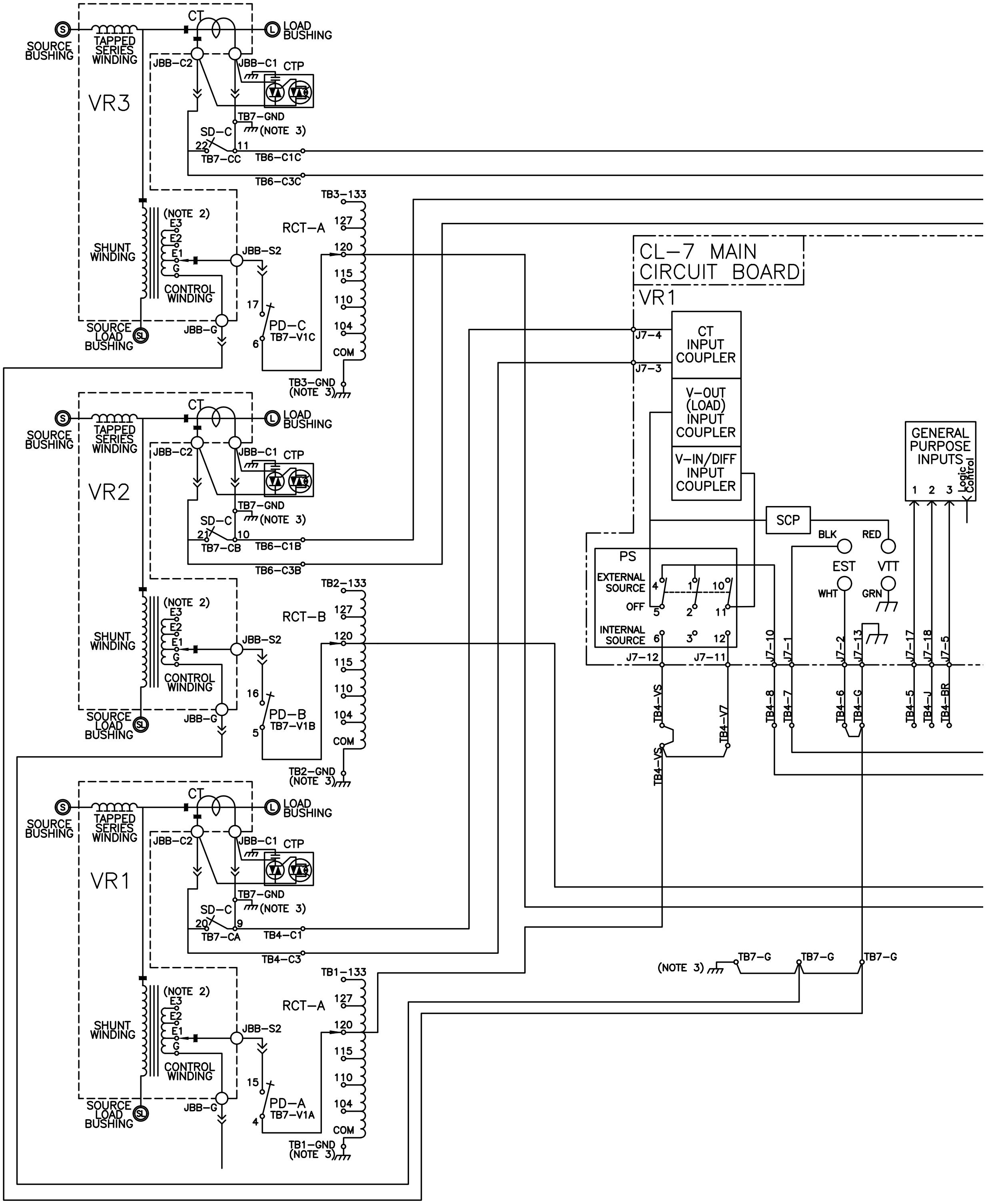
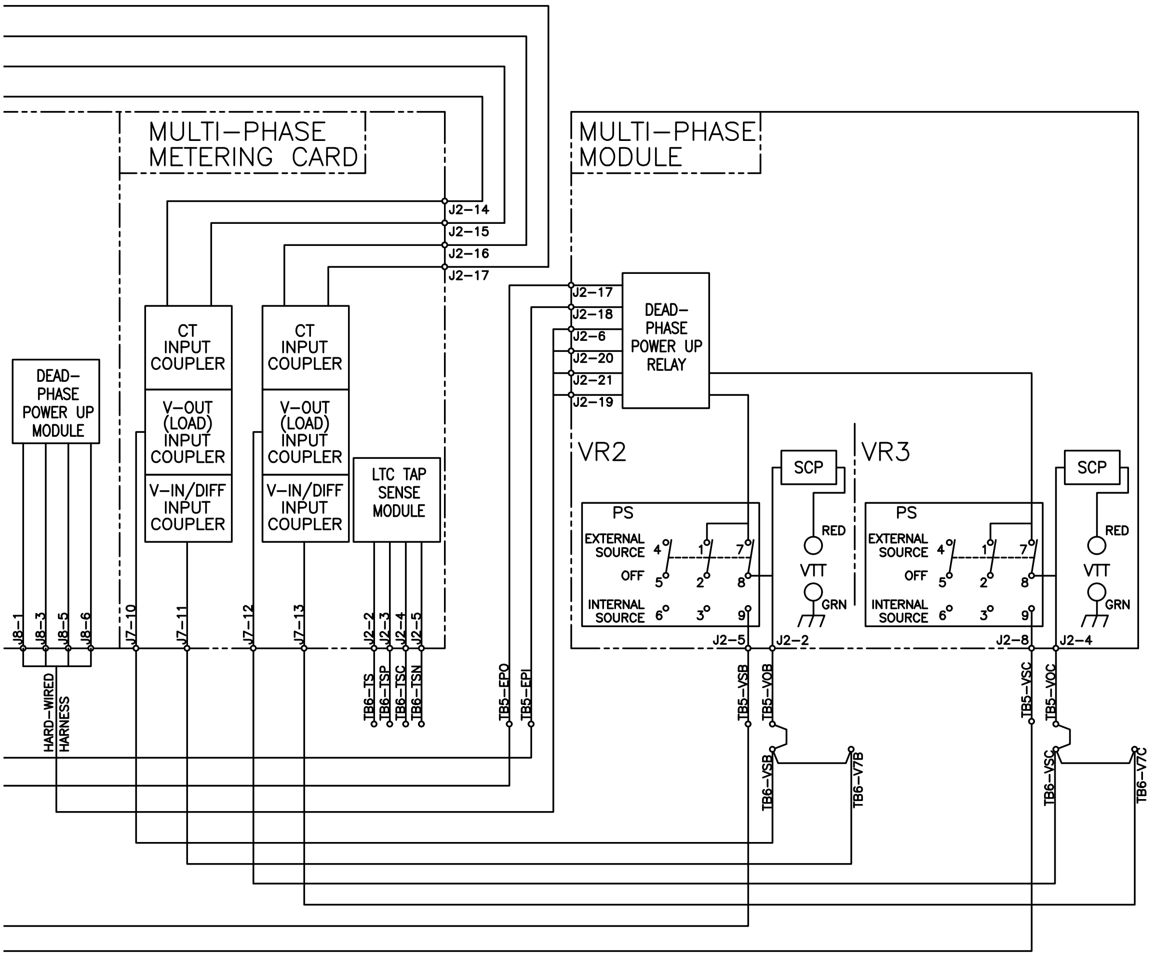
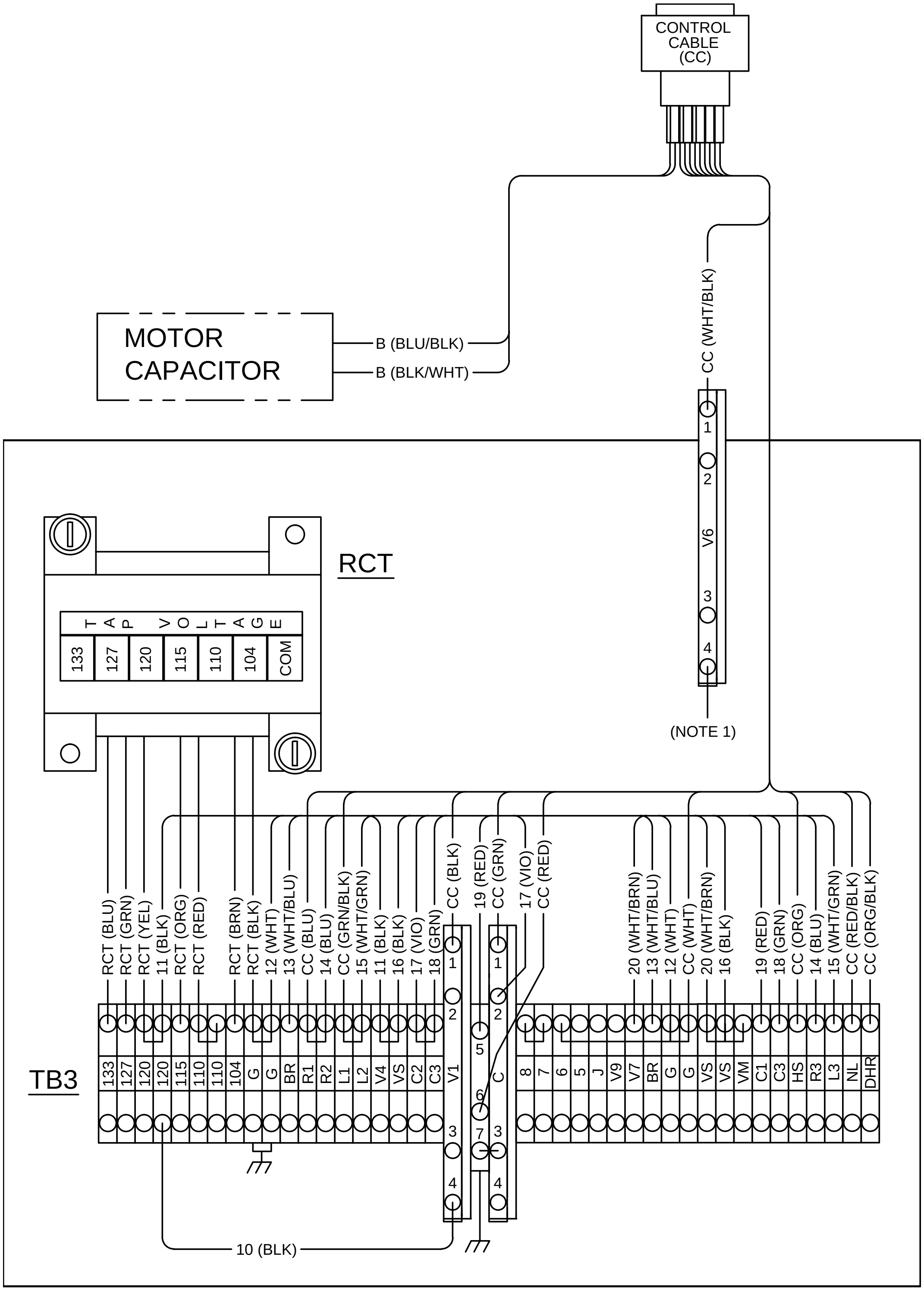


Figure 9-4. Multi-phase metering schematic



CT	Current Transformer (Toroidal Coil)
CTP	CT Protection Device
DHR	Drag Hand Reset
EST	External Source Terminals
JB	Junction Box on the Regulator Cover
JBB	Junction Box Terminal Board on the Cover
NL	Neutral Light
PD	Potential Opening Device
PS	Power Switch
RCT	Ratio Correction Transformer
SCP	Short Circuit Protection
TB	Control Terminal Board
VS	Sensing Voltage
VTT	Voltage Test Terminals



NOTES
1. LEAD 20 (WHT/BRN) CONNECTS V6-4 TO V7 INSTEAD OF VS TO V7 WHEN A DIFFERENTIAL PT IS UTILIZED.

Figure 9-5. Standard back panel signal circuit.

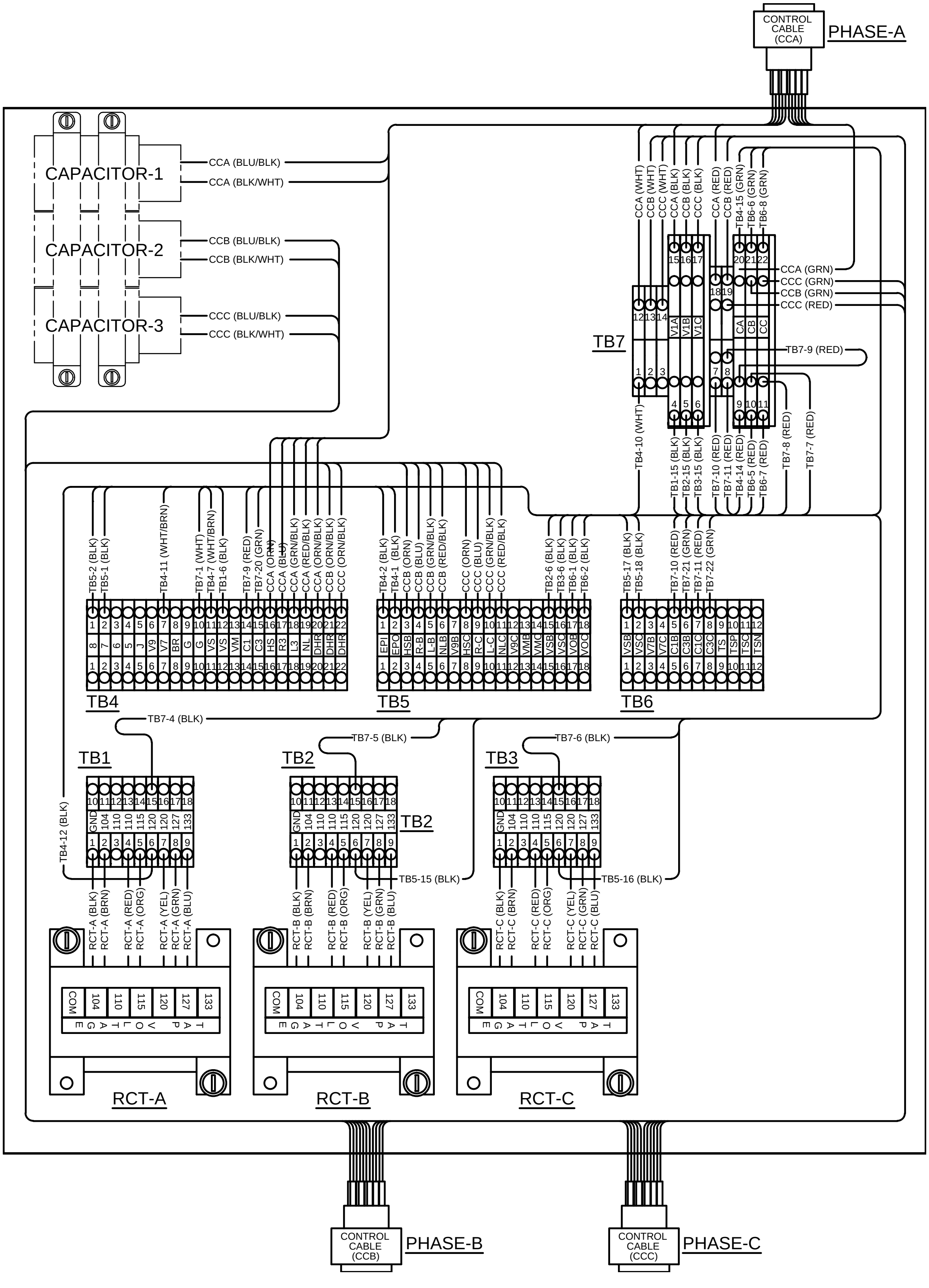


Figure 9-6. Multi-phase back panel signal circuit.

This page is intentionally left blank.

Powering Business Worldwide

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

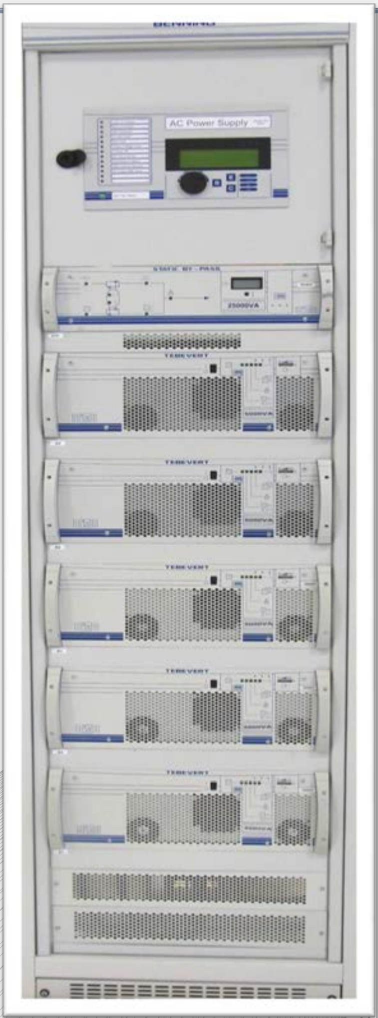
Eaton’s Power Systems Division
2300 Badger Drive
Waukesha, WI 53188
United States
Eaton.com/cooperpowerseries

Printed in USA
Publication No. MN225005EN / June 2016

For Eaton's Cooper Power series CL-7 regulator control product information, call 1-877-277-4636 or visit: www.eaton.com/cooperpowerseries.

BENNING

Operations and Maintenance Manual



Tebevert III 25kVA

120VDC Inverter System

028-0009-006 Rev. C

Benning Power Electronics
1220 Presidential Drive Suite 100
Richardson, TX 75081 USA
www.benning.us
800.910.3601

This manual contains important safety instructions that should be followed during installation and maintenance of the Power System.

TABLE OF CONTENTS

VERSION:

Revision	Date	Originator	Approver
A	06.01.08	C.Tumey	D.Almond
B	03.12.10	C.Tumey	E.McDonald
C	07.08.11	A.Waggott/J.Almond	D.Almond

Publication Document: Version 1.1

Proprietary Information: This manual contains proprietary information which is protected by copyright law. All rights are reserved. No part of this manual may be photocopied, reproduced, or translated to another language without prior written consent of Benning Power Electronics. Specifications in this manual are subject to change without notice.

PASSWORD:

Password Level 1: PW 1

Password Level 2: PW 2

Password Level 3: PW 3

Password Level 4: PW 4

NOTE: PUT A SPACE BETWEEN PW AND THE NUMBER

TEBEVERT III MODULAR
5-25 kVA INVERTER SYSTEM

The TEBEVERT III Modular Inverter System is designed to address the critical AC powering requirements of Industrial and Utility applications. The TEBEVERT III Modular Inverter System can be scaled in 5 kVA increments up to 25 kVA (non-redundant). Unlike conventional stand alone inverters, these parallel operating inverters can also be scaled to operate with N+1 redundancy. N+1 redundancy insures optimal availability for your critical load applications. If an inverter failure should ever occur, the faulty inverter module will automatically be removed from the output bus before a disruption in the output is seen by the critical load. In this mode of operation, a failure of one inverter will not effect the operation of your critical load. Since all units are designed for "hot swap" replacement, a faulty module can easily be unplugged and replaced to maintain power to your critical load.

120VDC Tebevert III System

Key Features

- Hot Swap 5 kVA Inverter Modules
- Hot Swap Static Switch Module
- Supports High Inrush Current Loads
- High Efficiency Operation, Lowers Operating Costs
- Low Distortion Output Voltage
- Integrated Maintenance Bypass Switch
- Meets EN 55022 Class B Requirements
- Automatic Master-Slave Operation
- Up to Five Inverter Modules Can Be Paralleled As Load Increases
- No Single Points Of Failure
- User Friendly Display Of Operating Mode
- Optional—Seismic Zone 4 Certified
- Optional—Internal AC Load Distribution Circuit Breakers

Certified ISO 9001 : 2000 by

Technical Specifications

	60HZ Models	
Output Capacity	5 - 25.0 KVA	
Maximum Number of Modules	The inverter cabinet supports a maximum of 5 inverter modules	
Nominal Bypass AC Input	120 VAC	208, 220, 240, 480VAC
# of Bypass AC Phases	1	2
Bypass AC Input Wiring	L, N, PE	L1, L2, PE
Nominal DC Input	120VDC	
DC Input Range	-15%, +20%	
Reflected DC Ripple, 120VDC	< 2mV reverse smoothing < 5% RMS	
Nominal AC Output Voltage	120VAC	120VAC
Optional AC Output Voltage	120/240VAC	120/240VAC
Output Voltage Regulation	+/- 5% for all combinations of line, load and temperature	
Output Power Factor	0.7 lagging to 0.8 leading	
Output Voltage Waveform	PWM sine-wave	
Output Crest Factor	2:8:1	
Output Voltage Distortion	< 3.5% @ 100% rated linear load	
Output Overcurrent Protection	Electronic current limiting	
Overload Rating (Inverters)	200% for approx. 75 cycles (1.25 seconds)	
Overload Rating (Static Bypass)	500% for 100ms	
System Operating Efficiency	> 89% (typical)	
Frequency Stability	+/- 0.1% free running, +/- 3% when AC present	
Module Capacity	5.0kVA/4.0kW	
Static Switch Transfer Time	< 2ms	
Cooling	Temperature controlled fans	
Maintenance Bypass Switch	Standard make-before-break mechanically interlocked switch provided on all models	
Remote Alarming	(1) Form-C Summary Alarm, Optional Relay Card (8 Alarms)	
LED indicators (Inverter Modules)	Output present, fault, overload, AC synchronized, parallel operation	
LED indicators (Static Bypass Switch)	Power flow diagram, normal, fault, ac present, dc present, overload, load on bypass, load on inverter	
Metering	(4) segment LCD display switchable between output voltage and current	
Cabinet Dimensions (H x W x D)	84” (2134 mm) x 23.6” (600 mm) x 23.6” (600 mm)	
Radio Interference	EN 55022, class B	
Altitude	6000 ft (1800 m), 13, 000 ft. (4000 m) at 30°C	
Operating Temperature	-5 to +40° C	
Operating Humidity	0-95% non-condensing	

Module Data	**5.0kVA**
Power Rating	5000VA/4000W
Nominal Input Current 120 VDC	38.0A
Maximum Input Current 120VDC	44A
Output Current NOM 120VAC	41.6A

Benning Power Electronics, Inc.
11120 Grader St . Dallas . TX 75238
E-Mail: sales@benning.us
WEB:www.benning.us

Toll Free: 800.910.3601
Outside the US: 214.553.1444
Fax: 214.553.1355

BENNING

PREFACE

Congratulations and thank you for purchasing a Benning TEBEVERT III Inverter System!

We at Benning are committed to supporting the needs of our customers by supplying the customer with the proper information and documentation needed to properly install and operate the unit purchased.

Important:

It is imperative that all the information be observed.

This avoids:

- ✓ Danger during installation and operation.
- ✓ Danger to operating personnel.
- ✓ Downtime.
- ✓ Increases the reliability and lifespan of the system.

This manual explains all the necessary information to unpack, install, and operate the Benning BLI Inverter System and related components. Refer questions outside the scope of this manual to our Customer Service Department.

Customer Service:

We are committed to excellence in dependability and customer satisfaction. If you have any questions or problems, please contact the Customer Service Department at: **1.800.910.3601 or 214.553.1444** for more information.

Please read all instructions before installing or operating the equipment and save these manuals for future reference.

Switched-Mode Modular
Series TEBEVERT
(HOT-PLUG-Version)
Inverter System

Model:

5.0kVA-25.0kVA (120VDC Input, 120 VAC Output Modules)

1 SAFETY NOTES AND MARKINGS

This operating manual contains important information for the installation, operation, and maintenance of the inverter system. This manual must be retained and observed at all times!

Explanation of the symbols used:

⚡	Indicates safety instructions which must be followed to avoid danger to persons!
⚠	Indicates instructions which must be followed to avoid material damage!
!📖	All specifications in these operating instructions must be observed at all times!

Index of abbreviations:

A	Amps
AC	Alternating Current
DC	Direct Current
I	Current
LVD	Low Voltage Detector
CB	Circuit Breaker
G	Ground
L	Line
N	Neutral
SNMP	Simple Network Management Protocol
V	Volts
W	Watts

Further symbols, diagrams and pictures are explained at the appropriate places within this operating manual.

Explanation of the abbreviations and definitions used:

SBS	Static By-Pass Switch (SBS)
DVA	Digital volt-ammeter
Mains	Commercial AC input power source
By-pass Input	Commercial AC Mains voltage providing an alternative AC source to the connected load equipment. The By-pass input is used by either the manual maintenance by-pass or the SBS for back-up support in the event of an inverter system failure.

> ⚠ The inverter system is an electrical unit with dangerous voltage and current levels. For this reason, the following safety instructions must be observed.

1. Installation, operation, maintenance, and repair should be carried out in strict accordance with the instructions in this document.

2. Ensure that only fully trained and qualified personnel have access to the system. Only qualified and authorized personnel should be able to open the units.

3. Even when the unit is completely switched off, some of its interior components remain live as long as they are connected to the mains supply or the battery.

4. Installed capacitors may be charged even when the system is disconnected. These must be correctly discharged by a qualified technician before the connections or terminals are touched.

5. When working at the unit, use properly insulated tools at all times which are suitable for the levels of voltage concerned.

6. All persons working with the unit must be familiar with the first-aid techniques to be adopted in cases of accidents involving electricity.

7. The regulations of the local power supply companies and all other applicable safety regulations must be observed at all times.

2 GENERAL

The TEBEVERT III family of modular inverter systems consists of: modular hot-plug, inverters, and an electronic static by-pass switch (SBS). All electrical connections are automatically disconnected or connected when the modules are pulled out of or pushed into the system cabinet. This may take place during normal operation without interruption in power to the connected load equipment. This design provides an uninterrupted supply of AC current and satisfies the highest requirements with respect to the expansion of the system, ease of maintenance and operating safety.

The TEBEVERT III is available for DC voltages of 120VDC. Each inverter module is available in 5.0kVA/4.0kW. Parallel operation of maximum of five (5) inverter modules provides a maximum system rating of 25.0kVA/20kW. The output voltage is 120VAC or 120/240VAC and can be adjusted to 50Hz or 60Hz according to the application.

⚠ ***Warning!***
Several inverter systems may not be operated in parallel. This may lead to the destruction of the inverter systems.

3 THE COMPONENTS OF THE TYPICAL INVERTER SYSTEM

The design and arrangement of the components of the inverter system are generally standardized.

The standard components are:

- (1) PSJ type equipment shelf
- 5 positions for the inverters
- (1– 5) inverter modules
- (1) position for the static by-pass switch (SBS)
- (1) manual maintenance by-pass switch

The input of the terminals and distribution positions within the cabinet depend on the supplied configuration. Refer to the equipment elevation drawing for specific terminal sizes and placement.

The inverter's static by-pass switch is only operational when properly installed into its corresponding position.

3.1 PSJ TYPE EQUIPMENT CABINET

The Benning TEBEVERT III system is built and supplied into a 19" PSJ type, fully enclosed, floor standing cabinet (23.6" X 23.6" X 7'0" outside overall dimension). Cabinets are available for New Equipment building Standards (NEBS) and non-NEBS applications. Deep cabinets (600mm x 800mm or 23.6" x 31.5" x 7'0") are available for special applications i.e. raised floor, etc. consult with Benning at time of order.

