SCHEMATICS MANUAL

Microtunneling System
Periphery Drive

Control Container, MTBM,
Remote Hydraulic Power Pack, Hydraulic Container,
VFD Container, Main Drive Power Container,
Pit Box, Guidance System,
Flowmeter & Jacking Frame

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SERVICE • RELIABILITY • INNOVATION

⚠ DANGER

This machine is powered by high voltage electricity.



Failure to lockout/tagout power before servicing will cause severe personal injury or death.

LOCKOUT/TAGOUT main power supply before servicing. ONLY a qualified and trained technician can operate and service this equipment. Electrical repairs must be performed only by a certified electrician.

DANGER

This machine is equipped with an accumulator.



Escaping oil or other fluids under pressure can penetrate your skin causing serious injury or death.

If accumulator requires repair, ONLY a certified service technician can check and fill the accumulator with dry nitrogen. Refer to the accumulator manufacturer for more information. NEVER FILL AN ACCUMULATOR WITH OXYGEN! An explosion WILL occur if oil and oxygen mix under pressure, resulting in serious injury or death. Also, NEVER fill accumulator with compressed air. Compressed air can cause premature wear to the accumulator seals.

Introduction

This schematic manual contains electrical and hydraulic schematics for your Akkerman Microtunneling Periphery Drive System. You must read and understand your Microtunneling System Operator's Manual before operating or servicing your Microtunneling System.

IMPORTANT: The contractor is responsible for the overall safety program on the equipment and job site. Only a qualified and trained technician can service this equipment. Electrical repairs must be performed by a certified electrician.

Additional copies of this manual may be purchased from the Akkerman Aftermarket Support Department, or downloaded from the Akkerman web site at www.akkerman.com.

The use of parts other than genuine Akkerman parts could affect the efficient performance of the Microtunneling System. ALWAYS use genuine Akkerman parts.

Understand safety signal words, DANGER, WARNING, CAUTION, SAFETY INSTRUCTIONS, and NOTICE. When you see these words in this manual or on safety decals mounted on your equipment, follow the safety message to avoid personal injury and/or property damage.

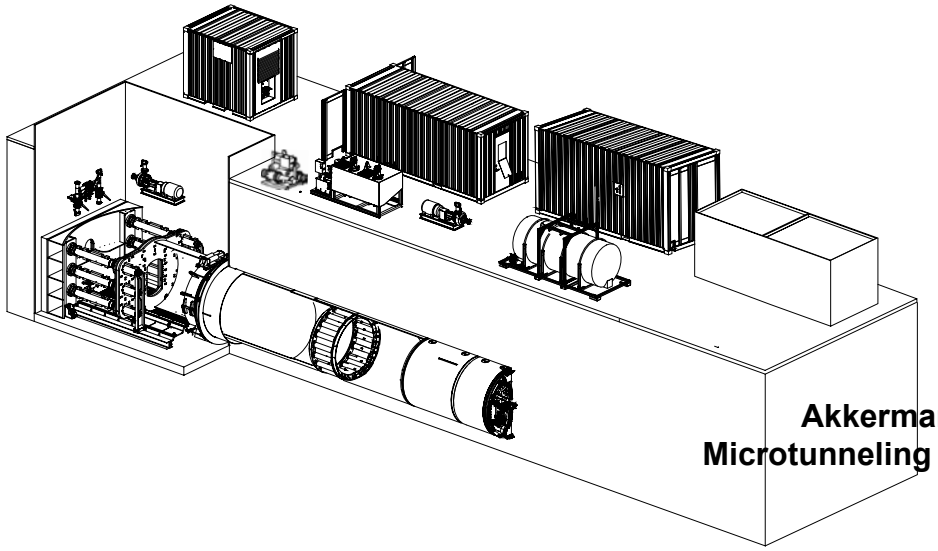
⚠DANGER Indicates an extremely hazardous situation which, if not avoided, WILL result in death or serious injury.

⚠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. It may also be used to alert against unsafe practices.

SAFETY INSTRUCTIONS Usually consists of individual messages stating procedures or actions that must be followed for the safe operation of a product.

NOTICE Identifies potential property damage and important installation, operator, or maintenance information.



Akkerman Microtunneling System

Microtunneling is a type of "trenchless technology." It is generally defined as remotely controlled pipejacking (personnel entry is not required). Microtunneling is an extremely accurate, laser guided method for installing pipelines in varied soil conditions from flowing soft ground to hard rock. Slurry pressure balanced microtunneling systems enable installations below the water table or in very wet soil without the need for dewatering. The basic operation of a microtunneling system consists of: a microtunneling boring machine (MTBM) for piloting the course and excavating the ground. Simultaneously, slurry is pumped to the MTBM, mixed with the spoil and pumped to the surface for separation. A jacking frame with hydraulic cylinders are used to advance the MTBM and pipeline.

If you find any errors with this manual or have suggestions for improvement, please let us know. Email your comments via the Akkerman web site (Contact Us web page), or mail your suggestions to: Akkerman Inc, ATTN: Technical Publications, 58256 266th Street, Brownsdale, MN 55918.

Akkerman Inc. reserves the right to improve its product without notice or obligation.

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Motor Control Center

The Motor Control Center (MCC) is made of standardized vertical sections consisting of totally enclosed, dead front, free standing structures bolted together. These sections support and house control units, a common bus bar for distributing power to the control units, and a network of wire trough and conductor entrance areas to accommodate outgoing load and control wires.

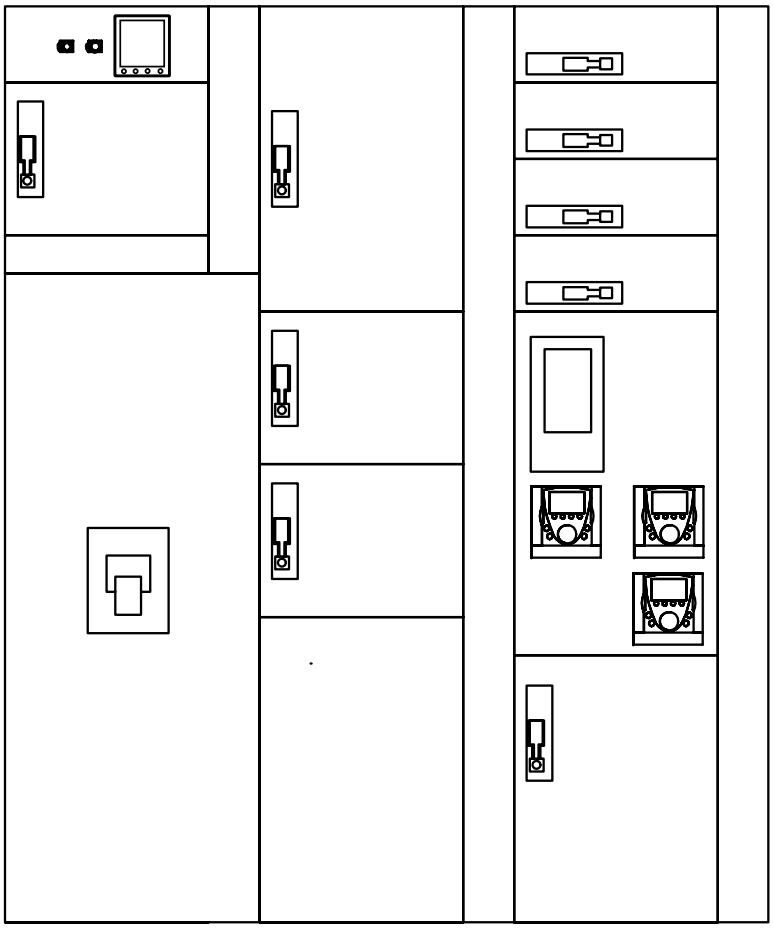
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Control Container SN FA22300F
MCC P0251-821 1-2

Control Container SN FA22299F, FA21900F-04/05
MCC P0251-646 1-15

VFD Container SN FA22241F
MCC P0251-937 1-25
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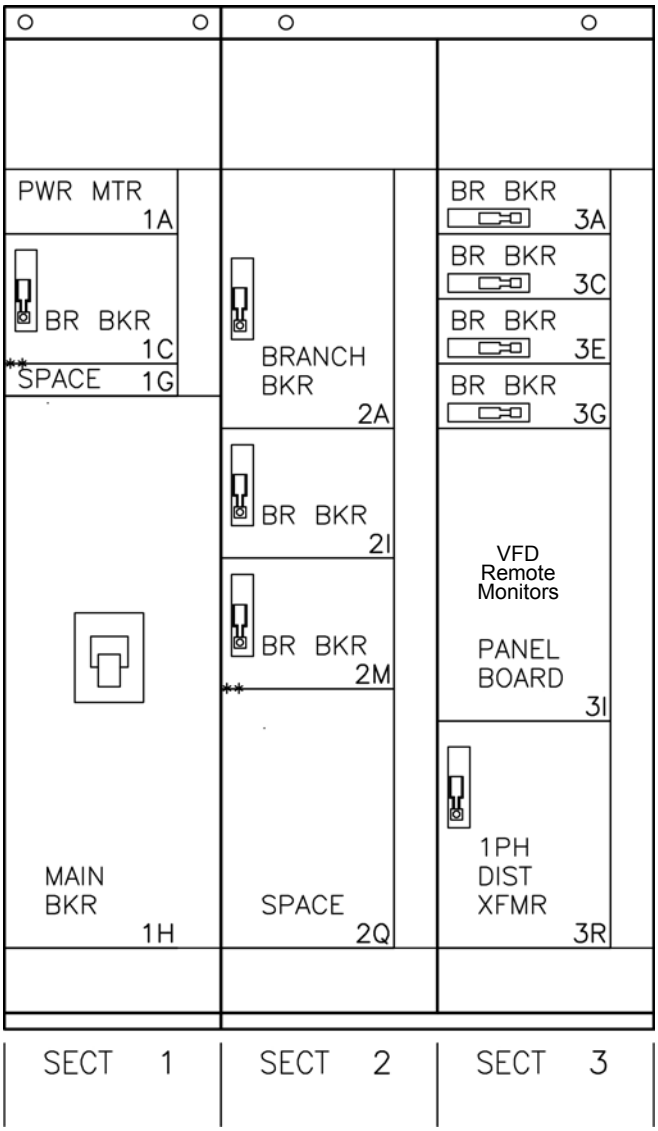
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SN FA22300F

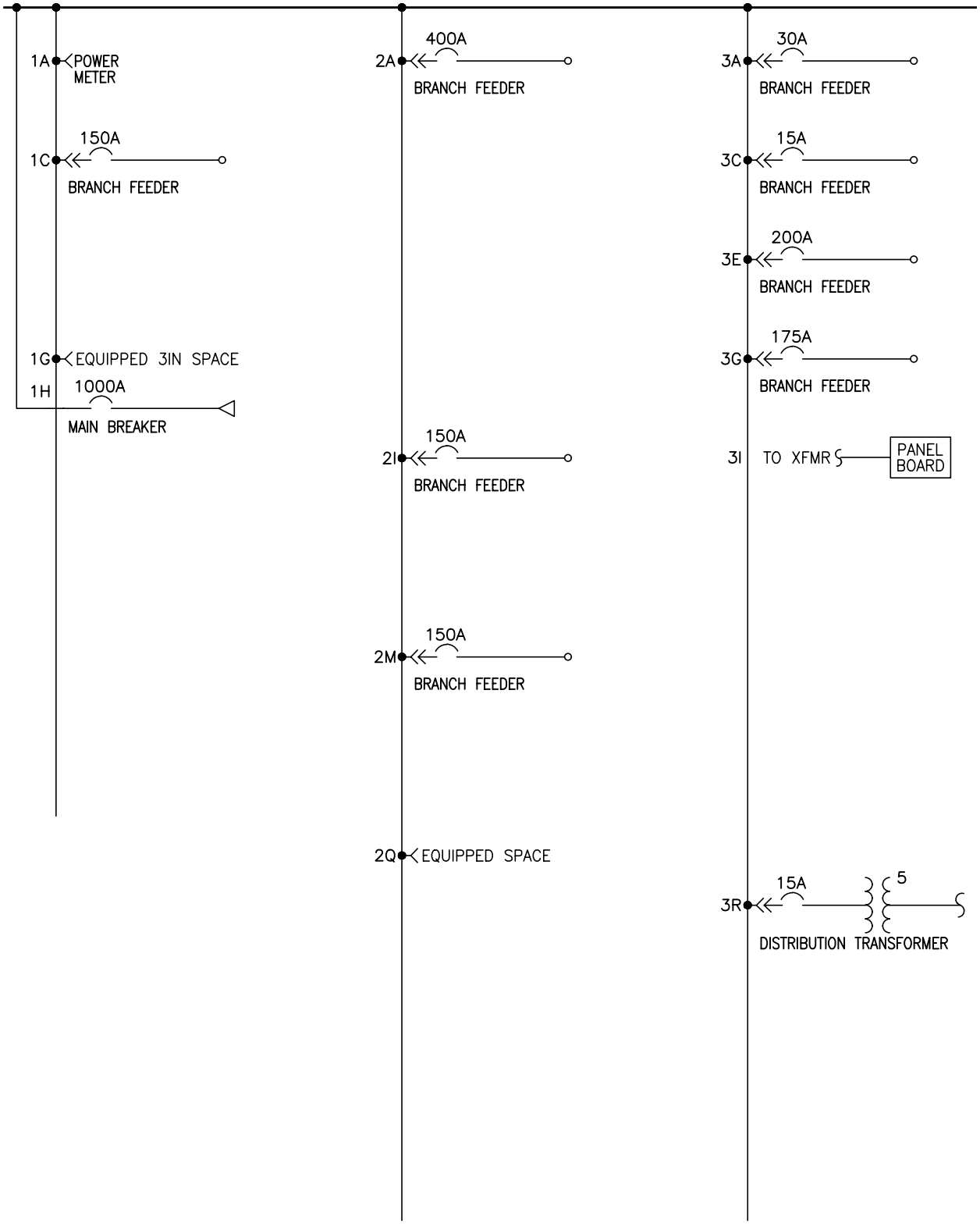
MOTOR CONTROL CENTER (MCC) P0251-821 ELECTRICAL SCHEMATICS CONTROL CONTAINER SN: FA22240F & FA22300F

Use the illustration below to locate the control units that are referenced in the MCC electrical schematics on the following pages.



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MCC Electrical Schematics - One Line Diagram



(continued on next page)

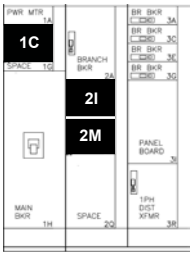
MCC Electrical Schematics - Component Information

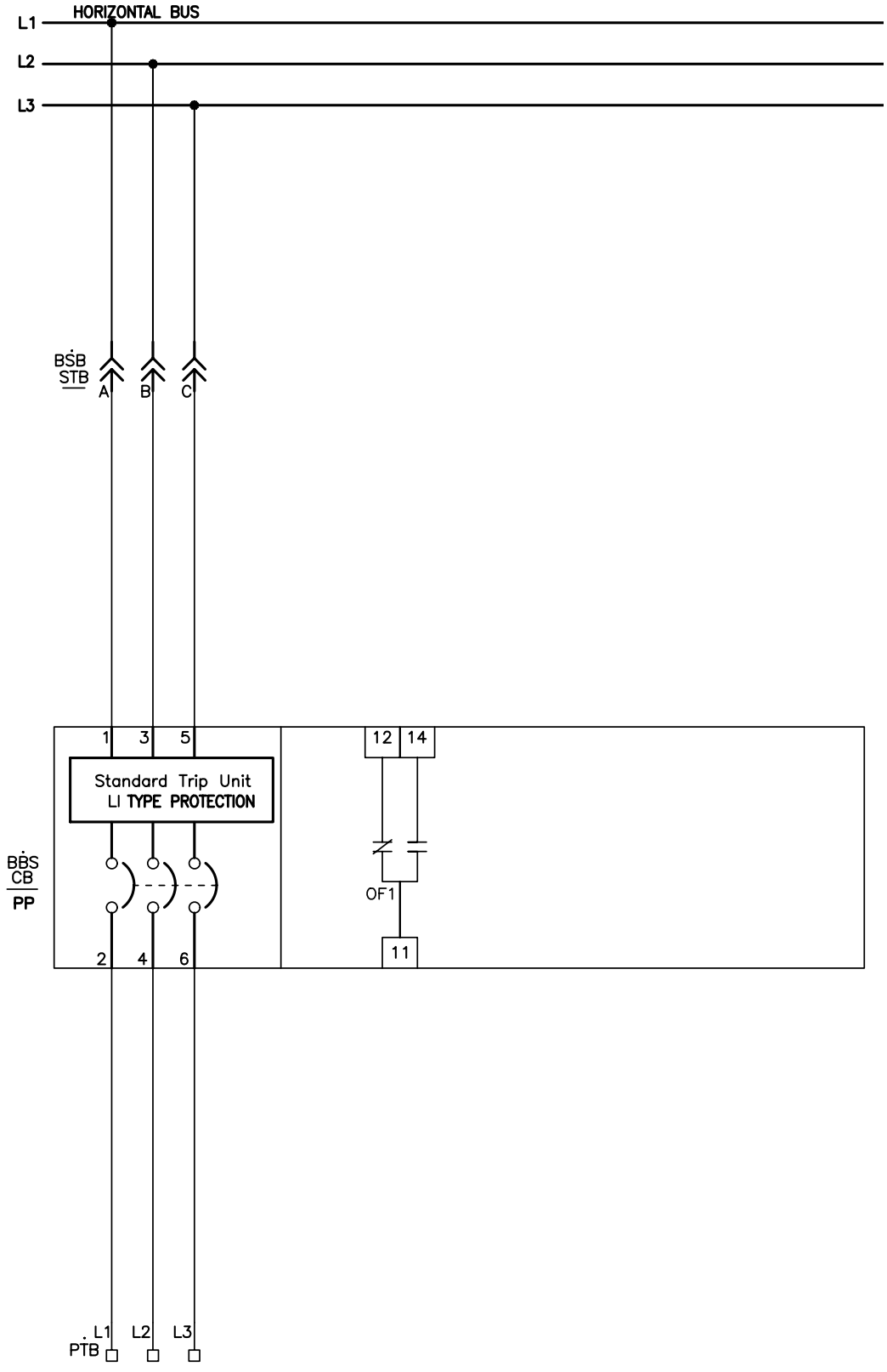
UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: 22 mm ** ON LIGHT	PILOT DEVICES: 22 mm ** OFF LIGHT	ADDL P/L	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #
1A	MONITORING UNIT FOR MAIN	POWER METER															PM5563 W/DISPLAY	E36573618-CR2-02
1C	LARGE MTBM HEAD POWER	BRANCH BKR			HJ 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE,	E36573618-CR2-01
																	ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C	
1G		SPACE																
1H	MAIN BREAKER	MAIN BKR			PL 1200	1000											3/0-500KCMIL 4 LUGS/PH, 80% RATED, AL MECH LUG AL/CU CABLE, ELECTRONIC STANDARD TRIP UNIT,	E36573618-CR2-02
																	INT INTLK 1A/1B FORM C, LSI TRIP FUNCTION, PHASE FAILURE/REV/UV RELAY, UV TRIP	
2A	CUTTER HEAD 575 VAC	BRANCH BKR			LJ 400	400											(2)3/0-500KCMIL 1 LUGS/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE,	E36573618-CR2-03
																	ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C	
2I	BOOSTER PUMP	BRANCH BKR			HJ 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE,	E36573618-CR2-01
																	ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C	
2M	RETURN PUMP	BRANCH BKR			HJ 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE,	E36573618-CR2-01
																	ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C	
2Q		SPACE																
3A	SMALL MTBM HEAD POWER	6" BRANCH BKR			HJ 150	30											14-3/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE, INT INTLK 1A/1B FORM C	E36573618-CR2-04
3C	COOLING PUMP	6" BRANCH BKR			HJ 150	15											14-3/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE, INT INTLK 1A/1B FORM C	E36573618-CR2-05
3E	FUTURE MID PUMP	6" BRANCH BKR			JJ 250	200											3/0-250 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE, INT INTLK 1A/1B FORM C	E36573618-CR2-06
3G	FEED PUMP	6" BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE, INT INTLK 1A/1B FORM C	E36573618-CR2-07
3I	PANELBOARD	PANEL BOARD	100A		OD												16 CIRCUITS, FULLY RATED, NQ PANELBOARD	E36573618-CR2-08
3R		1PH DIST XFMR	5 kVA		HJ 150	15											SECONDARY WIRE TO PANELBOARD	E36573618-CR2-09
UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: 22 mm ** ON LIGHT	PILOT DEVICES: 22 mm ** OFF LIGHT	ADDL P/L	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #

(continued on next page)

MCC Electrical Schematics - Large MTBM Head Power, Pumps: Booster - Return

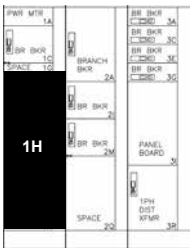
- *Large MTBM Head Power: Bucket Unit 1C*
- *Booster Pump: Bucket Unit 2I*
- *Return Pump: Bucket Unit 2M*

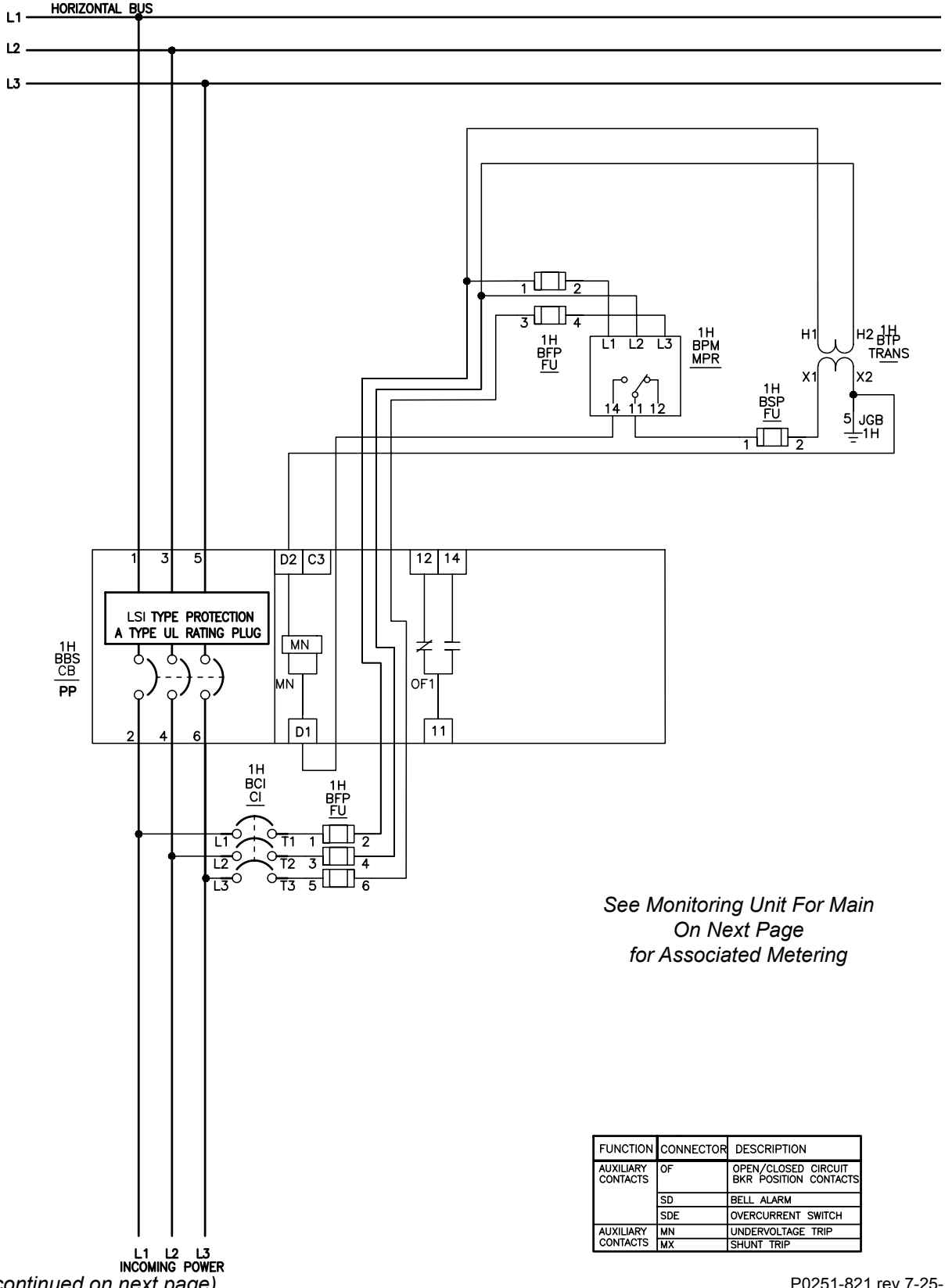




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MCC Electrical Schematics - Main Breaker
- Main Breaker: Bucket Unit 1H





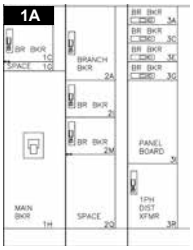
See Monitoring Unit For Main On Next Page for Associated Metering

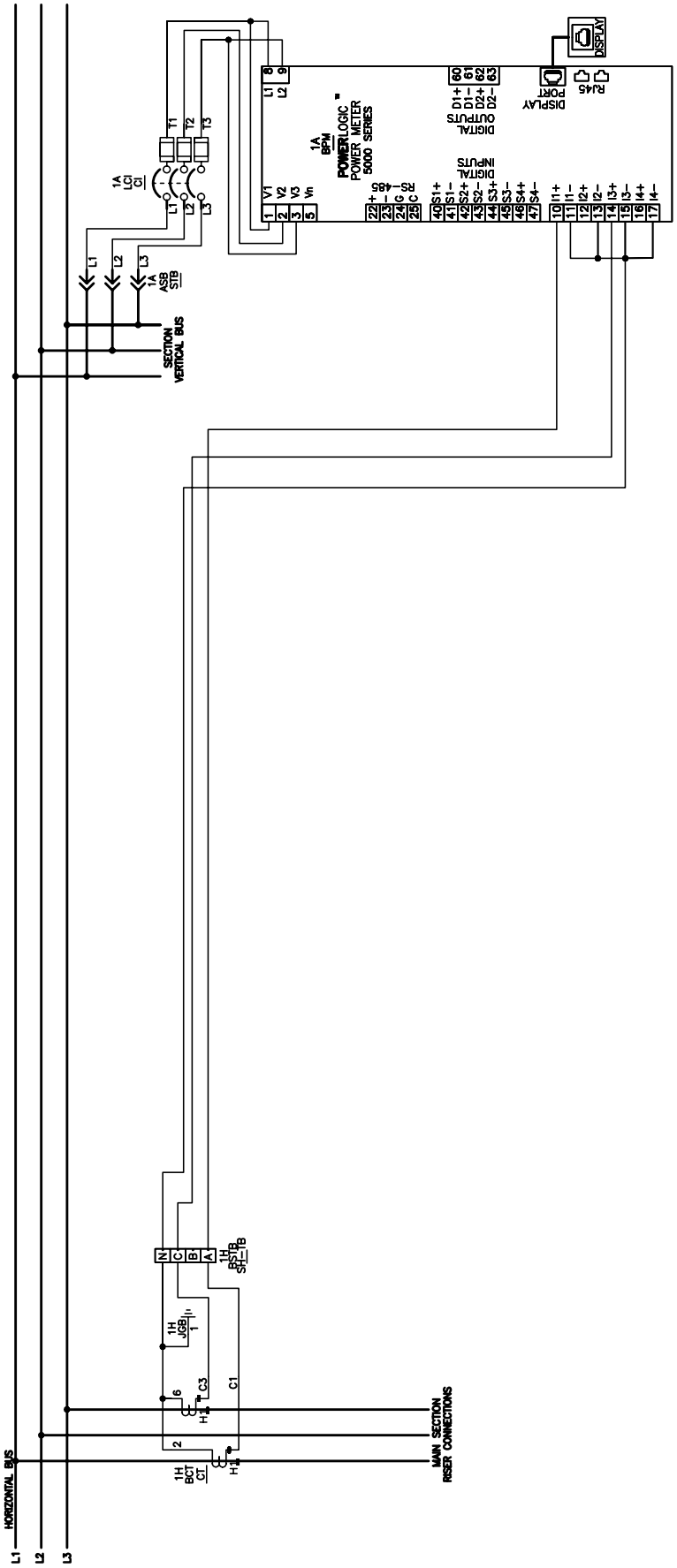
FUNCTION	CONNECTOR	DESCRIPTION
AUXILIARY CONTACTS	OF	OPEN/CLOSED CIRCUIT BKR POSITION CONTACTS
	SD	BELL ALARM
	SDE	OVERCURRENT SWITCH
AUXILIARY CONTACTS	MN	UNDERVOLTAGE TRIP
	MX	SHUNT TRIP

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MCC Electrical Schematics - Monitoring Unit For Main

- Bucket Unit 1A



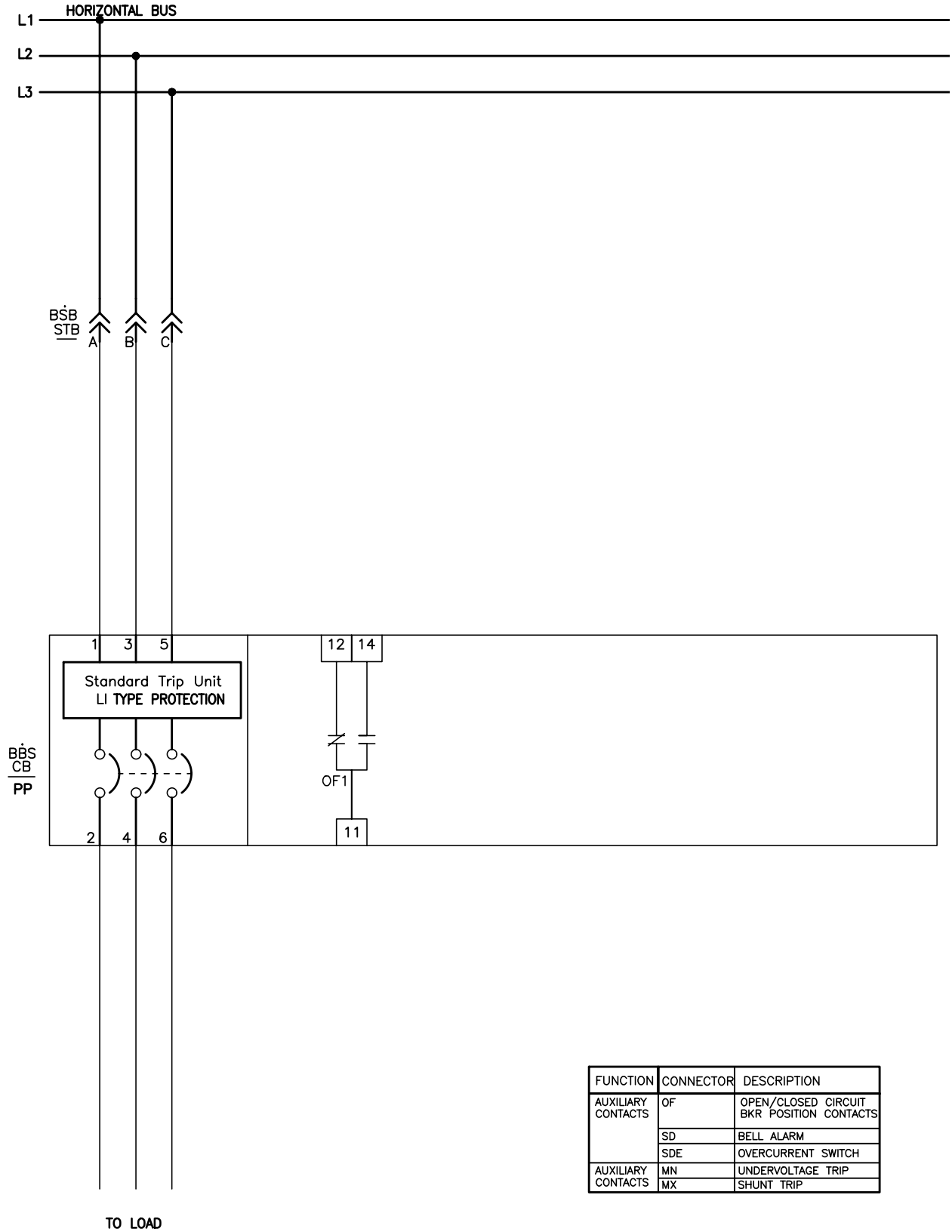


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MCC Electrical Schematics - Cutter Head 575 VAC

- Bucket Unit 2A



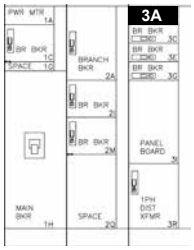


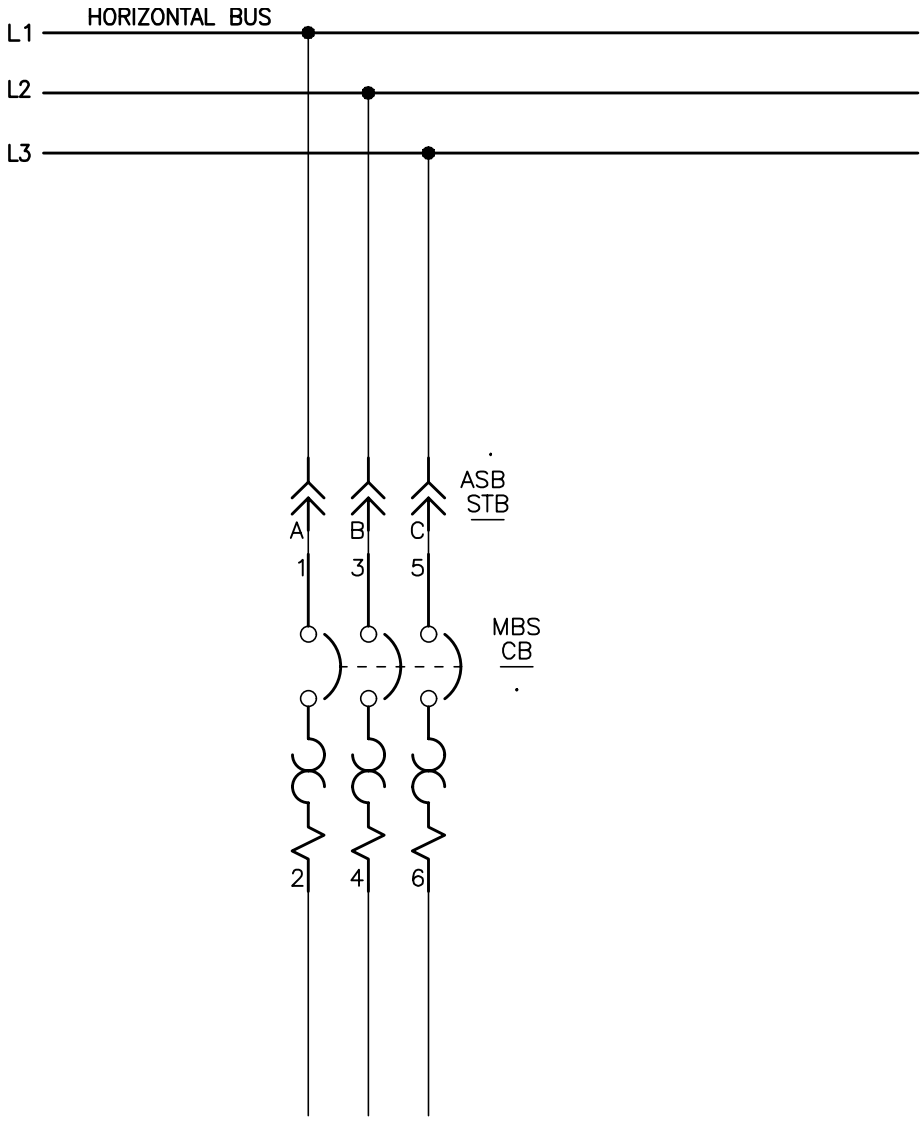
FUNCTION	CONNECTOR	DESCRIPTION
AUXILIARY CONTACTS	OF	OPEN/CLOSED CIRCUIT BKR POSITION CONTACTS
	SD	BELL ALARM
	SDE	OVERCURRENT SWITCH
AUXILIARY CONTACTS	MN	UNDERVOLTAGE TRIP
	MX	SHUNT TRIP

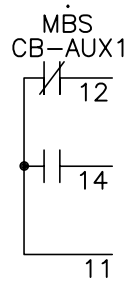
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MCC Electrical Schematics - Small MTBM Head Power

- Bucket Unit 3A



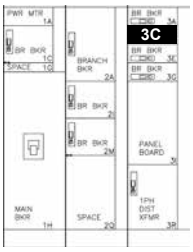


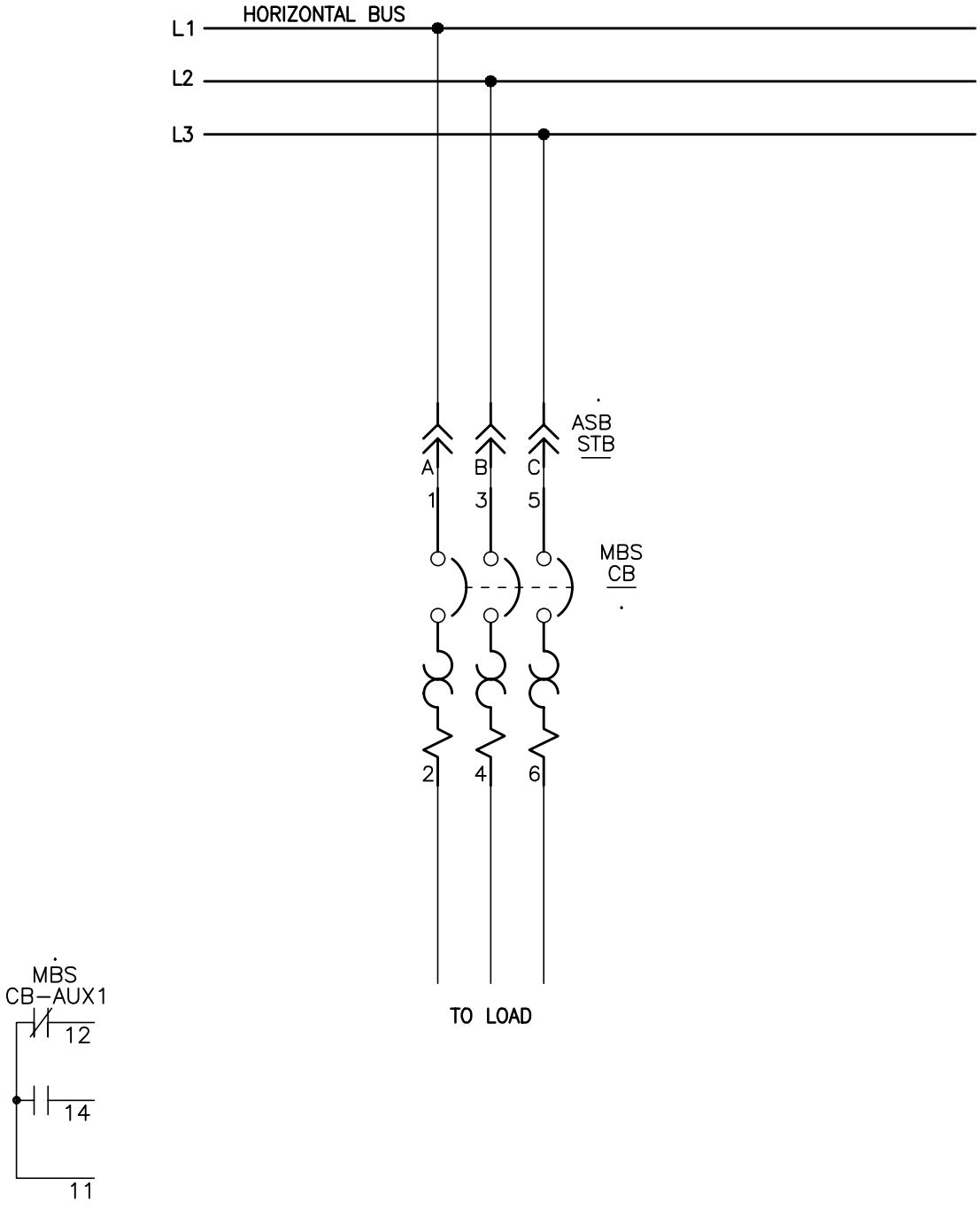


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MCC Electrical Schematics - Cooling Pump

- Bucket Unit 3C

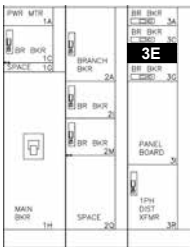


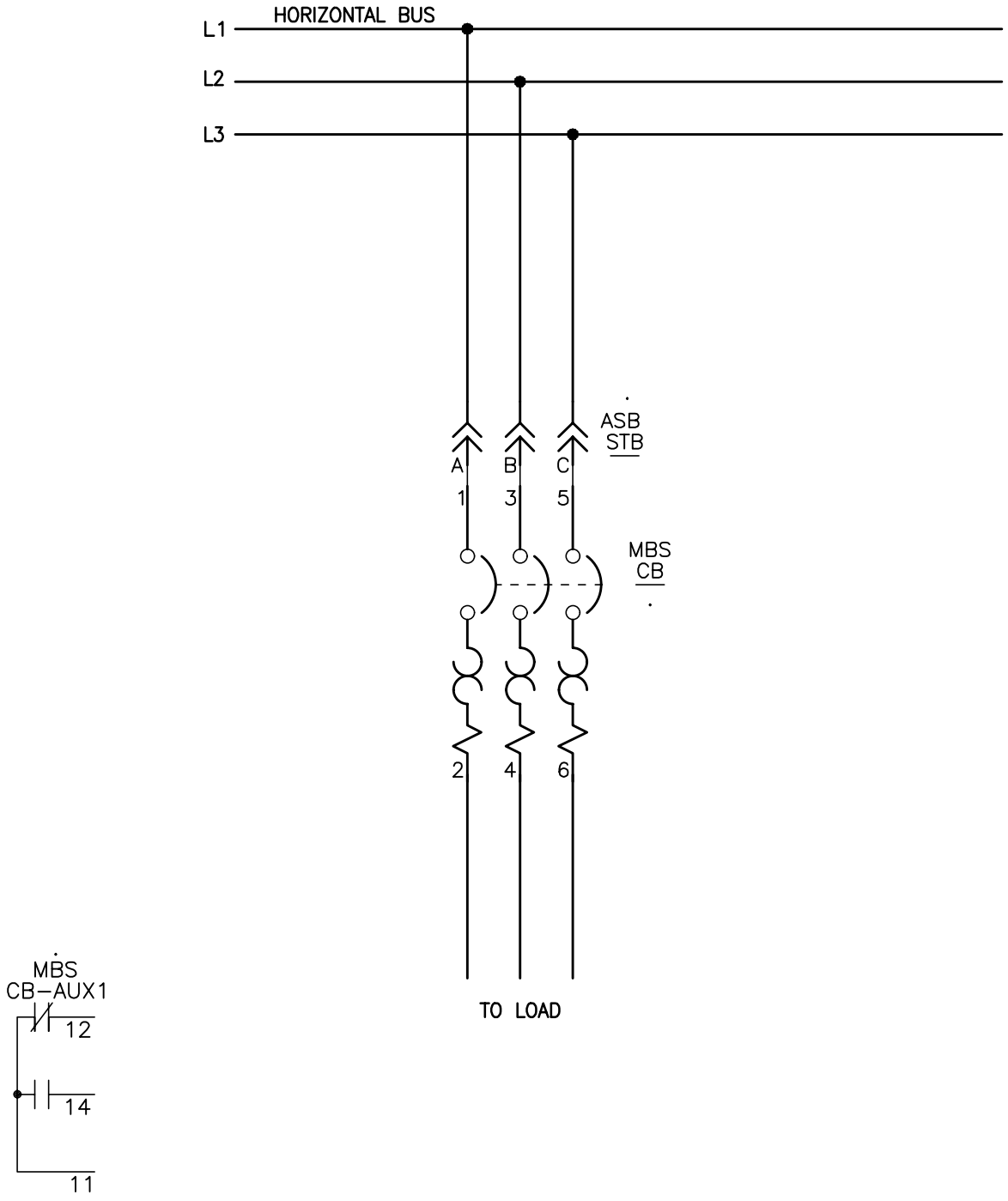


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MCC Electrical Schematics - Future Mid Pump

- Bucket Unit 3E

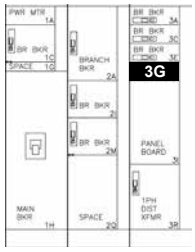


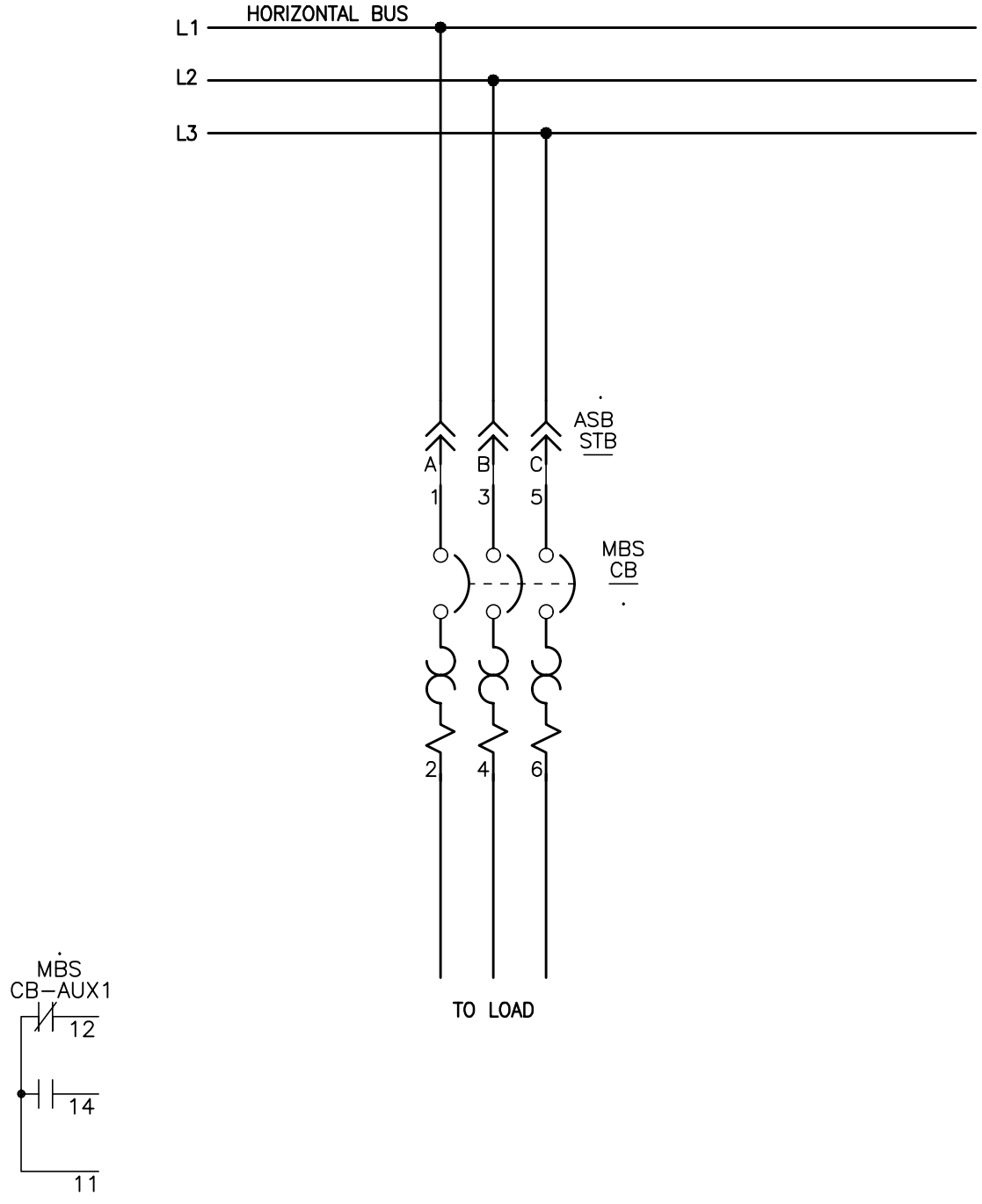


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MCC Electrical Schematics - Feed Pump

- Bucket Unit 3G

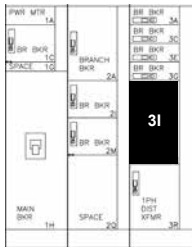


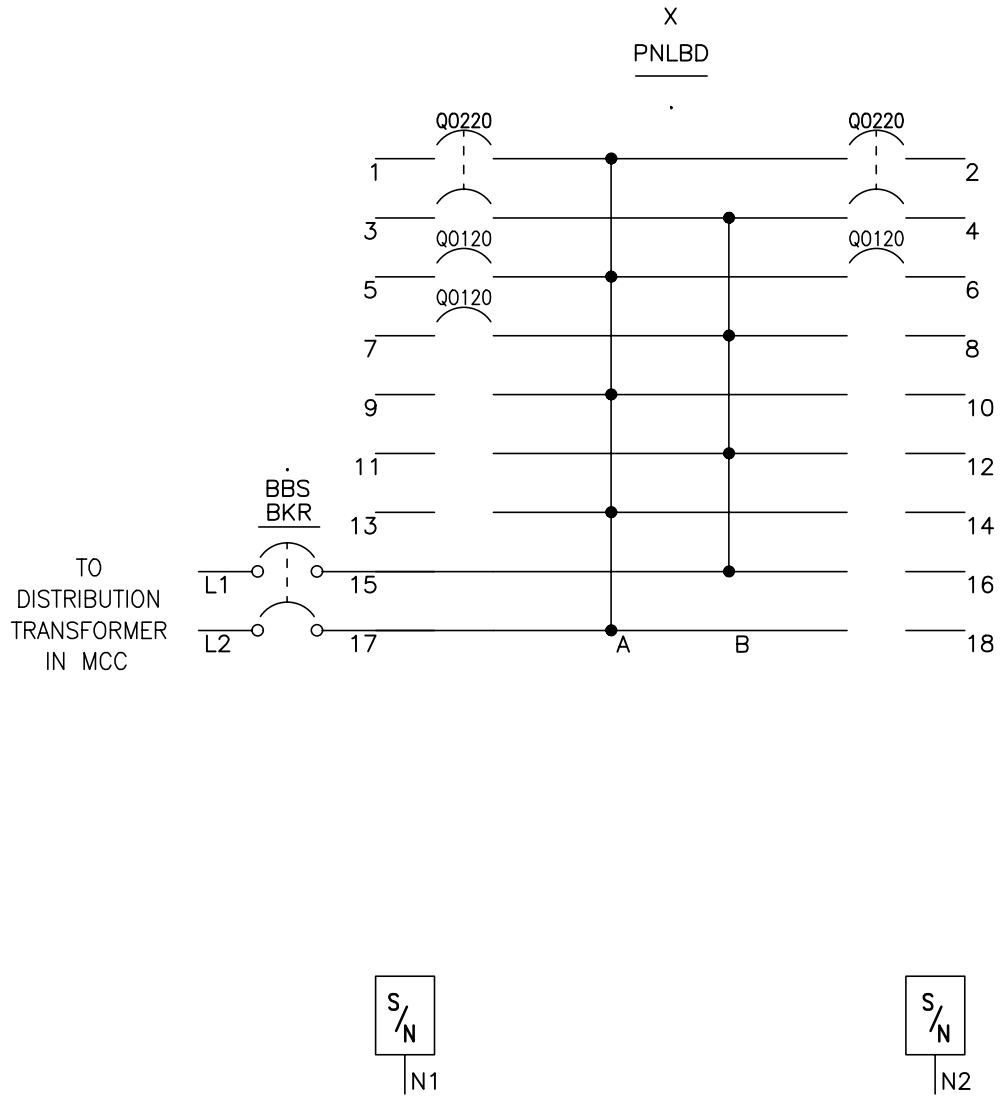


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MCC Electrical Schematics - Panel Board

- Bucket Unit 3I



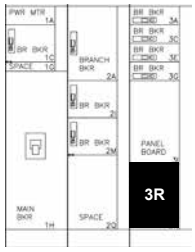


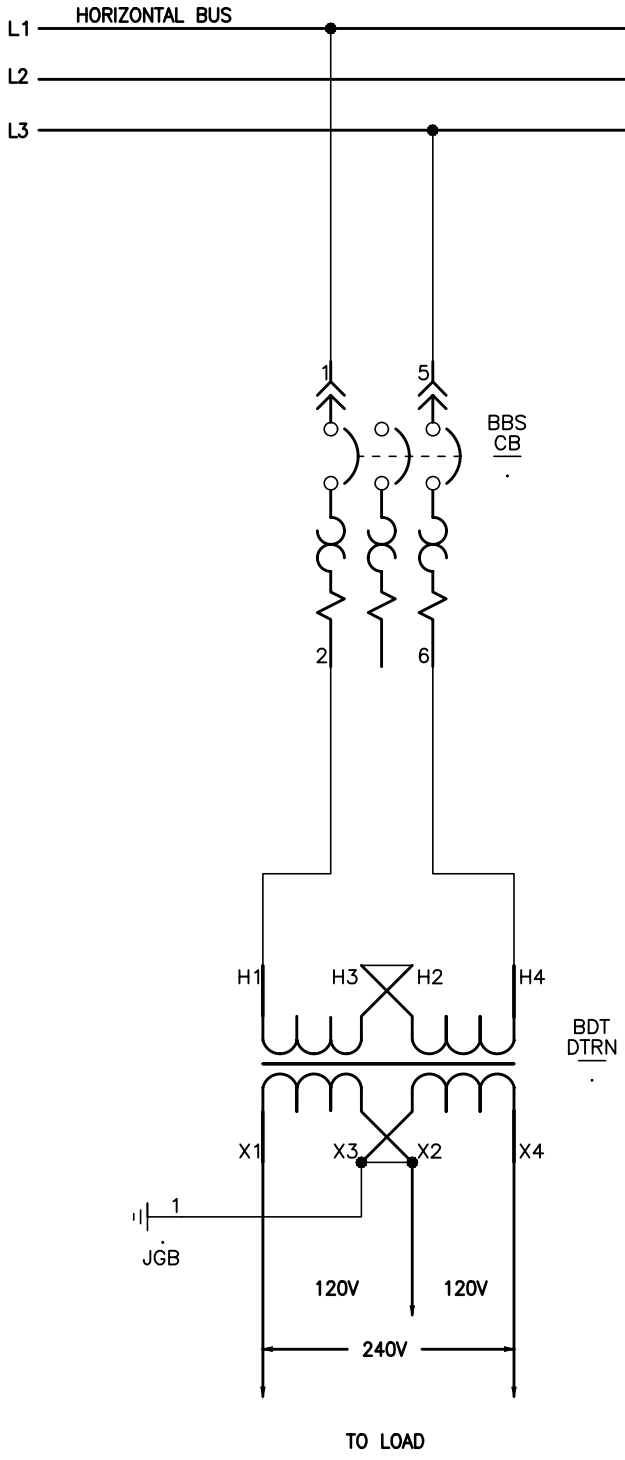
Note: Connect GFI/EPD/EPE
Neutral to Panel Neutral

(continued on next page)

MCC Electrical Schematics - Transformer

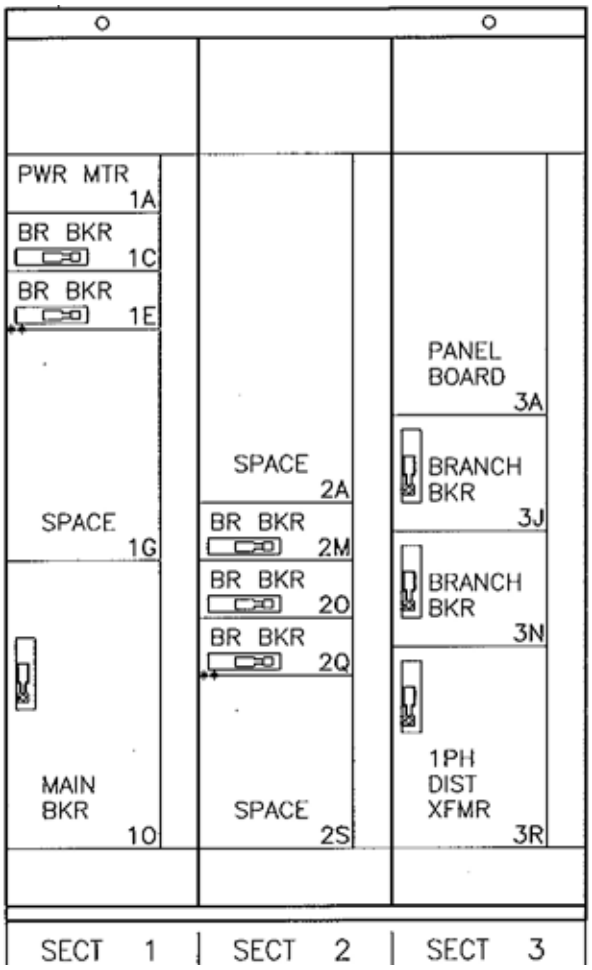
- Bucket Unit 3R





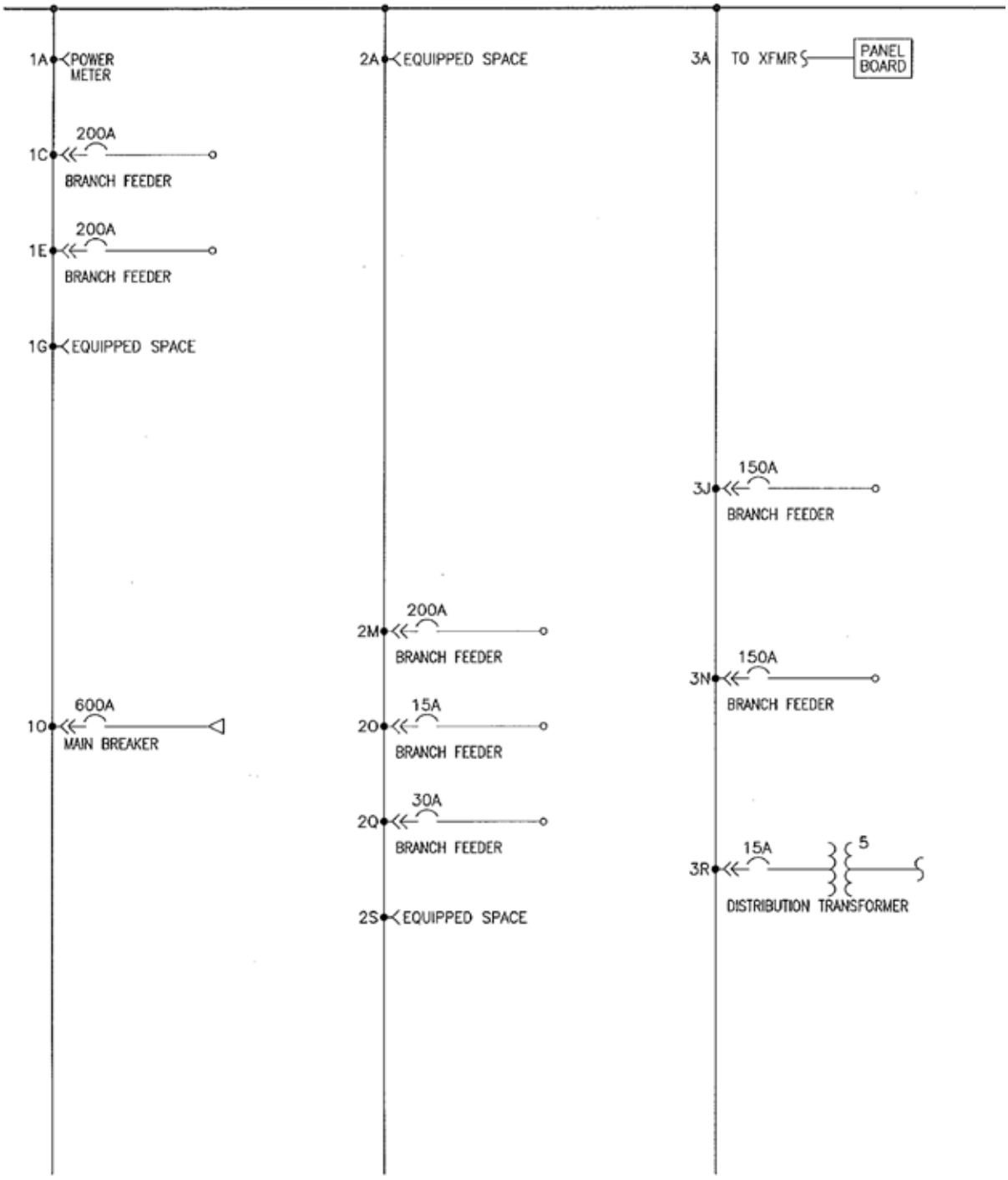
MOTOR CONTROL CENTER (MCC) P0251-646 ELECTRICAL SCHEMATICS CONTROL CONTAINER SN: FA22299F, FA21900F-04/05

Use the illustration below to locate the control units that are referenced in the MCC electrical schematics on the following pages.



(continued on next page)

MCC Electrical Schematics - One Line Diagram



(continued on next page)

MCC Electrical Schematics - Component Information

REV	DESCRIPTION	BY	DATE
-	-----	---	--/--/--
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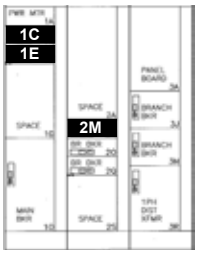
UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE SIZE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: ON LIGHT	PILOT DEVICES: OFF LIGHT	22 mm ** ADDL P/L	22 mm ** SS / PB	OTHER UNIT FEATURES	ELEMENTARY #
1A	MONITORING UNIT FOR MAIN	POWER METER															#14 AWG MIN CONTROL WIRE, PM820 W/DISPLAY	E34976496-001-02
1C	FEED PUMP	6" BRANCH BKR			JJ 250	200											3/0-250 1 LUG/PH, 85% RATED, ALUMINUM MECH LUGS, INT INTLK 1A/1B FORM C	E34976496-001-01
1E	RETURN PUMP	6" BRANCH BKR			JJ 250	200											3/0-250 1 LUG/PH, 85% RATED, ALUMINUM MECH LUGS, INT INTLK 1A/1B FORM C	E34976496-001-01
1G		SPACE																
1O	MAIN BREAKER	MAIN BKR			LJ 600	600											(2)3/0-500KCMIL 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, ALUMINUM MECH LUGS, ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C, PHASE FAILURE/REV/UV RELAY, UV TRIP	E34976496-001-02
2A		SPACE																
2M	BOOSTER PUMP	6" BRANCH BKR			JJ 250	200											3/0-250 1 LUG/PH, 80% RATED, ALUMINUM MECH LUGS, INT INTLK 1A/1B FORM C	E34976496-001-01
2O	COOLING PUMP	6" BRANCH BKR			HJ 150	15											14-3/0AWG 1 LUG/PH, 80% RATED, ALUMINUM MECH LUGS, INT INTLK 1A/1B FORM C	E34976496-001-03
2Q	HEAD POWER	6" BRANCH BKR			HJ 150	30											14-3/0AWG 1 LUG/PH, 80% RATED, ALUMINUM MECH LUGS, INT INTLK 1A/1B FORM C	E34976496-001-04
2S		SPACE																
3A	PANELBOARD	PANEL BOARD	100A		QO												16 CIRCUITS, FULLY RATED, NQ	E34976496-001-05
3J	MAIN CUTTER DRIVE	BRANCH BKR			HJ 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, ALUMINUM MECH LUGS, ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C	E34976496-001-06
3N	MAIN CUTTER DRIVE	BRANCH BKR			HJ 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, ALUMINUM MECH LUGS, ELECTRONIC STANDARD TRIP UNIT, INT INTLK 1A/1B FORM C	E34976496-001-06
3R		1PH DGT XFMR	5 kVA		HJ 150	15											SECONDARY WIRE TO PANELBOARD	E34976496-001-07

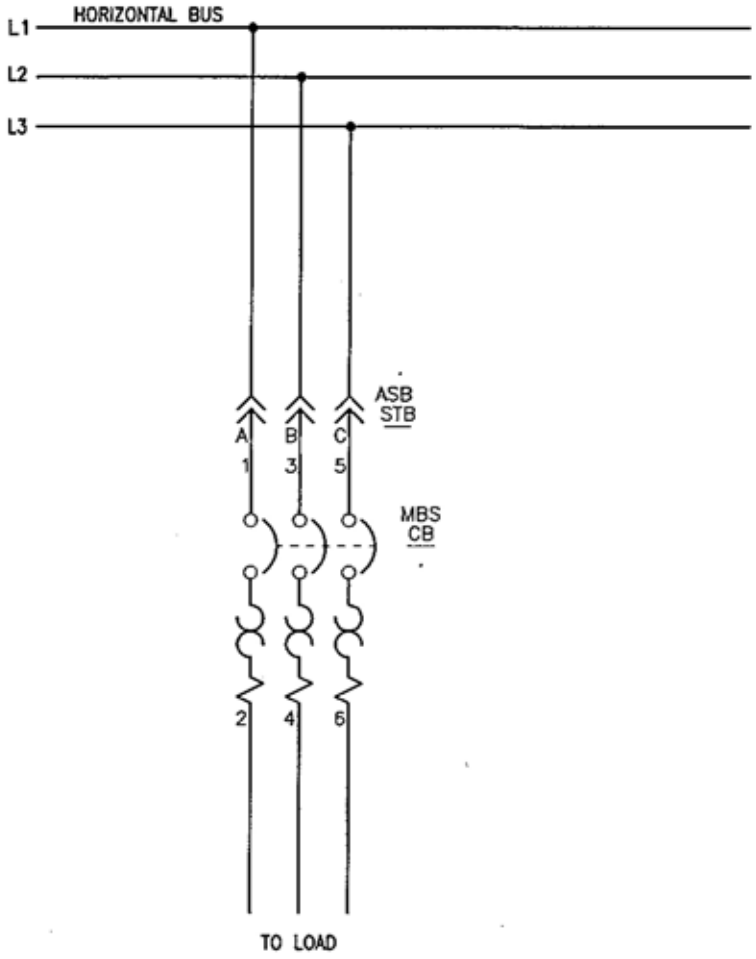
UNIT LOC	NAMEPLATE DESIGNATION	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	PRI FUSE SIZE	SEC FUSE SIZE	NO INTERLOCKS	NC INTERLOCKS	ON LIGHT PILOT DEVICES:	OFF LIGHT PILOT DEVICES:	ADDL P/L 22 mm **	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #

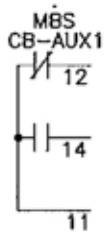
(continued on next page)

MCC Electrical Schematics - Pumps: Feed - Booster - Return

- *Feed Pump: Bucket Unit 1C*
- *Booster Pump: Bucket Unit 2M*
- *Return Pump: Bucket Unit 1E*



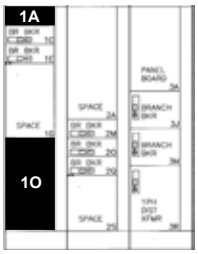


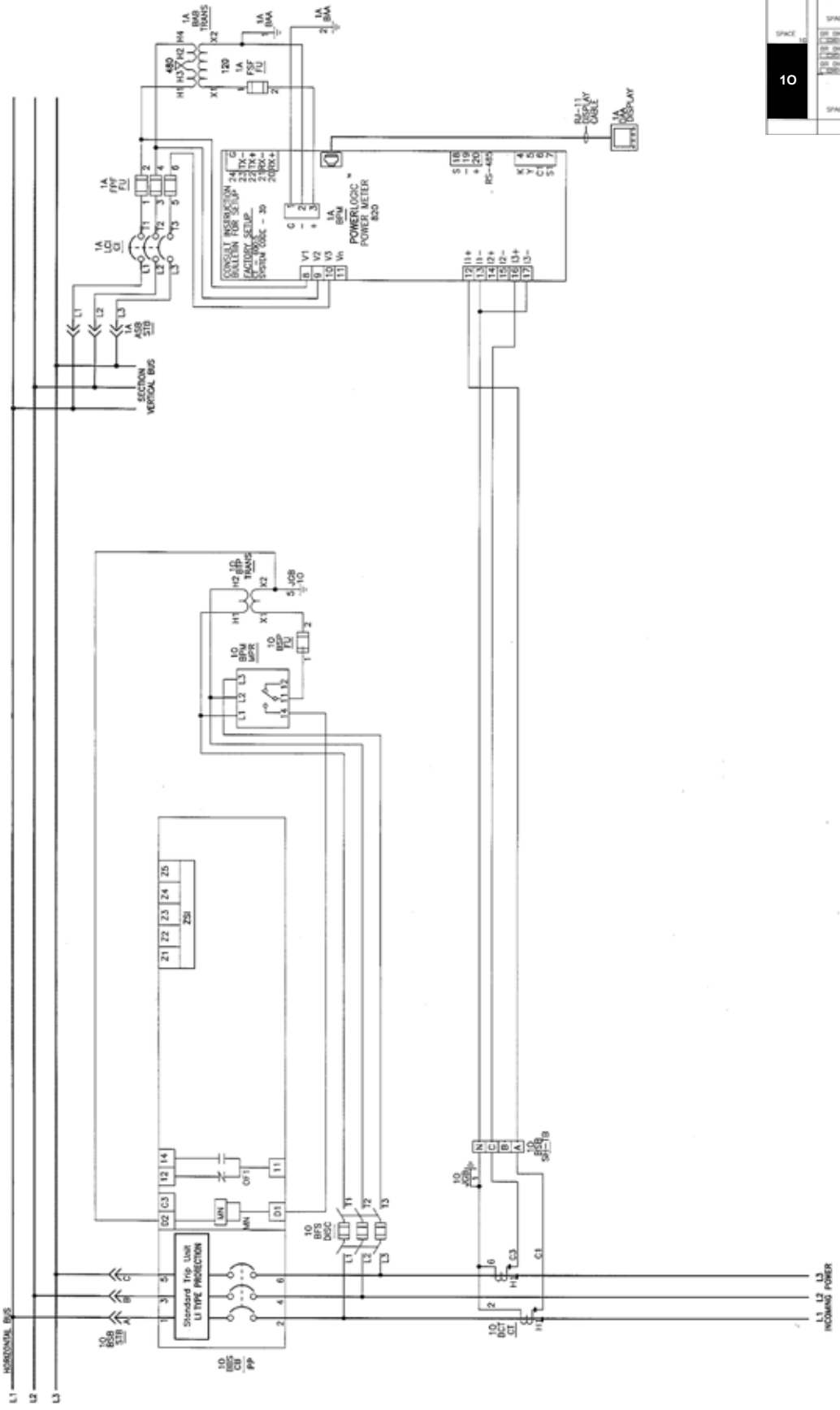


(continued on next page)

MCC Electrical Schematics - Monitoring Unit For Main - Main Breaker

- *Monitoring Unit For Main: Bucket Unit 1A*
- *Main Breaker: Bucket Unit 1O*





(continued on next page)

MCC Electrical Schematics - Main Cutter Drive
- Bucket Unit 3J
- Bucket Unit 3N

3J
3N

(continued on next page)

MCC Electrical Schematics - Cooling Pump - Bucket Unit 2O

2O

(continued on next page)

MCC Electrical Schematics - Head Power - Bucket Unit 2Q

2Q

(continued on next page)

MCC Electrical Schematics - Panelboard - Bucket Unit 3A

3A

(continued on next page)

MCC Electrical Schematics - Transformer - Bucket Unit 3R

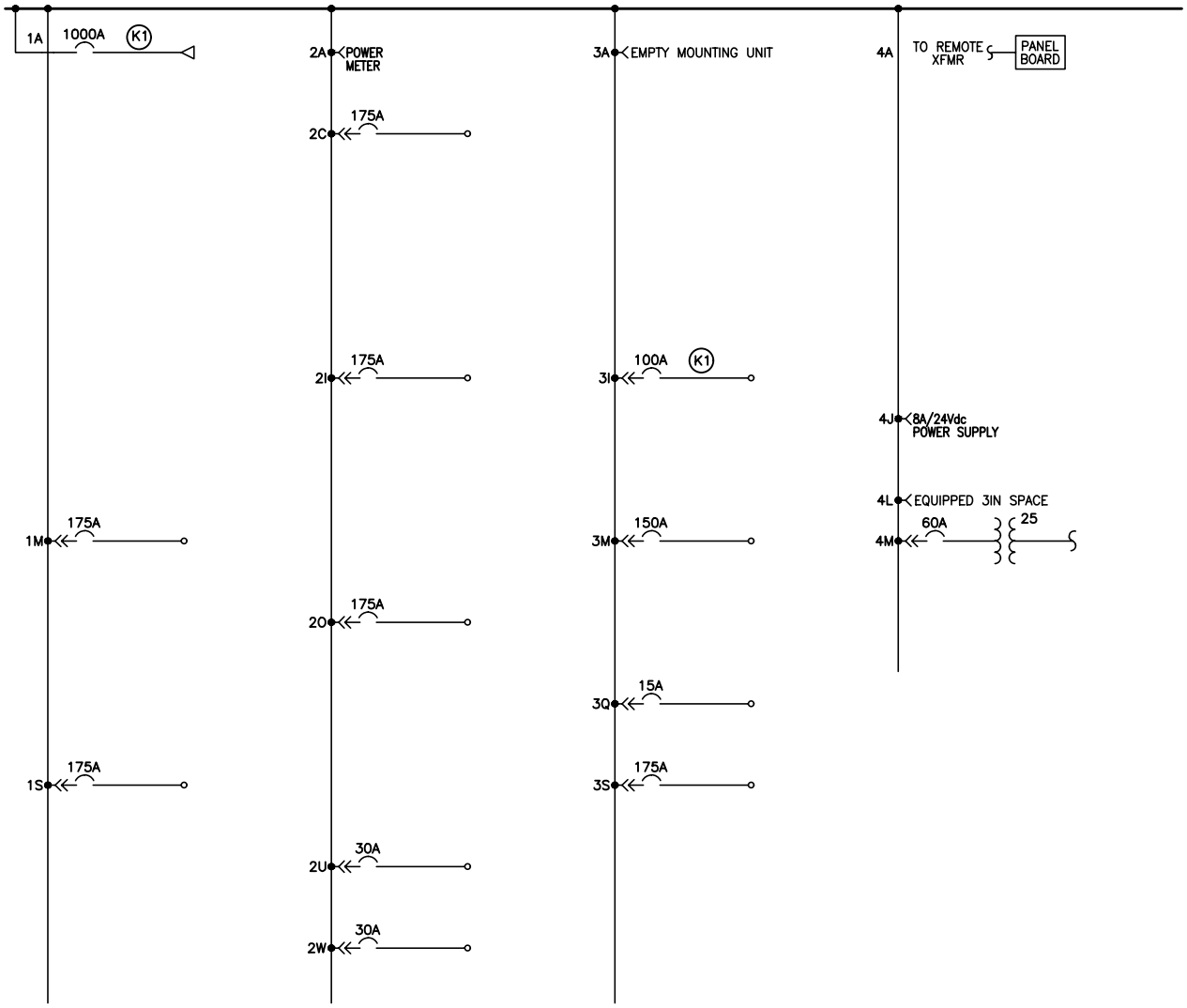
3R

MOTOR CONTROL CENTER (MCC-480) P0251-937 ELECTRICAL SCHEMATICS VFD CONTAINER SN: FA22241F

Use the illustration below to locate the control units that are referenced in the MCC electrical schematics on the following pages.