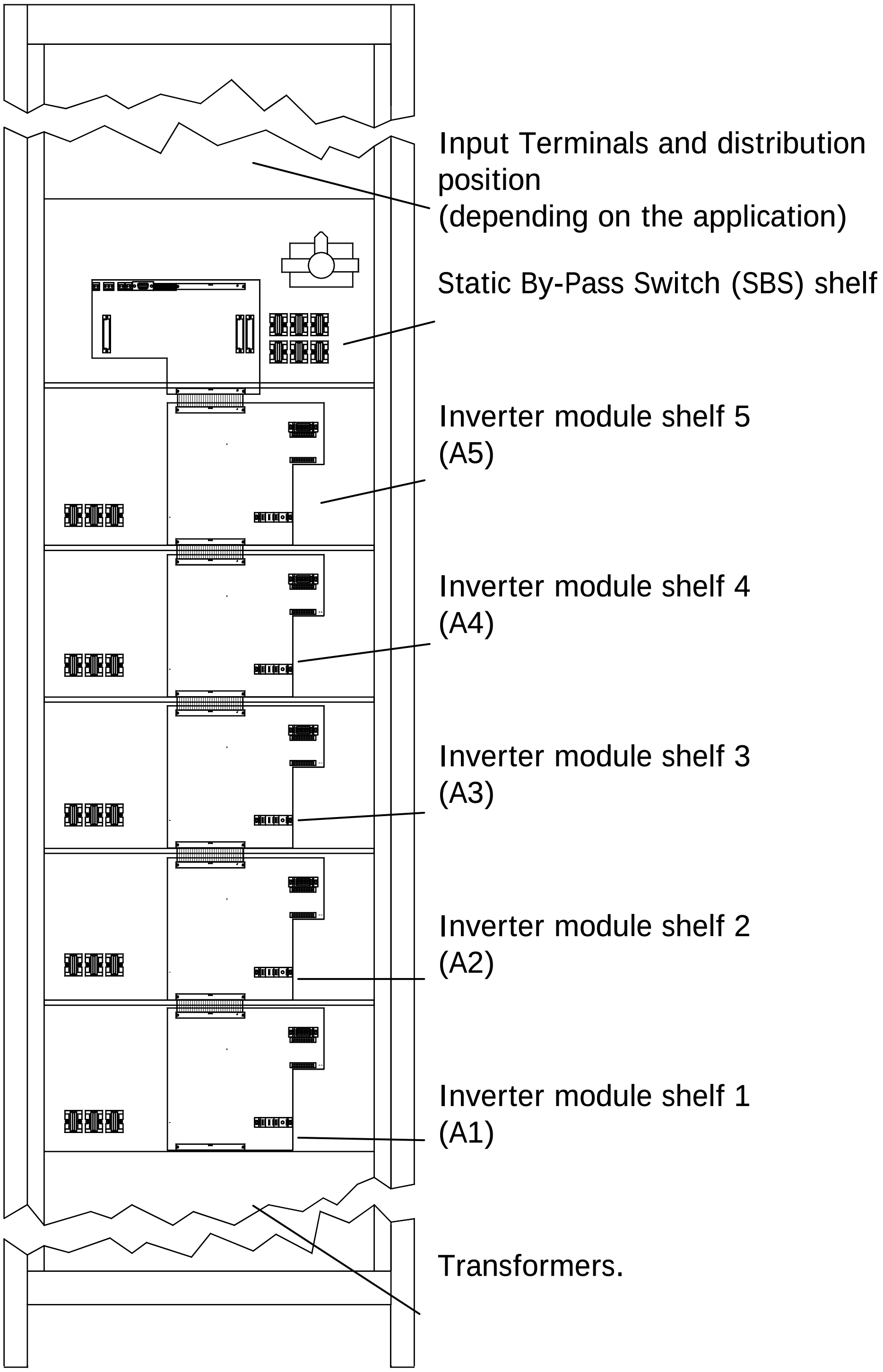


Fig. 1: Typical design of top feed cabinet

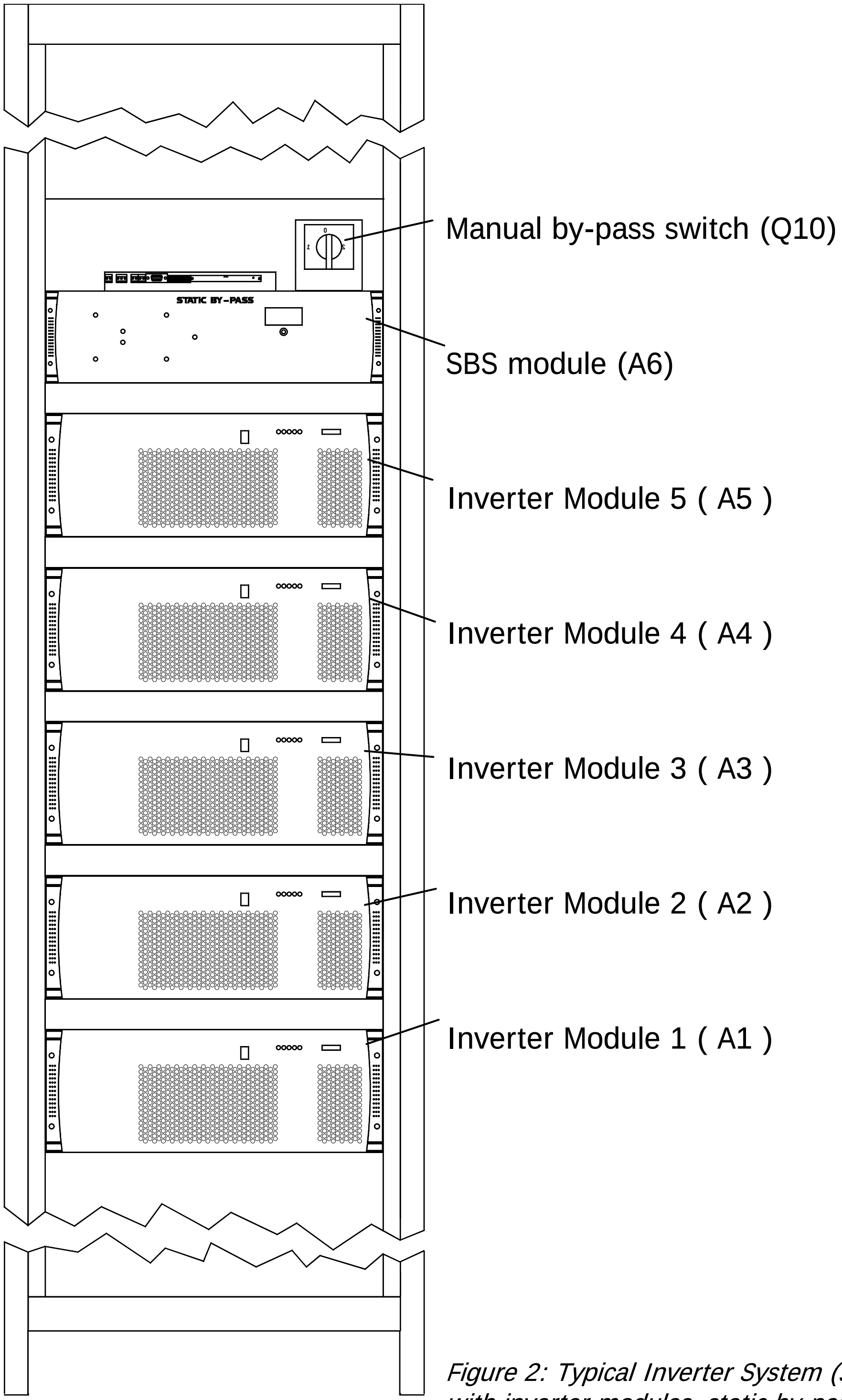


Figure 2: Typical Inverter System (shown with inverter modules, static by-pass)

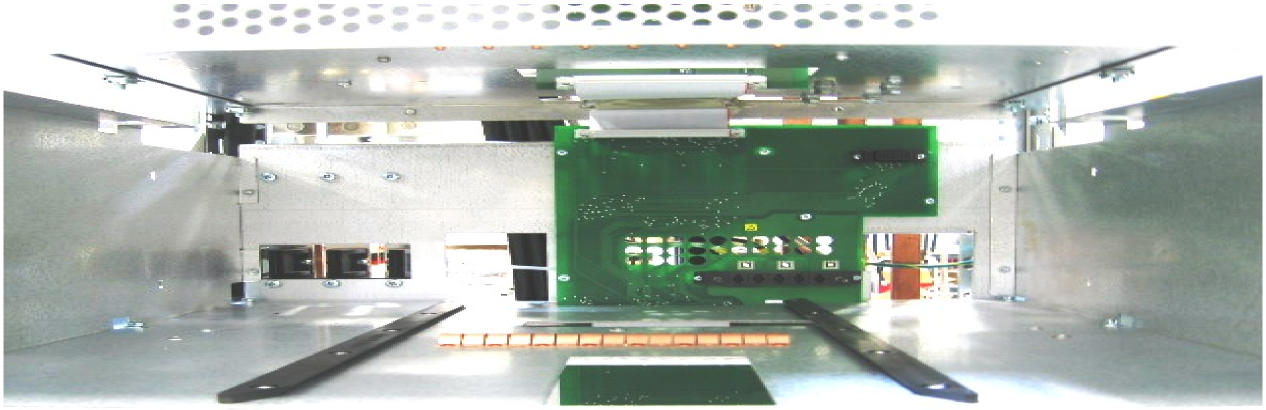
TYPICAL INPUT/OUTPUT TERMINALS FOR AN INDIVIDUAL FEED CONFIGURATION

Figure 3

TYPICAL SNMP OPTION

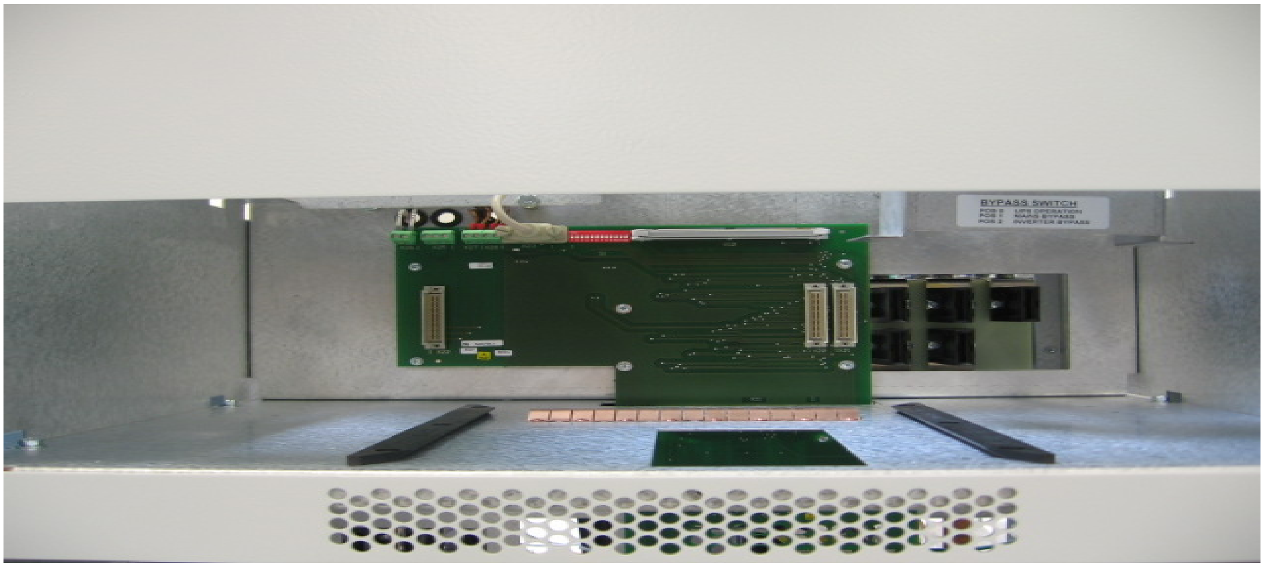
Figure 4

3.2 INVERTER MODULE SHELF



- Data line factory connected to the next inverter slot or the SBS slot (X1)
- Data connector for the inverter connection (X3)
- Load connector for the AC connection of the inverter output (X6) 3 poles (2.5kVA) 5 poles (5.0kVA)
- Data line factory connected to the next inverter slot (X2)
- Female connector for the DC connection of the inverter (+)
- Female connector for the DC connection of the inverter
- Female connector for the protective earth of the inverter (⏚)
- *Each inverter carrier is equipped with two guiding rails insuring the inverter is accurately positioned and a reliable contact is made.

3.3 SBS MODULE SHELF



- Terminal block for the connection of the auxiliary DC supply to the SBS (X26)
- Terminal block for the voltage-free collective fault messaging system of the inverter system (X25)
- Terminal block for the connection of the auxiliary contact signifying the by-pass switch is in the “manual by-pass inverter” position (X27)
- Terminal block for the connection of the auxiliary contact signifying the by-pass switch is in the "manual by-pass mains" position (X28)
- D-SUB connector for the optional connection of the inverter system to the MCU remote monitoring system (X23)
- DIP switches, without function (S1)
- Data line to the inverter slot (X10) (This is used if there are inverters arranged above the SBS. Not standard!)
- Manual by-pass switch with locking mechanism for the SBS (Q10)
- Female connector for the neutral contact mains input (N)
- Female connector for the neutral contact mains input (N)

- Female connector for the protective earth of the SBS (⏚)
- Female connector for the mains input (L1)
- Female connector for the SBS output and the inverter output (N)
- Female connector for the SBS output (L)
- Female connector for the inverter input (1L)
- Male connector for the data bus (X20; X21)
- Data line to the inverter slots
- Male connector for the auxiliary DC supply and the voltage-free fault messaging system (X22)

The SBS carrier is equipped with two guiding rails insuring the SBS module is accurately positioned and a reliable contact is made.

3. 4 MANUAL MAINTENANCE BY-PASS SWITCH

Fig. 5: Manual Maintenance By-pass Switch Q10

The manual maintenance by-pass switch is mechanically connected to both the SBS slot and the SBS itself. The locking mechanism prevents the SBS from being pulled out of the inverter system unless it has been switched to the proper position, Position “1” or “2”.

Significance of the switch positions (Refer to Section 6.1 for details):

Position 0: UPS operation

Position 1: Load on By-pass Input (Commercial AC)

Position 2: Load on Inverter Output

3.5 INVERTER

The inverter converts the incoming nominal DC voltage of 120VDC into AC voltage of 120VAC, 50 or 60Hz. (Refer to Section 4.3.x for specific wiring details)

⚠ *Important Note!*
The 120/240VAC configuration utilizes input/output transformers to convert the input and output voltages from the nominal 120VAC. Therefore the 120/240VAC system settings are configured the same as the standard 120VAC system.

3.5.1 DESIGN OF THE UNIT

The inverter module contains no serviceable components that must be accessible by the user during normal operation. Located on the front panel there are various LED´s used for the operational status and fault diagnosis.

⚠ Warning!
The removal of the front panel, the alteration of switching thresholds and the changing of the control fuse may only be carried out by qualified personnel.

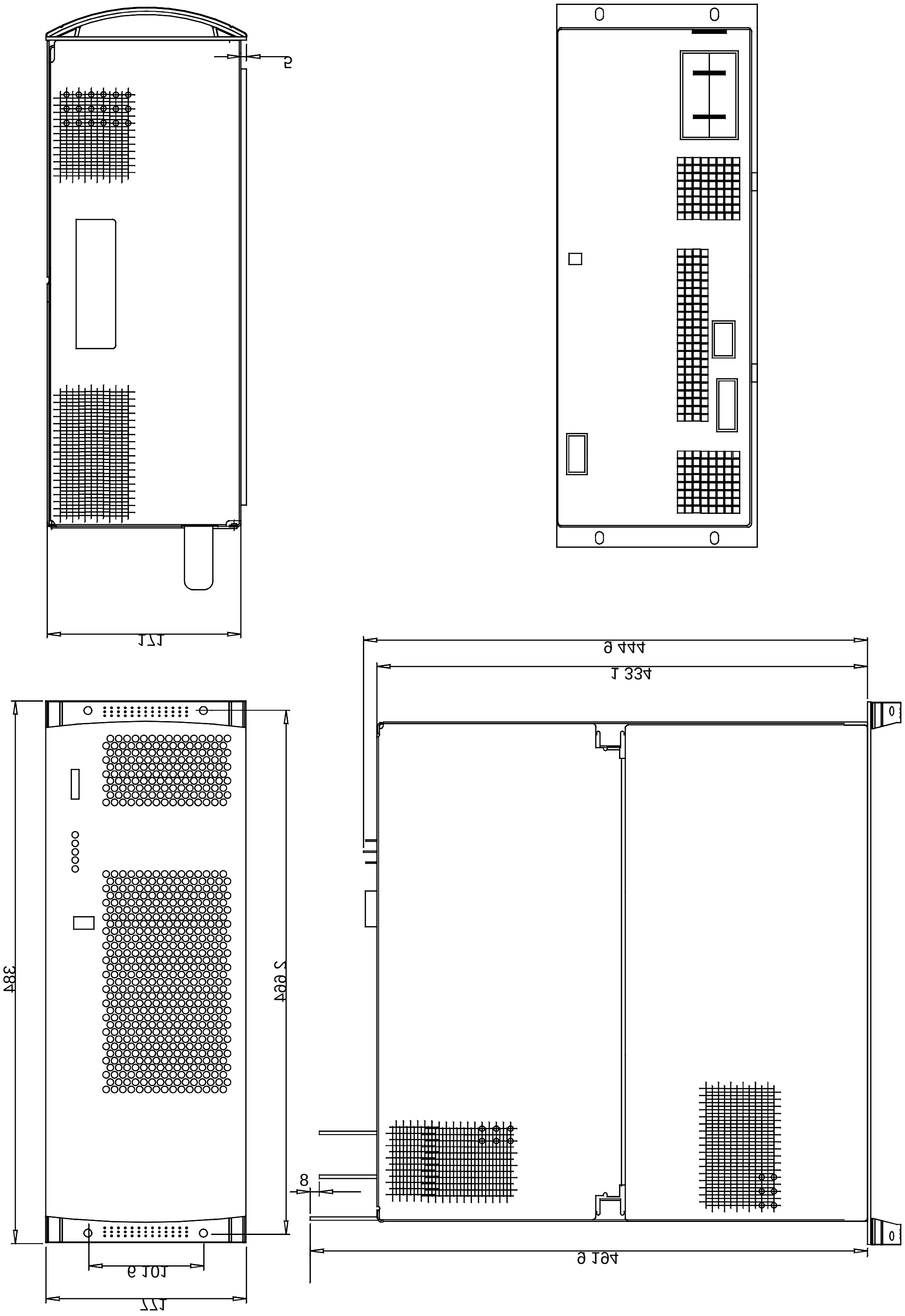


Fig. 6: Diagram of the modular inverter unit

3.5.2 TERMINALS AND OPERATING ELEMENTS

All terminals and operating elements are installed on the front or rear of the inverter module.

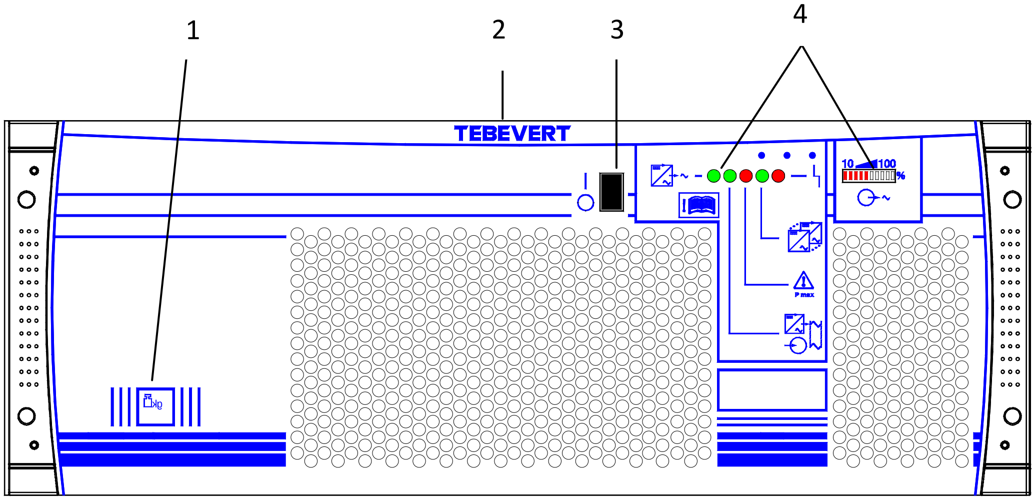


Fig. 7: Front view of the inverter

1	weight notice of the individual plug-in unit
2	type designation
3	on/off switch (S1)
4	LED signalling panel

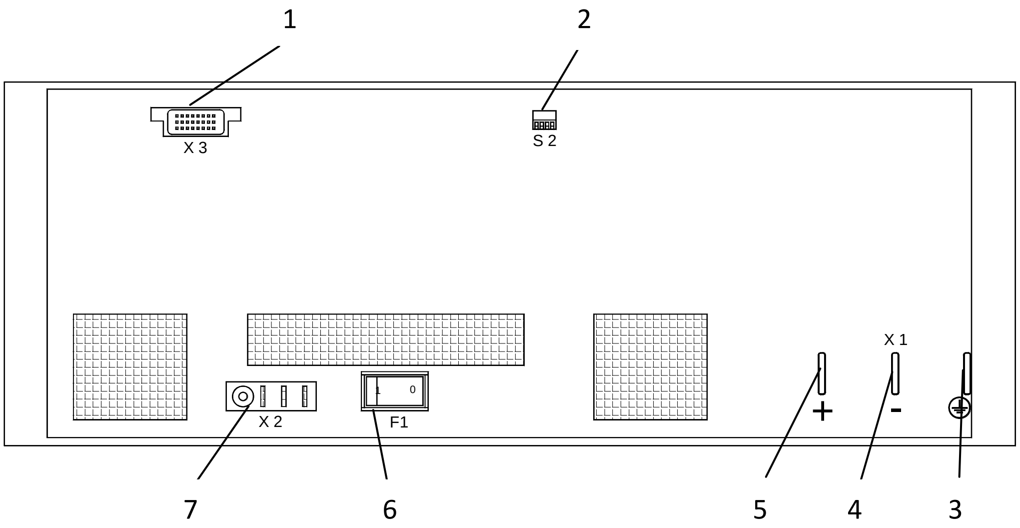


Fig. 8: Rear view of the modular inverter unit

1	Data connector (X3)
2	DIP switch to set the frequency (S2) (Refer to Section 4.1 for details)
3	Contact blade for the protective earth (X1: ⏚)
4	Contact blade for the DC input (X1: **-**)
5	Contact blade for the DC input (X1: **+**)
6	Inverter Output circuit breaker (F1) (Placed above of X2 for the 5.0kVA inverter)
7	Output connector (X2) 3 poles (5 poles for 5KVA/120VAC inverter)

3.5.3 SIGNALLING

On the front panel of the inverter there is a bar graph indicator and LED´s that are used to indicate the operating state of the inverter.

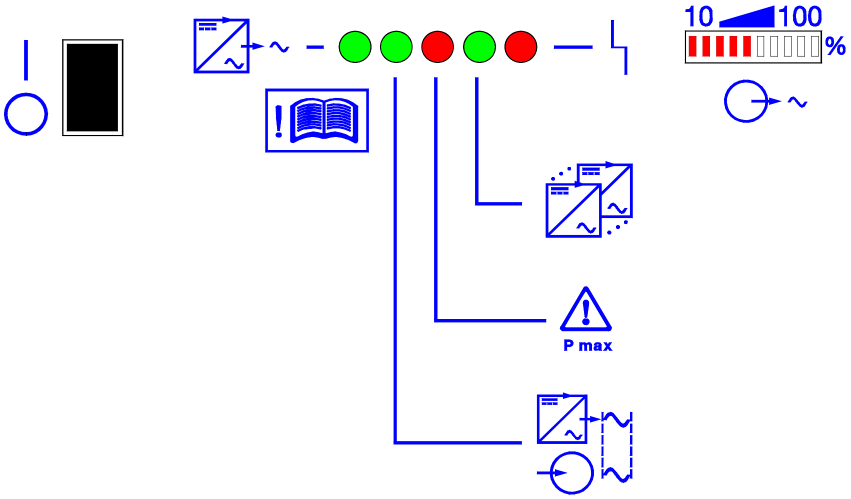
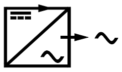
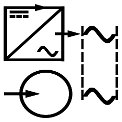
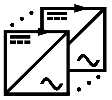


Fig. 9: Operating and signalling panel

!📖	This symbol indicates that all the points in this operating manual must be observed at all times.
I O	Indicates the position of the inverter's power switch, ON / I or OFF / O
○→~	Indicates the inverter output voltage is present. The bar graph indicator shows the output current of the inverter in steps of 10% relative to the maximum output current of the inverter.

LED	Color	Meaning when LED lights up
	green	The output voltage of the inverter is normal. (V_N= 120 or 120/240V) See note Important Note below. "OUTPUT VOLTAGE PRESENT"
	green	The output voltage of the inverter is in phase and frequency with the mains-supply voltage "MAINS-SUPPLY SYNCHRONIZED"
	red	The output current of the inverter is greater than 110% of the rated output current "OVERLOAD"
	green	The inverter is in parallel operation with other inverters. When this LED flashes, the inverter is operating as the MASTER. "PARALLEL OPERATION".
	red	The output voltage of the inverter is outside the tolerance range "FAULT".

Important Note!

The Benning Inverter Modules are 120VAC. Optional transformer converts the output of the inverter to 120/240VAC.

3.6 STATIC BY-PASS SWITCH (SBS) UNIT

The static by-pass switch (SBS) unit monitors the AC bypass input and DC input. The Inverter System operates primarily on DC and transfers to Ac automatically upon DC failure. The maintenance bypass switch should remain in position “0” for normal operation.

The SBS module can only be unplugged or inserted into the shelf when the manual maintenance by-pass switch is in position 1 or 2.

3.6.1 DESIGN OF THE UNIT

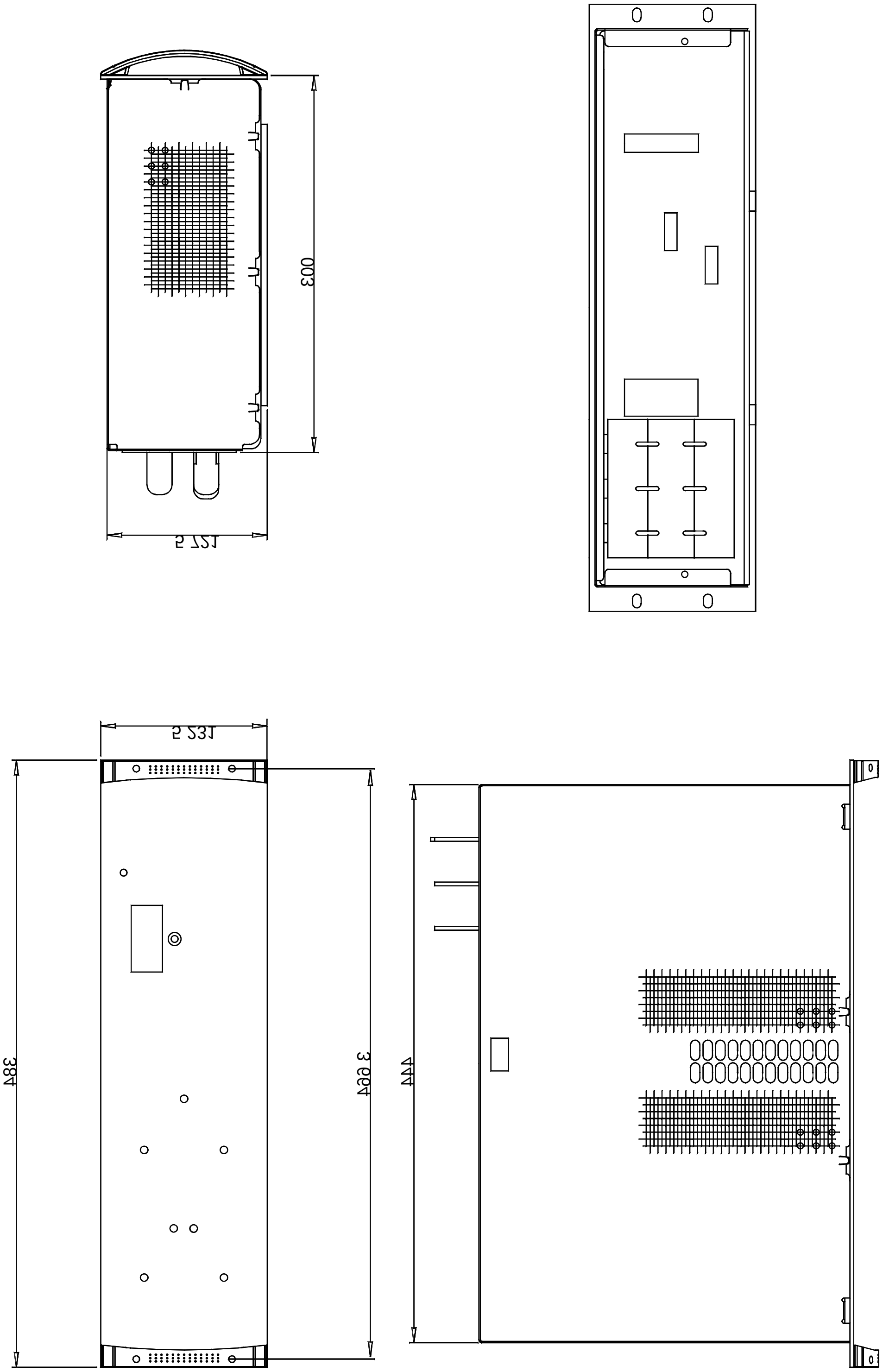


Fig. 10: Diagram of the static by-pass switch (SBS)

3.6.2 TERMINALS AND OPERATING ELEMENTS

All terminals and operating elements are on the front panel or rear of the SBS unit.

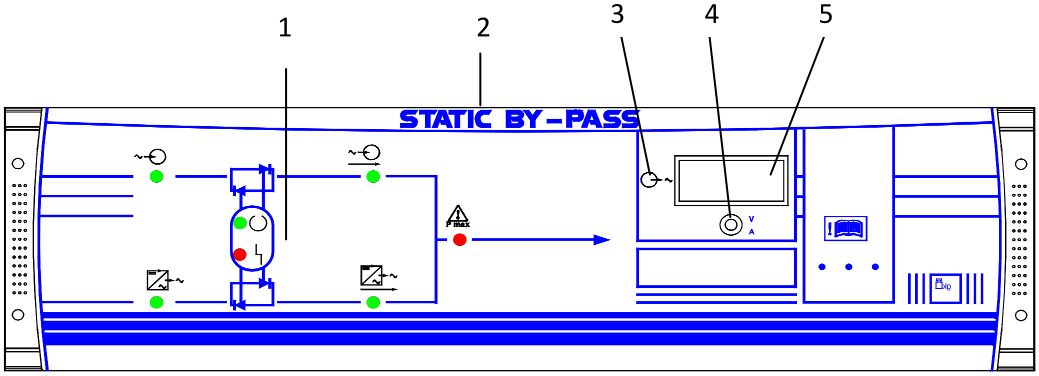
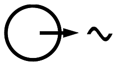


Fig. 11: Front view of the Static By-Pass Switch (SBS)

1 Display and signalling panel

2 Model designation

3  Indicates the system output

4 Selector switch to display either the inverter output voltage or inverter output current. According to the position of switch, the output voltage (V) or the output current (A) is displayed

5 Digital volt/ammeter (displays output voltage or the output current)

> ⚠ ***Important Note!***
> The 120/240VAC configuration utilizes input/output transformers to convert the input and output voltages from the nominal 120VAC. Therefore the voltage and current displayed on the Digital Voltmeter shall display the 120VAC component only.

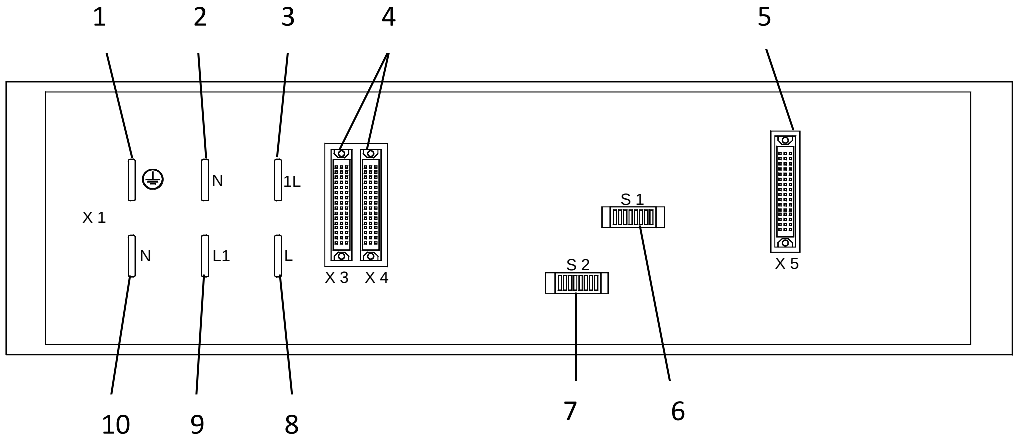


Fig. 12: Rear view of the Static By-Pass Switch (SBS)

1	Contact blade for the protective earth (X1: ⏚)
2	Contact blade for the SBS output (X1: N)
3	Contact blade for the inverter input (X1: 1L)
4	Female connector for the data bus (X3; X4)
5	Female connector for the auxiliary DC supply and voltage-free fault messaging system (X5)
6	DIP switches for system settings (S1) (Refer to Section 4.2 for details)
7	DIP switches for system settings (S2) (Refer to Section 4.2 for details)
8	Contact blade SBS output (X1: L)
9	Contact blade mains input (X1: L1)
10	Contact blade neutral contact, mains input (X1: N) (not included on 25.0kVA unit, part no. 120418)

3.6.3 SIGNALLING

On the front panel of the SBS module there is a digital volt/ammeter and various LED´s, used to indicate the operating state of the SBS unit.

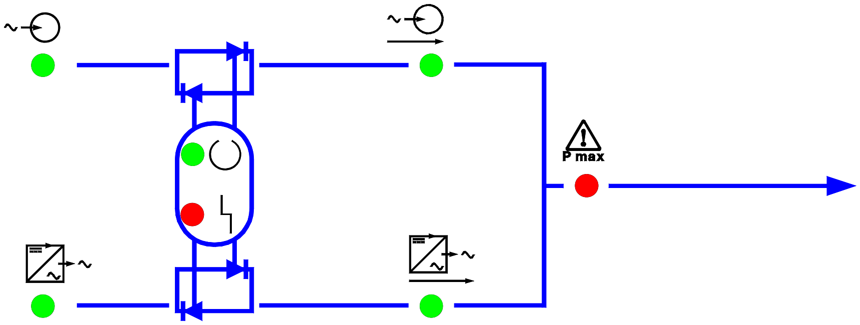


Fig. 13: Display and signalling panel

LED	Color	Meaning when LED lights up
∼→○ →	green	The SBS supplies the load equipment via the mains. "LOAD ON BY-PASS OPERATION"
⧄→∼ →	green	The SBS supplies the load equipment via the inverters modules. "LOAD ON INVERTER OPERATION"
∼→○	green	The mains voltage is within the limiting range. "MAINS VOLTAGE NORMAL"
⧄→∼	green	The inverter output voltage is within the limiting range. "INVERTER VOLTAGE NORMAL"
○	green	Mains voltage and inverter voltage are within the specified range, the inverters are operating synchronized to the mains. "NORMAL OPERATION"
ϟ	red	The SBS or the inverters have a fault. "FAULT".
⚠ P max	red	The inverter system is overloaded by more than 5%. "OVERLOAD"

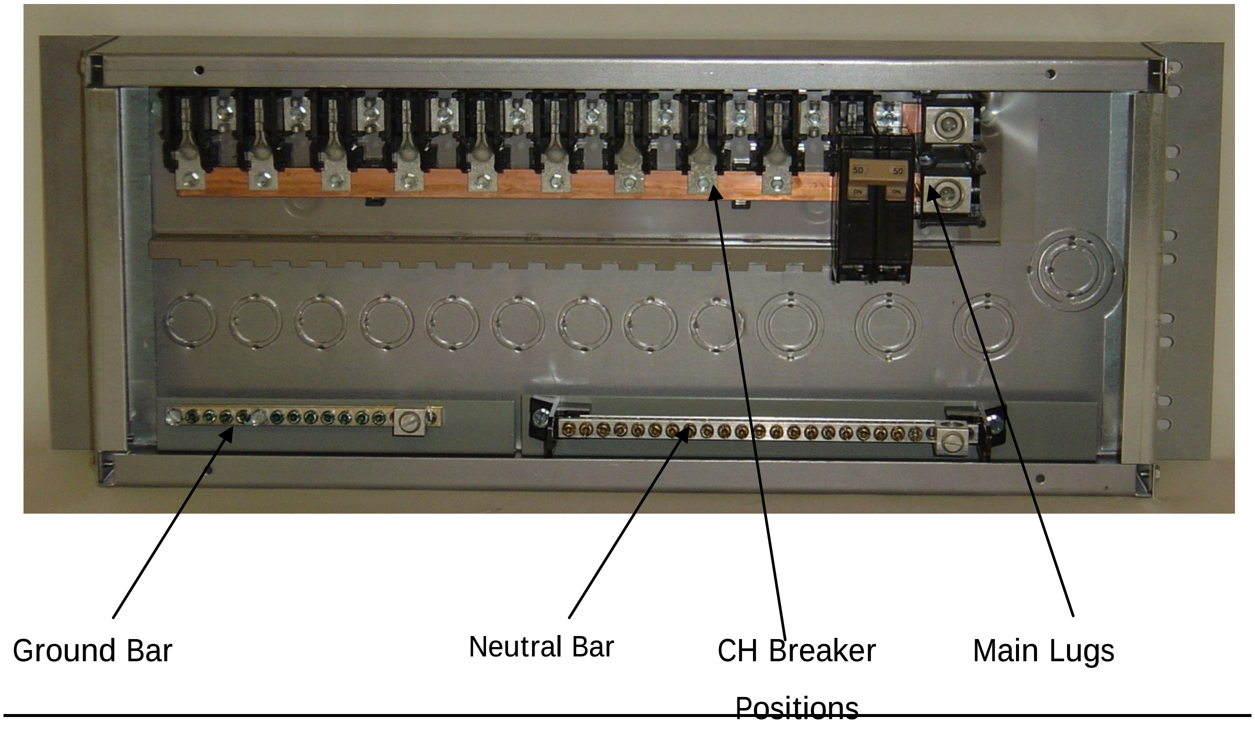
3.7 AC DISTRIBUTION PANEL

External AC electrical panels are recommended. These can be sourced from your local electrical supplier Benning. Two additional AC distribution options can be used with the inverter cabinet. One utilizes a standard North American style snap-in breaker and the other utilizes standard DIN style breakers.

3.7.1 NA STYLE SNAP-IN BREAKER PANEL

Note: This panel cannot be installed in the inverter cabinet.

This AC Distribution Panel is a UL Listed, externally mountable option. The panel is designed to accommodate up to 20 breaker positions using standard Eaton/Cutler Hammer CH style snap-in breakers. The maximum allowable sized breaker is 50A per pole. The maximum allowable current per bus is 125A. The AC Distribution Panel is designed to mount into a standard 19" relay rack and occupy 5U of vertical space. Conduit knockouts are provided for conduit to enter the back of the panel for the output wiring. These knockouts sized for either ¾" or 1" conduits. The input wiring is provided via a pigtail through a knockout also located at the rear of the panel. This panel can be wired to the inverter output. This option can be wired as 120VAC and Neutral or 120/240VAC and Neutral depending on the output voltage selected.



3.7.2 DIN RAIL STYLE BREAKER PANEL

This AC Distribution option is an internally mountable option. The panel is designed to accommodate up to 24 breaker positions using standard CBI type QL, UL Listed, 1 or 2-pole, DIN Rail mounting circuit breakers. The maximum allowable sized breaker is 25A per pole. The maximum allowable current per bus is 125A. This AC Distribution is designed to mount into the standard inverter cabinet and occupies 4U of vertical space. Neutral and Ground connections are provided as part of the distribution option. This option can be wired as 120VAC and Neutral or 120/240VAC and Neutral depending on the output voltage option selected.

Commercial AC

(By-pass)

1 or 2 pole

output breakers

(CBI) – L1 and/or

Ground (PE)

Neutral (N)

4 INSTALLATIN AND COMMISSIONING

After assembly, installation and commissioning of the inverter system, all components are ready for operation. No additional settings and adjustments are necessary.

> ⚠ ***Warning!***
> The safety instructions must be observed at all times during assembly, installation and commissioning.

The site chosen for the inverter system must have a solid and level floor. The inverter system is designed for operation in a restricted access, dry environment. The maximum ambient temperature is 40°C. Attention must be paid the inverter system is not exposed to air borne containments and the flow of cooling air is not hampered.

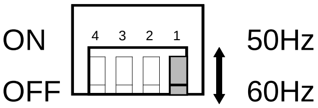
4.1 INVERTER SETTINGS

Each inverter is set to factory default values according to the required operating conditions. (See Chapter 3.7 / Technical data or the specification sheet) An adjustment of these settings is not usually necessary.

However, if the inverter must operate at 50 HZ, a simple adjustment can be carried out.

⚠ ***Warning!***
Alteration of the unit settings may only be carried out by qualified personnel. The altered settings must be clearly marked on the unit. Any alternations of these settings must also be performed on all other inverters within the system and on the SBS.

The output frequency is changed with the DIP switch S2 located on the rear side of the inverter unit (See Figure 8)



NOTE: Only the setting of switch 1 is changed. All the other switches must always remain in the OFF position.

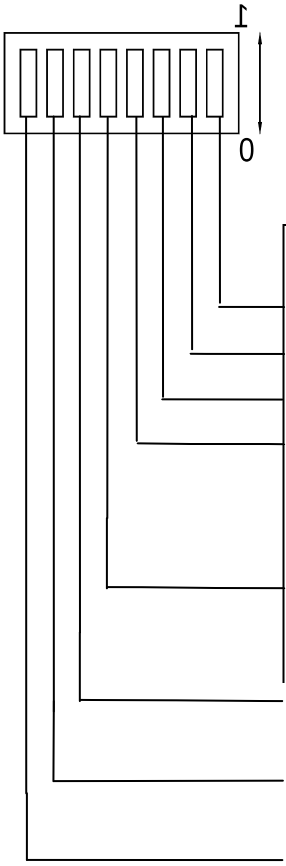
4.2 SETTINGS OF THE STATIC BY-PASS SWITCH (SBS)

The Static By-Pass Switch (SBS) is factory set to default values. (See Chapter 3.7 / Technical data or the specification sheet). It is not usually necessary to change these settings.

However, if the units are exchanged or there are different operating conditions, the settings must be checked or readjusted.

⚠ ***Warning!***
Qualified personnel may only carry out alteration of the settings on the unit. The altered settings must be clearly marked on the unit.

On the rear side of the SBS unit there are 2 sets of DIP switches S1 and S2. (See Figure 12)



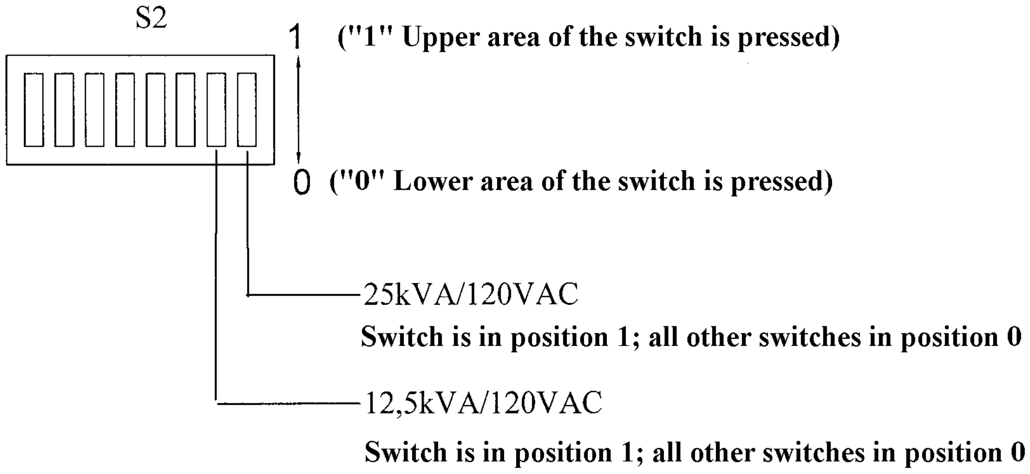
Adjustments	Position 1		Position 0	
Operating mode	inverter priority		mains priority	
Nominal voltage	120 or 120/240 V		230 V	
Nominal frequency	50 Hz		60Hz	
Mains error signal	no mains available (no mains failure indicator)		operation with mains! (mains failure indicator.)	
Fault signal	fault signal of STATIC BY-PASS		Common fault signal from the STATIC BY-PASS and inverter	
Maximum deviation of nominal frequency	Pos 1 □3%	Pos 0 □4%	Pos 1 □1%	Pos 0 □6%
Maximum deviation of nominal frequency	Pos 1	Pos 1	Pos 0	Pos 0
no function				

Note: The highlighted areas correspond to factory default settings.

The settings of S2 provides the SBS with the information on the output power of the connected inverters. Depending on inverter system (25kVA/120 or 120/240VAC) only one highlighted switch may be in position 1.

⚠ *Important Note!*

The setting of S2 shall be the same for both the 120 and 120/240VAC systems.



4.3 PANEL WRITING

The cable is fed into the inverter system from above or below, according to the model. The size and location of the terminal blocks and distribution assemblies are configuration dependant, refer to Elevation drawing for exact requirements. For the cross-sections and the recommended over-current protection the following values must be observed. The recommended cable sizes shown below meet National Electrical Code (NEC) Table 310-16 requirements, however please remember that larger size cables may be required in order to meet site voltage drop requirements. It is recommended that if a system can be expanded with additional inverters in the future, the initial AC wiring be sized for the maximum number of inverters.

Larger cross-sections should be used to reduce the effects of voltage-drop depending on the conditions at the installation site than would normally be necessary due to the current.

There are three options for the DC input section of the Inverter system.

- Bulk input accepting up to 750MCM two-hole lugs, two per pole in a back-to-back configuration. The hole pattern is designed for 3/8” holes at 1” cc. EC-701 must be ordered for this.
- Individual DC input per inverter module using screw compression type terminal blocks. These terminal blocks accept up to one 4/0 stranded cable.
- Individual DC input per inverter module accepting two-hole lugs with 3/8-16 studs on 1”cc. These terminal blocks accept up to one 4/0 stranded cable per pole.

Warning!

For the proper protection of the load circuits careful attention must be paid to the selection of upstream the mains protection.

⚠

The voltage-free fault messaging contact are rated for a maximum of 230VAC/1A or 270VDC/0.2A (50W max).

If a future inverter expansion is planned, the cable cross-sections and the fuse protection must be used for the maximum values of load power requirements.

Warning!

⚠

If an external battery is connected to the DC inputs of the inverter, then the instructions concerning the installation and maintenance given by the manufacturer of the battery must be observed.

The supply circuits must be equipped with a disconnecting device. It must be mounted close to the cabinet and easily accessible.

The system has high leakage current. Earth connection is essential before connecting supply

4.3.1 DC CABLE REQUIREMENTS FOR 25kVA, 120 VDC INDIVIDUAL DC INPUT (DIN RAIL OR BUSBAR TERMINAL BLOCK)

Terminal designation	Connection type	Terminal/connection capacity	Suggested protection
X1: 1L+/1L-	DC input/inverter 1	**Compression Type** 2AWG – 4/0	50A/8 AWG
X1: 2L+/2L-	DC input/inverter 2	**Compression Type** 2AWG – 4/0	50A/8 AWG
X1: 3L+/3L-	DC input/inverter 3	**Compression Type** 2AWG – 4/0	50A/8 AWG
X1: 4L+/4L-	DC input/inverter 4	**Compression Type** 2AWG – 4/0	50A/8 AWG
X1: 5L+/5L-	DC input/inverter 5	**Compression Type** 2AWG – 4/0	50A/8 AWG
X4: NC/C/NO	Alarm fault signal	**Compression Type** 28 - 10AWG	2A/18 AWG
Frame GND	Bonding ground	3/8” stud, 1”c-c two hole lug	

4.3.2 DC CABLE REQUIREMENTS FOR 25kVA, 120VDC, BULK DC INPUT SYSTEM

Supply conductor	Maximum system capacity	Suggested rating of disconnect device
DC Input	25kVA 5 Inverters	120VDC/(250-300) A

Terminal designation	Connection type	Terminal/connection capacity	Suggested protection
X1: +/-	DC input/inverter 1 max. DC input/inverter 2 max. DC input/inverter 3 max. DC input/inverter 4 max. DC input/inverter 5 max.	**Busbar** 3/8” x 1”cc 2 X 750MCM max. Requires Part. No. EC-701	(250-300) A
X4: NC/C/NO	Alarm fault signal	**Compression Type** 28 - 10AWG	2A/18 AWG
Frame GND	Bonding ground	3/8” single hole lug	

4.3.3 AC CABLE REQUIREMENTS FOR 25kVA, 120VAC AC INPUT RATINGS

Supply conductor	Maximum system capacity	Suggested rating of disconnect device
Mains	5 inverters	120VAC/250A

Terminal designation	Connection type	Terminal/connection capacity	Suggested protection
X2: L1/N/PE	5 inverters	**Compression Type** 2 AWG - 4/0	250A

4.3.4 AC CABLE REQUIREMENTS FOR 25kVA, 120/240VAC AC INPUT SYSTEM

Supply conductor	Maximum system capacity	Suggested rating of disconnect device
Mains	5 inverters	120/240VAC/150A

Terminal designation	Connection type	Terminal/connection capacity	Suggested protection
X2: L1/L2/PE	5 inverters	**Compression Type** 2 AWG - 4/0	150A

4.3.5 AC CABLE REQUIREMENTS FOR 25kVA, 208VAC AC INPUT SYSTEM

Supply conductor	Maximum system capacity	Suggested rating of disconnect device
Mains	5 inverters	120/208VAC/150A

Terminal designation	Connection type	Terminal/connection capacity	Suggested protection
X2:L1/L2/PE	5 inverters	**Compression Type** 2 AWG - 4/0	150A

4.3.6 AC CABLE REQUIREMENTS FOR 25kVA, 220VAC AC INPUT SYSTEM

Supply conductor	**Maximum system capacity**	**Suggested rating of disconnect device**
Mains	5 inverters	220VAC /150A

Terminal designation	**Connection type**	**Terminal/connection capacity**	**Suggested protection**
X2:L1/L2/PE	5 inverters	**Compression Type** 2 AWG - 4/0	150A

4.3.7 AC CABLE REQUIREMENTS FOR 25kVA, 240VAC AC INPUT SYSTEM

Supply conductor	**Maximum system capacity**	**Suggested rating of disconnect device**
Mains	5 inverters	120/240VAC /150A

Terminal designation	**Connection type**	**Terminal/connection capacity**	**Suggested protection**
X2:L1/L2/PE	5 inverters	**Compression Type** 2 AWG - 4/0	150A

4.3.8 AC CABLE REQUIREMENTS FOR 25kVA, 480VAC AC INPUT SYSTEM

Supply conductor	**Maximum system capacity**	**Suggested rating of disconnect device**
Mains	5 inverters	480VAC /70A

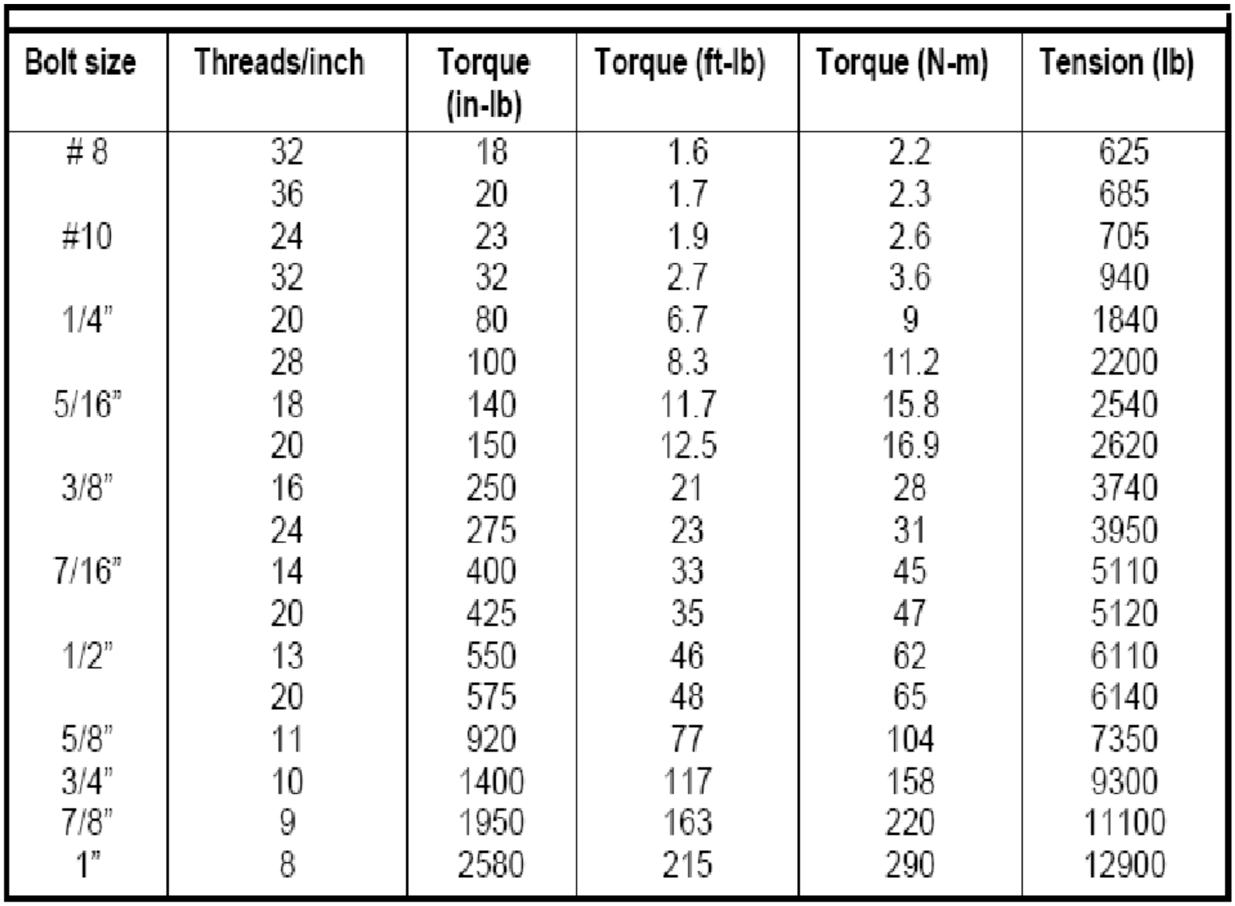
Terminal designation	**Connection type**	**Terminal/connection capacity**	**Suggested protection**
X2:L1/L2/PE	5 inverters	**Compression Type** 2 AWG - 4/0	70A

4.3.9 TORQUE TABLE FOR ALL TERMINATIONS

Terminal Block Torque Table

Terminal P/N#	in-lb	ft-lb
UKH95	177.01	14.75
UKH150	265.52	22.12

Stud Terminal Torque Table



Bolt size	Threads/inch	Torque (in-lb)	Torque (ft-lb)	Torque (N-m)	Tension (lb)
# 8	32	18	1.6	2.2	625
	36	20	1.7	2.3	685
#10	24	23	1.9	2.6	705
	32	32	2.7	3.6	940
1/4"	20	80	6.7	9	1840
	28	100	8.3	11.2	2200
5/16"	18	140	11.7	15.8	2540
	20	150	12.5	16.9	2620
3/8"	16	250	21	28	3740
	24	275	23	31	3950
7/16"	14	400	33	45	5110
	20	425	35	47	5120
1/2"	13	550	46	62	6110
	20	575	48	65	6140
5/8"	11	920	77	104	7350
3/4"	10	1400	117	158	9300
7/8"	9	1950	163	220	11100
1"	8	2580	215	290	12900

4.4 INSTALLATION OF THE UNITS

Prior to the installation of the Static By-Pass Switch (SBS) and the inverters in the inverter system, the following points must be checked and observed.

- Verify that the units are of the same type and model (120VDC / 120VAC) Since all inverters of this series are identical for the user, the exact model of the unit must be checked.
- Verify the position of circuit breaker (F1) located on the rear of the module. It must be in the "ON" position, position 1.
- Verify the SBS, as described in Chapter 4.2
- Verify all the inverters set to the same frequency (50Hz or 60Hz) (See Chapter 4.1)
- Verify that (S1) on front of each module is switched off.
  (Power switch position ON/OFF)

4.4.1 INSTALLATION OF THE STATIC BY-PASS SWITCH (SBS)

At the time the Static By-Pass Switch (SBS) is installed, the operating handle of the manual maintenance by-pass switch is attached. The handle is installed on top of the SBS unit using supplied four (4) M4 x 8mm screws. Position the switch mechanism and the operating element in the following position.