(continued on next page)

MCC Electrical Schematics - One Line Diagram



(continued on next page)

MCC Electrical Schematics - Component Information

UNIT LOC	UNIT DESIGNATIONS	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: ON LIGHT	PILOT DEVICES: OFF LIGHT	22 mm ** ADDL P/L	22 mm ** SS / PB	OTHER UNIT FEATURES	ELEMENTARY #
1A	MAIN BREAKER	MAIN BKR			PL 1200	1000											350-600KCMIL 3 LUGS/PH, 80% RATED, AL MECH LUG AL/CU CABLE, ELECTRONIC STANDARD TRIP UNIT,	E42836099-001-01
																	KEY INTERLOCK, LSI TRIP FUNCTION	
1M	CHARGE PUMP #2	BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-02
1S	RETURN PUMP #2	BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-02
2A	MONITORING UNIT FOR MAIN	POWER METER															PM5563 W/DISPLAY	E42836099-001-01
2C	CHARGE PUMP #3	BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-02
2I	RETURN PUMP #3	BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-02
2O	ABOVE GROUND FEED PUMP	BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-02
2U	HVAC	6" BRANCH BKR			HJ 150	30											14-3/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-03
2W	SMALL MTBM HEAD POWER	6" BRANCH BKR			HJ 150	30											14-3/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-03
3A	WAGO	MT UNIT																
3I	AUXILIARY POWER IN	BRANCH BKR			HJ 150	100											14-3/0AWG 1 LUG/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE,	E42836099-001-04
																	ELECTRONIC STANDARD TRIP UNIT, KEY INTERLOCK	
3M	LARGE MTBM HEAD POWER	BRANCH BKR			HJ 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-05
3Q	COOLING / JETTING	6" BRANCH BKR			HJ 150	15											14-3/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-06
3S	PIT RETURN PUMP	BRANCH BKR			JJ 250	175											4-4/0 AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-001-02
4A	PANEL BOARD	PANEL BOARD	100A		00												16 CIRCUITS, FULLY RATED, NO PANELBOARD	E42836099-001-07
4J	POWER SUPPLY	POWER SUPPLY															#16 AWG MTW CONTROL WIRE	E42836099-001-08
4L		SPACE																
4M	240V TRANSFORMER	1PH DIST XFMR	25 kVA		HJ 150	60												E42836099-001-09

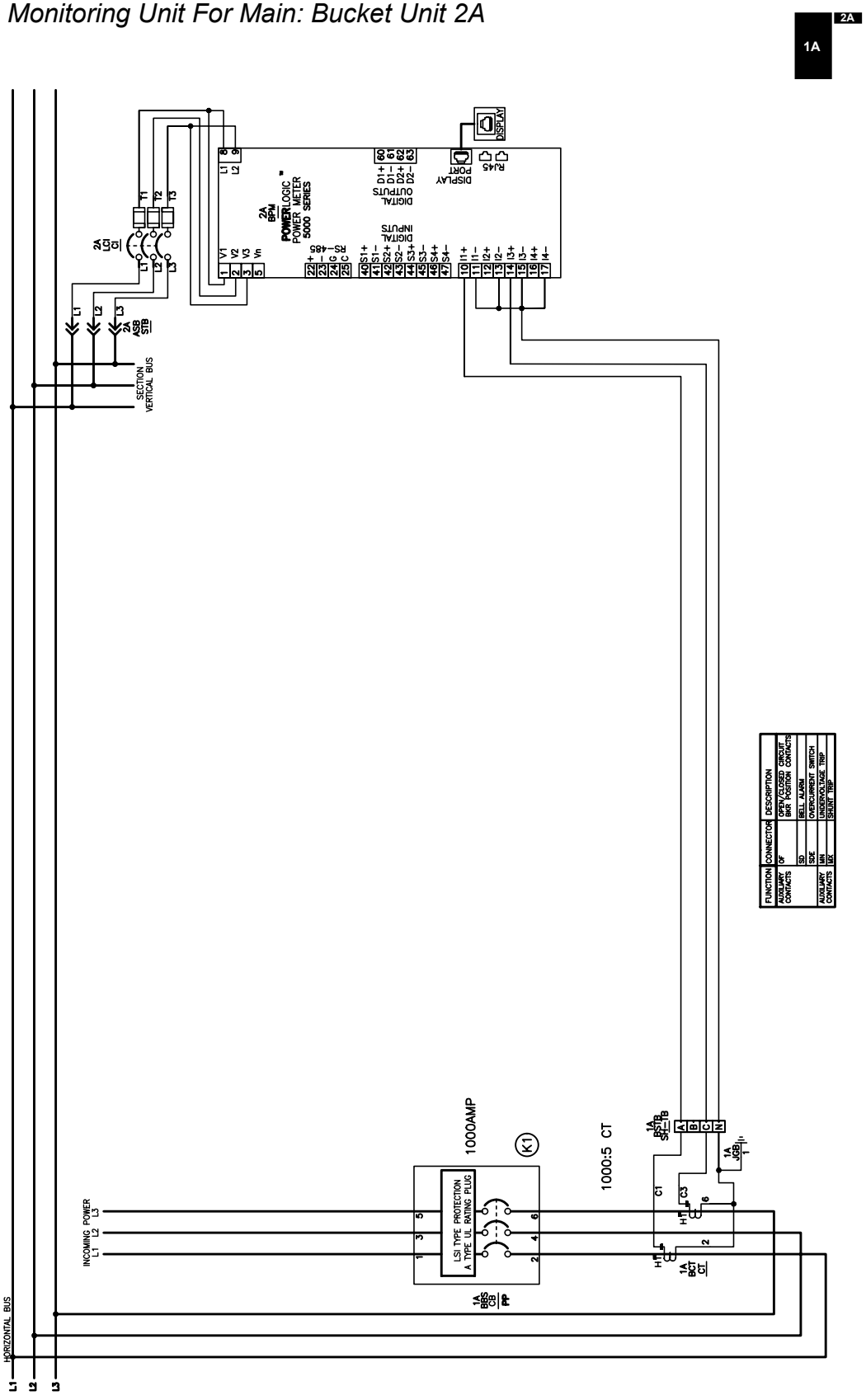
UNIT LOC	UNIT DESIGNATIONS	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: ON LIGHT	PILOT DEVICES: OFF LIGHT	22 mm ** ADDL P/L	22 mm ** SS / PB	OTHER UNIT FEATURES	ELEMENTARY #

(continued on next page)

MCC Electrical Schematics - Main Breaker - Monitoring Unit For Main (Power Meter)

- Main Breaker: Bucket Unit 1A

- Monitoring Unit For Main: Bucket Unit 2A



(continued on next page)

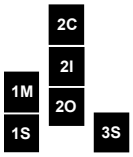
MCC Electrical Schematics - Charge Pumps #2 & #3, Return Pumps #2 & #3, Above Ground Feed Pump, Pit Return Pump

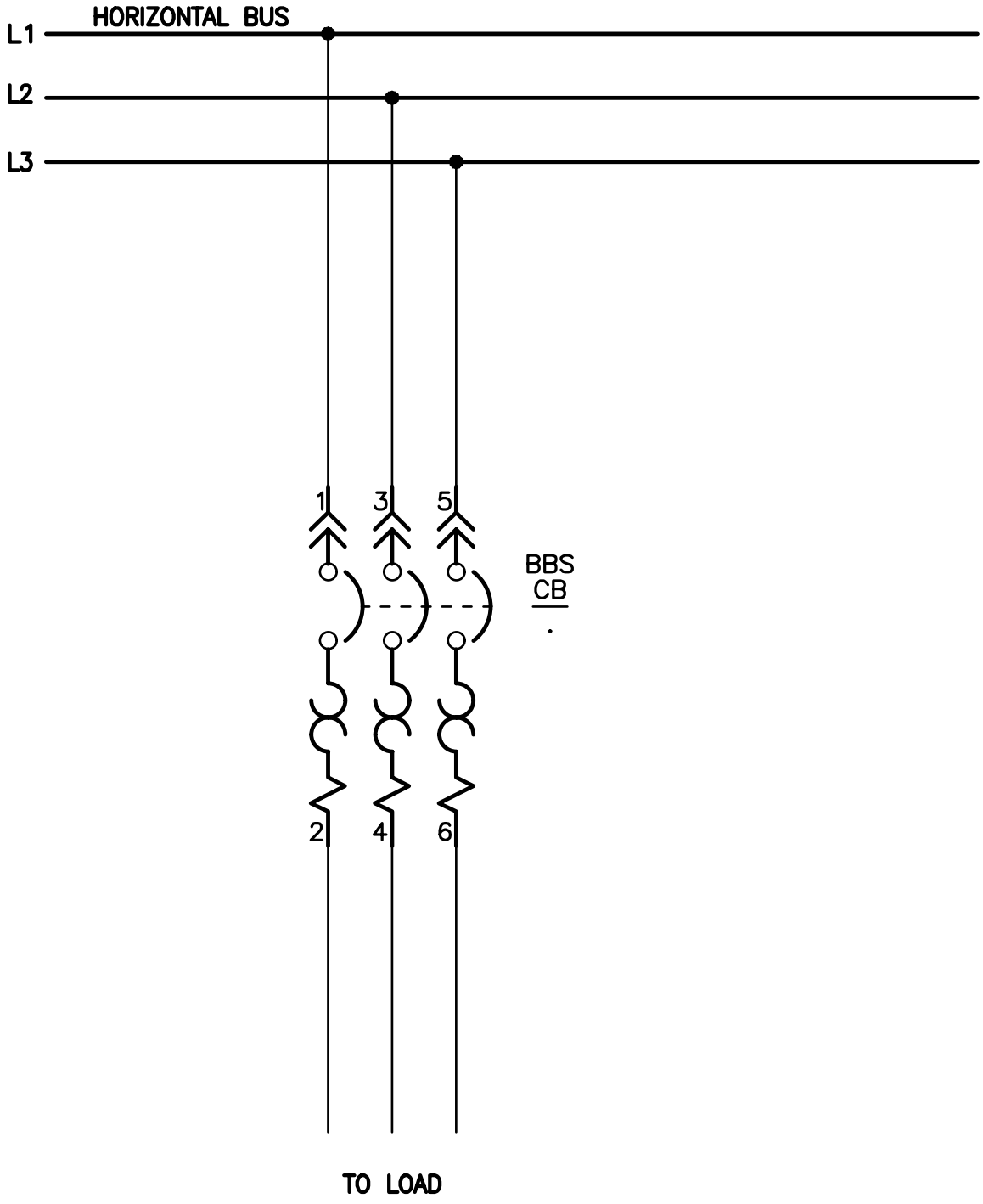
- Charge Pump #2: Bucket Unit 1M, Charge Pump #3: Bucket Unit 2C

- Return Pump #2: Bucket Unit 1S, Return Pump #3: Bucket Unit 2I

- Above Ground Feed Pump: Bucket Unit 2O

- Pit Return Pump: Bucket Unit 3S

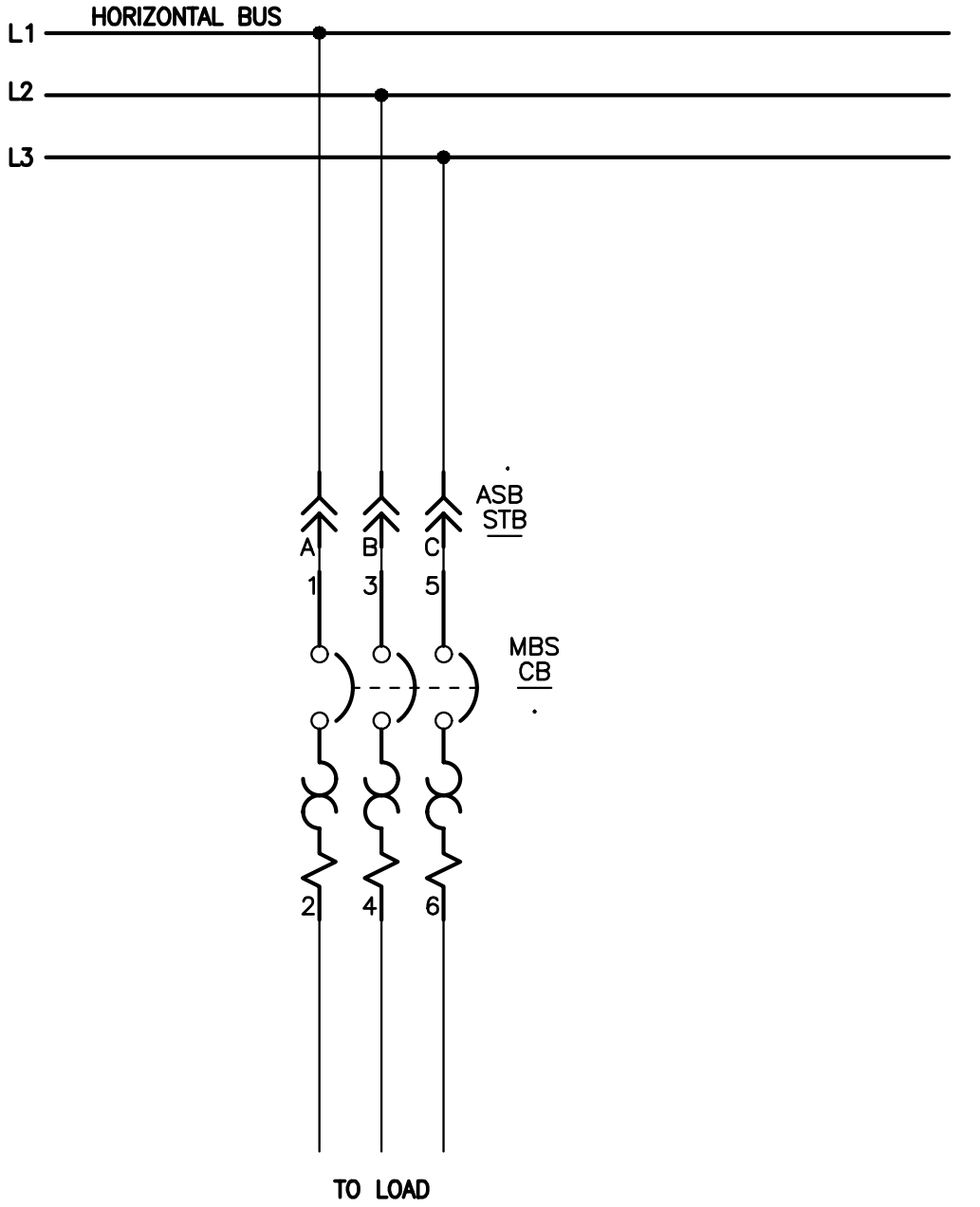




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MCC Electrical Schematics - HVAC - Small MTBM Head Power
- HVAC: Bucket Unit 2U
- Small MTBM Head Power: Bucket Unit 2W

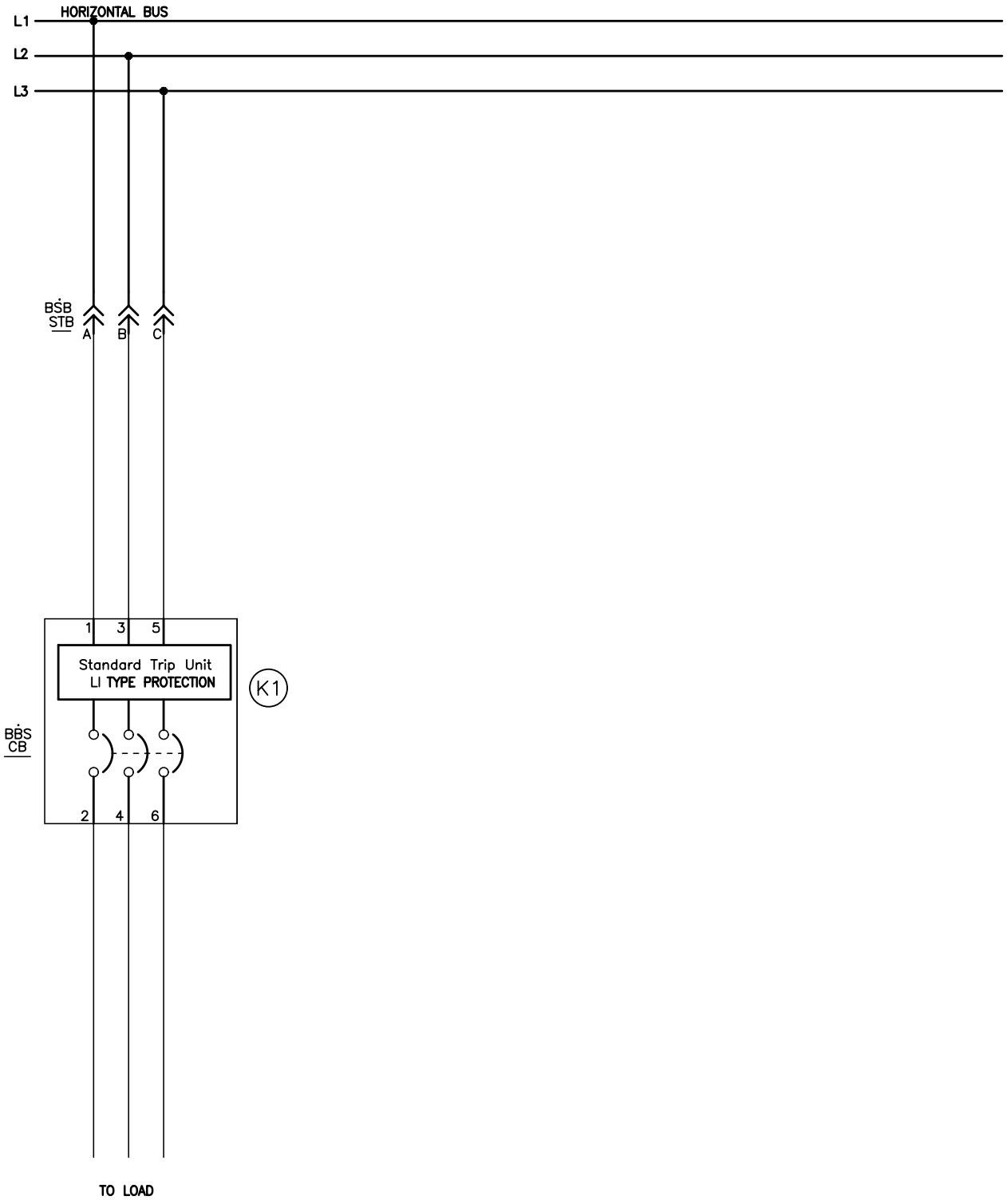
2U
2W



(continued on next page)

MCC Electrical Schematics - Auxiliary Power IN - Bucket Unit 3I

3I

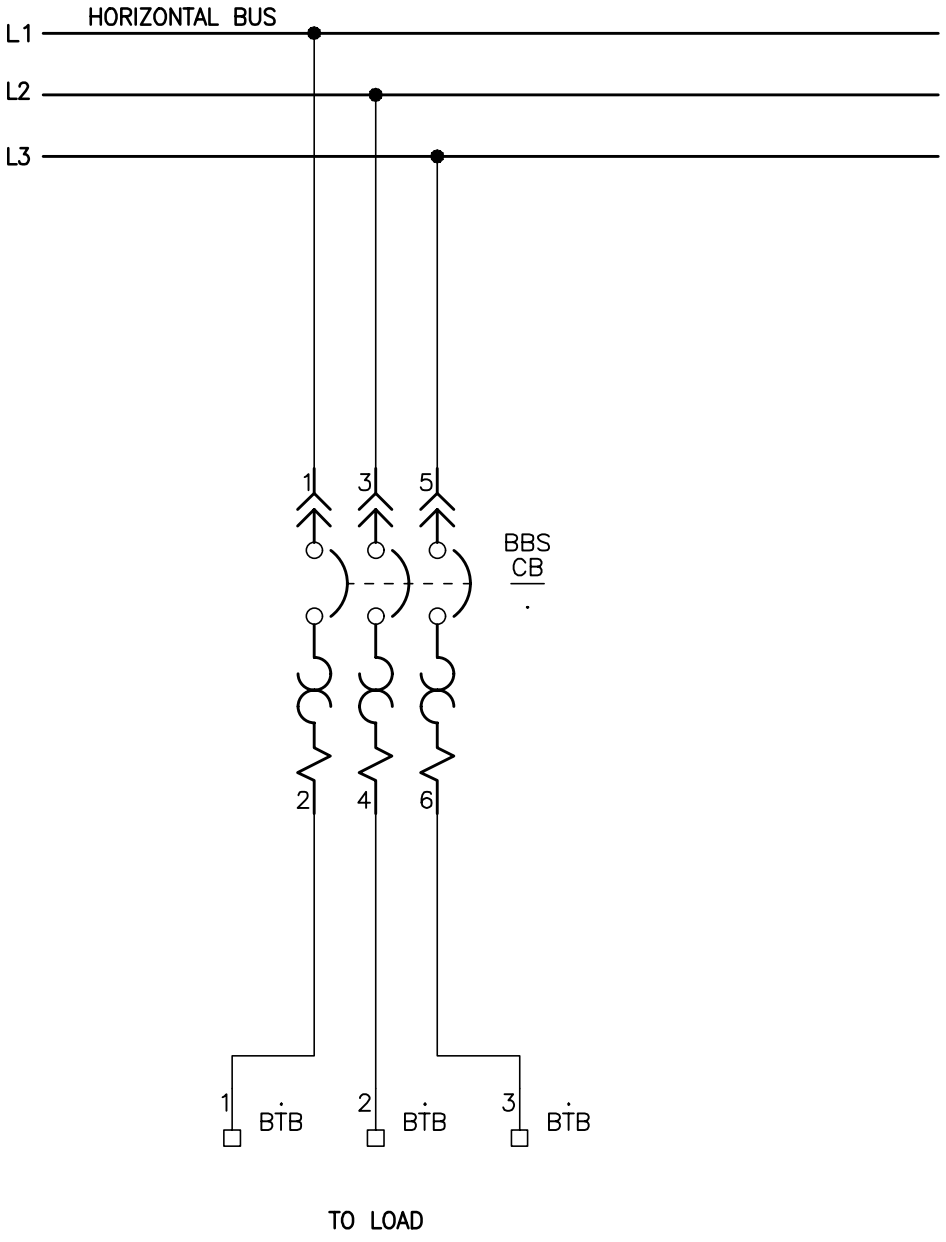


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P0251-937 rev 3-17-20

MCC Electrical Schematics - Large MTBM Head Power - Bucket Unit 3M

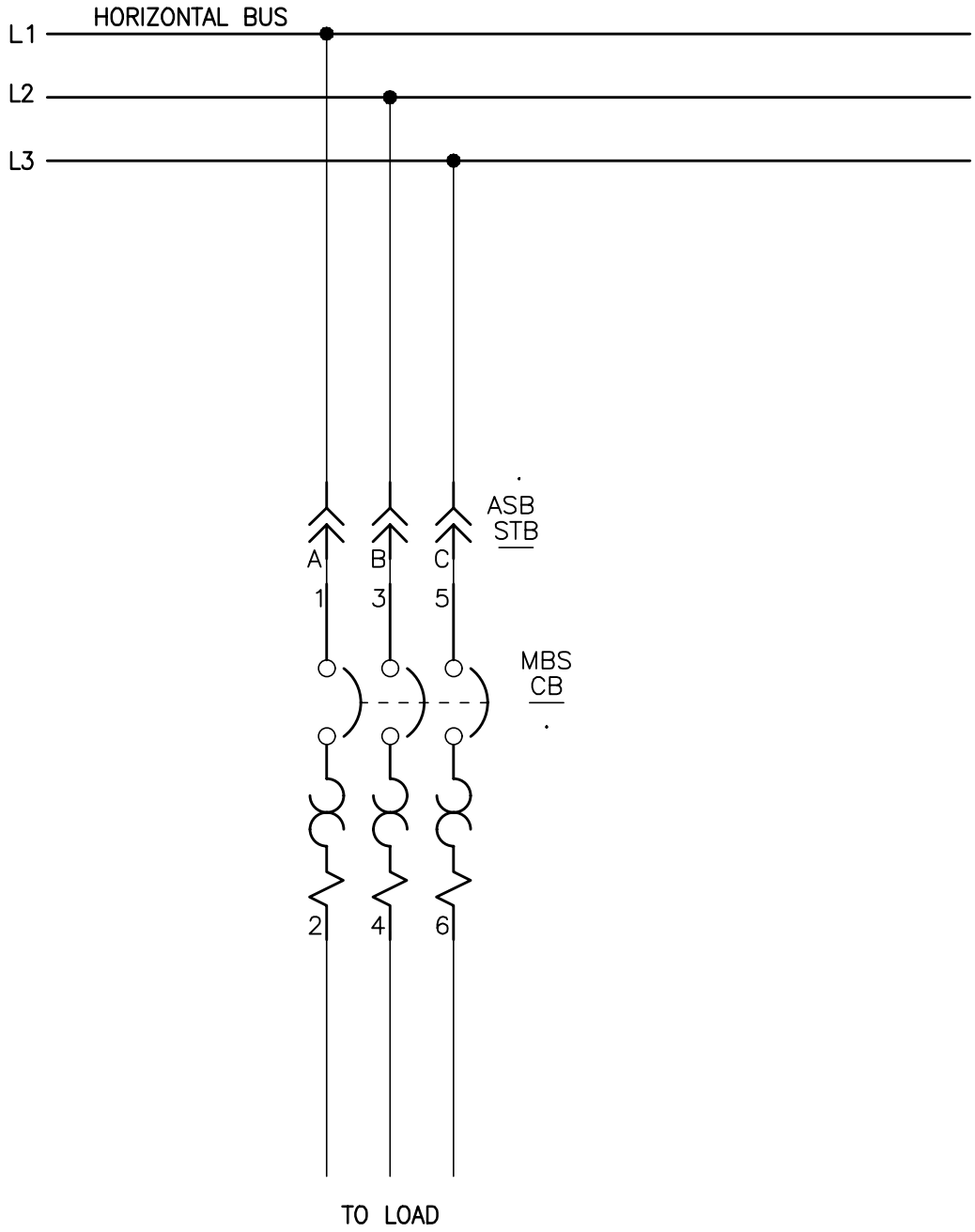
3M



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MCC Electrical Schematics - Cooling/Jetting - Bucket Unit 3Q

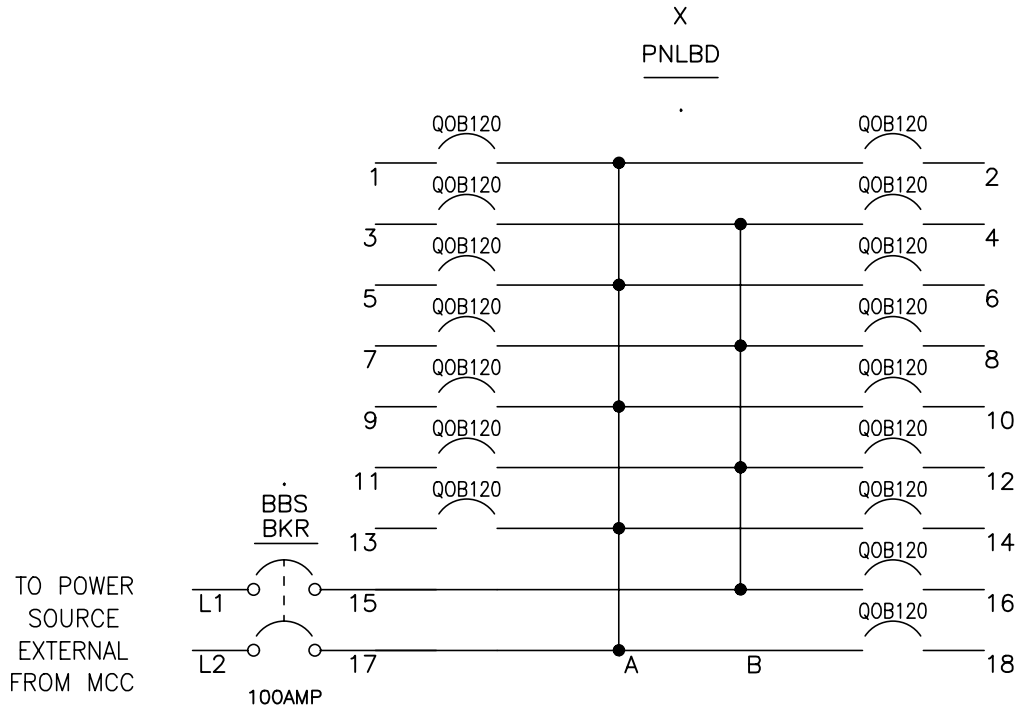
3Q

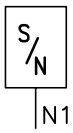


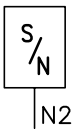
(continued on next page)

MCC Electrical Schematics - Panel Board - Bucket Unit 4A

4A



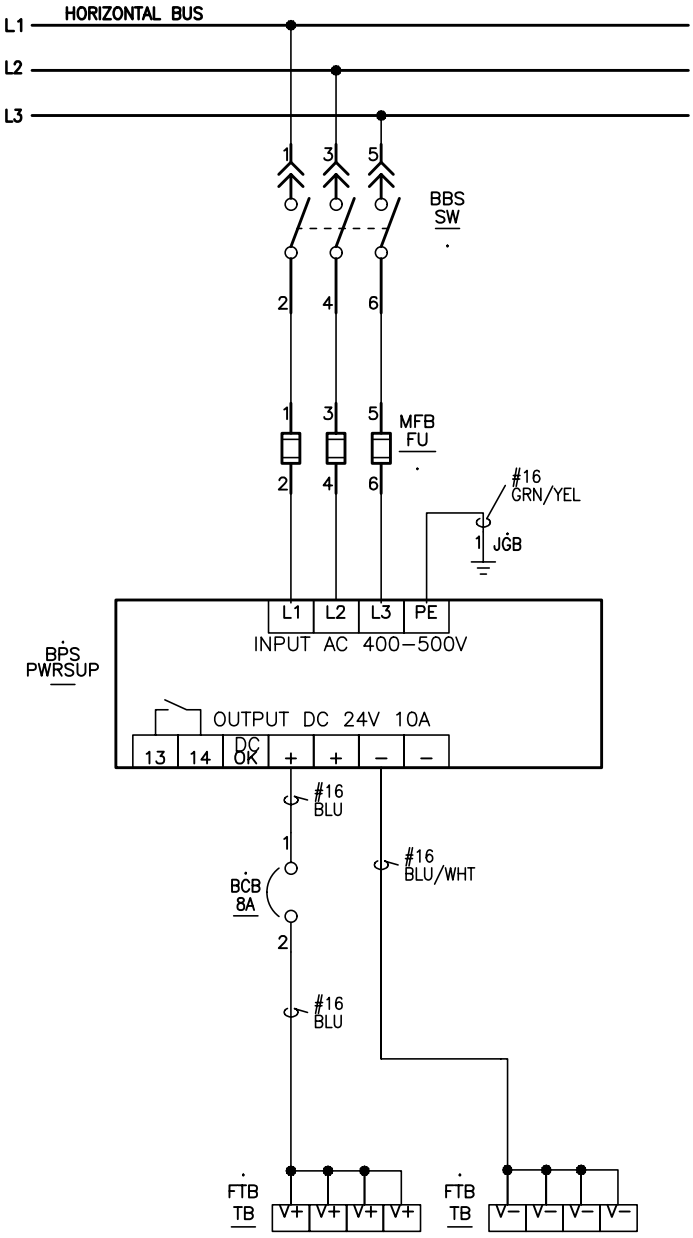




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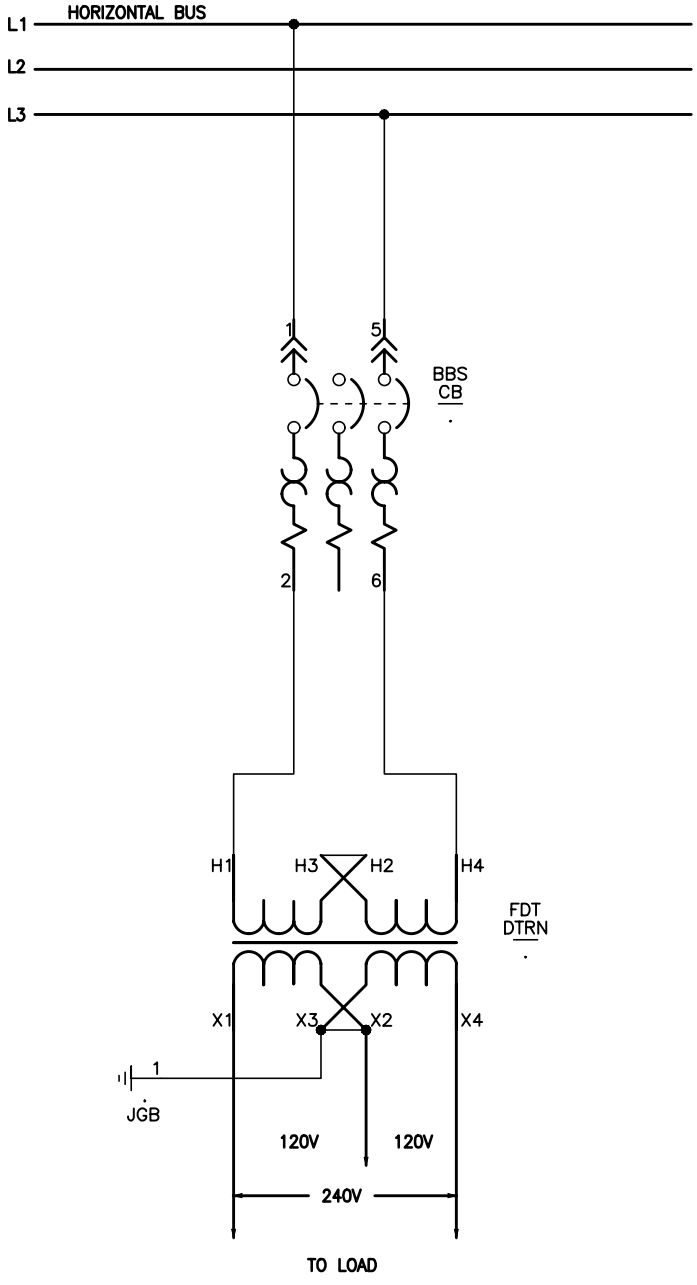
MCC Electrical Schematics - Power Supply - Bucket Unit 4J

4J



MCC Electrical Schematics - 240V Transformer - Bucket Unit 4M

4M



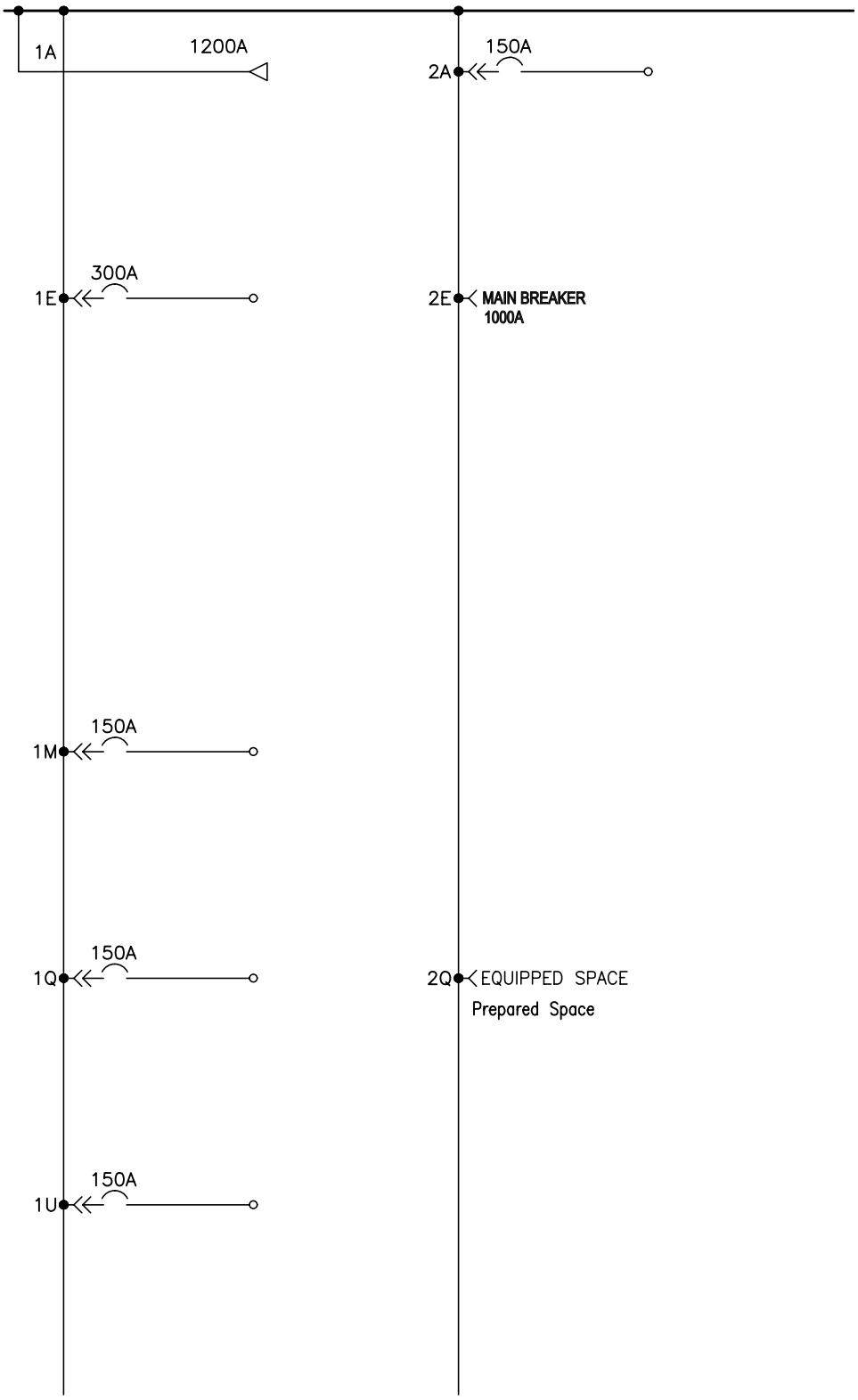
P0251-937 rev 3-17-20

MOTOR CONTROL CENTER (MCC-575) P0251-937 ELECTRICAL SCHEMATICS VFD CONTAINER SN: FA22241F

Use the illustration below to locate the control units that are referenced in the MCC electrical schematics on the following pages.

(continued on next page)

MCC Electrical Schematics - One Line Diagram



(continued on next page)

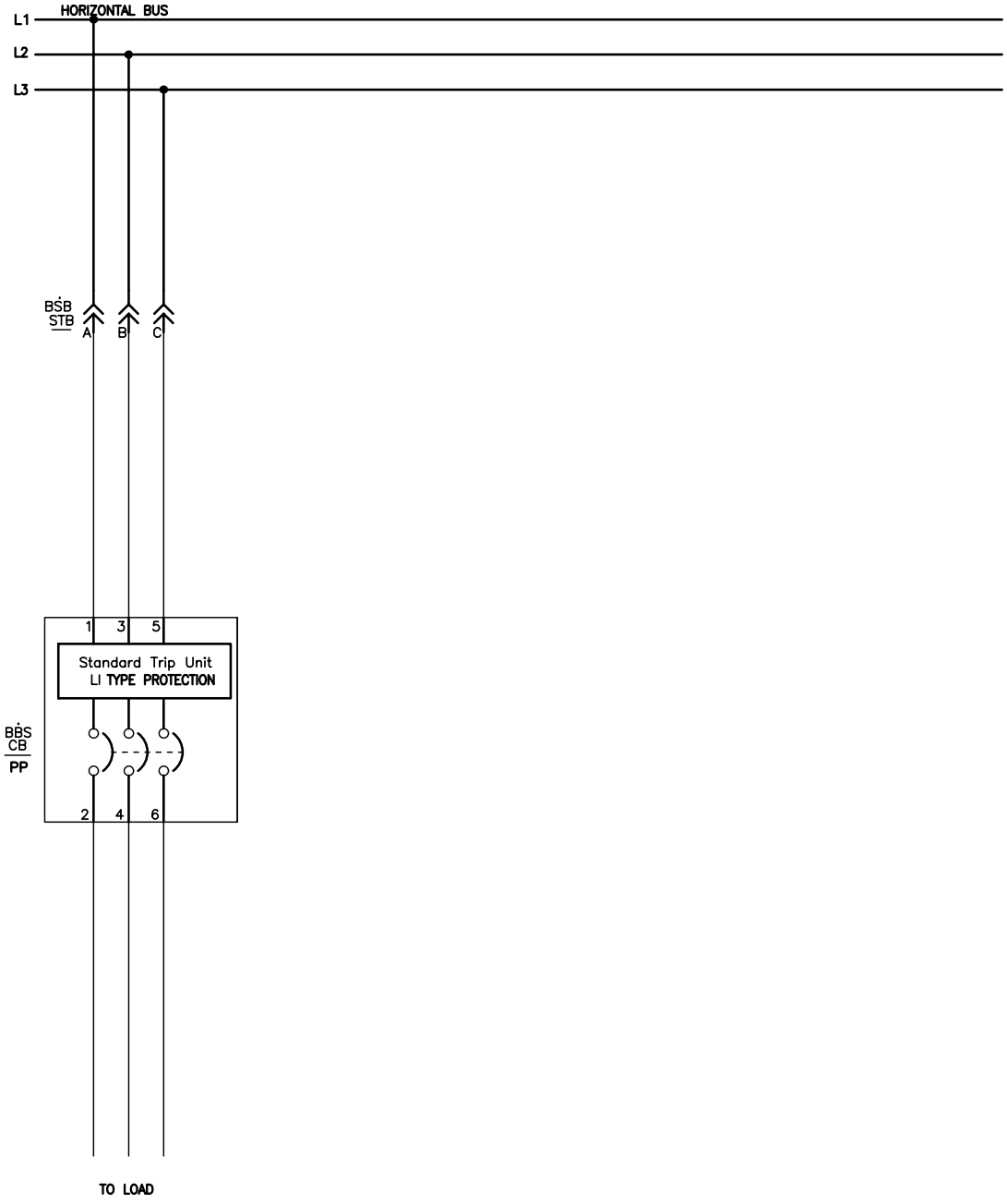
MCC Electrical Schematics - Component Information

UNIT LOC	UNIT DESIGNATIONS	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE SIZE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: 22 mm ** ON LIGHT	PILOT DEVICES: 22 mm ** OFF LIGHT	ADDL P/L	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #
1A		MAIN LUGS															3/0-600KCMIL 4 LUGS/PH, AL MECH LUG AL/CU CABLE	
1E	MTRM CENTER DRIVE CUTTER	BRANCH BKR			LL 400	300											(2)3/0-500KCMIL 1 LUGS/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE,	E42836099-002-01
																	ELECTRONIC STANDARD TRIP UNIT	
1M	CHARGE #1 PUMP	BRANCH BKR			HL 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-002-02
1Q	RETURN #1 PUMP	BRANCH BKR			HL 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-002-02
1U	BOOSTER PUMP	BRANCH BKR			HL 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-002-02
2A	SPARE	BRANCH BKR			HL 150	150											14-2/0AWG 1 LUG/PH, 80% RATED, AL MECH LUG AL/CU CABLE	E42836099-002-02
2E	MAIN BREAKER	MAIN BKR			PL 1200	1000												
2Q		MT UNIT																
UNIT LOC	UNIT DESIGNATIONS	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	PRI FUSE SIZE	SEC FUSE SIZE	NO INTERLOCKS	NC INTERLOCKS	ON LIGHT PILOT DEVICES:	OFF LIGHT PILOT DEVICES:	ADDL P/L 22 mm **	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #

(continued on next page)

MCC Electrical Schematics - MTBM Center Drive Cutter - Bucket Unit 1E

1E



(continued on next page)

MCC Electrical Schematics - Charge Pumps #2 & #3, Return Pumps #2 & #3, Above Ground Feed Pump, Pit Return Pump

- Charge #1 Pump: Bucket Unit 1M

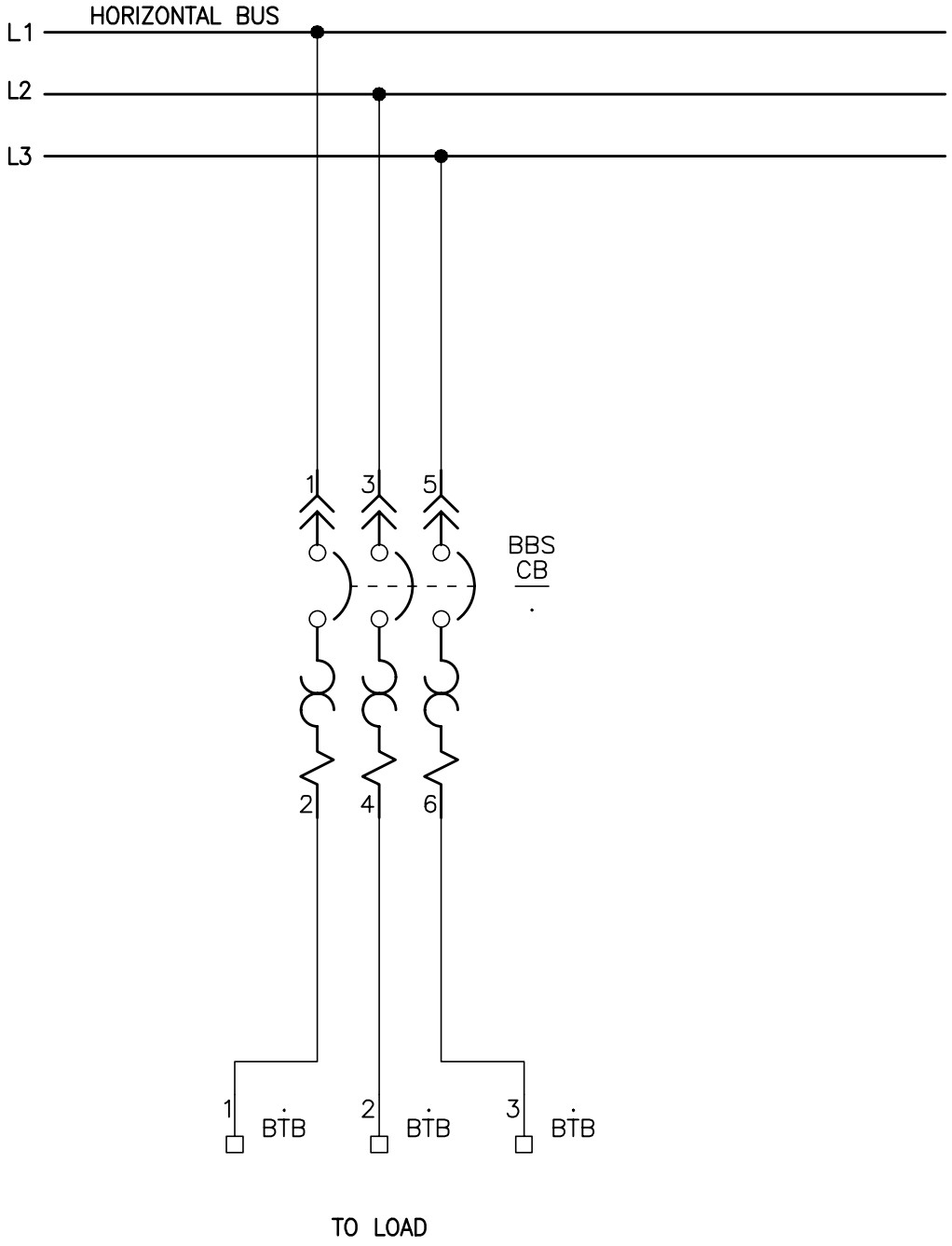
- Return #1 Pump #2: Bucket Unit 1Q

- Booster Pump: Bucket Unit 1U

- Spare: Bucket Unit 2A

2A

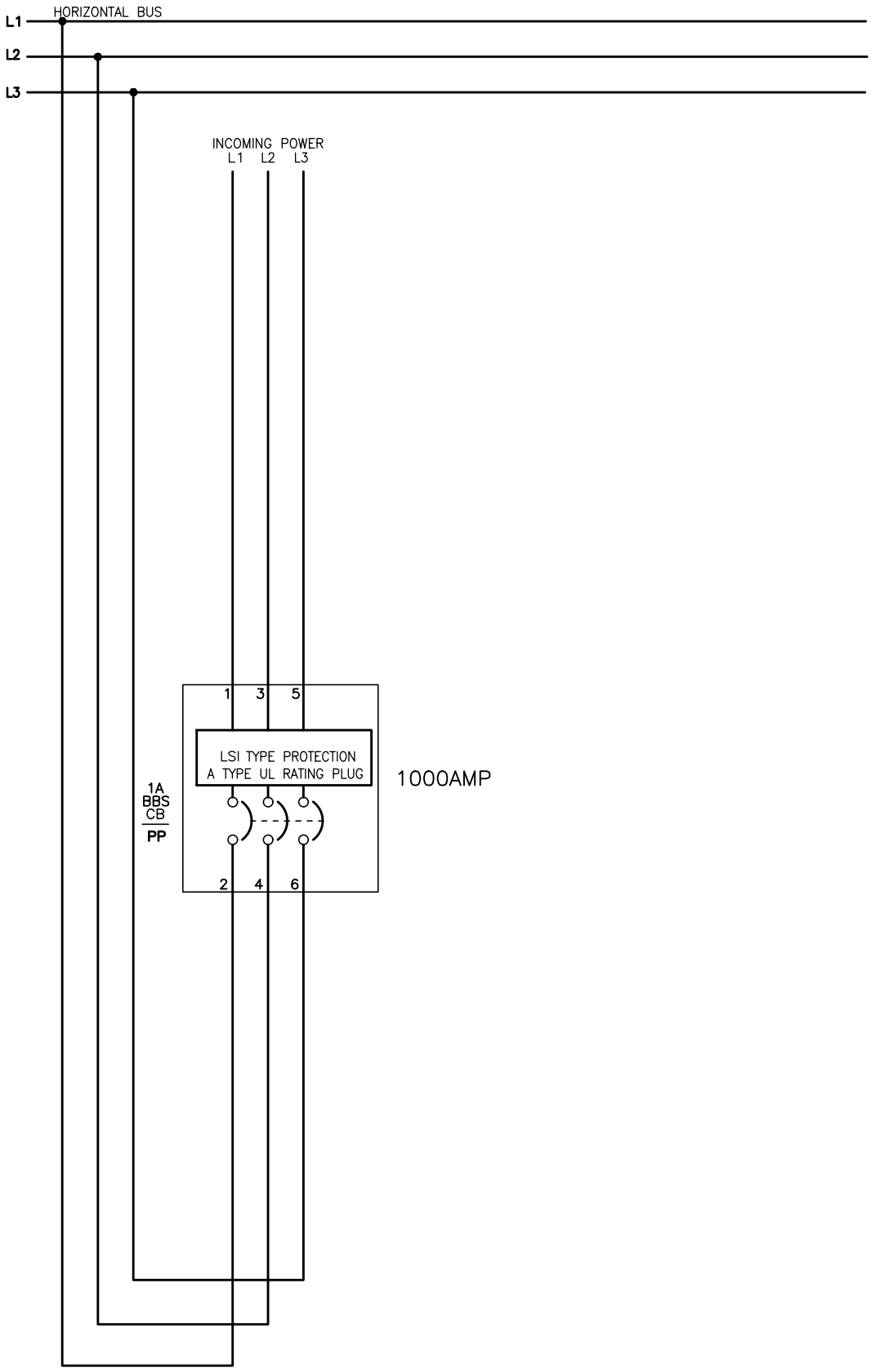
1M
1Q
1U



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MCC Electrical Schematics - Main Breaker
- Main Breaker: Bucket Unit 2E

2E



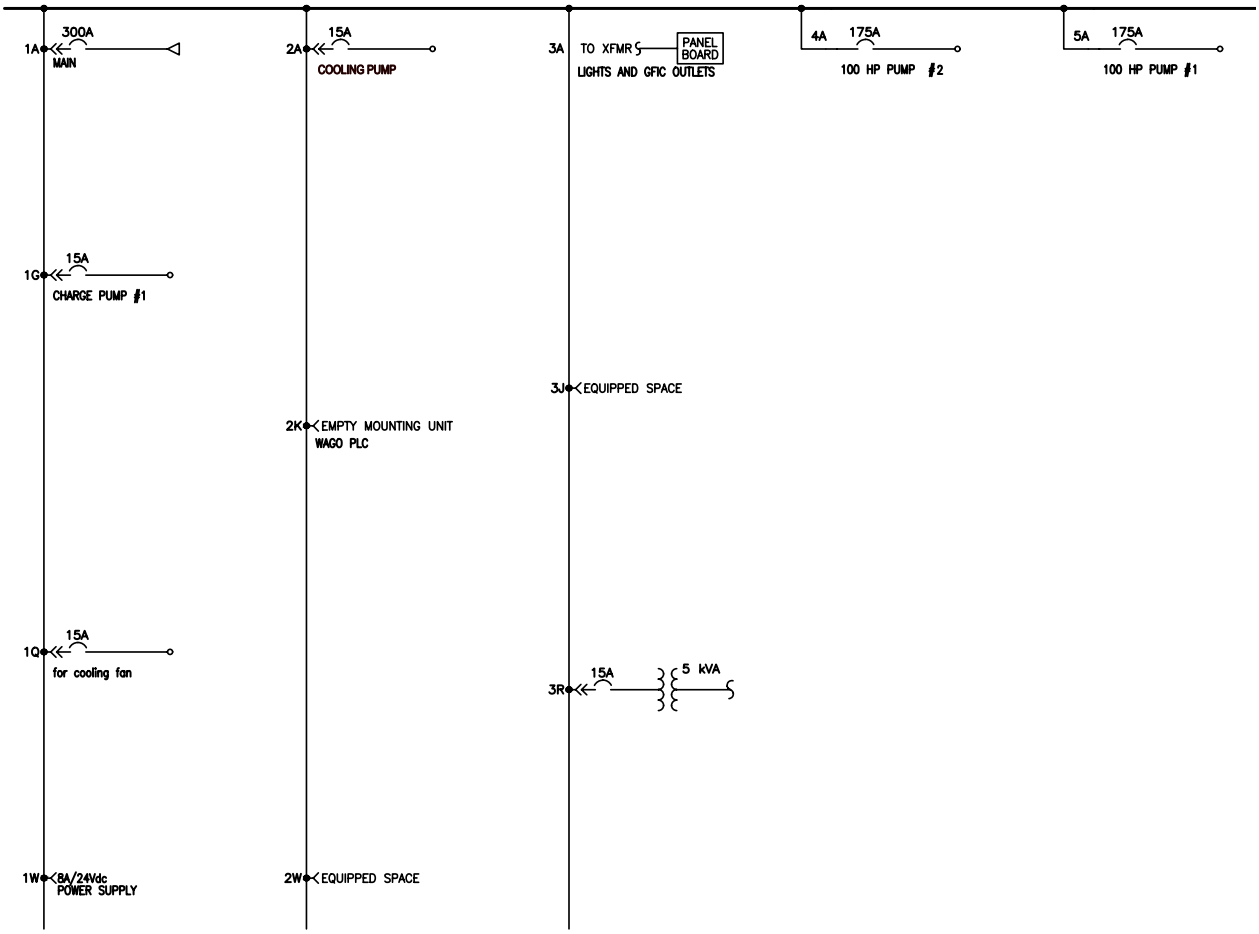
P0251-937 rev 3-18-20

MOTOR CONTROL CENTER P0251-943 ELECTRICAL SCHEMATICS HYDRAULIC POWER PACK CONTAINER SN: FA22243F

Use the illustration below to locate the control units that are referenced in the MCC electrical schematics on the following pages.

(continued on next page)

MCC Electrical Schematics - One Line Diagram



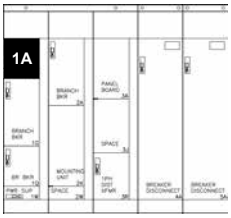
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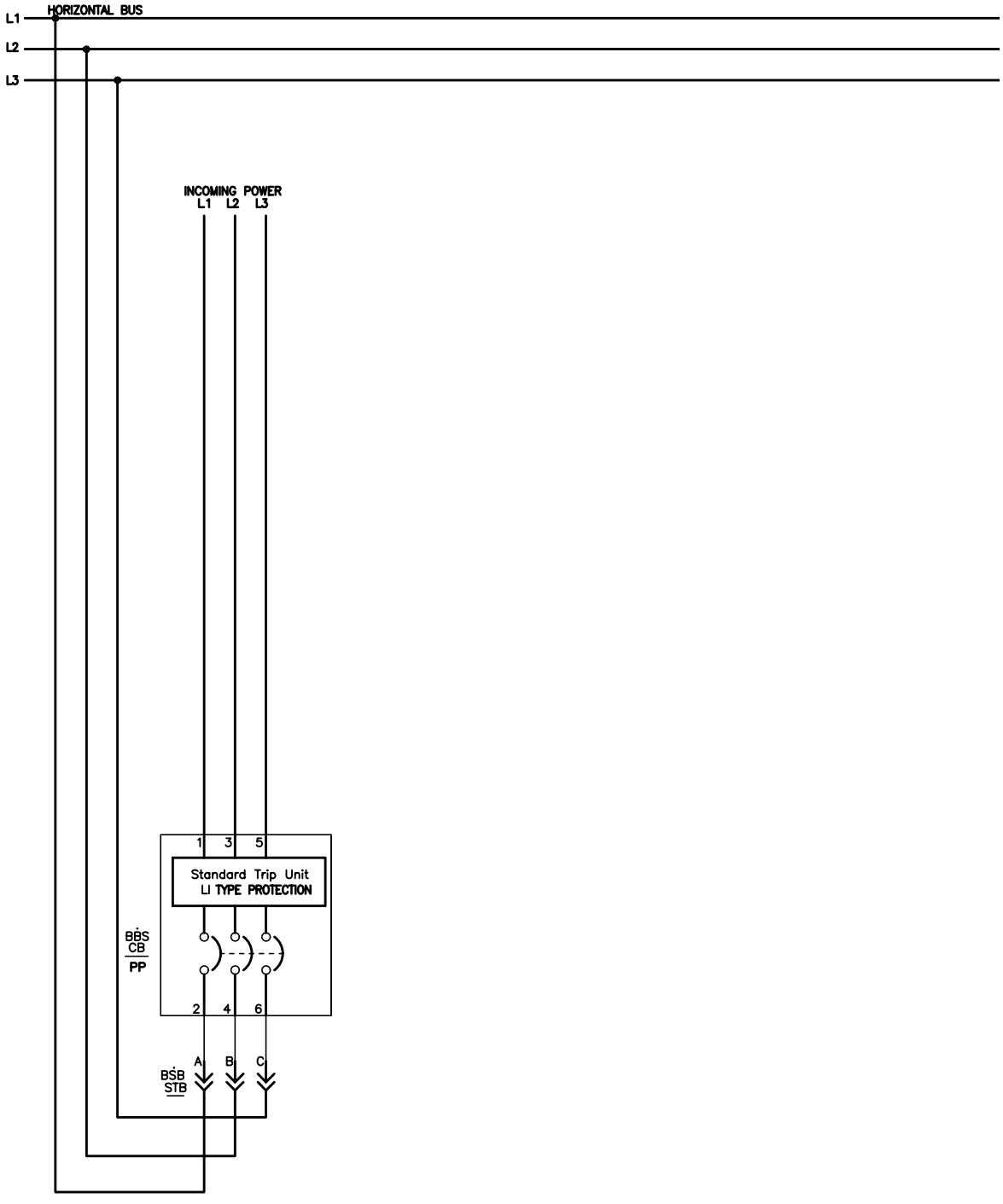
MCC Electrical Schematics - Component Information

UNIT LOC	UNIT NAMEPLATES (GRAY SURFACE/WHITE LETTERS)	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	FUSE PRI	FUSE SIZE SEC	INTERLOCKS NO	INTERLOCKS NC	PILOT DEVICES: ON LIGHT	PILOT DEVICES: OFF LIGHT	22 mm ** ADDL P/L	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #
1A	MAIN	MAIN BKR			LJ 400	300											(2)2/0-500KCMIL 1 LUGS/PH, 80% RATED, ADJ. L, ADJ. I TRIP FUNCTION, AL MECH LUG AL/CU CABLE; ELECTRONIC STANDARD TRIP UNIT	E42839374-001-01
1G	CHARGE PUMP #1	BRANCH BKR			HJ 150	15											14-3/0AWG 1 LUG/PH, 18" UNIT EXT, 80% RATED, AL MECH LUG AL/CU CABLE	E42839374-001-02
1Q	for cooling fan	BRANCH BKR			HJ 150	15											14-3/0AWG 1 LUG/PH, 6" UNIT EXT, 80% RATED, AL MECH LUG AL/CU CABLE	E42839374-001-02
1W	POWER SUPPLY	POWER SUPPLY															#16 AWG MTW CONTROL WIRE	E42839374-001-03
2A	COOLING PUMP	BRANCH BKR			HJ 150	15											14-3/0AWG 1 LUG/PH, 18" UNIT EXT, 80% RATED, AL MECH LUG AL/CU CABLE	E42839374-001-02
2K	WAGO PLC	MT UNIT																
2W		SPACE																
3A	LIGHTS AND GFIC OUTLETS	PANEL BOARD	100A		QO												16 CIRCUITS, FULLY RATED, NQ PANELBOARD	E42839374-001-04
3J		SPACE																
3R	240VTRANSFORMER	1PH DIST XFMR	5 kVA		HJ 150	15											SECONDARY WIRE TO PANELBOARD	E42839374-001-05
4A	100 HP PUMP #2	BKR DISC			JJ 250	175												E42839374-001-06
5A	100 HP PUMP #1	BKR DISC			JJ 250	175												E42839374-001-06
UNIT LOC	UNIT NAMEPLATES	UNIT TYPE	SIZE	HP	FRAME AMPS	TRIP AMPS	CONTROL SOURCE	VA	PRI FUSE	SEC FUSE SIZE	NO INTERLOCKS	NC INTERLOCKS	ON LIGHT PILOT DEVICES:	OFF LIGHT PILOT DEVICES:	ADDL P/L 22 mm **	SS / PB	OTHER UNIT FEATURES	ELEMENTARY #

(continued on next page)

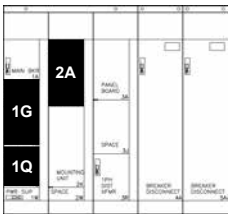
MCC Electrical Schematics - Main Breaker - Bucket Unit 1A

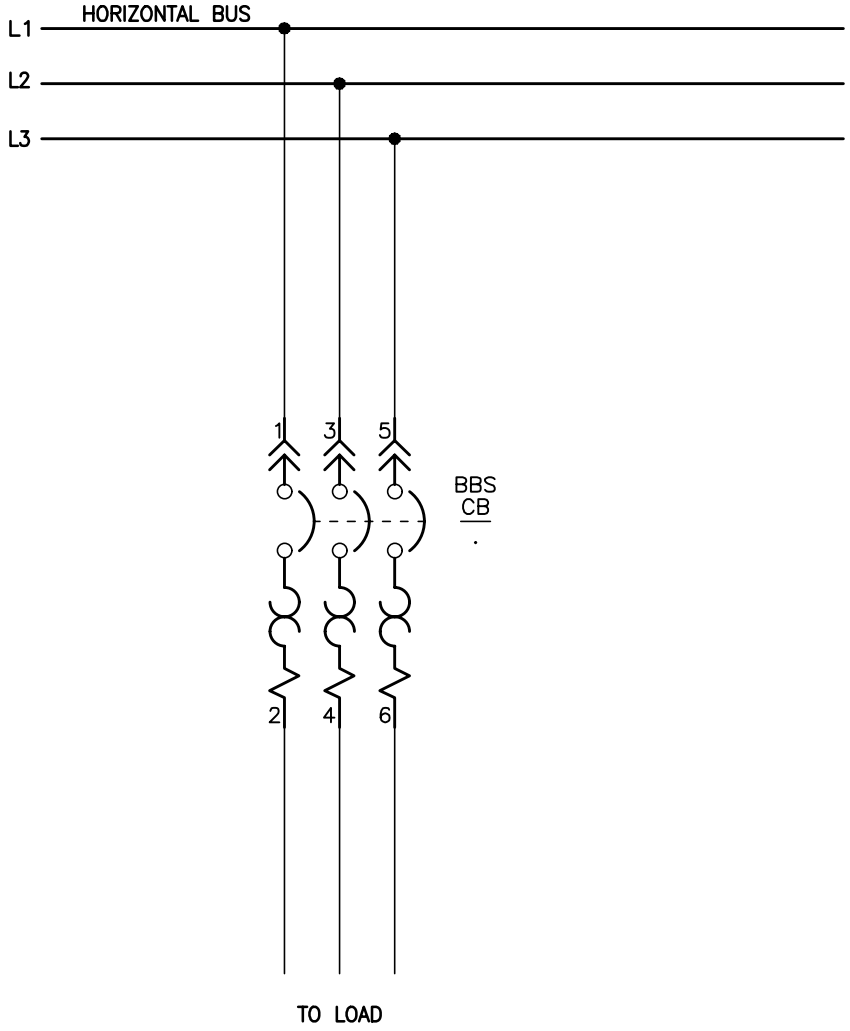




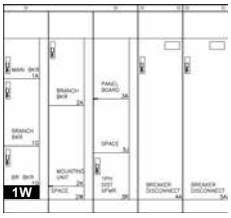
MCC Electrical Schematics - Charge Pump #1 - Cooling Fan - Cooling Pump

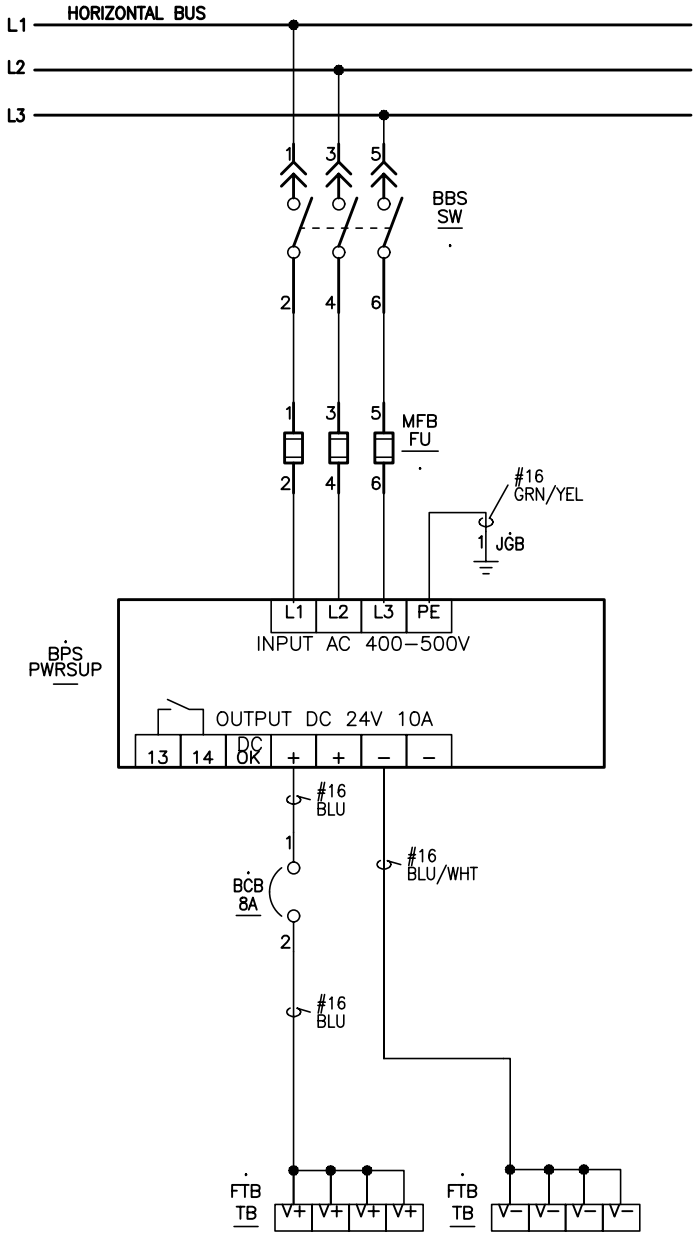
- *Charge Pump #1: Bucket Unit 1G*
- *Cooling Fan: Bucket Unit 1Q*
- *Cooling Pump: Bucket Unit 2A*





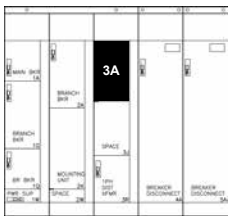
MCC Electrical Schematics - Power Supply - Bucket Unit 1W

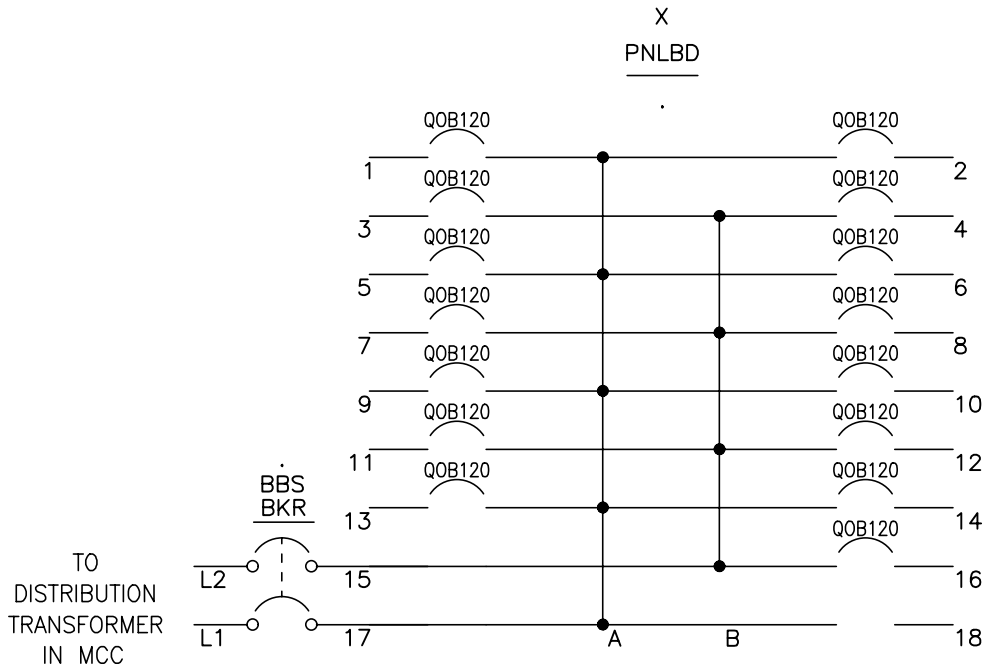




P0251-943 rev 3-18-20

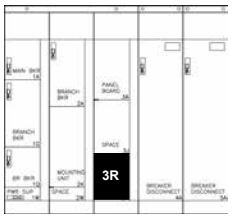
MCC Electrical Schematics - Panel Board (Lights & GFIC Outlets) - Bucket Unit 3A

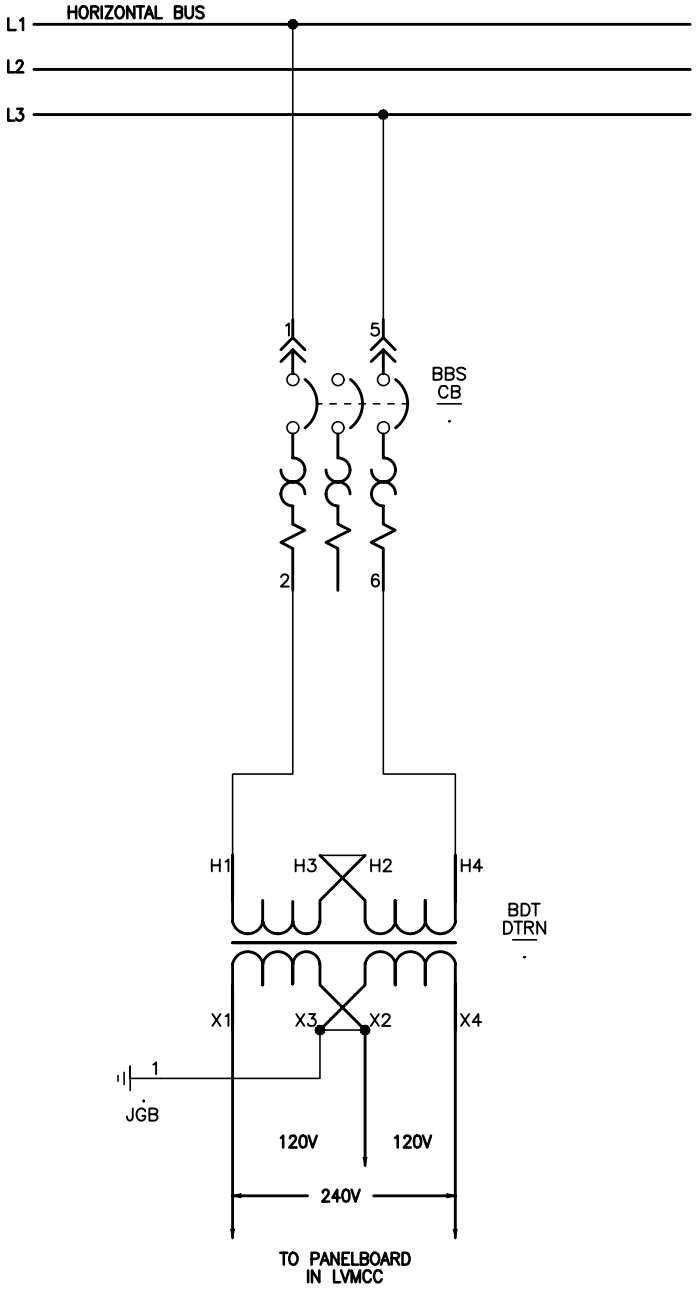




P0251-943 rev 3-18-20

MCC Electrical Schematics - 240V Transformer - Bucket Unit 3R



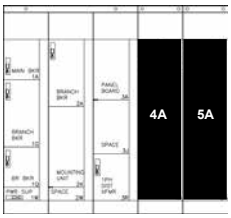


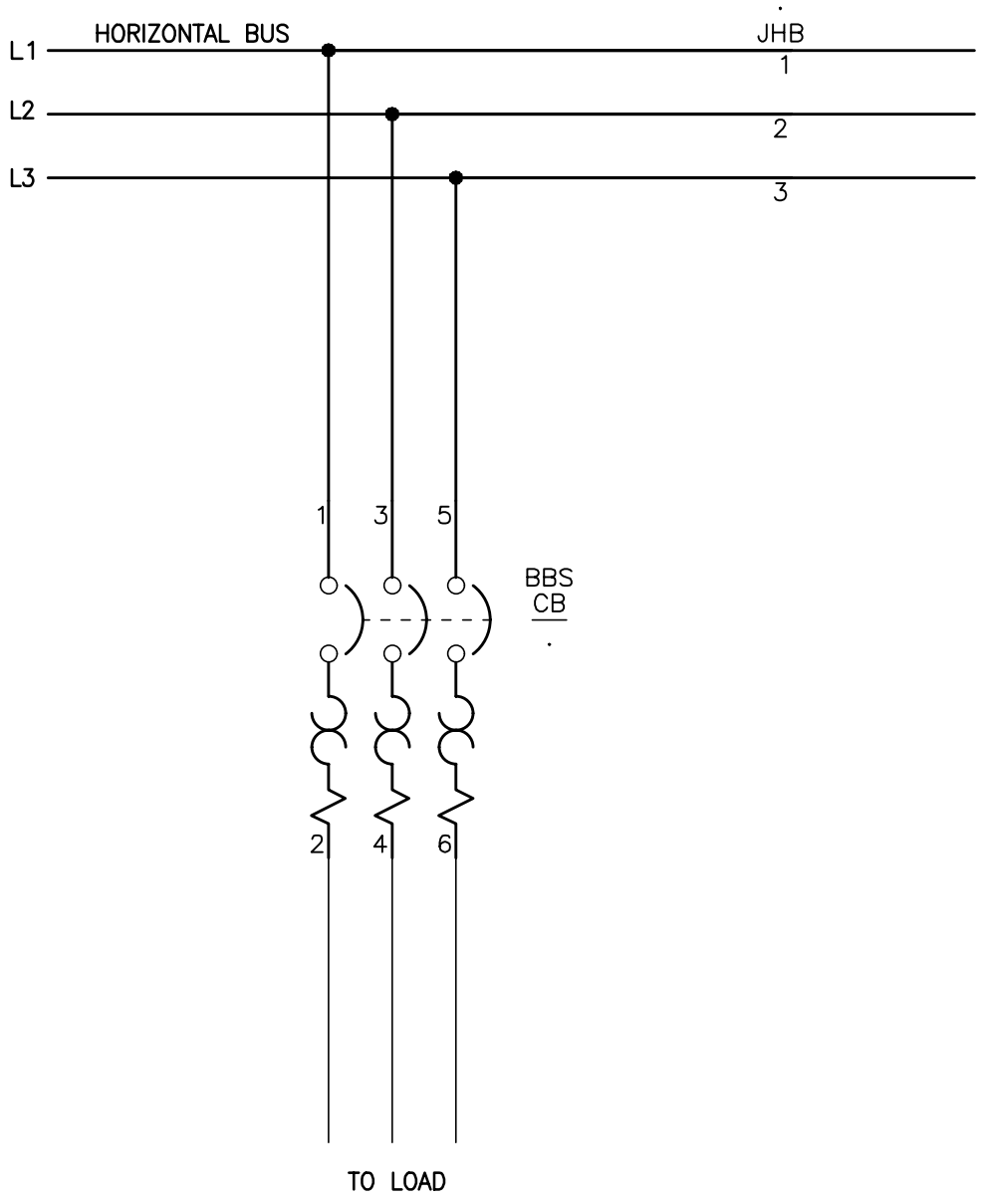
P0251-943 rev 3-18-20

MCC Electrical Schematics - 100 HP PUMP #1 & 100 HP PUMP #2

- 100 HP PUMP #1: Bucket Unit 5A

- 100 HP PUMP #2: Bucket Unit 4A





NOTES

Control Container

The Control Container houses the operator's control console, motor control centers for the slurry pumps, MTBM drive motor and bulkhead panel for electrical and communication connections. The operator monitors and controls all facets of the microtunneling operation from a dual-monitor display console and control station including: MTBM's pitch and yaw, rotation, torque, jetting, jacking thrust, steering, slurry flow and pressure, as well as the MTBMs anticipated position at the cutter face using our proprietary software programs. Variable Frequency Drives (VFDs) control the electric motors for the MTBM cutter head drive/booster pump, and feed, return and mid pumps.