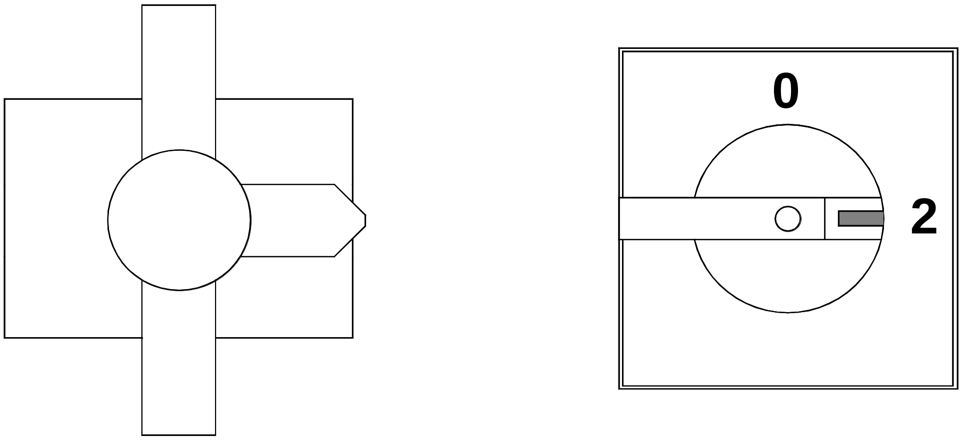


Fig. 14: Installation positions of the locking mechanism and the operating element

Using the guiding rails located on the base of the mounting shelf, slowly push the SBS unit into the shelf until the front panel is flush with the frame of the cabinet. This should require minimal effort. All electrical contacts have been made and the operating element of the manual by-pass switch is connected to its rotation axle. The SBS is fixed into the cabinet with four screws (supplied).

4.4.2 INSTALLATION OF THE INVERTERS

⚠ ***Warning!***
The weight of each inverter is approx. 35kg (77lbs). The unit may only be lifted and transported using the carrying handles built into each side of the unit. DO NOT carry or lift the unit using the handles on the front panel!

Before the inverter unit is installed, any materials used to protect the unit during transportation must be removed. The guiding rails on the base of the inverter shelf and under the inverters ensure the exact positioning of the modular inverter unit. The unit is slowly pushed in past a slight resistance until the front panel is flush with the frame of the cabinet. All electrical contacts have then been made. The inverter is then fixed into the cabinet with four screws (supplied).

Any free slots reserved for future inverter upgrades must be covered with dummy plates. These plates must be secured with four screws (supplied).

4.5 SWITCHING ON THE INVERTER SYSTEM

Before the AC by-pass is connected and the inverters are switched on, it must be verified that the manual maintenance by-pass switch is in position “0” (UPS operation). In this position the Static By-Pass Switch (SBS) is mechanically locked and cannot be pulled out of the cabinet.

The load circuits should not yet be connected and all the inverters should be switched off.   Normally, the Static By-Pass Switch (SBS) should be set to the operation mode "inverter priority" (See Section 4.2).

Step one, the DC supply should be switched on, all the LEDs on the SBS light up for a short time. (Reset of the internal processor!) Afterwards, only the LED "FAULT" is lit and the DVA indicates the voltage or current to be "0".

Second, the AC by-pass should be switched on. The LEDs "MAINS VOLTAGE PRESENT" and "MAINS OPERATION" are lit as well as the LED "FAULT".

The AC by-pass is connected to the output and the DVA shows the AC by-pass voltage (e.g. 120), if the selector switch underneath the DVA is in the position "V".

The first inverter can now be switched on. After a start-up time of approx. 20 seconds, the LEDs "INVERTER OUTPUT VOLTAGE PRESENT"; "MAINS SYNCHRONOUS" are lit up and the LED "PARALLEL OPERATION" starts to flash. The flashing of this LED indicates that this inverter has been assigned the MASTER function. At the same time, some of the LEDs on the SBS change their state. The LED "FAULT" is extinguished and the LED "READY FOR OPERATION" is lit. Assuming that the operation mode is "inverter priority", the inverter output voltage is connected to the output. The LEDs "INVERTER OUTPUT VOLTAGE PRESENT" and "INVERTER OPERATION" light up and the LED "MAINS OPERATION" are extinguished. The voltage-free fault indicator switches to the state "no fault".

The remaining inverters are then switched on. The state of the LEDs of the SBS and the first inverter do not change. After the start-up phase, the LEDs "INVERTER OUTPUT VOLTAGE PRESENT", "MAINS SYNCHRONIZED" and "PARALLEL OPERATION" are lit on the additional inverters.

Finally, the load circuits may be switched on. When the load is connected, the load current is divided equally between the individual inverters and the bar graph indicators show the output current of the individual inverter. The load voltage (inverter output voltage) or the total load current can be read off the DVA.

After all the system components have been connected or switched on as described, the states of the LEDs on the SBS and the inverter should be as follows.

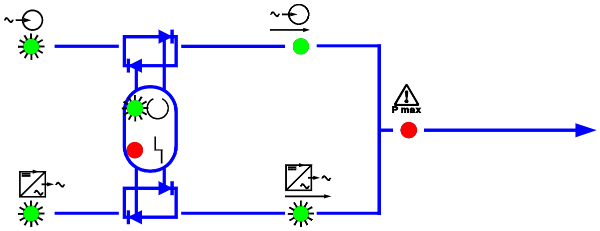
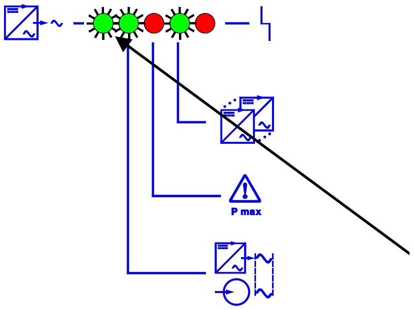


Fig. 15: LED states of the SBS (normal operation)



When the inverter operates as the master, this LED flashes.

Fig. 16: LED states of the inverter (normal operation)

5 PERFORMANCE TESTING

- The following load test is recommended by a Benning technician.

5.1 PRELIMINARIES TO PERFORMANCE TEST

The site manager must be informed of the test to be performed, and that alarms will be sent (if connected) to the central alarm center or Network Operations Center.

Read all of Section 5, make sure you know where to find all the buttons and other referenced items.

⚠ *Warning!*

During the performance test, pay attention to all safety notes located in Section 1. In addition, these inverters may be fed from multiple power sources, so additional precautions must be taken.

Take off rings, wristwatches and similar objects that may cause short-circuits.

Always use ESD-protection for any work to be carried out inside the cabinet.

5.2 TEST EQUIPMENT

- A suitable voltmeter with measuring range 250 VAC, 100 mV and 60 VDC.
- A clamp-on ammeter capable of measuring 250Amps AC.
- A load bank capable of supplying 26,000 W.

5.3 TEST OF THE INVERTERS

Make sure the system is in the following state:

- Disconnect commercial AC from the AC by-pass input.
- Switch off all inverter modules.
- Disconnect the load from the inverter.
- Connect the load bank to the output of the inverter system.
- Apply an ammeter around the phase conductor to the load bank.

5.3.1 INVERTER TEST ACTIVITIES

Action	Result
Switch on one of the inverter modules.	The green LED “OUTPUT VOLTAGE AVAILABLE” lights up. The green LED “PARALLEL OPERATION” starts flashing on the inverter. The red LED “FAULT” on the by-pass lights up indicating there is no mains voltage present and that not all connected inverters are not operating. Also an outgoing alarm will be given.
Connect a load of approximately 2kW (2.5kVA modules) or 4kW (5.0kVA modules). Switch the volt/ammeter toggle switch on the by-pass module to “V”. Connect a voltmeter to the output of the inverter system.	The reading of the voltmeter and of the display shall read 120 or 120/240VAC, ± 5%. **(See Important Note below)**
Switch the volt/ammeter toggle switch on the by-pass module to “A”	The volt/ammeter and the clamp-on ammeter shall be the same ±5%.
Connect a load of approximately 3kW (2.5kVA modules) or 6kW (5.0kVA	The red LEDs “OVERLOAD” light up on the inverter and the by-pass modules.

Action	Result
modules)	The internal temperature will rise and the inverter module will automatically switch off.
Disconnect the load bank and re-start the inverter by means of the On/Off Switch.	The green LEDs “OUTPUT VOLTAGE AVAILABLE” and PARALLEL OPERATION” will light up.
1. Switch off the inverter. 2. Short circuit the output of the inverter system by connecting a cable across the output terminals. **(WARNING! Verify the commercial AC input to the AC by-pass is turned-off.)** The cable shall be the same gauge as the normal load cables. 3. Switch on the inverter.	The inverter system shall pass into current limit and shall automatically switch off after approximately 40 to 50 seconds.
Remove the short circuit and restart the inverter module by means of the On/Off switch.	The inverter restarts
Switch off the inverter module	The inverter shuts off.

⚠ ***Important Note!***

The 120/240VAC configuration utilizes input/output transformers to convert the input and output voltages from the nominal 120VAC. Therefore the voltage displayed on Digital Voltmeter shall display the 120VAC component only.

Repeat test 5.3.1 for each inverter module installed.

5.4 TEST OF THE SBS UNIT

Make sure the system is in the following state:

- Disconnect the load from the inverter system.
- Connect the load bank to the output of the inverter system.
- Connect the commercial AC mains to the AC by-pass input.
- Switch on all inverter modules.

5.4.1 SBS TEST ACTIVITIES

Action	Result
Switch off the mains from the by-pass.	The green LED “MAIN VOLTAGE AVAILABLE” and “READY FOR OPERATION” go out and the red LED “FAULT” lights up. Also an outgoing alarm shall be given after approximately 10 seconds.
Connect a voltmeter to the output of the inverter system.	The reading of the voltmeter and of the display shall read 120VAC ± 5%. **(See Important Note below)**
Switch on the mains for the by-pass	**The green LED “MAINS AVAILABLE”, “INVERTER OPERATION” light up and the red LED “FAULT” goes out. The reading of the by-pass volt/ammeter shall be 120 or 120/240VAC ± 10%. The alarm ceases.**
Switch off all inverter modules.	The green LEDs “INVERTER VOLTAGE AVAILABLE” and “INVERTER OPERATION go out, the green LED “MAINS OPERATION” lights up and the red LED “FAULT” lights up. Also and outgoing alarm will be given.
Connect a voltmeter to the output of the inverter system.	The reading of the voltmeter shall be 120 or 120/240VAC ± 5%.
Switch on all inverter modules.	The green LEDs “INVERTER VOLTAGE AVAILABLE”, “INVERTER OPERATION” and “READY FOR OPERATION light up, and the green LED “MAINS OPERATION” and the red LED “FAULT” go out. The alarm ceases.

⚠ ***Important Note!***

The 120/240VAC configuration utilizes input/output transformers to convert the input and output voltages from the nominal 120VAC. Therefore the voltage displayed on Digital Voltmeter shall display the 120VAC component only.

5.5 FINAL STEPS

- Disconnect any test equipment that has been connected to the system and make sure that materials that do not belong in the equipment have been removed.
- Restore the equipment to its original condition. Make sure the cabinet is placed so that cooling air has free access.
- If a failure remains in the equipment, contact the responsible field engineer.

6 MAINTENANCE

All the components of the inverter system have been developed for continuous operation and are practically maintenance-free. To ensure continuous operation, it is recommended that flow of cooling air is periodically checked and any dust is removed from the units.

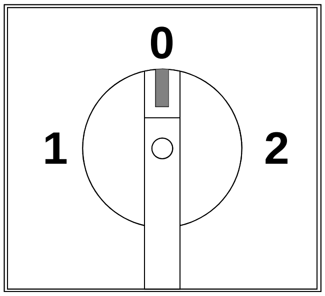
⚠ ***Warning!***
Do not use pressurized air to remove the dust since the dust particles can be blown into the interior of the unit and may cause malfunctions.

If servicing is required (exchange of units, work on the mains supply or the DC supply etc.) the proper position of the manual maintenance by-pass switch must be verified.

6.1 USE OF THE MANUAL BY-PASS SWITCH

The manual maintenance by-pass switch is only required for servicing. This manual switch when operated by-passes the SBS unit and connects without interruption the mains (“Load on By-pass Input”) or the inverter outputs (“Load on Inverter Output ") directly to the connected load equipment depending on the switch position.

⚠ ***Warning!***
The manual maintenance by-pass switch may only be operated by qualified personnel.



Position 0:	UPS operation
Position 1:	Load on Reserve Input
Position 2:	Load on Inverter Output

Prior to operating the manual maintenance by-pass switch verify the SBS is operating in one of the following modes. Failure to do so could result in an interruption in power to the connected load equipment:

1) The SBS is operating correctly

This is signalled on the front panel of the SBS by:

LED └┐ **"off"** LED ○ **"on"**

In this operating state, the manual by-pass switch can be switched either into position 1 (Load on By-pass Input) or position 2 (Load on Inverter Output). After the servicing work is complete and if the system is in proper working order, the manual by-pass switch can be turned back to position 0 (UPS operation).

2) The SBS shows a fault

This is signalled on the front panel of the SBS by:

LED └┐ **"on"** LED ○ **"off"**

In this operating state, two further cases must be differentiated.

a) The inverter system is operating in the inverter operation mode.

This is the case when the LED ⧄ on the front panel of the SBS is lit.

In this case only switch position 2 (Load on Inverter Output) is permissible!

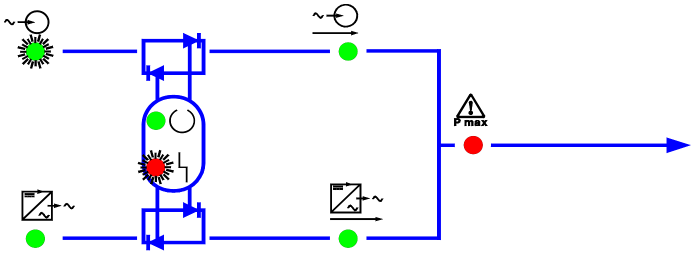
After the servicing work is complete (exchange of the SBS, work on the supply mains) and if the system is in proper working order, the manual by-pass switch can be turned back to position 0 (UPS operation).

b) The inverter system is working in the mains operation mode. This is the case if the LED ~ on the front panel of the SBS is lit.

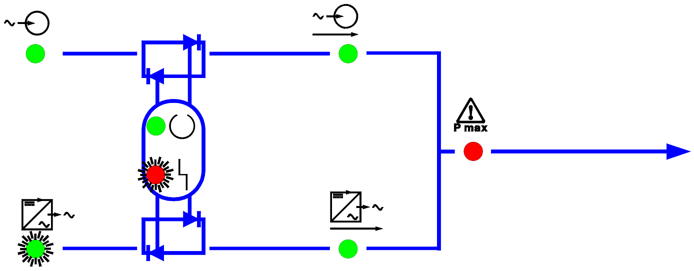
In this case only switch position 1 (Load on By-pass Input) is permissible!

After the servicing work is complete (exchange of the SBS, work on the DC supply mains, repair of the inverter) and if the system is in proper working order, the manual by-pass switch can be turned back to position 0 (UPS operation).

The states of the switch positions 1 (Load on By-pass Input) or 2 (Load on Inverter Output) are indicated by two flashing LEDs on the front panel of the SBS.



State "Load on By-pass Input"



State "Load on Inverter Output"

6.2 EXCHANGE OF UNITS

a) Exchange of an inverter

In this case, the manual by-pass switch does not need to be used. However, if this is desired for any reason, the manual by-pass switch must be switched to position 1 (Load on By-pass Input).

Removal of the inverter:

☐ Switch the inverter off using the unit switch (in case the remaining inverters in the system cannot take over the load, the connected load will be transferred to the mains supply via the SBS units).

☐ Remove the four retaining screws

☐ Pull the unit out of the front of the cabinet
(Attention**!** See warning statement in paragraph 4.4.2)

Insertion of the inverter:

☐ The inverter must be switched off!

☐ The circuit breaker (F1) on rear of unit must be switched on!

☐ Slide the inverter into the inverter shelf until the unit is flush with the frame of the cabinet.

☐ Screw in the four retaining screws

☐ Switch the inverter on

If necessary, turn the manual by-pass switch to position 0 (UPS operation).

b) Exchange of the SBS

⚠ ***Warning!***
The manual by-pass switch must be used in this case otherwise there will be an interruption in the power supply to the load equipment. It must be established beforehand, which of the scenarios described in Chapter 6.1 is valid (check the state of the SBS and the operation mode!)

Removal of the SBS:

After the manual by-pass switch has been turned to position 1 or 2, the 4 retaining screws are removed and the SBS is pulled out of the front of the cabinet. This simultaneously removes the operating element of the manual by-pass switch from its mounting shaft. The manual bypass switch is mechanically fastened to the SBS.

Insertion of the SBS:

If not already done, the By-pass handle assembly must be mounted onto the new SBS. Before the SBS is replaced into the cabinet, the operating element of the manual by-pass switch must be turned to position 1 or 2, according to the position of the switch before the SBS was removed. The SBS is pushed into the free slot until the unit is flush with the frame of the cabinet. The four retaining screws are screwed back in.
Finally, the manual by-pass switch must be turned back to position 0 (UPS operation).

6.3 UPGRADING THE SYSTEM

The inverter system can be equipped with a maximum of 5 inverters. Additional inverters can only be added to the system if there are free inverter shelves. The system can be upgraded during running operations without the need to switch off other components or the need to switch the manual by-pass switch.
The dummy plates covering the free inverter shelves are removed. The circuit breaker F1 located on the rear of the inverter module (Refer to Fig. 8) is switched on and the ON/OFF switch (Item 3, Fig. 7) is switched off. The new inverter is pushed into the slot, fixed with the 4 retaining screws and then switched on. After the start-up phase, the inverter is brought into parallel operation and the current then is evenly distributed to all inverters that are switched on.

7 DESCRIPTION OF FUNCTION

It is not necessary to understand the exact function of all components in this inverter system. However, basic knowledge of essential components aids in the understanding of the whole system and helps to avoid errors in the maintenance and operation.

7.1 TOTAL SYSTEM

The inverter system supplies a high availability AC current supply to load equipment that must have an uninterrupted input power supply at all times. According to the selected operating mode, the inverter output voltage (inverter priority) or the mains voltage (mains priority) is switched through to the load equipment by the SBS. In event the priority system (mains or inverters) should fail, the redundant system is switched with minimal interruption to the alternate source (within a few milliseconds). The use of the manual maintenance by-pass switch allows servicing and maintenance work to be carried out on the inverter system or the redundant mains without an interruption in the power supply to the load equipment.

7.2 INVERTER

The function of all the inverters in the system are identical. The applied DC voltage reaches an intermediate circuit via an input filter. The voltage in this intermediate circuit is increased to approximately 200V. A high-frequency transformer separates the voltage between the input and the output of the inverter. In the bridge of the inverter, the high DC voltage of the intermediate circuit is transformed into the inverter output voltage of 120 or 230 and a frequency of 50Hz or 60Hz.

In order to obtain a constant sinusoidal output voltage under all operating conditions, a series of monitoring functions and controls are necessary.

7.2.1 MONITORING OF THE INPUT VOLTAGE

The DC voltage applied to the inverter is monitored for under voltage or over voltage conditions. The inverter supplies continuous, regulated output voltage when operated within these limits.

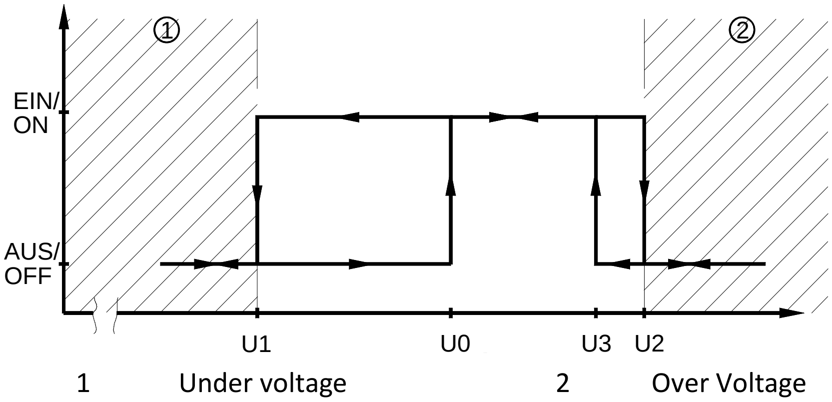


Fig. 17: Switching thresholds for over voltage and under voltage monitoring system

Figure 17 shows the main principles of the system. If over voltage is applied, the inverter switches off at U2. Once the voltage has dropped to below U3, the inverter switches on again automatically.

After switching off as a result of under voltage (U1), the inverter switches on again only after the input voltage U0 is reached. This value, U0, must also be available when the inverter is switched on at the main switch. This ensures that the unit does not start up briefly when the battery is not charged.

Because of component variances and setting tolerances, the following voltage ranges apply for the switching thresholds.

Nominal input voltage	U1	U0	U3	U2
U_N = 120V	100.8V-103.3V	121.3V-123.8V	142.5V-145.5V	148.5V-151.5V

⚠ The unit cannot be switched on when input voltages are below U0!

7.2.2 MONITORING THE OUTPUT VOLTAGE

The output voltage supplied by the inverter is also monitored. If the output voltage is within the range 120 □10% (108V … 132V), this targeted state is indicated by an LED on the front panel. If it is outside this range, an LED indicates the fault. If the output voltage exceeds the upper limit, the inverter is blocked and switches to a self-holding mode. The self-holding mode can be cancelled by switching the unit on again at the main ON/OFF switch.

7.2.3 MONITORING THE TEMPERATURE

The temperature is monitored in three phases.

If the cooling air temperature reaches a value of approximately 45°C, the fan inside the inverter automatically switches on.

If the temperature exceeds a value of approximately 85°C, the inverter switches off because of over temperature.

The air temperature inside the housing is also measured. The unit also switches off when this temperature reaches approximately 70°C. The high interior temperature may be due to high ambient temperatures or obstruction of the air supply. The shut-down of the inverter due to over temperature is indicated by the LED "FAULT" on the front panel.

7.2.4 OVERLOAD BEHAVIOR

The inverter is designed to withstand short-term overloading. In cases of overloading, an LED on the front panel lights up. 200% of the nominal effective current can be supplied for a maximum of 1.2 seconds (i.e. double the rated power). If the overload still exists after 1.2 seconds, the current is reduced to 1.3 times the rated value with a resultant reduction in the output voltage. If the overload situation still persists after another 41 seconds, the power unit of the inverter goes off. The inverter can only restart if, after the inverter has been switched off with the main switch, all LED´s on the front panel are extinguished and the inverter is switched on again.

When operating the inverter with a SBS (this is always the case for this inverter system), the SBS recognizes the overload. If the inverter output voltage lies outside the tolerance range, the SBS will switch the current mains supply through to the load equipment.

7.2.5 SHORT-CIRCUIT BEHAVIOR

The inverter is permanently short-circuit proof. Short-circuits are a special type of overload. At the time of the short-circuit, the current is limited for 5 seconds to 2.8 times the nominal effective current. During this period, the short-circuit current can trigger the AC load protection circuits in the customer provided AC distribution.. After approx. 5 seconds have elapsed, the power unit of the inverter switches off. A restart of the inverter is only possible when the inverter has been switched off with the main On/Off switch, all LED´s on the front panel are extinguished, and the inverter has then been switched On again.

If the short-circuit persists, this procedure is repeated.

When the inverter is operated with an Static By-Pass Switch (SBS), the connected AC bypass supplies the short-circuit current.

7.3 ELECTRONIC SWITCHING/SBS UNIT

The electronic switching unit accurately monitors all the relevant data of the inverter system. This includes:

☐ Inverter operational states
☐ AC by-pass voltage
☐ Inverter voltage
☐ AC by-pass frequency
☐ phase position between the inverter output and the mains
☐ level of the load

This information is fed to an internal controller, which controls the Static By-Pass Switch (SBS) via a logical trigger switching the AC by-pass or the inverter output voltage through to the load equipment. If the system is functioning correctly, the voltage, which has been pre-selected by the setting of the operation mode, is switched through the Static By-Pass Switch (SBS), i.e. "mains priority" or "inverter priority".

In addition to the visual indicators (LEDs), the SBS also controls dry contact alarm relay A setting option is used to select whether this messaging is a collective fault message from the SBS and the inverter, or a single fault message of the SBS. This message follows the visual indication with a delay of approximately 10seconds.
The cause of these faults may be:

☐ disturbances in the AC by-pass supply
☐ disturbances in the inverter / inverter system
☐ disturbances in the SBS

The reset of the dry contact alarm relay occurs without a delay. To permit operation of the SBS via the remote monitoring system MCU, an additional unit (satellite card) must be installed. Through this optional unit, operational states and measurement values of the SBS and the associated inverter system are transmitted to the remote monitoring system via a serial interface to RS485 standard.

In the standard design, 6 different types of status information are transmitted, resulting from the linkage of the various status data.

The transmitted status information comprises:

- Inverter operation
- SBS warning
- SBS fault
- Overload
- Faulty output voltage
- SBS blocked

In addition, 15 detected or calculated measuring values are transmitted.

- Heat sink temperature SBS
- Inverter voltage
- AC by-pass voltage
- Output voltage SBS
- Output current SBS
- Output current inverter 1 – inverter 5
- Active power
- Apparent power
- Reactive power (calculated)
- Crest factor
- Output frequency

All indicated states and measuring values of the inverter system can be further processed and evaluated using the service software of the remote monitoring system.

Redundancy function for the SBS Satellite function (5 kVA and 2.5 kVA inverters)

From Version 1.03 on we support a redundancy function generating two events in the SBS satellite. This can be mapped to an input of the optional MCU and used to control alarm relays in the relay box Option.

The first alarm (Minor-non urgent) is activated, when one or more inverters have a fault.

A fault is defined as:

- inverter is not working properly in any way (error message of the inverter)
- inverter is turned off with the switch on the front
- inverter is removed from system (the total amount of inverters is logged, so if you plug in the inverter into a different place, the fault will be reset)

The second alarm (Major-urgent) is activated, when two or more inverters have a fault. Fault conditions are defined above.

Note: If the alarm is triggered by removal of an inverter (e.g. for service purposes) this can be reset by pushing the reset/led test button on the LED-panel of the MCU.

Notes

Notes

Notes

Benning Power Electronics
1220 Presidential Drive Suite 100
Richardson, TX 75081 USA
www.benning.us
800.910.3601

This manual contains important safety instructions that should be followed during installation and maintenance of the Power System.

Sturgeon ELECTRIC
12150 East 112th Avenue
Henderson, CO 80640

JOBSITE OFFICE:

Phone:
Fax:

TRANSMITTAL SHEET

Attention: John Crowder
Company: 1776 Lincoln St Suite 600
Denver, Co. 80203

Phone:
Fax:

Date: 6/25/2015
Sturgeon Job No.: 822611
Transmittal No.: 0012
Re: Relay Cabinet Re-Submittal

We are sending you the attached following items:

___ Shop Drawings
___ Specifications
_X_ Other: Re-Submittal

___ Prints
___ Copy of Letter

___ Change Order
___ Samples

Copies	Date	Description
1	6/25/2015	Re-Submittal of Am West Relay Cabinet

These are transmitted as checked below:

_X_ For Approval
___ For Your Use
___ As Requested
___ For Review and Comment
___ For Bids Due ____________

___ Approved as Submitted
___ Approved as Noted
___ Returned for Corrections

___ Resubmit
___ Submit
___ Return
___ Other ____________
___ Prints Returned After Loaned to Us

___ Copies for Approval
___ Copies for Distribution
___ Corrected Prints

Remarks:

Copy To:

Signed: Jim Shireman 6/25/15
(Name & Title)

Received By: ____________

Date Received: ____________

STURGEON ELECTRIC COMPANY, INC.
SUBMITTAL COVER SHEET
Eisenhower/Johnson Memorial Tunnel 24.9 Electrical Upgrade
Project # IM822611

Owner:	**Colorado Department of Trans.** **Region 1, West Program** **425A Corporate Circle** **Golden, CO 80401**	Submittal No.:	**SECO- 011 B**
		Spec. Section:	613.47
		Dwg. Reference:	21
		Detail No.:	
Contractor:	**Sturgeon Electric Company, Inc.** **12150 E. 112th Ave** **Henderson, CO 80640** **Jason Willis 303-994-1190**	Submittal Type:	
		Sub Submittal #:	
		Date Returned:	
		Approval Status:	
Subcontractor:		Supplier:	**AmWest Control Inc.**

Submittal Description:

Relays and Relay Cabinet

Date Submitted: **6/25/2015**

Requested Response Date: 7/15/2015

Deviation: ☐ No ☐ Yes See notes

Substitution: ☐ No ☑ Yes See Attached

Subcontractor Review: All of the materials included in this Submittal have been reviewed and approved by Subcontractor in acordance with the requirements of the Subcontract General Conditions, Submittals and Deliverables, and are complete, legible, accurate, devoid of information that does not pertain to this Submittal, and are in strict conformance with the contract drawings and specification except as otherwise noted.

Reviewed By: ______________________ Date: 6/25/2015

Submittal Notes:

Contractor Stamp

X	No Exceptions Taken
	Approved As Noted
	Make Corrections Noted
	Revise And Resubmit
	Rejected
	Submit Specified Item

Sturgeon Electric

Date:____________By:_______________

Engineers Stamp

AmWest Control, Inc.

Transmitted To: **Sturgeon Electric**
Owner: **Colo. Dept. of Transportation**
Date: **April 30, 2015**
Project Manager: **Murray Joss**
AmWest Project No.: **2100**
Submittal No.: **1A**

Re-Submittal
Colo. Dept. of Transportation
Eisenhower Relay Replacement Panels
Electrical Equipment

Table of Contents:

Response to Engineer Comments

Page 1 of 1 04/30/15

Subject: **Eisenhower Relay Replacement Panel Submittal Return Comments**
Colorado Department of Transportation

From: **Murray Joss/Kristi Stoltenberg-Majors**
AmWest Control, Inc.

This is in response to the Engineer Comments. Each item is addressed per item number.

1. *Confirm available space for relay cabinet. Submitted 72"x72"x16" cabinet - Sheet 21 specifies 36"x84"x18" cabinet. Submitted size is approved as long there is sufficient vertical and horizontal clearance.*
Cabinet has been changed to a 72” x 48” x 24”. See revised drawings and bill of materials.

AmWest Control, Inc.

NOTES TO ENGINEER

Included in this submittal are certificates of compliance with the Buy American Act for the materials being submitted on, with the exception of terminal blocks. There are no manufacturers of terminal blocks in the US that we or any of our vendors are aware of and therefore, none can comply with the requirements of the Buy American Act. We are submitting on Phoenix Contact terminal blocks which are a high quality, industry standard product that we use on all our industrial control panel projects.

Bill-Of-Materials

Job Name: Sturg/Eisenhower Tunnel

Equipment Description: ***LCP-NBRR: North Bore Relay Replacement Panel***

AmWest Client: Sturgeon Electric

Owner: Colo. Dept. of Transportation

Item	Manufacturer	Description	Qty.	Part Number
1	Eaton/Cutler-Hammer	4 Pole, Convertible Contact, 12VDC Coil Machine Tool Relay	80	ARD440D
2	Phoenix Contact	Gray UT 4 Terminal Block (10-26 AWG) standard terminal block	450	3044102
3	Phoenix Contact	UT 4-PE Grounding Terminal Block (10-26 AWG)	1	3044128
4	Phoenix Contact	E/NS End Clamp	4	0800886
5	Phoenix Contact	D-UT 2.5/10 End Cover attaches to UT 4 Terminal Block	2	3047028
6	Saginaw	NEMA-12 FSD Enclosure 72"H x 48"W x 24"D	1	SCE-724824FSD
7	Saginaw	Subpanel - Bent	1	SCE-72P48
8	Saginaw	Side Panel	2	SCE-72SMP20

AmWest Control, Inc.

Revision:
1 – Revised per Eng. comments
2 – Revised per request

Print Date: 6/24/15
Job Number: 2100

Bill-Of-Materials

Job Name: Sturg/Eisenhower Tunnel

Equipment Description: ***LCP-SBRR: South Bore Relay Replacement Panel***

AmWest Client: Sturgeon Electric

Owner: Colo. Dept. of Transportation

Item	Manufacturer	Description	Qty.	Part Number
1	Eaton/Cutler-Hammer	4 Pole, Convertible Contact, 12VDC Coil Machine Tool Relay	80	ARD440D
2	Phoenix Contact	Gray UT 4 Terminal Block (10-26 AWG) standard terminal block	450	3044102
3	Phoenix Contact	UT 4-PE Grounding Terminal Block (10-26 AWG)	1	3044128
4	Phoenix Contact	E/NS End Clamp	4	0800886
5	Phoenix Contact	D-UT 2.5/10 End Cover attaches to UT 4 Terminal Block	2	3047028
6	Saginaw	NEMA-12 FSD Enclosure 72"H x 48"W x 24"D	1	SCE-724824FSD
7	Saginaw	Subpanel - Bent	1	SCE-72P48
8	Saginaw	Side Panel	2	SCE-72SMP20

AmWest Control, Inc.

Revision:
1 – Revised per Eng. comments
2 – Revised per request

Print Date: 6/24/15
Job Number: 2100

Product Selection

When Ordering, Specify

- Catalog number of basic relay with 120/60, 110/50 AC coil from AR/ARD Relays table.
- If a coil voltage other than listed is required, select the suffix code from the Coil Voltage table below and substitute it for the last letter in the catalog number. Example: AR64**V** for a 110/60 AC coil.

AR/ARD Relays

AR/ARD Relays

	Contact			AR 600 Vac Relays 120/60, 110/50 AC Coil	ARD 600 Vdc Relays 120 DC Coil
Number of Poles	**NO**	**NC**	**Blank Cavities**	**Catalog Number**	**Catalog Number**
4	0	0	4	**AR4A**	**ARD4S**
	2	0	2	**AR420A**	**ARD420S**
	4	0	0	**AR440A**	**ARD440S**
6	0	0	6	**AR6A**	**ARD6S**
	4	0	2	**AR640A**	—
	6	0	0	**AR660A**	**ARD660S**
8 ①	6	0	2	**AR860A**	**ARD860S** ②
	8	0	0	**AR880A**	**ARD880S**
10 ①	10	0	0	**AR10100A**	**ARD10100S**

Coil Voltage

AR Coils		
Volts AC	**Hz**	**Suffix Code**
12	60	**F**
24	60	**I**
48	60	**G**
110	60	**V**
110/120	50/60	**A**
208	60	**B**
220/240	50/60	**W**
277	60	**C**
380/440	50/60	**H**
440/480	50/60	**X**
550	60	**D**
550/600	50/60	**E**

ARD Coils	
Volts DC	**Suffix Code**
12	**D**
24	**L**
48	**M**
95	**B**
120	**S**
130	**U**
240	**T**

Contact Cartridges—600V

Terminal Type	Standard Contact Cartridge Catalog Number ③	Overlap Contact Cartridge Catalog Number ④
AC Cartridges		
With clamp terminals	**ARC**	**AROC**
With screw terminals	**ARCR**	**AROCR**
DC Cartridges		
With clamp terminals	**ARDC**	**ARDOC**
With screw terminals	**ARDCR**	**ARDOCR**

Notes

① Will not accept top-mounted latch or timers.

② Contact Customer Support Center for availability.

③ Standard cartridges are sold in cartons of four cartridges. Catalog number is for single cartridge.

④ Overlap contact cartridges are sold in sets of two cartridges. Catalog number is for sets of two.

Technical Data and Specifications

General

Contact Ratings—600 Vac Cartridge NEMA A600

	Maximum Current			Maximum VA	
Volts	**Cont.**	**Make**	**Break**	**Make**	**Break**
120	10	60	6	7200	720
240	10	30	3	7200	720
480	10	15	1.5	7200	720
600	10	12	1.2	7200	720

DC Cartridges—NEMA P600

	Maximum Current		Maximum VA
Volts	**Continuous**	**Make or Break**	**Make or Break**
125	5	1.10	138
250	5	0.55	138
600	5	0.20	138

Resistive Rating

125 Vdc	3A
250 Vdc	1.5A

Coil Power Requirements

AC	96 VA open, 14 VA closed
DC	DC: 14 watts open, 250V max.

Voltage	AR Relays	ARD Relays
Pickup voltage (max.)	85%	65%
Dropout voltage (min.)	60%	15%
Voltage (max.)	110%	110%

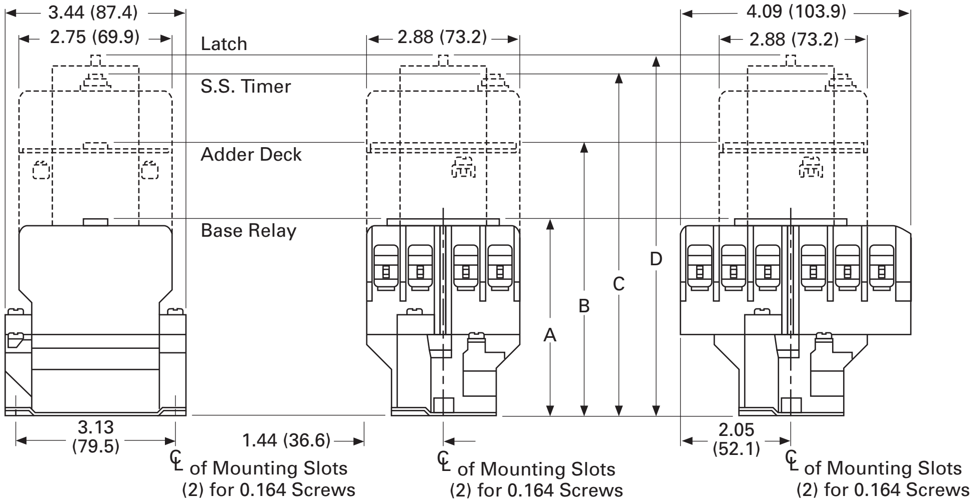
Solid-State Timer

Description	Specification
Input	120 Vac, ±10%, 50/60 Hz
	120, 48, 24 Vdc, ±10%
Power required	AC, DC: 2 VA max.
Contact ratings	AC, 0.2A inductive
Inrush	1.3A max.
DC will switch four-, eight- and 10-pole ARD relays	48 Vdc: 0.25A
	24 Vdc: 0.5A
Repeatability	AC ±2% w/10% voltage variation ±7.5% and 15% temperature variation
	DC ±1% w/10% voltage variation and 15°C temperature variation
Ambient temperature range	–20° to 70°C
Duty cycle	AC, DC: 150 operations/minute max.
Reset time ART and ARTD	ON delay ART: 50 ms max.
	ON delay ARTD: 100 ms independent of time setting and duty cycle
	OFF delay: instantaneous

Dimensions

Approximate Dimensions in Inches (mm)

Four- and Six-Pole with Four-Pole Adder, Solid-State Timer and Mechanical Latch

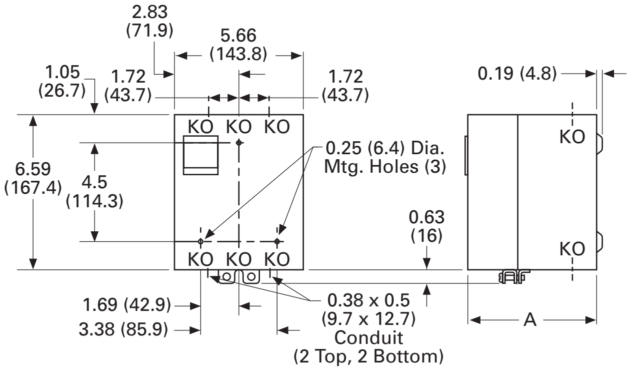


End View, 4- and 6-Pole **Side View, 4-Pole** **Side View, 6-Pole**

Four- and Six-Pole with Four-Pole Adder, Solid-State Timer and Mechanical Latch

Relay Catalog Number	A Four-, Six-Pole Relays	B Relay Adder	C Relay with Timer	D Relay with Latch
AR	3.56 (90.4)	4.94 (125.5)	6.00 (152.4)	6.39 (162.3)
ARD	4.63 (117.6)	6.00 (152.4)	7.06 (179.3)	7.45 (189.2)

Enclosures—NEMA 1 for BF, BFD, AR and ARD



Enclosures—NEMA 1 for BF, BFD, AR and ARD

Poles	Catalog Number	Dimension A NEMA 1
Relays without Attachments		
All	**BF, AR, ARD**	5.34 (135.6)
4–8	**BFD**	5.34 (135.6)
10, 12	**BFD**	7.97 (202.4)
Relays with Attachments		
All	**BF, AR, ARD**	7.97 (202.4)

EATON

8022 Southpark Circle, Suite 300
Littleton, CO 80120-5657
303 738-2318, fax 303 738-2324

January 26, 2015

Mr. Murray Joss
AmWest Control Inc.
10175 E 106th Avenue
Brighton, CO 80601

Ref: ARD relays

This letter is to confirm that the Eaton type AR / ARD machine tool control relays are manufactured within the United States of America and as such, do satisfy the requirements of the Buy American clause of the American Recovery & Reinvestment Act (ARRA).

Section 1605 of the American Recovery & Reinvestment Act (ARRA) requires that all the iron, steel, and manufactured goods used in an ARRA project for the construction, alteration, maintenance, or repair of public building or public work must be produced in the United States. Pursuant to 74 Fed. Reg. 14623 (March 31, 2009) (FAR Interim Rule) and 74 Fed. Reg. 18449 (April 23, 2009) (OMB Interim Final Guidance), a manufactured good is considered a domestic construction material without regard to the source or origin of components as long as the construction material used in the project is manufactured in the United States. 74 Fed. Reg. at 14624 & 14626; 74 Fed. Reg. at 18452.

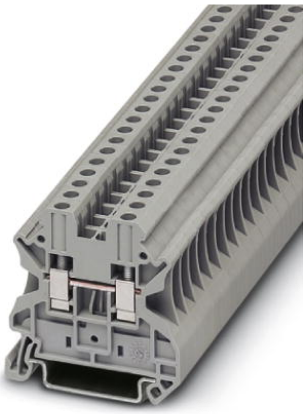
Typically this requirement applies to the location of final assembly such as the control panels built by Amwest Control Inc and not the components within the control panel but the Eaton AR / ARD control relays are also American made.

Mike Yuhas

Mike Yuhas
Sr. Sales Engineer

UT 4

Order No.: 3044102



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044102

Feed-through modular terminal block, Connection method: Screw connection, Screw connection, Cross section: 0.14 mm² - 6 mm², AWG 26 - 10, Width: 6.2 mm, Color: gray, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

http://www.download.phoenixcontact.com Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Commercial data

GTIN (EAN)	4 017918 960391
sales group	A800
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 27 (CL1-2011)

Technical data

General

Number of levels	1
Number of connections	2
Color	gray

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	6.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Maximum load current	41 A (with 6 mm^2 conductor cross section)
Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-1
Nominal current I_N	32 A (with 4 mm² conductor cross section)
Nominal voltage U_N	1000 V
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²

2 conductors with same cross section, stranded min.	0.14 mm²
2 conductors with same cross section, stranded max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

Certification	CB, CSA, CUL, DNV, GL, LR, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Accessories

Item	Designation	Description
Assembly		
3047167	ATP-UT	Partition plate, Length: 50 mm, Width: 2 mm, Height: 48 mm, Color: gray
3022276	CLIPFIX 35-5	Snap-on end bracket, for NS 35/7.5 or NS 35/15 DIN rail, can be fitted with Zack strip ZB 5 and ZBF 5, terminal strip marker KLM 2 and KLM, parking facility for FBS...5, FBS...6, KSS 5, KSS 6, width: 5,15 mm, color: gray
3047028	D-UT 2,5/10	End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1207640	NS 35/ 7,5 PERF 755MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 755 mm
1207653	NS 35/ 7,5 PERF 955MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 955 mm
1207666	NS 35/ 7,5 PERF 1155MM	NS 35 DIN rail, height 7.5 mm, length 1155 mm
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2000 mm
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep drawn, high profile, unperforated, 1.5 mm thick, material: aluminum, height 15 mm, width 35 mm, length 2000 mm
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1207679	NS 35/15 PERF 755MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 755 mm
1207682	NS 35/15 PERF 955MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 955 mm
1207695	NS 35/15 PERF 1155MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 1155 mm
1201730	NS 35/15 PERF 2000MM	DIN rail, material: steel galvanized and passivated with a thick layer, perforated, height 15 mm, width 35 mm, length: 2000 mm
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m

Bridges

3030336	FBS 2-6	Plug-in bridge, Number of positions: 2, Color: red
3030242	FBS 3-6	Plug-in bridge, Number of positions: 3, Color: red
3030255	FBS 4-6	Plug-in bridge, Number of positions: 4, Color: red
3030349	FBS 5-6	Plug-in bridge, Number of positions: 5, Color: red
3030271	FBS 10-6	Plug-in bridge, Number of positions: 10, Color: red
3030365	FBS 20-6	Plug-in bridge, Number of positions: 20, Color: red
3032224	FBS 50-6	Plug-in bridge, Number of positions: 50, Color: red

Marking

3047332	WS UT 4	Warning sign for UT terminal blocks
0811228	X-PEN 0,35	Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm

1051016	ZB 6,LGS:FORTL.ZAHLEN	Zack marker strip, 10-section, printed horizontally: with the numbers 1 - 10, 11 - 20 and so on up to 491 - 500, color: white
5060935	ZB 6/WH-100:UNBEDRUCKT	Zack strip, unprinted: For individual labeling with M-PEN, ZB-T or CMS system, large batch, sufficient for labeling 1000 terminal blocks, for a terminal width of 6.2 mm, color: White
1050499	ZB 6:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Plug/Adapter

0201689	MPS-IH BU	Insulating sleeve, Color: blue
0201676	MPS-IH RD	Insulating sleeve, Color: red
0201663	MPS-IH WH	Insulating sleeve, Color: white
0201744	MPS-MT	Test plugs
3030925	PAI-4	Test adapter, Color: gray
3030996	PS-6	Test adapter, Color: red

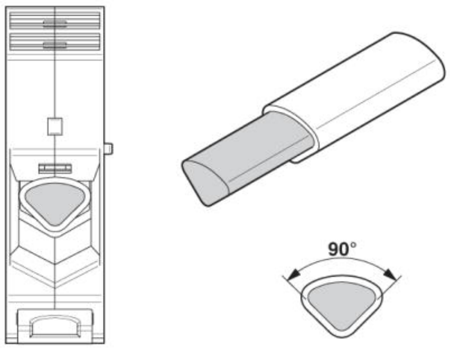
Tools

1205053	SZS 0,6X3,5	Actuation tool, for ST terminal blocks, insulated, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip

Diagrams/Drawings

Circuit diagram

Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

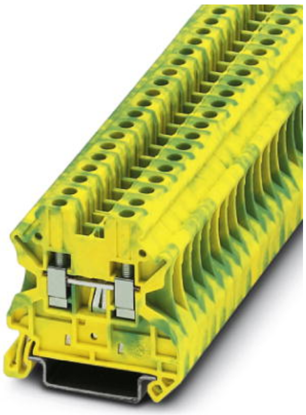
Address

PHOENIX CONTACT Deutschland GmbH
Flachsmarktstr. 8
32825 Blomberg,Germany
Phone +49 5235 3 12000
Fax +49 5235 3 41200
http://www.phoenixcontact.de

Extract from the online catalog

UT 4-PE

Order No.: 3044128



http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3044128

Universal ground terminal block, Connection method: Screw connection, Screw connection, Cross section: 0.14 mm² - 6 mm², AWG 26 - 10, Width: 6.2 mm, Color: green-yellow, Mounting type: NS 35/7.5, NS 35/15

Product notes

WEEE/RoHS-compliant since: 01/01/2003

Commercial data

GTIN (EAN)	4 017918 960407
sales group	A803
Pack	50 pcs.
Customs tariff	85369010
Catalog page information	Page 35 (CL1-2011)

http://
www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Technical data

General

Number of levels	1
Number of connections	2
Color	green-yellow

Insulating material	PA
Inflammability class acc. to UL 94	V0

Dimensions

Width	6.2 mm
Length	47.7 mm
Height NS 35/7.5	47.5 mm
Height NS 35/15	55 mm

Technical data

Rated surge voltage	8 kV
Pollution degree	3
Surge voltage category	III
Insulating material group	I
Connection in acc. with standard	IEC 60947-7-2
Open side panel	ja

Connection data

Note	Note: Product releases, connection cross sections and notes on connecting aluminum cables can be found in the download area.
Conductor cross section solid min.	0.14 mm²
Conductor cross section solid max.	6 mm²
Conductor cross section stranded min.	0.14 mm²
Conductor cross section stranded max.	6 mm²
Conductor cross section AWG/kcmil min.	26
Conductor cross section AWG/kcmil max	10
Conductor cross section stranded, with ferrule without plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule without plastic sleeve max.	4 mm²
Conductor cross section stranded, with ferrule with plastic sleeve min.	0.14 mm²
Conductor cross section stranded, with ferrule with plastic sleeve max.	4 mm²
2 conductors with same cross section, solid min.	0.14 mm²
2 conductors with same cross section, solid max.	1.5 mm²
2 conductors with same cross section, stranded min.	0.14 mm²

2 conductors with same cross section, stranded max.	1.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, min.	0.5 mm²
2 conductors with same cross section, stranded, TWIN ferrules with plastic sleeve, max.	2.5 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, min.	0.14 mm²
2 conductors with same cross section, stranded, ferrules without plastic sleeve, max.	1.5 mm²
Connection method	Screw connection
Stripping length	9 mm
Internal cylindrical gage	A4
Screw thread	M3
Tightening torque, min	0.6 Nm
Tightening torque max	0.8 Nm

Certificates / Approvals

Certification	CB, CSA, CUL, DNV, GL, LR, UL, VDE-PZI
Certification Ex:	IECEx, KEMA-EX

Accessories

Item	Designation	Description
Assembly		
3047167	ATP-UT	Partition plate, Length: 50 mm, Width: 2 mm, Height: 48 mm, Color: gray
3022276	CLIPFIX 35-5	Snap-on end bracket, for NS 35/7.5 or NS 35/15 DIN rail, can be fitted with Zack strip ZB 5 and ZBF 5, terminal strip marker KLM 2 and KLM, parking facility for FBS...5, FBS...6, KSS 5, KSS 6, width: 5,15 mm, color: gray
3047028	D-UT 2,5/10	End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray
0801762	NS 35/ 7,5 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, height 7.5 mm, width 35 mm, length: 2 m

1207640	NS 35/ 7,5 PERF 755MM	NS 35 DIN rail, height 7.5 mm, length 755 mm
1207653	NS 35/ 7,5 PERF 955MM	NS35 DIN rail, height 7.5 mm, length 955 mm
1207666	NS 35/ 7,5 PERF 1155MM	NS 35 DIN rail, height 7.5 mm, length 1155 mm
0801733	NS 35/ 7,5 PERF 2000MM	DIN rail, material: Steel, galvanized and passivated with a thick layer, perforated, height 7.5 mm, width 35 mm, length: 2 m
0801681	NS 35/ 7,5 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 7.5 mm, width 35 mm, length: 2 m
1201756	NS 35/15 AL UNPERF 2000MM	DIN rail, deep-drawn, high profile, unperforated, 1.5 mm thick, material: Aluminum, height 15 mm, width 35 mm, length 2 m
1201895	NS 35/15 CU UNPERF 2000MM	DIN rail, material: Copper, unperforated, 1.5 mm thick, height 15 mm, width 35 mm, length: 2 m
1207679	NS 35/15 PERF 755MM	NS 35 DIN rail, perforated, height 15 mm, length 755 mm
1207682	NS 35/15 PERF 955MM	NS 35 DIN rail, perforated, height 15 mm, length 955 mm
1207695	NS 35/15 PERF 1155MM	NS 35 DIN rail, perforated, height 15 mm, length 1155 mm
1201730	NS 35/15 PERF 2000MM	DIN rail, material: Steel, perforated, height 15 mm, width 35 mm, length: 2 m
1201714	NS 35/15 UNPERF 2000MM	DIN rail, material: Steel, unperforated, height 15 mm, width 35 mm, length: 2 m
1201798	NS 35/15-2,3 UNPERF 2000MM	DIN rail, material: Steel, unperforated, 2.3 mm thick, height 15 mm, width 35 mm, length: 2 m

Bridges

3030336	FBS 2-6	Plug-in bridge, Number of positions: 2, Color: red
3030242	FBS 3-6	Plug-in bridge, Number of positions: 3, Color: red
3030255	FBS 4-6	Plug-in bridge, Number of positions: 4, Color: red
3030349	FBS 5-6	Plug-in bridge, Number of positions: 5, Color: red
3030271	FBS 10-6	Plug-in bridge, Number of positions: 10, Color: red
3030365	FBS 20-6	Plug-in bridge, Number of positions: 20, Color: red
3032224	FBS 50-6	Plug-in bridge, Number of positions: 50, Color: red

Marking

3047332	WS UT 4	Warning sign for UT terminal blocks
0811228	X-PEN 0,35	Marker pen without ink cartridge, for manual labeling of markers, labeling extremely wipe-proof, line thickness 0.35 mm
1051016	ZB 6,LGS:FORTL.ZAHLEN	Zack marker strip, 10-section, printed horizontally: with the numbers 1 - 10, 11 - 20 and so on up to 491 - 500, color: white
5060935	ZB 6/WH-100:UNBEDRUCKT	Zack strip, unprinted: For individual labeling with M-PEN, ZB-T or CMS system, large batch, sufficient for labeling 1000 terminal blocks, for a terminal width of 6.2 mm, color: White
1050499	ZB 6:SO/CMS	Zack strip, 10-section, divisible, special printing, marking according to customer requirements

Plug/Adapter

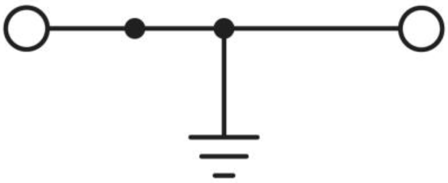
0201689	MPS-IH BU	Insulating sleeve, Color: blue
0201676	MPS-IH RD	Insulating sleeve, Color: red
0201663	MPS-IH WH	Insulating sleeve, Color: white
0201744	MPS-MT	Test plugs
3030925	PAI-4	Test adapter, Color: gray
3030996	PS-6	Test adapter, Color: red

Tools

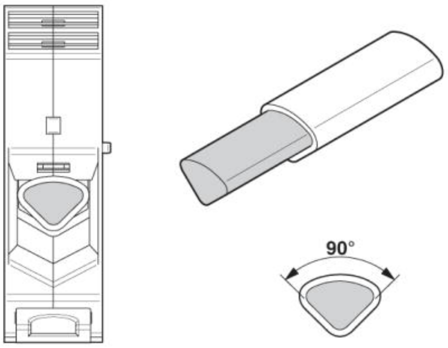
1205053	SZS 0,6X3,5	Actuation tool, for ST terminal blocks, insulated, also suitable for use as a bladed screwdriver, size: 0.6 x 3.5 x 100 mm, 2-component grip, with non-slip grip

Diagrams/Drawings

Circuit diagram



Schematic diagram



Connecting aluminum cables. Further notes can be found in the download area

Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
Middletown, PA 17057,USA
Phone (800) 888-7388
Fax (717) 944-1625
http://www.phoenixcon.com

End clamp - E/NS 35 N - 0800886

End clamp, width: 9.5 mm, color: gray

Product Features

☑ Large-surface labeling

Key commercial data

Packing unit	1 pc
GTIN	4 017918 129309
Weight per Piece (excluding packing)	14.8 GRM
Custom tariff number	39269097
Country of origin	Germany

Technical data

Dimensions

Height	32.8 mm
Length	48.6 mm
Width	9.5 mm

General

Material	PA
Color	gray
Tightening torque, min	0.4 Nm
Tightening torque max	0.5 Nm