Control Container SN FA22240F

Control Console 2-2
Transformer 2-15
VFD 2-16
Bulkhead 2-18
Bulkhead Pilot Circuit With Indicators In Control Console 2-21
120 VAC Power Wire Diagram 2-22
Power Wire Line Diagram 2-23
Ground, Phase Monitor, Pilot Indicator Diagram 2-24
Ethernet Network Wiring 2-25
MTBM Ethernet IP Addresses 2-26
Wire Number & Circuit Descriptions 2-27

Control Container SN FA22299F, FA21900F-04/05

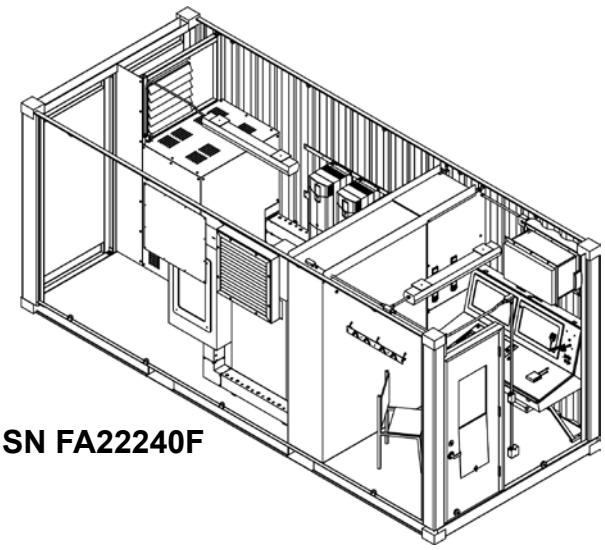
Control Console 2-29
Transformer 2-43
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Control Container SN FA22300F

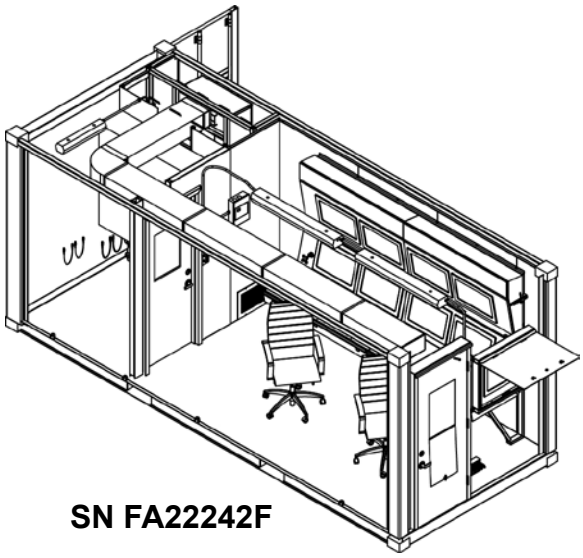
Control Console 2-50
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Wire Number Table 2-70

Control Container SN FA22242F

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120 VAC Power Wire Diagram 2-85
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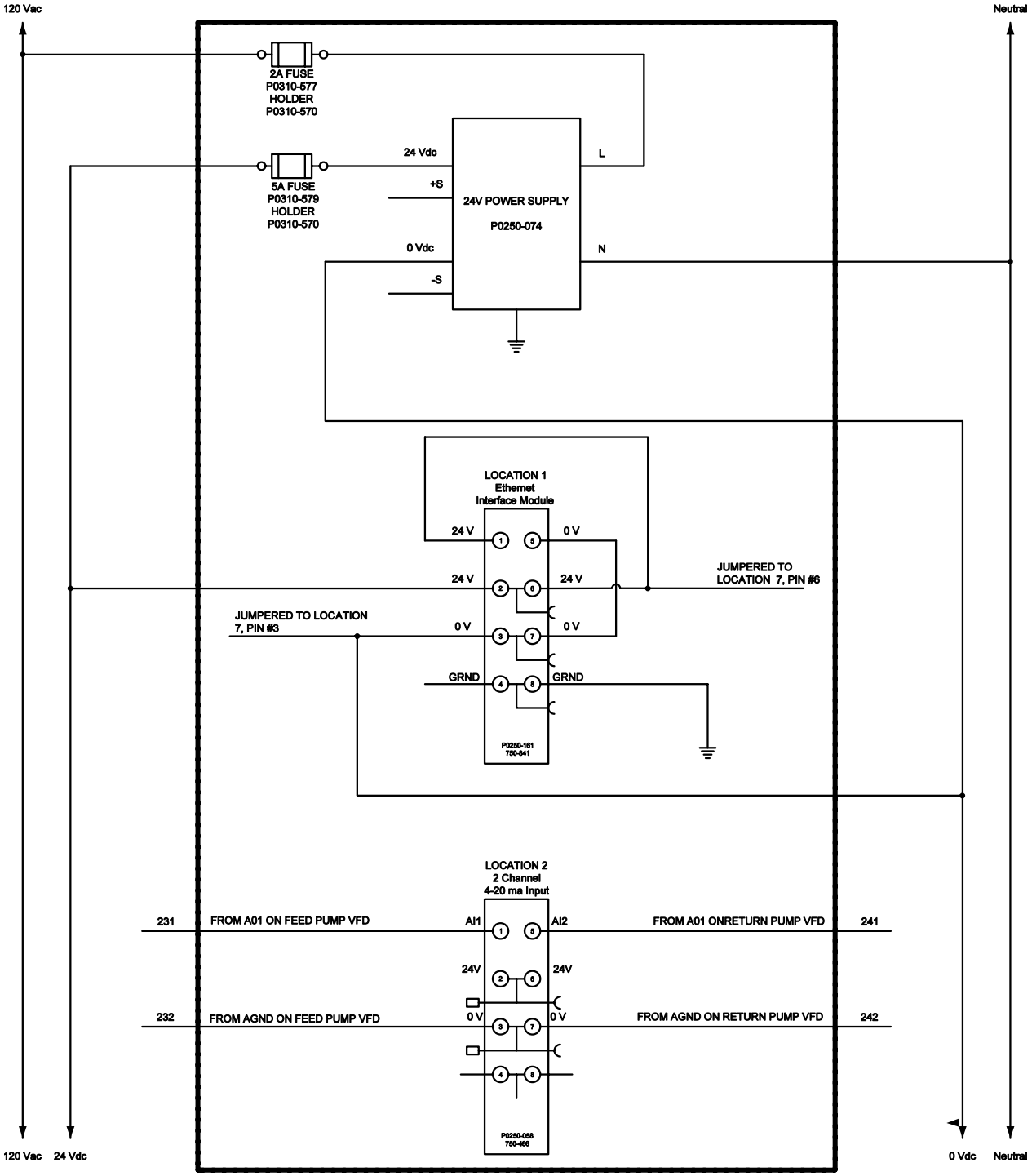
SN FA22240F



SN FA22242F

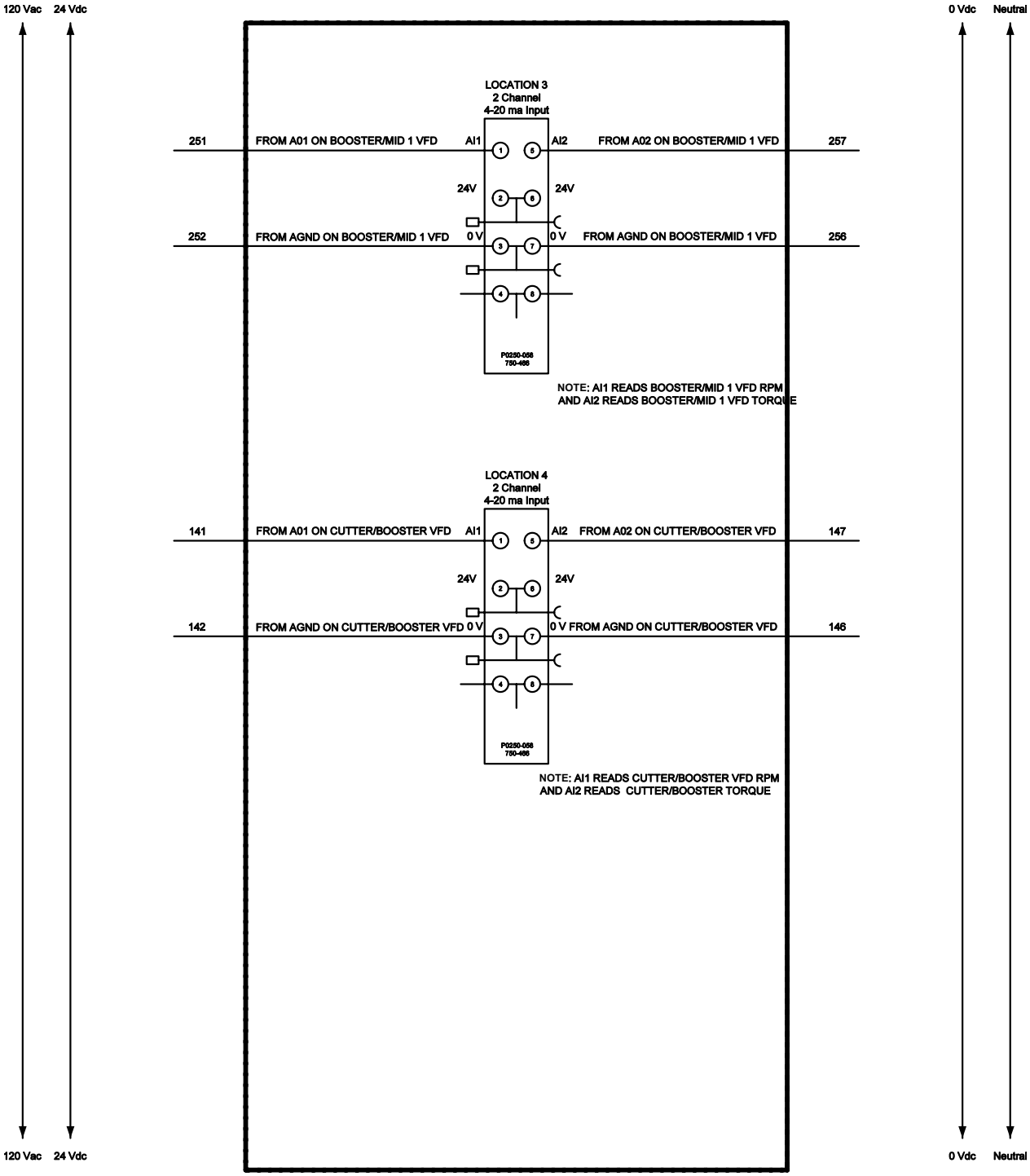
CONTROL CONSOLE ELECTRICAL SCHEMATICS - SN FA22240F

Electrical Schematic - Part 1 of 13



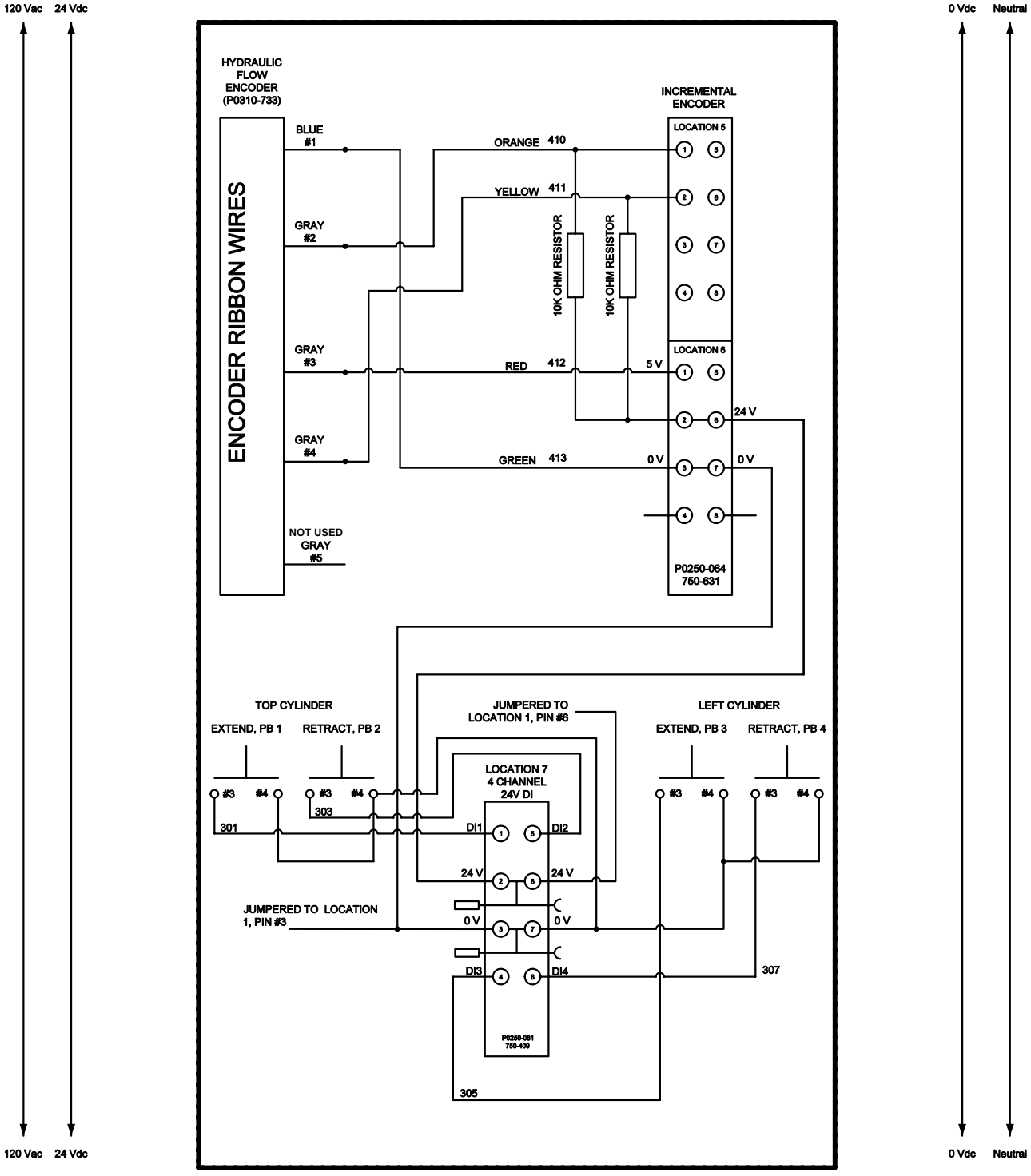
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 2 of 13



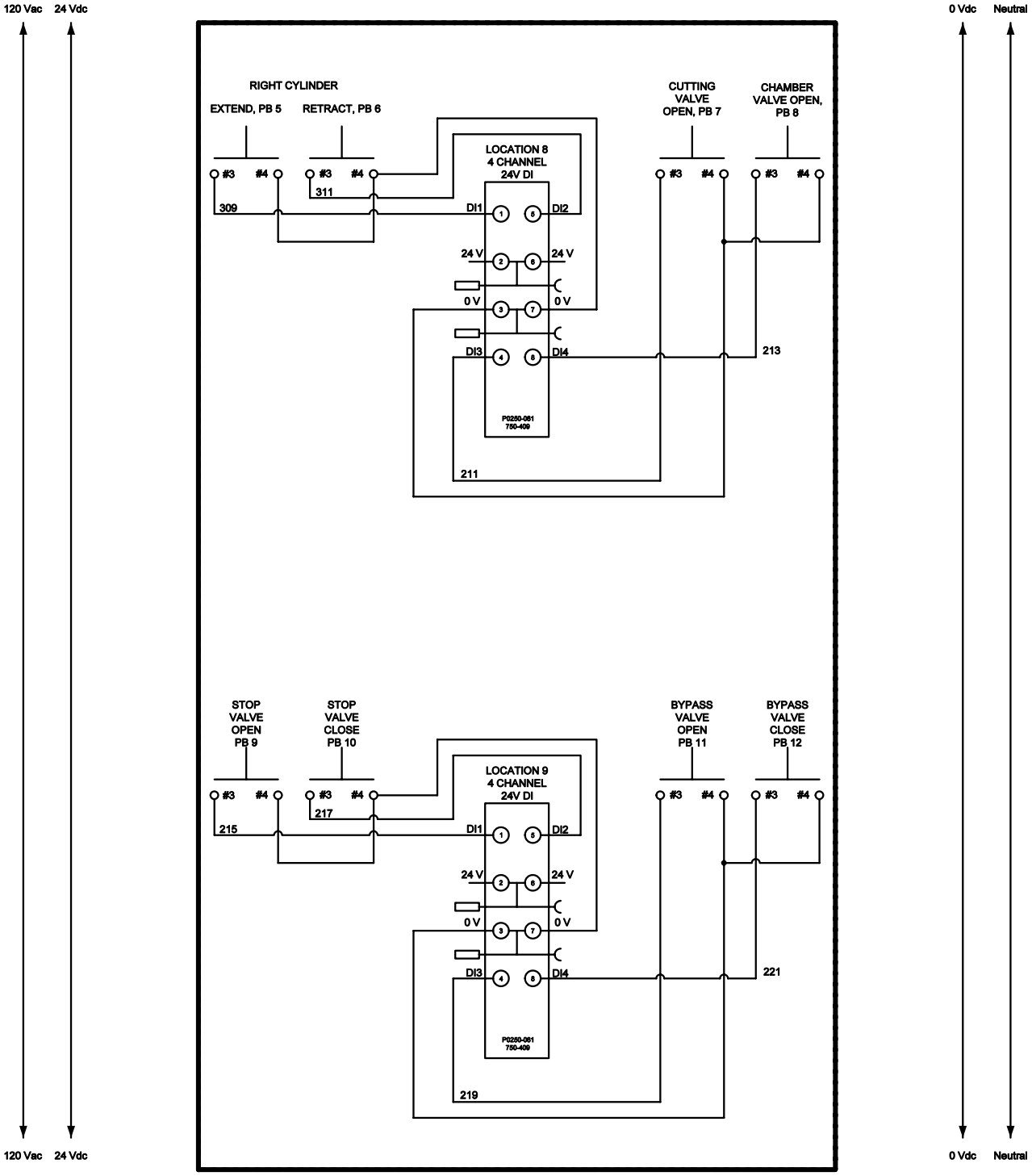
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 3 of 13



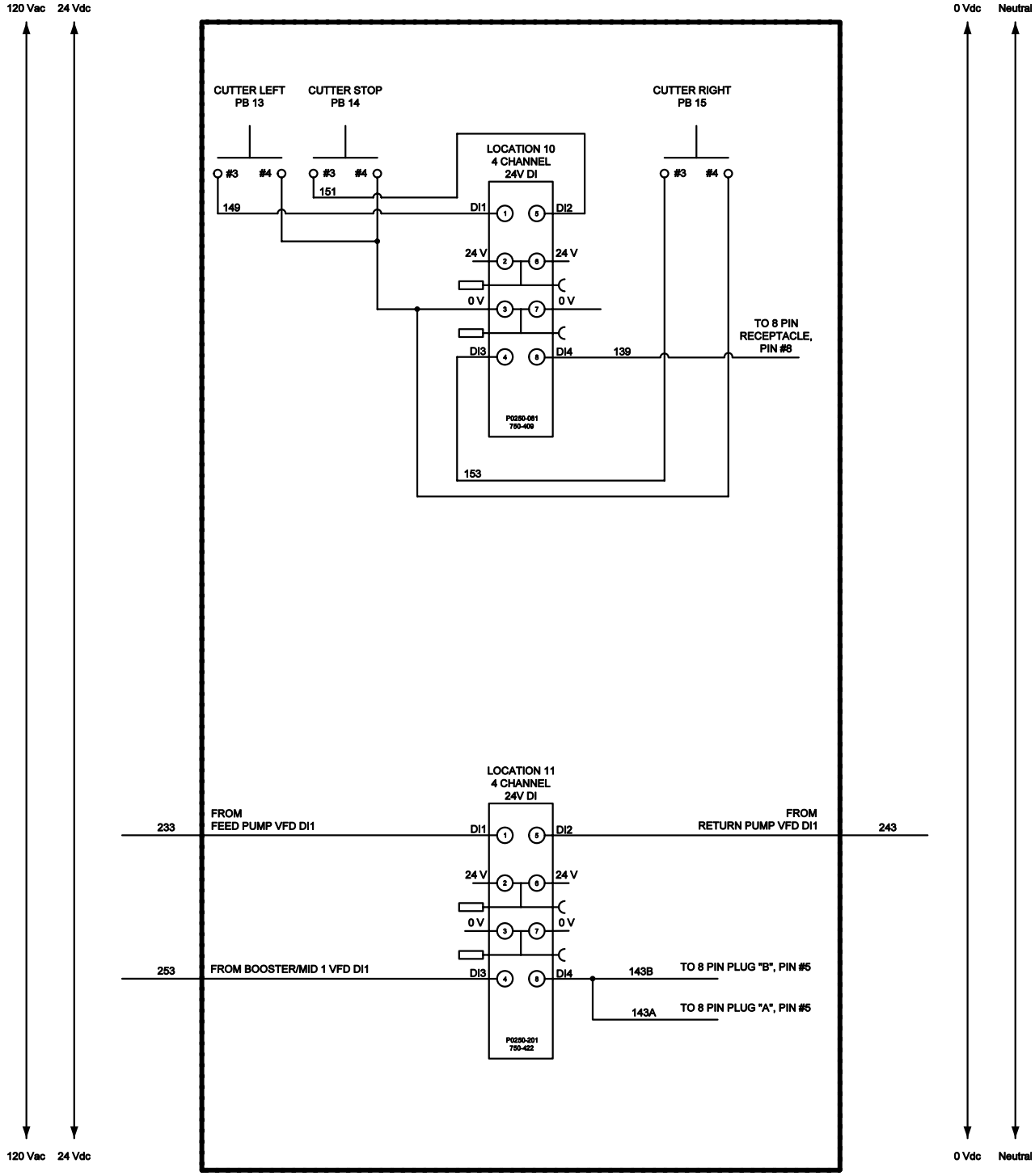
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 4 of 13



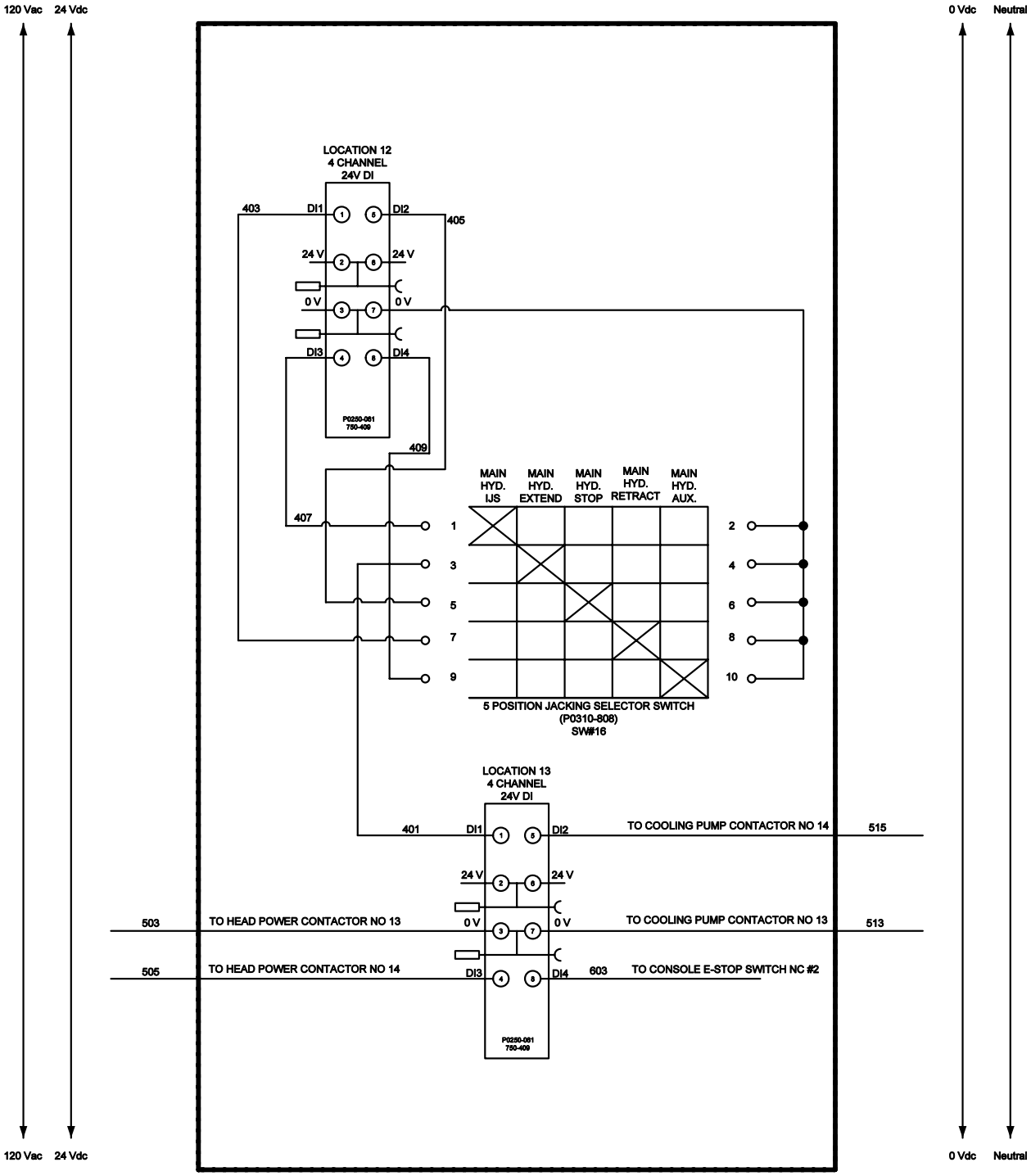
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 5 of 13



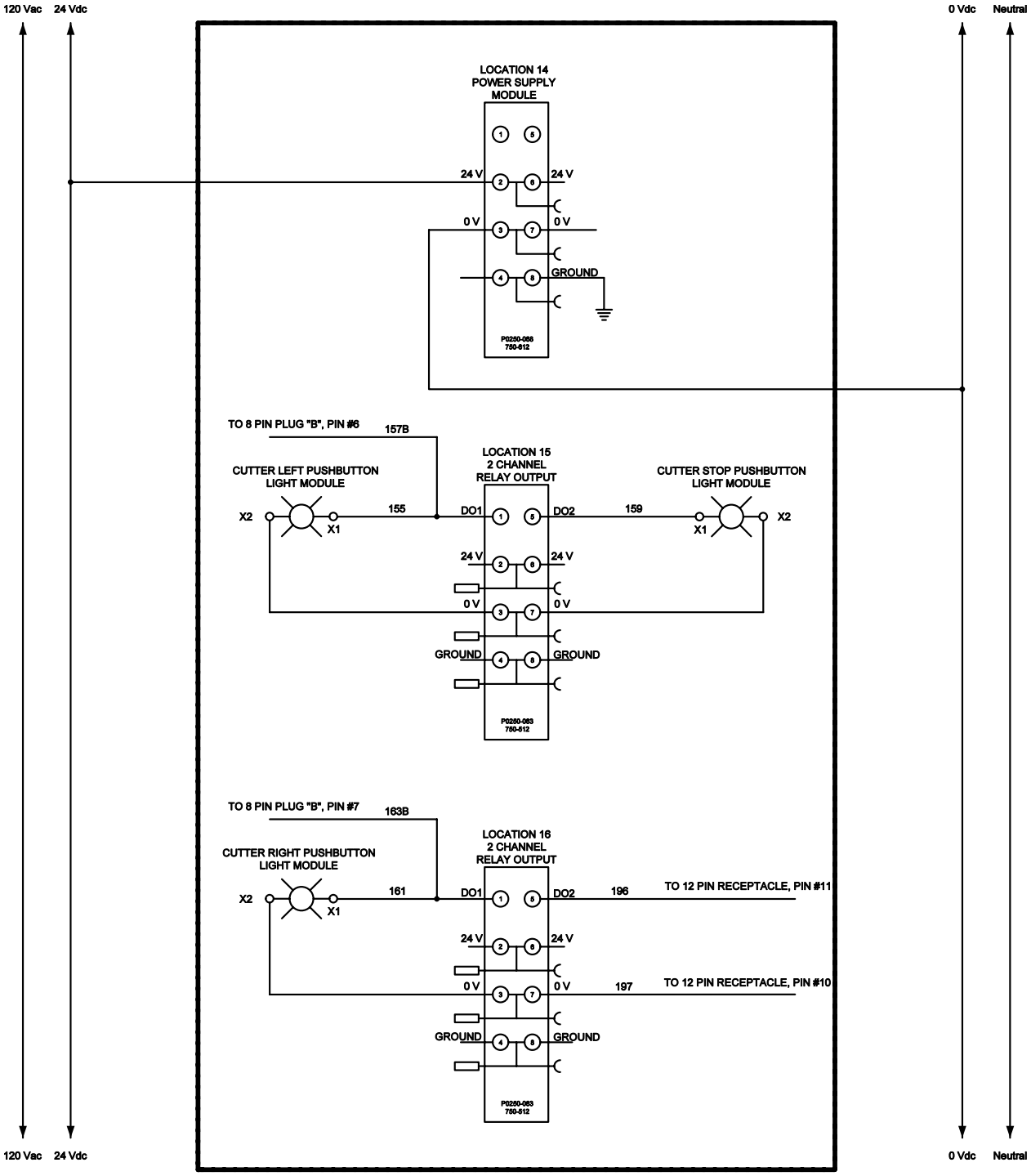
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 6 of 13



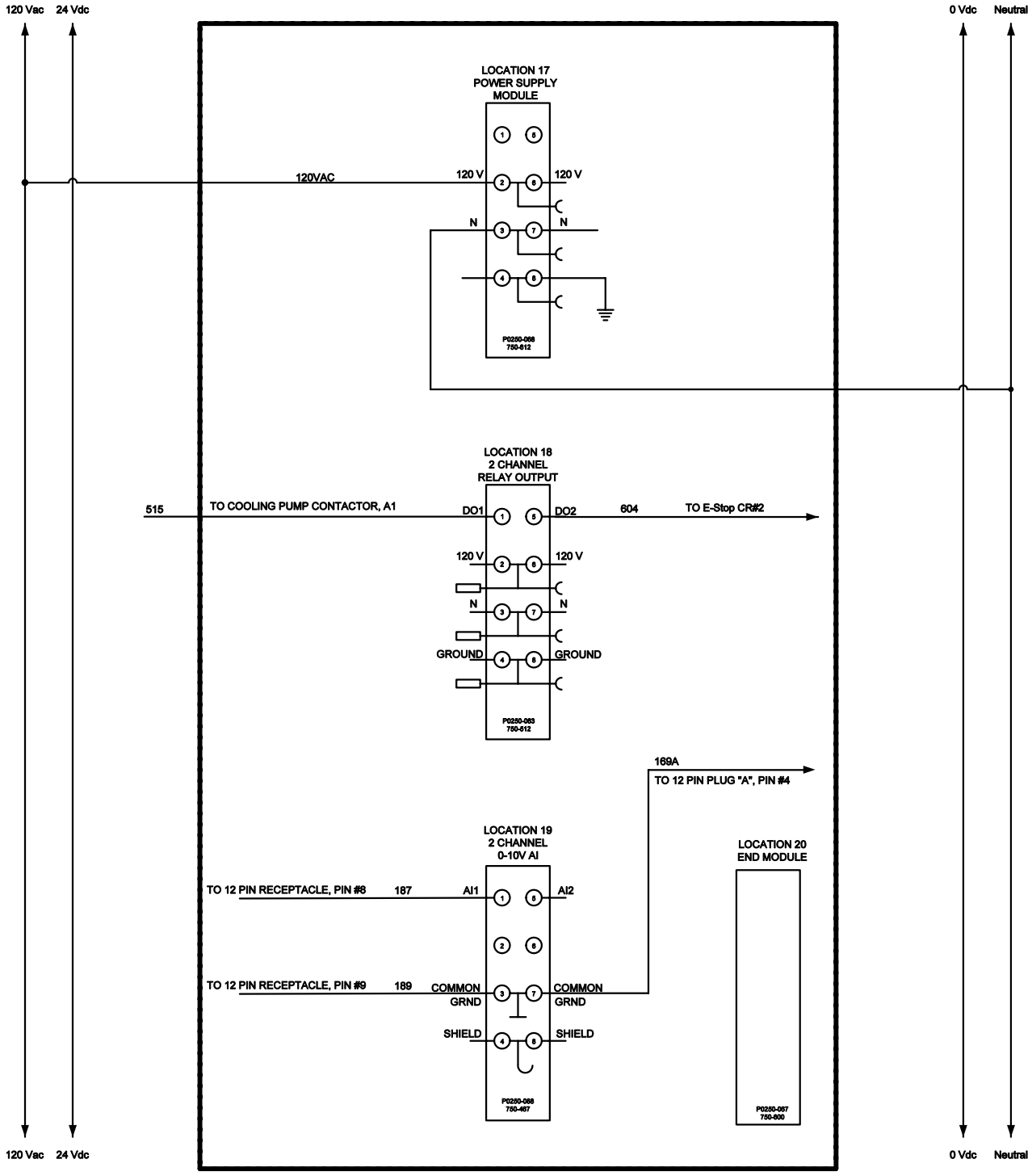
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 7 of 13



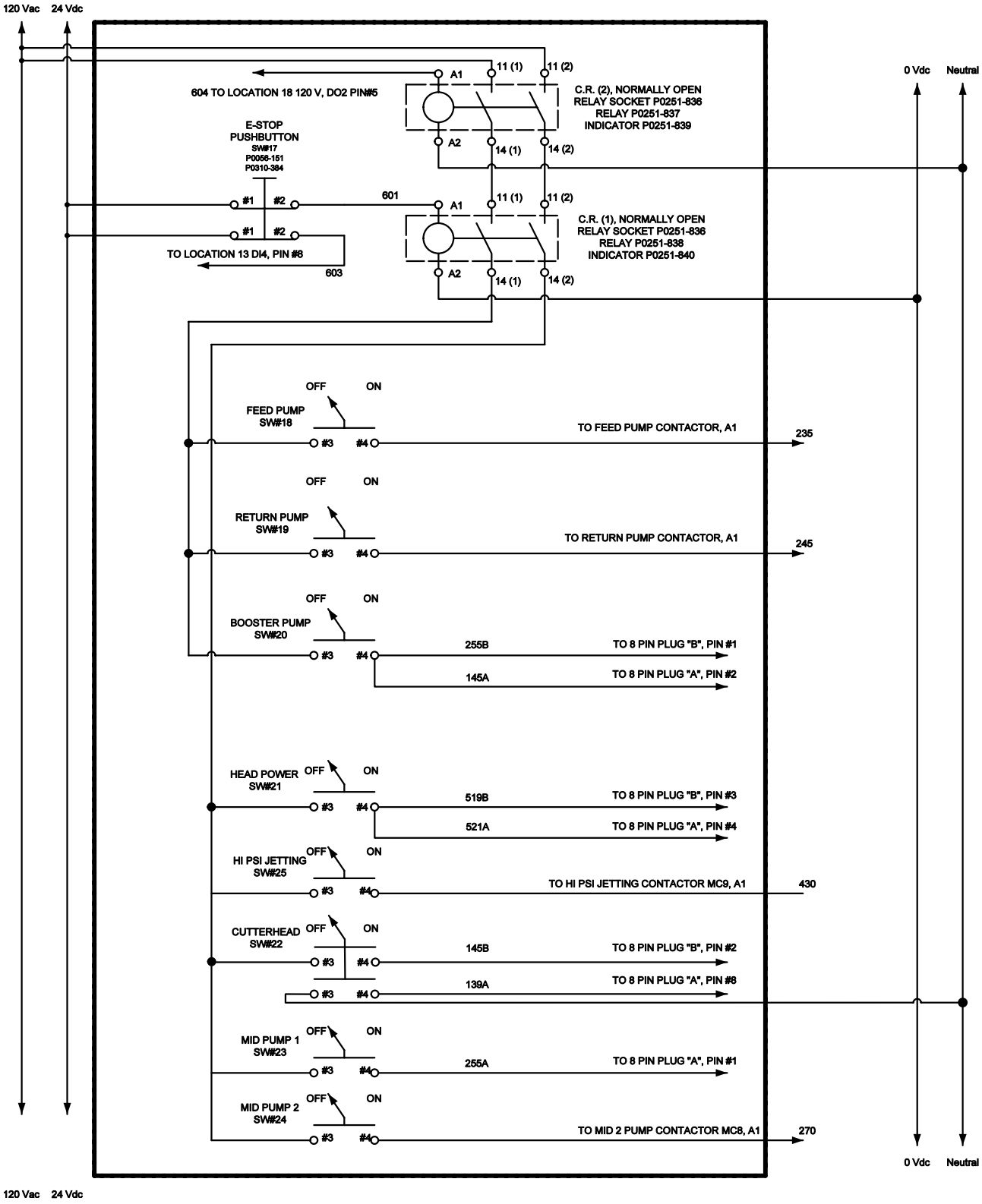
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 8 of 13



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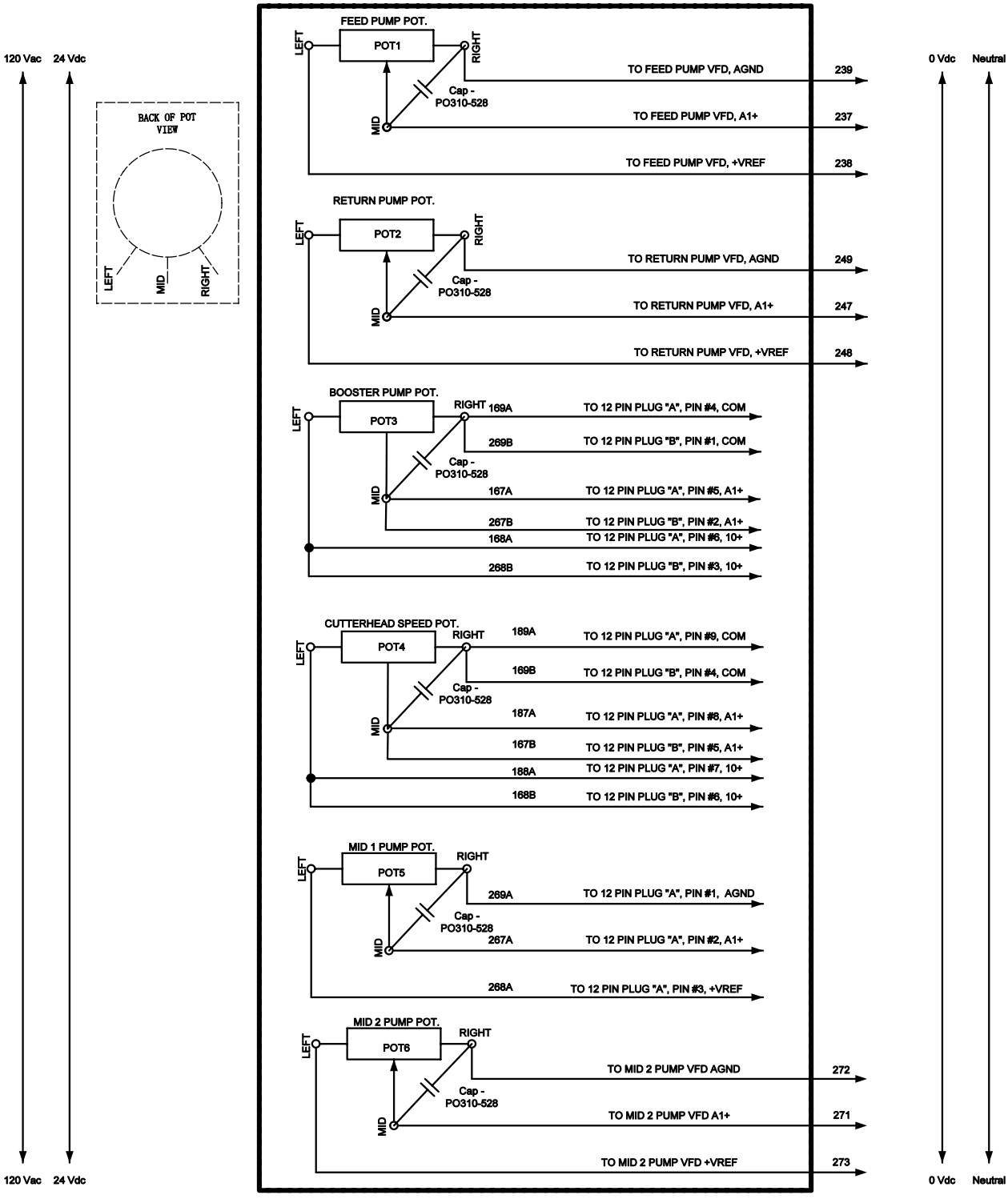
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 9 of 13



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Control Console Electrical Schematics (continued)

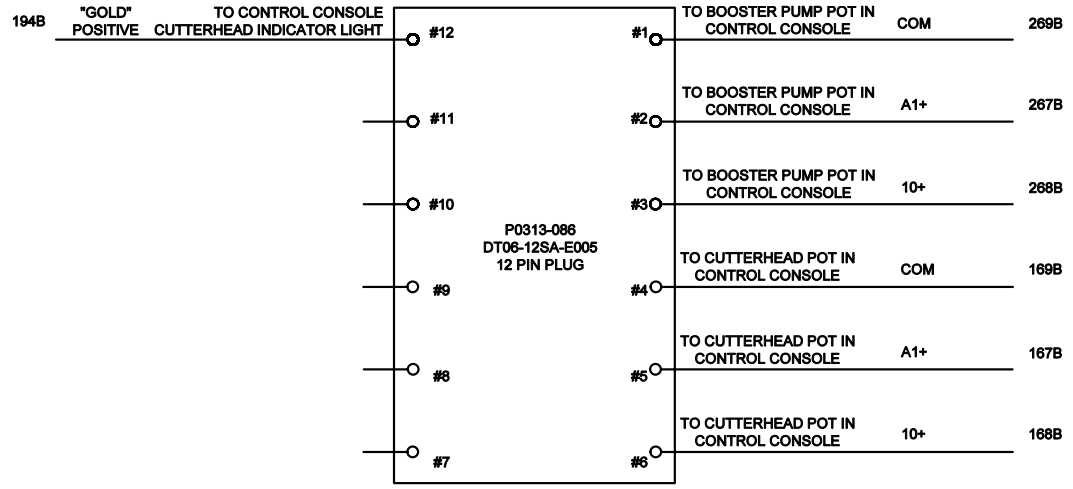
Electrical Schematic - Part 10 of 13



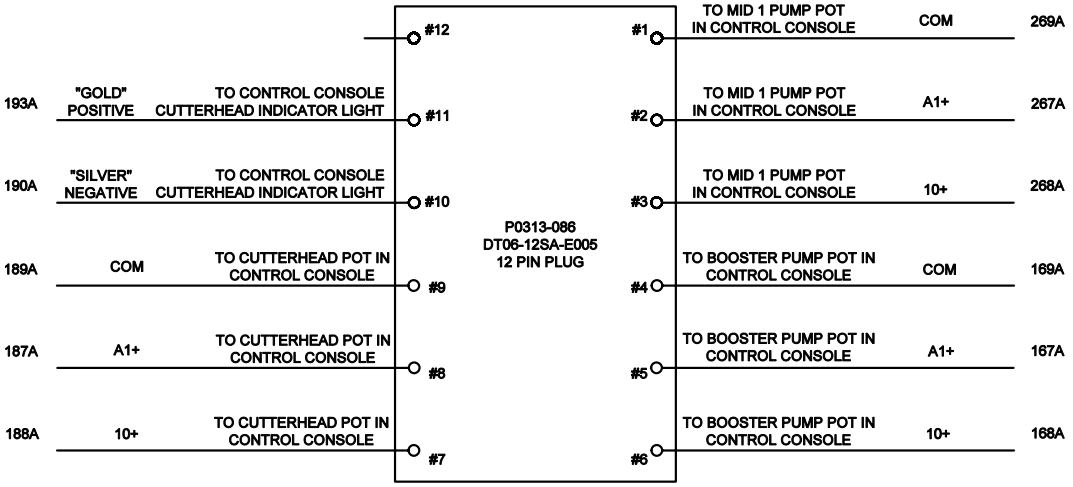
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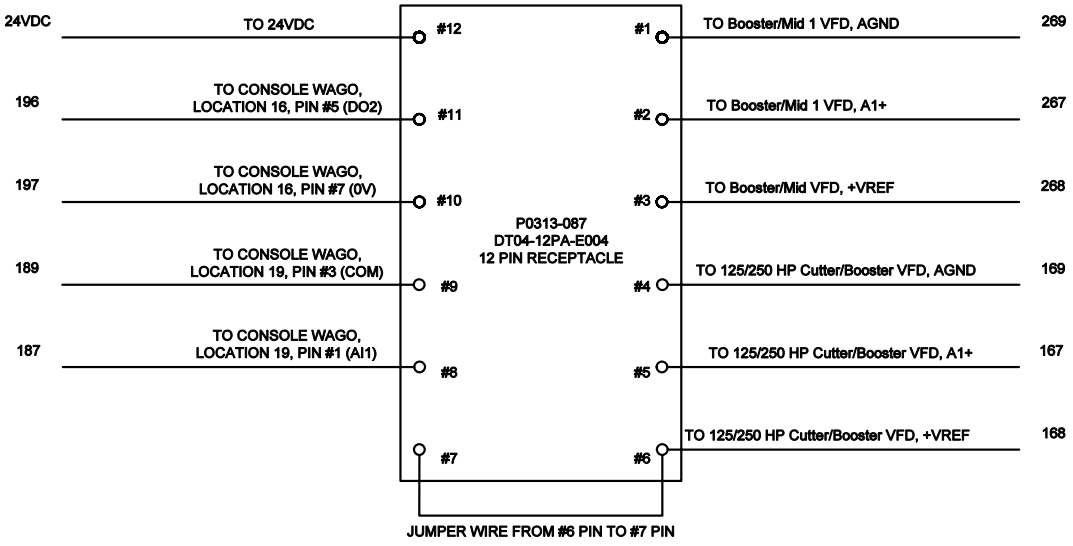
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 11 of 13

"B" PLUG FOR SMALL MTBM



"A" PLUG FOR LARGE MTBM

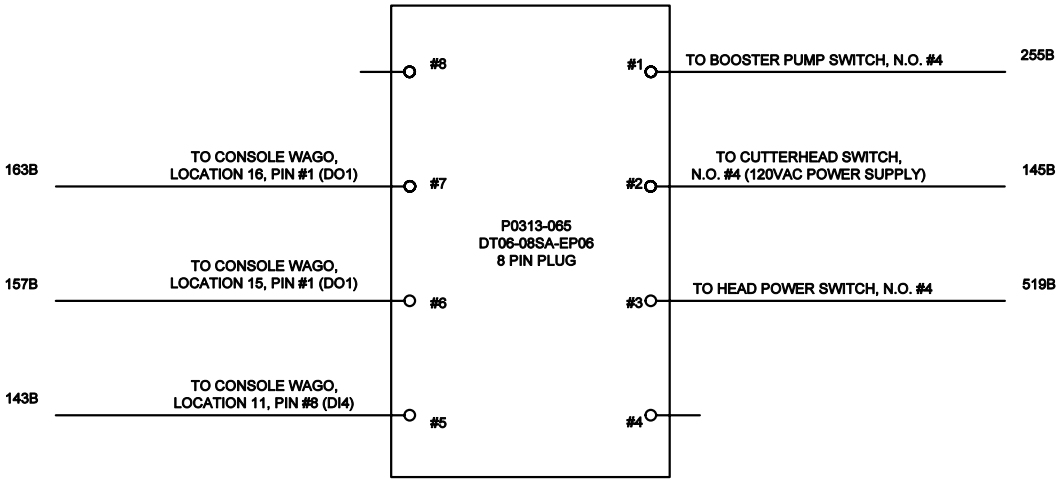




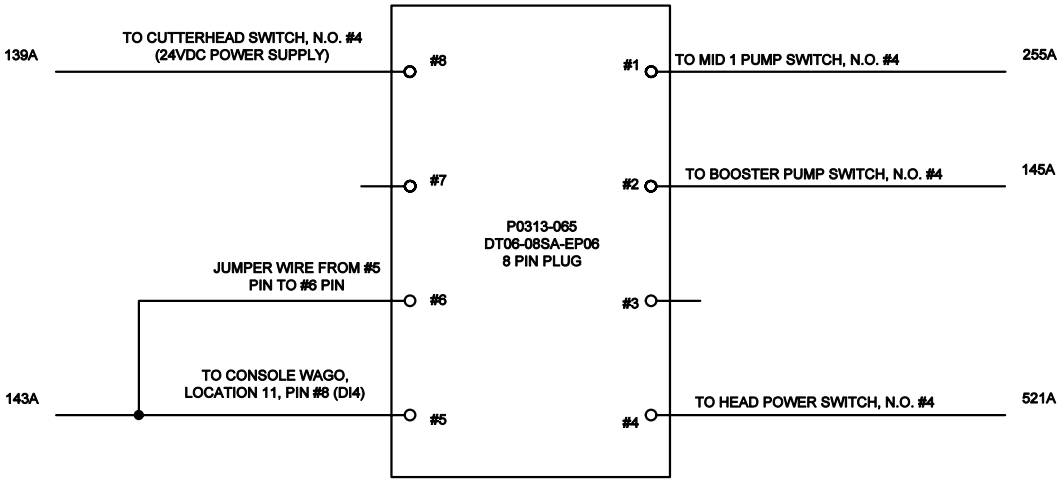
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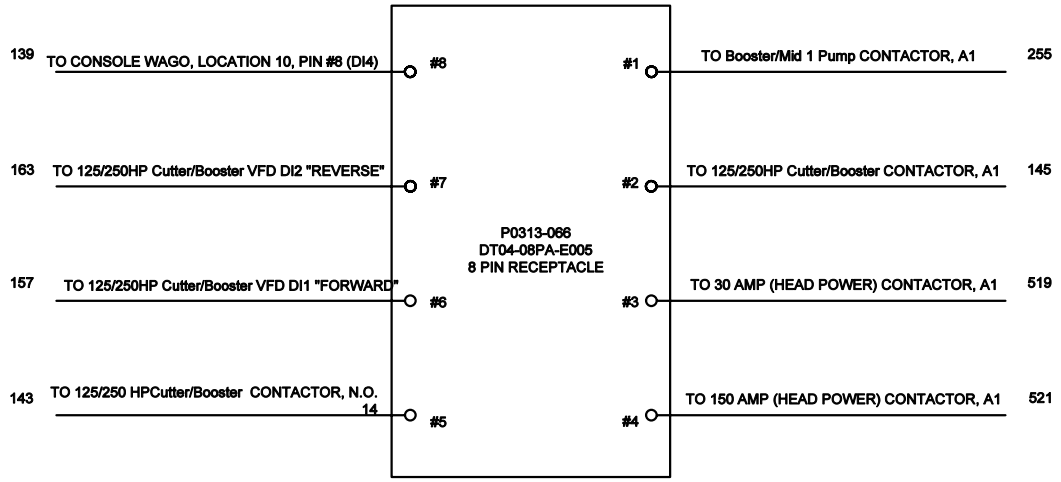
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 12 of 13

"B" PLUG FOR SMALL MTBM



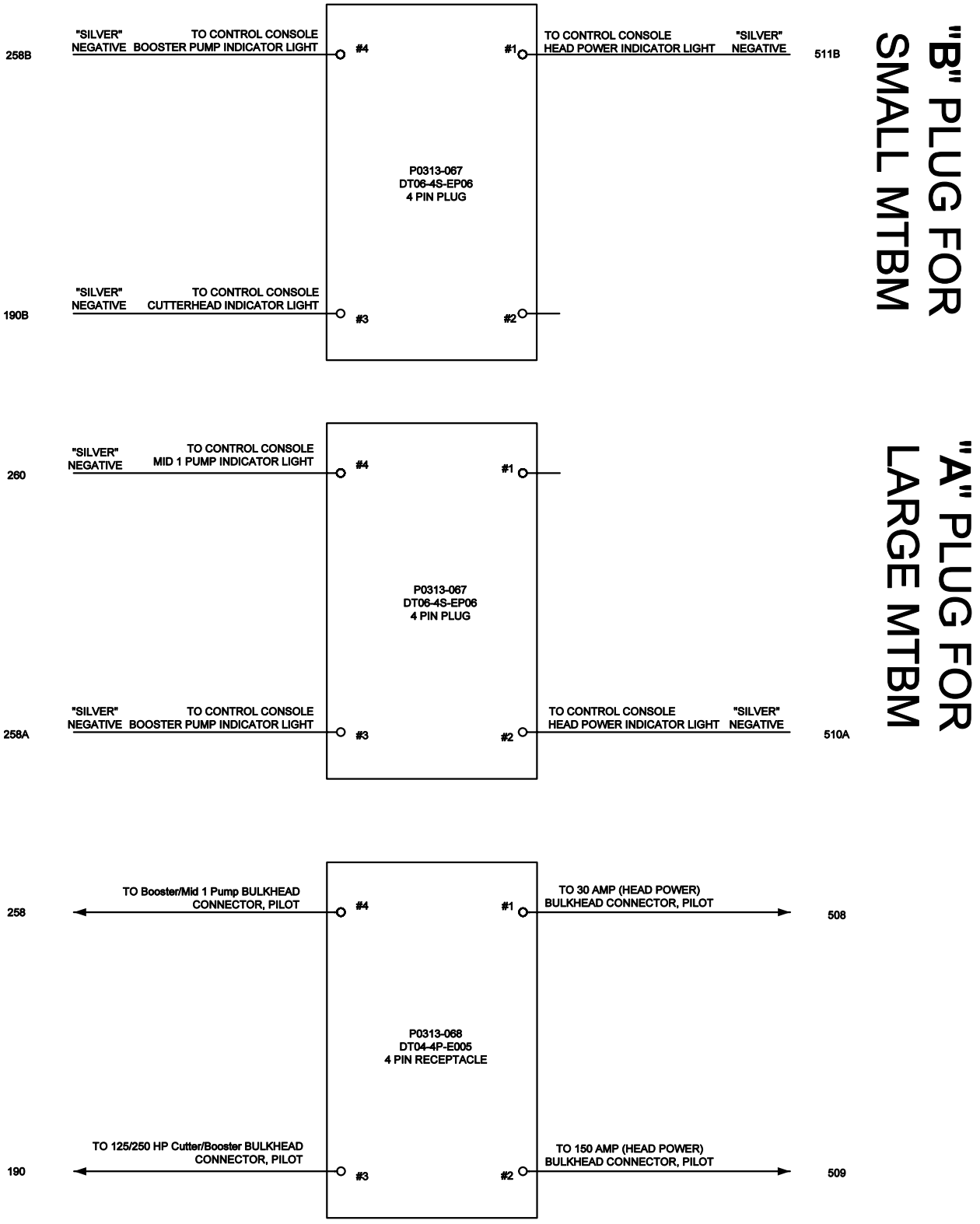
"A" PLUG FOR LARGE MTBM



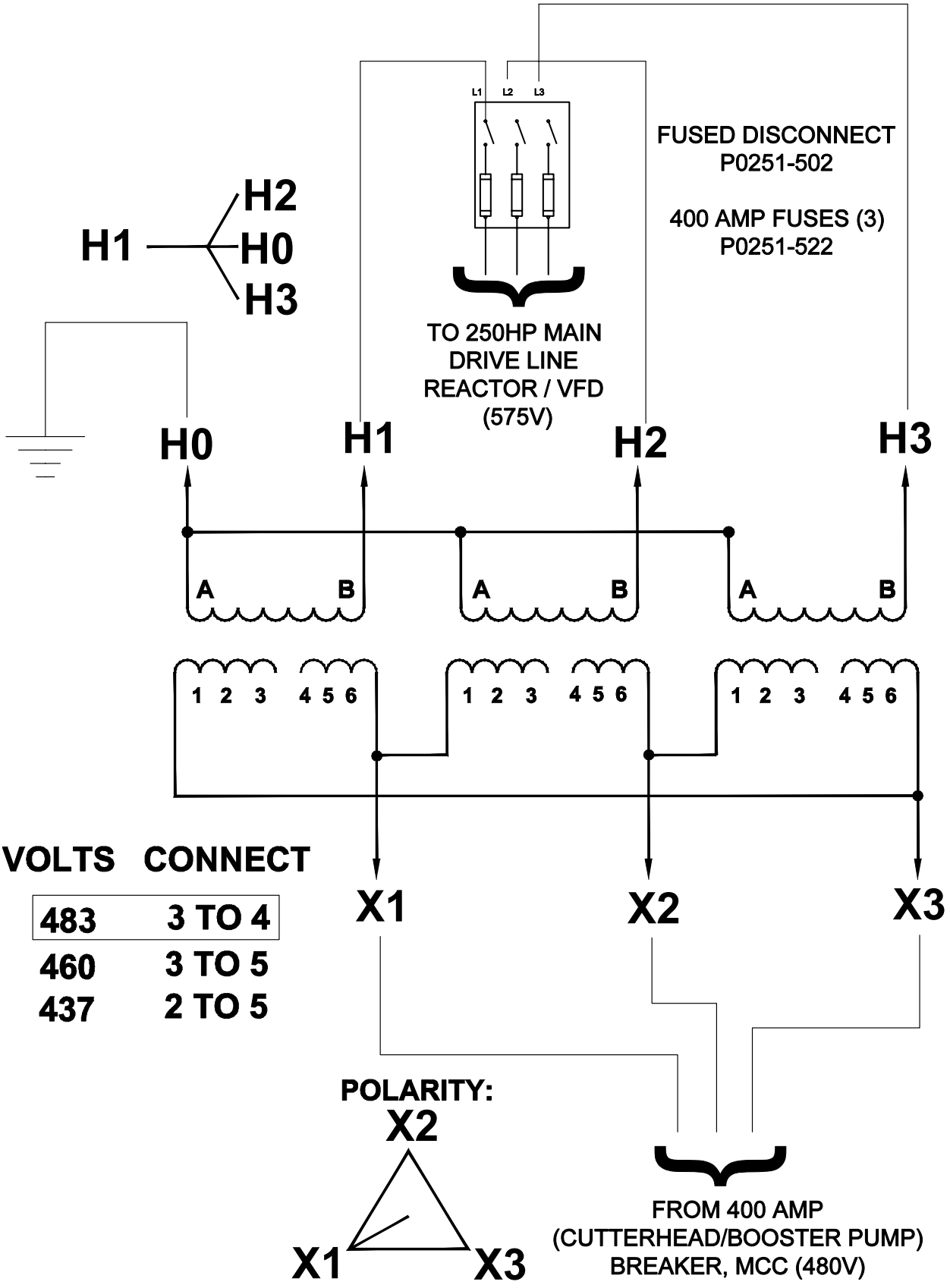


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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 13 of 13

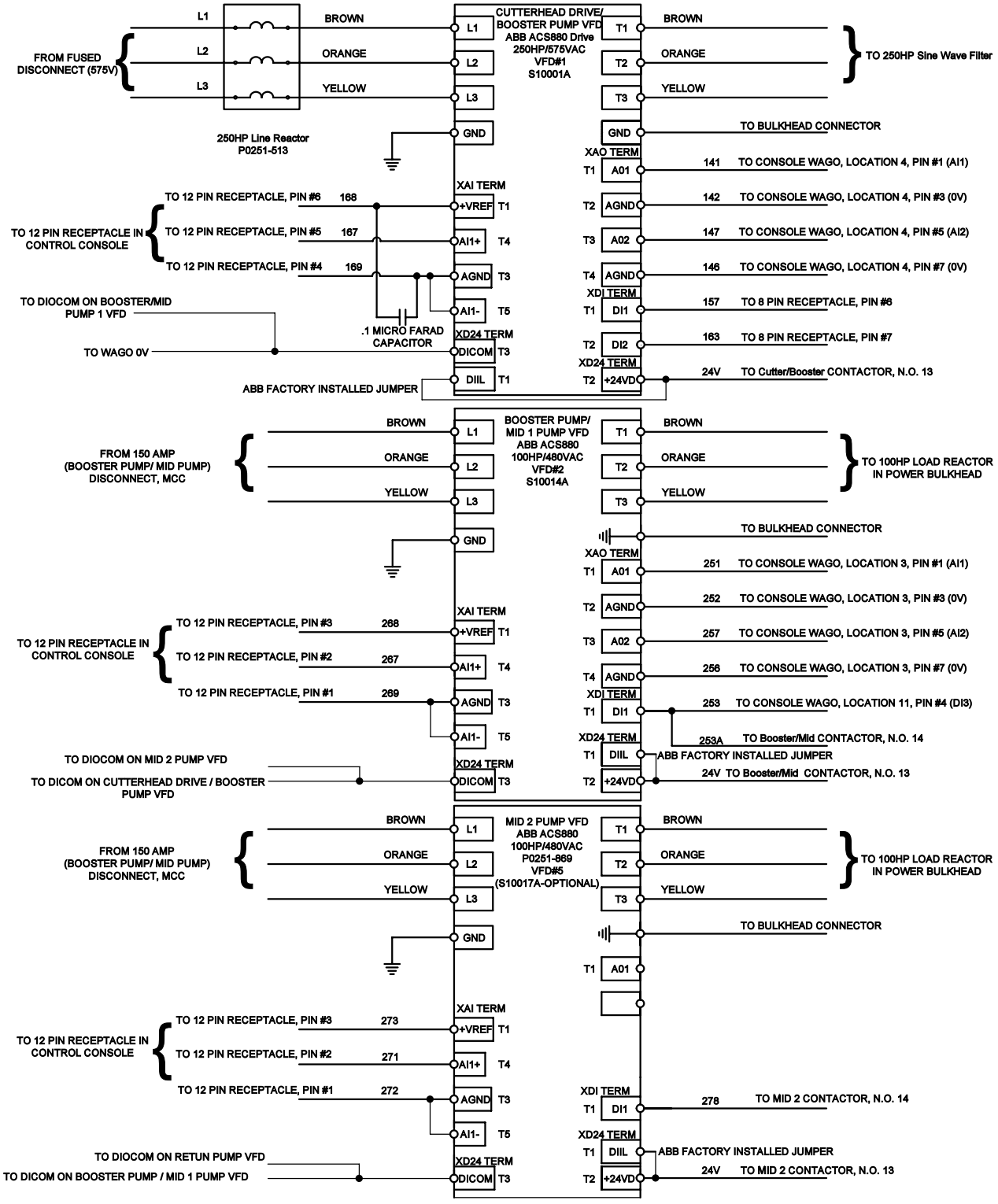


CONTROL CONTAINER TRANSFORMER ELECTRICAL SCHEMATIC - SN FA22240F



CONTROL CONTAINER VFD ELECTRICAL SCHEMATICS - SN FA22240F

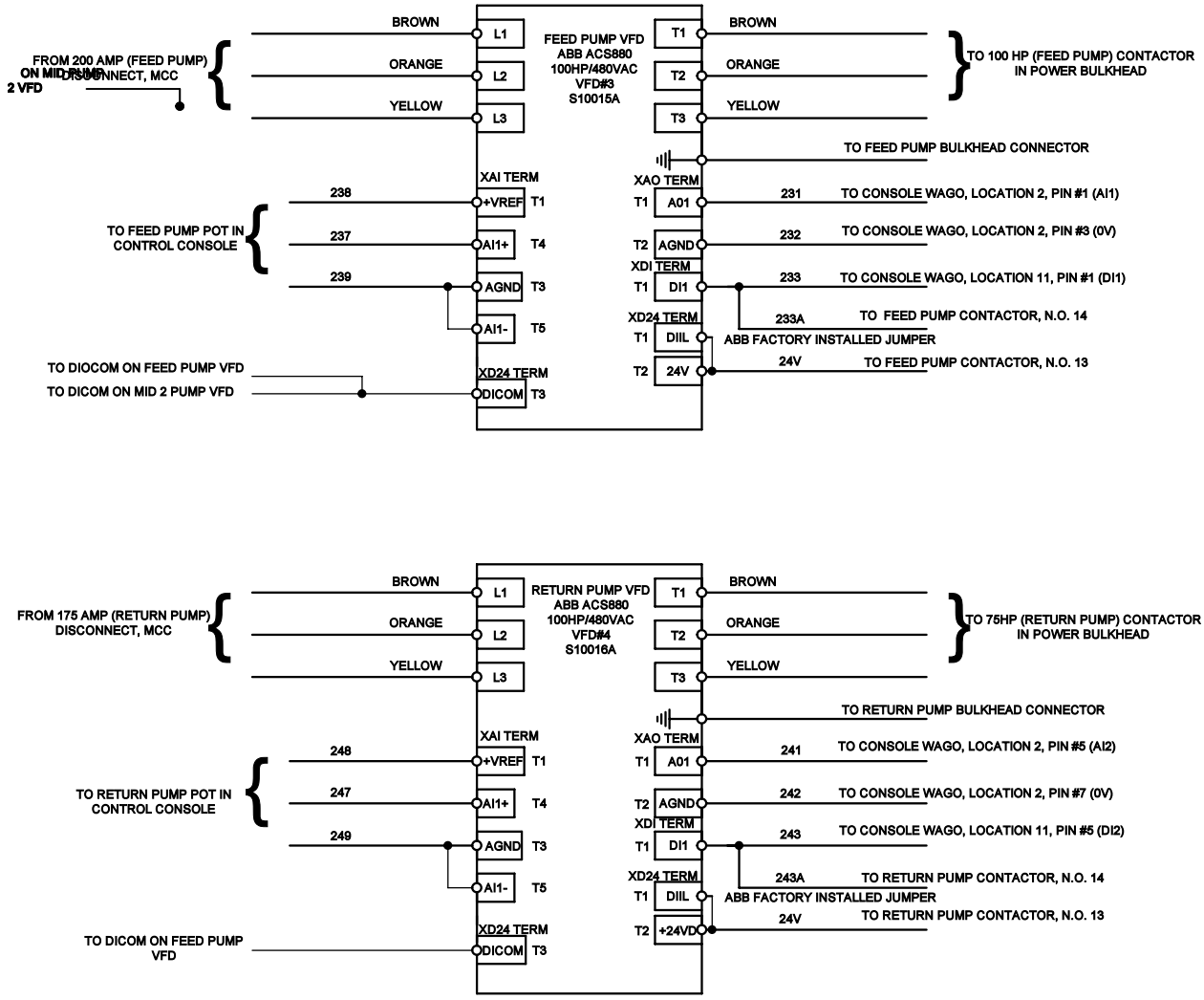
Electrical Schematic - Part 1 of 2



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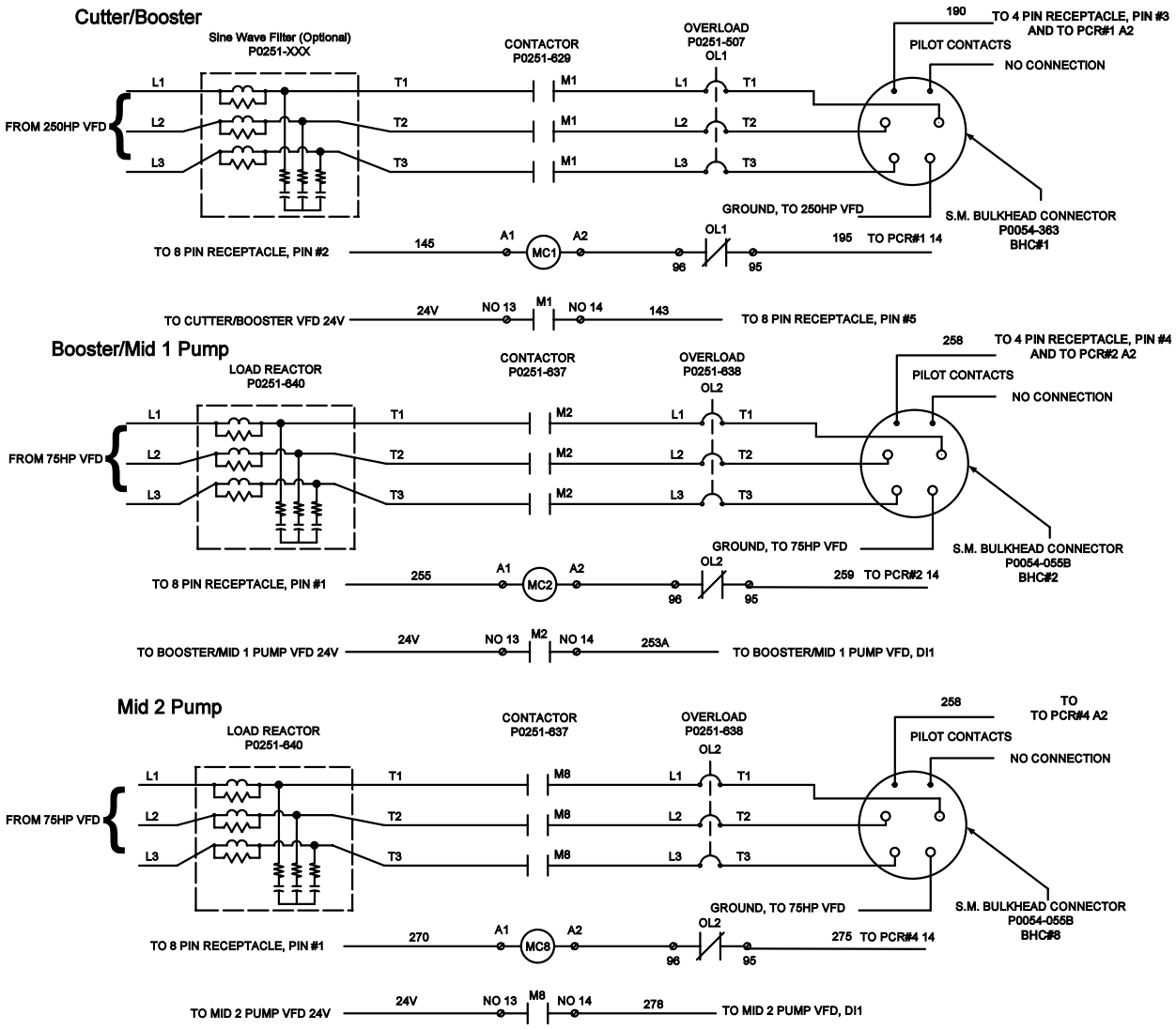
Control Container VFD Electrical Schematics (continued)

Electrical Schematic - Part 2 of 2



CONTROL CONTAINER BULKHEAD ELECTRICAL SCHEMATICS - SN FA22240F

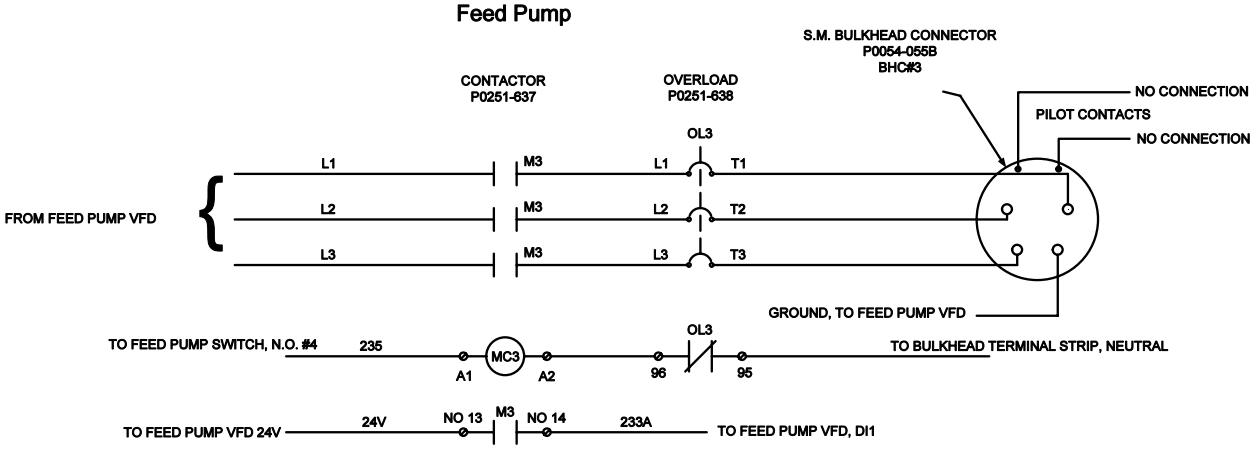
Electrical Schematic - Part 1 of 3

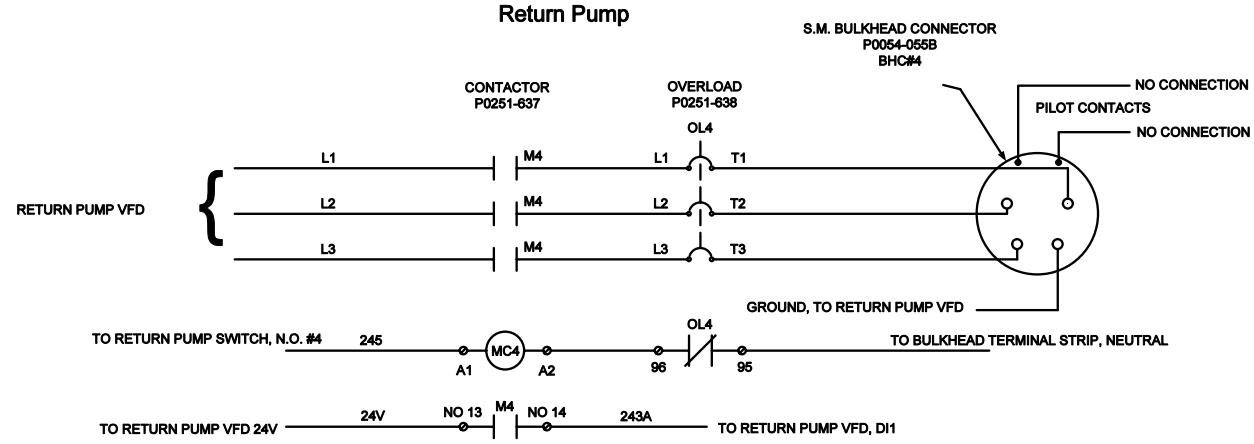


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Control Container Bulkhead Electrical Schematics (continued)

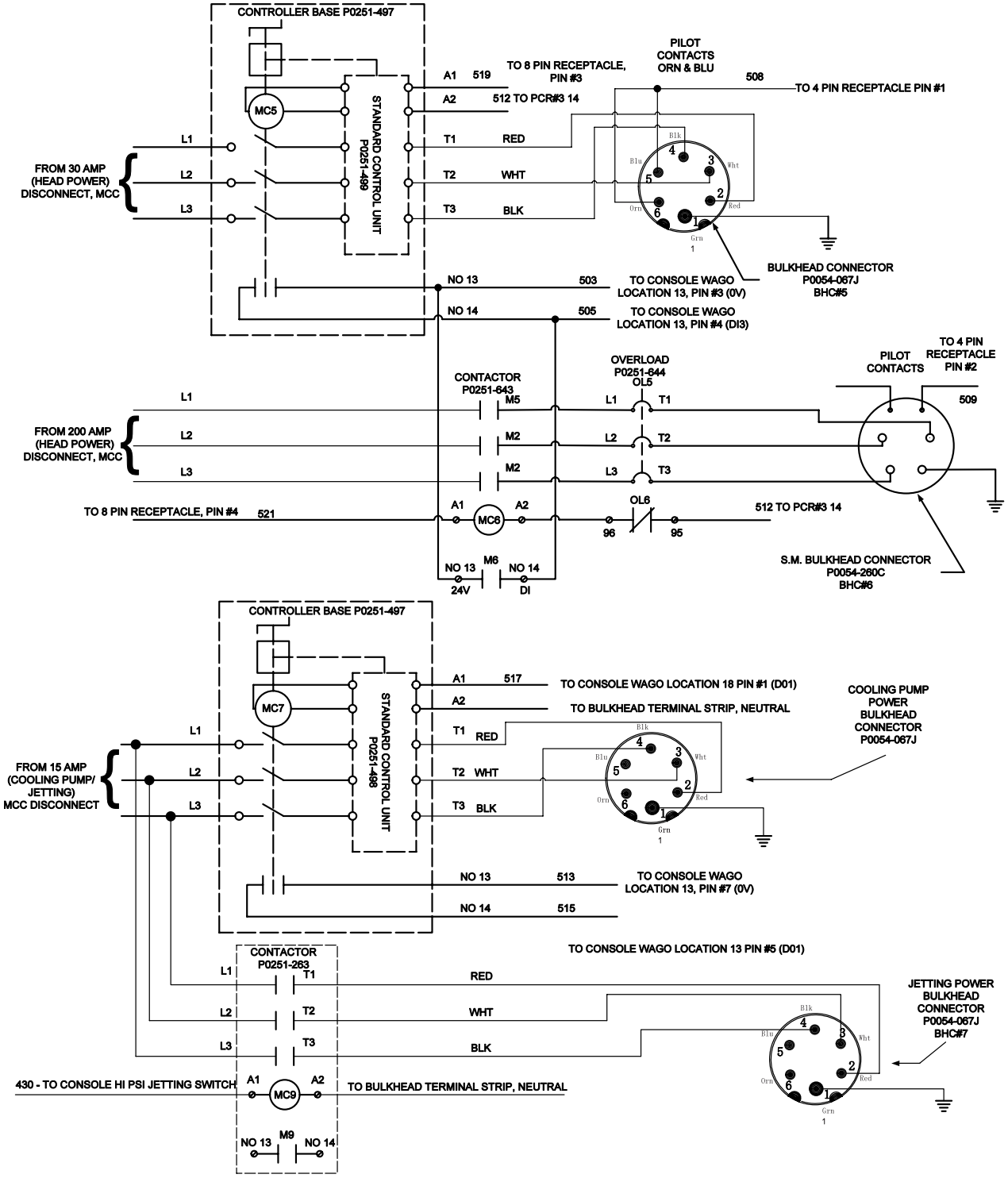
Electrical Schematic - Part 2 of 3





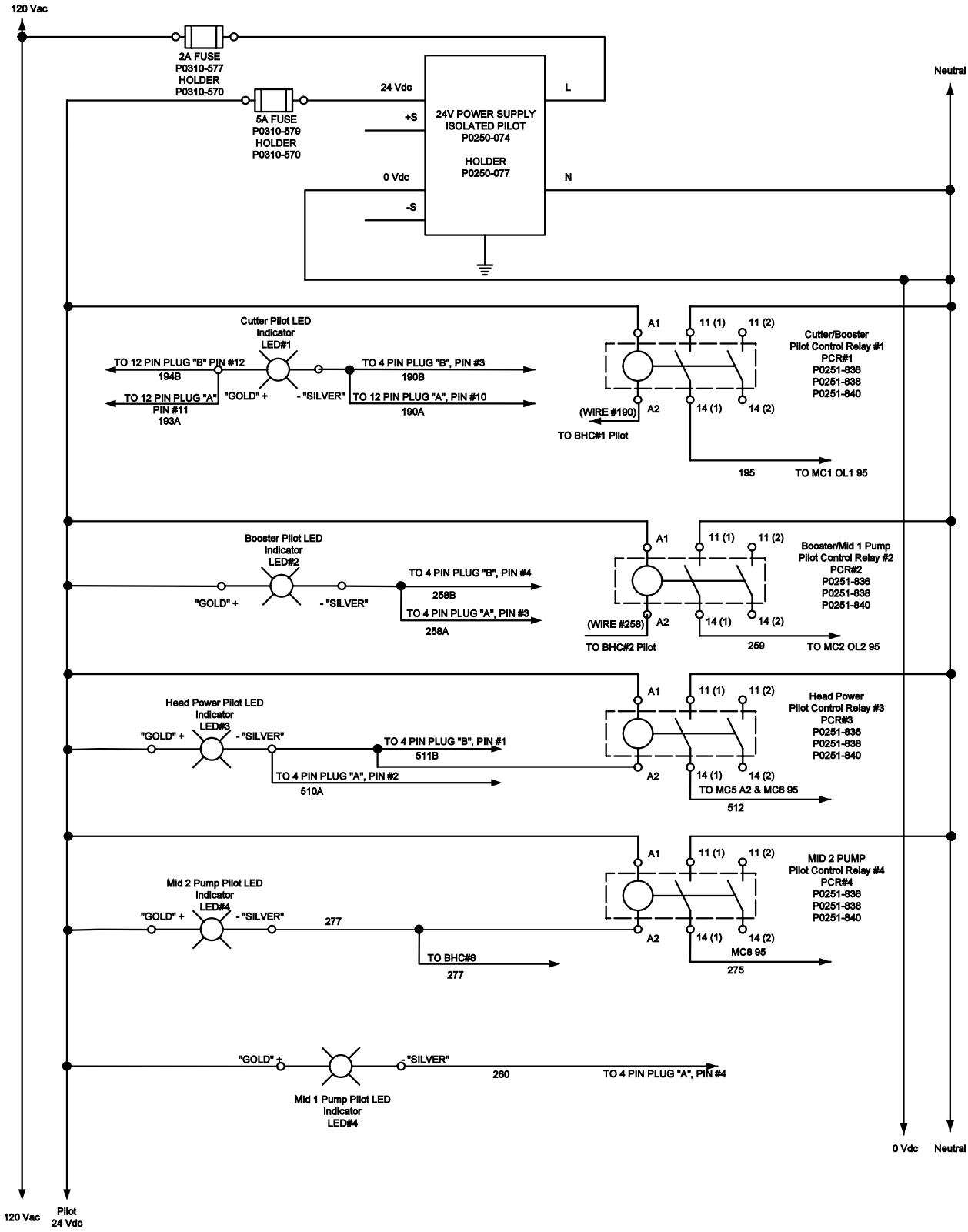
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Control Container Bulkhead Electrical Schematics (continued)
Electrical Schematic - Part 3 of 3

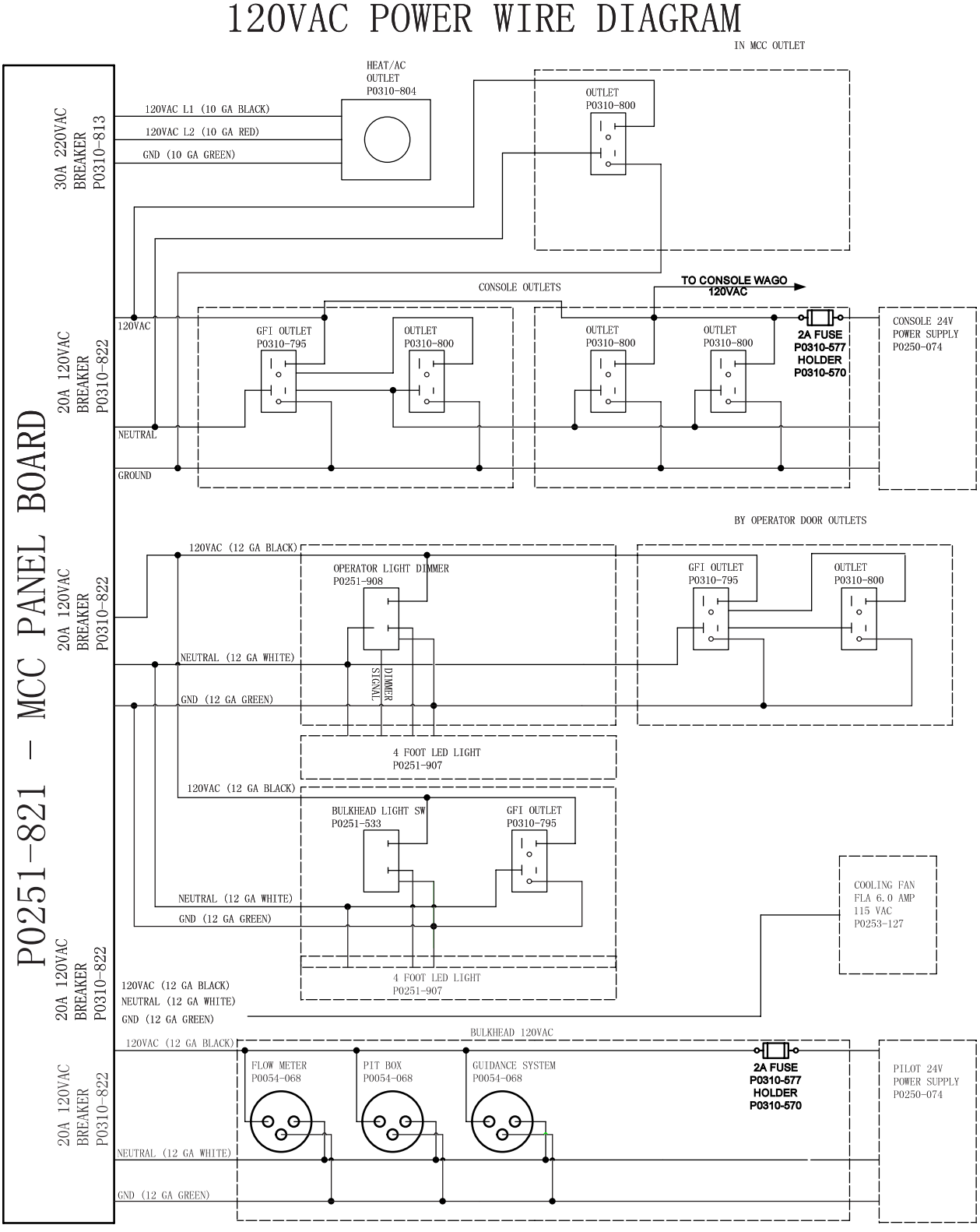


OVE ALL BURRS AND SHARP EDGES.

BULKHEAD PILOT CIRCUIT INDICATOR WITH INDICATORS IN CONTROL CONSOLE - SN FA22240F

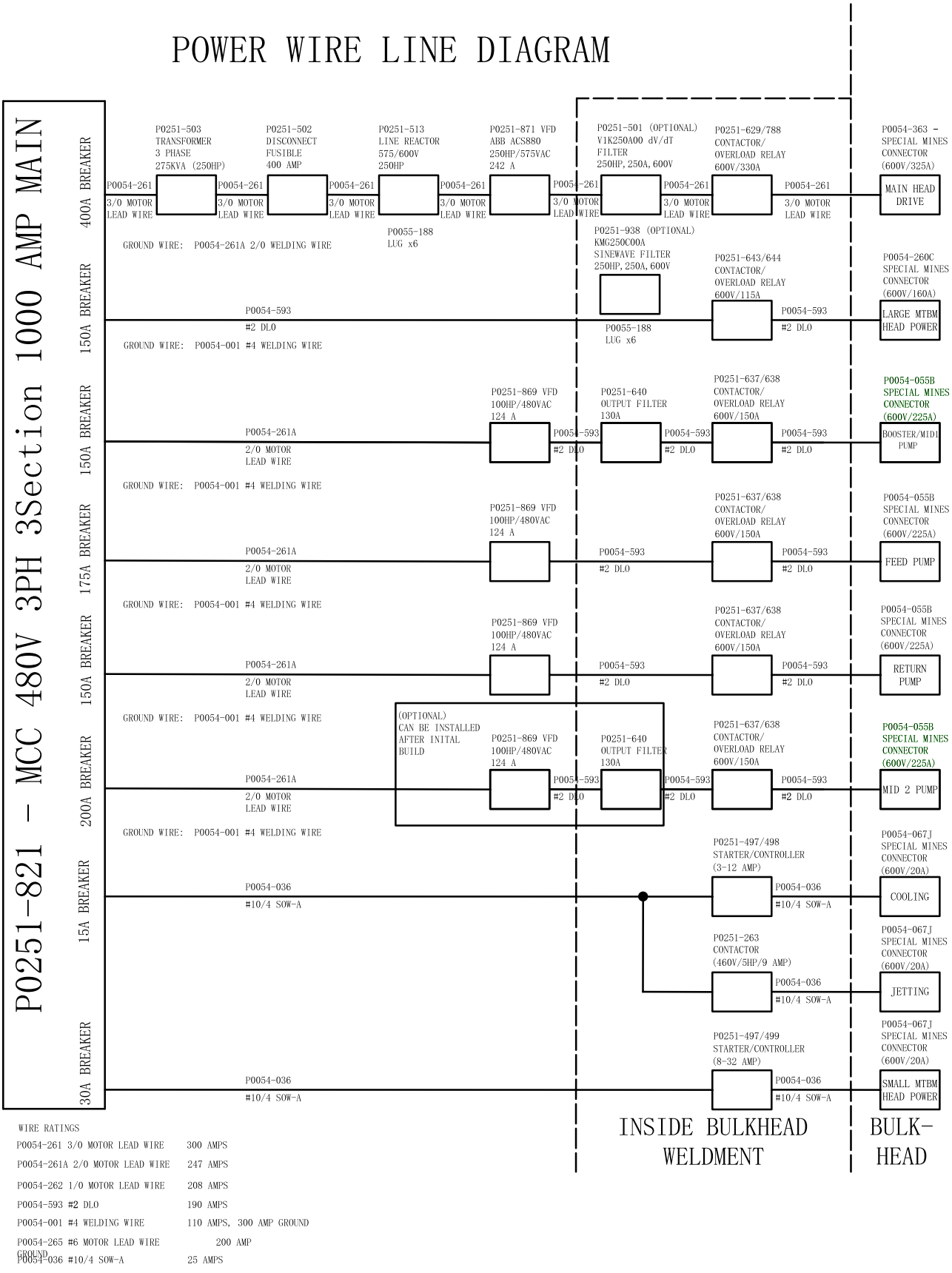


120 VAC POWER WIRE DIAGRAM - SN FA22240F



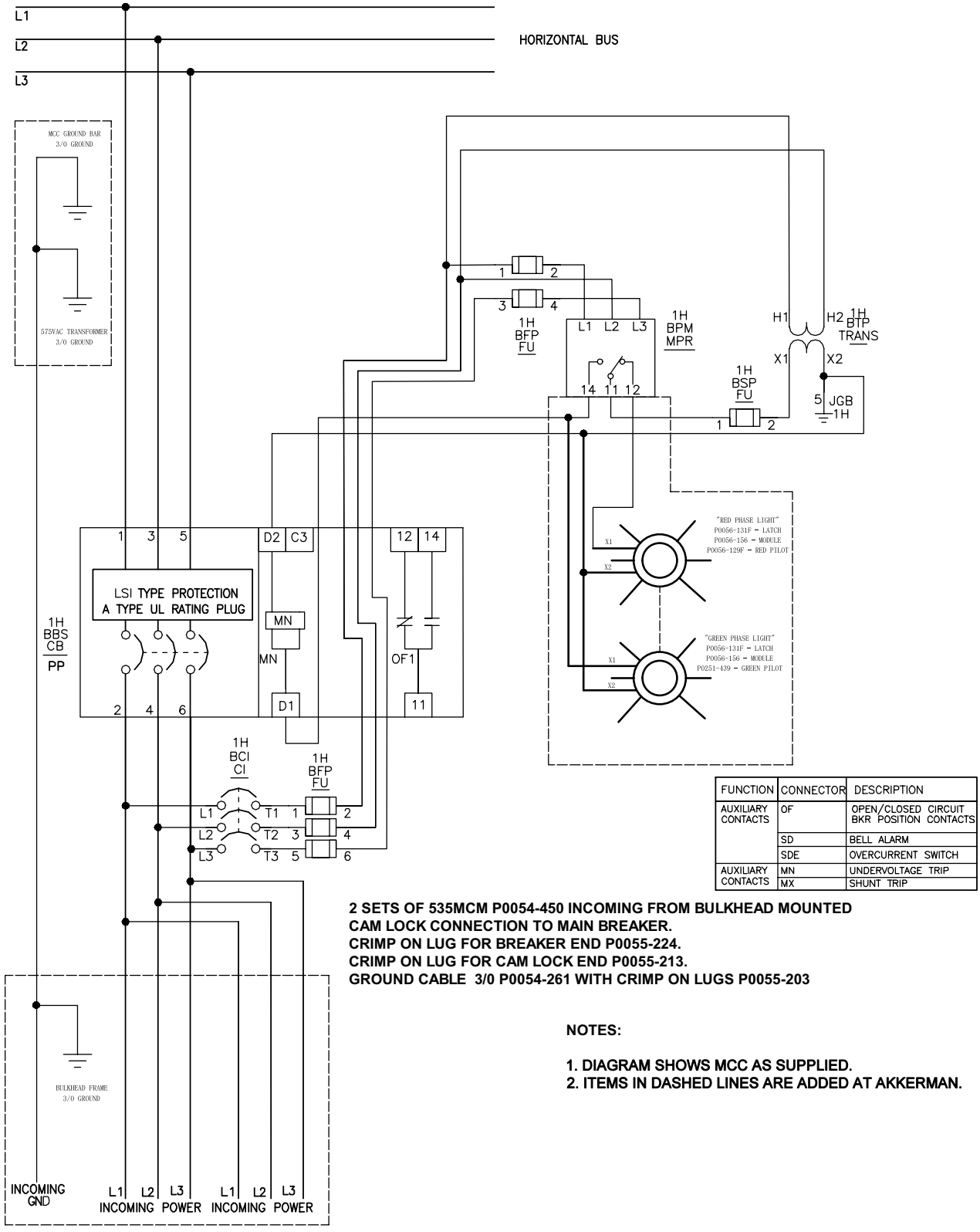
TWO 2-POLE 20A BREAKERS
INCLUDED WITH PANEL BOARD
NOT USED. LEAVE IN FOR
FUTURE USE.

POWER WIRE LINE DIAGRAM - SN FA22240F



GROUND, PHASE MONITOR & PILOT INDICATOR DIAGRAM - SN FA22240F

GROUND, PHASE MONITOR AND PILOT INDICATORS DIAGRAM



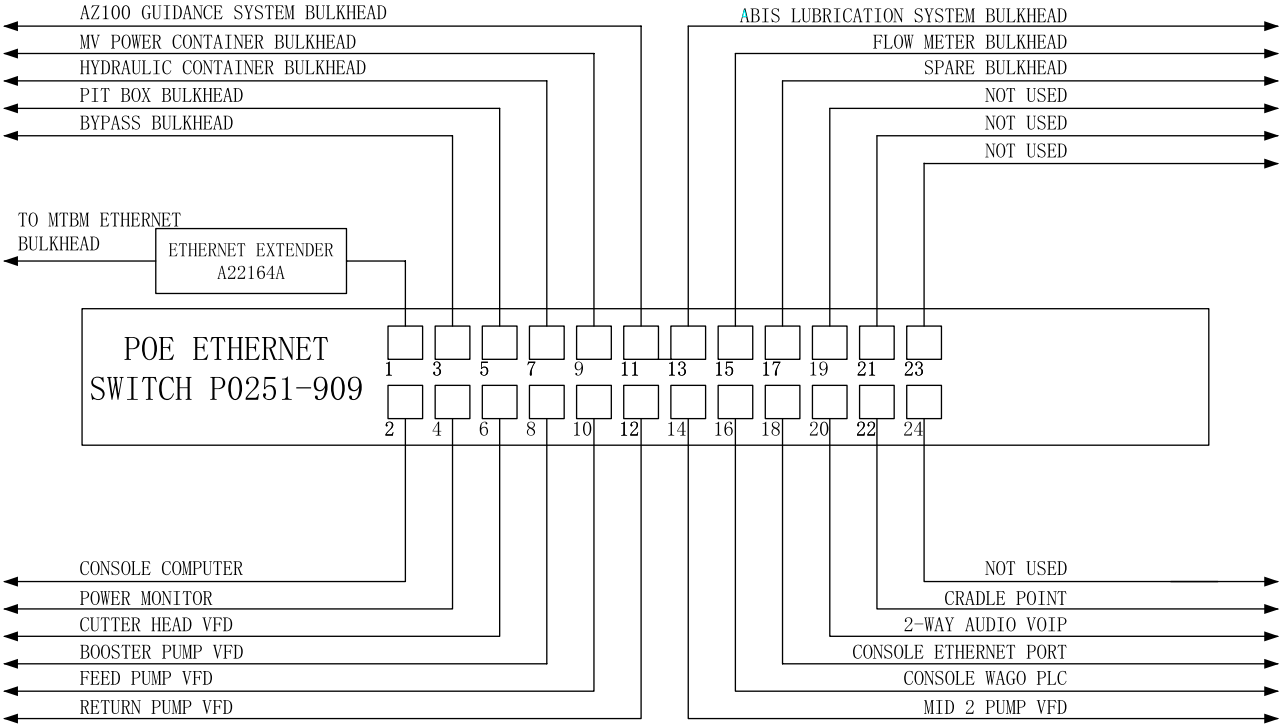
FUNCTION	CONNECTOR	DESCRIPTION
AUXILIARY CONTACTS	OF	OPEN/CLOSED CIRCUIT BKR POSITION CONTACTS
	SD	BELL ALARM
	SDE	OVERCURRENT SWITCH
AUXILIARY CONTACTS	MN	UNDERVOLTAGE TRIP
	MX	SHUNT TRIP

2 SETS OF 535MCM P0054-450 INCOMING FROM BULKHEAD MOUNTED CAM LOCK CONNECTION TO MAIN BREAKER.
CRIMP ON LUG FOR BREAKER END P0055-224.
CRIMP ON LUG FOR CAM LOCK END P0055-213.
GROUND CABLE 3/0 P0054-261 WITH CRIMP ON LUGS P0055-203

NOTES:

1. DIAGRAM SHOWS MCC AS SUPPLIED.
2. ITEMS IN DASHED LINES ARE ADDED AT AKKERMAN.

ETHERNET NETWORK WIRING - SN FA22240F



MTBM ETHERNET DEVICE IP ADDRESSES - SN FA22240F

Device	Static IP Address
Cradle Point Gateway	192.168.10.1
ABIS PLC	192.168.10.11
ABIS HMI	192.168.10.12
VOIP Container to Pit	192.168.10.15
VOIP Pit to Container	192.168.10.16
VOIP Container to MTBM Head	192.168.10.17
VOIP MTBM Head to Container	192.168.10.18
Console Computer	192.168.10.21
AZ100 Stations	192.168.10.30-53
Front PD	192.168.10.54
Front PD Module767 Speedway	192.168.10.56
Trail PD	192.168.10.57
Front MTBM	192.168.10.50
Middle MTBM	192.168.10.55
Trail MTBM	192.168.10.60
Hydraulic Container	192.168.10.90
LubeCan	192.168.10.54
Pit Box	192.168.10.70
Jack Can PD	192.168.10.59
Mid Voltage Container PD	192.168.10.58
Booster VFD	192.168.10.85
Feed VFD	192.168.10.84
Return VFD	192.168.10.86
Cutter VFD	192.168.10.94
Hydraulic VFD	192.168.10.87
Charge VFD	192.168.10.88
Mid 2 Pump	192.168.10.89
MCC208 (seriplex only)	192.168.10.40
MCC480 (seriplex only)	192.168.10.42
MCC575 (seriplex only)	192.168.10.44
MCC Seriplex (seriplex only)	192.168.10.81
MCC Power Monitor	192.168.10.82
MTBM Camera	192.168.10.71
Seriplex Panasonic Camera	192.168.10.74
Control Container Console Wago	192.168.10.120
Slurry Flow Meters	192.168.10.140
Managed Switch	192.168.10.200
Brick IO (Future)	192.168.10.210-220

WIRE NUMBER & CIRCUIT DESCRIPTIONS - SN FA22240F

WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
0v	Ground	various	various	Wht/Blu 16 AWG
24v	24 Volt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	various	various	White 16 AWG
120 L	120VAC Line	various	various	Black 16 AWG
139	Cutter Head Switch	8 Pin Rec Pin 8	Wago #10 DI4	White 20 AWG
139A	Cutter Head Switch	SW22 NO#2 Pin #4	8 Pin Plug A Pin 8	White 20 AWG
141	Cutter Head RPM Analog 4-20mA	Cutter Head VFD#1 A01	Wago #4 AI1	Sheilded CBL#1 Black 1
142	Cutter Head Common	Cutter Head VFD#1 AGND	Wago #4 0V	Sheilded CBL#1 White 1
143	Large Contactor In	M1 NO	8 Pin Rec Pin 5	Blue 20 AWG
143A	Booster Contactor In - Large MTBM	8 Pin Plug Pin 5/ Pin 6	Wago #11 DI4	Blue 20 AWG
143B	Cutter Contactor In - Small MTBM	8 Pin Plug Pin 5	Wago #11 DI4	Blue 20 AWG
145	Cutter/Booster Contactor	MC1 A1	8 Pin Rec Pin 2	Blu/Blk 16 AWG
145A	Booster Pump Switch +120VAC	8 Pin Plug Pin 2	8 Pin Plug A Pin 2	Blu/Blk 16 AWG
145B	Cutterhead Switch	SW22 NO#1 Pin #4	8 Pin Plug B Pin 2	Blu/Blk 16 AWG
146	Cutter Head Common	Cutter Head VFD#1 AGND	Wago #4 0V	Sheilded CBL#1 White 2
147	Cutter Head Torque Analog 4-20mA	Cutter Head VFD#1 A02	Wago #4 AI2	Sheilded CBL#1 Black 2
149	Cutter Left	Cutter Left PB13	Wago #10 DI1	Blue 20 AWG
151	Cutter Stop	Cutter Stop PB14	Wago #13 DI2	Blue 20 AWG
153	Cutter Right	Cutter Right PB15	Wago #10 DI3	Blue 20 AWG
155	Cutter Left Button Light	Light X1	Wago #15 DO1	Blue 20 AWG
157	125/250HP VFD Run Forward	VFD#1 DI1	8 Pin Rec Pin 6	Blue 20 AWG
157B	Cutter Left Command	8 Pin Plug Pin 6	Wago #15 DO1	Blue 20 AWG
159	Cutter Stop Button Light	Light X1	Wago #15 DO2	Blue 20 AWG
161	Cutter Right Button Light	Light X1	Wago #16 DO1	Blue 20 AWG
163	125/250HP VFD Run Reverse	VFD#1 DI2	8 Pin Rec Pin 7	Blue 20 AWG
163B	Cutter Right Command	8 Pin Plug Pin 7	Wago #16 DO1	Blue 20 AWG
167	Cutter/Booster Speed Command	VFD#1 AI1+	12 Pin Rec Pin 5	Sheilded CBL#1 Black 3
167A	Booster Pump Speed Command	POT3	12 Pin Plug A Pin 5	Black 20 AWG
167B	Cutterhead Pot Signal	POT4	12 Pin Plug B Pin 5	Black 20 AWG
168	Cutter/Booster POT +	VFD#1 10+	12 Pin Rec Pin 6&7	Sheilded CBL#1 Black 4
168A	Booster Pump Pot +	POT3	12 Pin Plug A Pin 6	Black 20 AWG
168B	Cutterhead Pot +	POT4	12 Pin Plug B Pin 6	Black 20 AWG
169	Cutter/Booster POT Common	VFD#1 AGND	12 Pin Rec Pin 4	Sheilded CBL#1 White 4
169A	Booster Pump Pot COM	POT3	12 Pin Plug A Pin 4	White 20 AWG
169B	Cutterhead Pot COM	POT4	12 Pin Plug B Pin 4	White 20 AWG
187	Cutterhead Pot Signal	12 Pin Rec Pin 8	Wago #19 AI1	White 20 AWG
187A	Cutterhead Pot Signal	POT4	12 Pin Plug A Pin 8	White 20 AWG
188A	Cutterhead Pot +	POT4	12 Pin Plug A Pin 7	Black 20 AWG
189	Cutterhead Pot COM	12 Pin Rec Pin 9	Wago #19 Common	White 20 AWG
189A	Cutterhead Pot COM	POT4	12 Pin Plug A Pin 9	White 20 AWG
190	Cutter/Booster Pilot Relay Ground	BHC#1 Pilot	4 Pin Rec Pin 3	Blu/Wht 16 AWG
190A	Booster Pilot LED Ground	12 Pin Plug A Pin 10	LED#1 Silver-	White 20 AWG
190B	Cutter Pilot LED Ground	4 Pin Plug B Pin 3	LED#1 Silver-	White 20 AWG
193A	Cutter Pilot LED Supply	12 Pin Plug A Pin 11	LED#1 Gold+	Black 20 AWG
194B	Cutter Pilot LED Supply	12 Pin Plug B Pin 12	LED#1 Gold+	Black 20 AWG
195	Cutter Pilot Contactor Ground	PCR#1	MC1 OL1 95	White 16 AWG
196	Cutter Pilot LED Wago Supply	12 Pin Rec Pin 11	Wago #16 D02	Blue 20 AWG
197	Cutter Pilot LED Wago 0v	12 Pin Rec Pin 10	Wago #16 0v	White 20 AWG
211	Cutting Valve Open	Extend PB7	Wago #8 DI1	Blue 20 AWG
213	Chamber Valve Open	Retract PB8	Wago #8 DI2	Blue 20 AWG
215	Stop Valve Open	Extend PB9	Wago #9 DI1	Blue 20 AWG
217	Stop Valve Close	Retract PB10	Wago #9 DI2	Blue 20 AWG
219	Bypass Valve Open	Extend PB11	Wago #11 DI3	Blue 20 AWG
221	Bypass Valve Close	Retract PB12	Wago #12 DI4	Blue 20 AWG
231	Feed Pump RPM Analog 4-20mA	Feed Pump VFD A01	Wago #2 AI1	Sheilded CBL#2 Black 1
232	Feed Pump Common	Feed Pump VFD AGND	Wago #2 0V	Sheilded CBL#2 White 1
233	Feed Pump Contactor In	VFD#3 DI1	Wago #11 DI1	Sheilded CBL#2 White 2
233A	Feed Pump Contactor In	M3 NO	VFD#3 DI1	Blue 20 AWG
235	Feed Pump Switch +120VAC	SW#18 NO Pin#4	MC3 A1	Blu/Blk 16 AWG
237	Feed Pump Speed Command	POT1	VFD#3 AI1+	Sheilded CBL#2 Black 2
238	Feed Pump Pot +	POT1	VFD#3 +VREF	Sheilded CBL#2 Black 3
239	Feed Pump Pot COM	POT1	VFD#3 AGND	Sheilded CBL#2 White 3
241	Return Pump RPM Analog 4-20mA	Return Pump VFD A01	Wago #2 AI2	Sheilded CBL#3 Black 2
242	Return Pump Common	Return Pump VFD AGND	Wago #2 0V	Sheilded CBL#3 White 2
243	Return Pump Contactor In	VFD#4 DI1	Wago #11 DI2	Sheilded CBL#3 White 4
243A	Return Pump Contactor In	M4 NO	VFD#4 DI1	Blue 20 AWG
245	Return Pump Switch +120VAC	SWx #4	MC4 A1	Blu/Blk 16 AWG
247	Return Pump Speed Command	POT2	VFD#4 AI1+	Sheilded CBL#3 Black 4
248	Return Pump Pot +	POT2	VFD#4 +VREF	Sheilded CBL#3 Black 3
249	Return Pump Pot COM	POT2	VFD#4 AGND	Sheilded CBL#3 White 3
251	Booster Pump RPM Analog 4-20mA	Booster Pump VFD A01	Wago #3 AI1	Sheilded CBL#4 Black 1
252	Booster Pump Common	Booster Pump VFD AGND	Wago #3 0V	Sheilded CBL#4 White 1
253	Booster Pump Contactor In	VFD#2 DI1	Wago #11 DI3	Sheilded CBL#4 White 3
253A	Booster Pump Contactor In	M2 NO	VFD#2 DI1	Blue 20 AWG
255	Booster/Mid 1 Pump Contactor	8 Pin Rec Pin 1	MC2 A1	Blu/Blk 16 AWG
255A	Mid 1 Pump Switch +120VAC	SW20 #4	8 Pin Plug A Pin 1	Blu/Blk 16 AWG
255B	Booster Pump Switch +120VAC	SW23 #4	8 Pin Plug B Pin 1	Blu/Blk 16 AWG
256	Booster Pump Common	Booster Pump VFD AGND	Wago #3 0V	Sheilded CBL#4 White 2
257	Booster Pump Torque Analog 4-20mA	Booster Pump VFD A02	Wago #3 AI2	Sheilded CBL#4 Black 2
258	Booster/Mid 1 Pilot Relay Ground	BHC#2 Pilot	4 Pin Rec Pin 4	Blu/Wht 16 AWG
258A	Mid 1 Pump Pilot LED Ground	4 Pin Plug A Pin 3	Mid 1 Pilot Relay	Blu/Wht 16 AWG
258B	Booster Pilot LED Ground	4 Pin Plug B Pin 4	Booster Pilot Relay	Blu/Wht 16 AWG
259	Booster Pilot Contactor Ground	PCR#2	MC2 OL2 95	White 16 AWG
260	Mid 1 Pilot LED Ground	LED#3 Silver -	4 Pin Plug A Pin 4	White 20 AWG
267	Mid 1/Booster Pump Speed Command	VFD#2 AI1+	12 Pin Rec Pin 2	Sheilded CBL#4 Blk 3
267A	Mid 1 Pump Pot Speed Command	POT5	12 Pin Plug A Pin 2	Black 20 AWG
267B	Booster Pump Speed Command	POT3	12 Pin Plug B Pin 2	Black 20 AWG
268	Mid 1/Booster Pump POT +	VFD#2 10+	12 Pin Rec Pin 2	Black 20 AWG
268A	Mid 1 Pump Pot +	POT5	12 Pin Plug A Pin 3	Black 20 AWG
268B	Booster Pump Pot +	POT3	12 Pin Plug B Pin 3	Black 20 AWG
269	Mid 1/Booster Pump POT COM	VFD#2 AGND	12 Pin Rec Pin 1	Black 20 AWG
269A	Mid 1 Pump Pot COM	POT5	12 Pin Plug A Pin 1	White 20 AWG
269B	Booster Pump Pot COM	POT3	12 Pin Plug B Pin 1	White 20 AWG

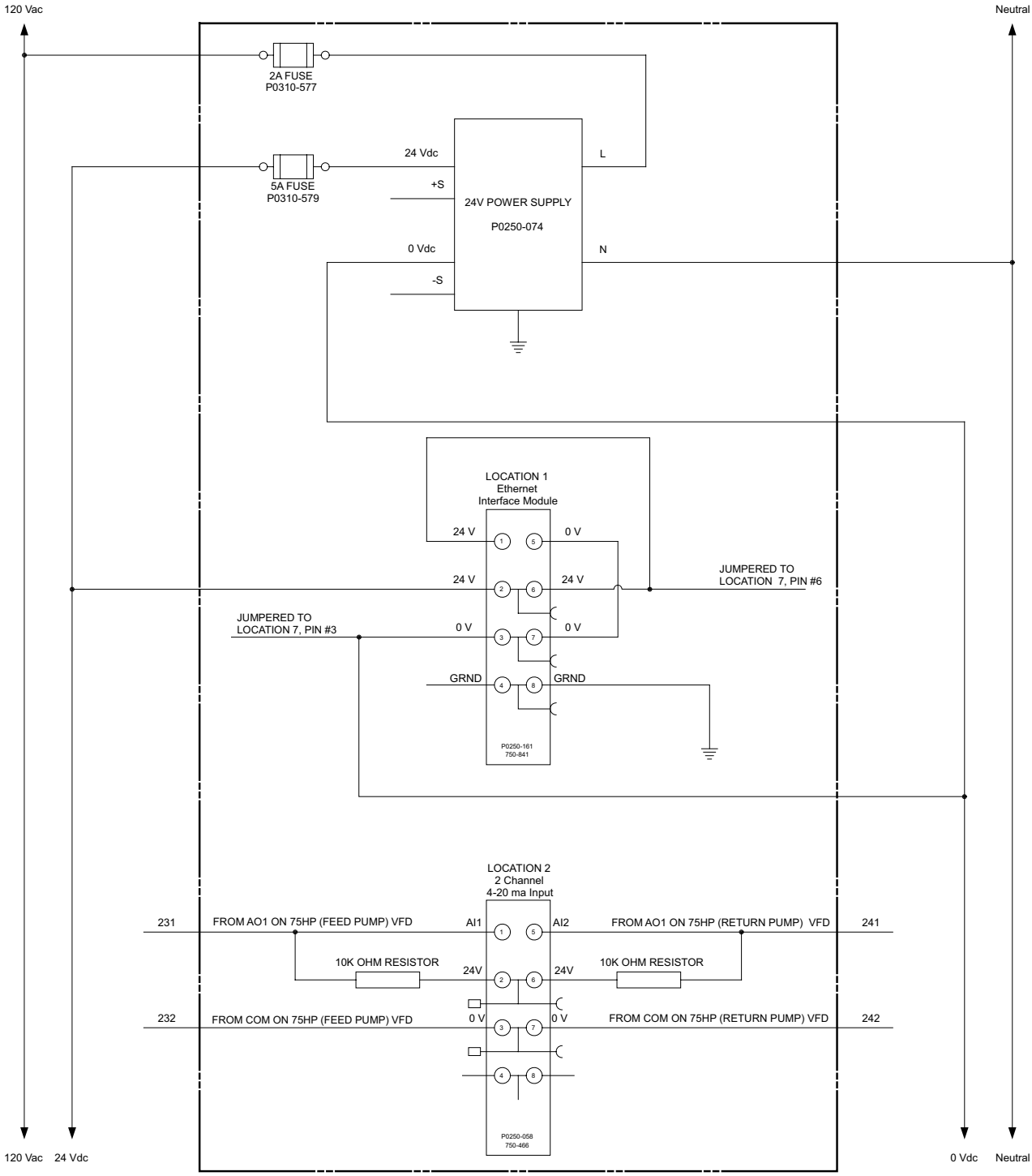
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Wire Number & Circuit Descriptions (continued)

WIRE NUMBER1	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
269B	Booster Pump Pot COM	POT3	12 Pin Plug B Pin 1	White 20 AWG
270	Mid 2 Pump Switch +120VAC	SW24 #4	MC8 A1	Blu/Blk 16 AWG
271	Mid 2 Pump Speed Command	POT6	VFD#5 AI1+	Black 20 AWG
272	Mid 2 Pump Common	Booster Pump VFD AGND	Wago #3 0V	Sheilded CBL#4 White 2
273	Mid 2 Pump POT +	VFD#5 10+	VFD#5 +VREF	Sheilded CBL#4 Black 3
274	Mid 2 Pilot Relay Ground	BHC#2 Pilot	4 Pin Rec Pin 4	Blu/Wht 16 AWG
275	Mid 2 Contactor Ground	PCR#4	MC8 OL6 95	White 16 AWG
276	Booster/Mid 1 Pilot Relay Ground	BHC#2 Pilot	4 Pin Rec Pin 4	Blu/Wht 16 AWG
277	Mid 2 Pilot Relay Ground	BHC#8 Pilot	PCR#2 A2, LED#4 Silver -	White 20 AWG
278	Booster Pump Contactor In	M8 NO	VFD#5 DI1	Blue 20 AWG
301	Steering Top Cylinder Extend	Extend PB1	Wago #7 DI1	Blue 20 AWG
303	Steering Top Cylinder Retract	Retract PB2	Wago #7 DI2	Blue 20 AWG
305	Steering Left Cylinder Extend	Extend PB3	Wago #7 DI3	Blue 20 AWG
307	Steering Left Cylinder Retract	Retract PB4	Wago #7 DI4	Blue 20 AWG
309	Steering Right Cylinder Extend	Extend PB5	Wago #8 DI1	Blue 20 AWG
311	Steering Right Cylinder Retract	Retract PB6	Wago #8 DI2	Blue 20 AWG
401	Jacking Selector Switch	Jacking Switch #3	Wago #13 DI1	Blue 20 AWG
403	Jacking Selector Switch	Jacking Switch #7	Wago #12 DI1	Blue 20 AWG
405	Jacking Selector Switch	Jacking Switch #5	Wago #12 DI2	Blue 20 AWG
407	Jacking Selector Switch	Jacking Switch #1	Wago #12 DI3	Blue 20 AWG
409	Jacking Selector Switch	Jacking Switch #5	Wago #12 DI4	Blue 20 AWG
410	Hydraulic Encoder Phase A	Encoder Dial Pin 4	Wago #5 Pin 1	Orange
411	Hydraulic Encoder Phase B	Encoder Dial Pin 2	Wago #5 Pin 2	Yellow
412	Hydraulic Encoder 5 Volt	Encoder Dial Pin 1	Wago #6 Pin 1	Red
413	Hydraulic Encoder 0 Volt	Encoder Dial Pin 3	Wago #6 Pin 3	Green
430	High PSI Jetting Switch	SW25 #4	MC9 A1	Black 16 AWG
503	Head Power Contactor NO 13	MC6 NO 13	Wago #13 0V	Blu/Wht 16 AWG
505	Head Power Contactor NO 14	MC6 NO 14	Wago #13 DI3	Blu/Wht 16 AWG
508	Small MTBM Pilot Relay Ground	BHC#5 Pilot	4 Pin Rec Pin 1	Blu/Wht 16 AWG
509	Large MTBM Pilot Relay Ground	BHC#6 Pilot	4 Pin Rec Pin 2	Blu/Wht 16 AWG
510A	Head Power LED Ground	LED#3 Silver -	4 Pin Plug A Pin 2	White 20 AWG
511B	Head Power LED Ground	LED#3 Silver -	4 Pin Plug B Pin 1	White 20 AWG
512	Head Pilot Contactor Ground	PCR#3	MC5 A2 & MC6 OL6 95	White 16 AWG
513	Cooling Pump Contactor NO 13	MC7 NO 13	Wago #13 0V	Blu/Wht 16 AWG
515	Cooling Pump Contactor NO 14	MC7 NO 14	Wago #13 DI2	Blu/Wht 16 AWG
517	Cooling Pump Contactor A1	MC7 A1	Wago #18 DO1	Black 16 AWG
519B	Head Power Switch	SW#21 #4	8 Pin Plug B Pin 3	Black 16 AWG
521	Large MTBM Head Power Contactor	8 Pin Rec Pin 4	MC6 A1	Black 16 AWG
521A	Head Power Switch	SW#21 #4	8 Pin Plug A Pin 4	Black 16 AWG
601	Console E-Stop NC #2	E-Stop NC #2	A1 E-Stop CR#1	Blue 16 AWG
603	Console E-Stop NC #2	E-Stop NC #2	Wago #13 DI4	Blue 16 AWG
604	Wago E-Stop Trip	A1 E-Stop CR#2	Wago #18 DO2	Black 16 AWG

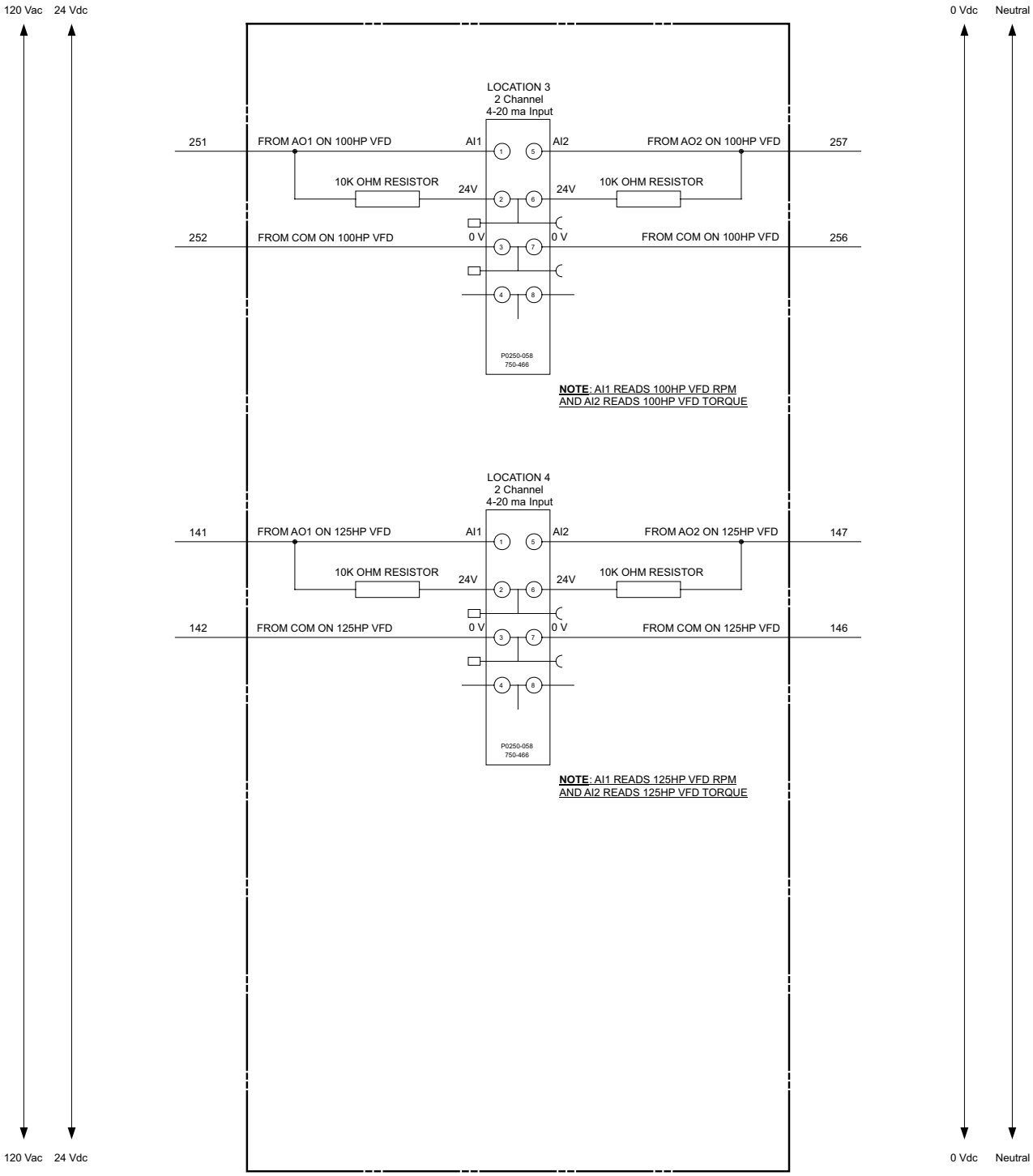
CONTROL CONSOLE ELECTRICAL SCHEMATICS - SN FA22299F, FA21900F-04/05

Electrical Schematic - Part 1 of 13



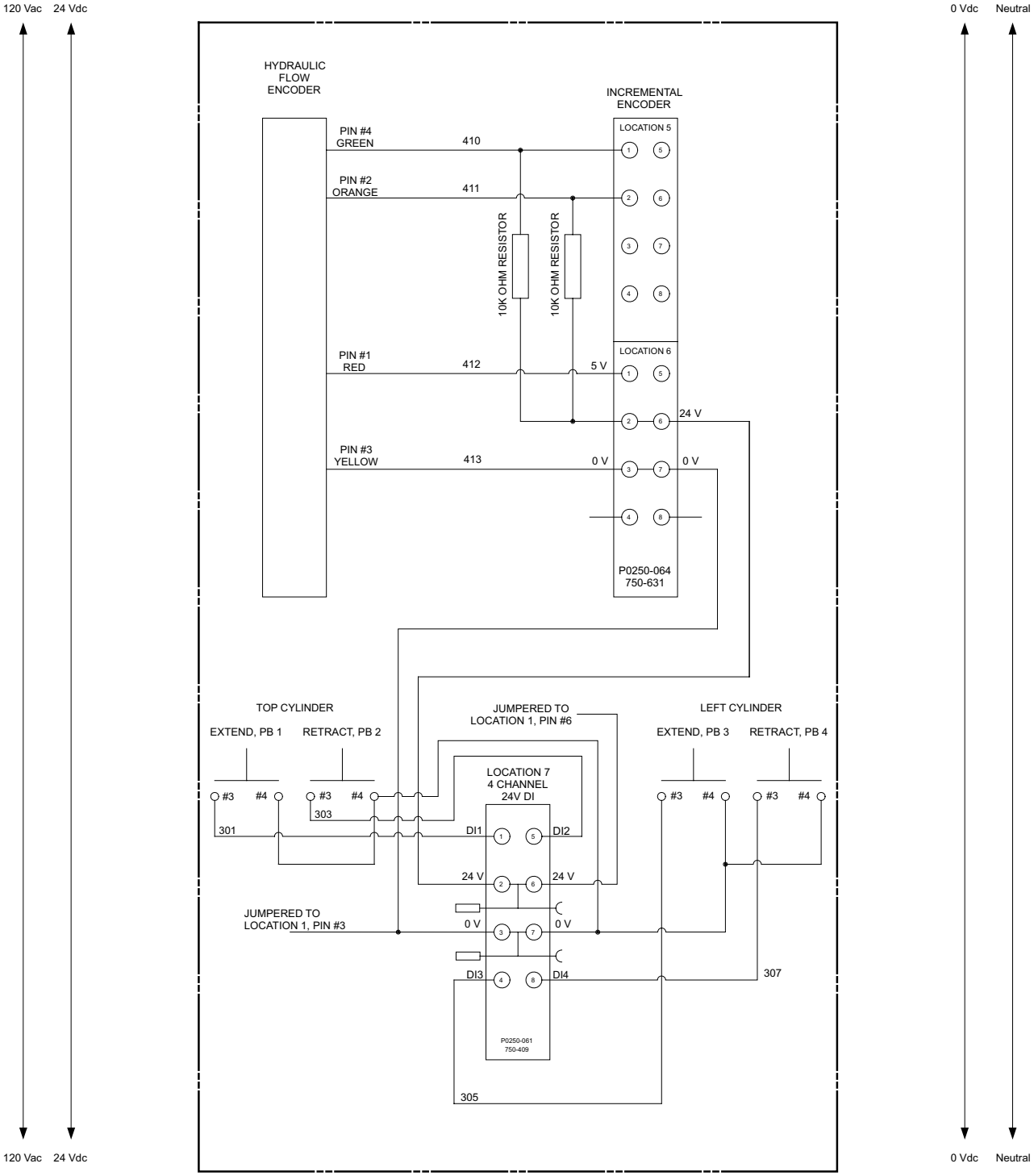
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 2 of 13



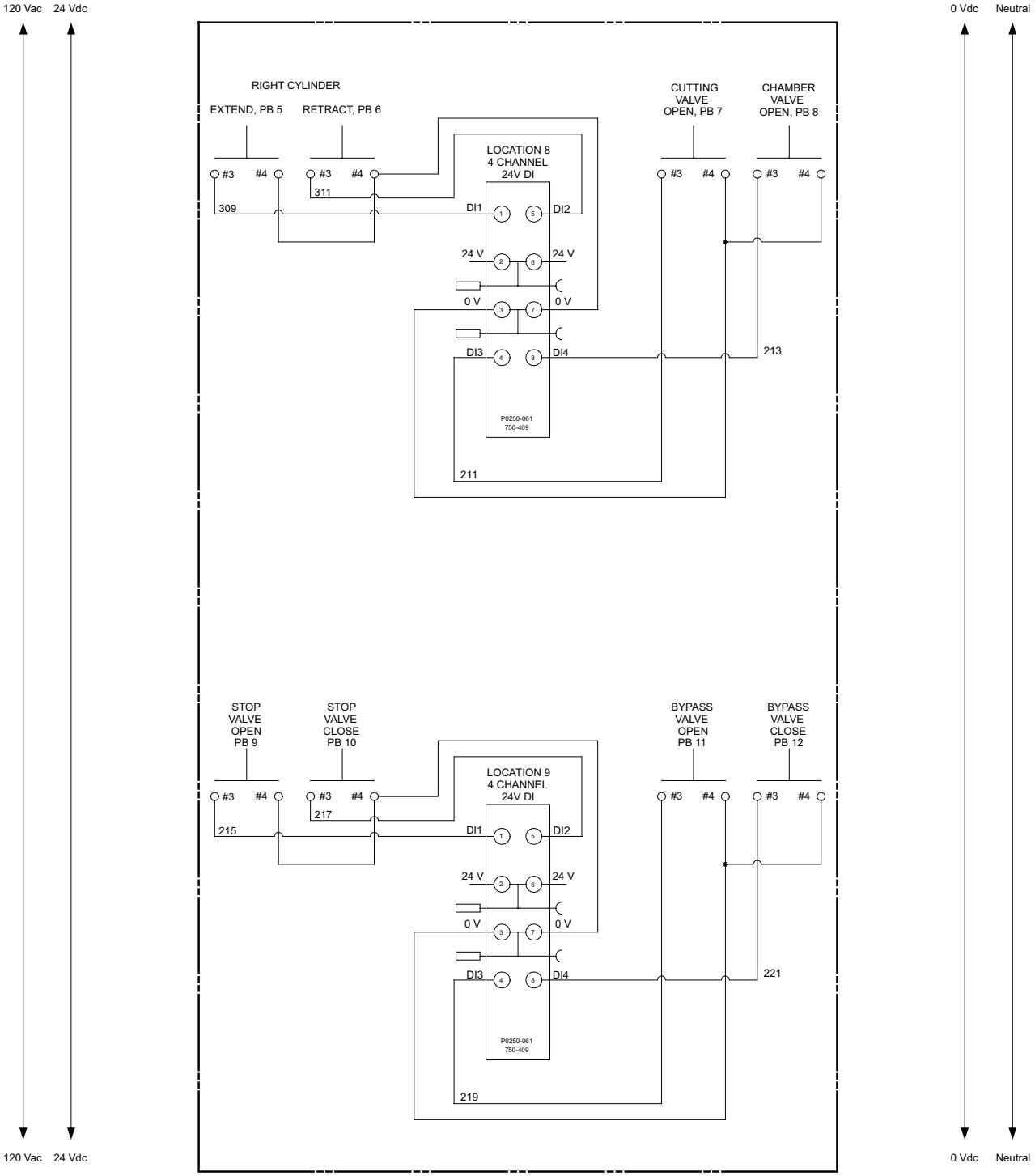
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 3 of 13



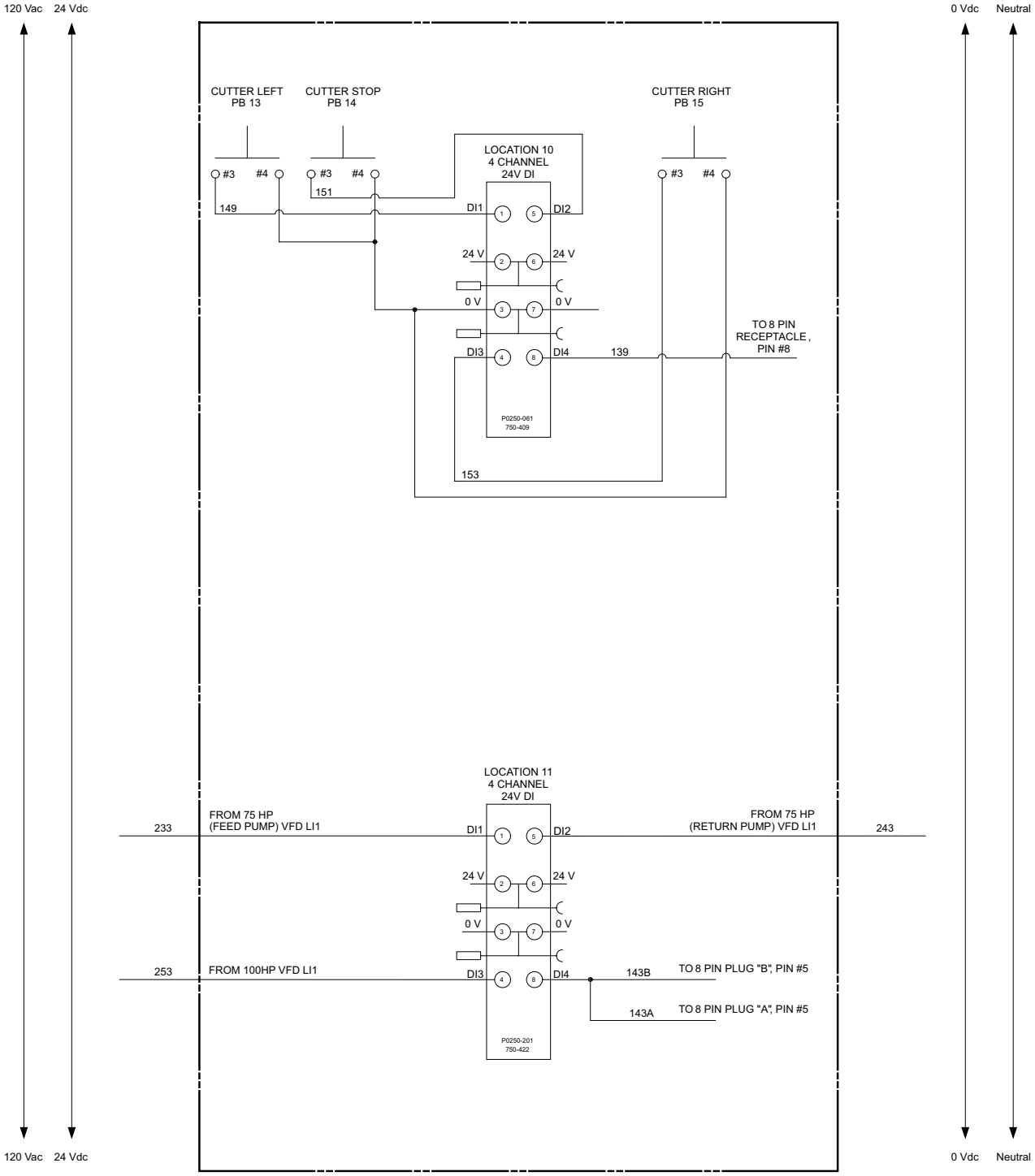
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 4 of 13



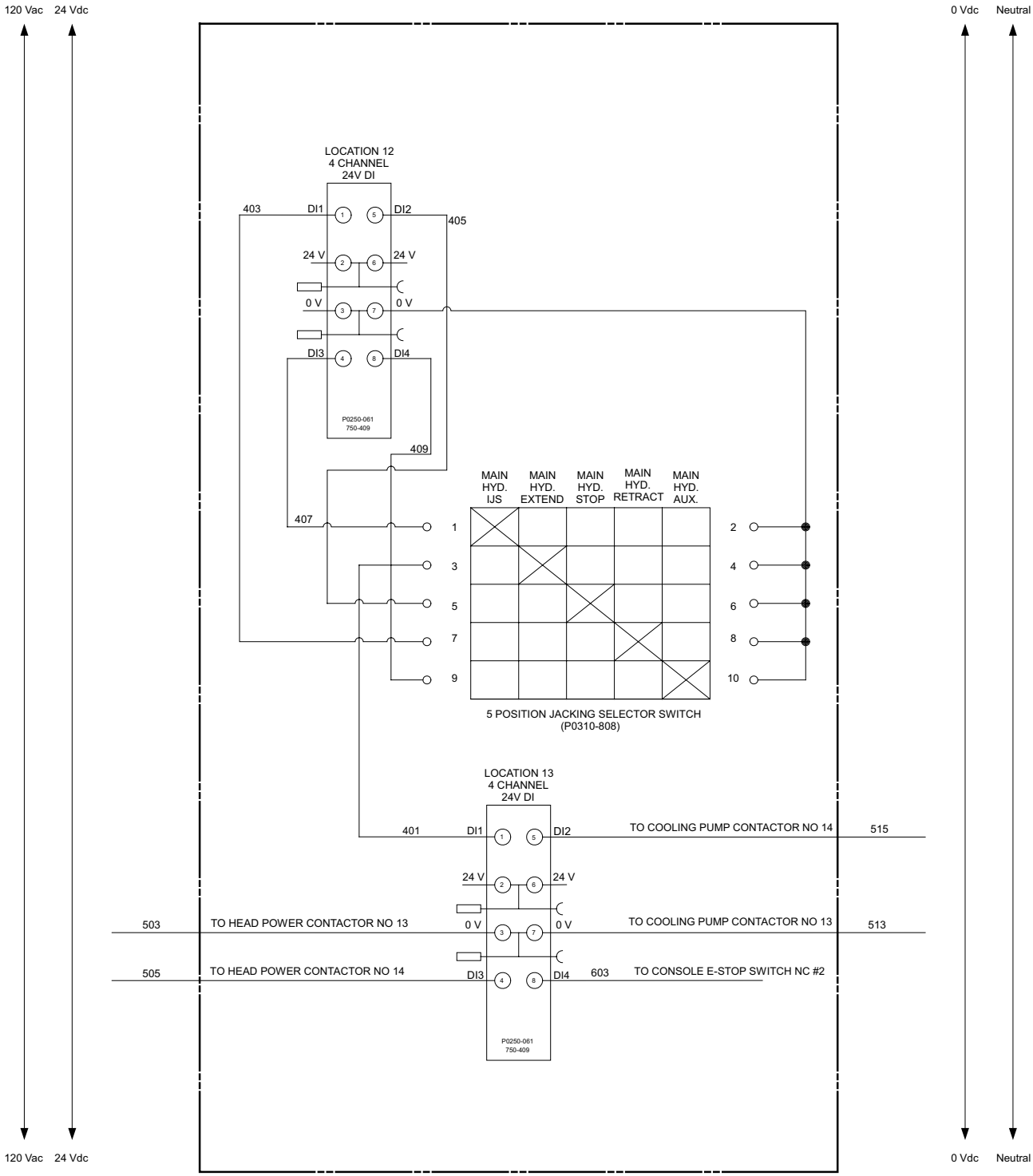
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 5 of 13



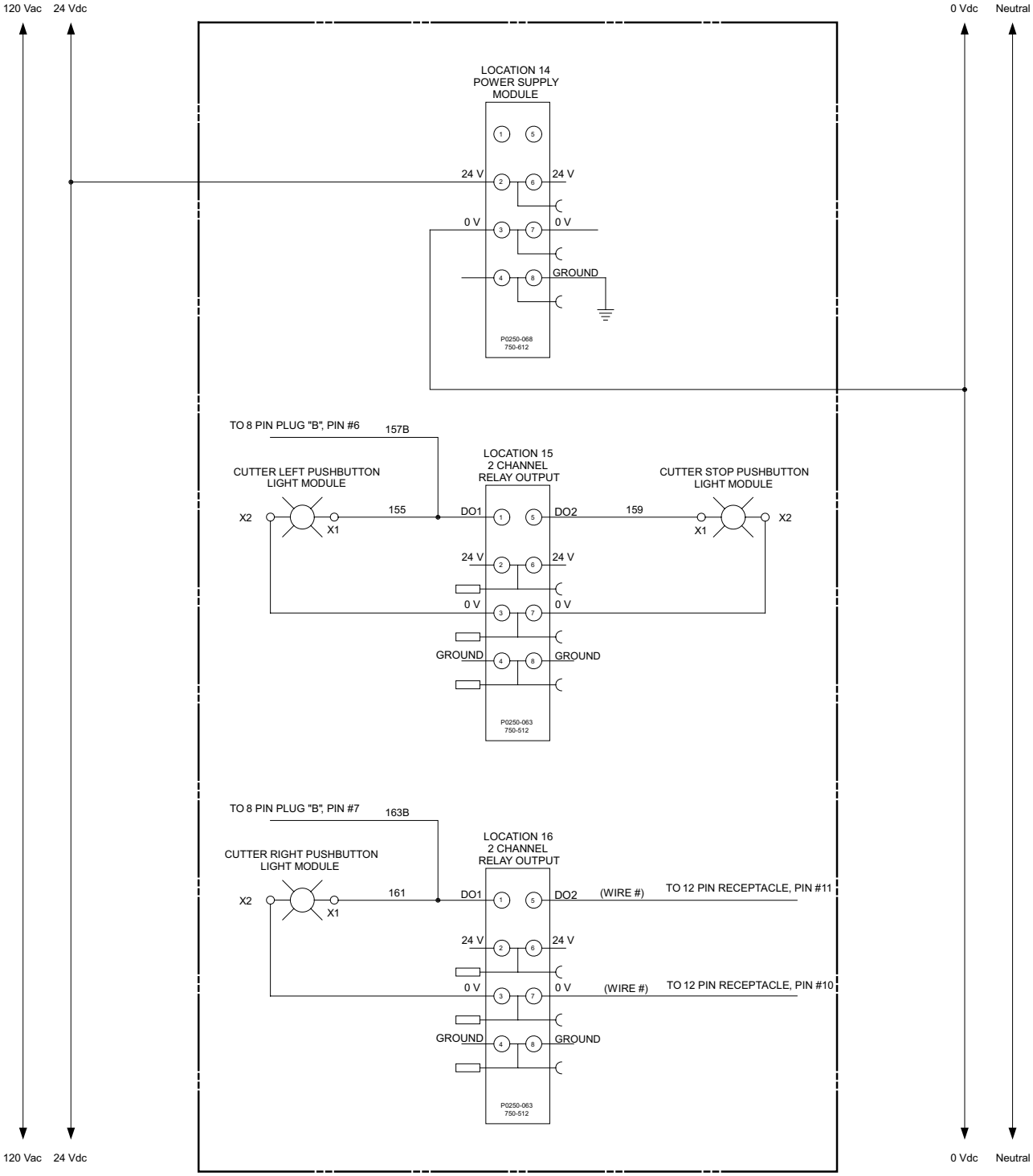
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 6 of 13



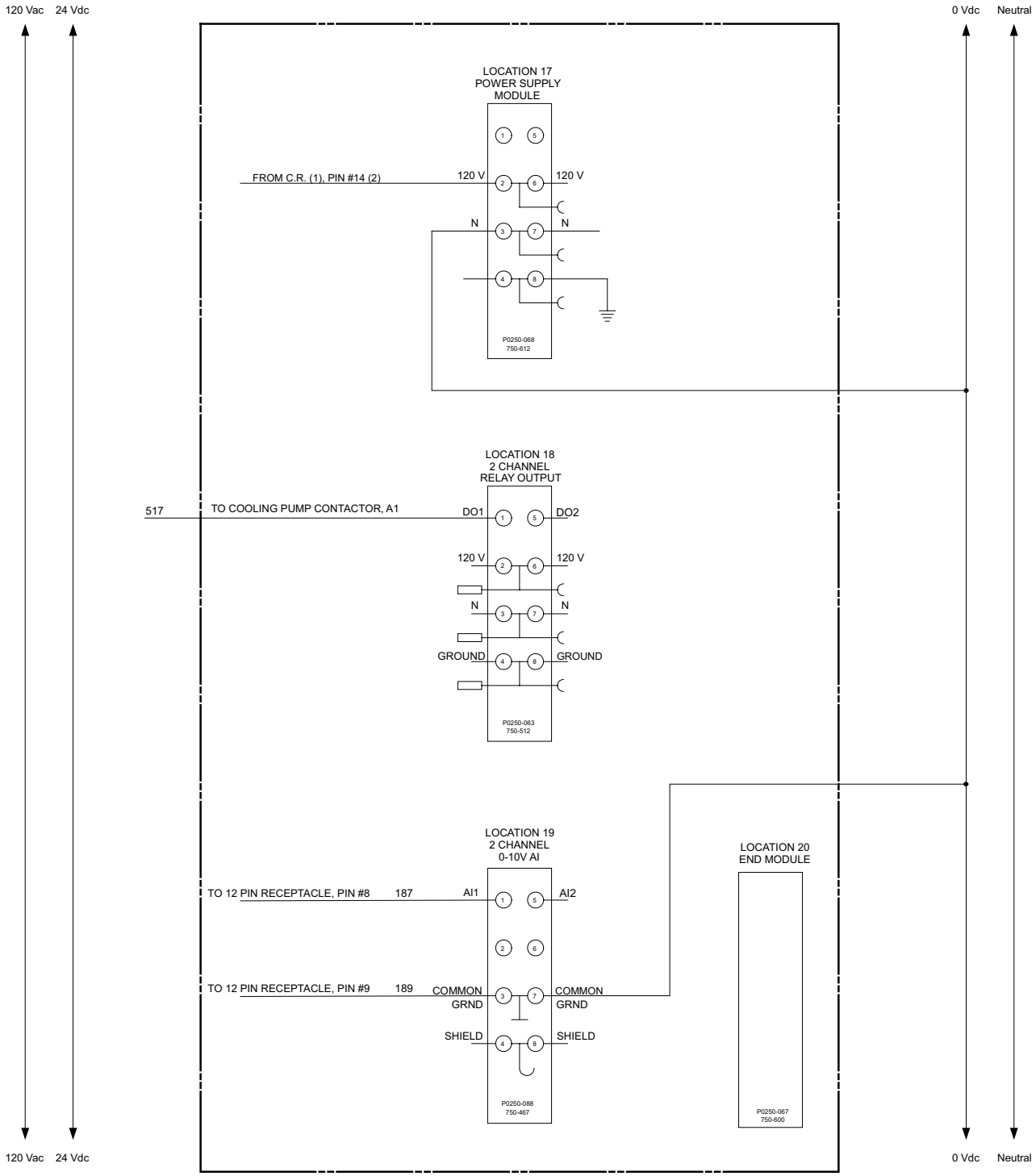
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 7 of 13



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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 8 of 13

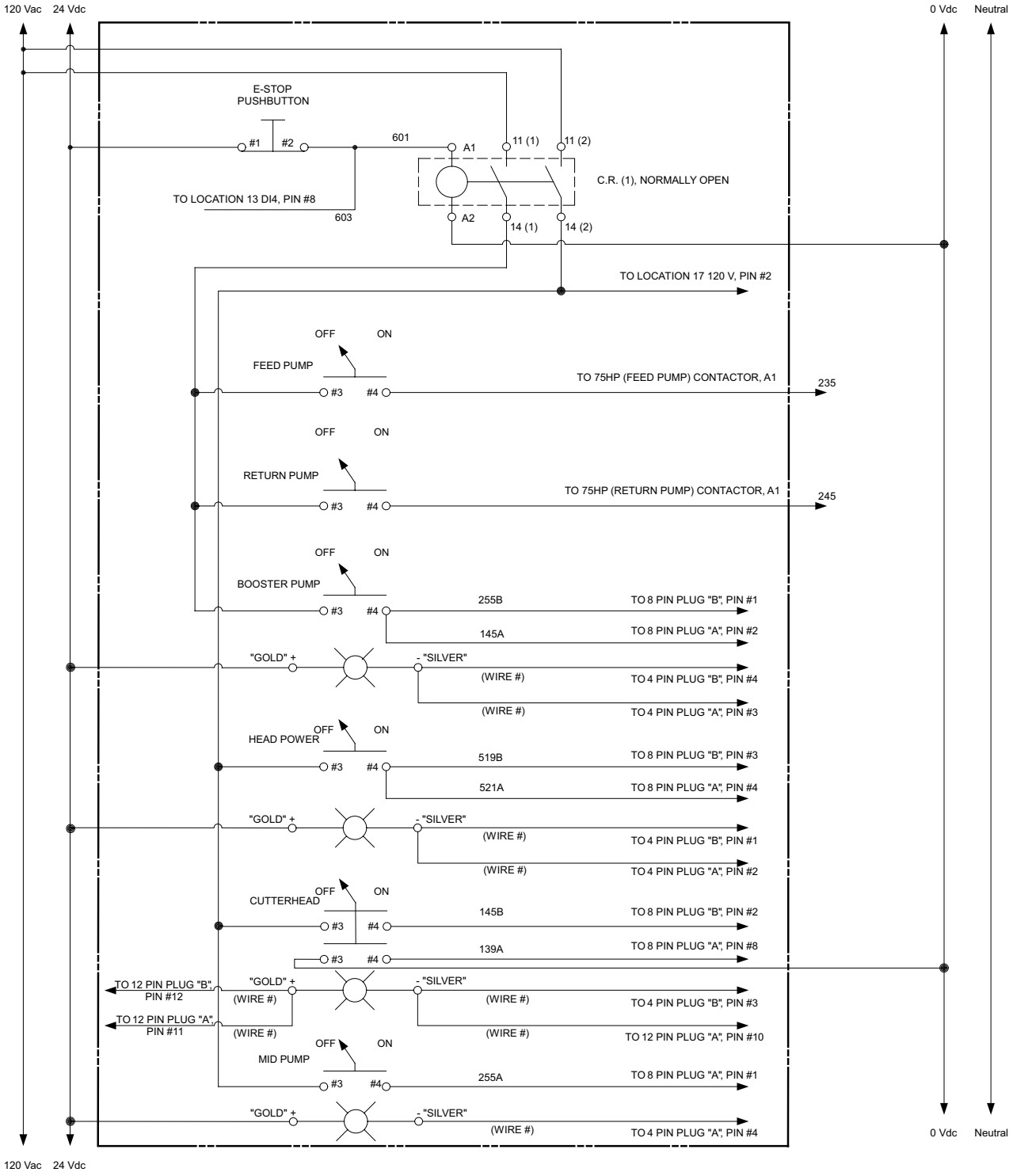


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Control Console Electrical Schematics **For SN FA22299F & FA21900F-04** *(continued)*

See next page for SN FA21900F-05

Electrical Schematic - Part 9 of 13



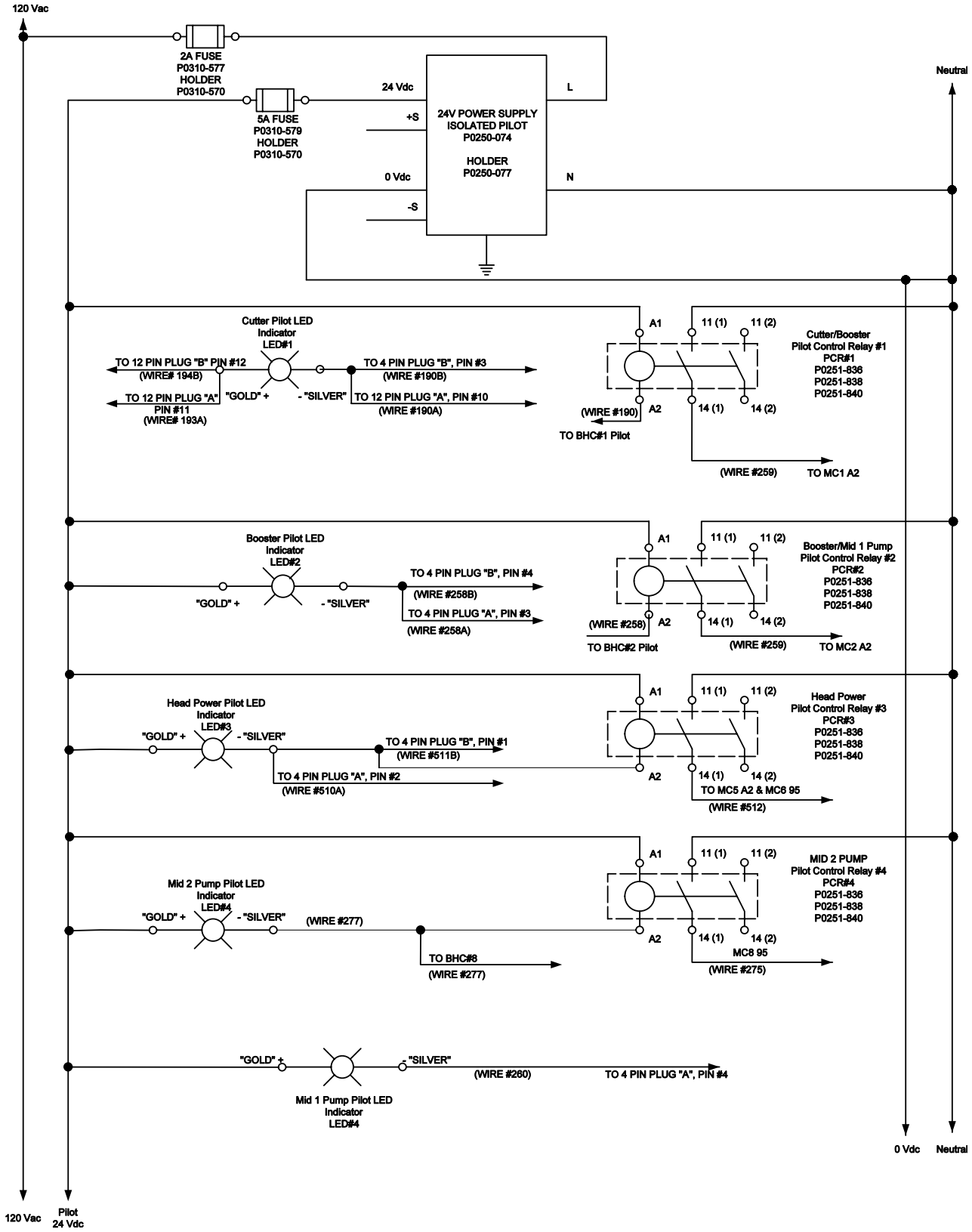
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Control Console Electrical Schematics **For SN FA21900F-05** *(continued)*

See previous page for SN* FA22299F & *FA21900F-04

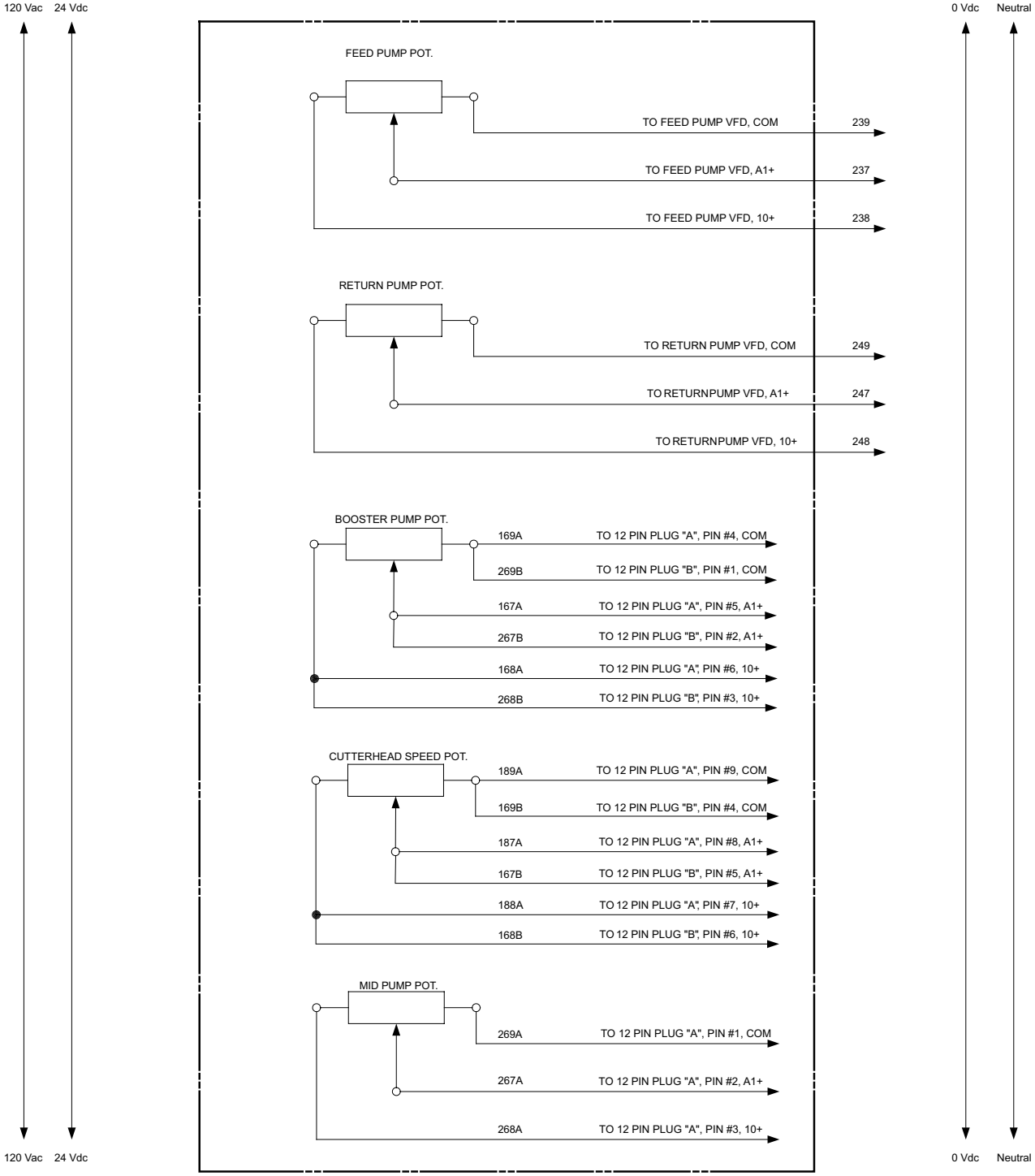
NOTICE ***SN FA21900F-05 has been updated to run a periphery drive MTBM with a pilot control circuit.***

Electrical Schematic - Part 9 of 13



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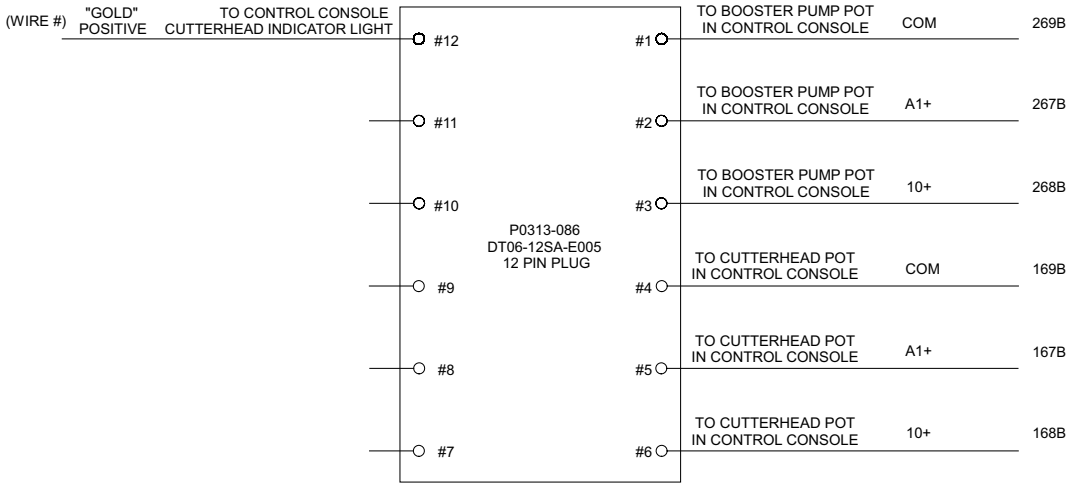
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 10 of 13