End clamp - E/NS 35 N - 0800886

Classifications

eCl@ss

eCl@ss 4.0	27141199
eCl@ss 4.1	27141199
eCl@ss 5.0	27141135
eCl@ss 5.1	27141145
eCl@ss 6.0	27141135
eCl@ss 7.0	27141135
eCl@ss 8.0	27141135

ETIM

ETIM 2.0	EC000761
ETIM 3.0	EC001041
ETIM 4.0	EC001041
ETIM 5.0	EC001041

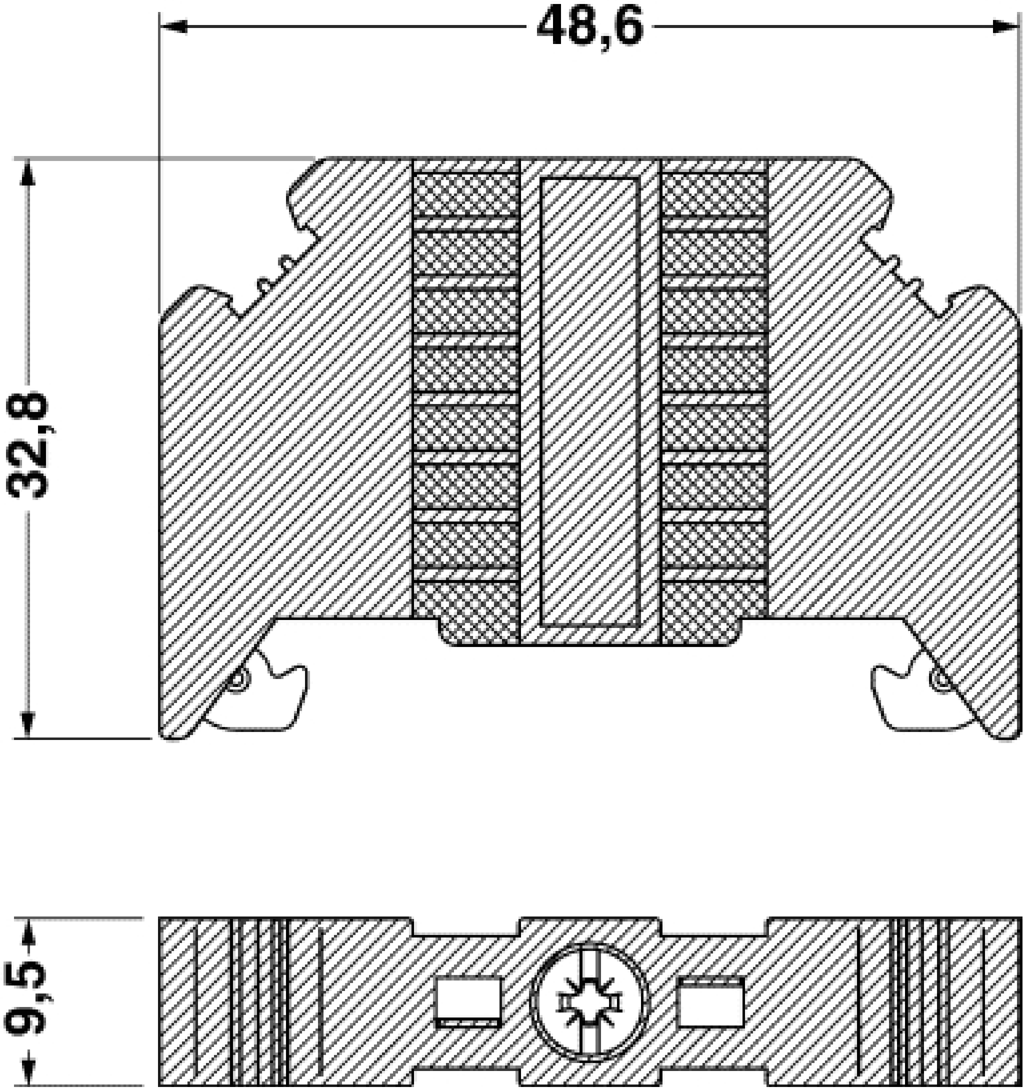
UNSPSC

UNSPSC 6.01	30212109
UNSPSC 7.0901	39121708
UNSPSC 11	39121708
UNSPSC 12.01	39121708
UNSPSC 13.2	39121708

Drawings

End clamp - E/NS 35 N - 0800886

Dimensioned drawing



Extract from the online catalog

D-UT 2,5/10

Order No.: 3047028

http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=3047028

End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm,
Color: gray

Commercial data	
GTIN (EAN)	4 017918 960346
sales group	A892
Pack	50 pcs.
Customs tariff	85389099
Catalog page information	Page 26 (CL1-2011)

Product notes

WEEE/RoHS-compliant since:
01/01/2003

http://
www.download.phoenixcontact.com
Please note that the data given here has been taken from the online catalog. For comprehensive information and data, please refer to the user documentation. The General Terms and Conditions of Use apply to Internet downloads.

Address

PHOENIX CONTACT Inc., USA
586 Fulling Mill Road
Middletown, PA 17057,USA
Phone (800) 888-7388
Fax (717) 944-1625
http://www.phoenixcon.com

Part Details - SCE-724824FSD

Part Number: SCE-724824FSD
Description: FSD Enclosure
Height: 72.00 inches
Width: 48.00 inches
Depth: 24.00 inches
Est. Shipweight: 494.00 lbs.
NEMA Rating: 12
Body Stiffeners D: 24.00
Body Stiffeners E: 23.88

Construction -

- 0.125IN carbon steel.
- Seams continuously welded and ground smooth, no holes or knockouts.
- Strong, rigid construction with stiffeners welded on backs of single access boxes.
- Lifting eyes for easy handling.
- Black zinc die cast keylocking/padlocking handle.
- 3-point latching mechanism.
- Latch rods have rollers for easier door closing.
- Removable print pocket provided on door with 3-point latch.
- Mounting channels welded horizontally on sides of interior body at top, bottom and middle for optional panels or rack mounting angles.
- Oil resistant gasket and adhesive.
- Ground stud on door.
- Flange trough collar around all sides of door opening.
- Concealed hinge.
- Removable and interchangeable doors.

Application -

Designed to house a variety of electrical and electronic controls and instruments. Provisions for optional surface mounting or rack mounting of almost any type of equipment. Provides protection from dust, dirt, water and oil. The enclosures are extra deep for applications requiring more interior space.

Finish -

White epoxy polyester powder coated inside and ANSI-61 high solids recoatable gray finish outside over phosphatized surfaces. Stainless steel enclosures are Type 304 stainless steel with #4 brushed finish. Optional panels are powder coated white epoxy polyester.

Industry Standards -

NEMA Type 12 & Type 13
UL Listed Type 12
CSA Type 12
IEC 60529 IP 55

Part Details - SCE-72SMP20

Part Number: SCE-72SMP20
Description: Subpanel, Side Mount
Height: 60.00 inches
Width: 20.00 inches
Depth: 0.88 inches
Est. Shipweight: 41.00 lbs.
NEMA Rating: N/A

Part Details - SCE-72P48F1

Part Number: SCE-72P48F1
Description: Subpanel, Full
Height: 60.00 inches
Width: 44.00 inches
Depth: 0.88 inches
Est. Shipweight: 121.00 lbs.
NEMA Rating: N/A

SCE SAGINAW CONTROL & ENGINEERING
Your Enclosure Source ®

95 Midland Road
Saginaw, Michigan 48638-5770

Telephone (989)799-6871
Fax (989)799-4524

An ISO 9001 Certified Company

Certificate of Origin

Buy America

Issued By
Saginaw Control & Engineering
95 Midland Road
Saginaw, MI 48638-5770

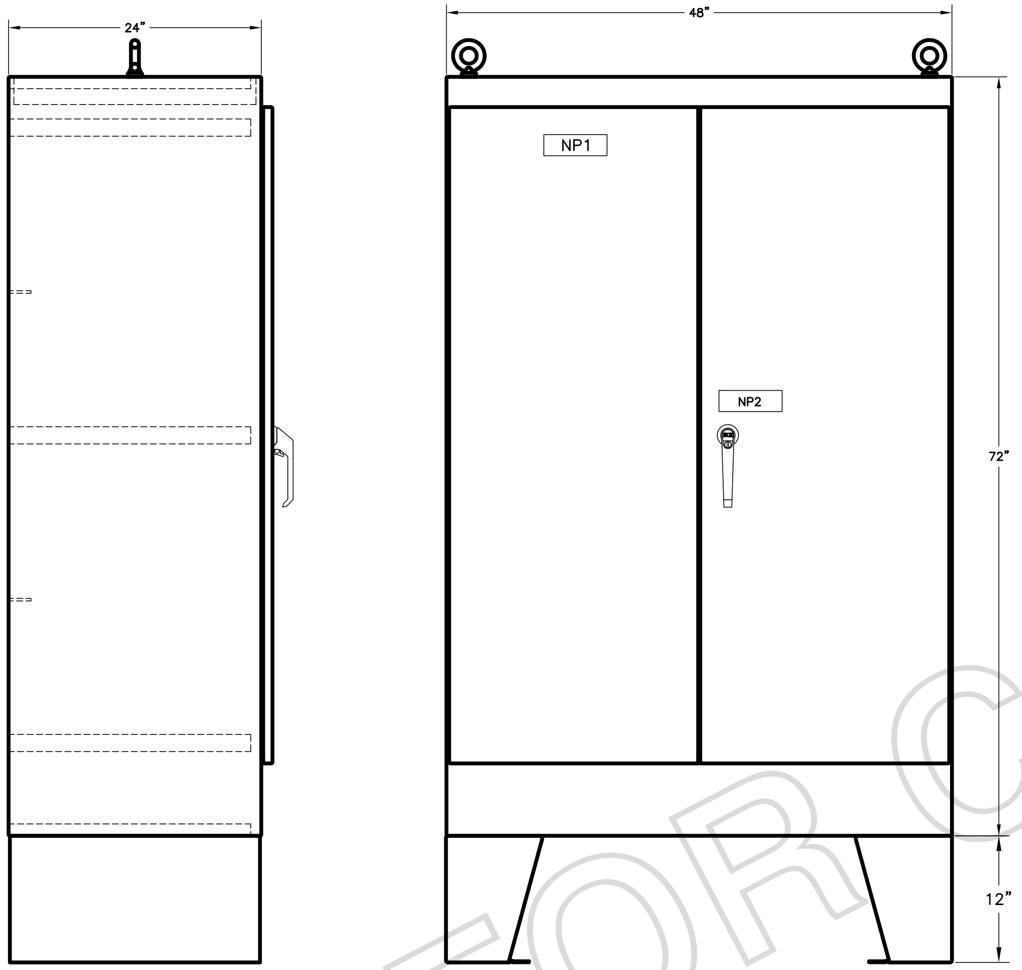
Saginaw Control & Engineering hereby certifies that all Enclosures manufactured by Saginaw Control & Engineering are manufactured in the United States of America with 100% US Steel and meets the requirements Buy America.

Ron Zeitler

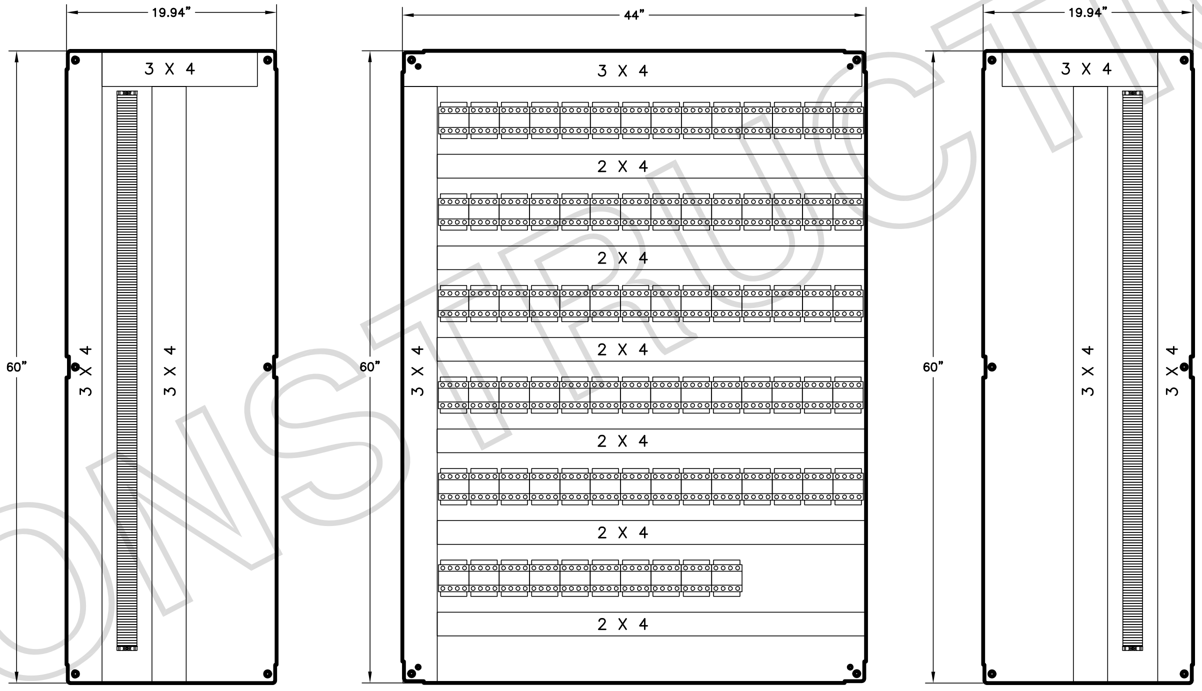
Quality Assurance Manager 1/26/2015

Ron Zeitler

Saginaw Control & Engineering



NEMA-12 ENCLOSURE 72"H X 48"W X 24"D
PAINT: ANSI GRAY



LEGEND SCHEDULE
MATERIAL: GRAVOPLY-II, BLACK FIELD WITH WHITE LETTERS

LEGEND					
IDENT	SIZE	TEXT SIZE	LINE 1	LINE 2	LINE 3
NP1	2 X 6	1/2"	LCP-NBRR NORTH BORE	RELAY REPLACEMENT	PANEL

NP2 DETAIL

"CAUTION"
RISK OF ELECTRIC SHOCK
MORE THAN ONE SWITCH OR UNINTERRUPTIBLE
POWER SUPPLY IS REQUIRED TO BE OPERATED
TO DE-ENERGIZE EQUIPMENT BEFORE SERVICING.

AmWest Control, Inc.
10175 E. 106th Ave.
Brighton, CO 80601
Ph. 303-289-2115

Device: LCP-NBRR
Type: 12 Enclosure
Job #: 2100
Owner: Co. Dept. of Transportation
Voltage: 120VDC,
Max FLA: ?Amps
Reference Field Wiring Diagram: North
Short Circuit Current: 10KA

REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	REVISED PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY:M. JOSS
CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

FRONT ELEVATION
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

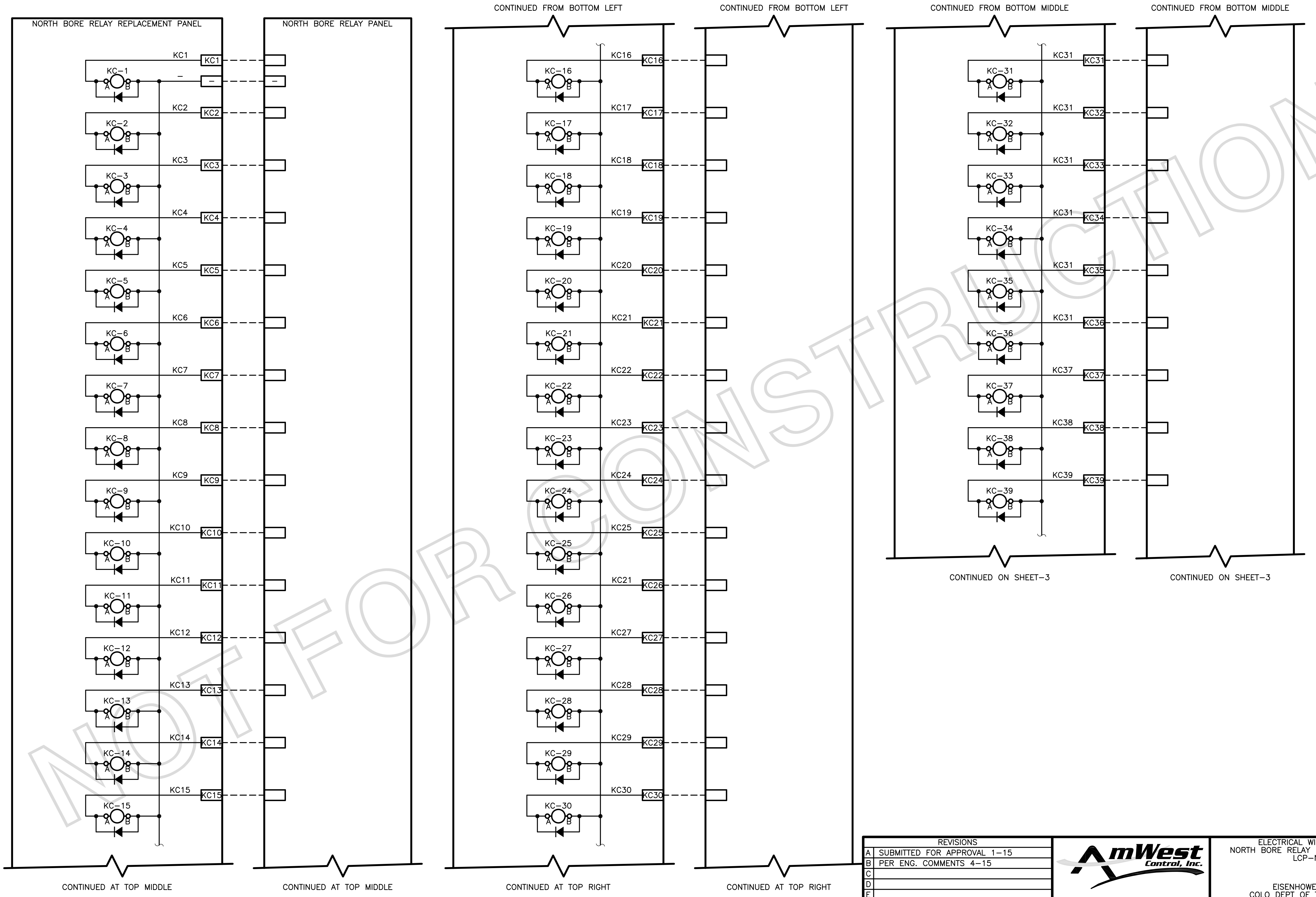
DATE:	1-15	JOB #:	2100
FILE:	NORTH	SET ID:	

1 / 8

LAST PRINTED: 4/29/2015 5:18:48 PM

NORTH.dwg

4/29/2015 5:06 PM



REVISIONS	
A	SUBMITTED FOR APPROVAL 1–15
B	PER ENG. COMMENTS 4–15
C	
D	
E	
F	

DESIGNED BY:M. JOSS | CHECKED BY: M. JOSS

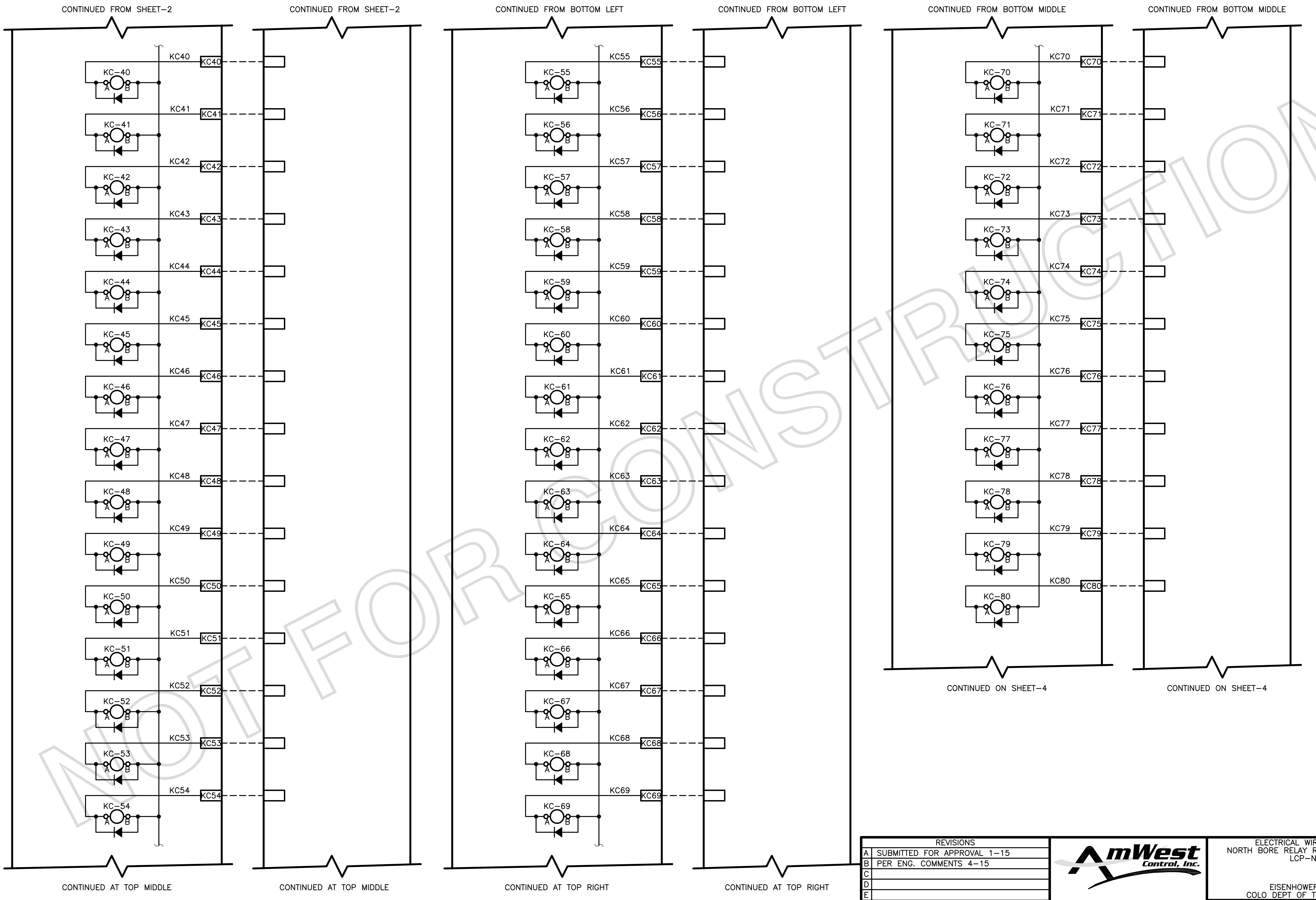
AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP–NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1–15
JOB #: 2100
FILE: NORTH
SET ID:

2
8



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

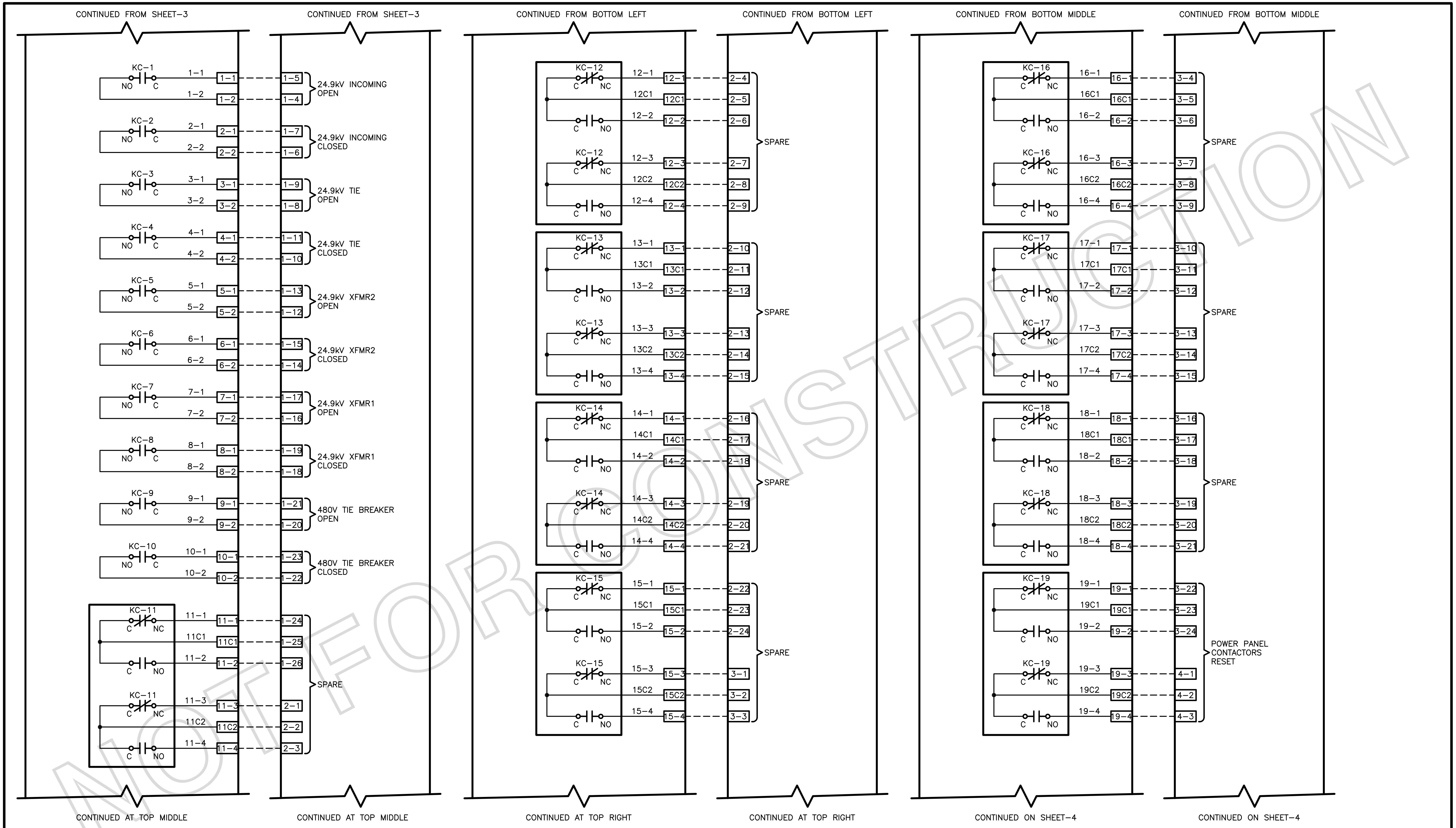
DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15
JOB #: 2100
FILE: NORTH
SET ID:
3
8