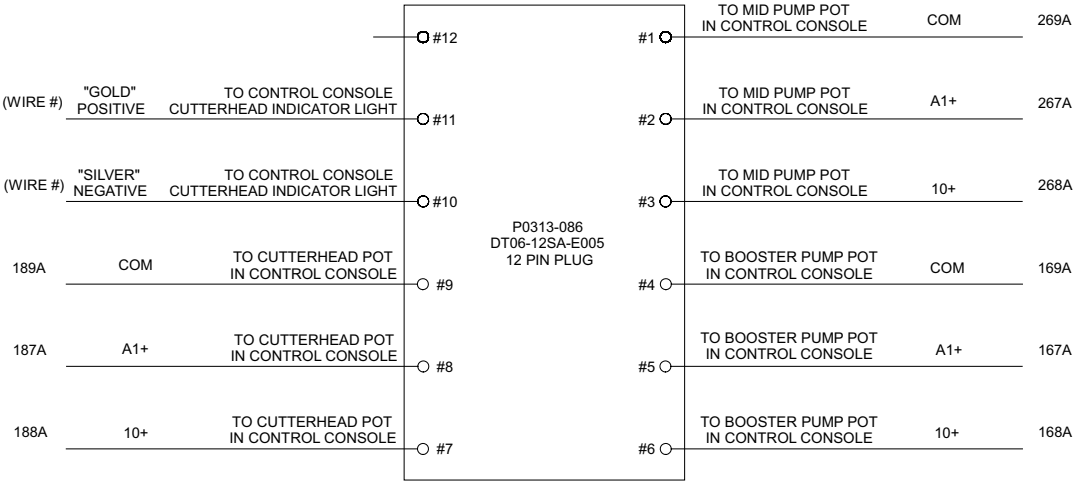
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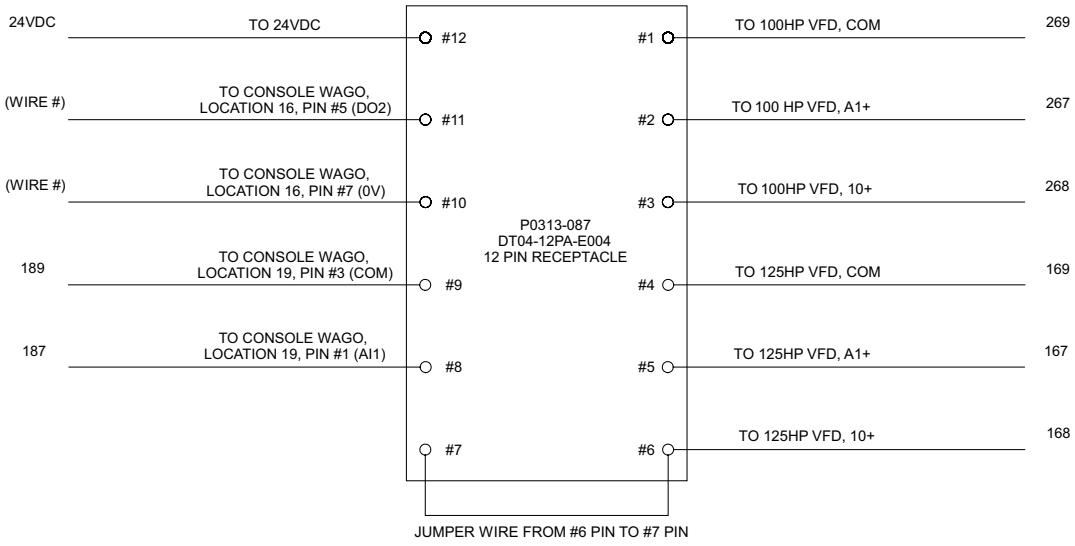
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 11 of 13

"B" PLUG FOR SMALL MTBM



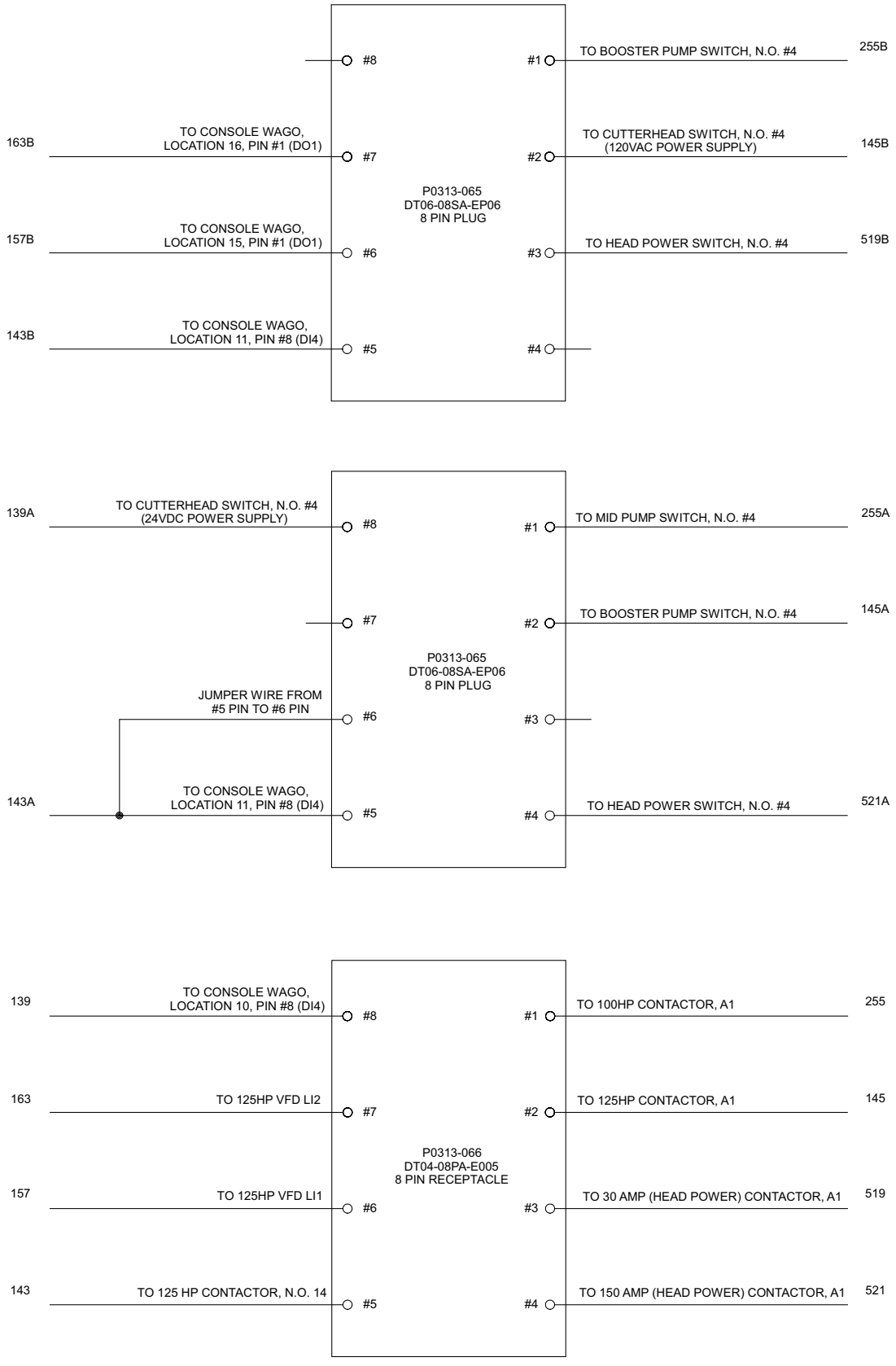
"A" PLUG FOR LARGE MTBM





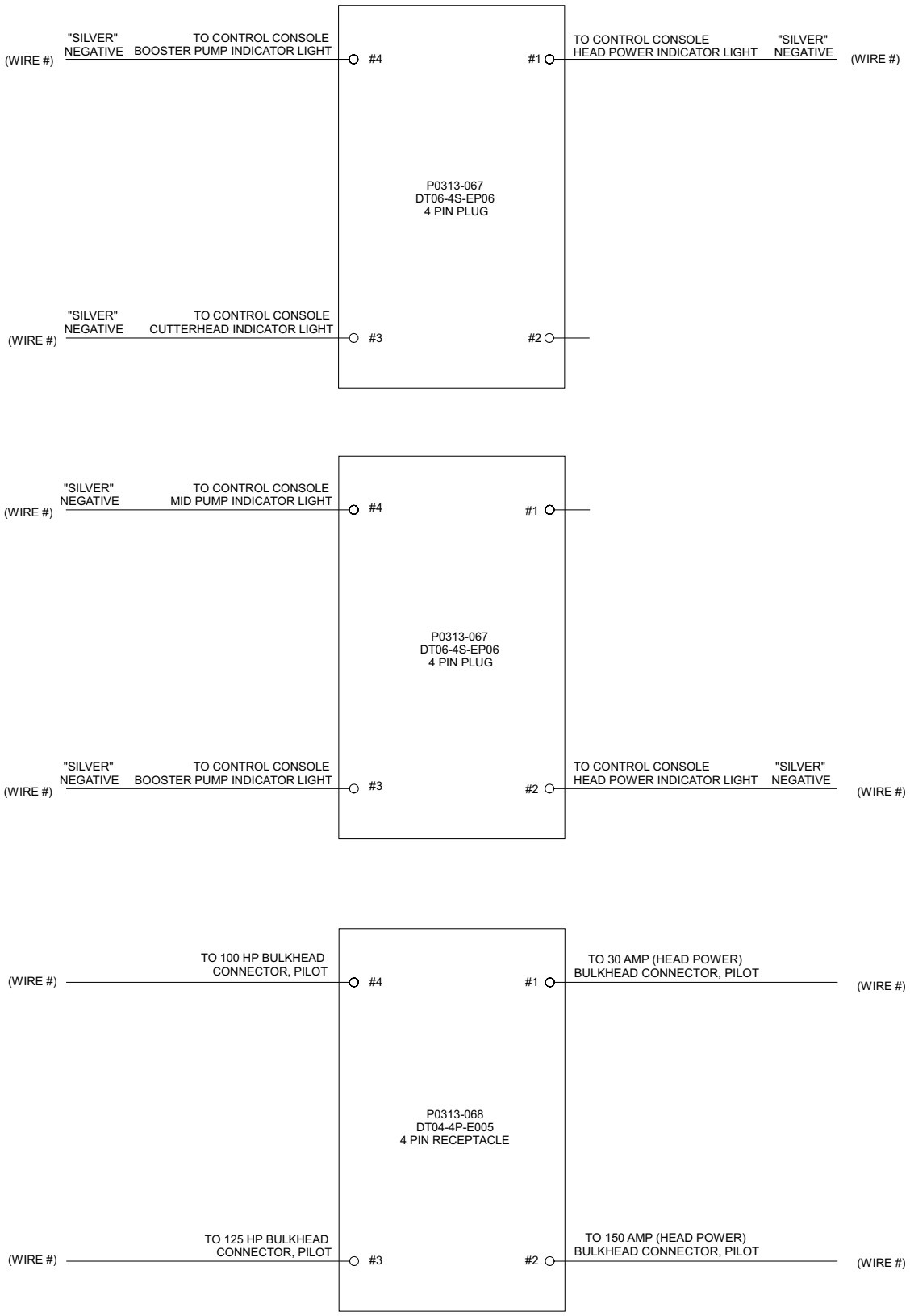
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 12 of 13

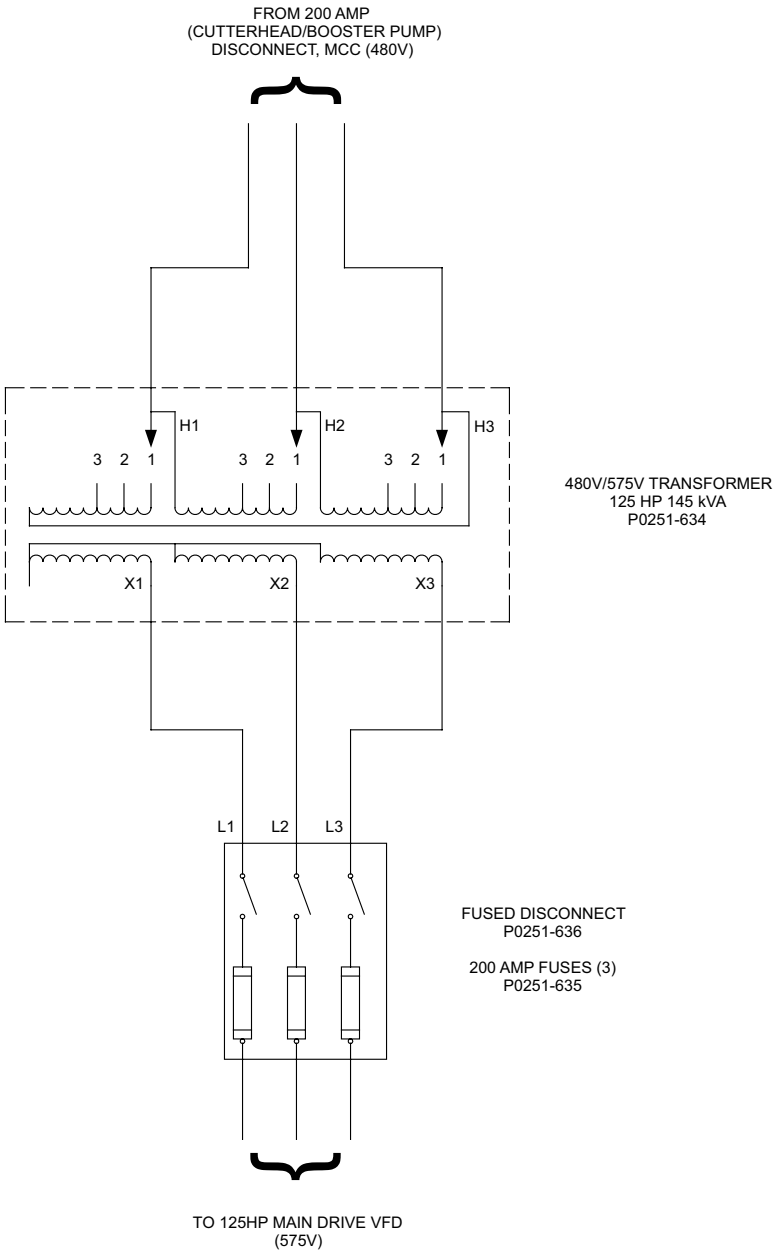


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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 13 of 13



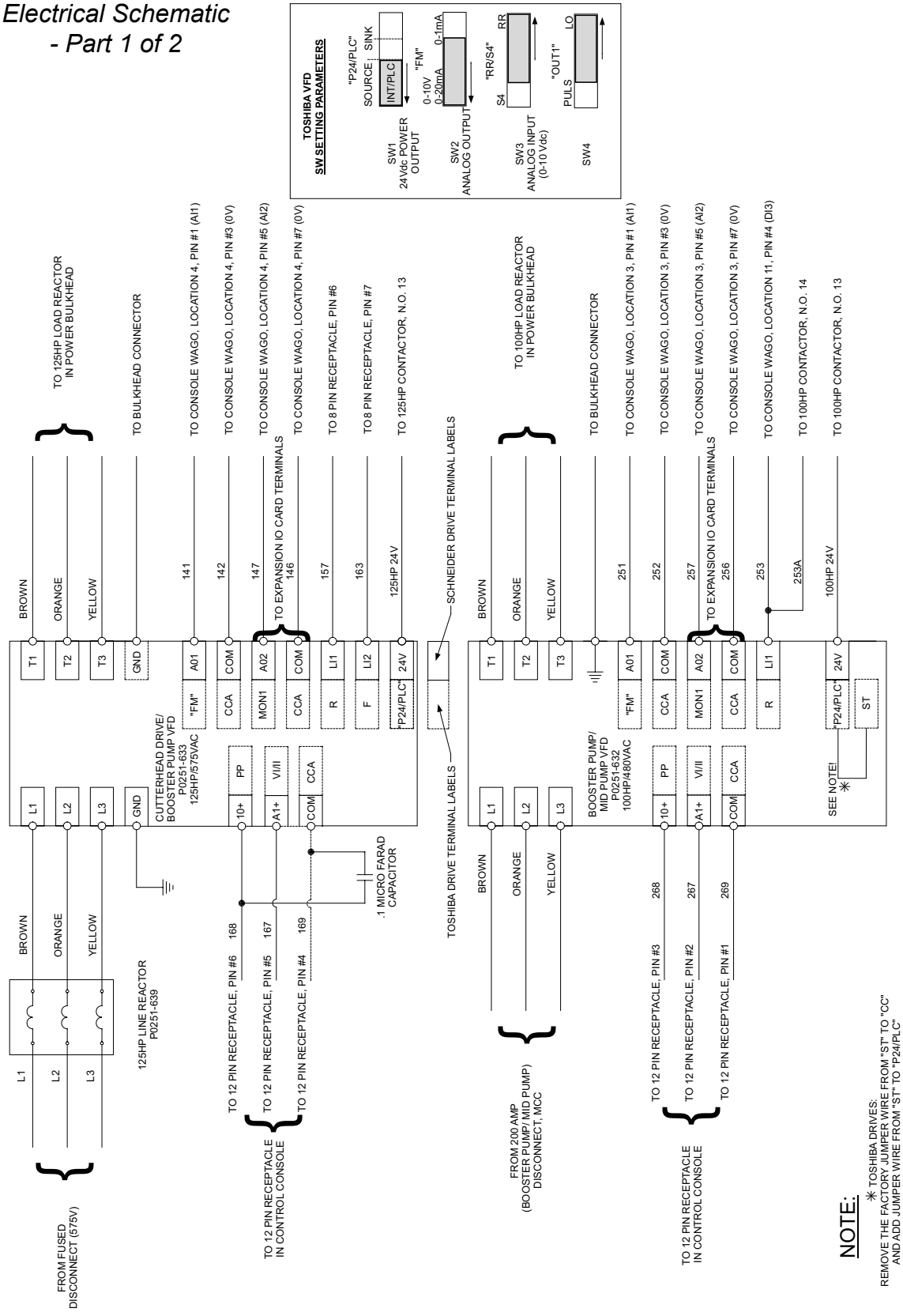
CONTROL CONTAINER TRANSFORMER ELECTRICAL SCHEMATIC - SN FA22299F, FA21900F-04/05



CONTROL CONTAINER VFD ELECTRICAL SCHEMATICS - SN FA22299F, FA21900F-04/05

NOTICE ***SN FA21900F-04 & 05 have been updated to run a periphery drive MTBM. The cutter head drive utilizes a 250HP Cutter VFD (P0251-203D).***

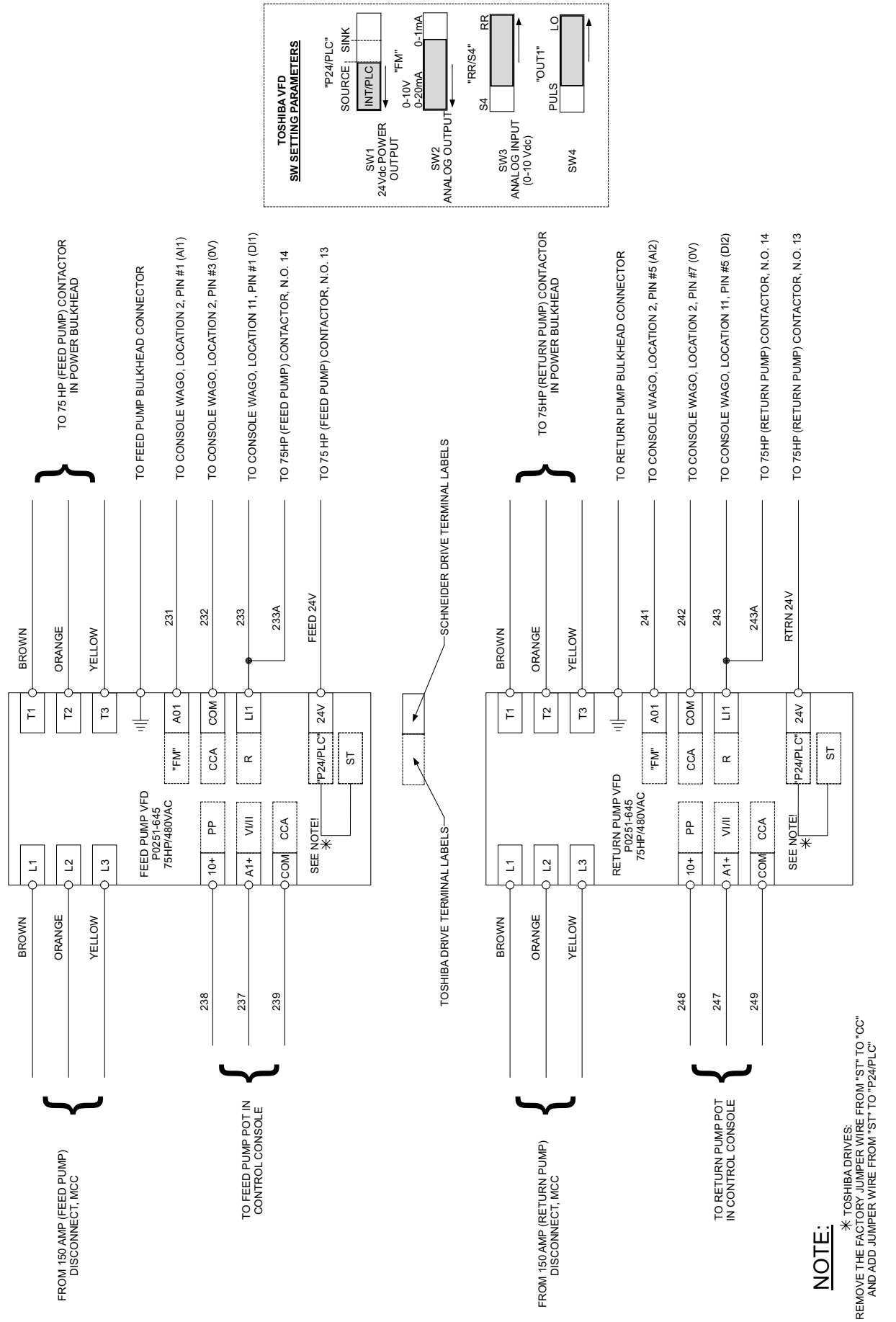
Electrical Schematic - Part 1 of 2



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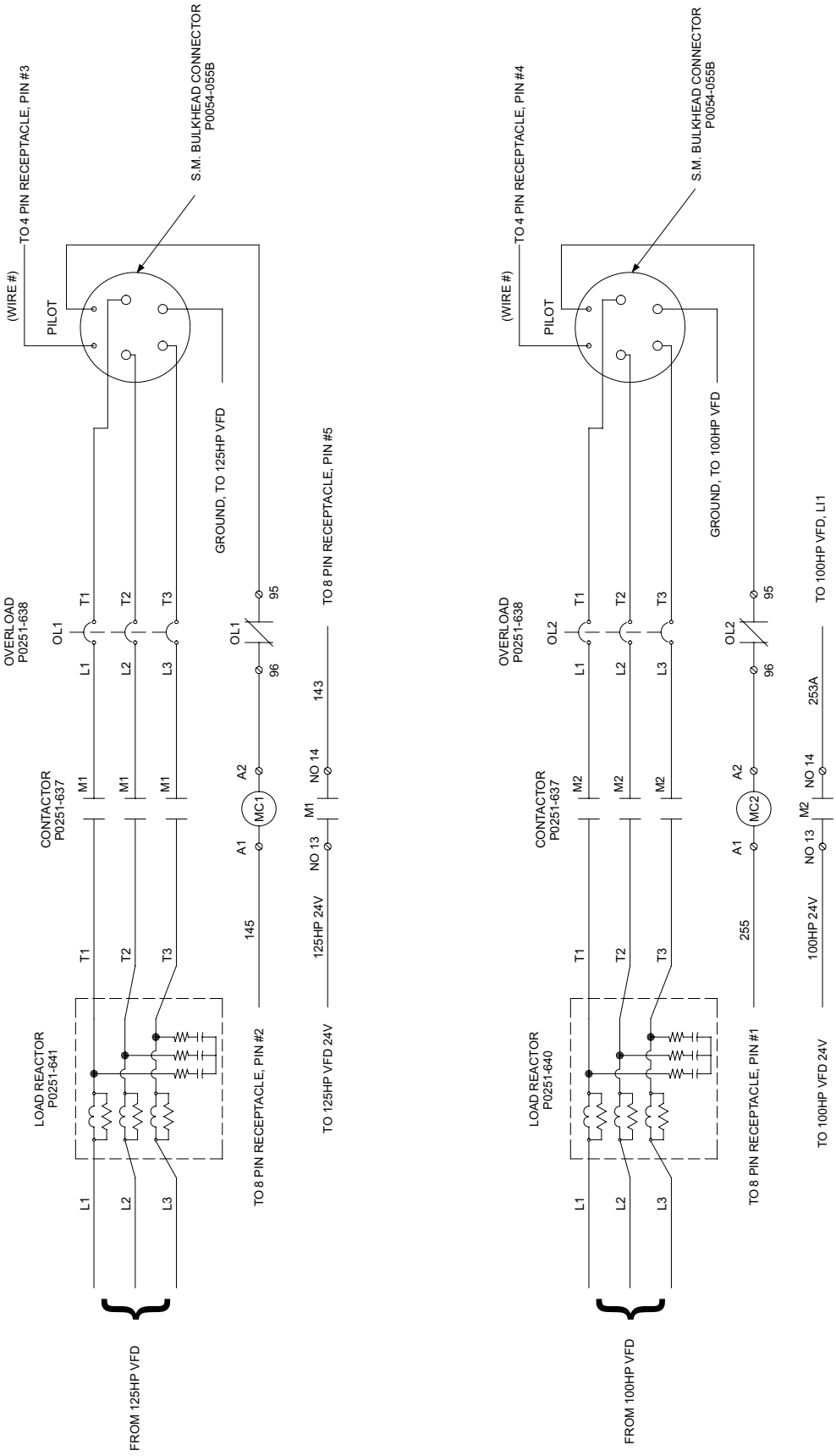
Control Container VFD Electrical Schematics (continued)

Electrical Schematic - Part 2 of 2



CONTROL CONTAINER BULKHEAD ELECTRICAL SCHEMATICS - SN FA22299F, FA21900F-04/05

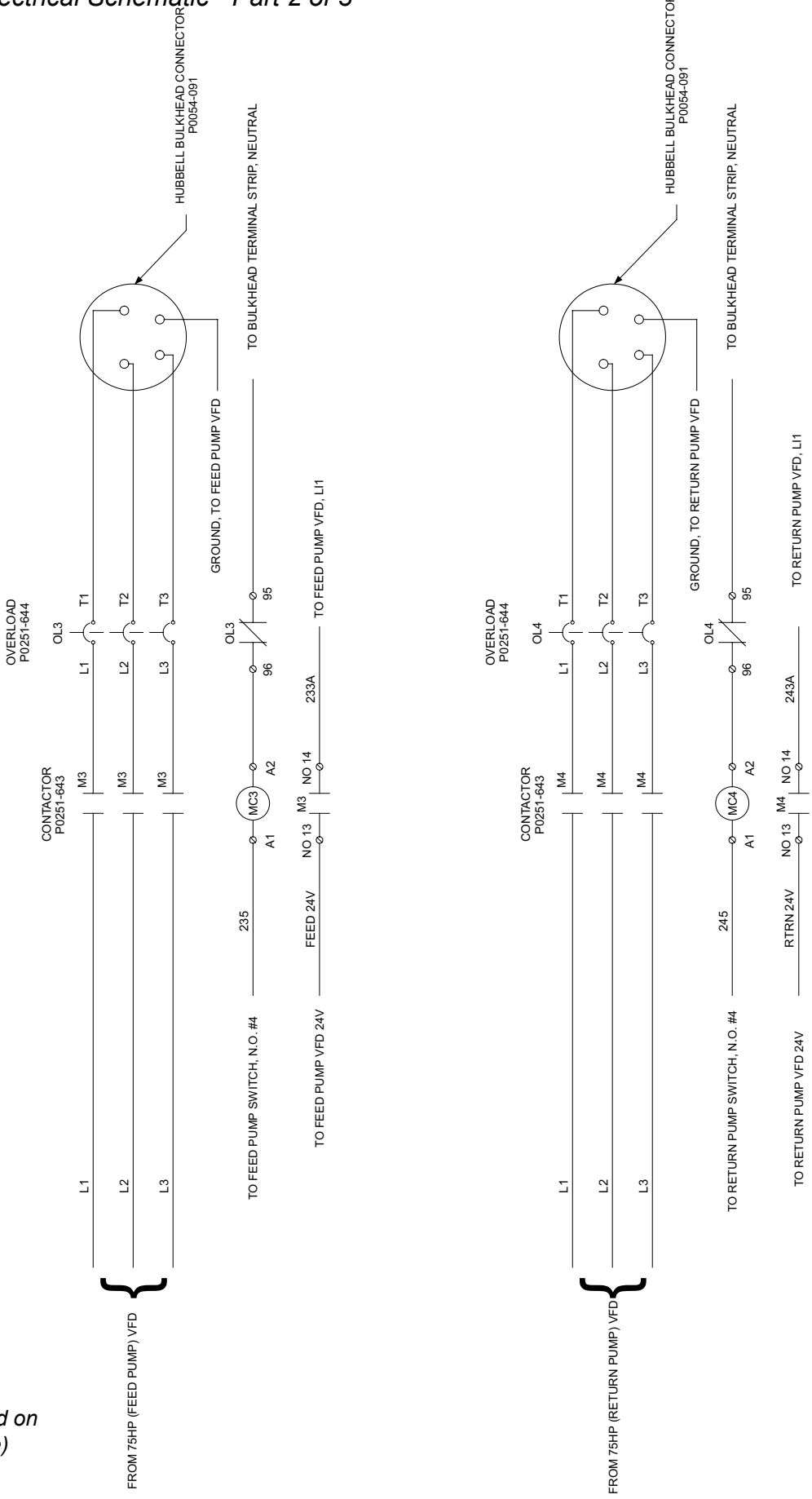
Electrical Schematic - Part 1 of 3



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Control Container Bulkhead Electrical Schematics (continued)

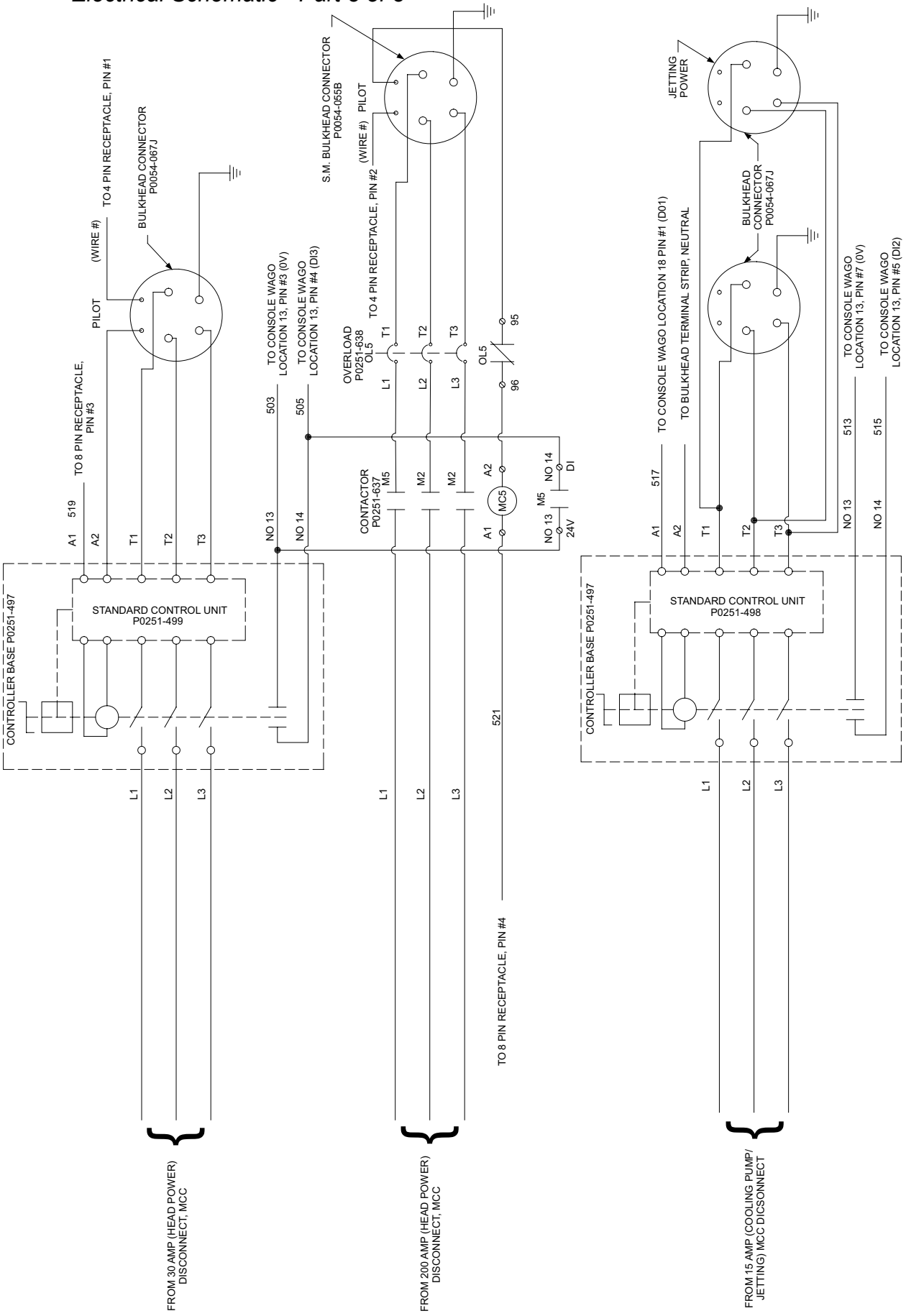
Electrical Schematic - Part 2 of 3



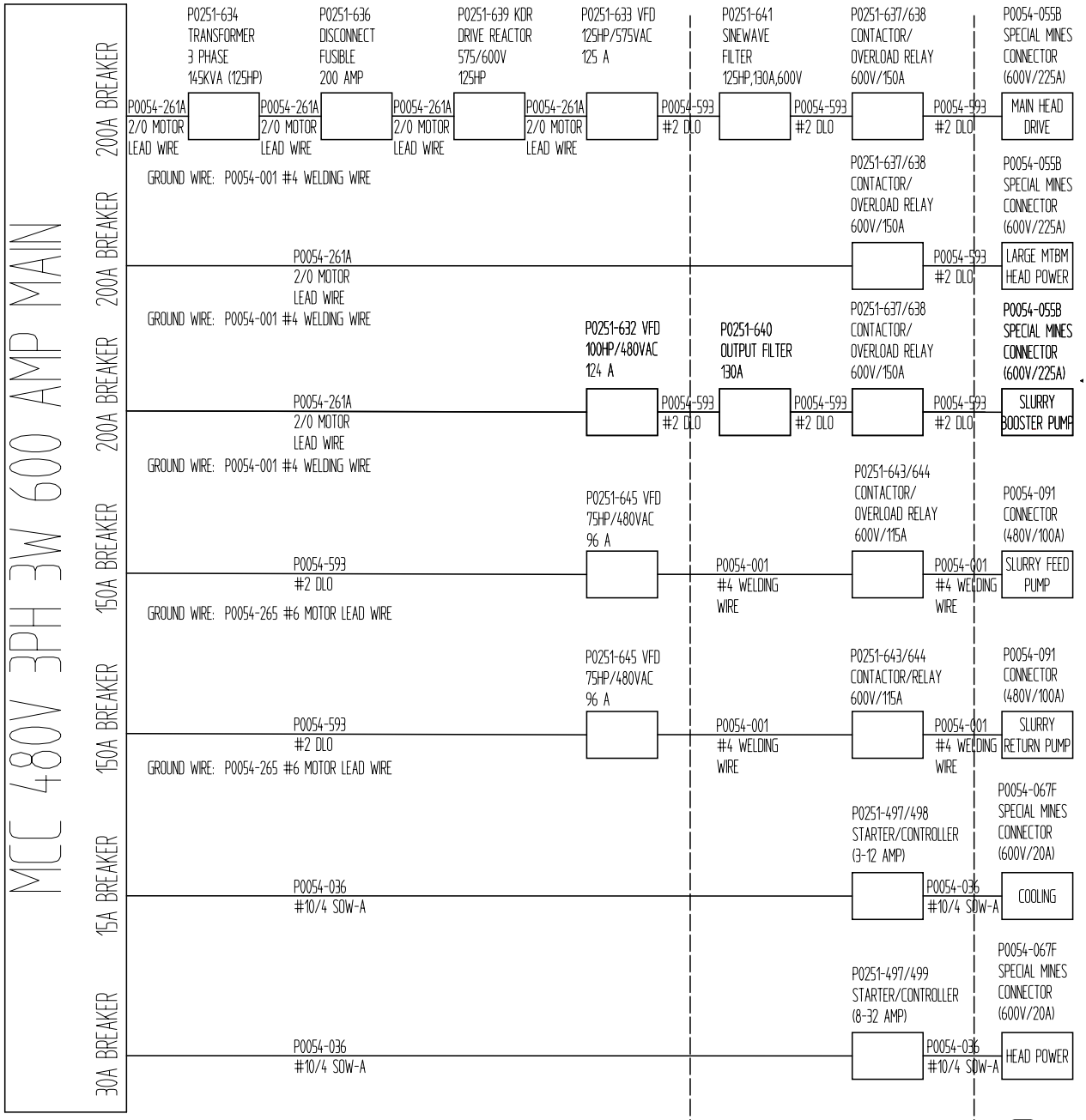
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Control Container Bulkhead Electrical Schematics (continued)

Electrical Schematic - Part 3 of 3



POWER WIRE LINE DIAGRAM - SN FA22299F ONLY

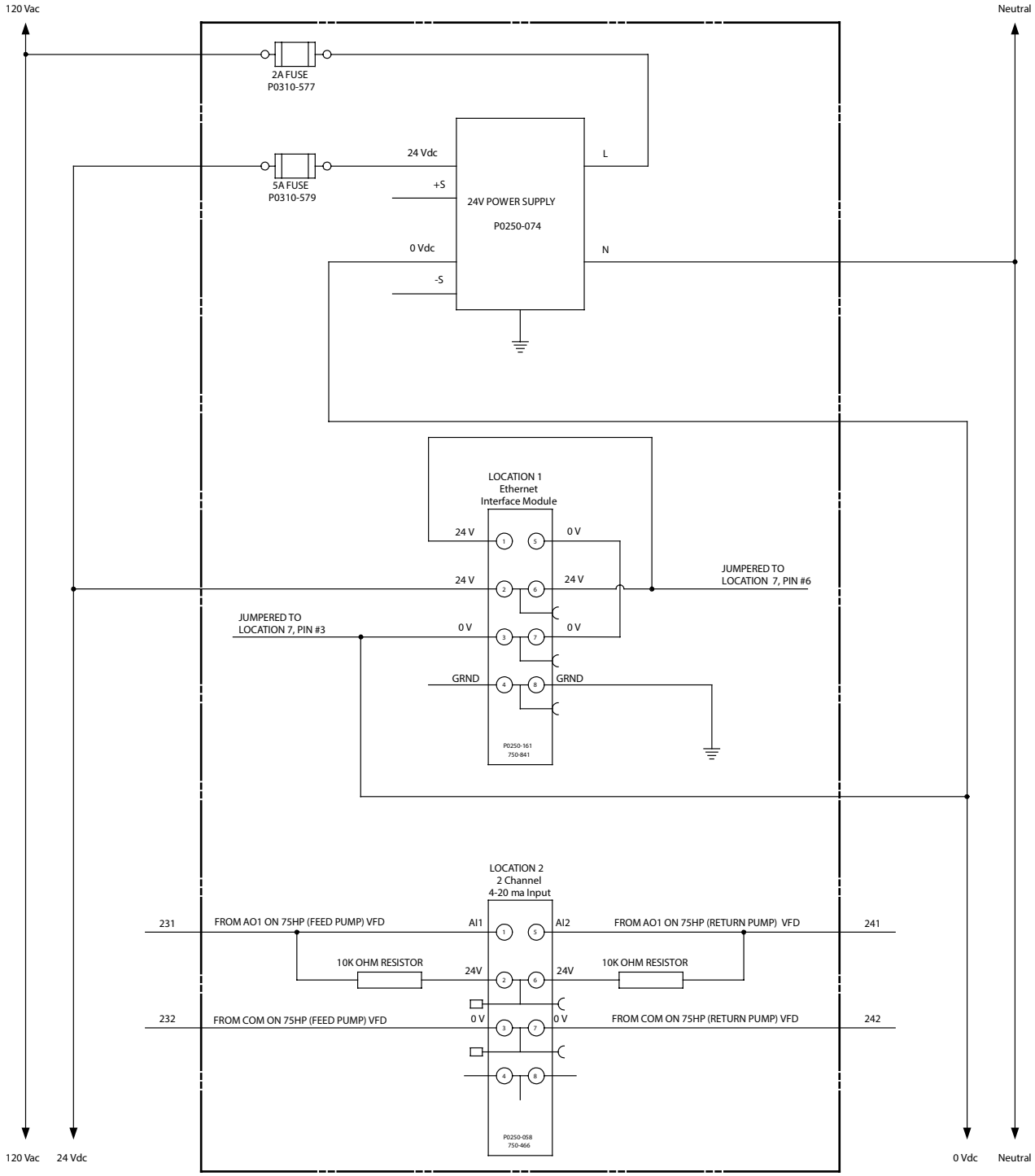


WIRE RATINGS

P0054-261A 2/0 MOTOR LEAD WIRE	247 AMPS
P0054-262 1/0 MOTOR LEAD WIRE	208 AMPS
P0054-593 #2 DLO	190 AMPS
P0054-001 #4 WELDING WIRE	110 AMPS, 300 AMP GROUND
P0054-265 #6 MOTOR LEAD WIRE	200 AMP GROUND
P0054-036 #10/4 SOW-A	25 AMPS

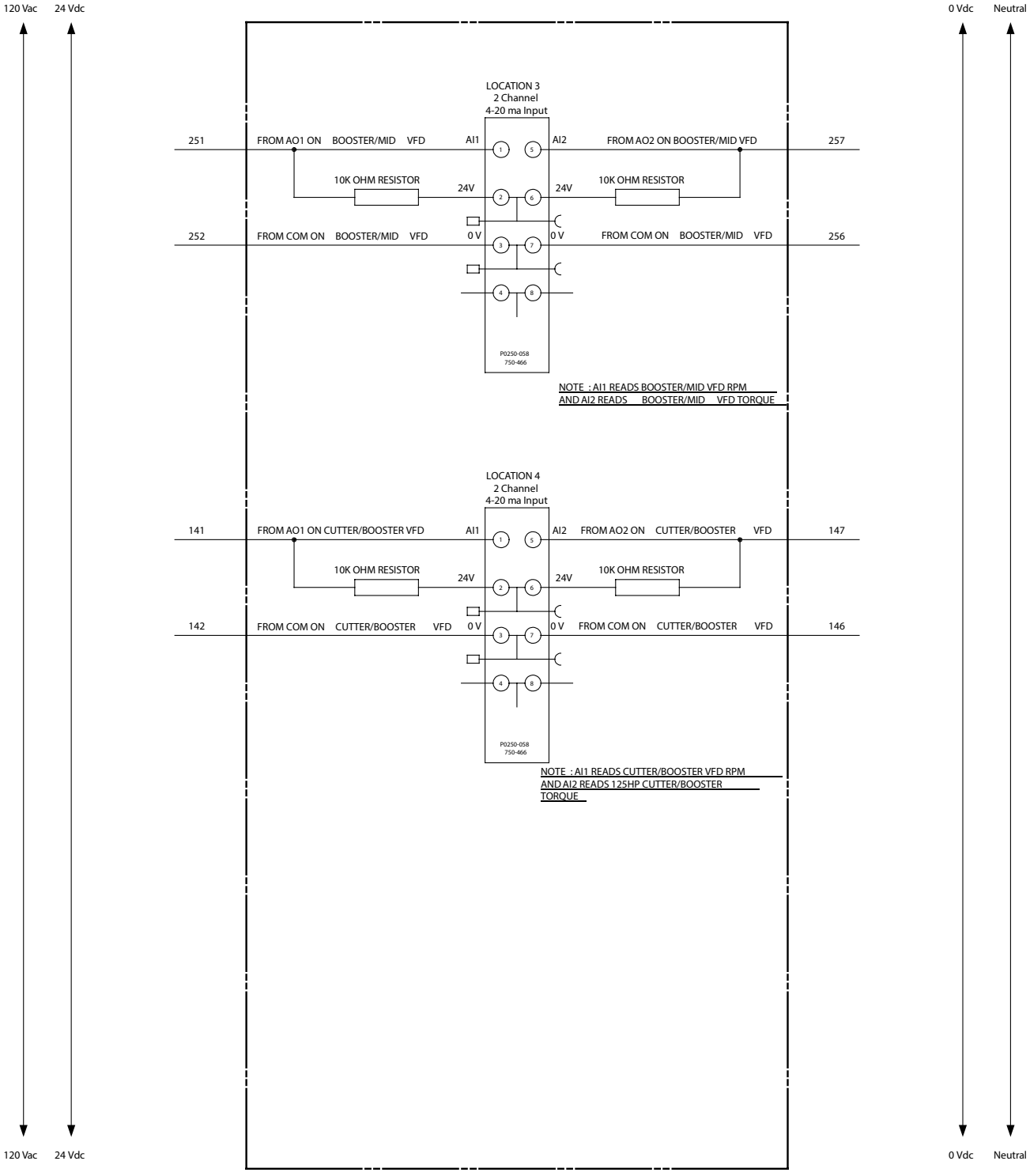
CONTROL CONSOLE ELECTRICAL SCHEMATICS - SN FA22300F

Electrical Schematic - Part 1 of 13



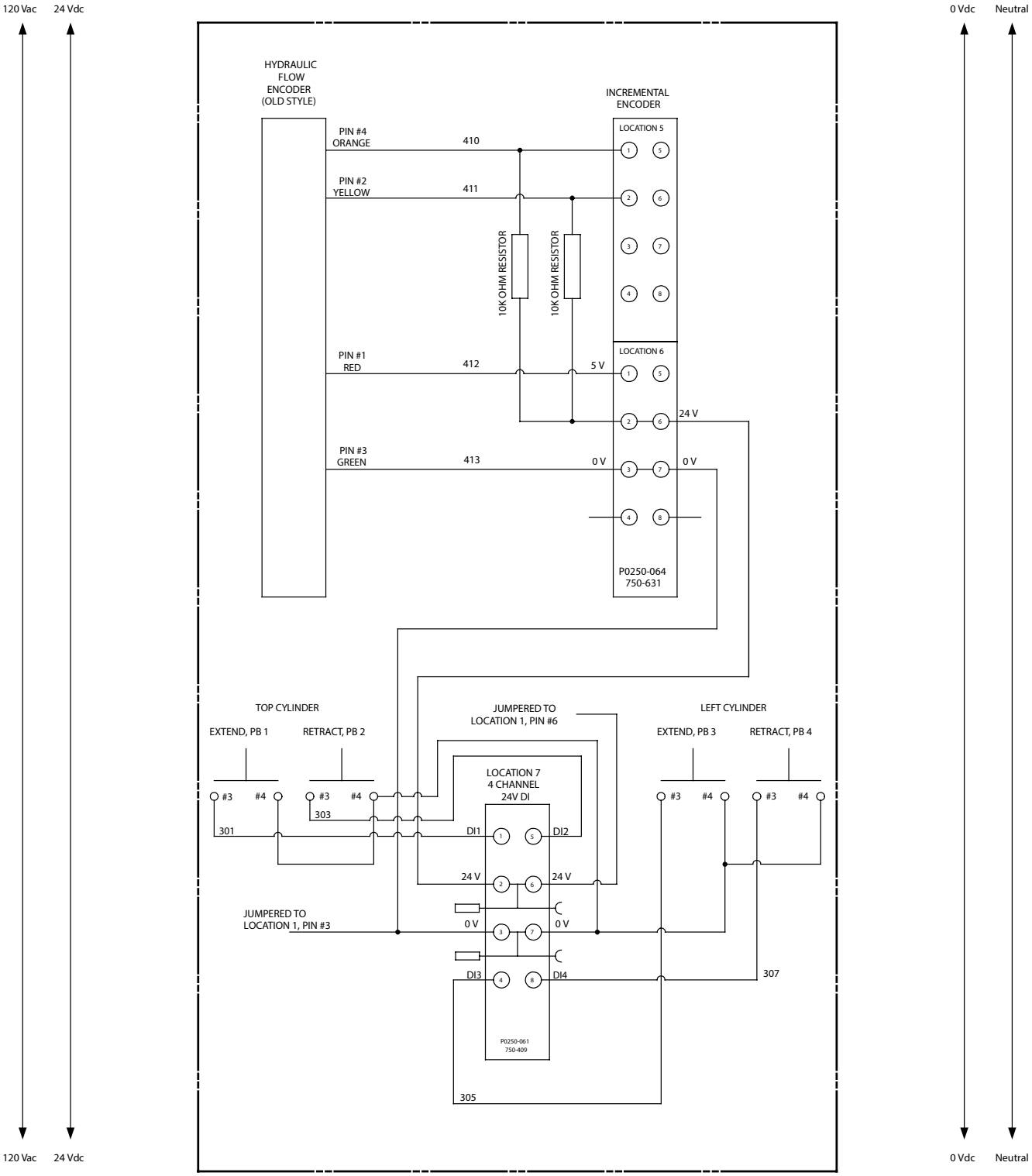
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 2 of 13



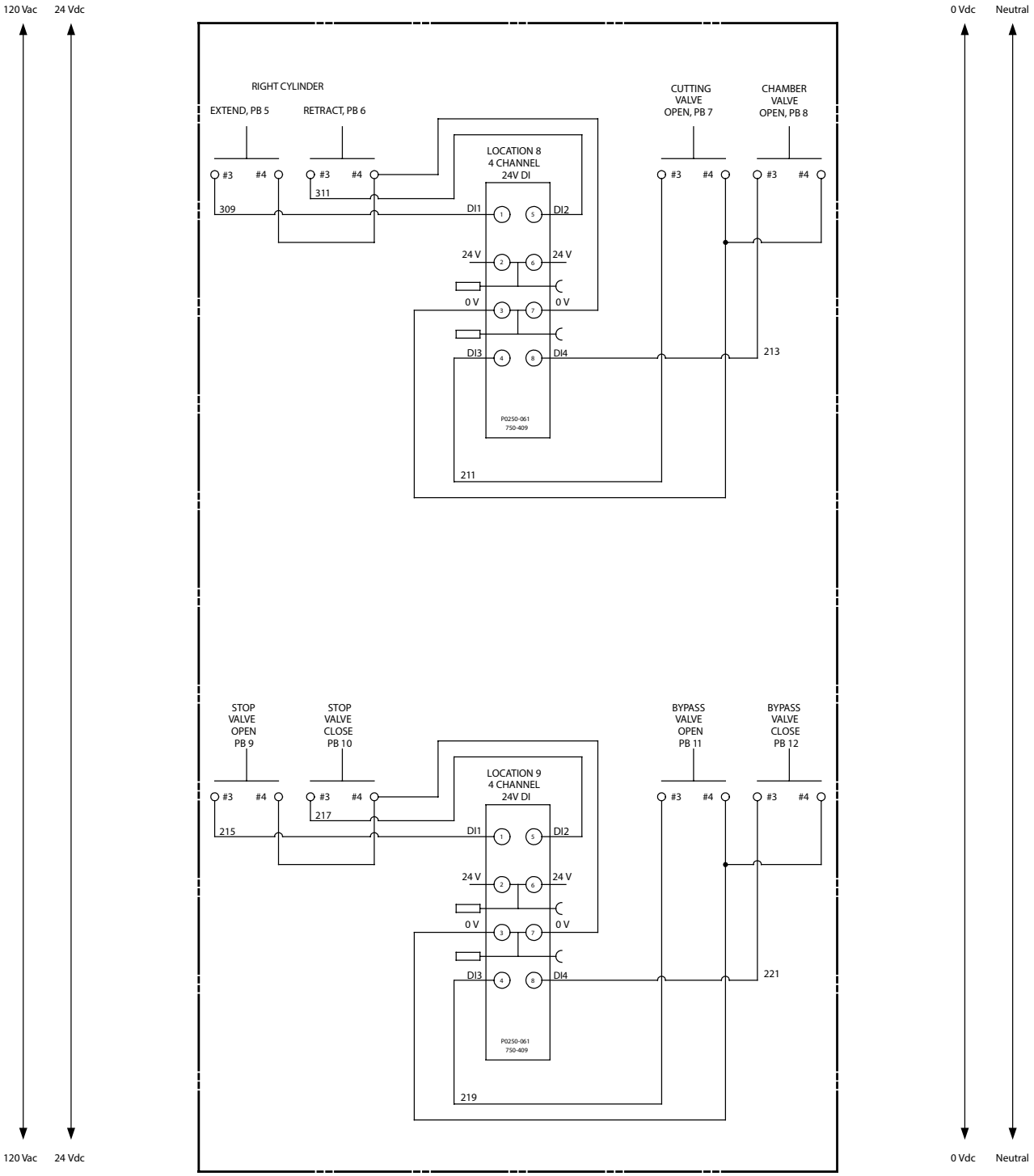
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 3 of 13



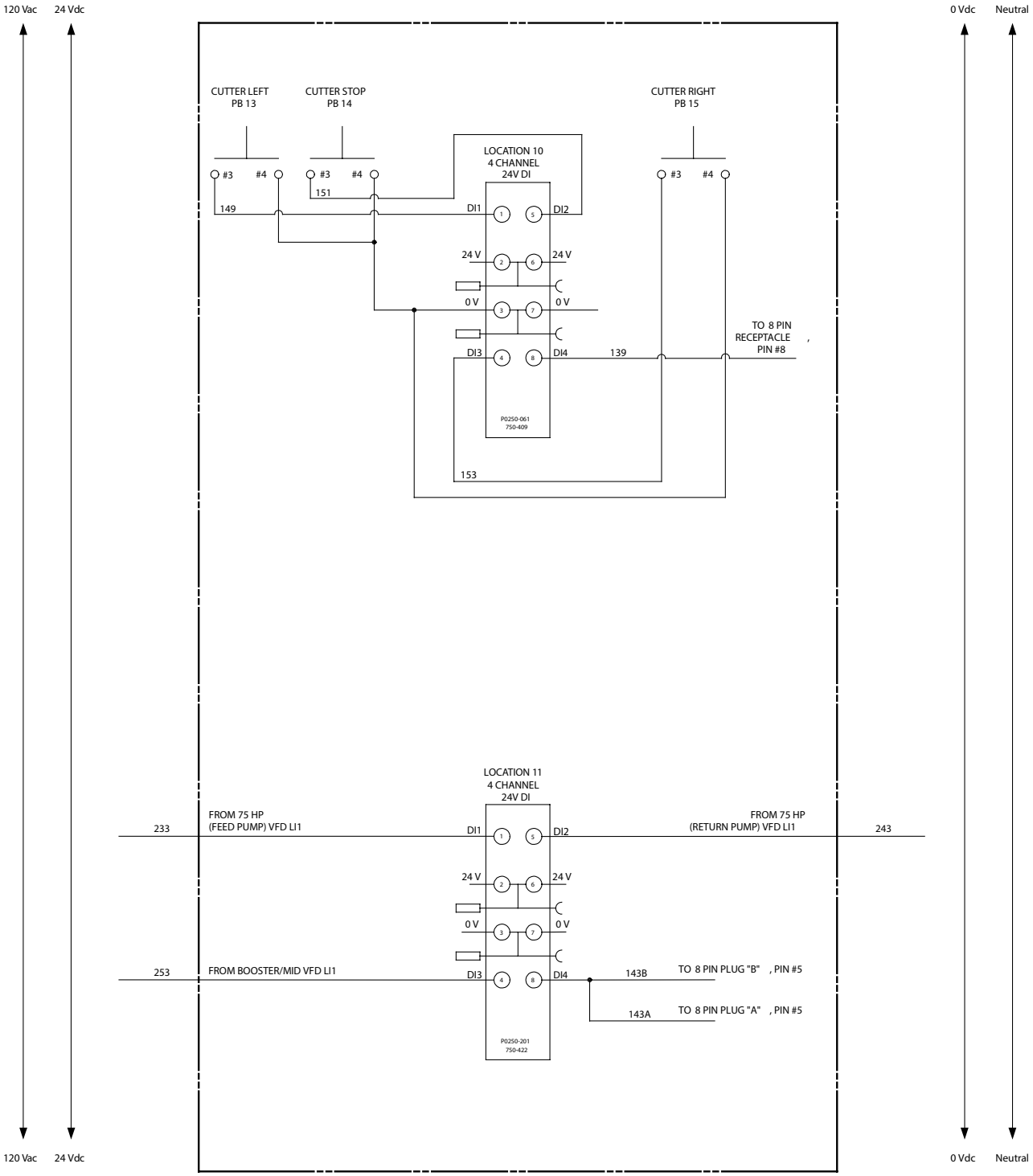
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 4 of 13



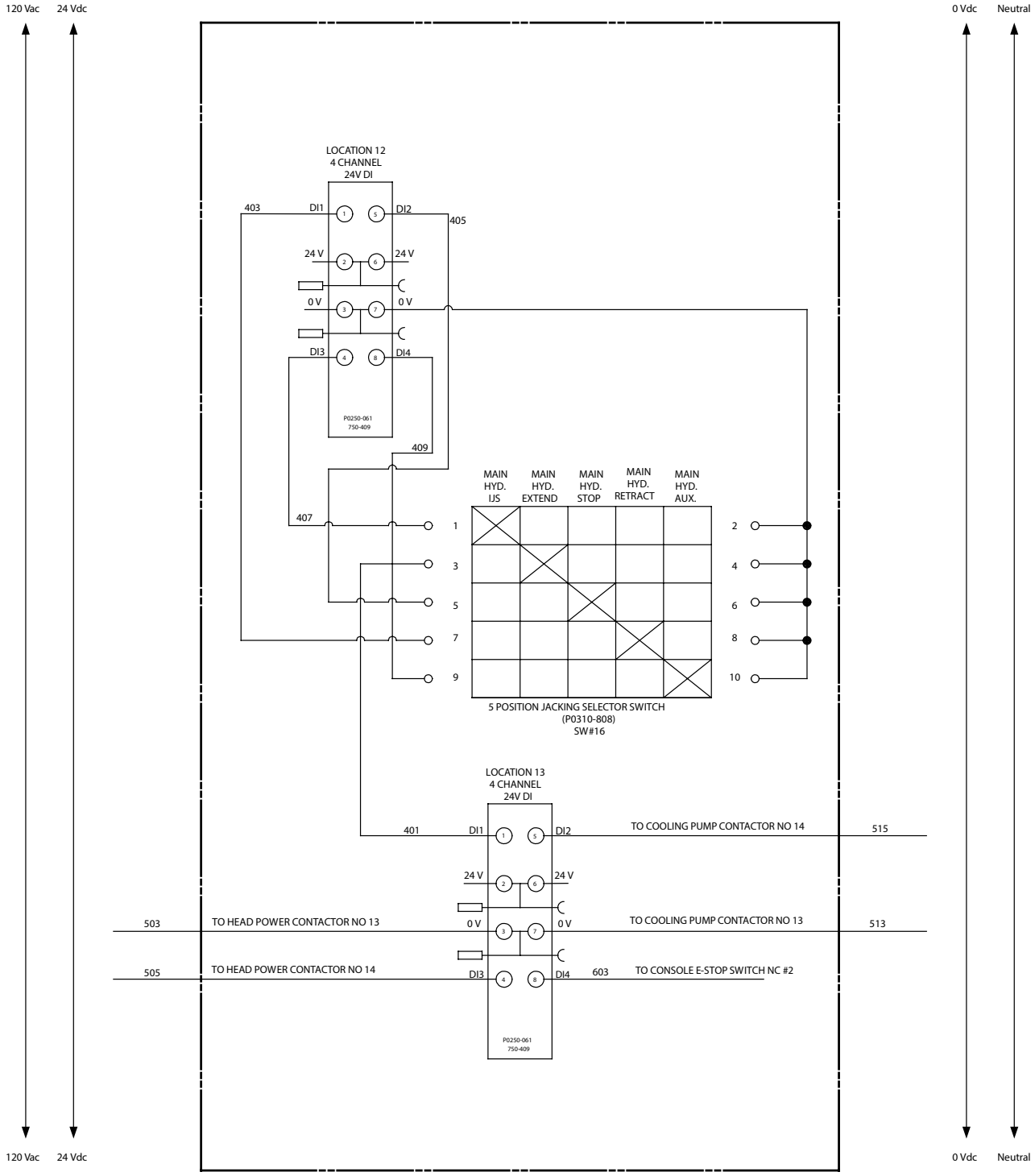
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 5 of 13



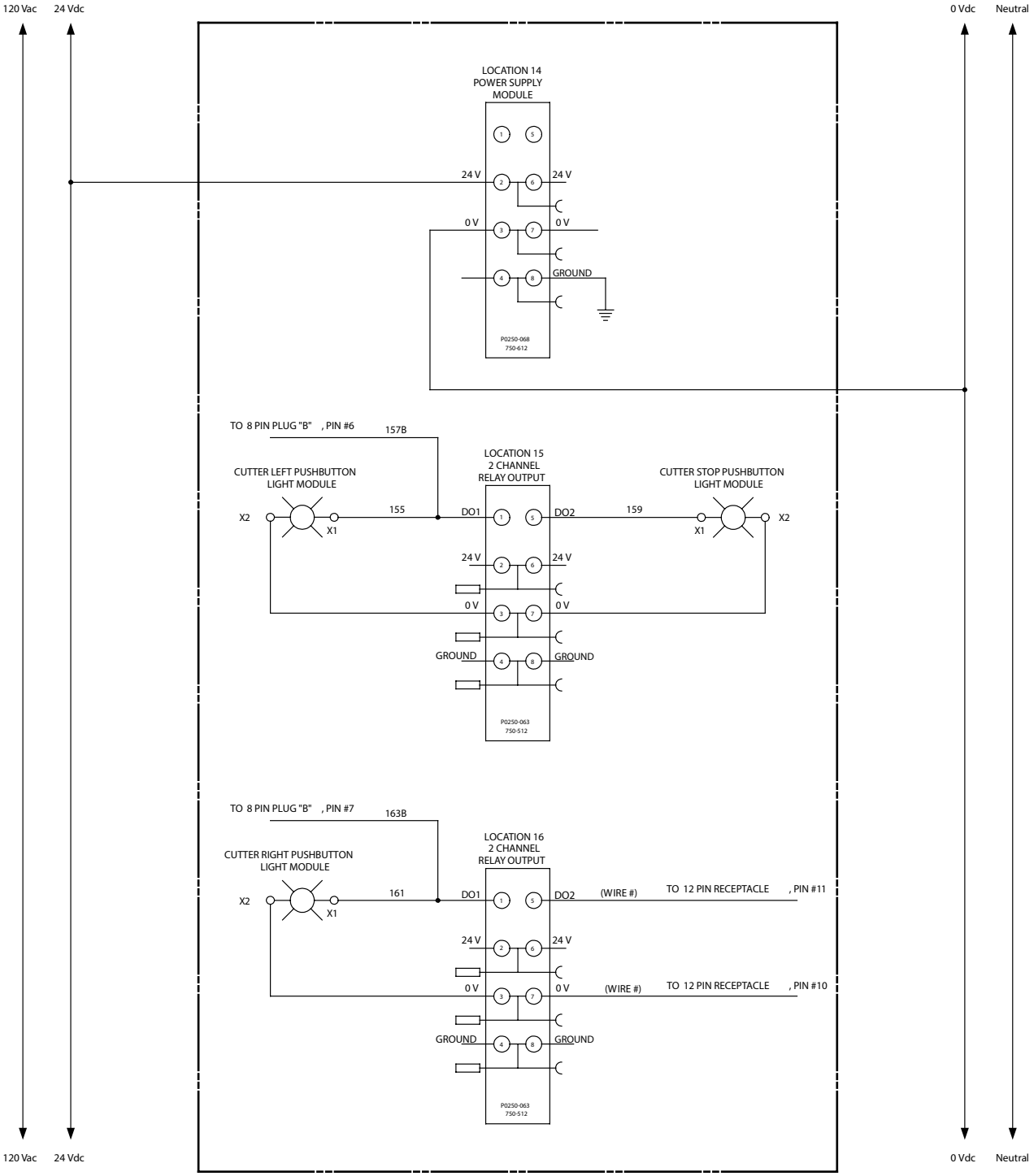
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 6 of 13



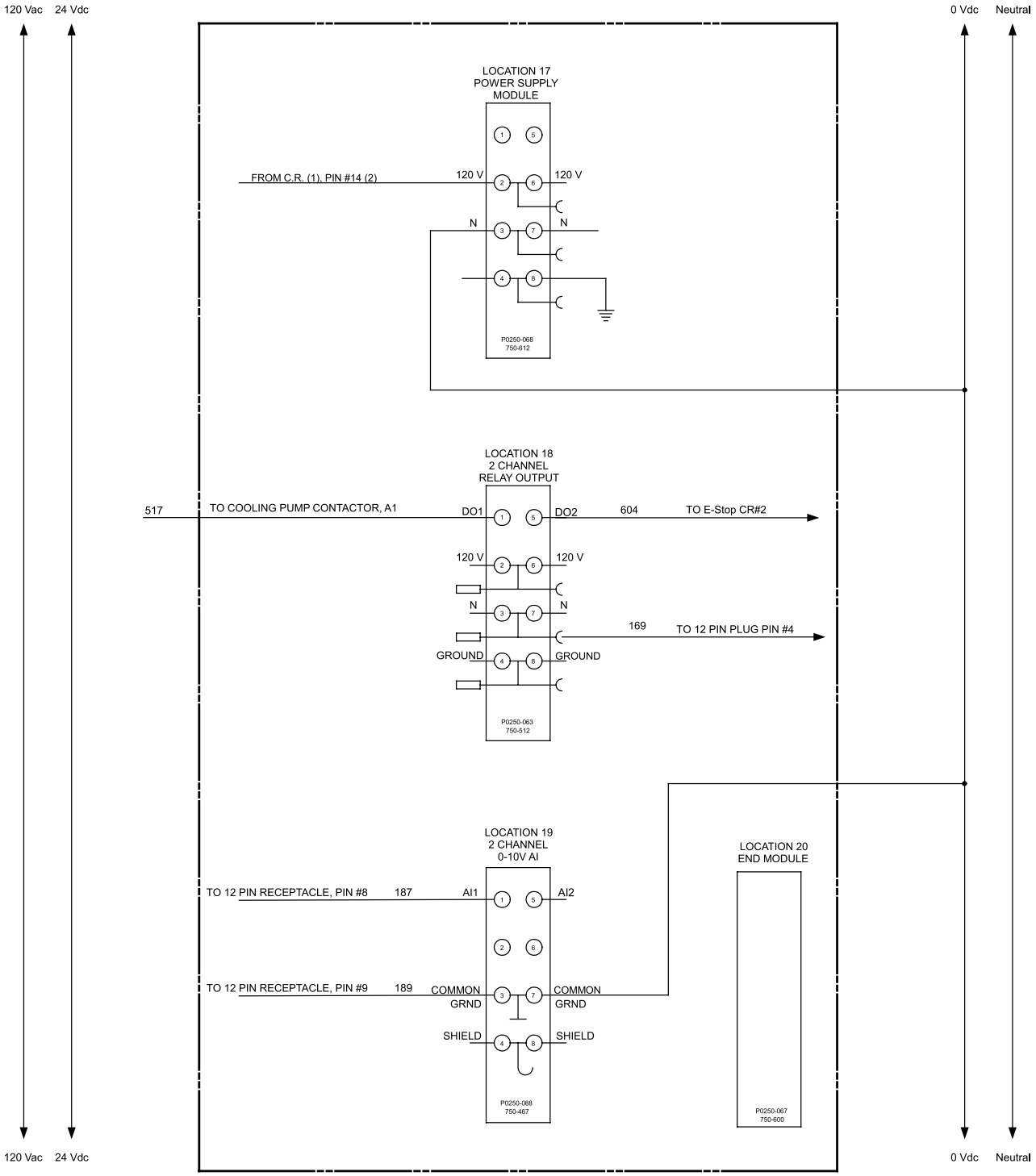
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 7 of 13



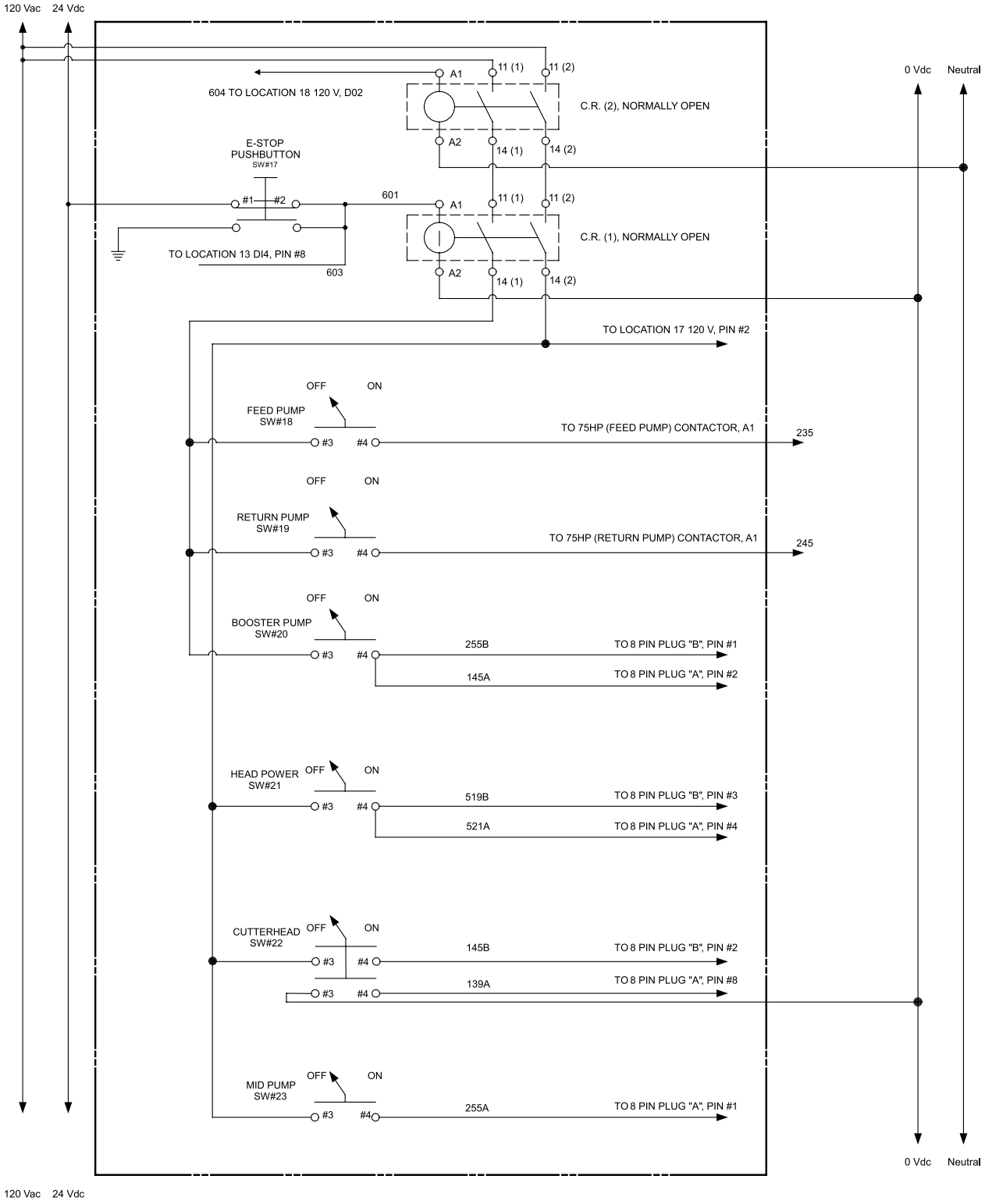
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 8 of 13



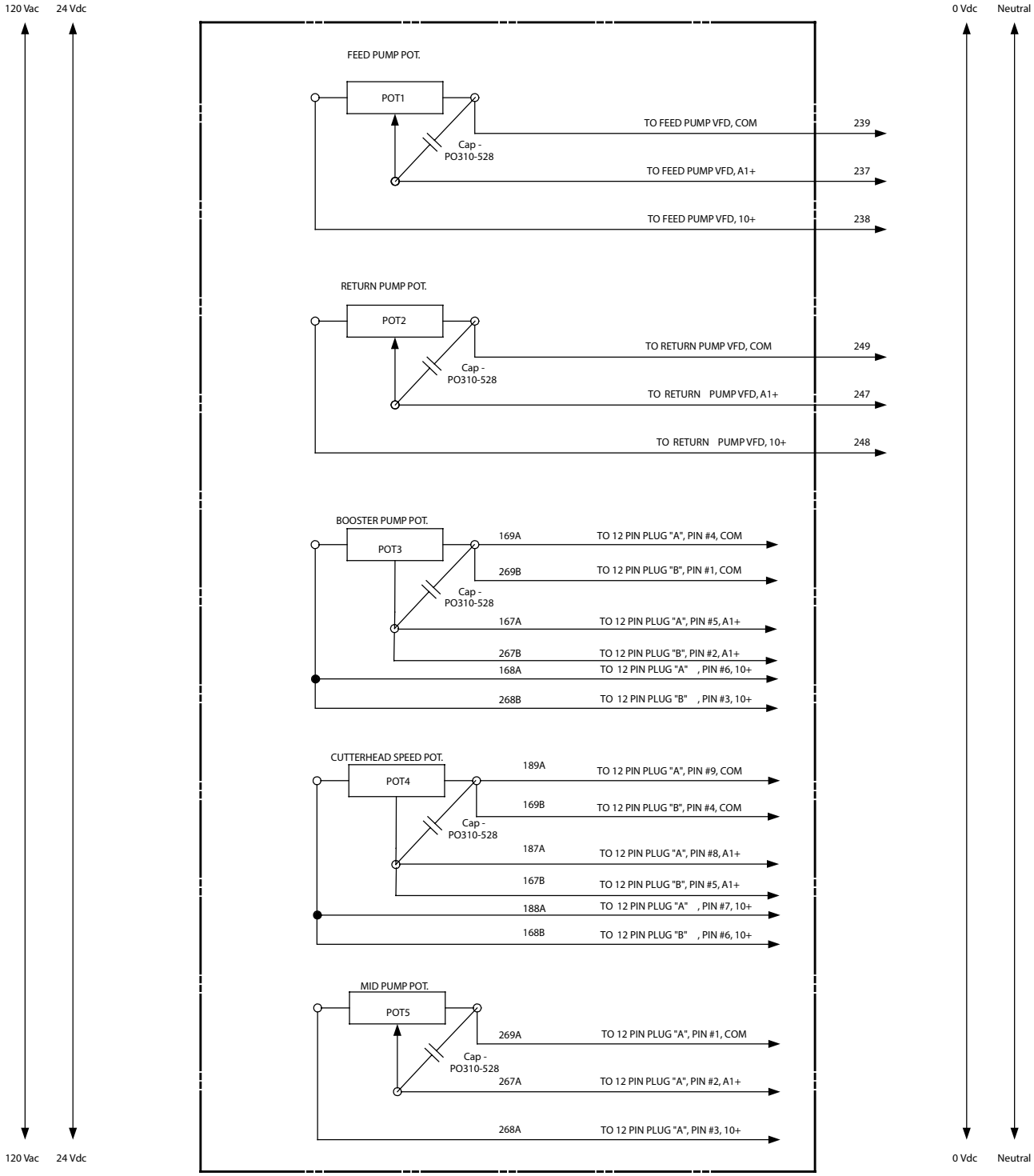
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 9 of 13



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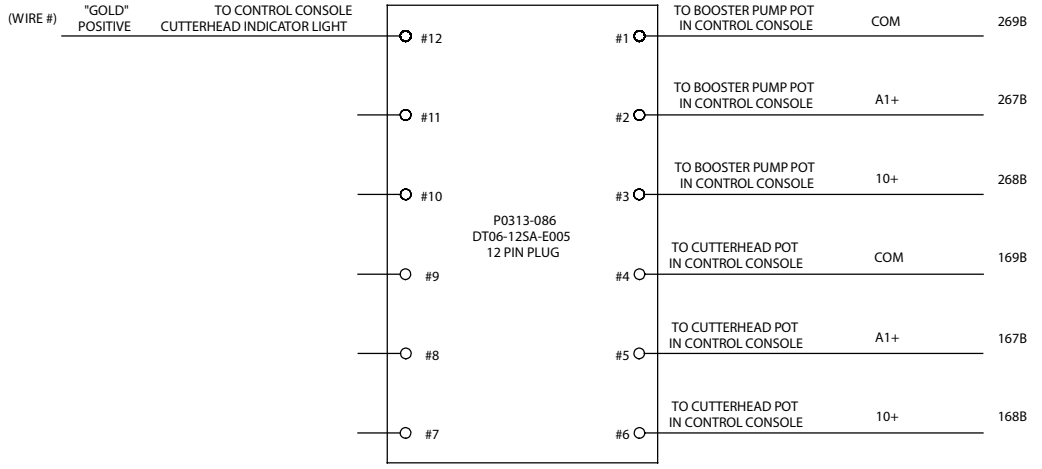
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 10 of 13



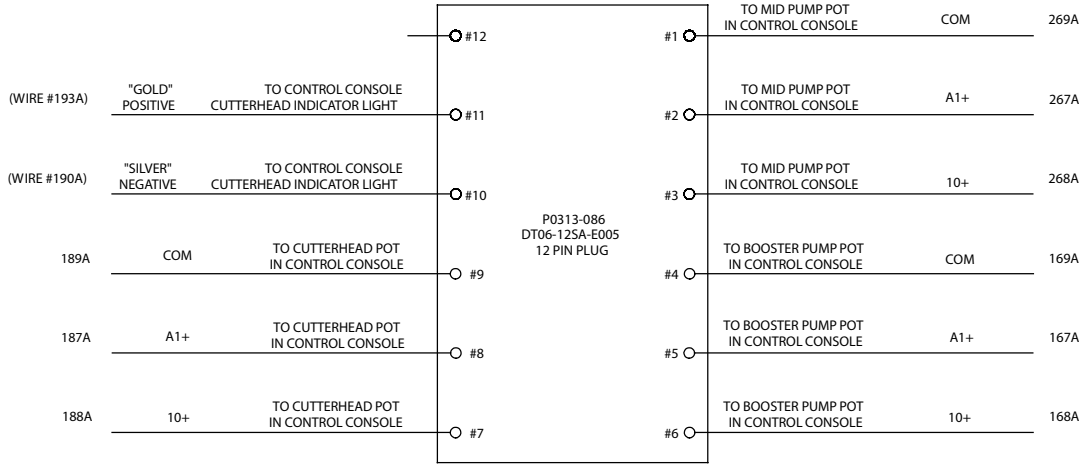
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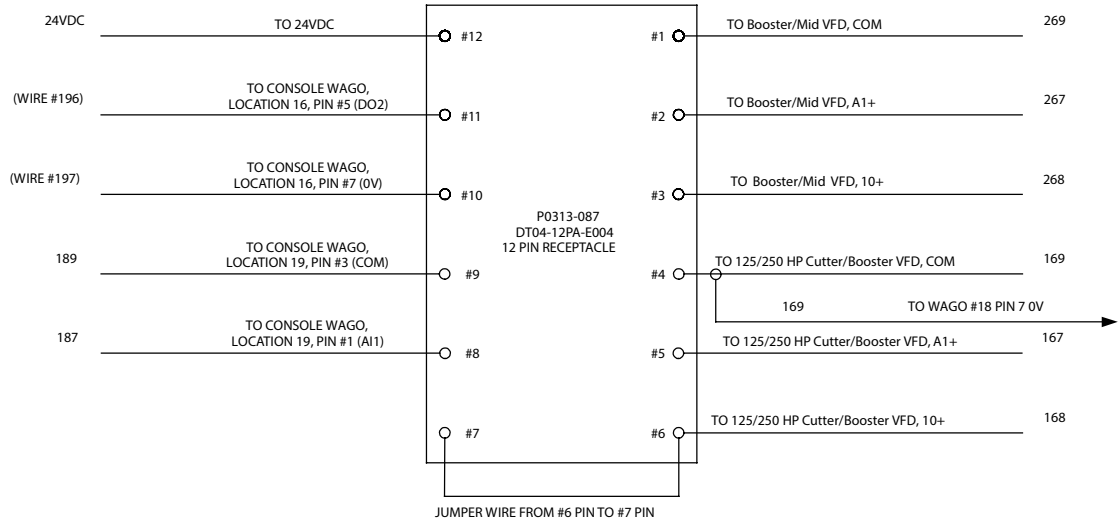
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 11 of 13

"B" PLUG FOR SMALL MTBM



"A" PLUG FOR LARGE MTBM

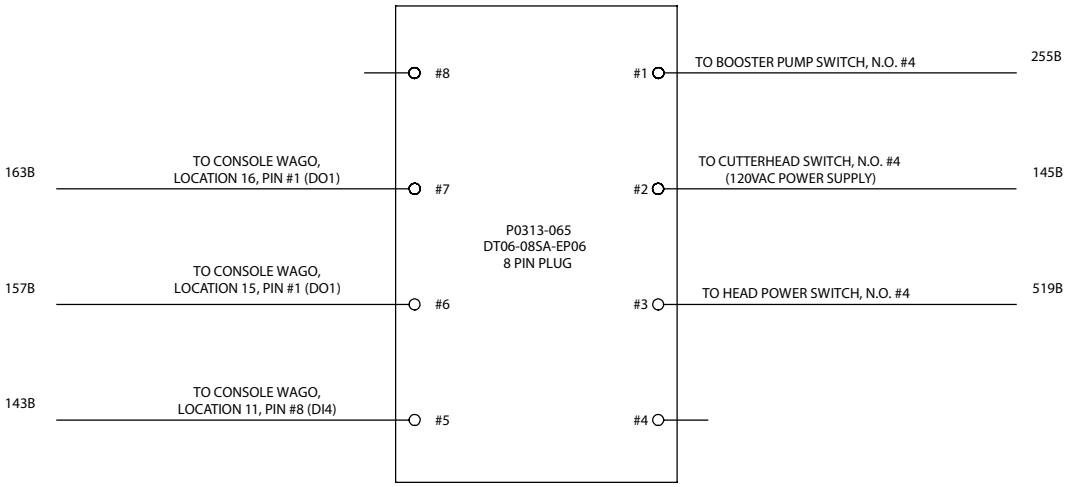




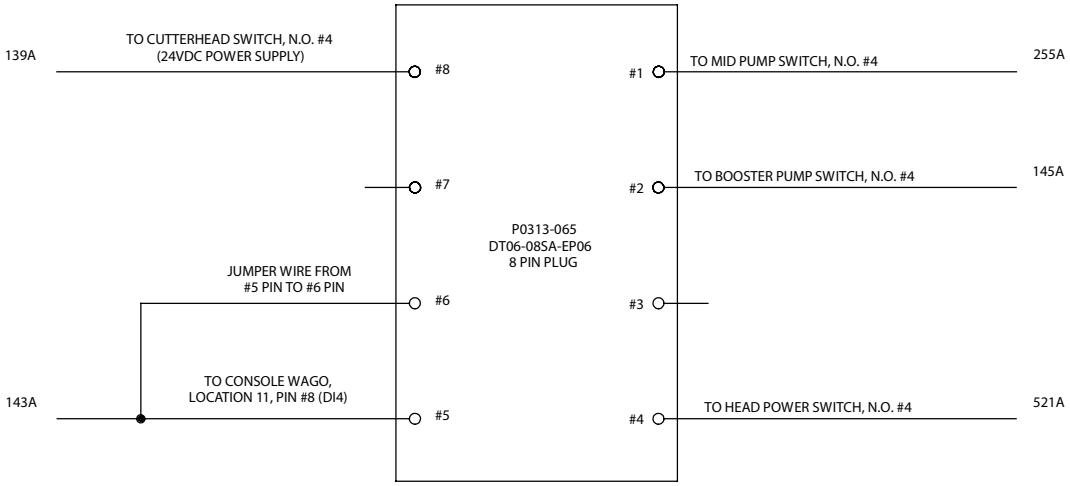
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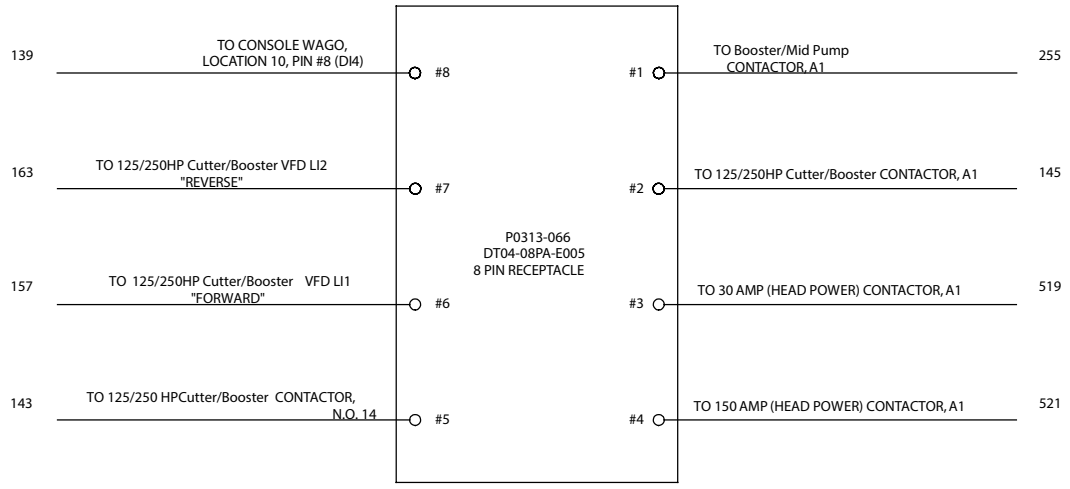
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 12 of 13

"B " PLUG FOR SMALL MTBM



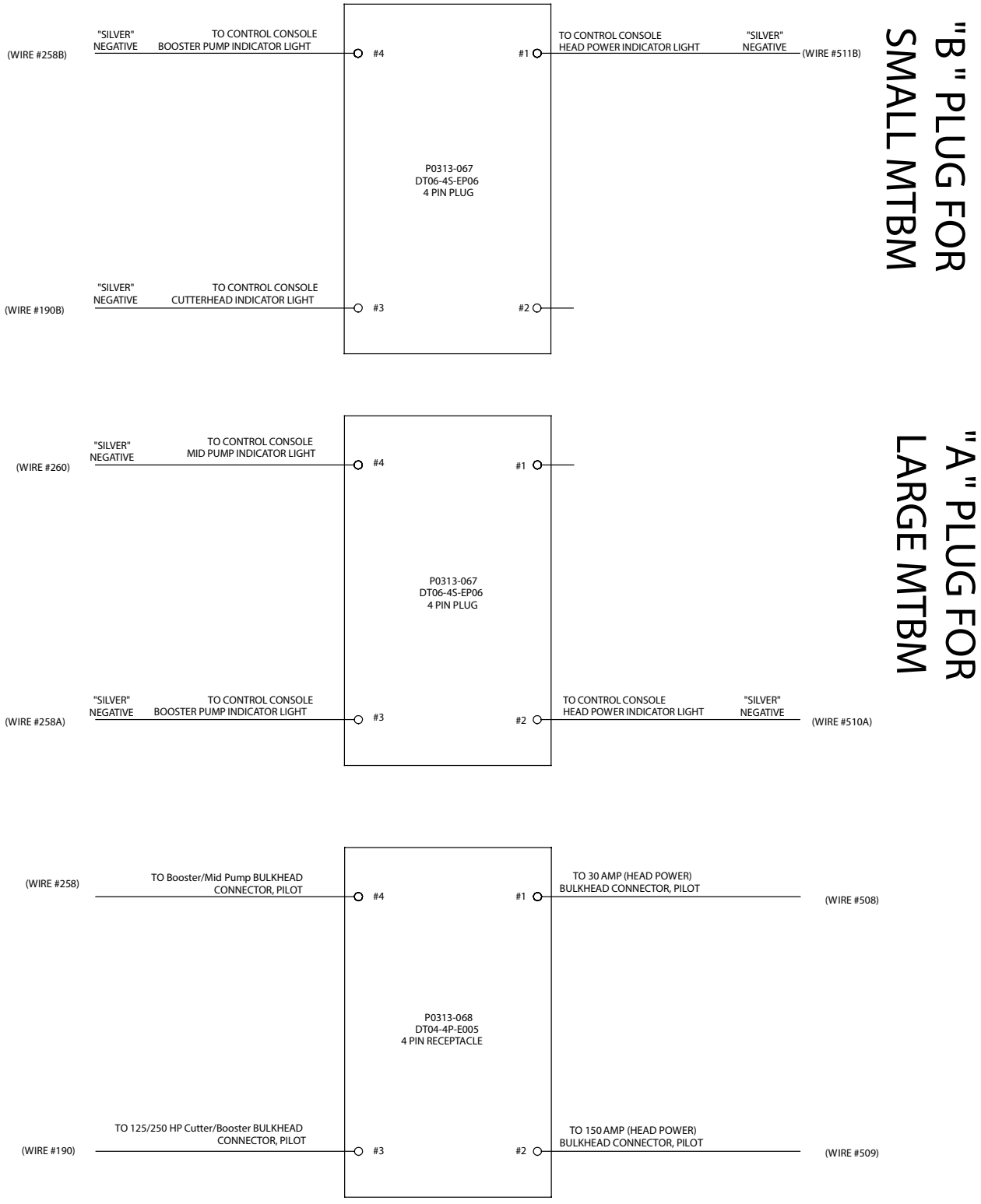
"A " PLUG FOR LARGE MTBM



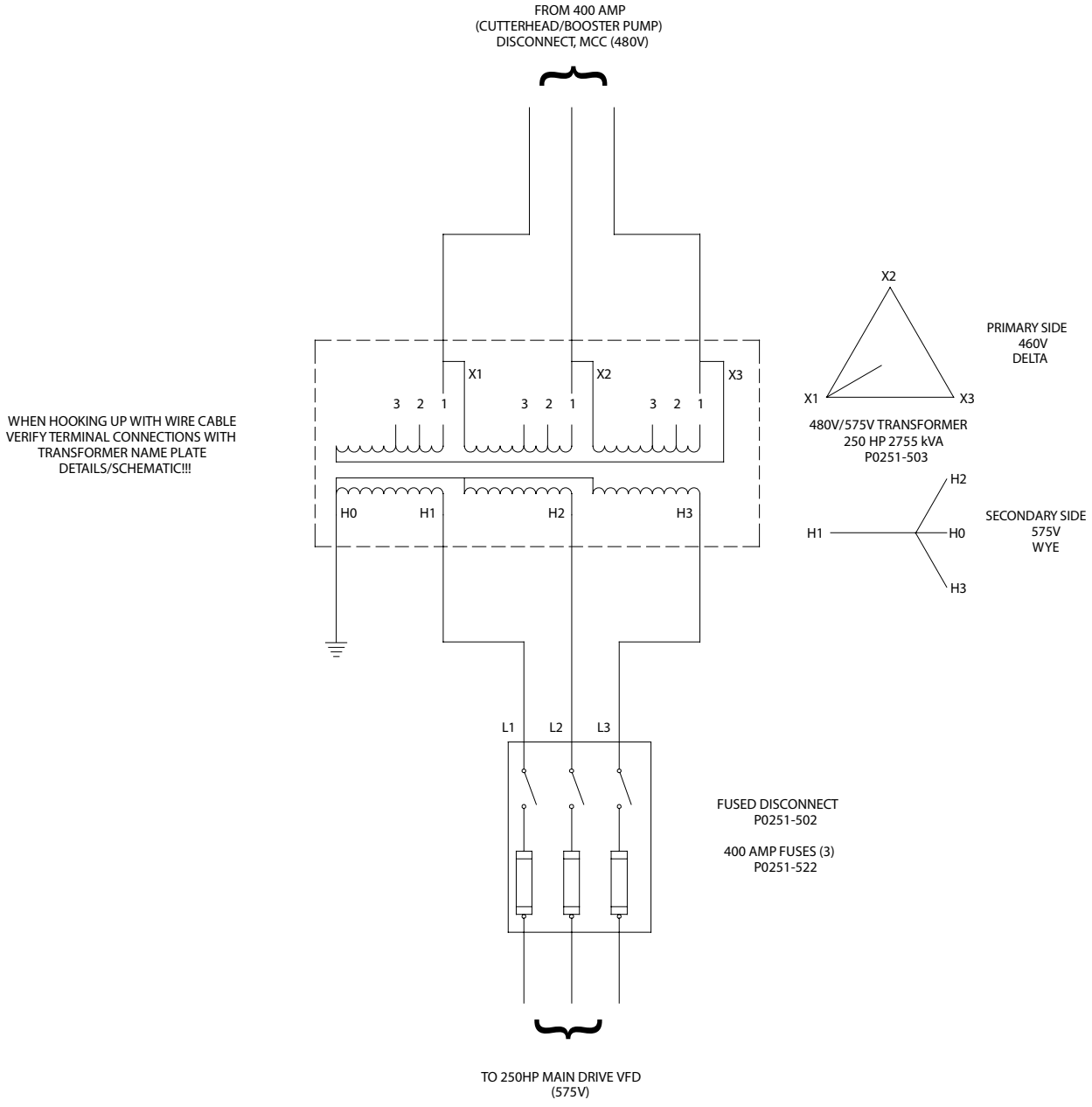


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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 13 of 13

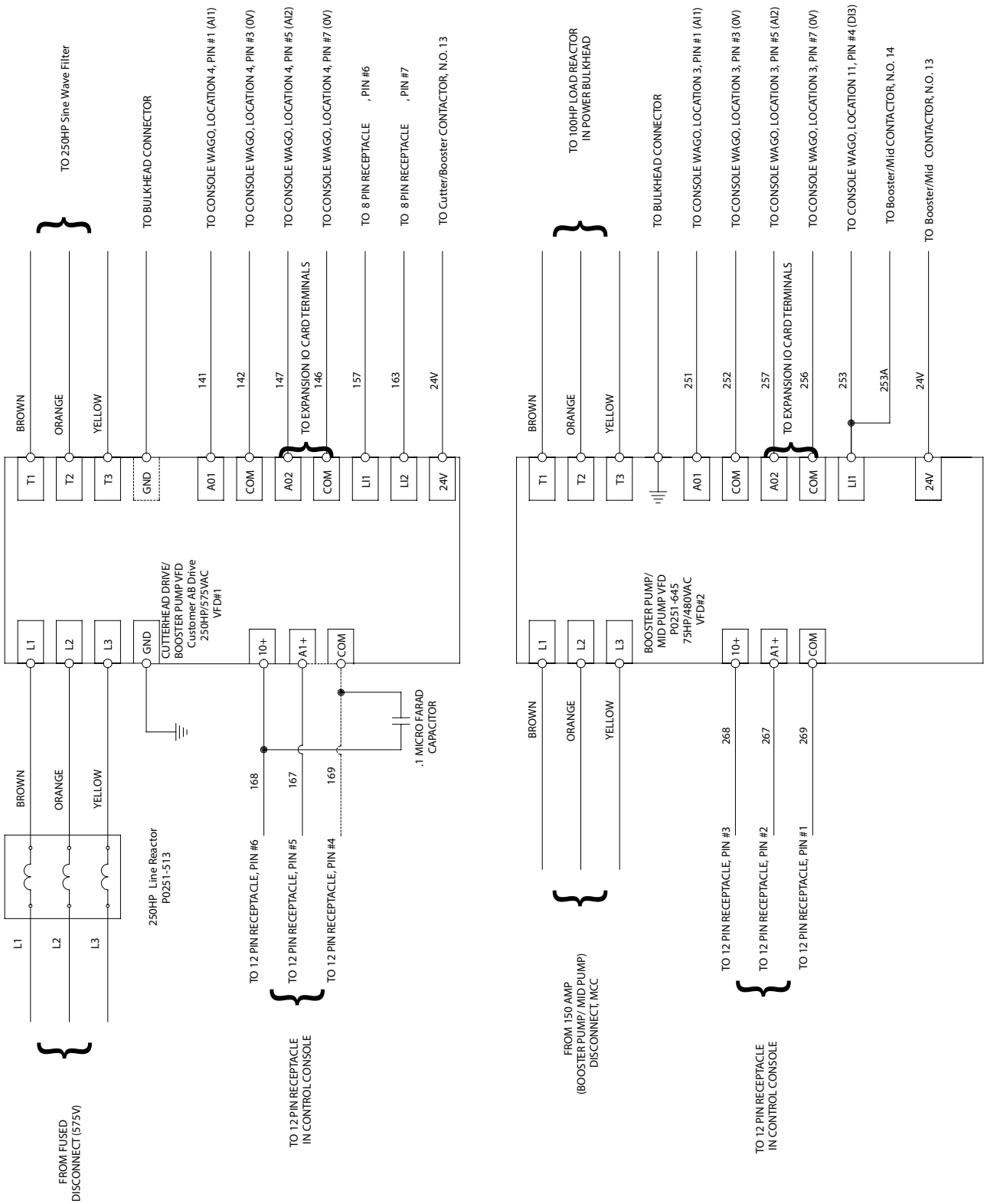


CONTROL CONTAINER TRANSFORMER ELECTRICAL SCHEMATIC - SN FA22300F



CONTROL CONTAINER VFD ELECTRICAL SCHEMATICS - SN FA22300F

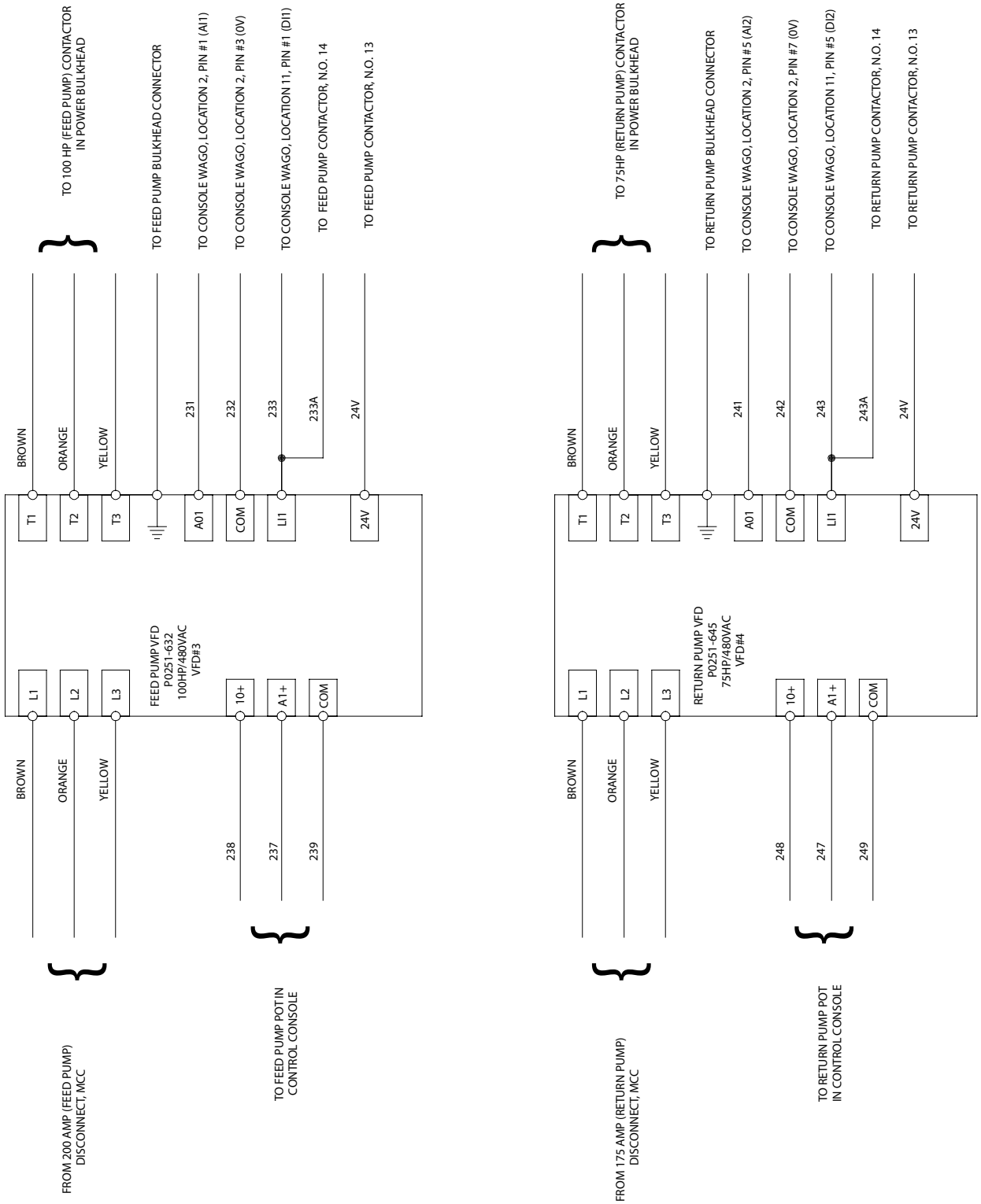
Electrical Schematic - Part 1 of 2



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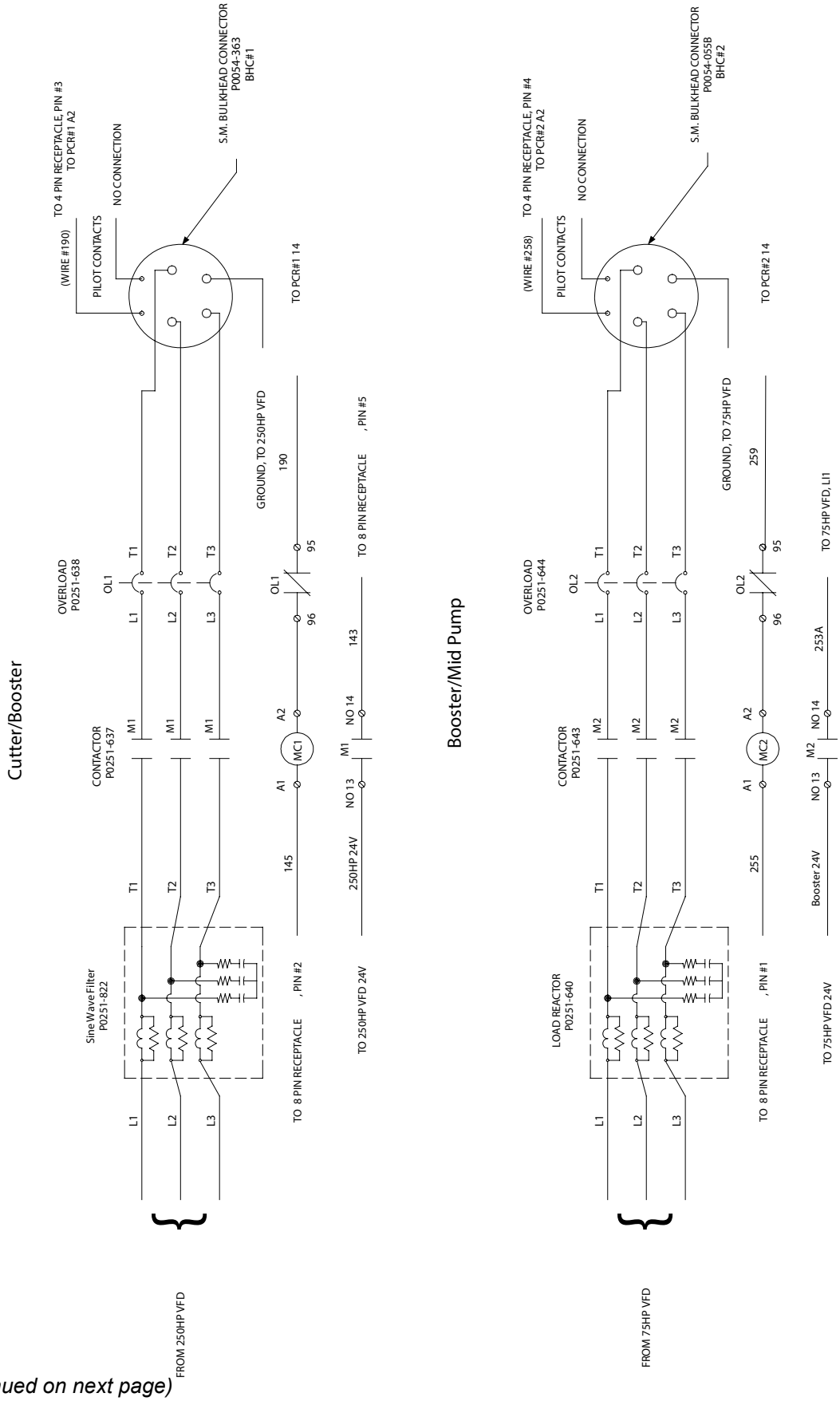
Control Container VFD Electrical Schematics (continued)

Electrical Schematic - Part 2 of 2



CONTROL CONTAINER BULKHEAD ELECTRICAL SCHEMATICS - SN FA22300F

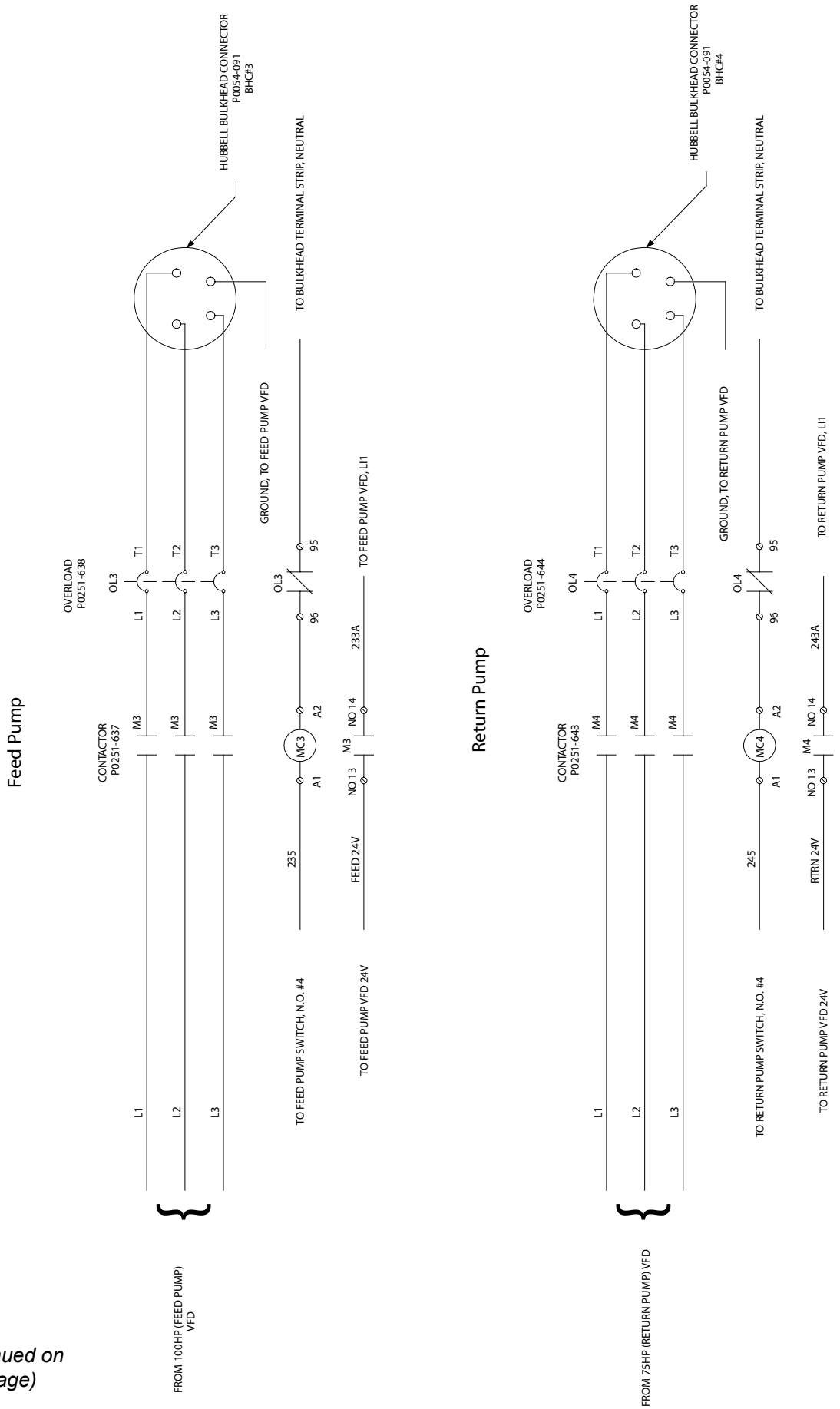
Electrical Schematic - Part 1 of 3



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Control Container Bulkhead Electrical Schematics (continued)

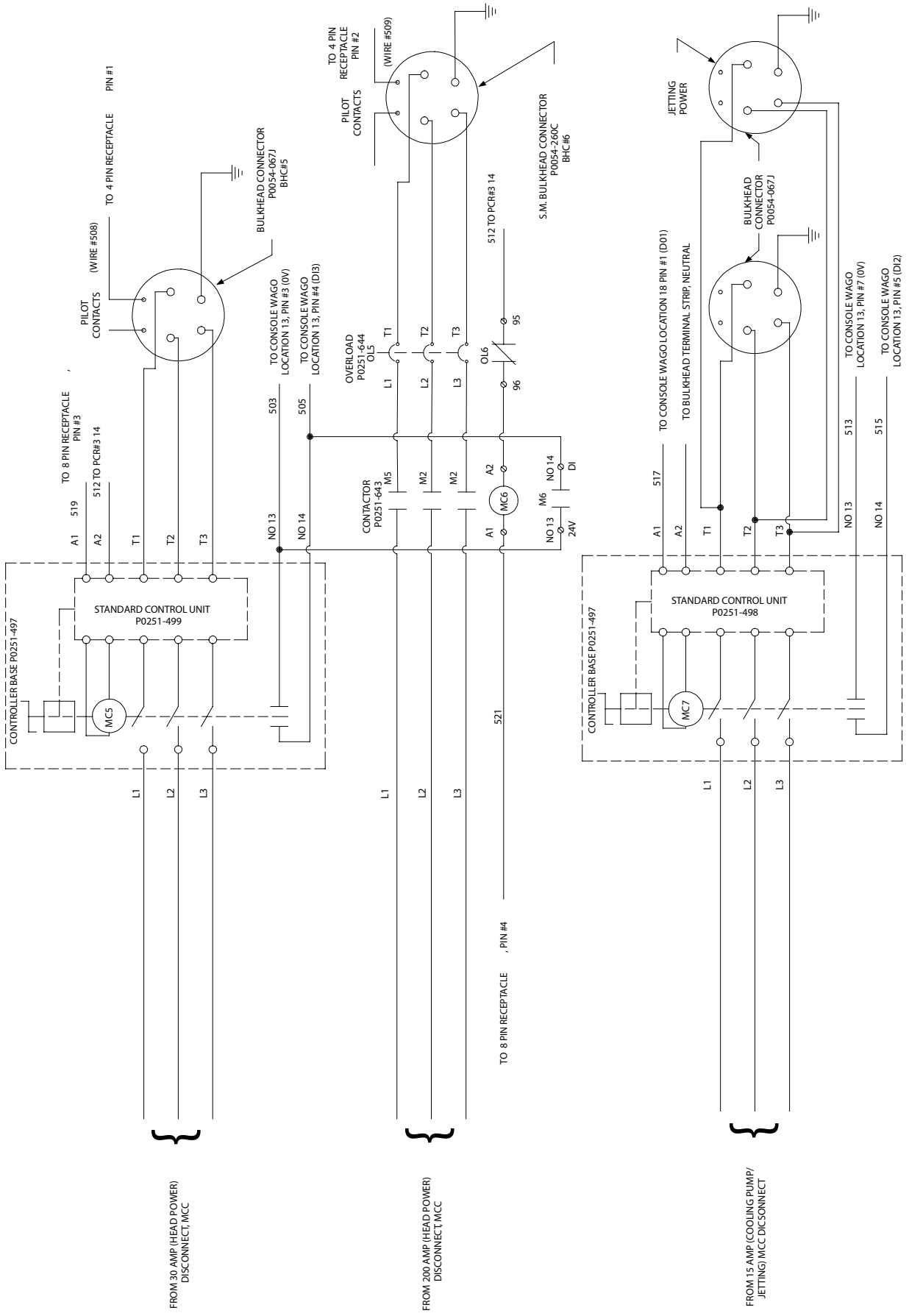
Electrical Schematic - Part 2 of 3



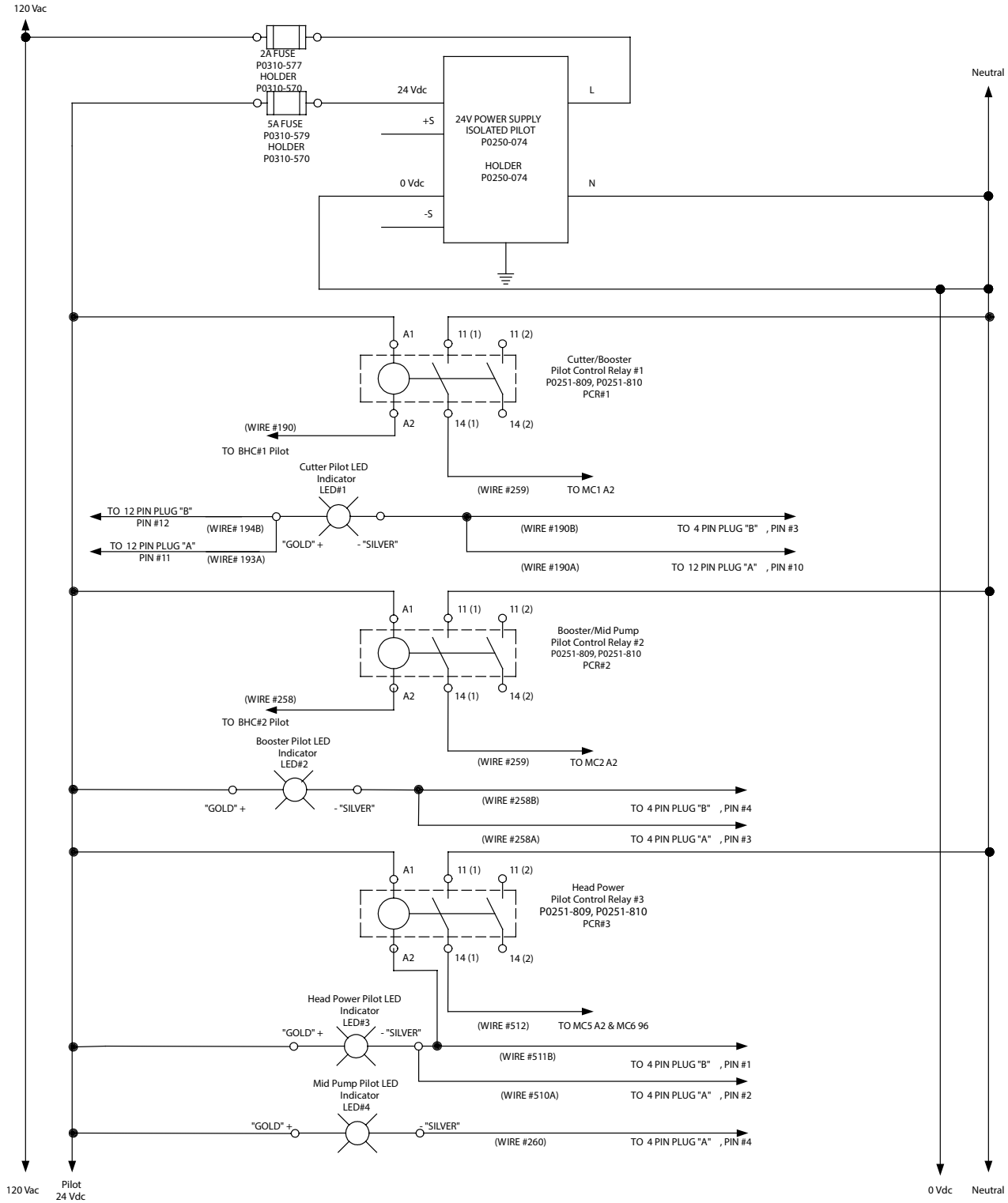
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Control Container Bulkhead Electrical Schematics (continued)

Electrical Schematic - Part 3 of 3



BULKHEAD PILOT CIRCUIT INDICATOR WITH INDICATORS IN CONTROL CONSOLE - SN FA22300F



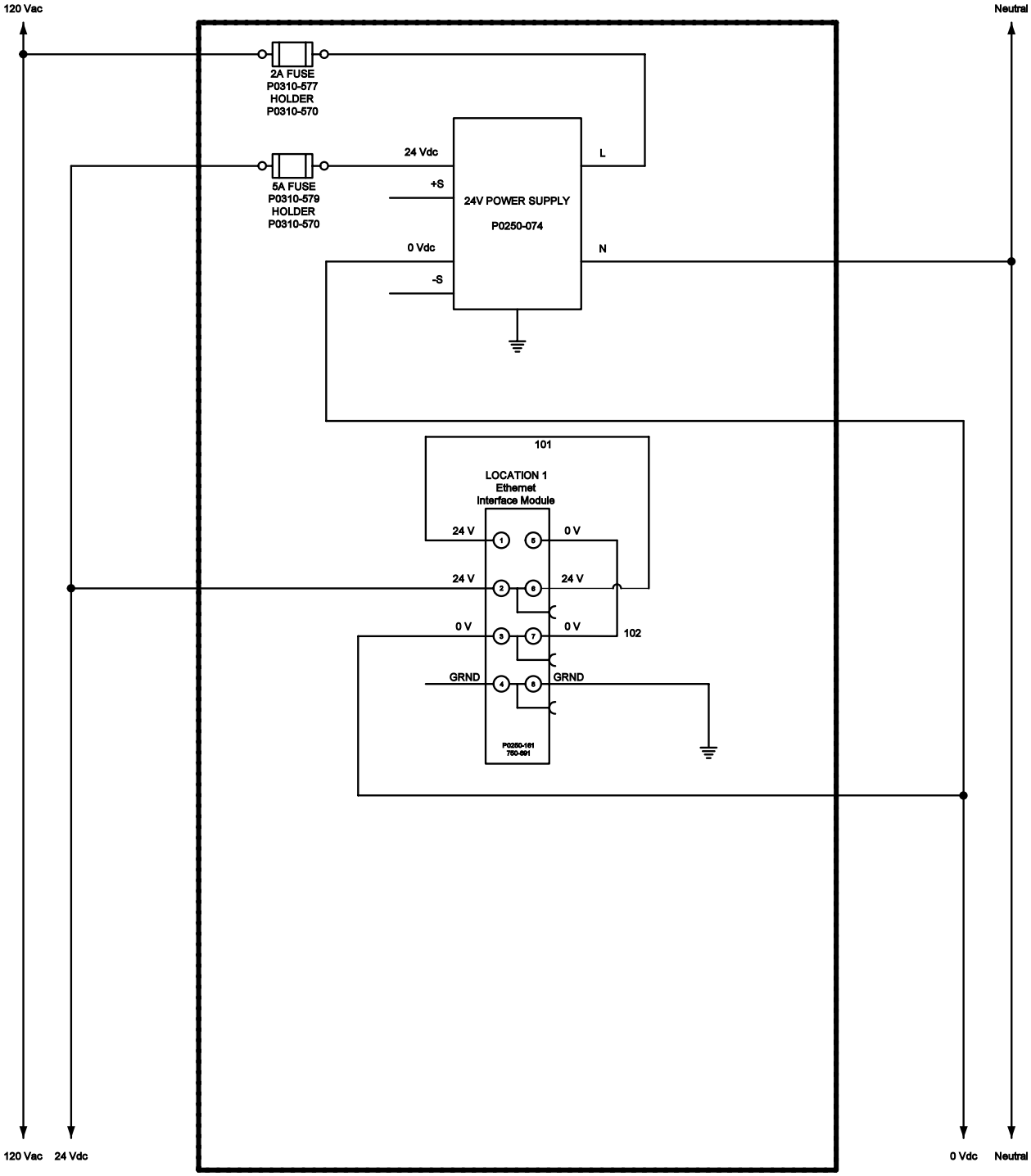
WIRE NUMBER TABLE - CONTROL CONTAINER - SN FA22300F

Wire Numbe	Description	From Location #1	To Location #2	Wire Color/Gauge
0v	Ground	various	various	Wht/Blu 16 AWG
24v	24 Vdt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	various	various	White 16 AWG
120 L	120VAC Line	various	various	Black 16 AWG
139	Cutter Head Switch	8 Pin Rec Pin 8	Wago #10 DI4	White 20 AWG
139A	Cutter Head Switch	SW22 NO#2 Pin #4	8 Pin Plug A Pin 8	White 20 AWG
141	Cutter Head RPM Analog 4-20mA	Cutter Head VFD#1 A01	Wago #4 AI1	Sheilded CBL#1 Black 1
142	Cutter Head Common	Cutter Head VFD#1 Com	Wago #4 0V	Sheilded CBL#1 White 1
143	Large Contactor In	M1 NO	8 Pin Rec Pin 5	Blue 20 AWG
143A	Booster Contactor In - Large MTBM	8 Pin Plug Pin 5/ Pin 6	Wago #11 DI4	Blue 20 AWG
143B	Cutter Contactor In - Small MTBM	8 Pin Plug Pin 5	Wago #11 DI4	Blue 20 AWG
145	Cutter/Booster Contactor	MC1 A1	8 Pin Rec Pin 2	Blu/Blk 16 AWG
145A	Booster Pump Switch +120VAC	8 Pin Plug Pin 2	8 Pin Plug A Pin 2	Blu/Blk 16 AWG
145B	Cutterhead Switch	SW22 NO#1 Pin #4	8 Pin Plug B Pin 2	Blu/Blk 16 AWG
146	Cutter Head Common	Cutter Head VFD#1 Com	Wago #4 0V	Sheilded CBL#1 White 2
147	Cutter Head Torque Analog 4-20mA	Cutter Head VFD#1 A02	Wago #4 AI2	Sheilded CBL#1 Black 2
149	Cutter Left	Light X1	Wago #10 DI1	Blue 20 AWG
151	Cutter Stop	Cutter Stop PB14	Wago #13 DI2	Blue 20 AWG
153	Cutter Right	Cutter Right PB15	Wago #10 DI3	Blue 20 AWG
155	Cutter Left Button Light	Light X1	Wago #15 DO1	Blue 20 AWG
157	125/250HP VFD Run Forward	VFD#1 LI1	8 Pin Rec Pin 6	Blue 20 AWG
157B	Cutter Left Command	8 Pin Plug Pin 6	Wago #15 DO1	Blue 20 AWG
159	Cutter Stop Button Light	Light X1	Wago #15 DO2	Blue 20 AWG
161	Cutter Right Button Light	Light X1	Wago #16 DO1	Blue 20 AWG
163	125/250HP VFD Run Reverse	VFD#1 LI2	8 Pin Rec Pin 7	Blue 20 AWG
163B	Cutter Right Command	8 Pin Plug Pin 7	Wago #16 DO1	Blue 20 AWG
167	Cutter/Booster Speed Command	VFD#1 AI1	12 Pin Rec Pin 5	Sheilded CBL#1 Black 3
167A	Booster Pump Speed Command	POT3	12 Pin Plug A Pin 5	Black 20 AWG
167B	Cutterhead Pot Signal	POT4	12 Pin Plug B Pin 5	Black 20 AWG
168	Cutter/Booster POT +	VFD#1 10+	12 Pin Rec Pin 3	Sheilded CBL#1 Black 4
168A	Booster Pump Pot +	POT3	12 Pin Plug A Pin 6	Black 20 AWG
168B	Cutterhead Pot +	POT4	12 Pin Plug B Pin 6	Black 20 AWG
169	Cutter/Booster POT Common	VFD#1 COM	12 Pin Rec Pin 1	Sheilded CBL#1 White 4
169A	Booster Pump Pot COM	POT3	12 Pin Plug A Pin 4	White 20 AWG
169B	Cutterhead Pot COM	POT4	12 Pin Plug B Pin 4	White 20 AWG
187	Cutterhead Pot Signal	12 Pin Rec Pin 8	Wago #19 AI1	White 20 AWG
187A	Cutterhead Pot Signal	POT4	12 Pin Plug A Pin 8	White 20 AWG
188A	Cutterhead Pot +	POT4	12 Pin Plug A Pin 7	Black 20 AWG
189	Cutterhead Pot COM	12 Pin Rec Pin 9	Wago #19 Common	White 20 AWG
189A	Cutterhead Pot COM	POT4	12 Pin Plug A Pin 9	White 20 AWG
190	Cutter/Booster Pilot Relay Ground	BHC#1 Pilot	4 Pin Rec Pin 3	Blu/Wht 16 AWG
190A	Booster Pilot LED Ground	12 Pin Plug A Pin 10	LED#1 Silver-	White 20 AWG
190B	Cutter Pilot LED Ground	4 Pin Plug B Pin 3	LED#1 Silver-	White 20 AWG
193A	Cutter Pilot LED Supply	12 Pin Plug A Pin 11	LED#1 Gold+	Black 20 AWG
194B	Cutter Pilot LED Supply	12 Pin Plug B Pin 12	LED#1 Gold+	Black 20 AWG
195	Cutter Pilot Contactor Ground	PCR#1	MC1 OL1 95	White 16 AWG
196	Cutter Pilot LED Wago Supply	12 Pin Rec Pin 11	Wago #16 DI2	Blue 20 AWG
197	Cutter Pilot LED Wago 0v	12 Pin Rec Pin 10	Wago #16 0v	White 20 AWG
211	Cutting Valve Open	Extend PB7	Wago #8 DI1	Blue 20 AWG
213	Chamber Valve Open	Retract PB8	Wago #8 DI2	Blue 20 AWG
215	Stop Valve Open	Extend PB9	Wago #9 DI1	Blue 20 AWG
217	Stop Valve Close	Retract PB10	Wago #9 DI2	Blue 20 AWG
219	Bypass Valve Open	Extend PB11	Wago #11 DI3	Blue 20 AWG
221	Bypass Valve Close	Retract PB12	Wago #12 DI4	Blue 20 AWG
231	Feed Pump RPM Analog 4-20mA	Feed Pump VFD A01	Wago #2 AI1	Sheilded CBL#2 Black 1
232	Feed Pump Common	Feed Pump VFD Com	Wago #2 0V	Sheilded CBL#2 White 1
233	Feed Pump Contactor In	VFD#3 LI1	Wago #11 DI1	Sheilded CBL#2 White 2
233A	Feed Pump Contactor In	M3 NO	VFD#3 LI1	Blue 20 AWG
235	Feed Pump Switch +120VAC	SW#18 NO Pin#4	MC3 A1	Blu/Blk 16 AWG
237	Feed Pump Speed Command	POT1	VFD#3 AI1	Sheilded CBL#2 Black 2
238	Feed Pump Pot +	POT1	VFD#3 10V+	Sheilded CBL#2 Black 3
239	Feed Pump Pot COM	POT1	VFD#3 COM	Sheilded CBL#2 White 3
241	Return Pump RPM Analog 4-20mA	Return Pump VFD A01	Wago #2 AI2	Sheilded CBL#3 Black 2
242	Return Pump Common	Return Pump VFD Com	Wago #2 0V	Sheilded CBL#3 White 2
243	Return Pump Contactor In	VFD#4 LI1	Wago #11 DI2	Sheilded CBL#3 White 2

Wire Numbe	Description	From Location #1	To Location #2	Wire Color/Gauge
243A	Return Pump Contactor In	M4 NO	VFD#4 LI1	Blue 20 AWG
245	Return Pump Switch +120VAC	SWx #4	MC4 A1	Blu/Blk 16 AWG
247	Return Pump Speed Command	POT2	VFD#4 AI1	Sheilded CBL#3 Black 2
248	Return Pump Pot +	POT2	VFD#4 10V+	Sheilded CBL#3 Black 3
249	Return Pump Pot COM	POT2	VFD#4 COM	Sheilded CBL#3 White 3
251	Booster Pump RPM Analog 4-20mA	Booster Pump VFD A01	Wago #3 AI1	Sheilded CBL#4 Black 1
252	Booster Pump Common	Booster Pump VFD Com	Wago #3 0V	Sheilded CBL#4 White 1
253	Booster Pump Contactor In	VFD#2 LI1	Wago #11 DI3	Sheilded CBL#4 White 3
253A	Booster Pump Contactor In	M2 NO	VFD#2 LI1	Blue 20 AWG
255	Booster/Mid Pump Contactor	8 Pin Rec Pin 1	MC2 A1	Blu/Blk 16 AWG
255A	Mid Pump Switch +120VAC	SW20 #4	8 Pin Plug A Pin 1	Blu/Blk 16 AWG
255B	Booster Pump Switch +120VAC	SW20 #4	8 Pin Plug B Pin 1	Blu/Blk 16 AWG
256	Booster Pump Common	Booster Pump VFD Com	Wago #3 0V	Sheilded CBL#4 White 2
257	Booster Pump Torque Analog 4-20mA	Booster Pump VFD A02	Wago #3 AI2	Sheilded CBL#4 Black 2
258	Booster/Mid Pilot Relay Ground	BHC#2 Pilot	4 Pin Rec Pin 4	Blu/Wht 16 AWG
258A	Mid Pump Pilot LED Ground	4 Pin Plug A Pin 3	Mid Pilot Relay	Blu/Wht 16 AWG
258B	Booster Pilot LED Ground	4 Pin Plug B Pin 4	Booster Pilot Relay	Blu/Wht 16 AWG
259	Booster Pilot Contactor Ground	PCR#2	MC2 OL2 95	White 16 AWG
260	Mid Pilot LED Ground	LED#3 Silver -	4 Pin Plug A Pin 4	White 20 AWG
267	Mid/Booster Pump Speed Command	VFD#2 AI1	12 Pin Rec Pin 2	Shelded CBL#4 Blk 3
267A	Mid Pump Pot Speed Command	POT5	12 Pin Plug A Pin 2	Black 20 AWG
267B	Booster Pump Speed Command	POT3	12 Pin Plug B Pin 2	Black 20 AWG
268	Mid/Booster Pump POT +	VFD#2 10+	12 Pin Rec Pin 2	Black 20 AWG
268A	Mid Pump Pot +	POT5	12 Pin Plug A Pin 3	Black 20 AWG
268B	Booster Pump Pot +	POT3	12 Pin Plug B Pin 3	Black 20 AWG
269	Mid/Booster Pump POT COM	VFD#2 COM	12 Pin Rec Pin 1	Black 20 AWG
269A	Mid Pump Pot COM	POT5	12 Pin Plug A Pin 1	White 20 AWG
269B	Booster Pump Pot COM	POT3	12 Pin Plug B Pin 1	White 20 AWG
301	Steering Top Cylinder Extend	Extend PB1	Wago #7 DI1	Blue 20 AWG
303	Steering Top Cylinder Retract	Retract PB2	Wago #7 DI2	Blue 20 AWG
305	Steering Left Cylinder Extend	Extend PB3	Wago #7 DI3	Blue 20 AWG
307	Steering Left Cylinder Retract	Retract PB4	Wago #7 DI4	Blue 20 AWG
309	Steering Right Cylinder Extend	Extend PB5	Wago #8 DI1	Blue 20 AWG
311	Steering Right Cylinder Retract	Retract PB6	Wago #8 DI2	Blue 20 AWG
401	Jacking Selector Switch	Jacking Switch #3	Wago #13 DI1	Blue 20 AWG
403	Jacking Selector Switch	Jacking Switch #7	Wago #12 DI1	Blue 20 AWG
405	Jacking Selector Switch	Jacking Switch #5	Wago #12 DI2	Blue 20 AWG
407	Jacking Selector Switch	Jacking Switch #1	Wago #12 DI3	Blue 20 AWG
409	Jacking Selector Switch	Jacking Switch #5	Wago #12 DI4	Blue 20 AWG
410	Hydraulic Encoder Phase A	Encoder Dial Pin 4	Wago #5 Pin 1	Orange
411	Hydraulic Encoder Phase B	Encoder Dial Pin 2	Wago #5 Pin 2	Yellow
412	Hydraulic Encoder 5 Volt	Encoder Dial Pin 1	Wago #6 Pin 1	Red
413	Hydraulic Encoder 0 Volt	Encoder Dial Pin 3	Wago #6 Pin 3	Green
503	Head Power Contactor NO 13	MC6 NO 13	Wago #13 0V	Blu/Wht 16 AWG
505	Head Power Contactor NO 14	MC6 NO 14	Wago #13 DI3	Blu/Wht 16 AWG
508	Small MTBM Pilot Relay Ground	BHC#5 Pilot	4 Pin Rec Pin 1	Blu/Wht 16 AWG
509	Large MTBM Pilot Relay Ground	BHC#6 Pilot	4 Pin Rec Pin 2	Blu/Wht 16 AWG
510A	Head Power LED Ground	LED#3 Silver -	4 Pin Plug A Pin 2	White 20 AWG
511B	Head Power LED Ground	LED#3 Silver -	4 Pin Plug B Pin 1	White 20 AWG
512	Head Pilot Contactor Ground	PCR#3	MC5 A2 & MC6 OL6 95	White 16 AWG
513	Cooling Pump Contactor NO 13	MC7 NO 13	Wago #13 0V	Blu/Wht 16 AWG
515	Cooling Pump Contactor NO 14	MC7 NO 14	Wago #13 DI2	Blu/Wht 16 AWG
517	Cooling Pump Contactor A1	MC7 A1	Wago #18 DO1	Black 16 AWG
519B	Head Power Switch	SW#21 #4	8 Pin Plug B Pin 3	Black 16 AWG
521	Large MTBM Head Power Contactor	8 Pin Rec Pin 4	MC6 A1	Black 16 AWG
521A	Head Power Switch	SW#21 #4	8 Pin Plug A Pin 4	Black 16 AWG
601	Console E-Stop NC #2	E-Stop NC #2	A1 E-Stop CR#1	Blue 16 AWG
603	Console E-Stop NC #2	E-Stop NC #2	Wago #13 DI4	Blue 16 AWG
604	Wago E-Stop Trip	A1 E-Stop CR#2	Wago #18 DO2	Black 16 AWG

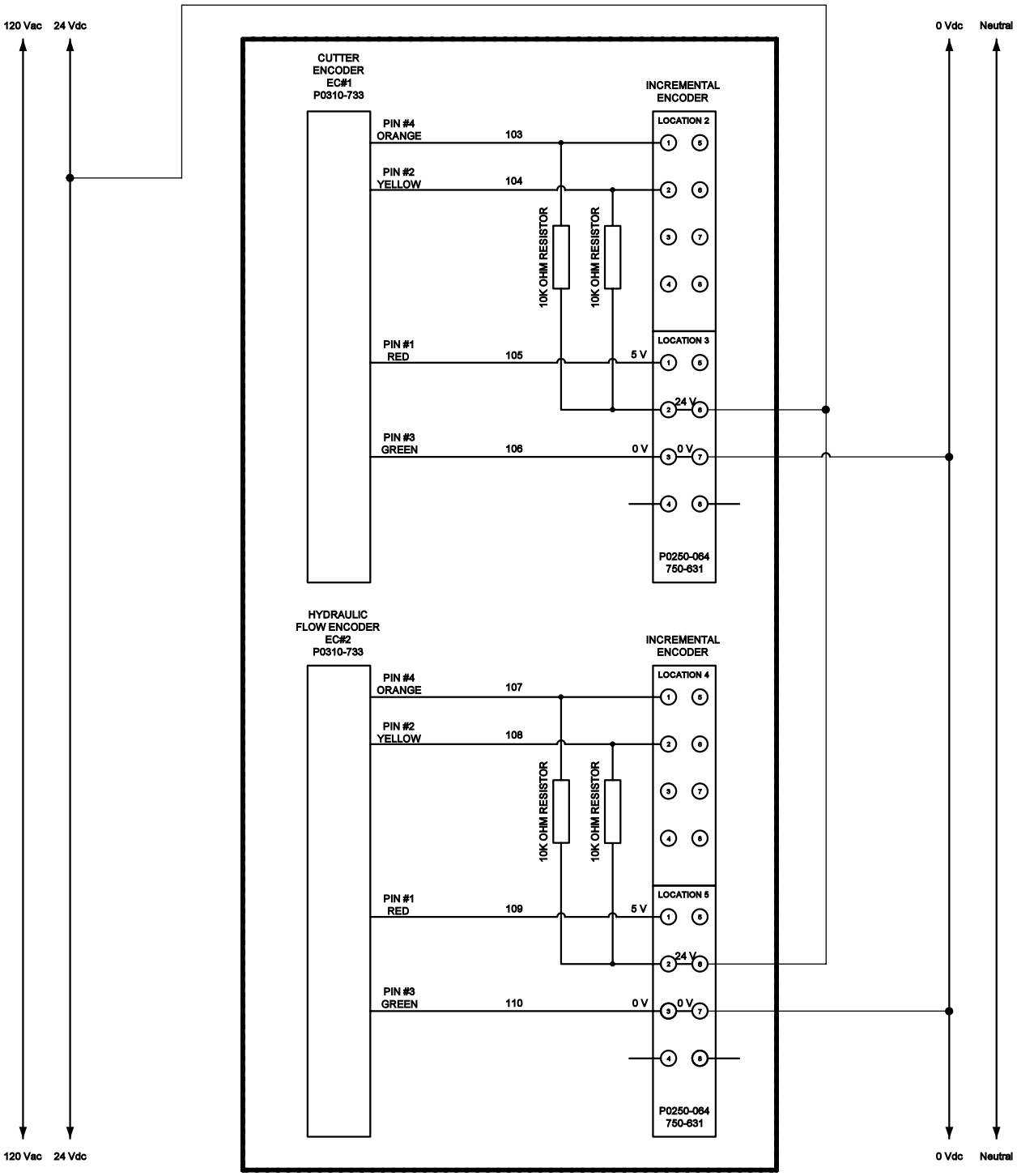
CONTROL CONSOLE ELECTRICAL SCHEMATICS - SN FA22242F

Electrical Schematic - Part 1 of 14



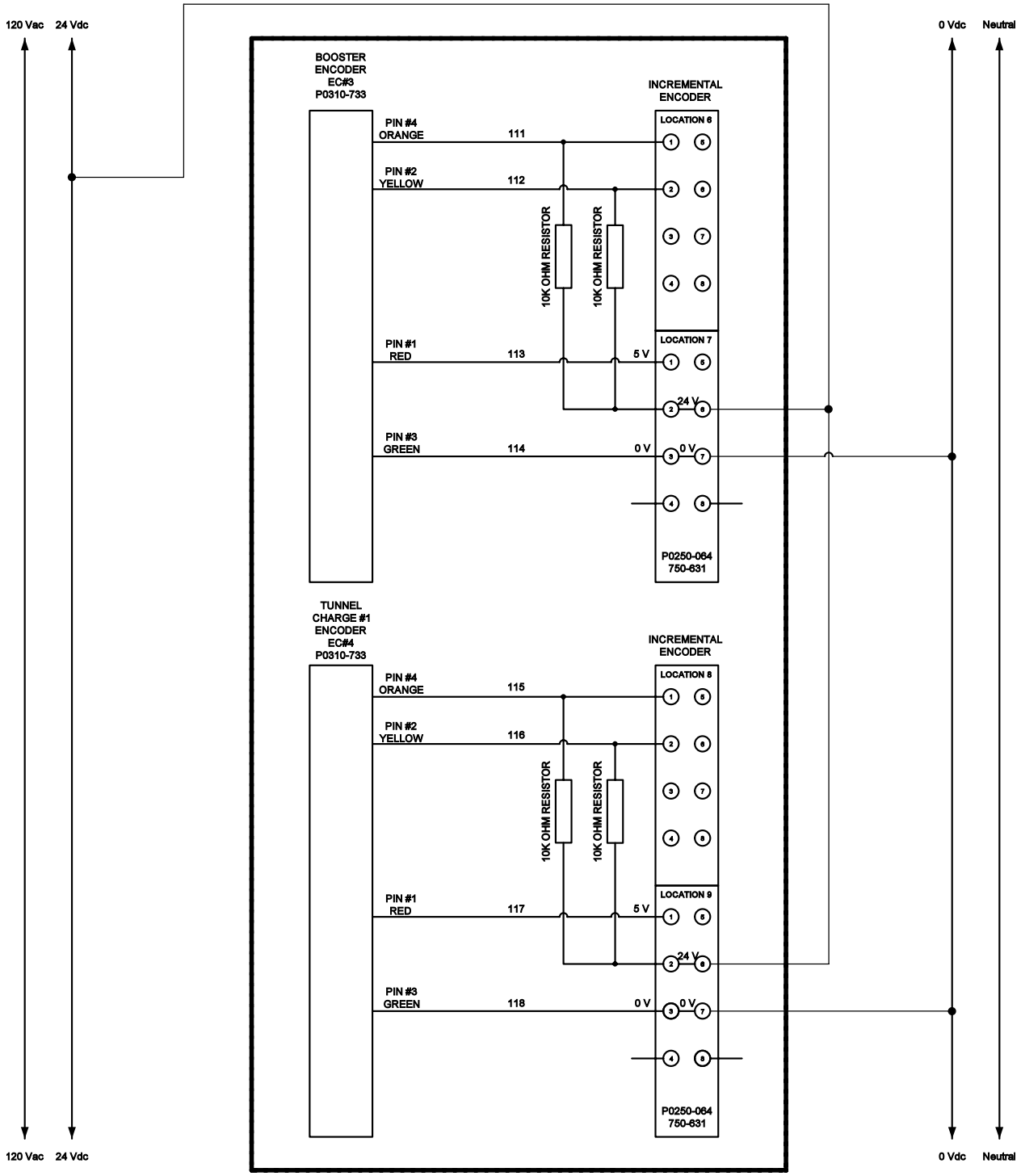
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 2 of 14



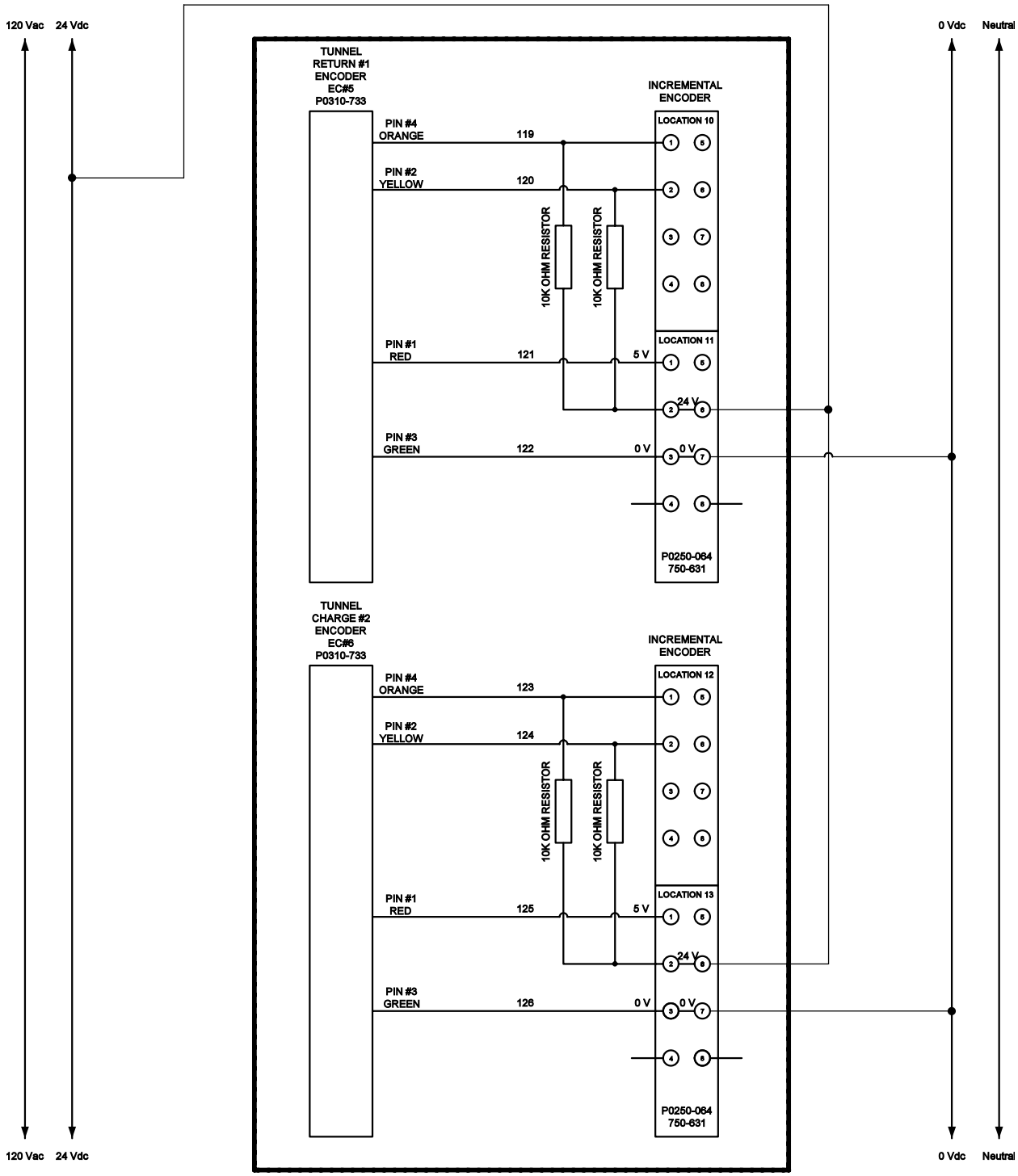
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 3 of 14



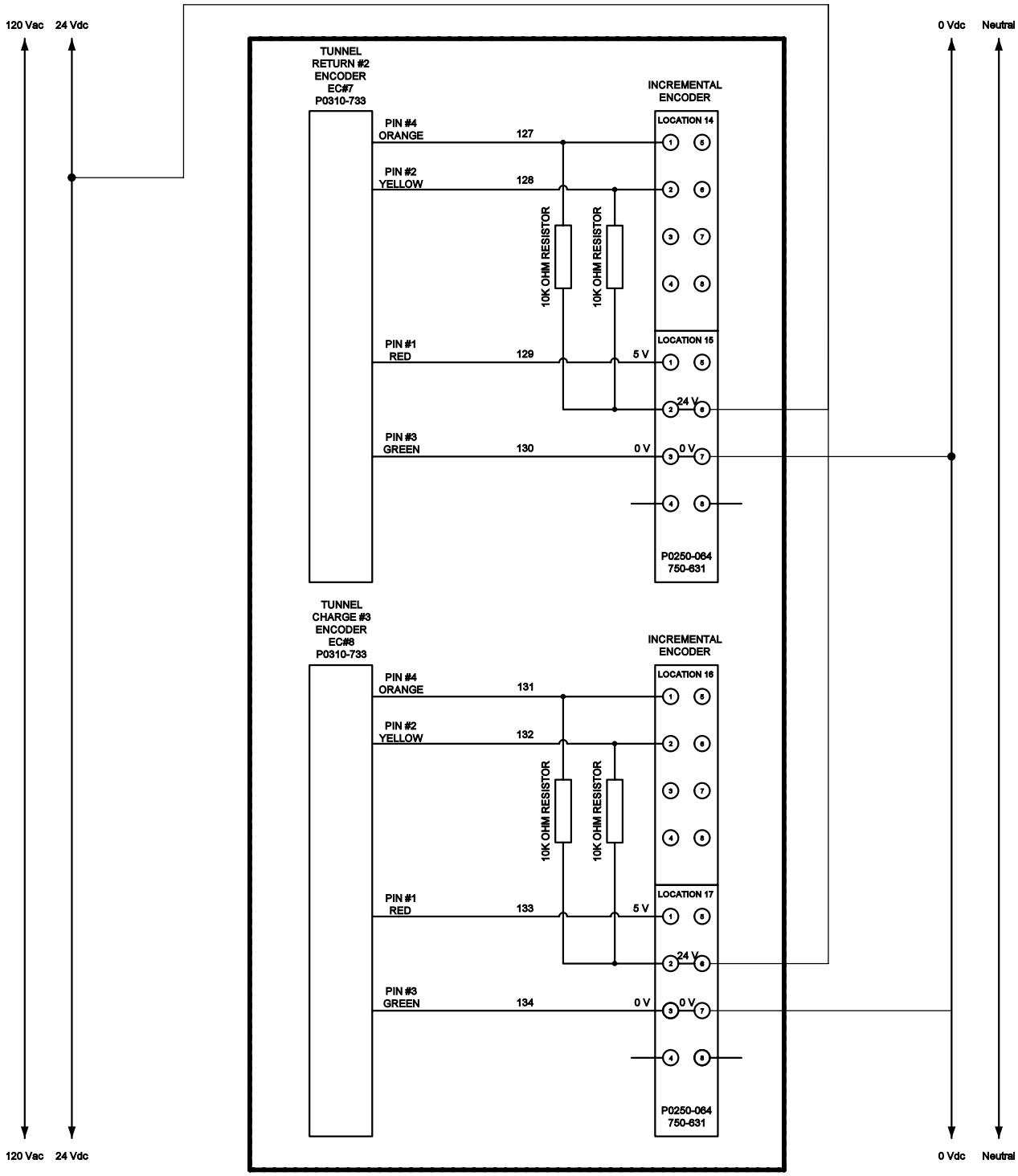
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 4 of 14



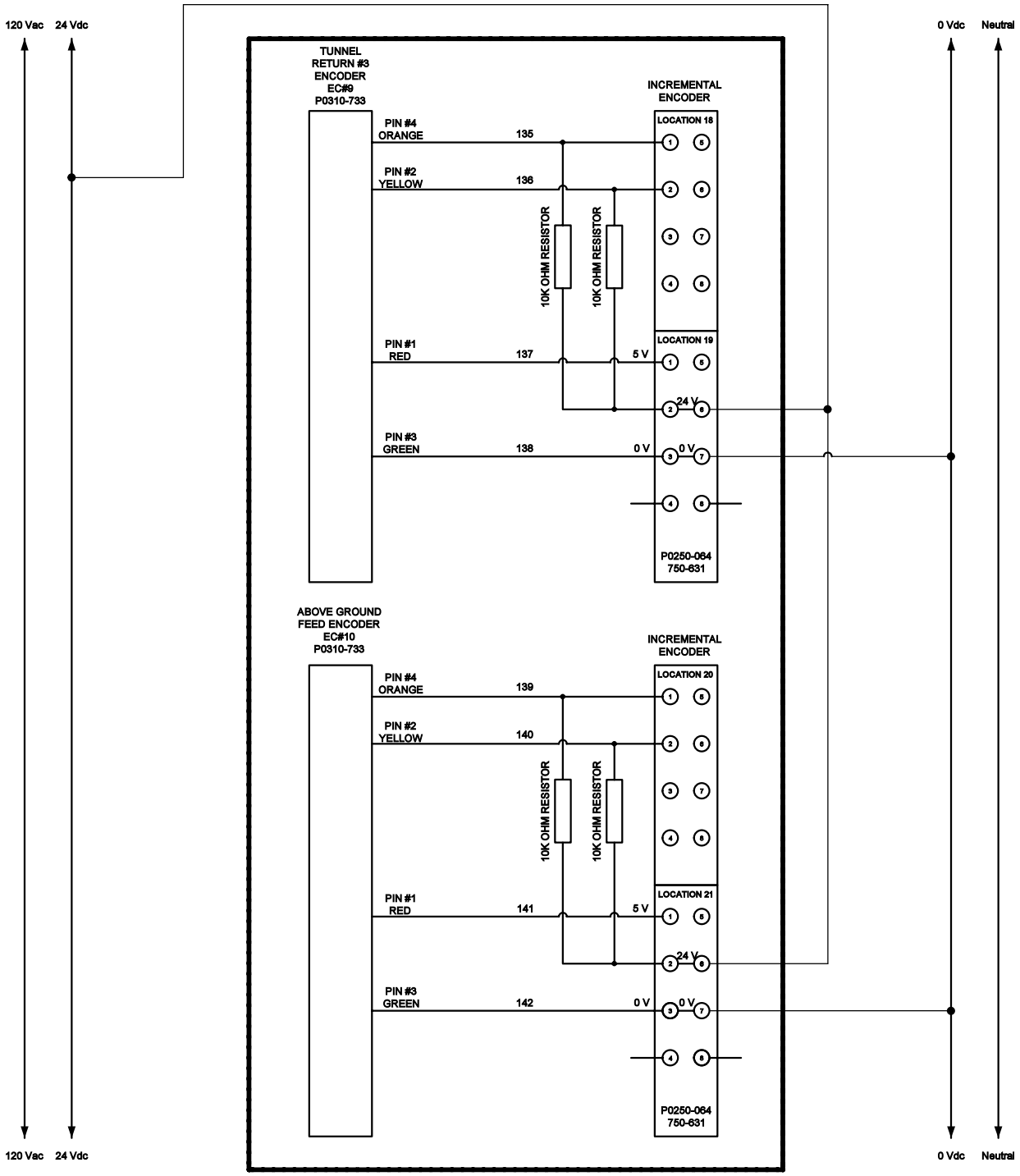
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 5 of 14



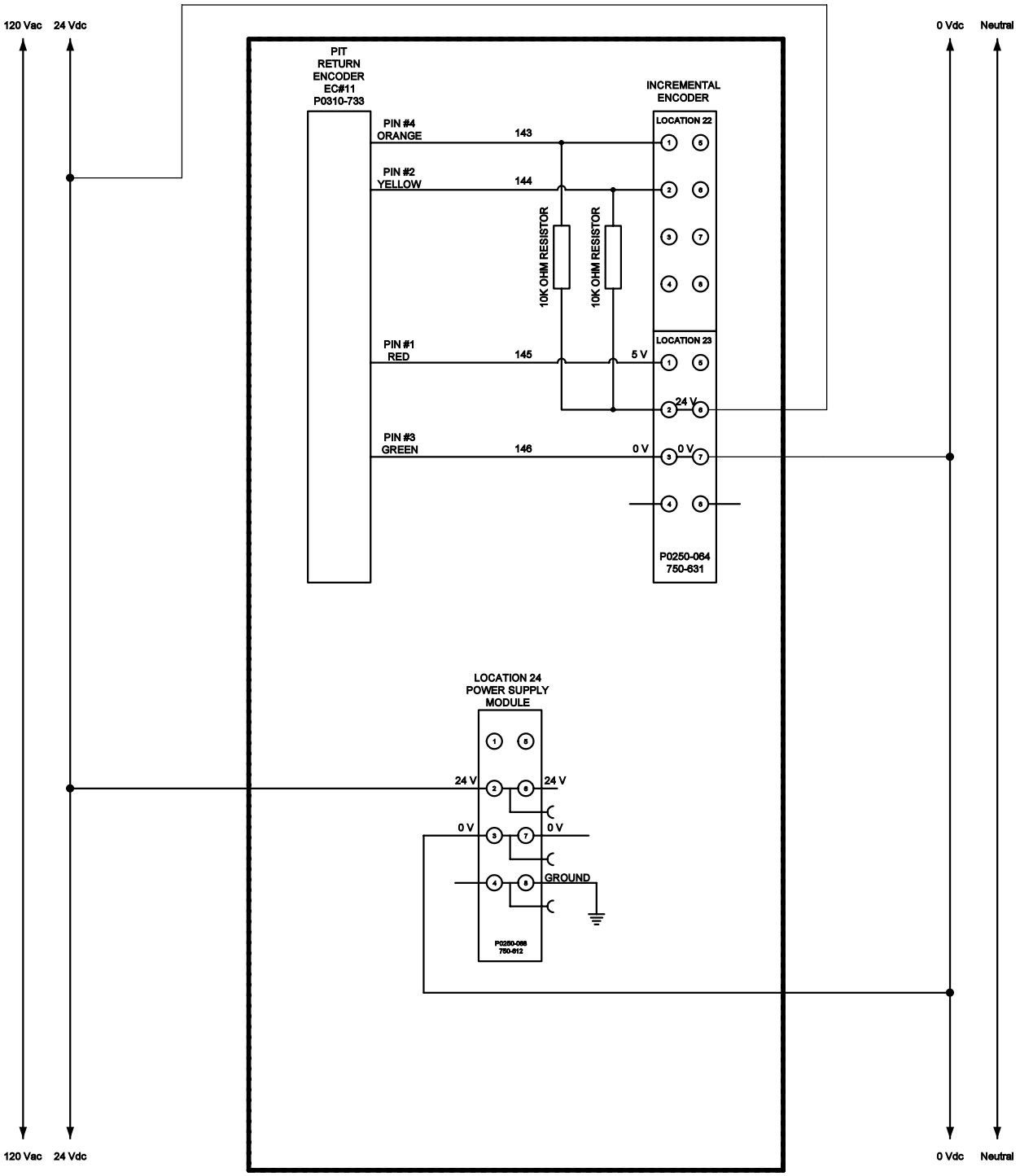
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 6 of 14