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

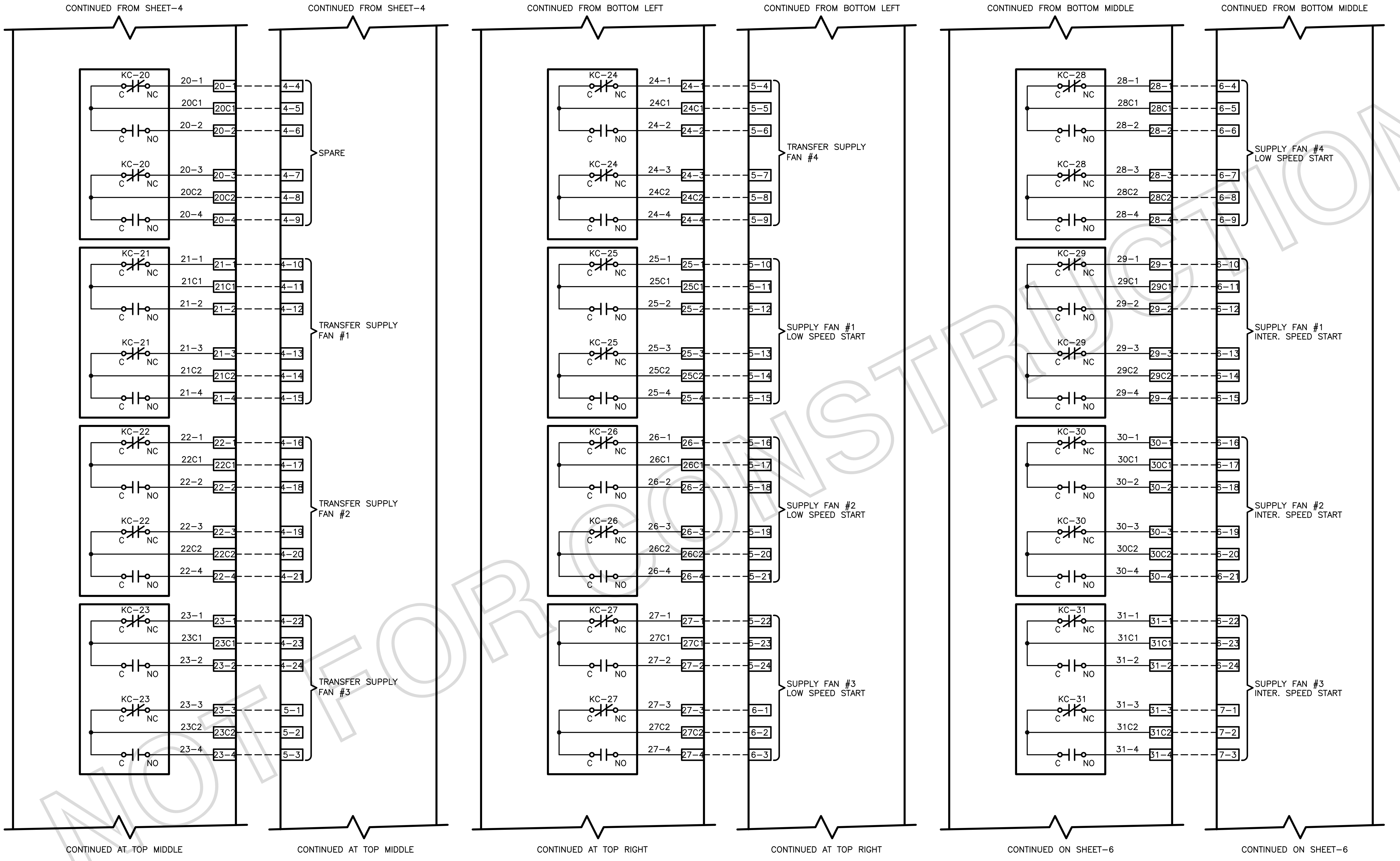
DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE:	1-15	JOB #:	2100	4
FILE:	NORTH	SET ID:		8



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

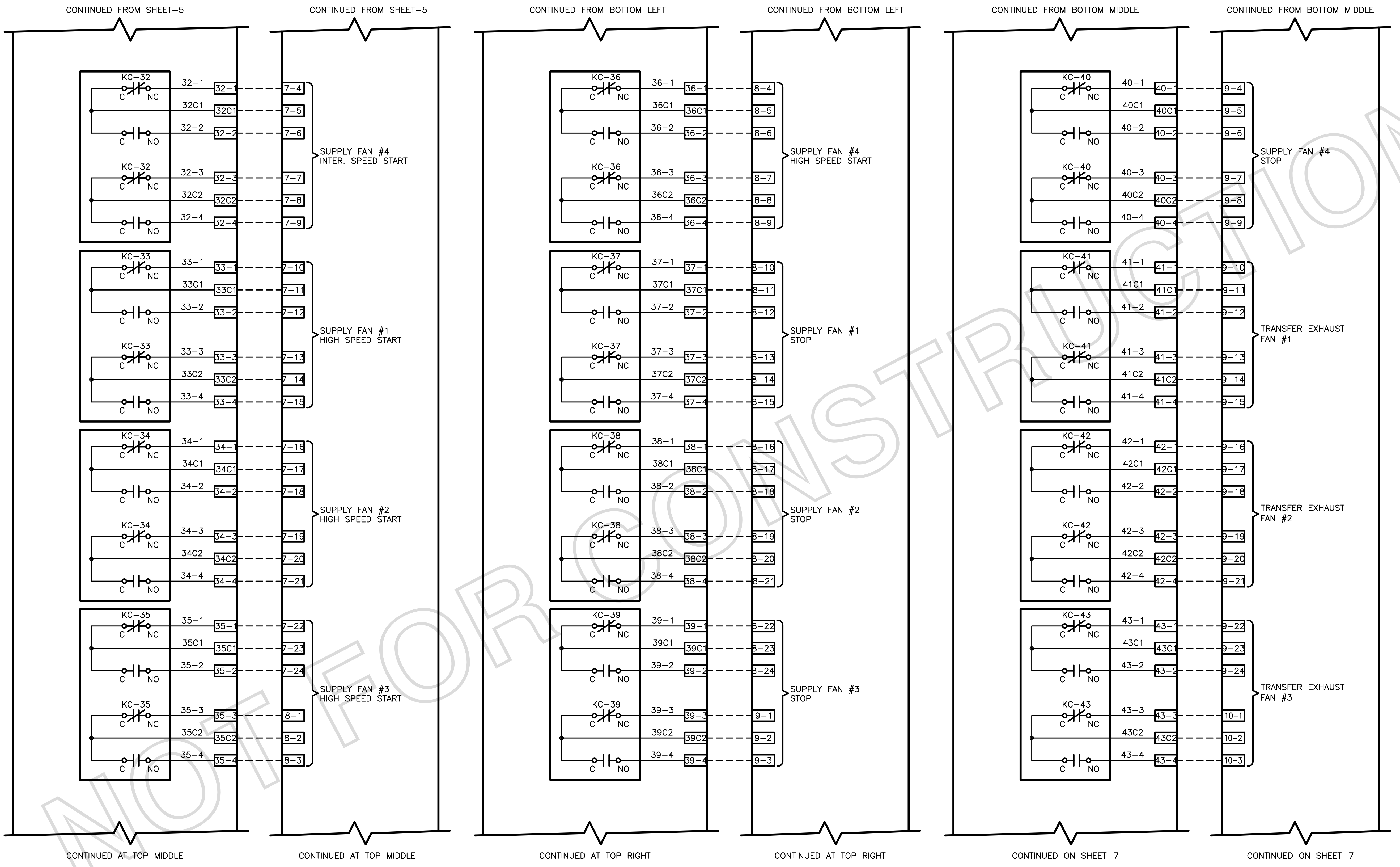
DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE:	1-15	JOB #:	2100	5
FILE:	NORTH	SET ID:		8



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

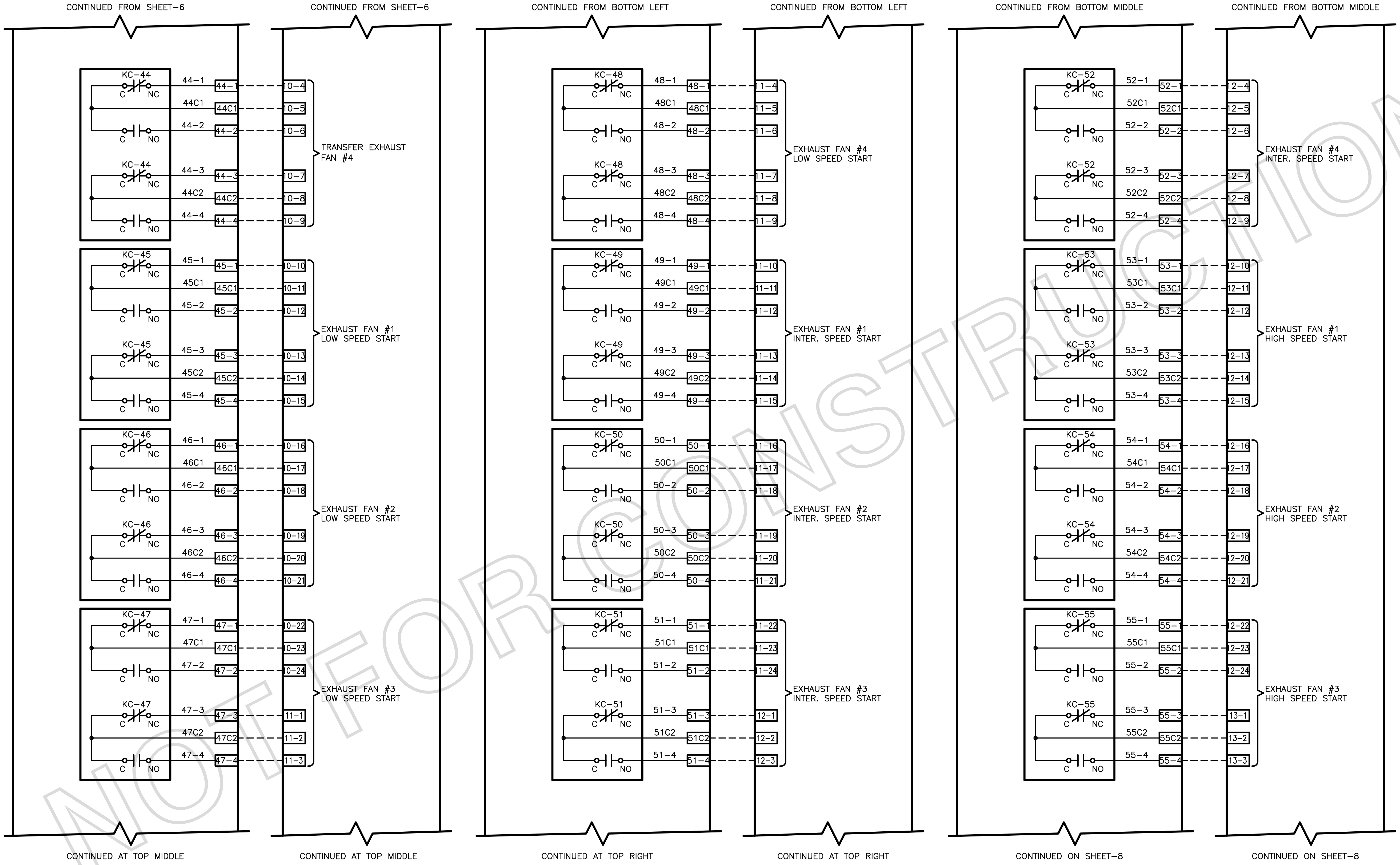
DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15 | JOB #: 2100 | 6
FILE: NORTH | SET ID: | 8



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY: M. JOSS
CHECKED BY: M. JOSS

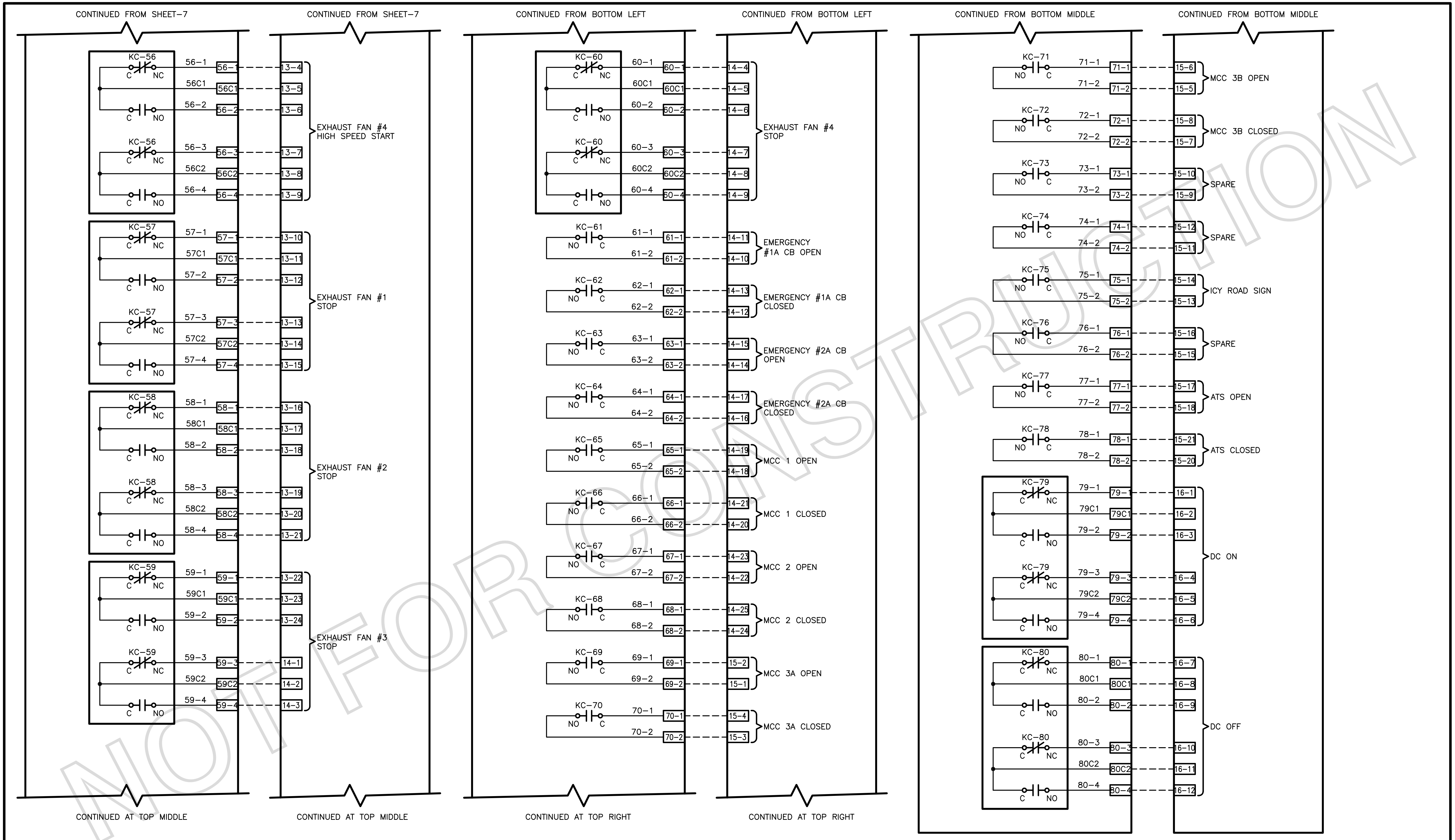
AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15
JOB #: 2100
FILE: NORTH
SET ID:

7
8



	REVISIONS
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

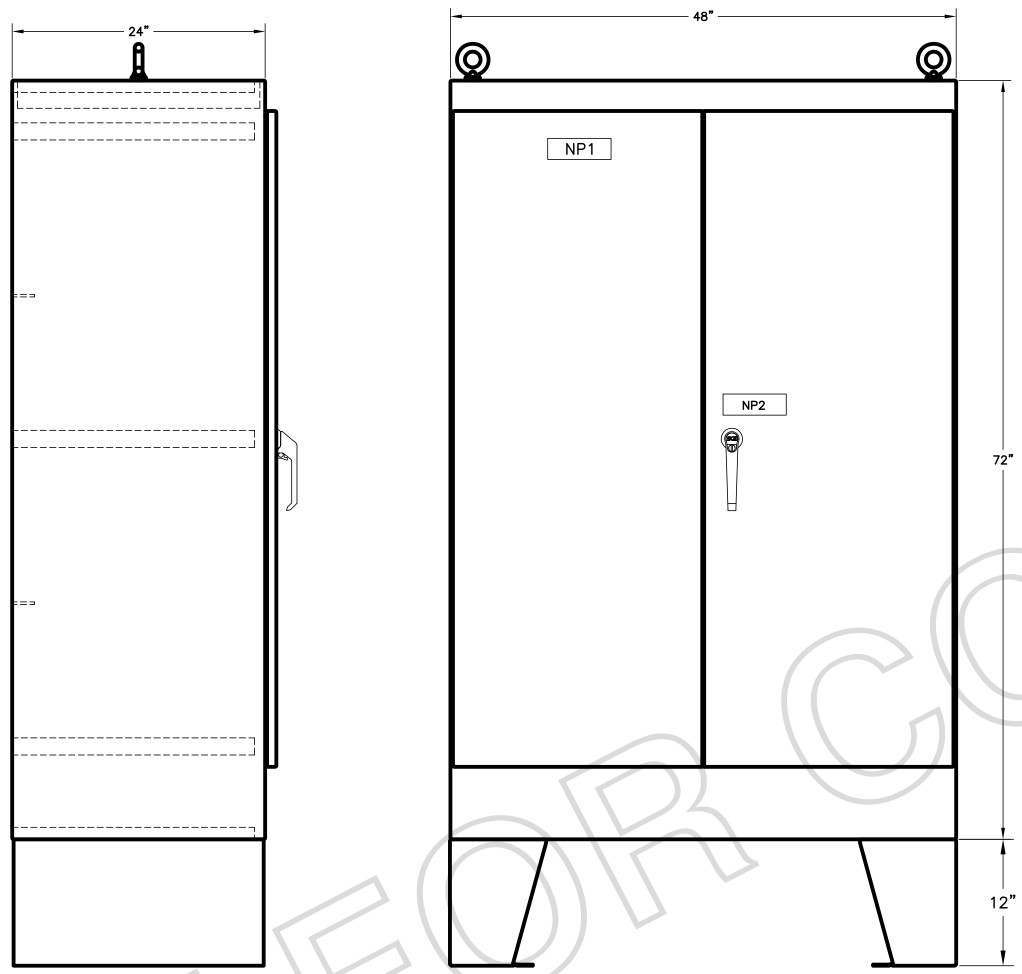
AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
NORTH BORE RELAY REPLACEMENT PANEL
LCP-NBRR

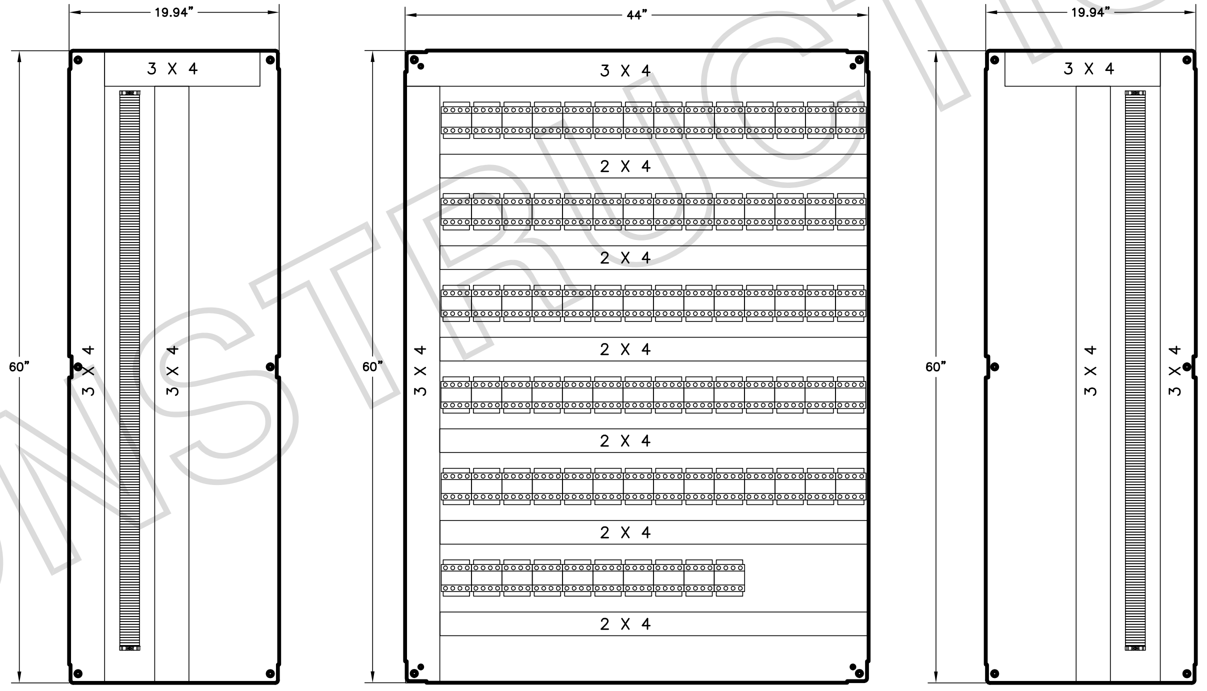
EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15 | JOB #: 2100 | 8
FILE: NORTH | SET ID: | 8

LAST PRINTED: 4/29/2015 5:19:14 PM



NEMA-12 ENCLOSURE 72"H X 48"W X 24"D
PAINT: ANSI GRAY



LEGEND SCHEDULE
MATERIAL: GRAVOPLY-II, BLACK FIELD WITH WHITE LETTERS

LEGEND					
IDENT	SIZE	TEXT SIZE	LINE 1	LINE 2	LINE 3
NP1	2 X 6	1/2"	LCP-SBRR SOUTH BORE	RELAY REPLACEMENT	PANEL

NP2 DETAIL

"CAUTION"
RISK OF ELECTRIC SHOCK
MORE THAN ONE SWITCH OR UNINTERRUPTIBLE
POWER SUPPLY IS REQUIRED TO BE OPERATED
TO DE-ENERGIZE EQUIPMENT BEFORE SERVICING.

AmWest Control, Inc.
10175 E. 106th Ave.
Brighton, CO 80601
Ph. 303-289-2115

Device: LCP-SBRR
Type: 12 Enclosure
Job #: 2100
Owner: Co. Dept. of Transportation
Voltage: 120VAC,
Max FLA: ?Amps
Reference Field Wiring Diagram: SOUTH
Short Circuit Current: 10KA

REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	REVISED PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY:M. JOSS
CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

FRONT ELEVATION
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

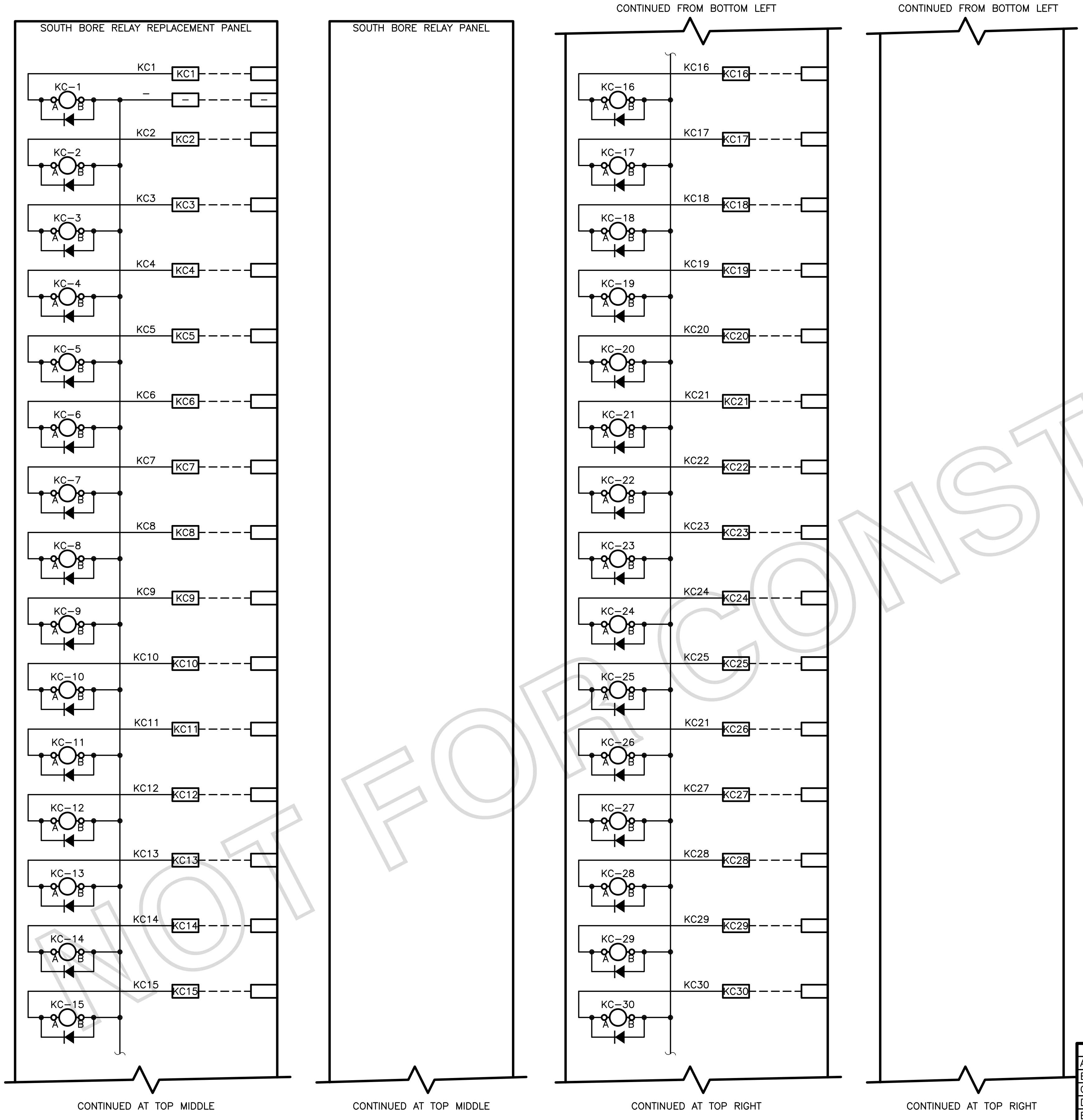
EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

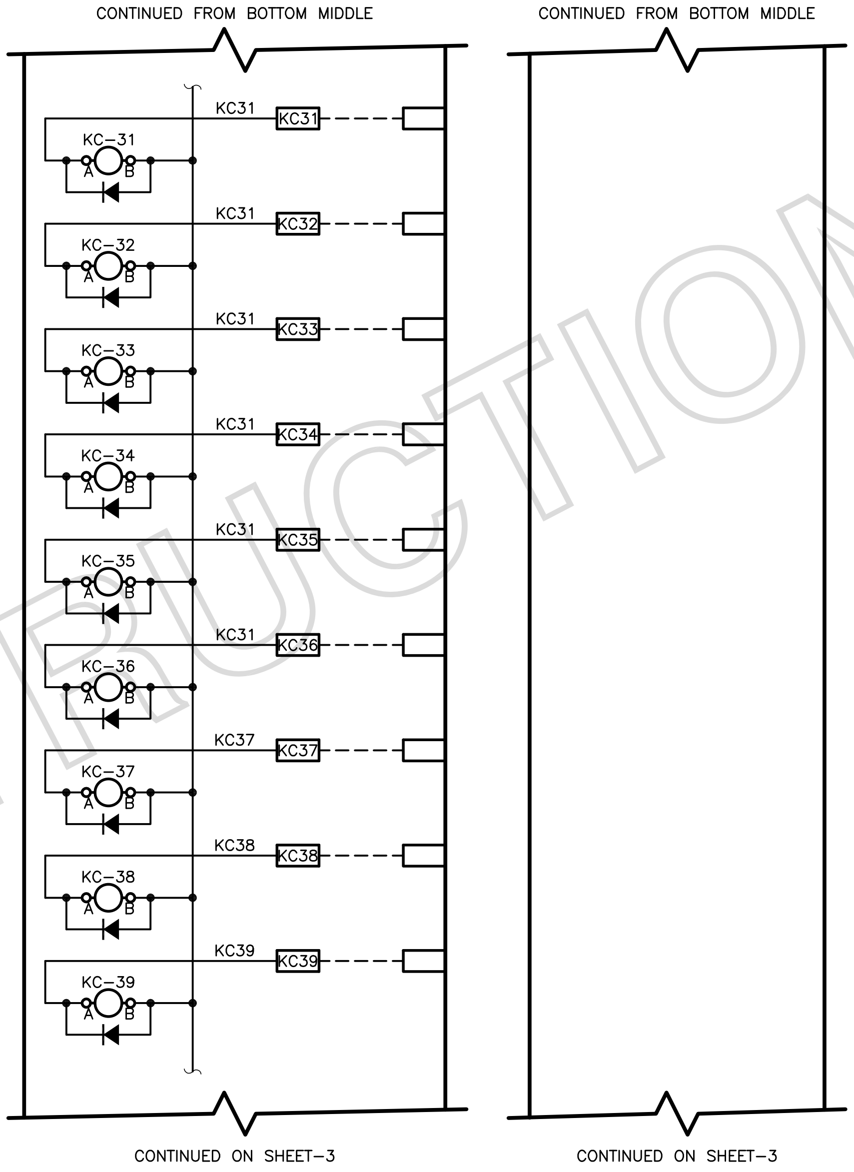
DATE: 1-15
JOB #: 2100
FILE: SOUTH
SET ID:

1
9

SOUTH.dwg

4/29/2015 5:17 PM





REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

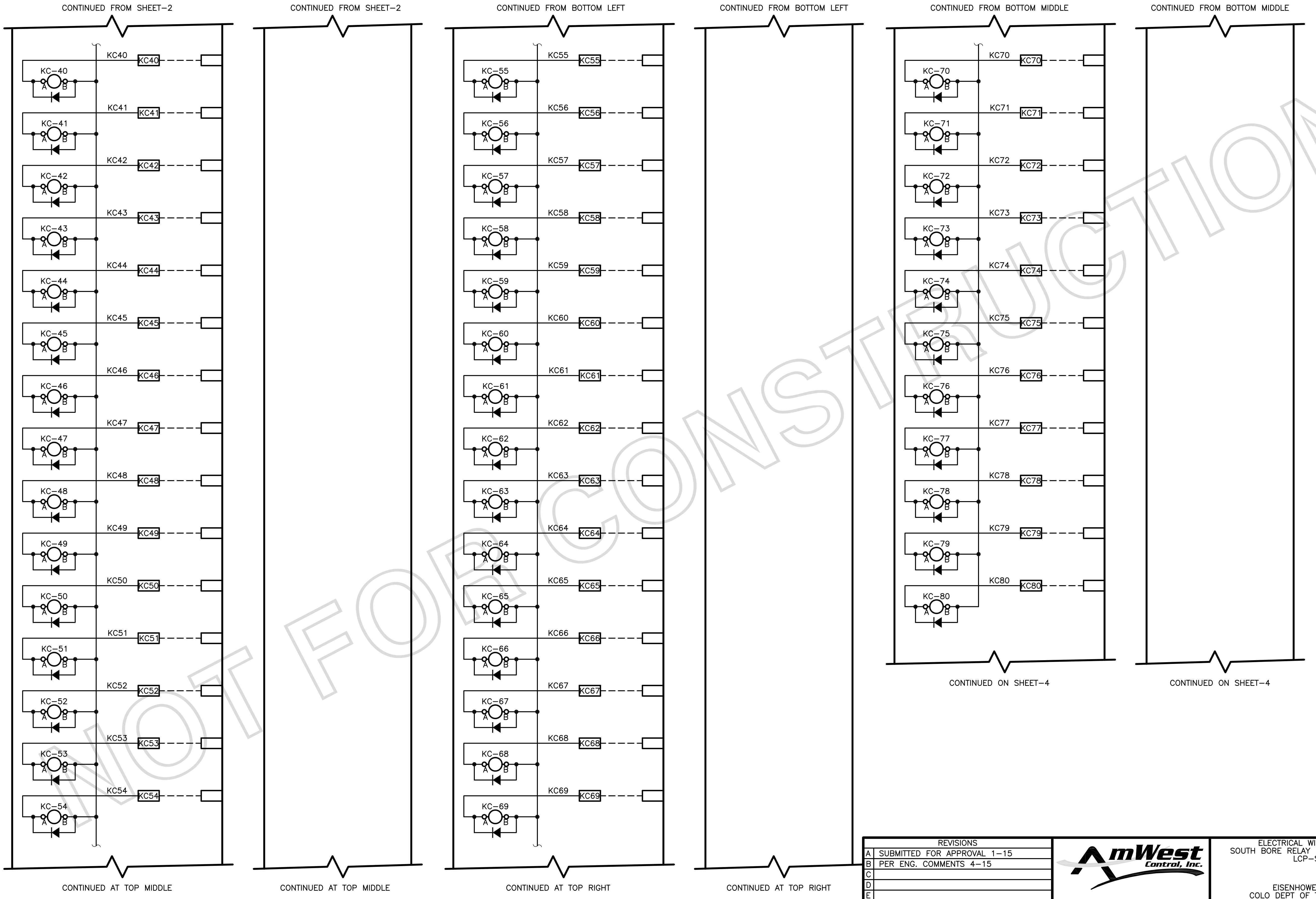
DESIGNED BY: M. JOSS
CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15
JOB #: 2100
FILE: SOUTH
SET ID:
2
9



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

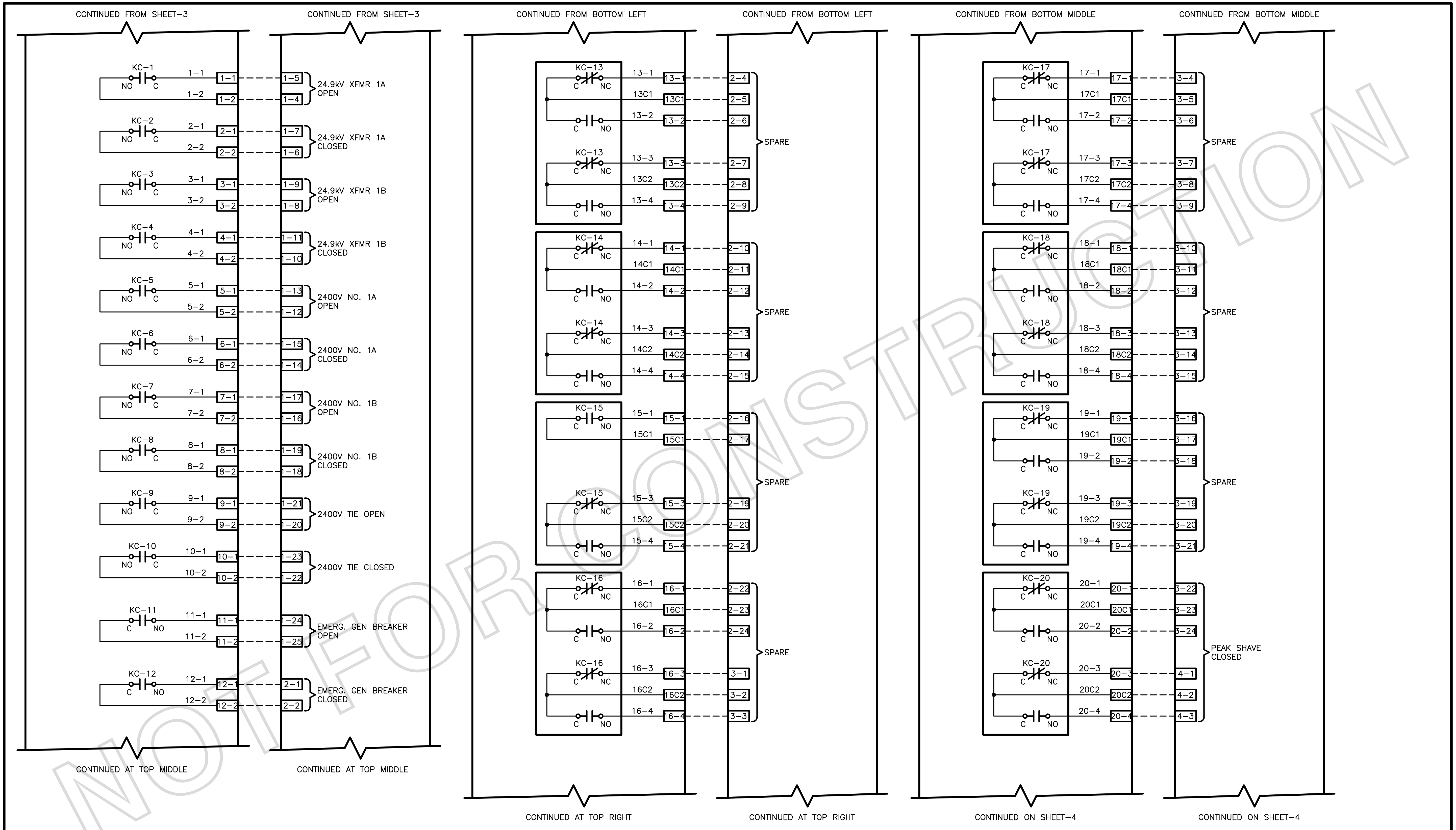
AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15 | JOB #: 2100
FILE: SOUTH | SET ID:

3
9



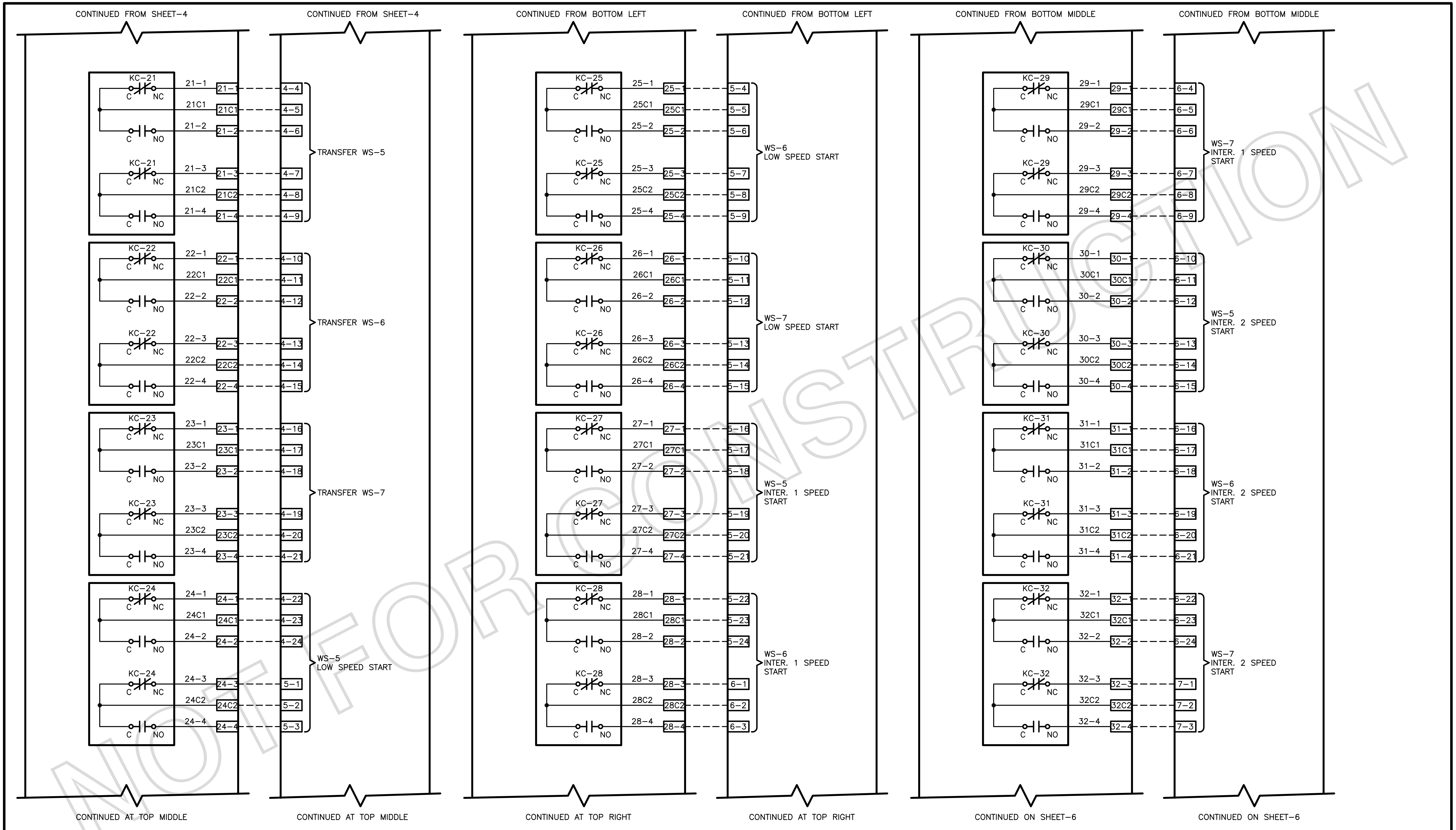
REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	
DESIGNED BY: M. JOSS	CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE:	1-15	JOB #:	2100	4
FILE:	SOUTH	SET ID:		9



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

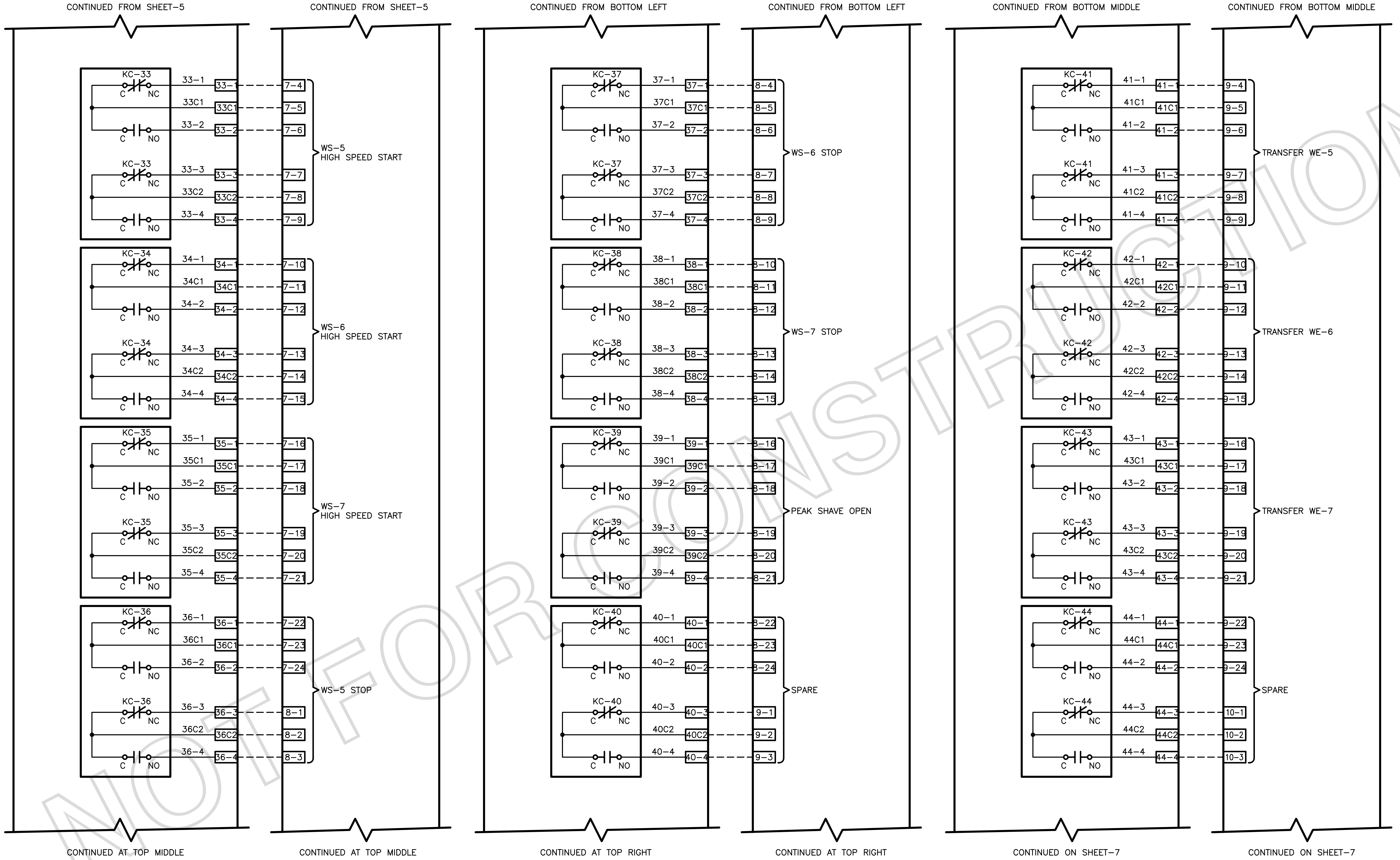
DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE:	1-15	JOB #:	2100	5
FILE:	SOUTH	SET ID:		9



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

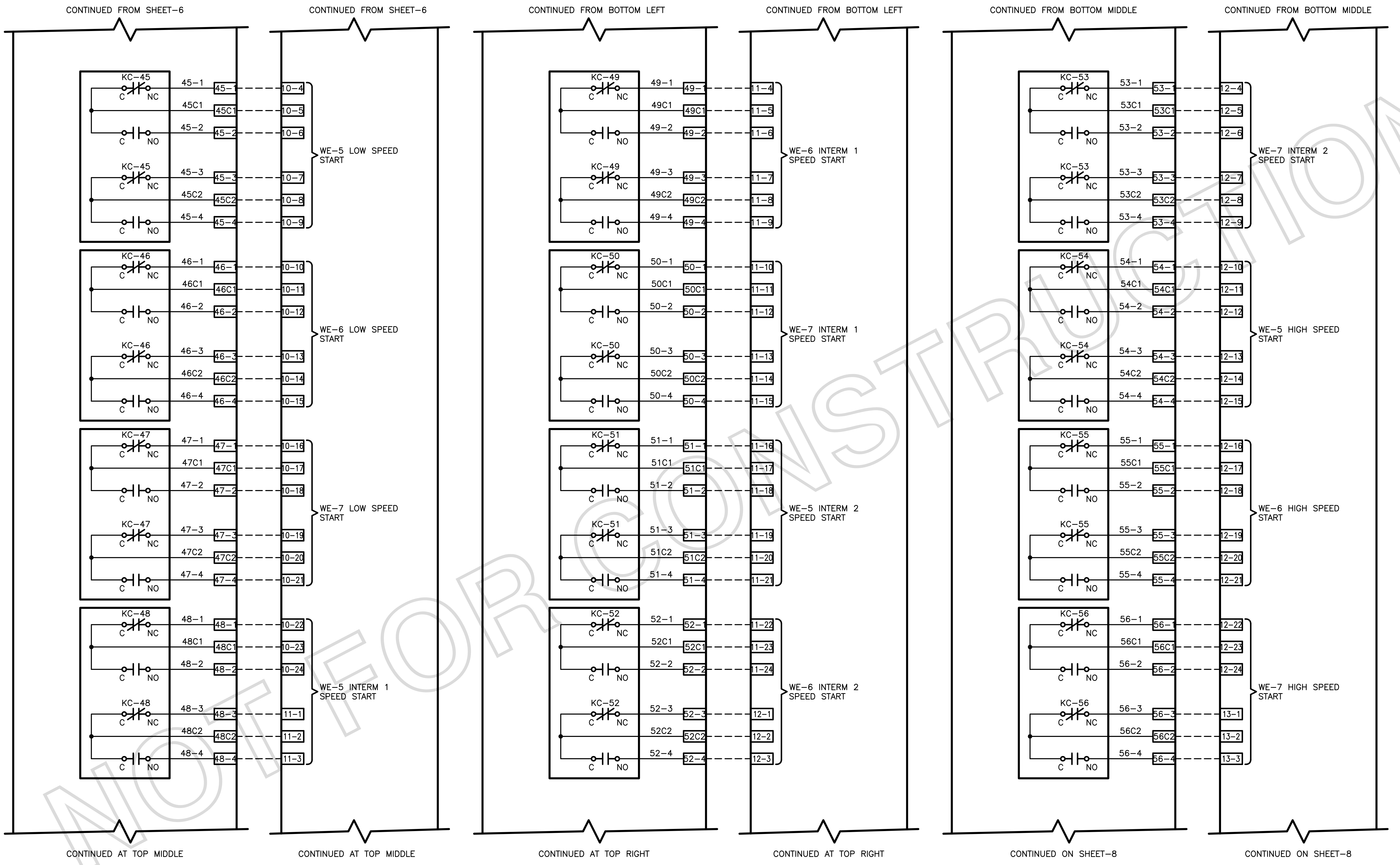
DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15
JOB #: 2100
FILE: SOUTH
SET ID:



SOUTH.dwg

4/29/2015 5:17 PM

REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

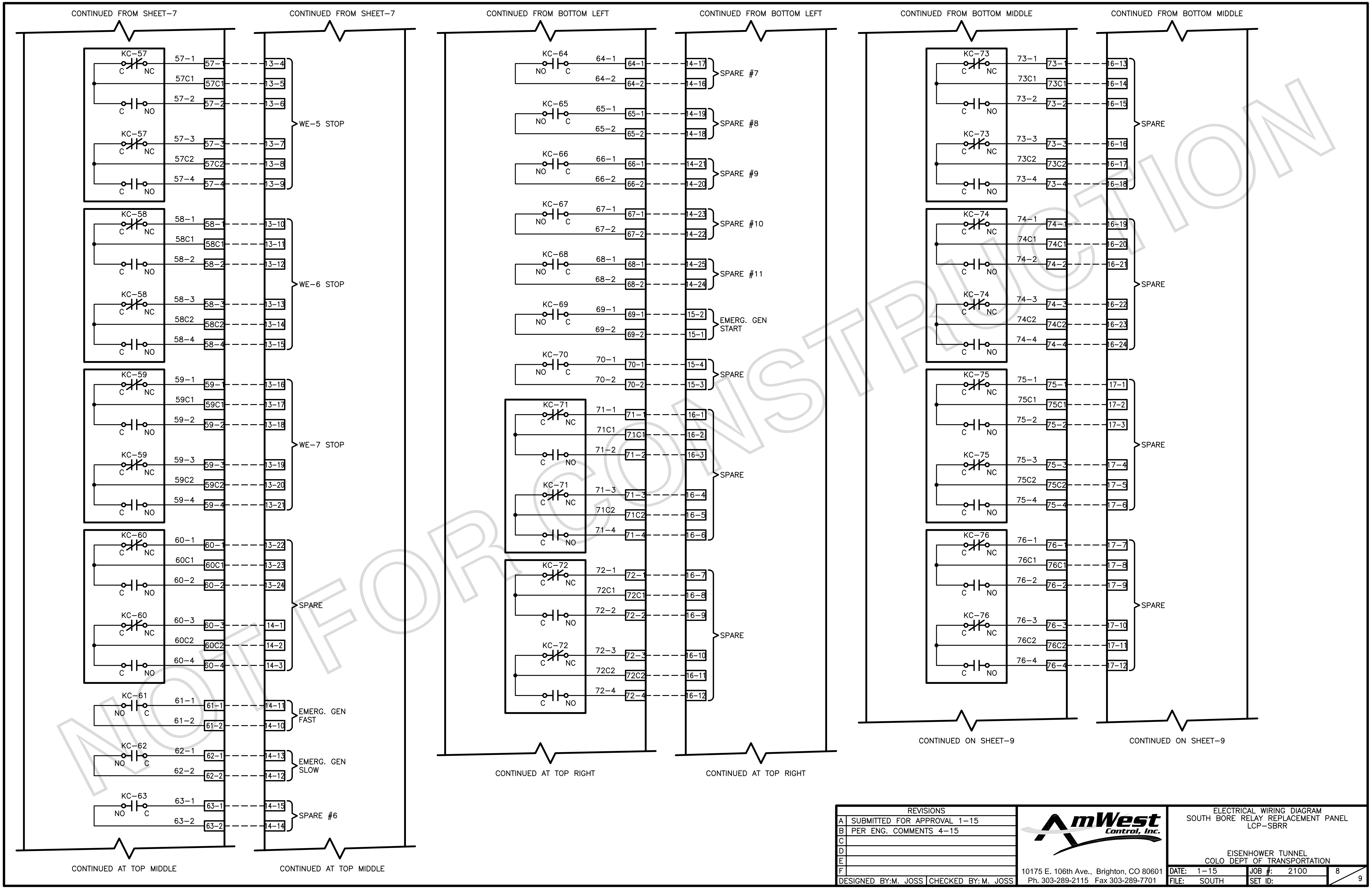
AmWest Control, Inc.

10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE:	1-15	JOB #:	2100	7
FILE:	SOUTH	SET ID:		9



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.
10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

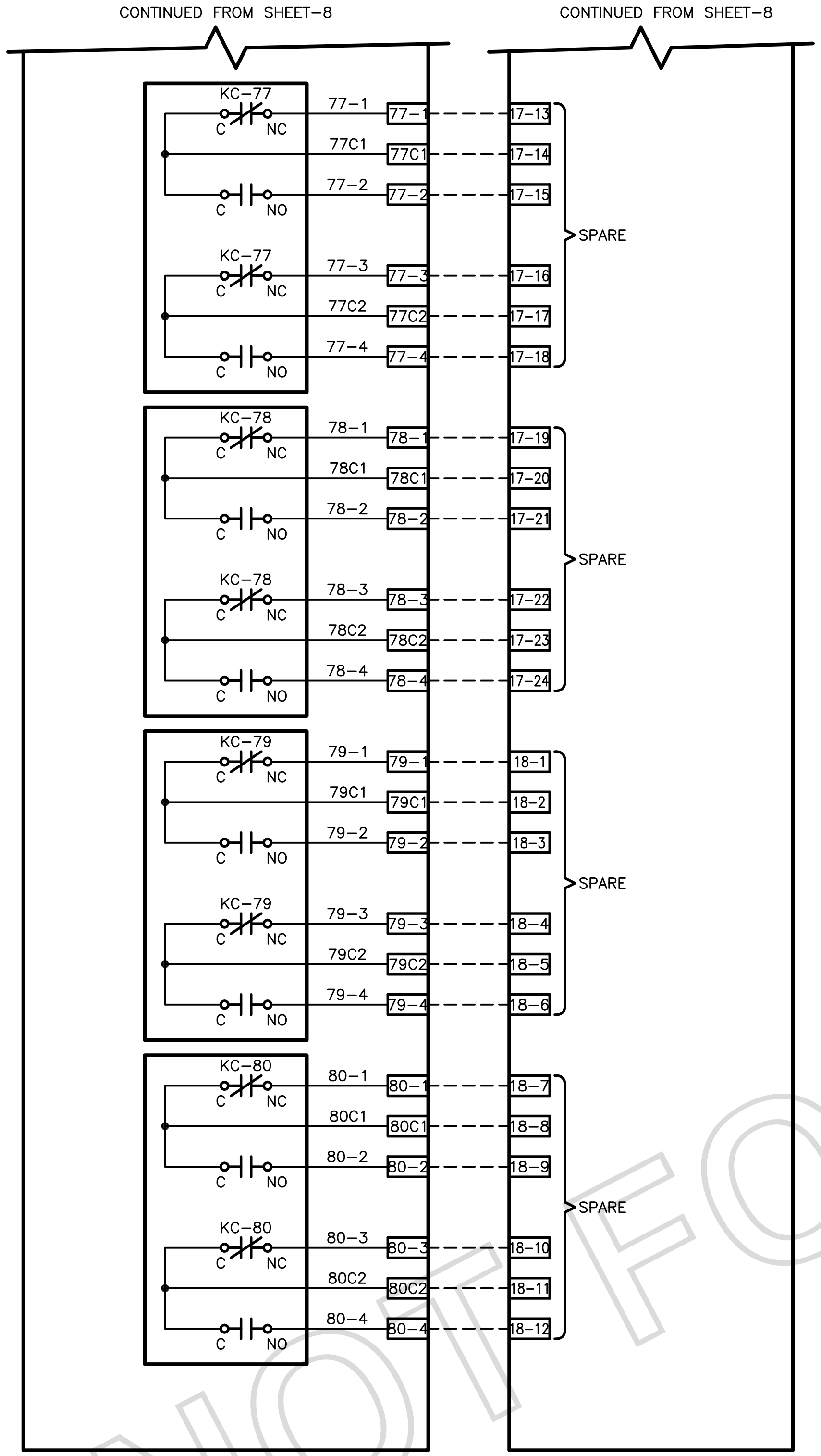
EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE:	1-15	JOB #:	2100	8
FILE:	SOUTH	SET ID:		9

LAST PRINTED: 4/29/2015 5:19:24 PM

SOUTH.dwg

4/29/2015 5:17 PM



REVISIONS	
A	SUBMITTED FOR APPROVAL 1-15
B	PER ENG. COMMENTS 4-15
C	
D	
E	
F	

DESIGNED BY: M. JOSS | CHECKED BY: M. JOSS

AmWest Control, Inc.

10175 E. 106th Ave., Brighton, CO 80601
Ph. 303-289-2115 Fax 303-289-7701

ELECTRICAL WIRING DIAGRAM
SOUTH BORE RELAY REPLACEMENT PANEL
LCP-SBRR

EISENHOWER TUNNEL
COLO DEPT OF TRANSPORTATION

DATE: 1-15	JOB #: 2100	9
FILE: SOUTH	SET ID:	9