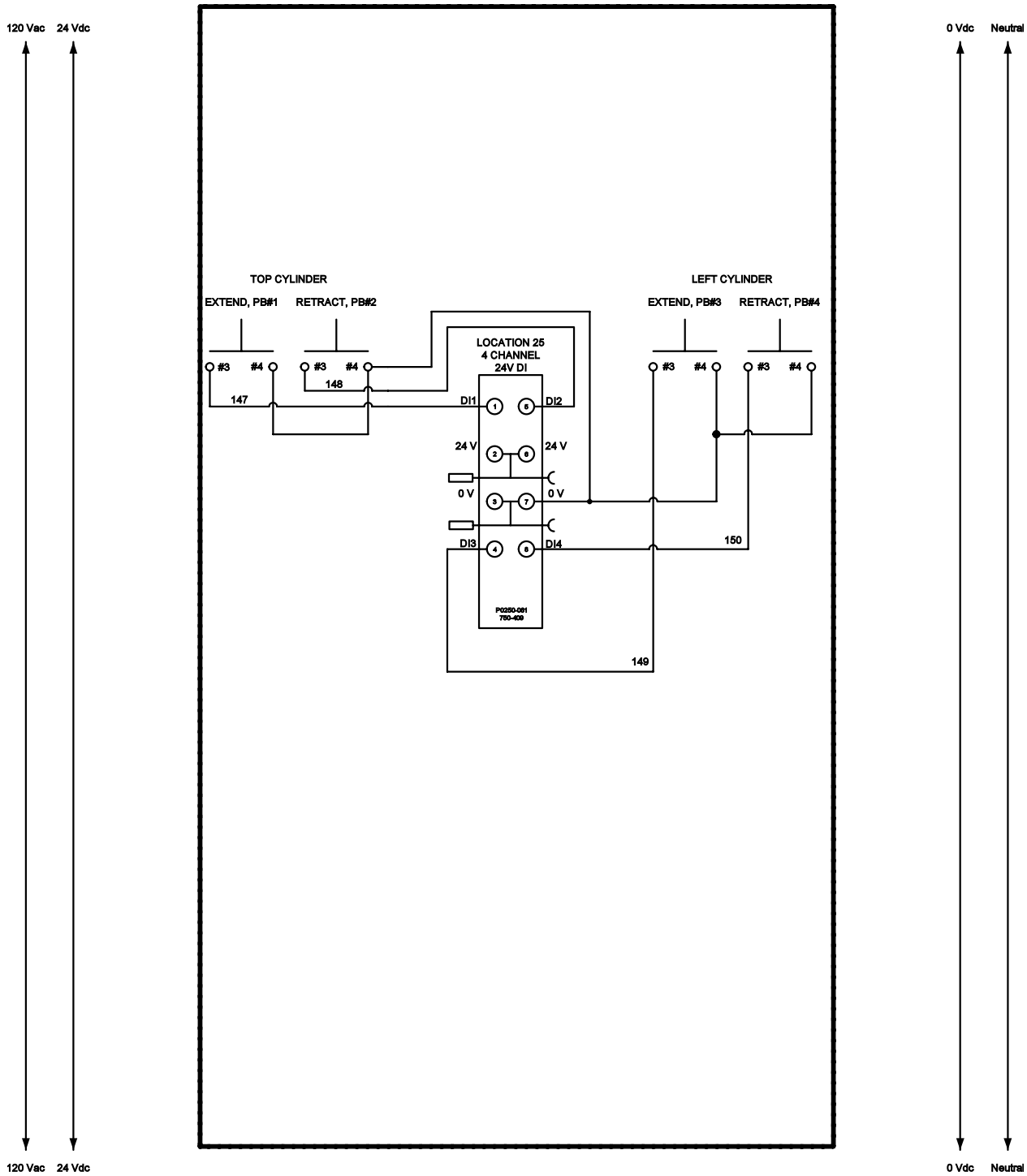
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 7 of 14



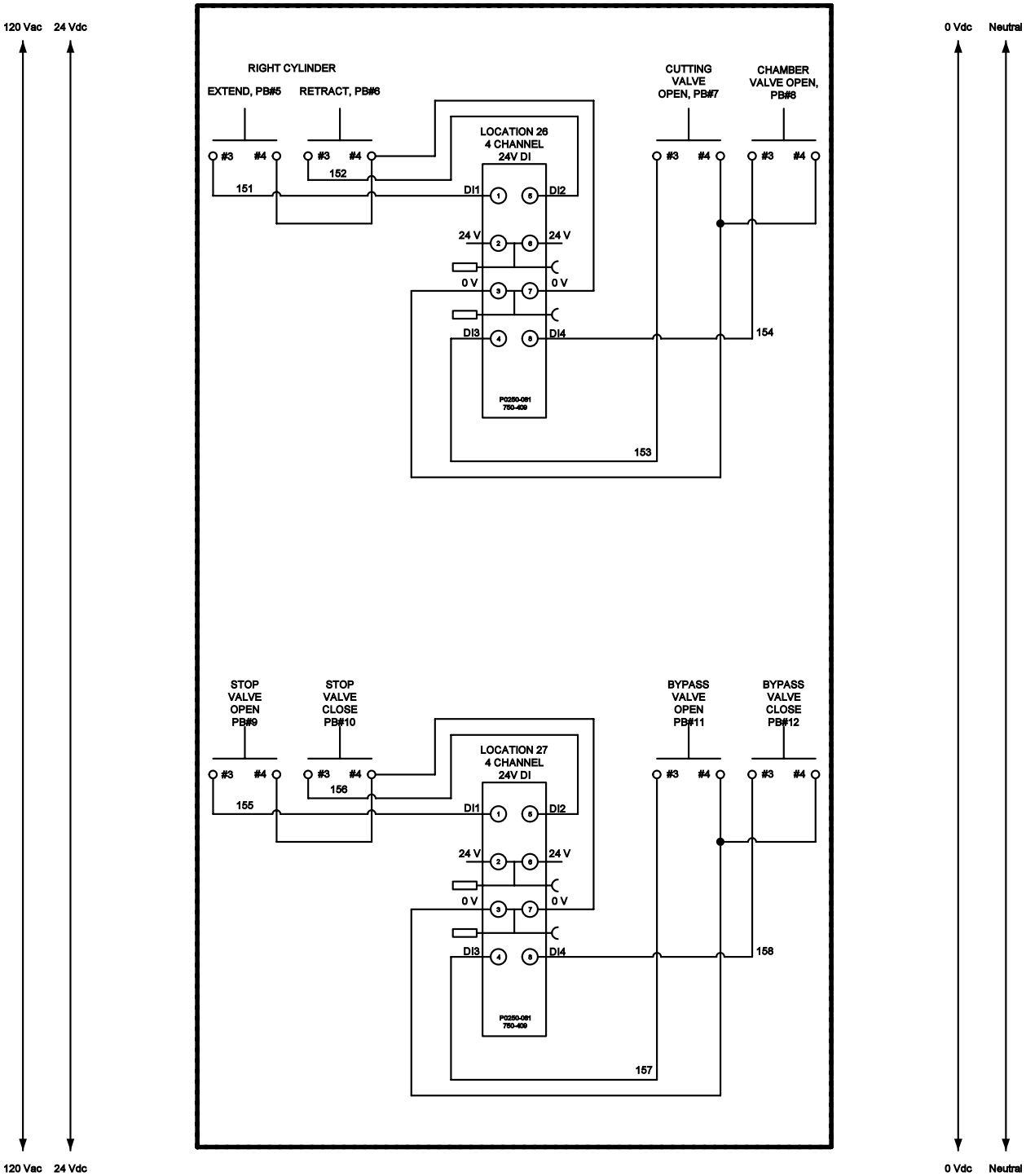
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 8 of 14



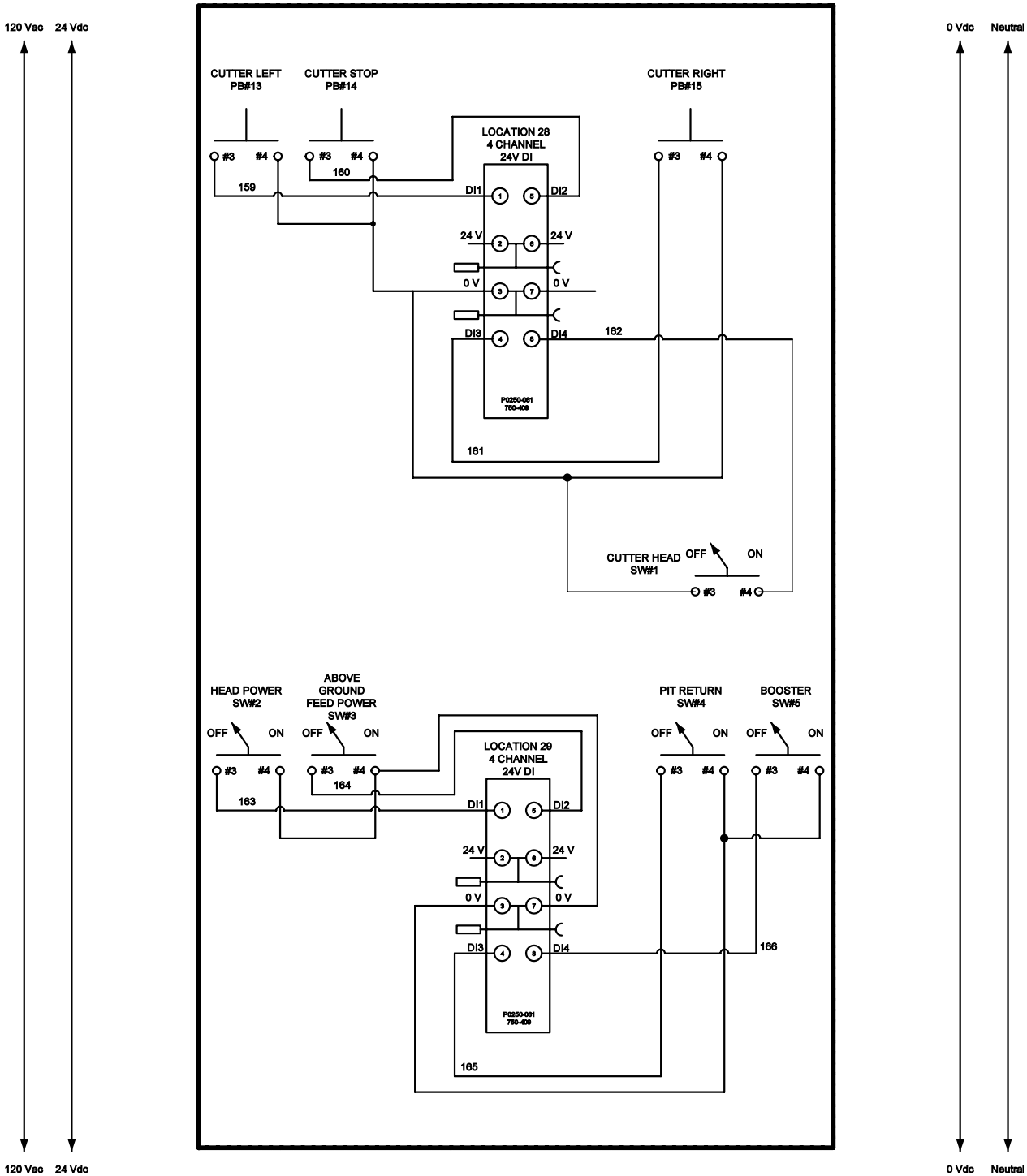
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 9 of 14



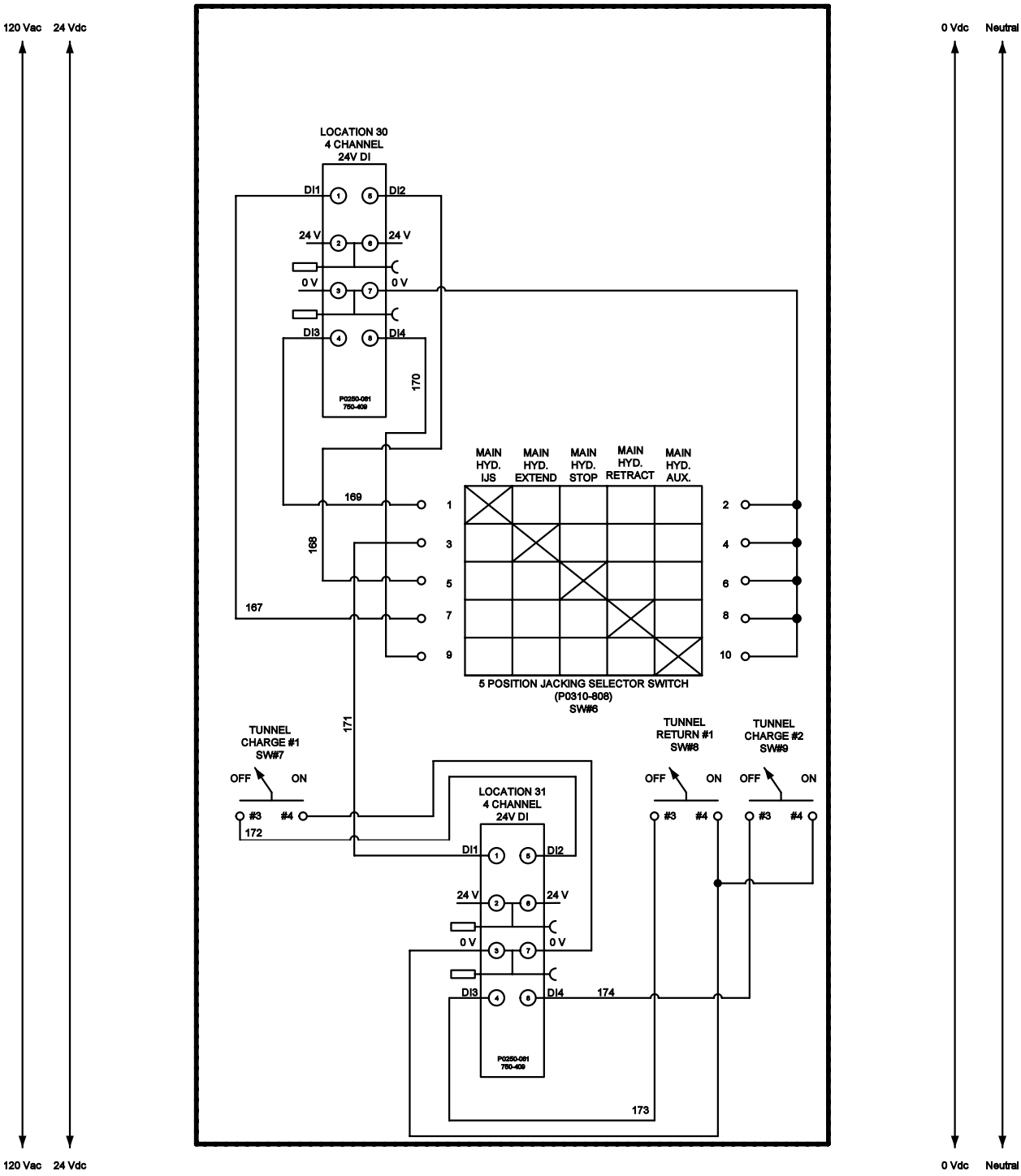
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 10 of 14



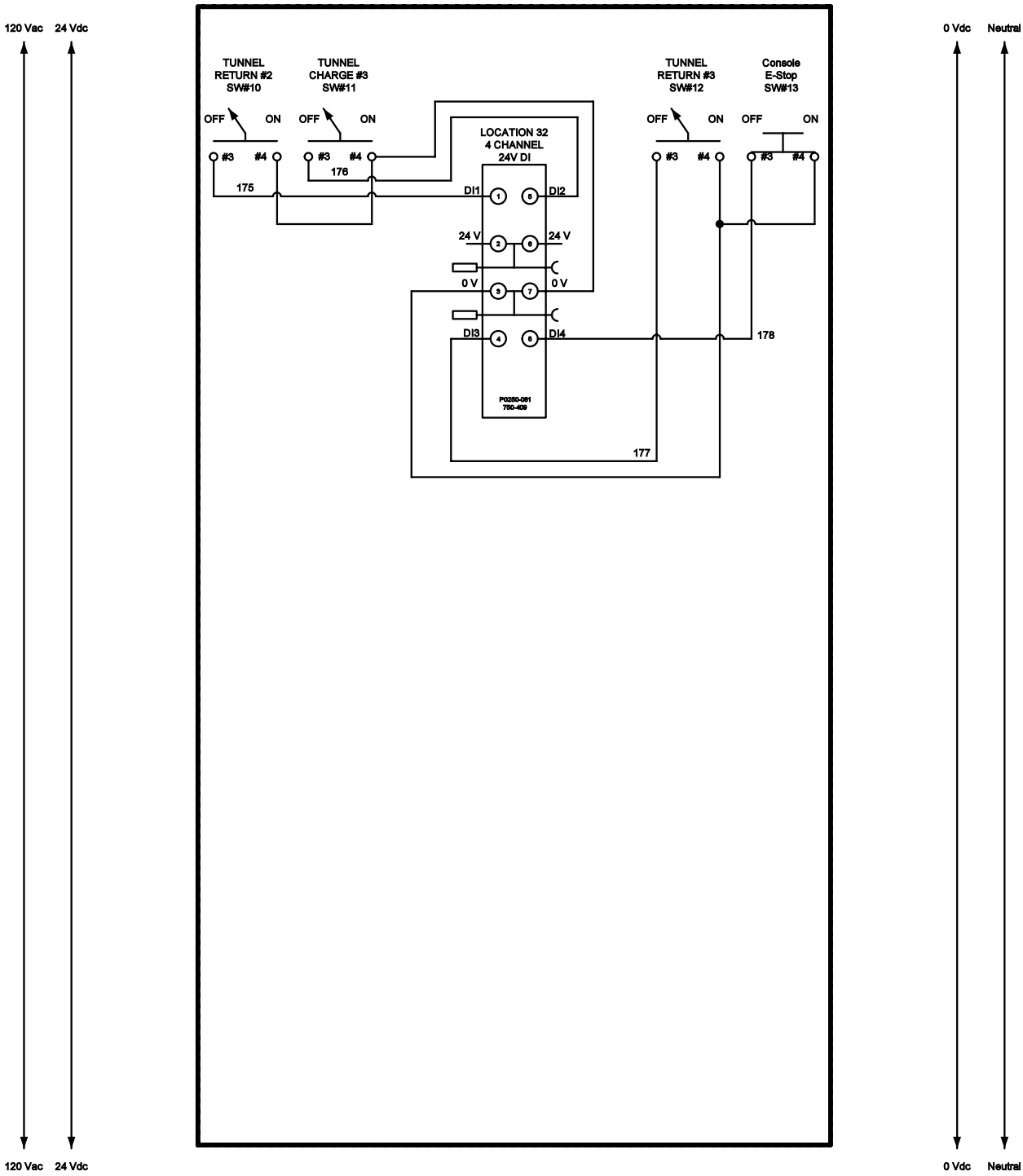
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 11 of 14



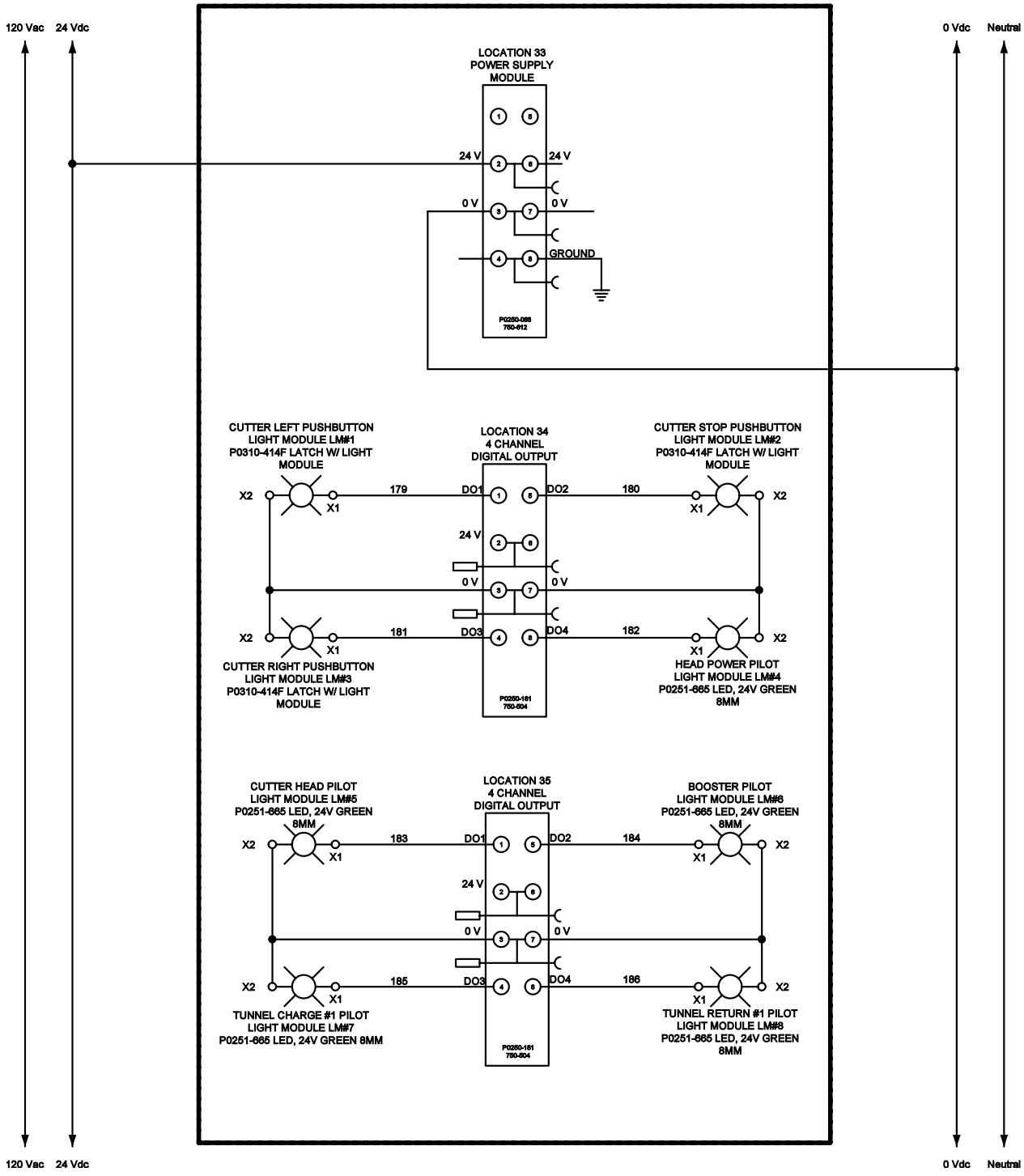
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Control Console Electrical Schematics (continued)
Electrical Schematic - Part 12 of 14



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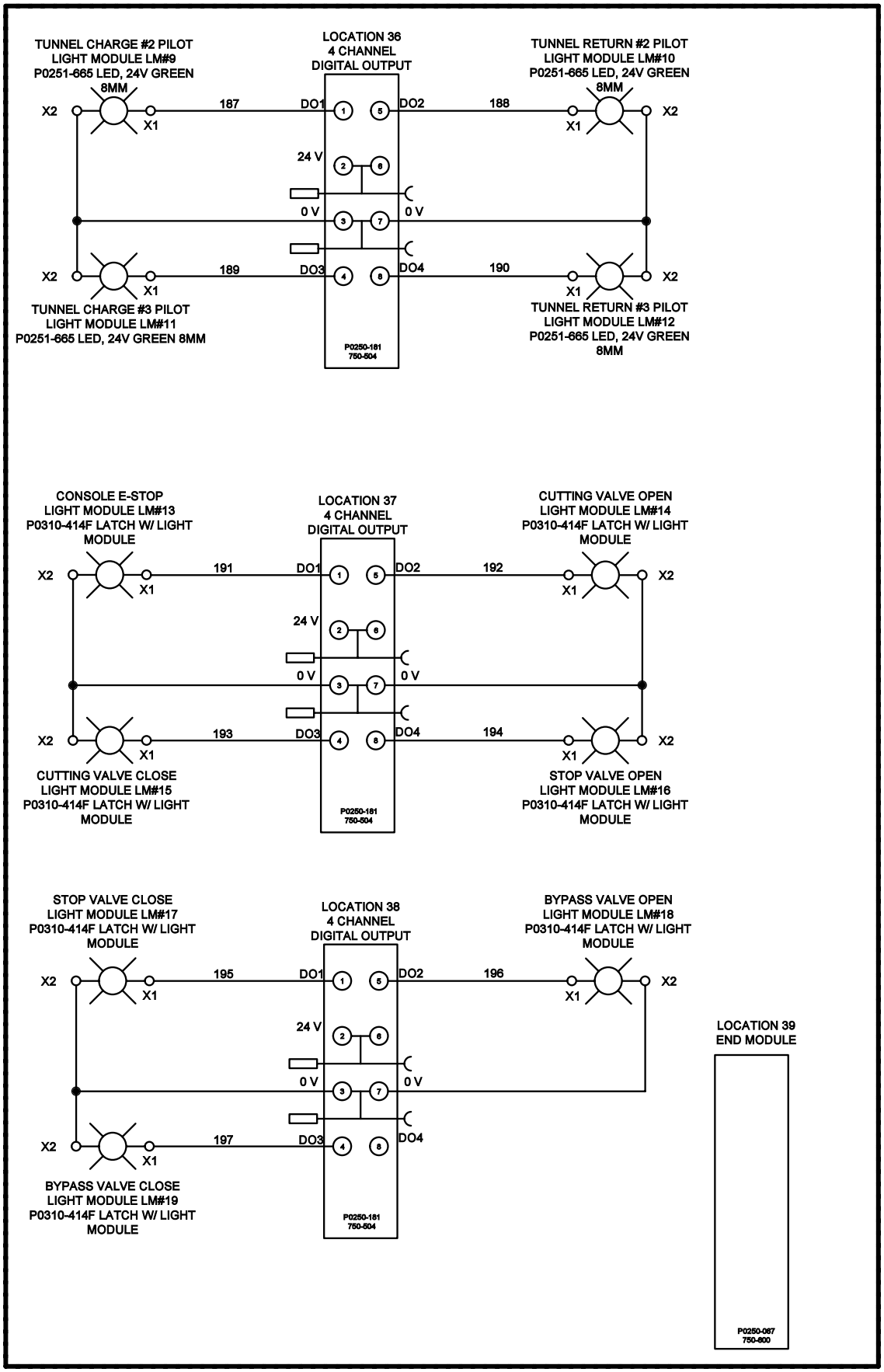
Control Console Electrical Schematics (continued)
Electrical Schematic - Part 13 of 14



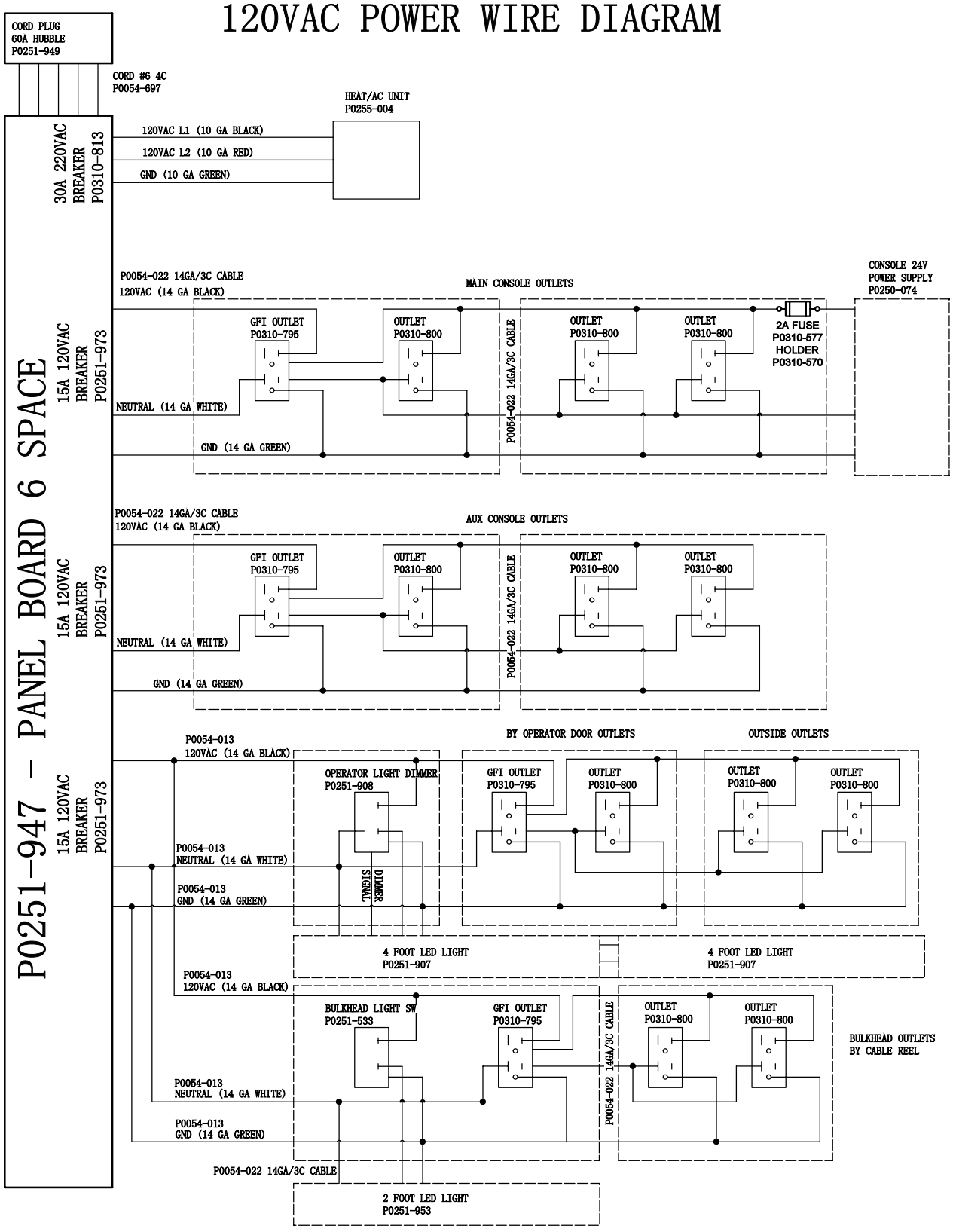
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Control Console Electrical Schematics (continued)

Electrical Schematic - Part 14 of 14

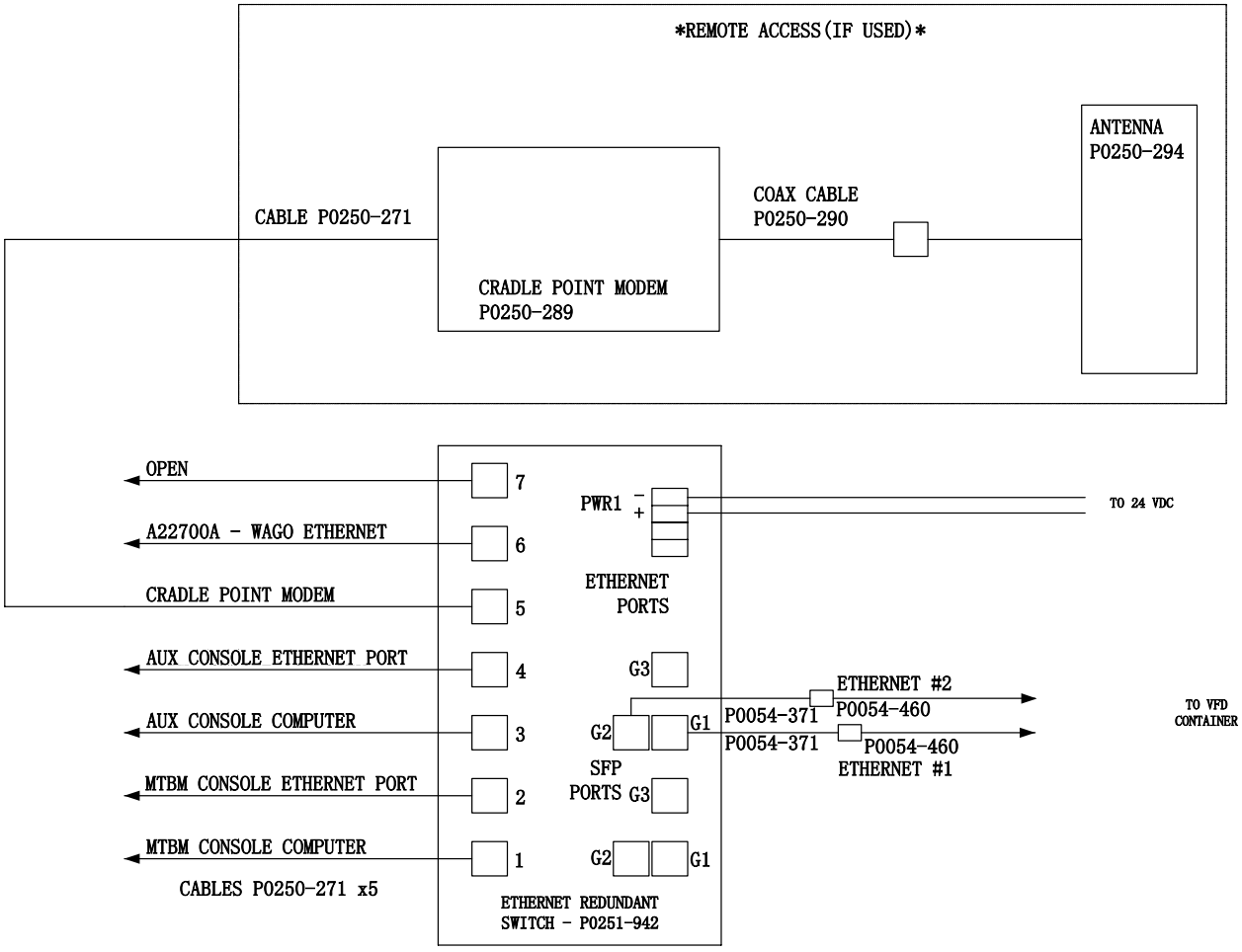


120 VAC POWER WIRE DIAGRAM - SN FA22242F



ETHERNET NETWORK WIRING - SN FA22242F

CONTROL CONTAINER ETHERNET NETWORK WIRING



WIRE NUMBER TABLE - CONTROL CONTAINER - SN FA22242F

Part 1 of 2

WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
0v	Ground	various	various	Wht/Blu 16 AWG
24v	24 Volt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	various	various	White 16 AWG
120 L	120VAC Line	various	various	Black 16 AWG
101	Wago #1 - Ethernet Int. Mod. 24v	Wago #1- Pin #1	Wago #1 - Pin #6	Blu/Wht 16 AWG
102	Wago #1 - Ethernet Int. Mod. 0v	Wago #1- Pin #5	Wago #1- Pin #7	Wht/Blu 16 AWG
103	EC #1 - Cutter Encoder Phase A	EC #1 - Pin #4	Wago #2 - Pin #1	Orange
104	EC #1 - Cutter Encoder Phase B	EC #1 - Pin #2	Wago #2 - Pin #2	Yellow
105	EC #1 - Cutter Encoder 5 Volt	EC #1 - Pin #1	Wago #3 - Pin #1	Red
106	EC #1 - Cutter Encoder 0 Volt	EC #1 - Pin #3	Wago #3 - Pin #3	Green
107	EC #2 - Hyd. Flow Encoder Phase A	EC #2 - Pin #4	Wago #4 - Pin #1	Orange
108	EC #2 - Hyd. Flow Encoder Phase B	EC #2 - Pin #2	Wago #4 - Pin #2	Yellow
109	EC #2 - Hyd. Flow Encoder 5 Volt	EC #2 - Pin #1	Wago #5 - Pin #1	Red
110	EC #2 - Hyd. Flow Encoder 0 Volt	EC #2 - Pin #3	Wago #5 - Pin #3	Green
111	EC #3 - Booster Encoder Phase A	EC #3 - Pin #4	Wago #6 - Pin #1	Orange
112	EC #3 - Booster Encoder Phase B	EC #3 - Pin #2	Wago #6 - Pin #2	Yellow
113	EC #3 - Booster Encoder 5 Volt	EC #3 - Pin #1	Wago #7 - Pin #1	Red
114	EC #3 - Booster Encoder 0 Volt	EC #3 - Pin #3	Wago #7 - Pin #3	Green
115	EC #4 - Tunnel Chrg #1 Encoder Phase A	EC #4 - Pin #4	Wago #8 - Pin #1	Orange
116	EC #4 - Tunnel Chrg #1 Encoder Phase B	EC #4 - Pin #2	Wago #8 - Pin #2	Yellow
117	EC #4 - Tunnel Chrg #1 Encoder 5 Volt	EC #4 - Pin #1	Wago #9 - Pin #1	Red
118	EC #4 - Tunnel Chrg #1 Encoder 0 Volt	EC #4 - Pin #3	Wago #9 - Pin #3	Green
119	EC #5 - Tunnel Ret. #1 Encoder Phase A	EC #5 - Pin #4	Wago #10 - Pin #1	Orange
120	EC #5 - Tunnel Ret. #1 Encoder Phase B	EC #5 - Pin #2	Wago #10 - Pin #2	Yellow
121	EC #5 - Tunnel Ret. #1 Encoder 5 Volt	EC #5 - Pin #1	Wago #11 - Pin #1	Red
122	EC #5 - Tunnel Ret. #1 Encoder 0 Volt	EC #5 - Pin #3	Wago #11 - Pin #3	Green
123	EC #6 - Tunnel Chrg #2 Encoder Phase A	EC #6 - Pin #4	Wago #12 - Pin #1	Orange
124	EC #6 - Tunnel Chrg #2 Encoder Phase B	EC #6 - Pin #2	Wago #12 - Pin #2	Yellow
125	EC #6 - Tunnel Chrg #2 Encoder 5 Volt	EC #6 - Pin #1	Wago #13 - Pin #1	Red
126	EC #6 - Tunnel Chrg #2 Encoder 0 Volt	EC #6 - Pin #3	Wago #13 - Pin #3	Green
127	EC #7 - Tunnel Ret. #2 Encoder Phase A	EC #7 - Pin #4	Wago #14 - Pin #1	Orange
128	EC #7 - Tunnel Ret. #2 Encoder Phase B	EC #7 - Pin #2	Wago #14 - Pin #2	Yellow
129	EC #7 - Tunnel Ret. #2 Encoder 5 Volt	EC #7 - Pin #1	Wago #15 - Pin #1	Red
130	EC #7 - Tunnel Ret. #2 Encoder 0 Volt	EC #7 - Pin #3	Wago #15 - Pin #3	Green
131	EC #8 - Tunnel Chrg #3 Encoder Phase A	EC #8 - Pin #4	Wago #16 - Pin #1	Orange
132	EC #8 - Tunnel Chrg #3 Encoder Phase B	EC #8 - Pin #2	Wago #16 - Pin #2	Yellow
133	EC #8 - Tunnel Chrg #3 Encoder 5 Volt	EC #8 - Pin #1	Wago #17 - Pin #1	Red
134	EC #8 - Tunnel Chrg #3 Encoder 0 Volt	EC #8 - Pin #3	Wago #17 - Pin #3	Green
135	EC #9 - Tunnel Ret. #3 Encoder Phase A	EC #9 - Pin #4	Wago #18 - Pin #1	Orange
136	EC #9 - Tunnel Ret. #3 Encoder Phase B	EC #9 - Pin #2	Wago #18 - Pin #2	Yellow
137	EC #9 - Tunnel Ret. #3 Encoder 5 Volt	EC #9 - Pin #1	Wago #19 - Pin #1	Red
138	EC #9 - Tunnel Ret. #3 Encoder 0 Volt	EC #9 - Pin #3	Wago #19 - Pin #3	Green
139	EC #10 - Above Grnd Feed Encoder Phase A	EC #10 - Pin #4	Wago #20 - Pin #1	Orange
140	EC #10 - Above Grnd Feed Encoder Phase B	EC #10 - Pin #2	Wago #20 - Pin #2	Yellow
141	EC #10 - Above Grnd Feed Encoder 5 Volt	EC #10 - Pin #1	Wago #21 - Pin #1	Red
142	EC #10 - Above Grnd Feed Encoder 0 Volt	EC #10 - Pin #3	Wago #21 - Pin #3	Green
143	EC #11 - Pit Ret. Encoder Phase A	EC #11 - Pin #4	Wago #22 - Pin #1	Orange
144	EC #11 - Pit Ret. Encoder Phase B	EC #11 - Pin #2	Wago #22 - Pin #2	Yellow
145	EC #11 - Pit Ret. Encoder 5 Volt	EC #11 - Pin #1	Wago #23 - Pin #1	Red
146	EC #11 - Pit Ret. Encoder 0 Volt	EC #11 - Pin #3	Wago #23 - Pin #3	Green
147	PB #1 - Top Cyl. Extend	PB #1 - Pin #3	Wago #25 - DI1	Blue 20 AWG
148	PB #2 - Top Cyl. Retract	PB #2 - Pin #3	Wago #25 - DI2	Blue 20 AWG
149	PB #3 - Left Cyl. Extend	PB #3- Pin #3	Wago #25 - DI3	Blue 20 AWG
150	PB #4 - Left Cyl. Retract	PB #4 - Pin #3	Wago #25 - DI4	Blue 20 AWG
151	PB #5 - Right Cyl. Extend	PB #5- Pin #3	Wago #26 - DI1	Blue 20 AWG
152	PB #6 - Right Cyl. Retract	PB #6 - Pin #3	Wago #26 - DI2	Blue 20 AWG
153	PB #7 - Cutting Valve Open	PB #7 - Pin #3	Wago #26 - DI3	Blue 20 AWG
154	PB #8 - Chamber Valve Open	PB #8 - Pin #3	Wago #26 - DI4	Blue 20 AWG

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Wire Number Table (continued)
Part 2 of 2

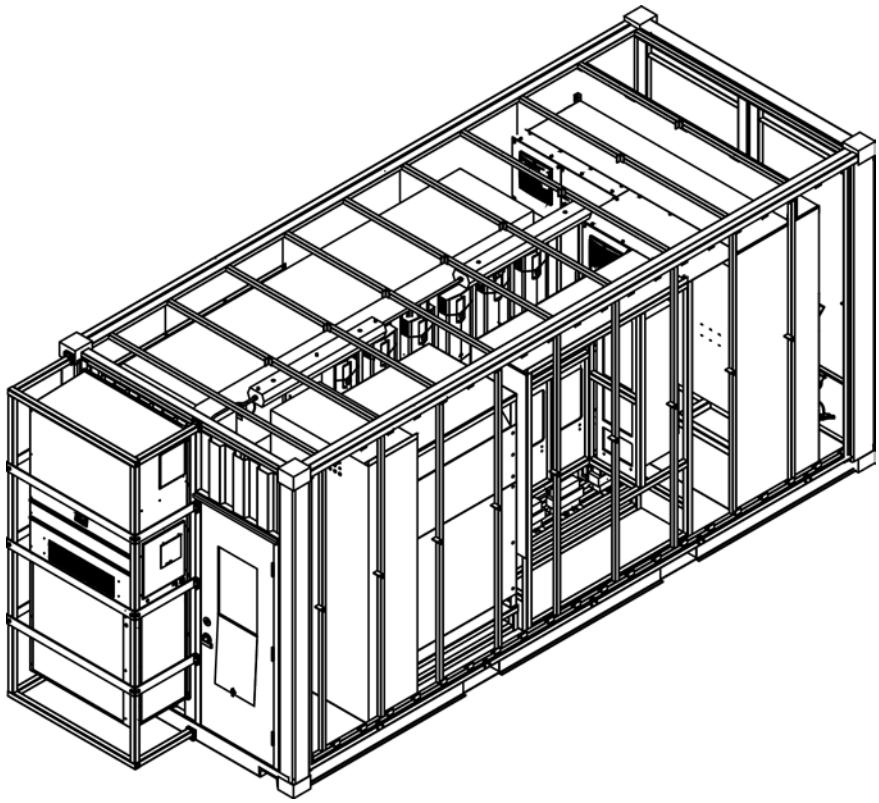
WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
155	PB #9 - Stop Valve Open	PB #9 - Pin #3	Wago #27 - DI1	Blue 20 AWG
156	PB #10 - Stop Valve Close	PB #10 - Pin #3	Wago #27 - DI2	Blue 20 AWG
157	PB #11 - Bypass Valve Open	PB #11 - Pin #3	Wago #27 - DI3	Blue 20 AWG
158	PB #12 - Bypass Valve Close	PB #12 - Pin #3	Wago #27 - DI4	Blue 20 AWG
159	PB #13 - Cutter Left	PB #13- Pin #3	Wago #28 - DI1	Blue 20 AWG
160	PB #14 - Cutter Stop	PB #14 - Pin #3	Wago #28 - DI2	Blue 20 AWG
161	PB #15 - Cutter Right	PB #15 - Pin #3	Wago #28 - DI3	Blue 20 AWG
162	SW #1 - Cutter Head	SW #1 - Pin #4	Wago #28 - DI4	Blue 20 AWG
163	SW #2 - Head Power	SW #2 - Pin #3	Wago #29 - DI1	Blue 20 AWG
164	SW #3 - Above Ground Feed Power	SW #3 - Pin #3	Wago #29 - DI2	Blue 20 AWG
165	SW #4 - Pit Return	SW #4 - Pin #3	Wago #29 - DI3	Blue 20 AWG
166	SW #5 - Booster	SW #5 - Pin #3	Wago #29 - DI4	Blue 20 AWG
167	SW #6 - 5 POS. SW. - Main Hyd. Retract	SW #6 - Pin #7	Wago #30 - DI1	Blue 20 AWG
168	SW #6 - 5 POS. SW. - Main Hyd. Stop	SW #6 - Pin #5	Wago #30 - DI2	Blue 20 AWG
169	SW #6 - 5 POS. SW. - Main Hyd. IJS	SW #6 - Pin #1	Wago #30 - DI3	Blue 20 AWG
170	SW #6 - 5 POS. SW. - Main Hyd. AUX	SW #6 - Pin #9	Wago #30 - DI4	Blue 20 AWG
171	SW #6 - 5 POS. SW. - Main Hyd. Extend	SW #6 - Pin #3	Wago #31 - DI1	Blue 20 AWG
172	SW #7 - Tunnel Charge #1	SW #7 - Pin #3	Wago #31 - DI2	Blue 20 AWG
173	SW #8 - Tunnel Return #1	SW #8 - Pin #3	Wago #31 - DI3	Blue 20 AWG
174	SW #9 - Tunnel Charge #2	SW #9 - Pin #3	Wago #31 - DI4	Blue 20 AWG
175	SW #10 - Tunnel Return #2	SW #10	Wago #32 - DI1	Blue 20 AWG
176	SW #11 - Tunnel Charge #3	SW #11	Wago #32 - DI2	Blue 20 AWG
177	SW #12 - Tunnel Return #3	SW #12	Wago #32 - DI3	Blue 20 AWG
178	SW #13 - Console E-Stop	SW #13	Wago #32 - DI4	Blue 20 AWG
179	LM #1 - Cutter Left Push Button	LM #1 - X1	Wago #34 - DO1	Blue 20 AWG
180	LM #2 - Cutter Stop Push Button	LM #2 - X1	Wago #34 - DO2	Blue 20 AWG
181	LM #3 - Cutter Right Push Button	LM #3 - X1	Wago #34 - DO3	Blue 20 AWG
182	LM #4 - Head Power Pilot	LM #4 - X1	Wago #34 - DO4	Blue 20 AWG
183	LM #5 - Cutter Head Pilot	LM #5 - X1	Wago #35 - DO1	Blue 20 AWG
184	LM #6 - Booster Pilot	LM #6 - X1	Wago #35 - DO2	Blue 20 AWG
185	LM #7 - Tunnel Charge #1 Pilot	LM #7 - X1	Wago #35 - DO3	Blue 20 AWG
186	LM #8 - Tunnel Return #1 Pilot	LM #8 - X1	Wago #35 - DO4	Blue 20 AWG
187	LM #9 - Tunnel Charge #2 Pilot	LM #9 - X1	Wago #36 - DO1	Blue 20 AWG
188	LM #10 - Tunnel Return #2 Pilot	LM #10 - X1	Wago #36 - DO2	Blue 20 AWG
189	LM #11 - Tunnel Charge #3 Pilot	LM #11 - X1	Wago #36 - DO3	Blue 20 AWG
190	LM #12 - Tunnel Return #3 Pilot	LM #12 - X1	Wago #36 - DO4	Blue 20 AWG
191	LM #13 - CONSOLE E-STOP	LM #13 - X1	Wago #37 - DO1	Blue 20 AWG
192	LM #14 - CUTTING VALVE OPEN	LM #14 - X1	Wago #37 - DO2	Blue 20 AWG
193	LM #15 - CUTTING VALVE CLOSE	LM #15 - X1	Wago #37 - DO3	Blue 20 AWG
194	LM #16 - STOP VALVE OPEN	LM #16 - X1	Wago #37 - DO4	Blue 20 AWG
195	LM #17 - STOP VALVE CLOSE	LM #17 - X1	Wago #38 - DO1	Blue 20 AWG
196	LM #18 - BYPASS VALVE OPEN	LM #18 - X1	Wago #38 - DO2	Blue 20 AWG
197	LM #19 - BYPASS VALVE CLOSE	LM #19 - X1	Wago #38 - DO3	Blue 20 AWG

VFD Container

The VFD Container is equipped with ten variable frequency drives (VFDs) to efficiently operate the electric motors for the main MTBM drive, slurry feed, slurry booster and slurry return systems. The motors are operated from the control container, control console controls.

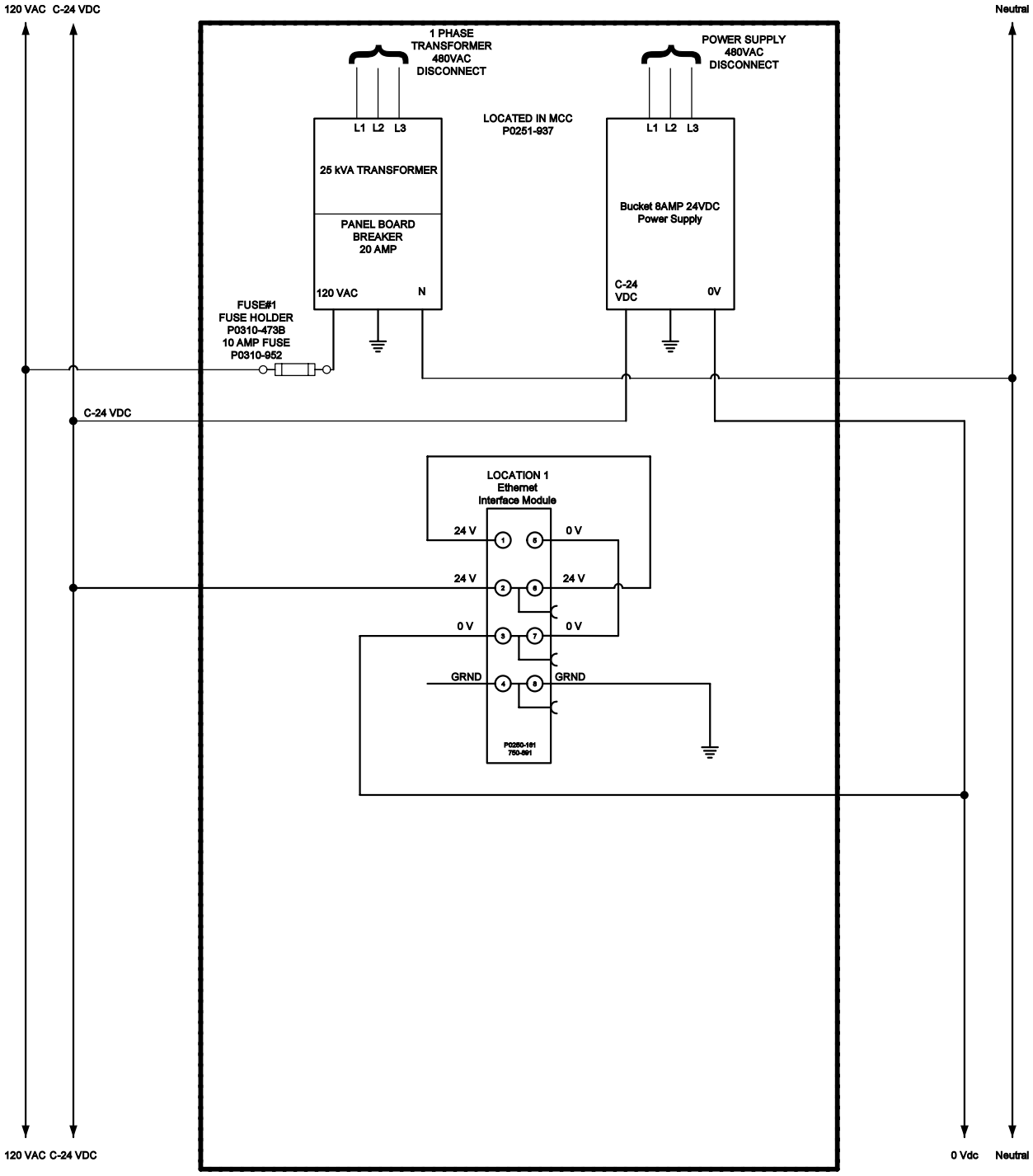
VFD Container SN FA22241F

Electrical Schematics 3-2

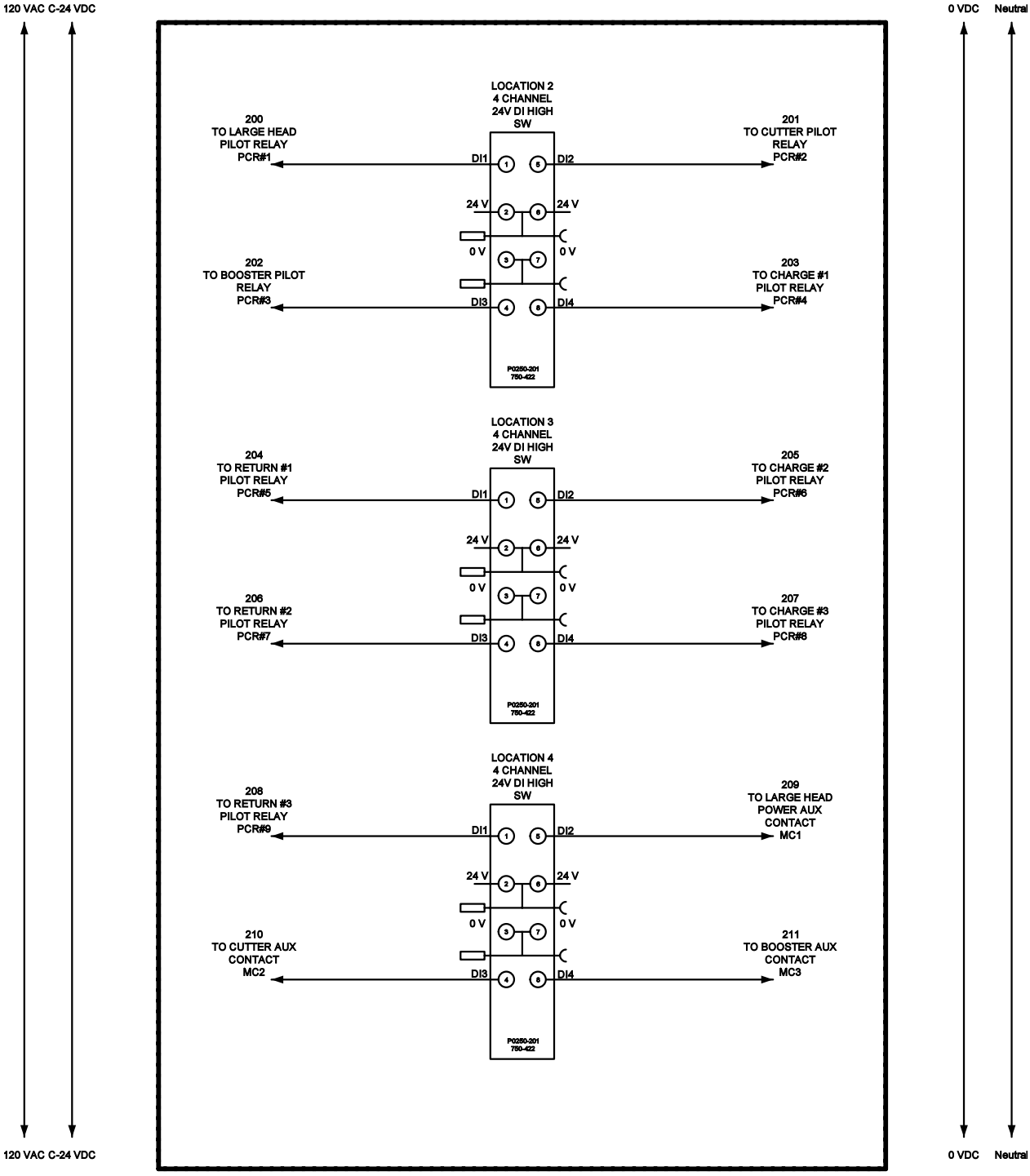


VFD CONTAINER ELECTRICAL SCHEMATICS - SN FA22241F

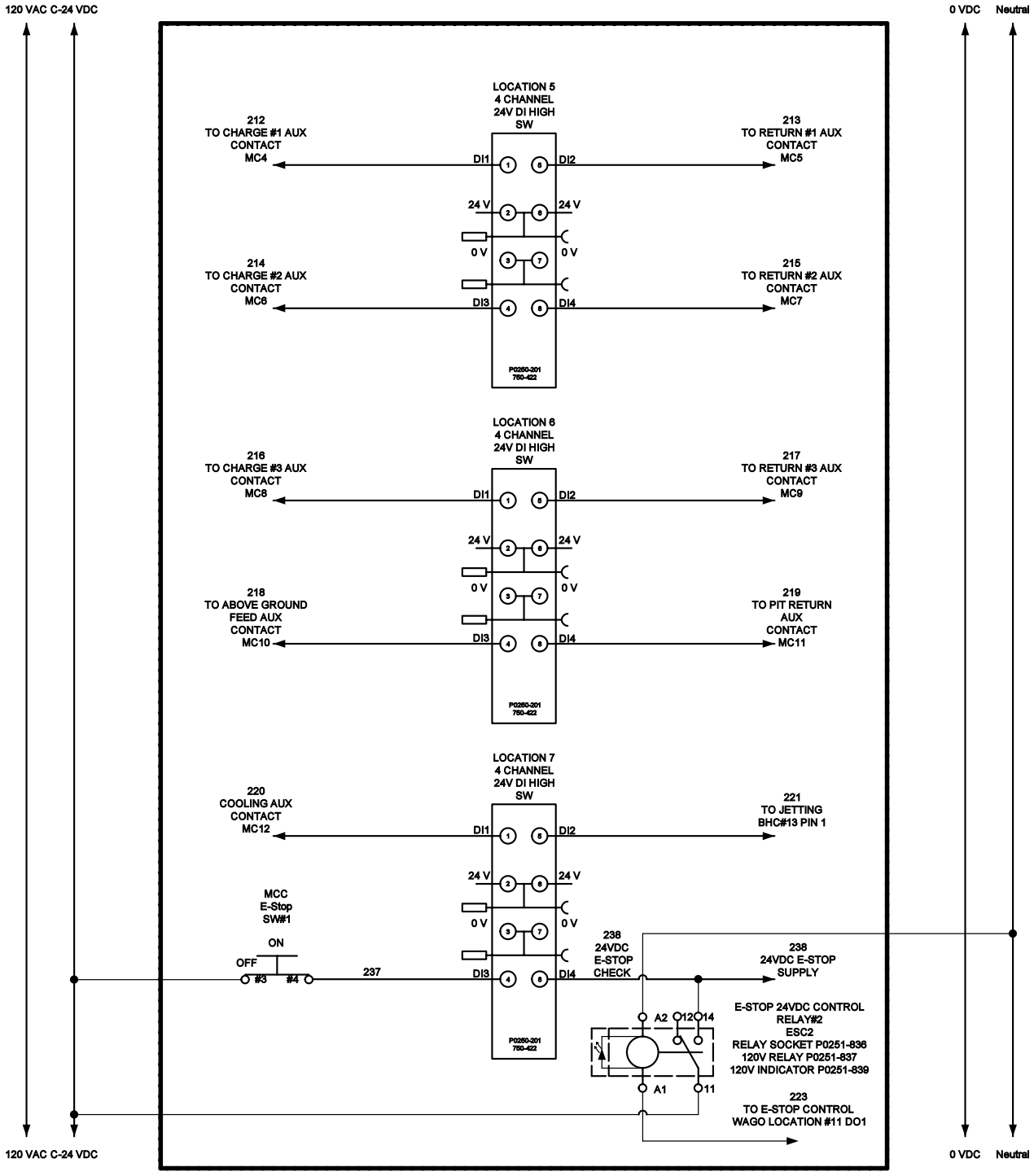
Electrical Schematic - Part 1 of 29



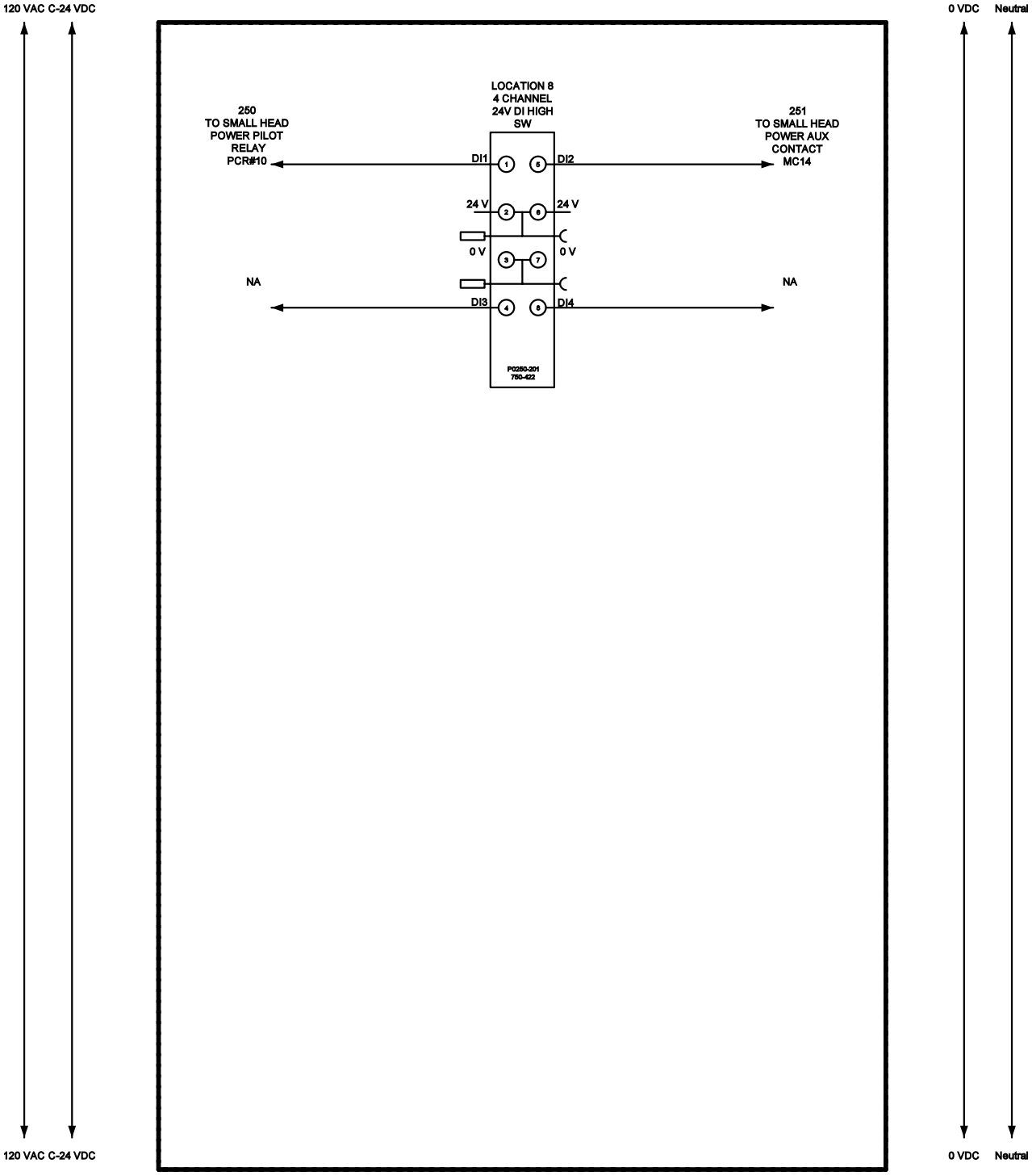
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 2 of 29



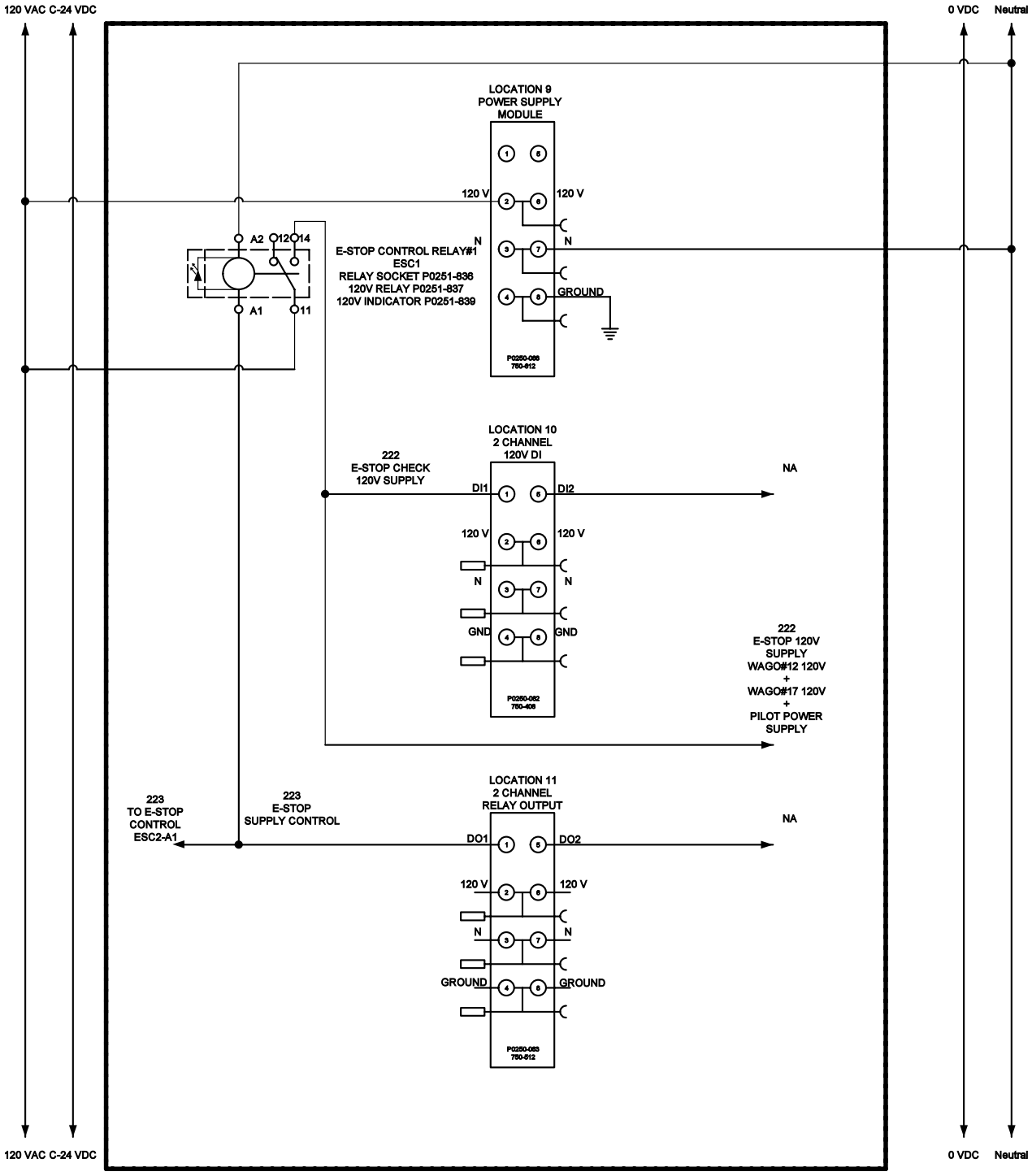
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 3 of 29



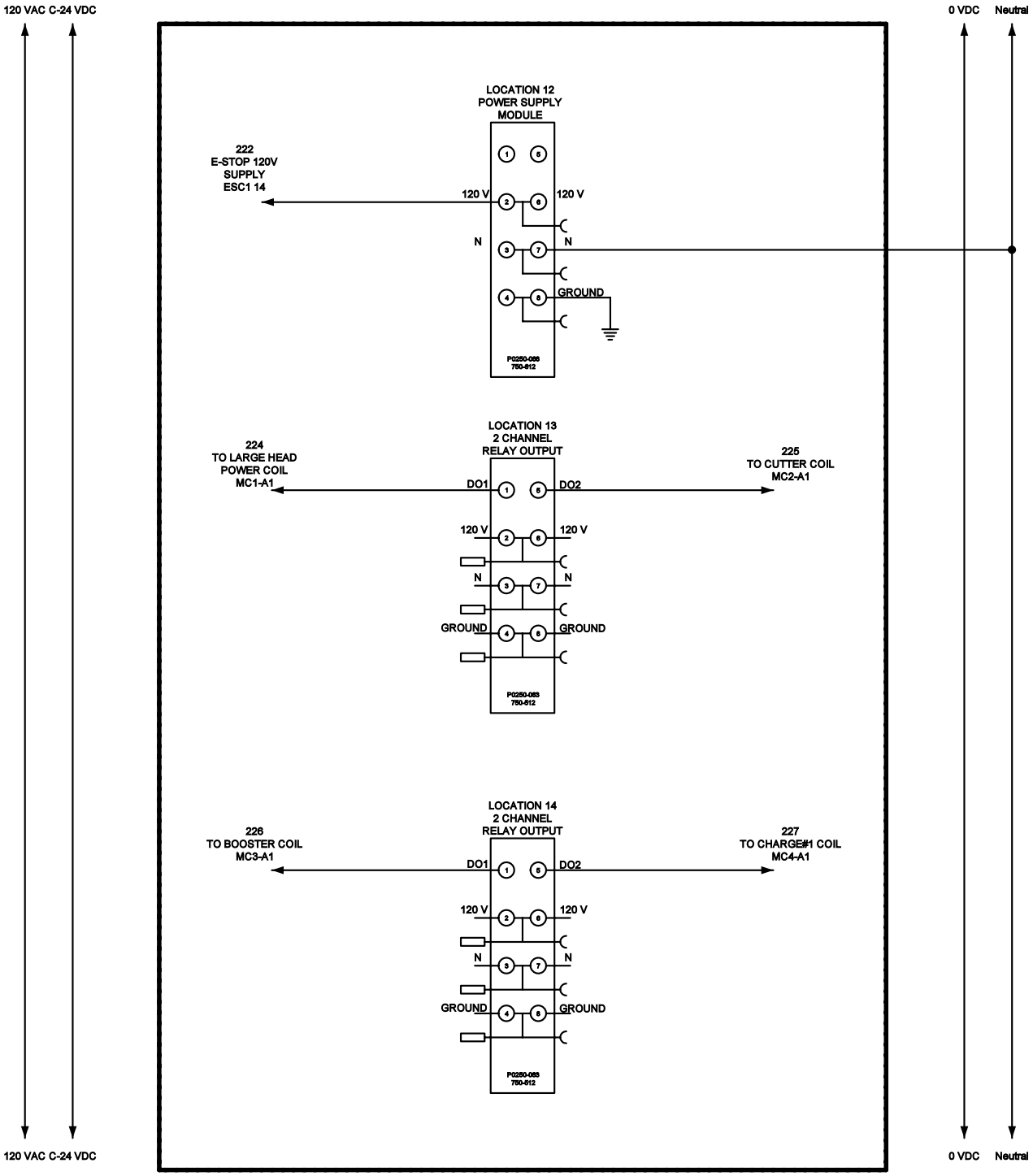
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 4 of 29



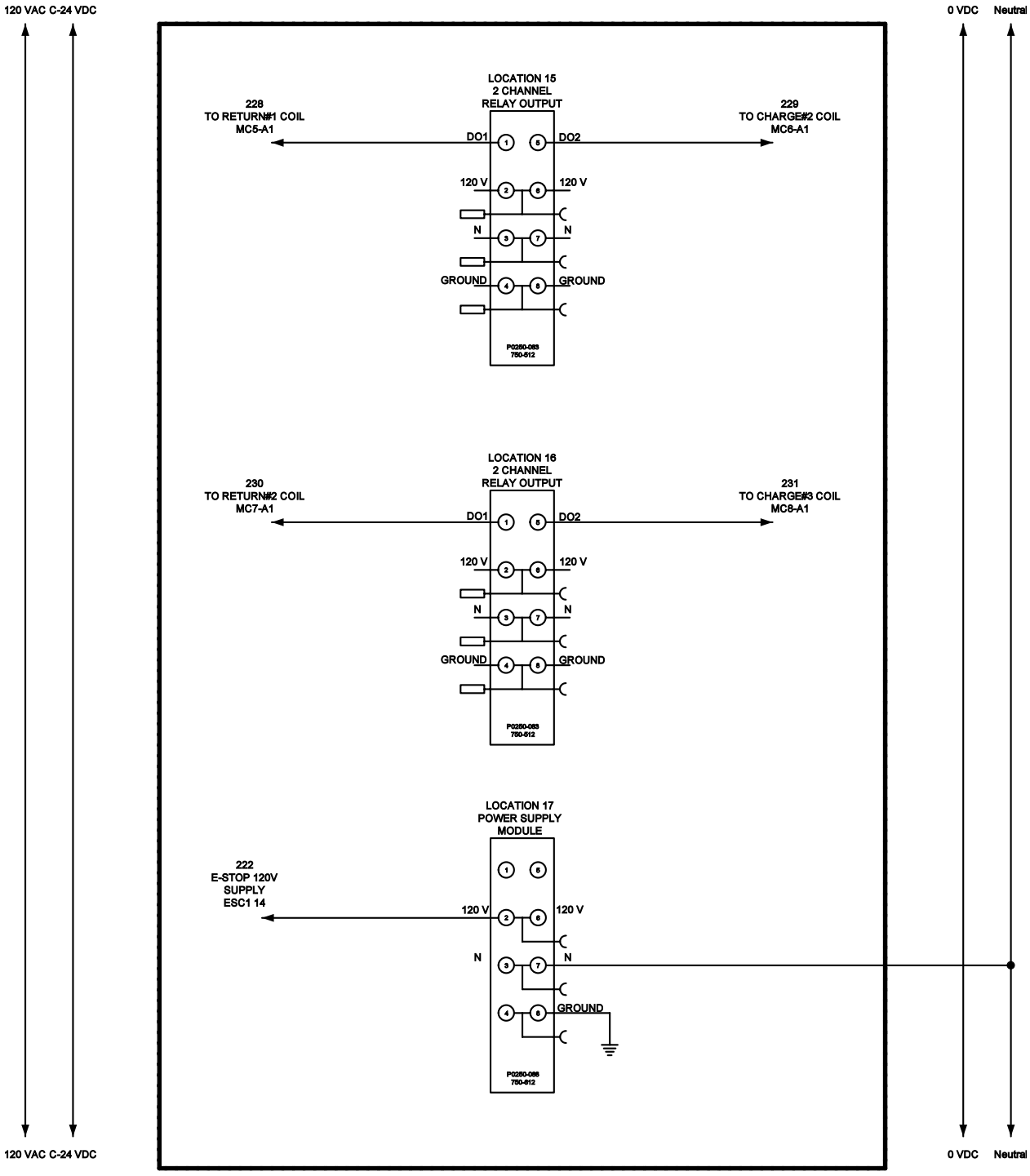
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 5 of 29



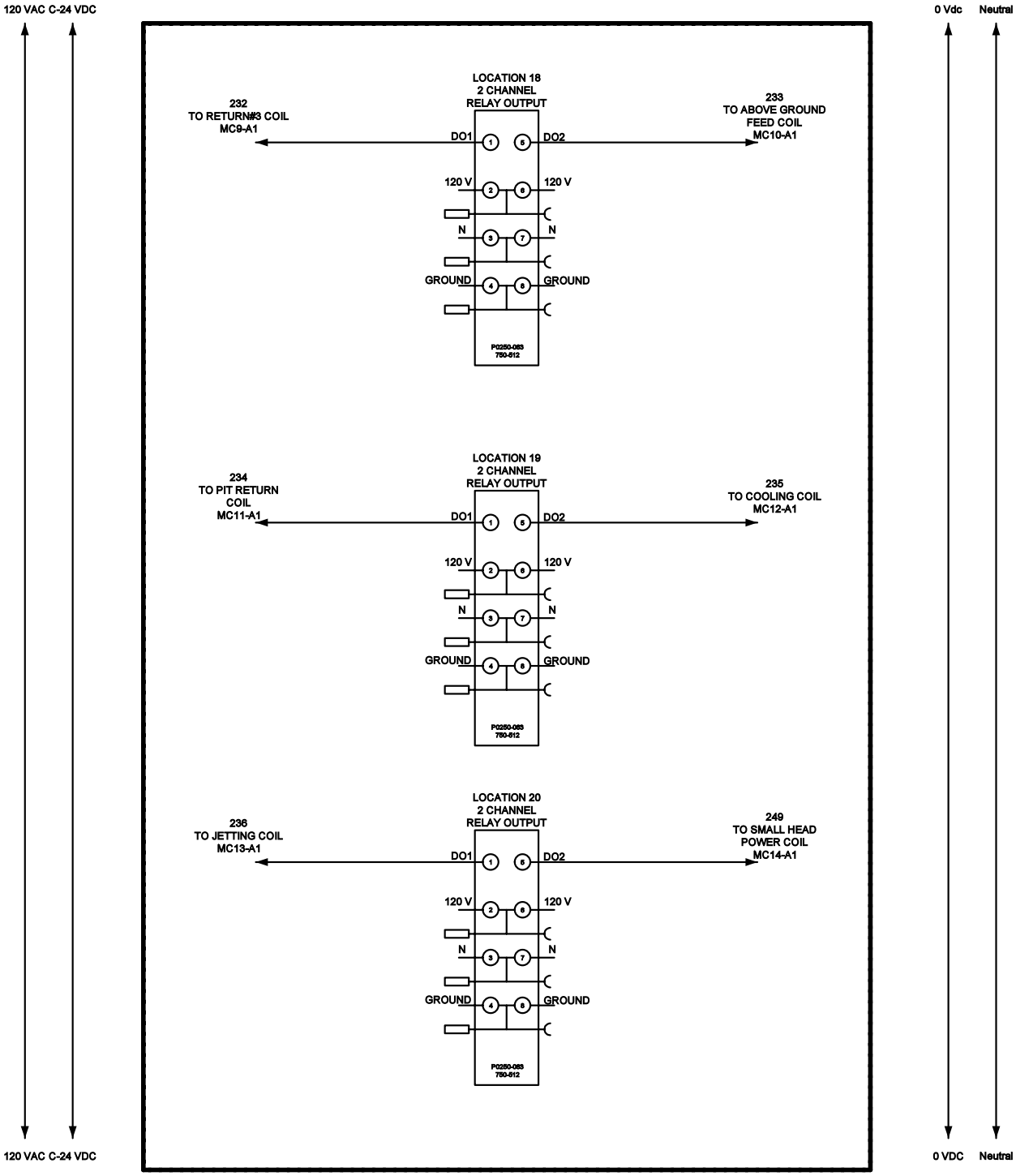
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 6 of 29



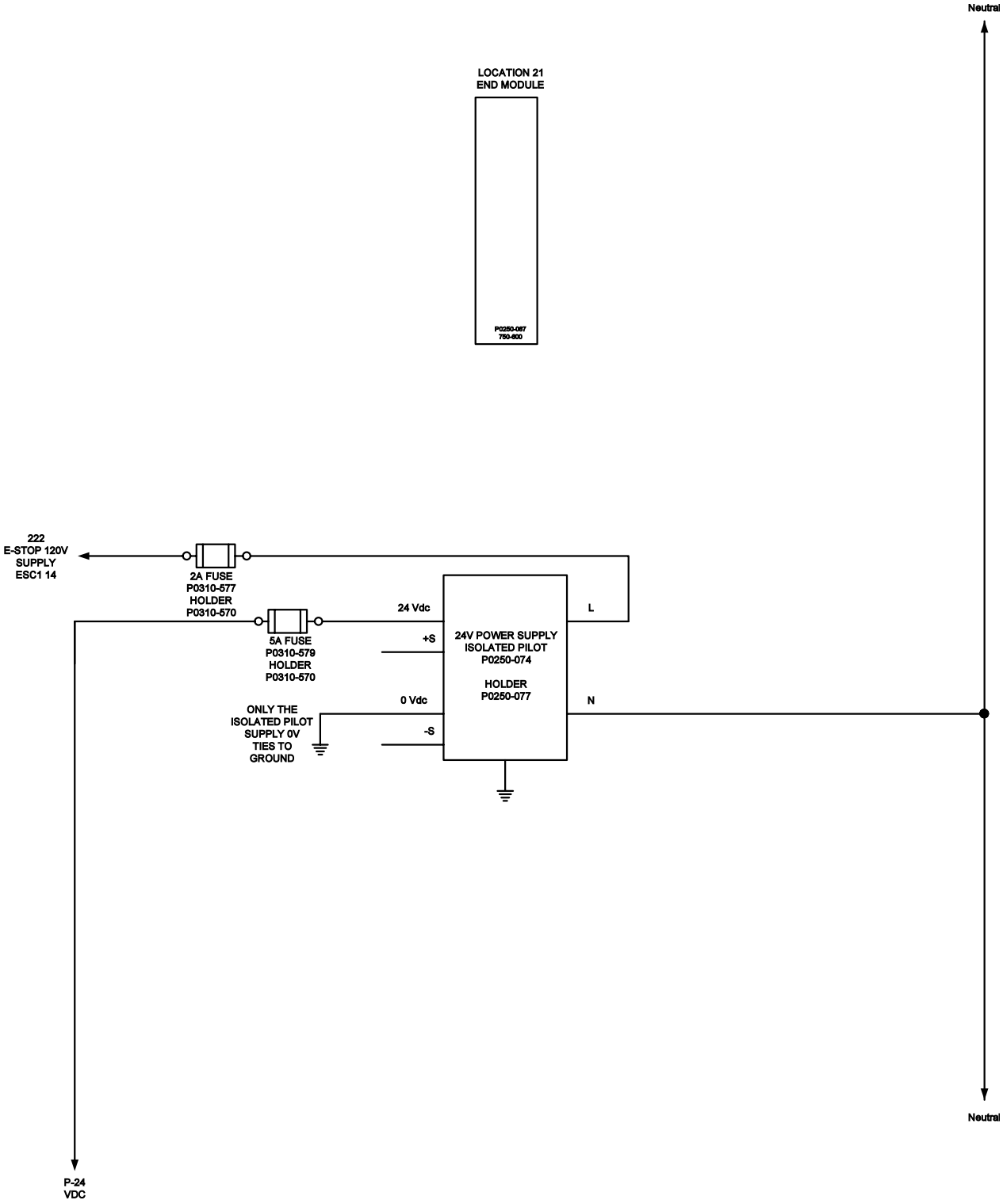
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 7 of 29



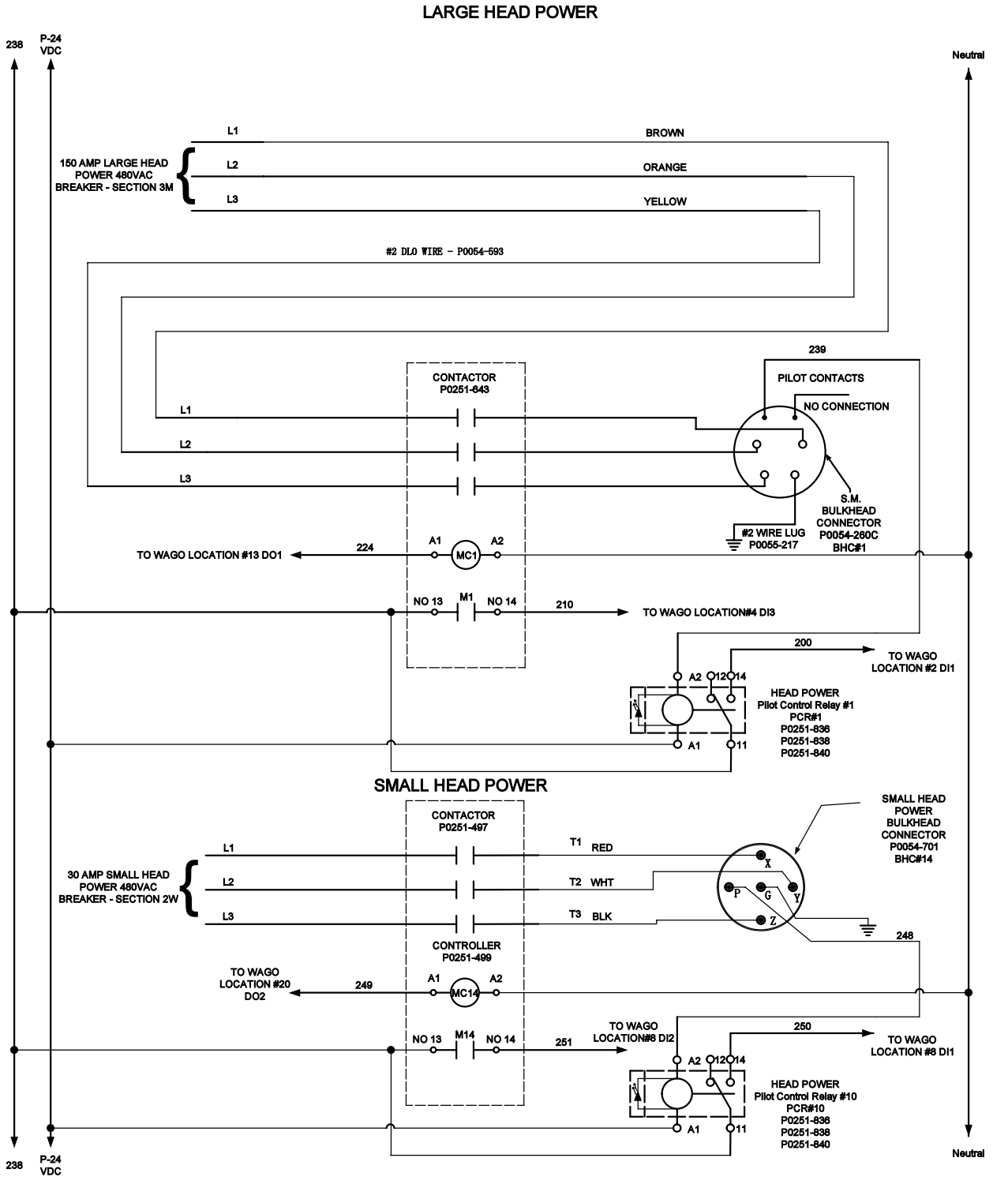
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 8 of 29



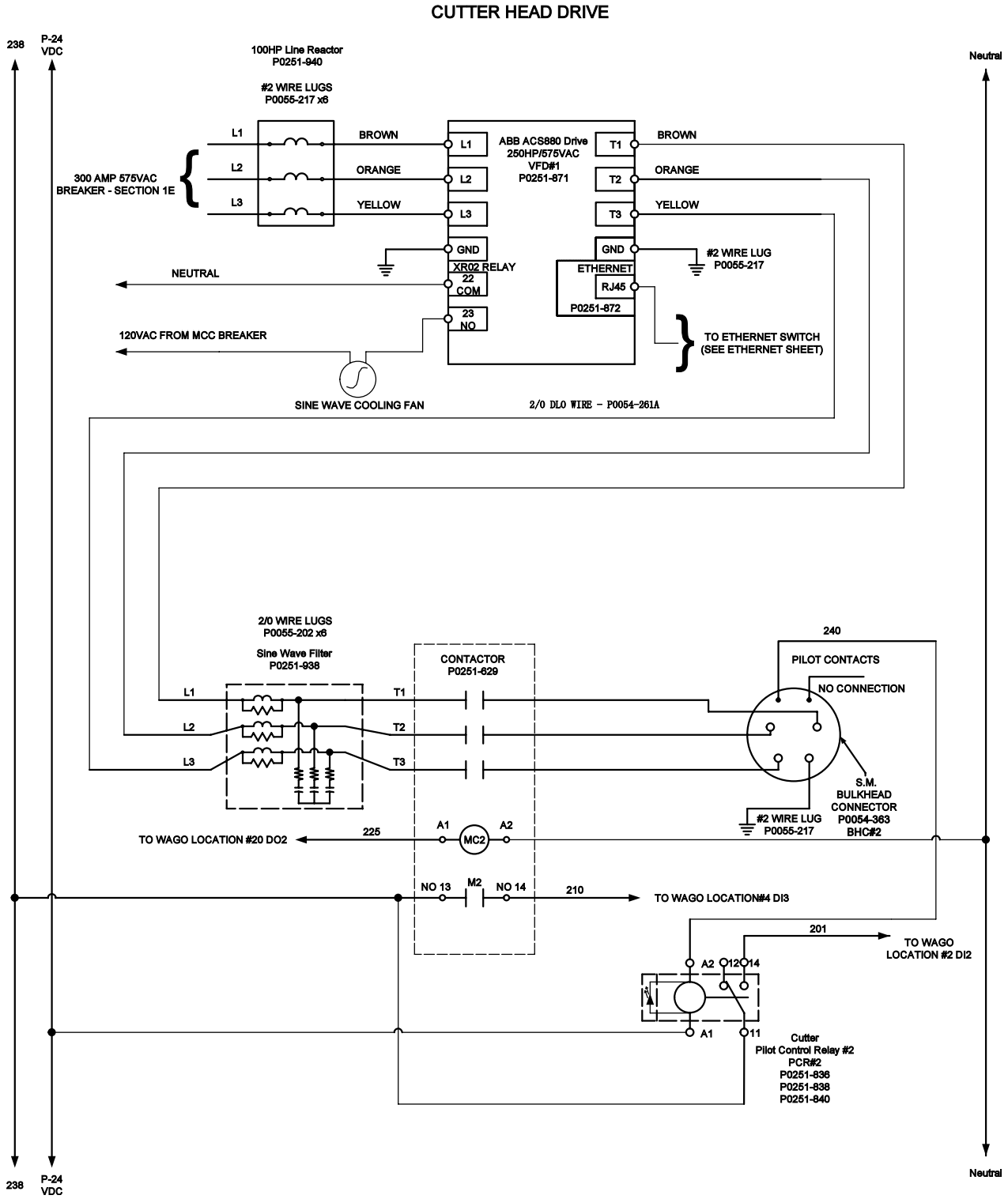
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 9 of 29



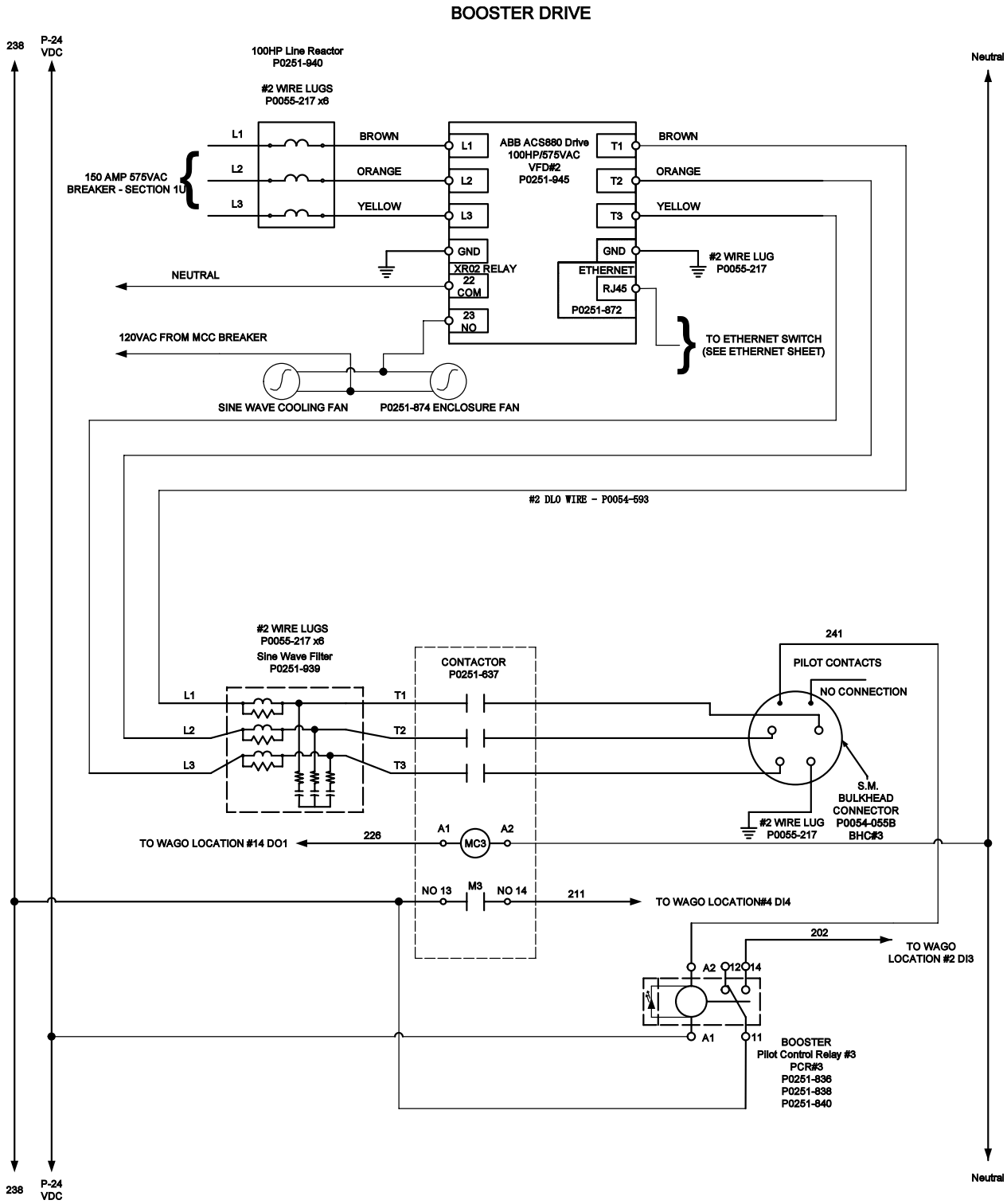
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 10 of 29



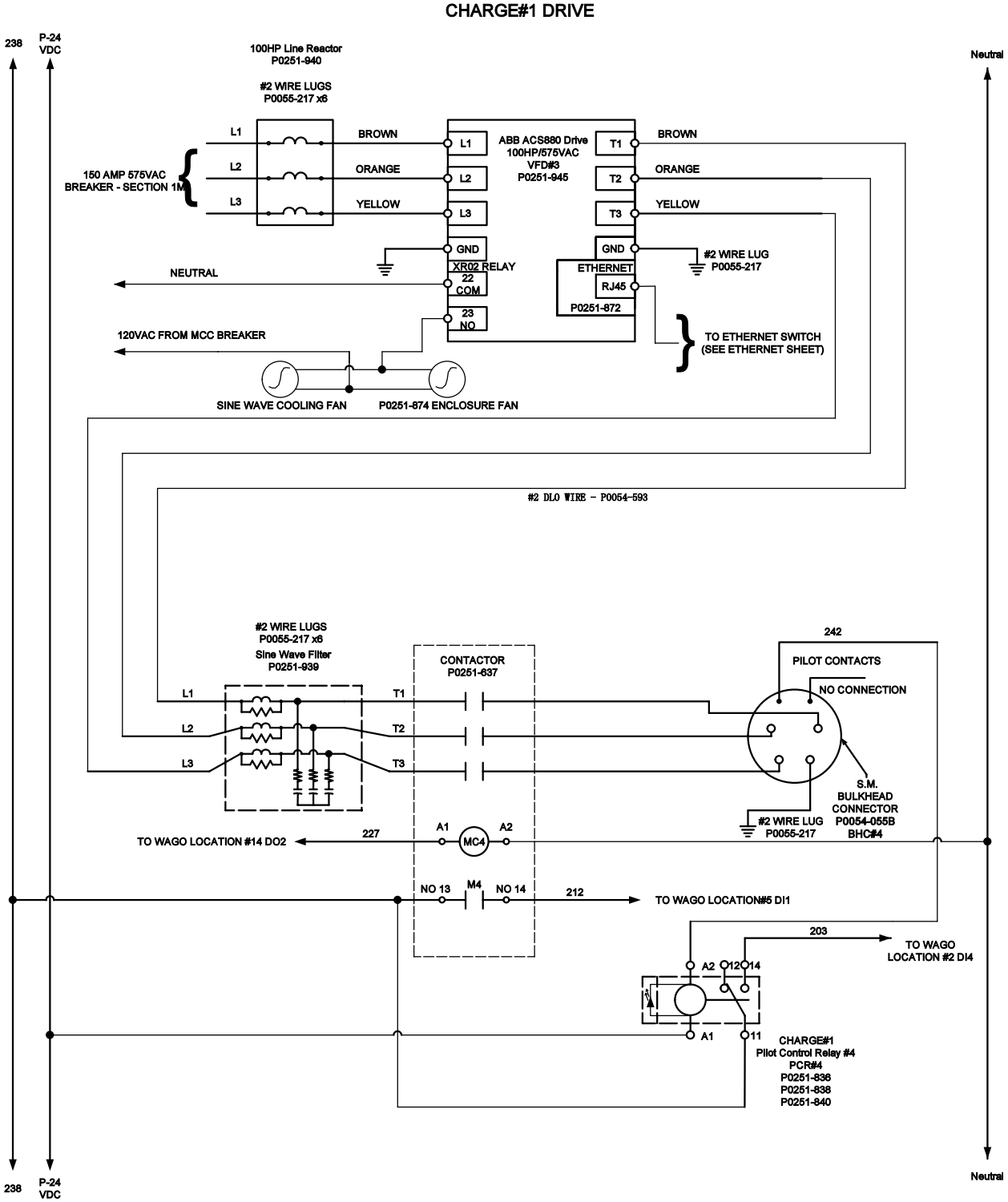
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 11 of 29



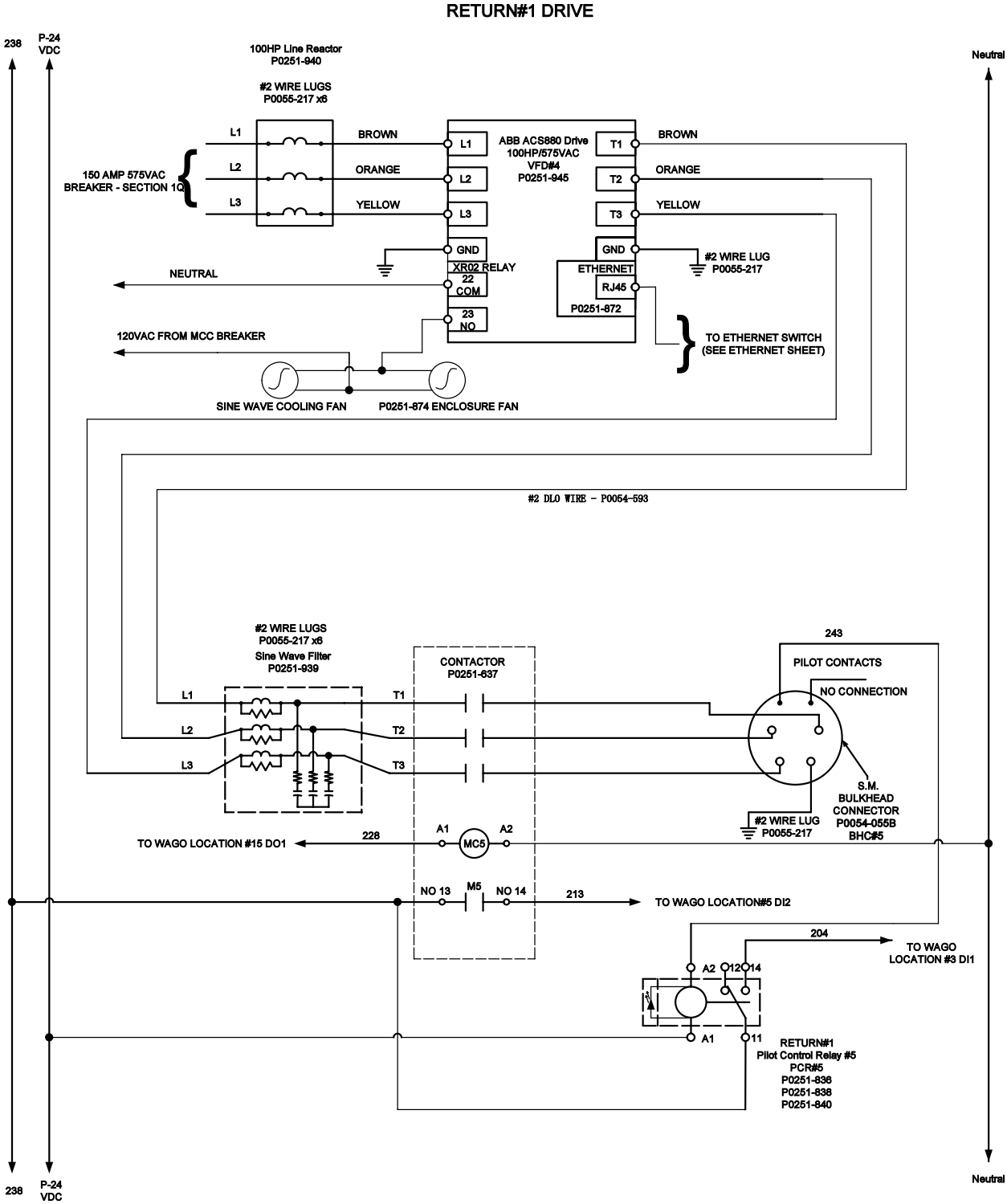
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 12 of 29



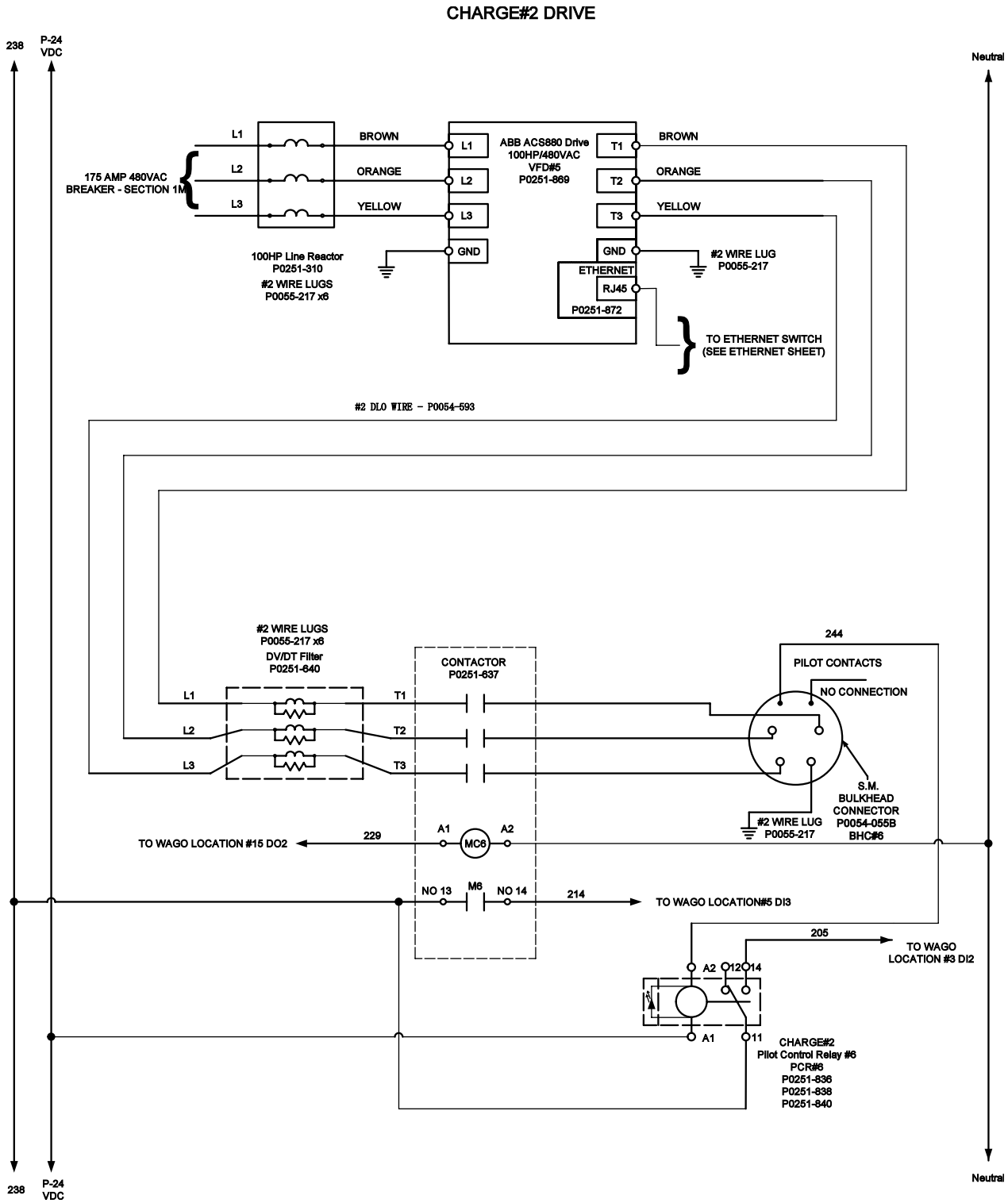
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 13 of 29



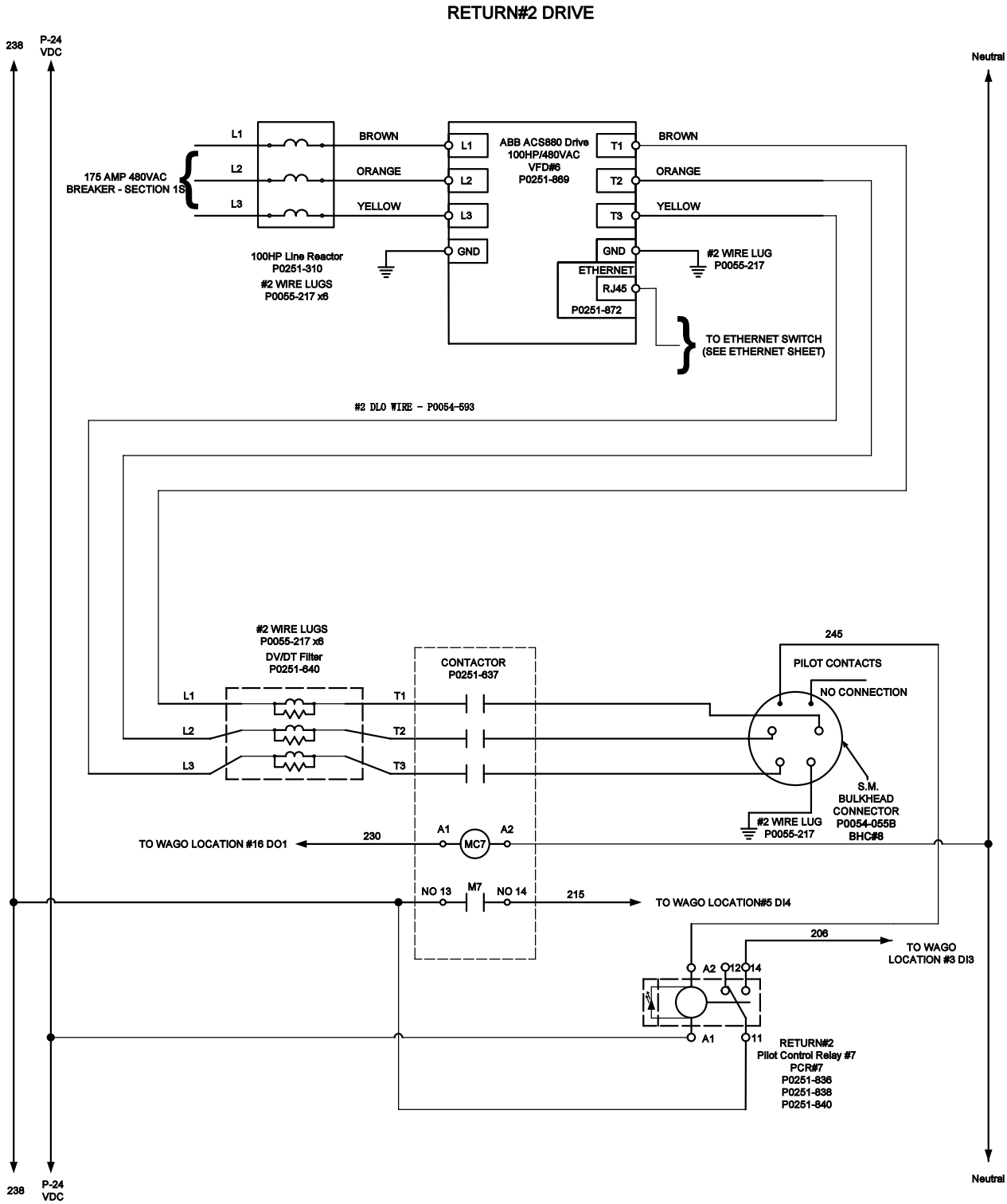
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 14 of 29



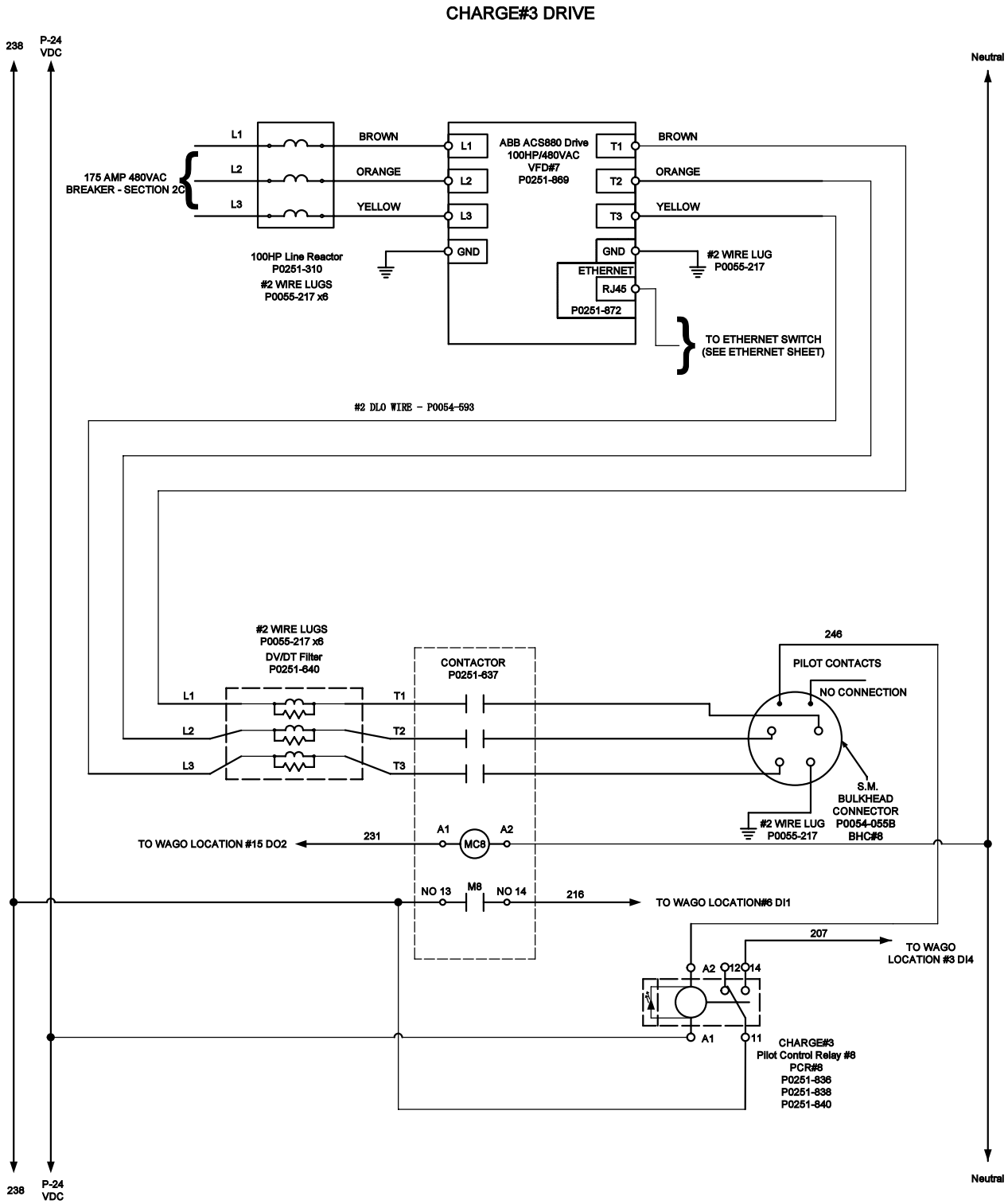
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 15 of 29



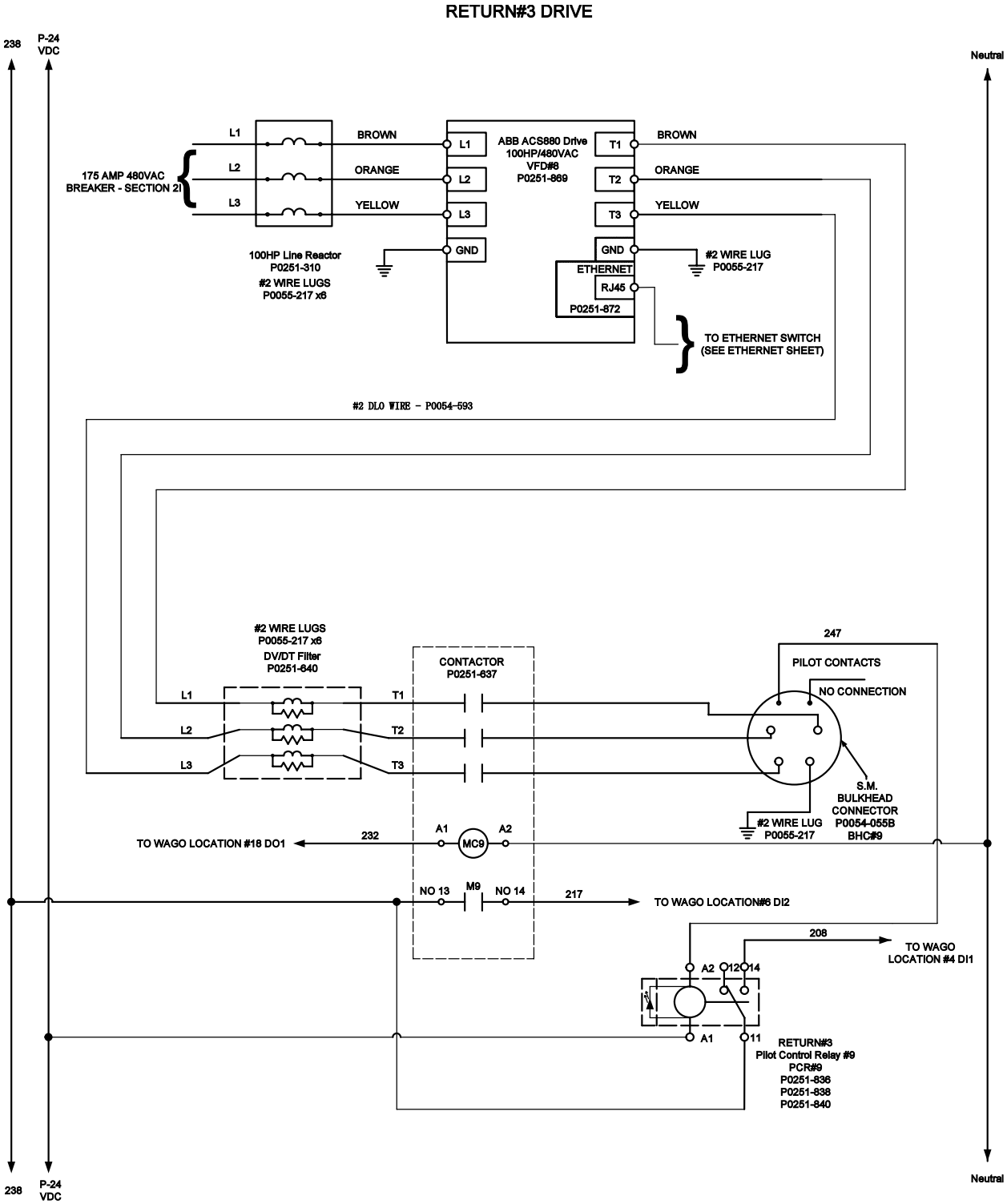
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 16 of 29



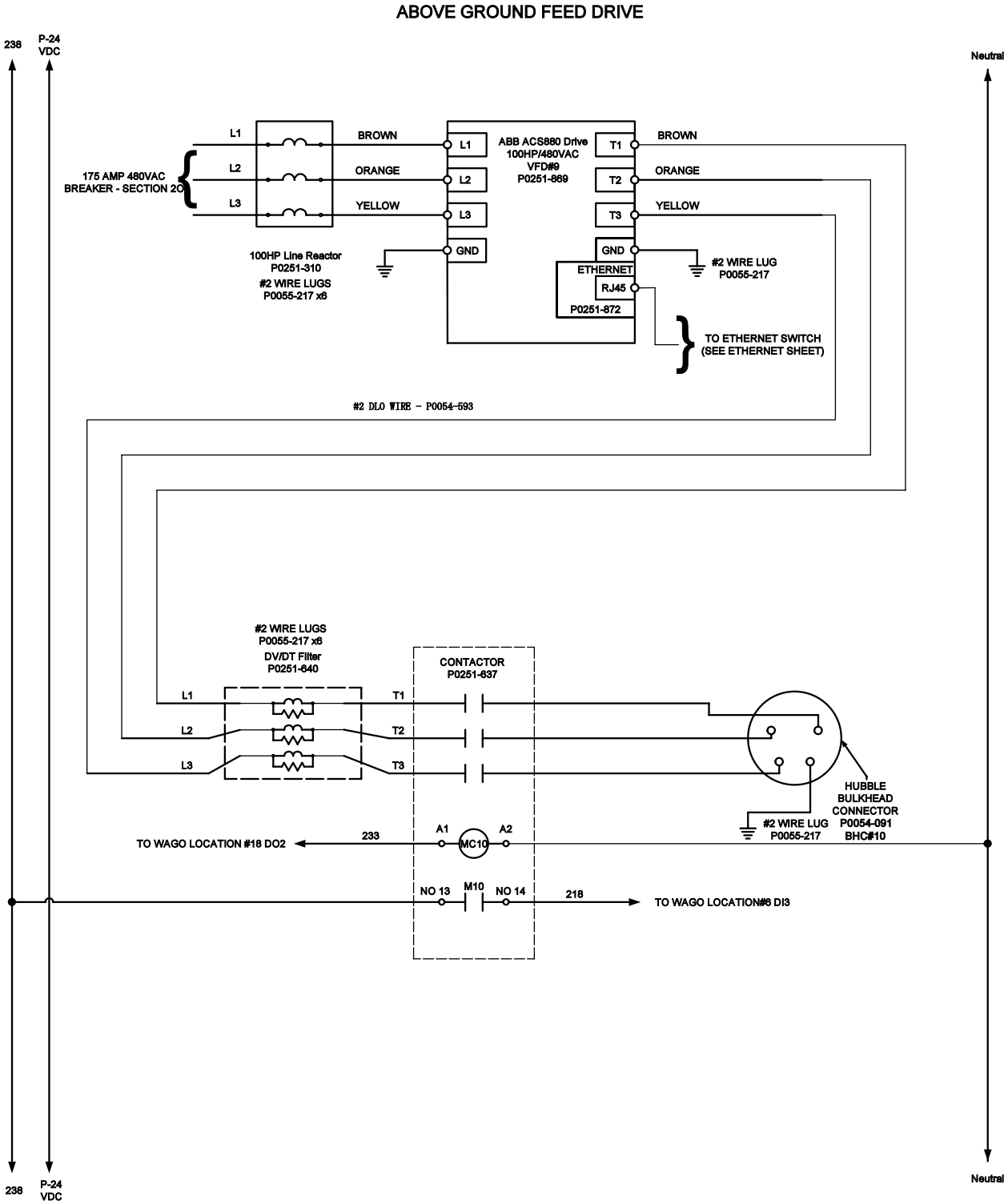
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 17 of 29



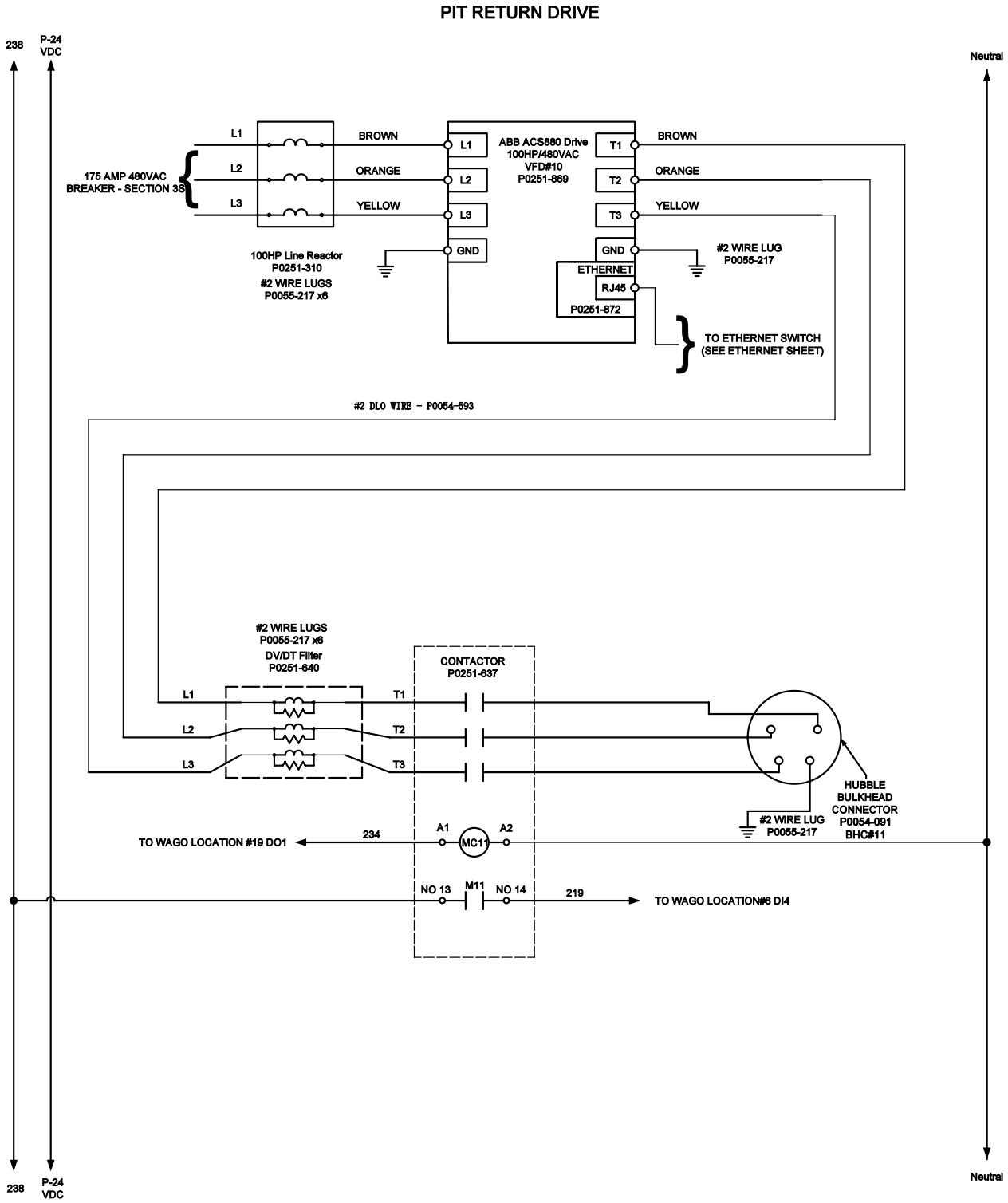
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 18 of 29



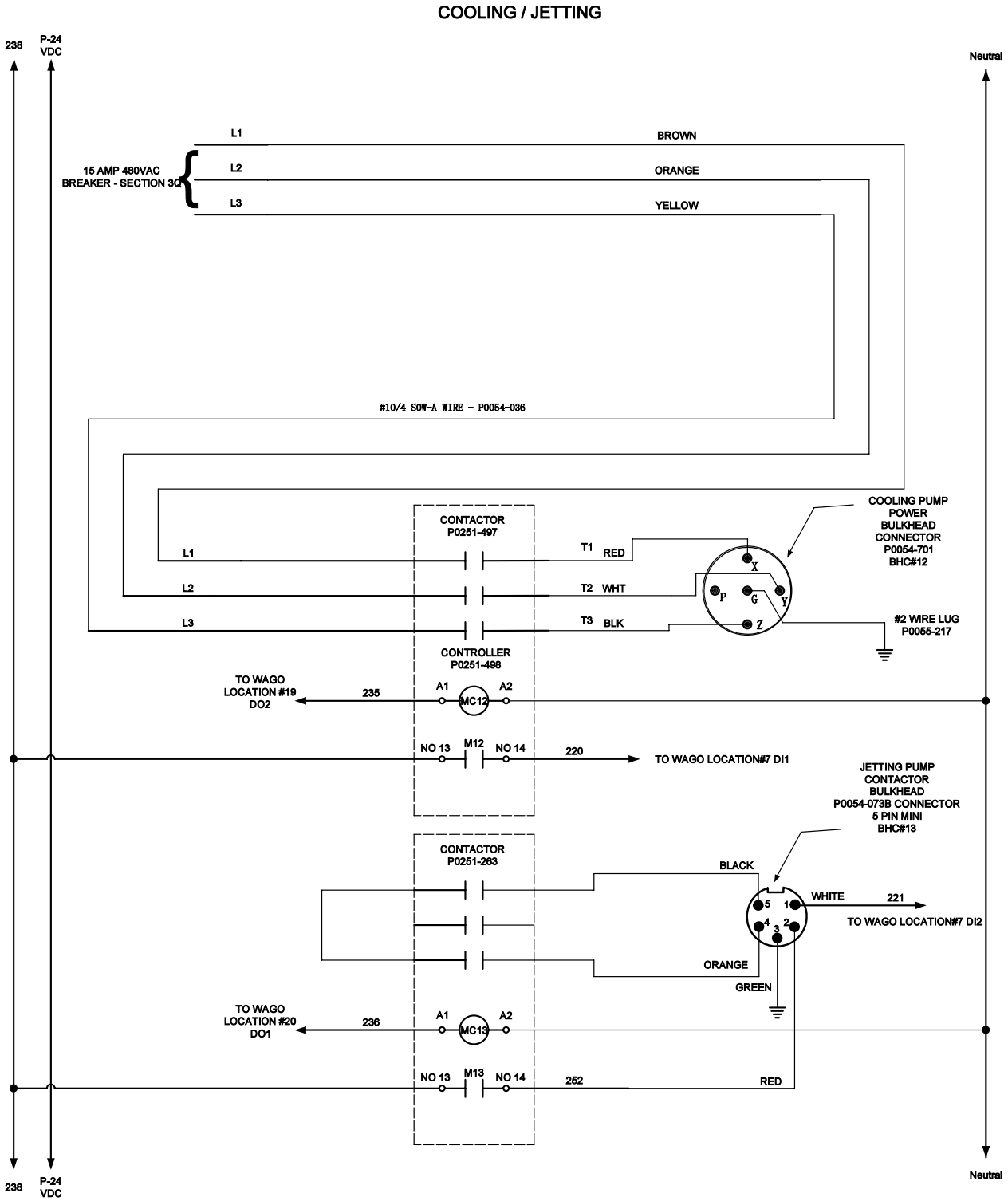
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 19 of 29



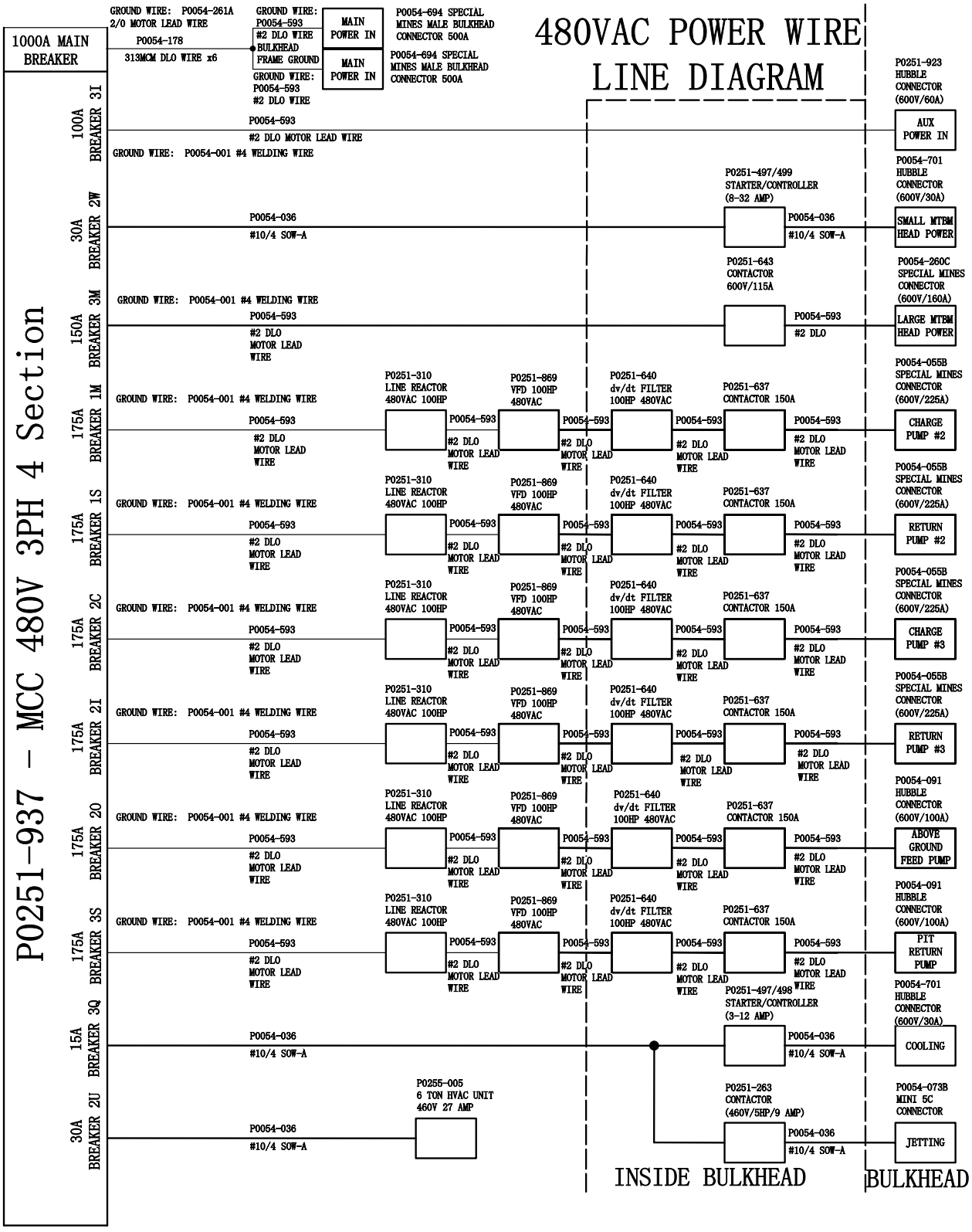
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 20 of 29



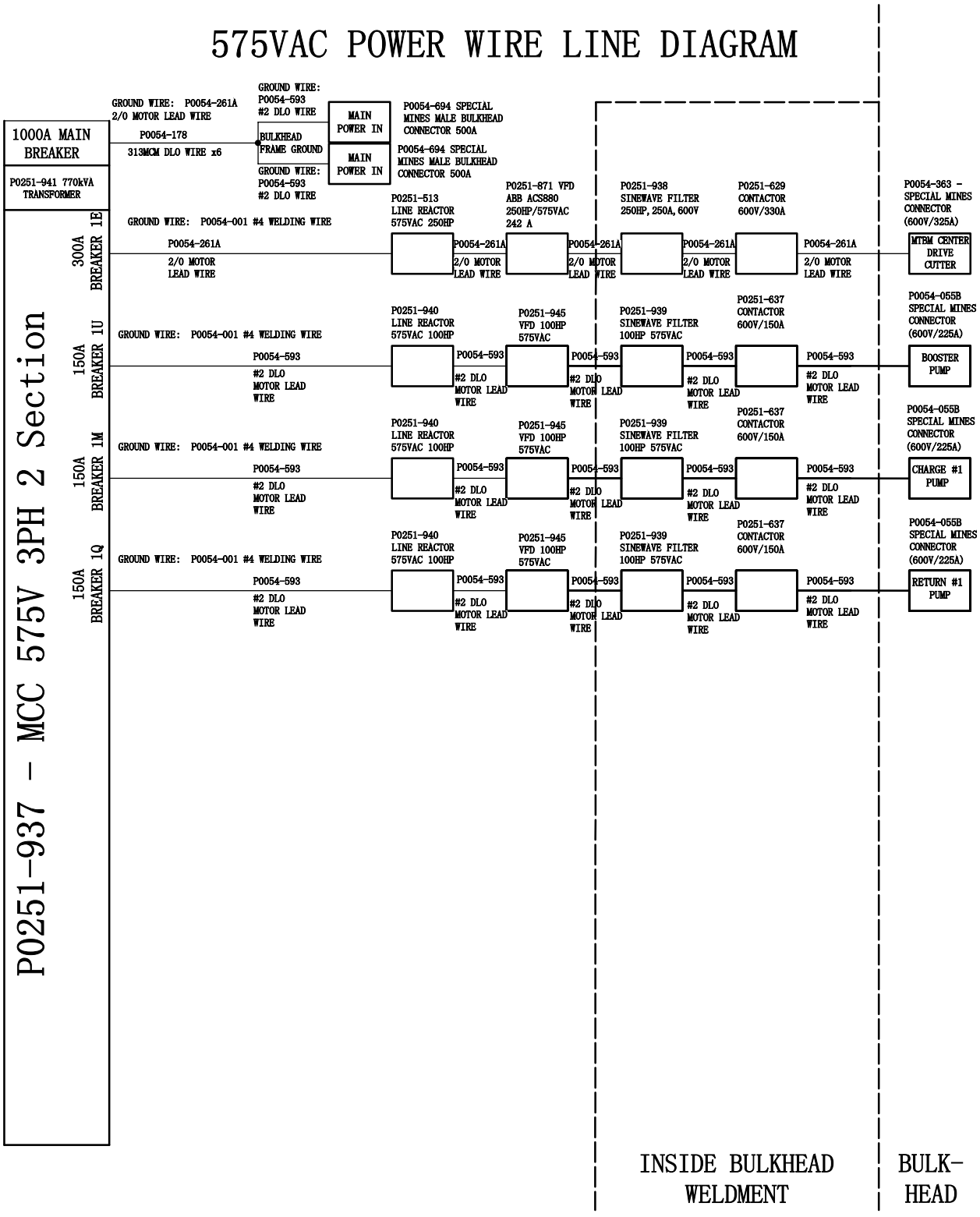
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 21 of 29



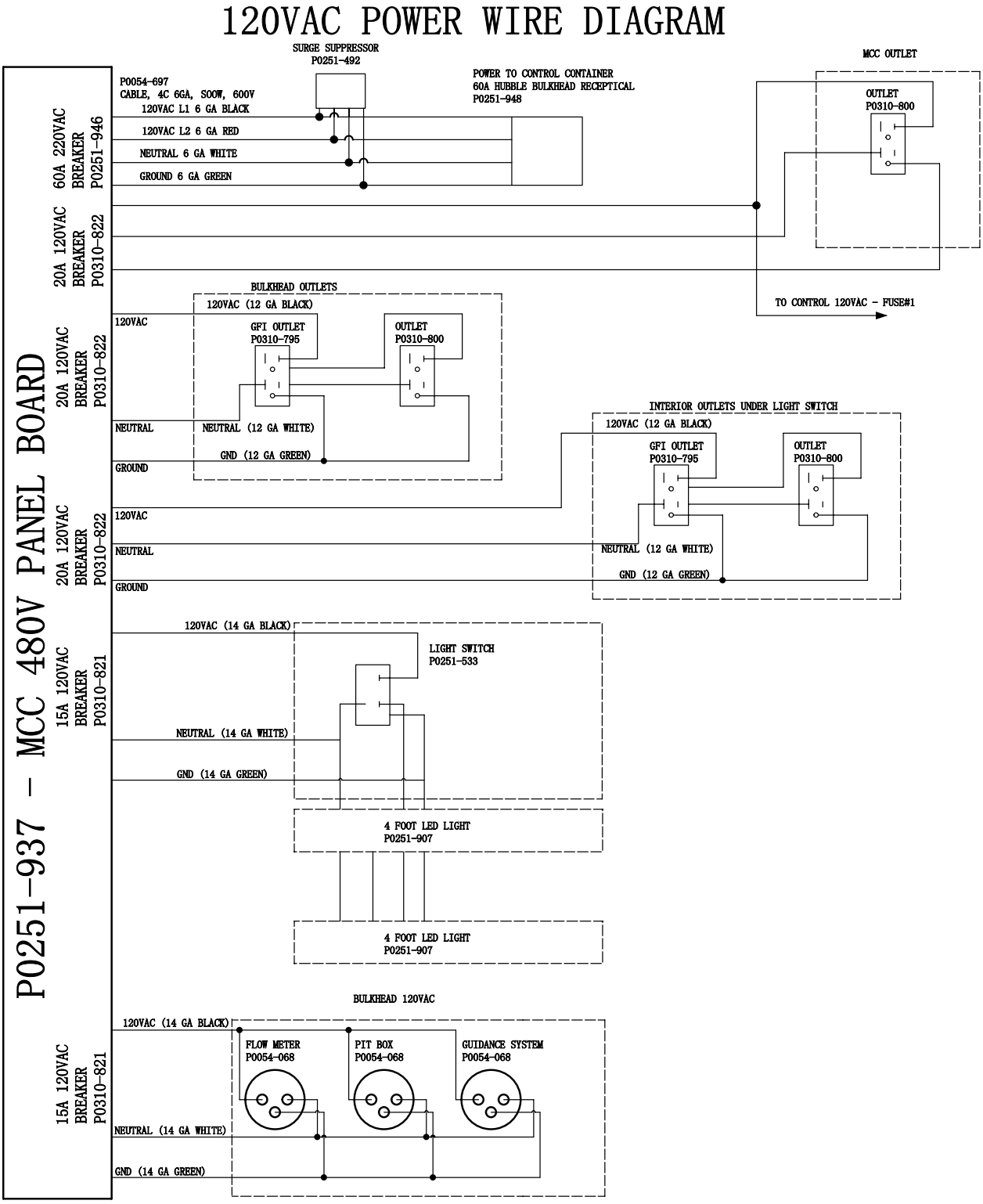
VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 22 of 29



VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 23 of 29

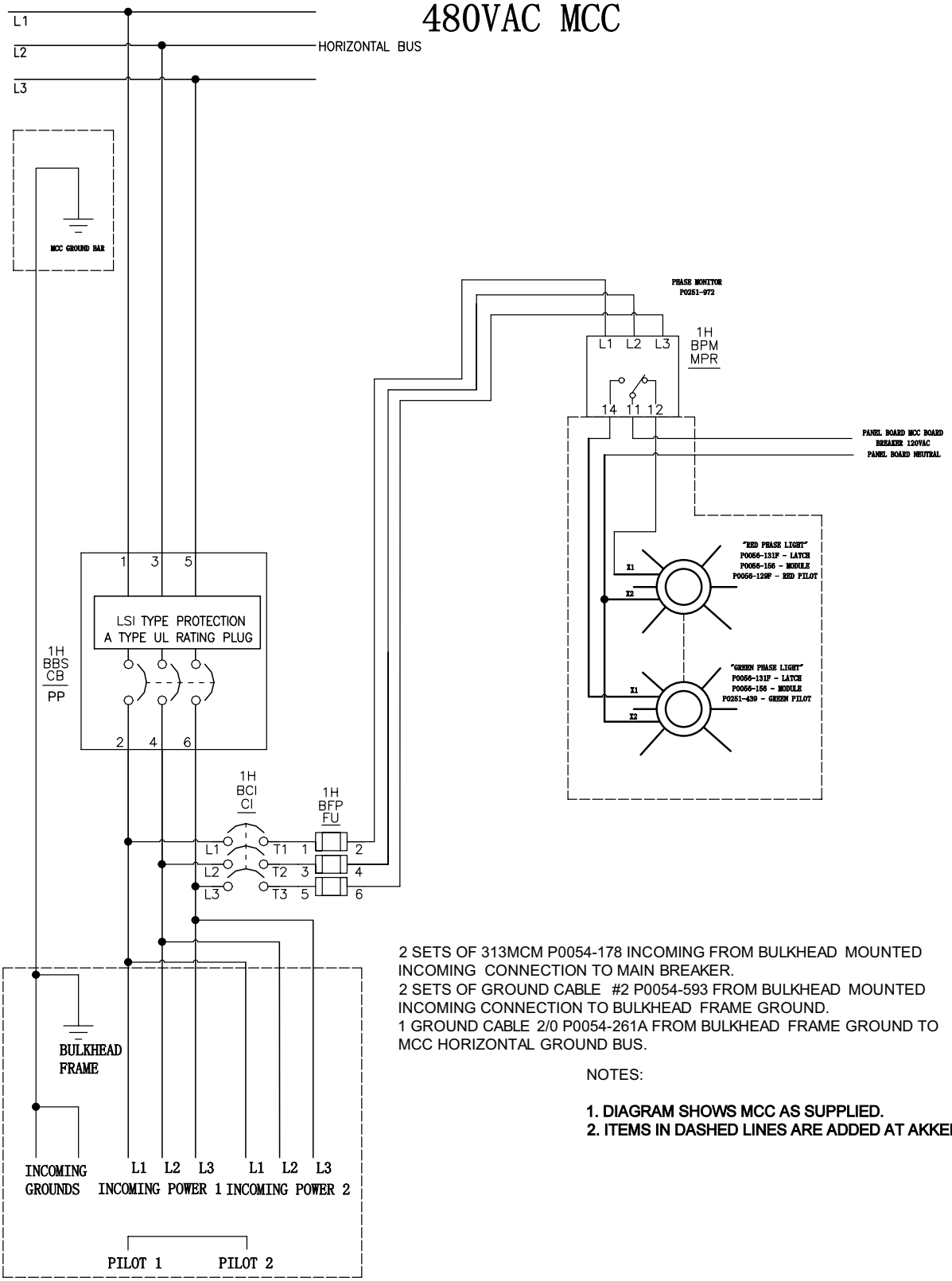


VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 24 of 29



VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 25 of 29

INCOMING POWER, PHASE MONITOR, PILOT INDICATORS 480VAC MCC

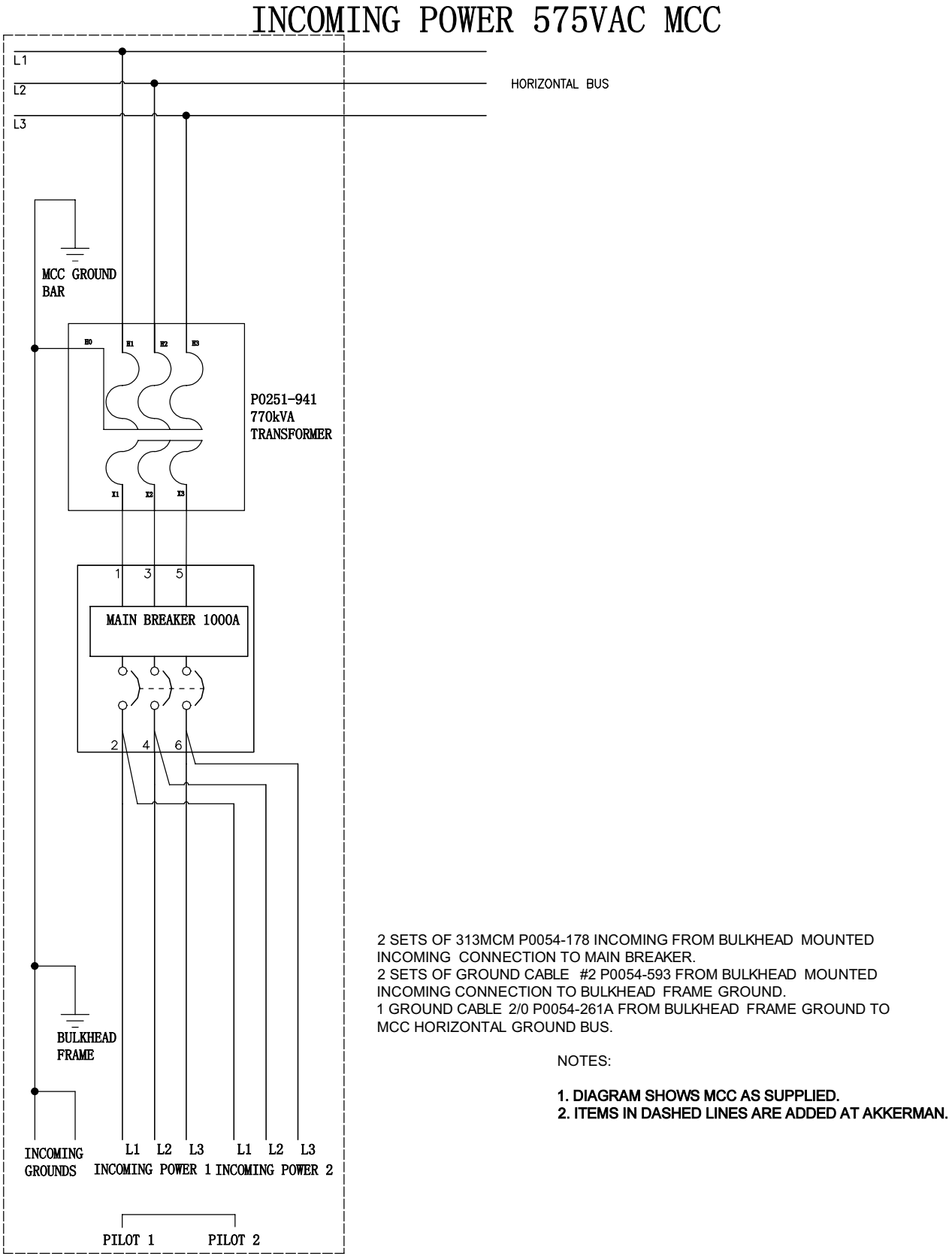


2 SETS OF 313MCM P0054-178 INCOMING FROM BULKHEAD MOUNTED INCOMING CONNECTION TO MAIN BREAKER.
2 SETS OF GROUND CABLE #2 P0054-593 FROM BULKHEAD MOUNTED INCOMING CONNECTION TO BULKHEAD FRAME GROUND.
1 GROUND CABLE 2/0 P0054-261A FROM BULKHEAD FRAME GROUND TO MCC HORIZONTAL GROUND BUS.

NOTES:

1. DIAGRAM SHOWS MCC AS SUPPLIED.
2. ITEMS IN DASHED LINES ARE ADDED AT AKKERMAN.

VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 26 of 29



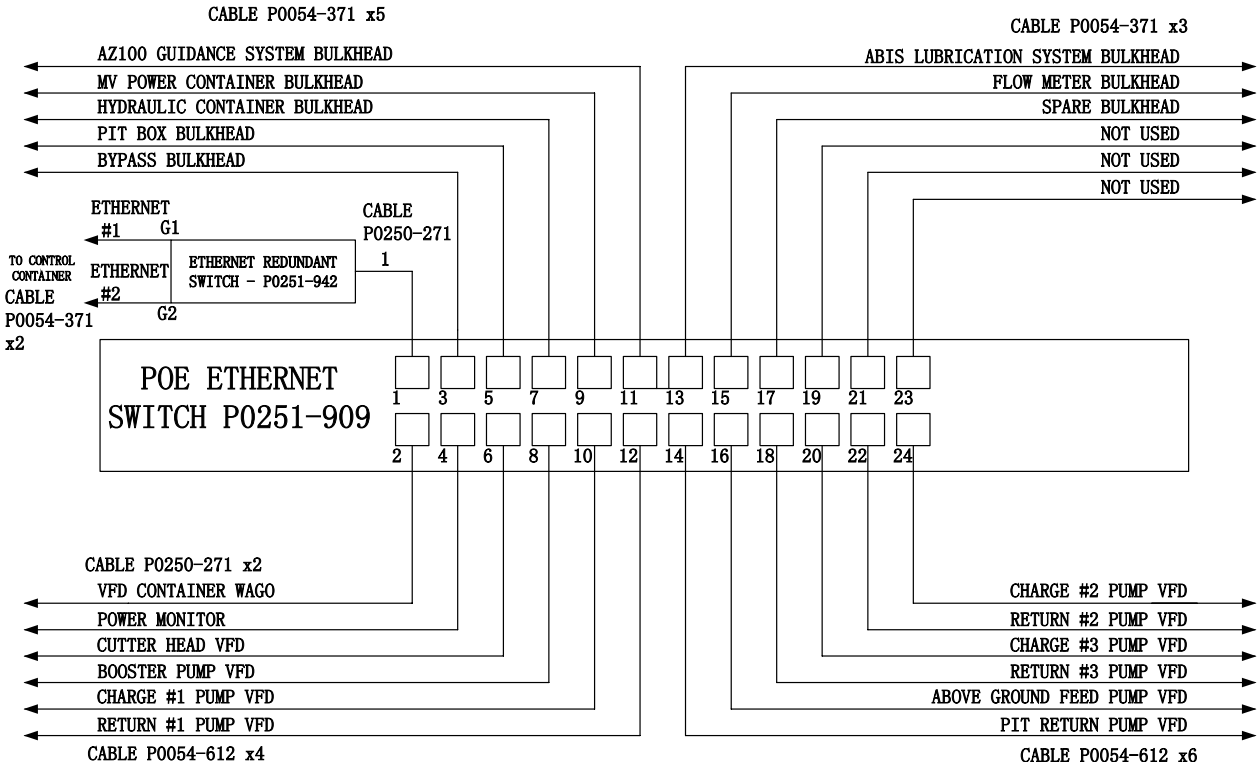
2 SETS OF 313MCM P0054-178 INCOMING FROM BULKHEAD MOUNTED INCOMING CONNECTION TO MAIN BREAKER.
2 SETS OF GROUND CABLE #2 P0054-593 FROM BULKHEAD MOUNTED INCOMING CONNECTION TO BULKHEAD FRAME GROUND.
1 GROUND CABLE 2/0 P0054-261A FROM BULKHEAD FRAME GROUND TO MCC HORIZONTAL GROUND BUS.

NOTES:

1. DIAGRAM SHOWS MCC AS SUPPLIED.
2. ITEMS IN DASHED LINES ARE ADDED AT AKKERMAN.

VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 27 of 29

VFD CONTAINER ETHERNET NETWORK WIRING



VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 28 of 29

MTBM ETHERNET DEVICE IP ADDRESSES

Device	Static IP Address
Data GATEWAY MODEM	192.168.10.1
ABIS PLC	192.168.10.11
ABIS HMI	192.168.10.12
VOIP Container to Pit	192.168.10.15
VOIP Pit to Container	192.168.10.16
VOIP Container to MTBM Head	192.168.10.17
VOIP MTBM Head to Container	192.168.10.18
Console Computer	192.168.10.21
Aux Console Computer	192.168.10.22
AZ100 Stations	192.168.10.30-53
Front PD	192.168.10.54
Front PD Module767 Speedway	192.168.10.56
Trail PD	192.168.10.57
Front MTBM	192.168.10.50
Middle MTBM	192.168.10.55
Trail MTBM	192.168.10.60
Hydraulic Container	192.168.10.90
LubeCan	192.168.10.54
Pit Box	192.168.10.70
Jack Can PD	192.168.10.59
Mid Voltage Container PD	192.168.10.58
Slurry Charge #1 VFD	192.168.10.76
Slurry Return #1 VFD	192.168.10.77
Slurry Charge #2 VFD	192.168.10.78
Slurry Return #2 VFD	192.168.10.79
Slurry Charge #3 VFD	192.168.10.80
Slurry Return #3 VFD	192.168.10.83
Booster VFD	192.168.10.85
Above Ground Feed VFD	192.168.10.84
Pit Return VFD	192.168.10.86
Cutter VFD	192.168.10.94
Hydraulic #1 VFD	192.168.10.87
Hydraulic Charge #1 VFD	192.168.10.88
Hydraulic #2 VFD (was Mid 2 Pump)	192.168.10.89
Hydraulic Cooling VFD	192.168.10.92
VFD WAGO (was MCC208 (seriplex only))	192.168.10.40
VFD Redundant Switch (was MCC480 (seriplex only)	192.168.10.42
Control Redundant Switch (was MCC575 (seriplex only))	192.168.10.44
MCC Seriplex (seriplex only)	192.168.10.81
MCC Power Monitor	192.168.10.82
MTBM Camera 1	192.168.10.71
MTBM Camera 2	192.168.10.72
MTBM Camera 3	192.168.10.73
Seriplex Panasonic Camera	192.168.10.74
Tunnel VOIP Stations	192.168.10.100-119
Control Container Console Wago	192.168.10.120
ABIS Station PLCs	192.168.125-139
Slurry Flow Meters	192.168.10.140
Managed Switch	192.168.10.200
Brick IO (Future)	192.168.10.210-220

VFD Container Electrical Schematics (continued)
Electrical Schematic - Part 29 of 29

MTBM CONTROL WIRE NUMBERS

WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
C-0V	Ground	various	various	Wht/Blu 16 AWG
C-24 VDC	24 Volt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	various	various	White 16 AWG
120 L	120VAC Line	various	various	Black 16 AWG
P-0V	Ground	BULKHEAD PILOT POWER	BULKHEADS	Wht/Blu 16 AWG
P-24VDC	24 Volt	BULKHEAD PILOT POWER	PILOT RELAY CONTROL	Blu/Wht 16 AWG
200	LARGE HEAD PILOT	WAGO LOCATION#2 DI1	PCR#1 14	Blu/Wht 16 AWG
201	CUTTER PILOT	WAGO LOCATION#2 DI2	PCR#2 14	Pink 16 AWG
202	BOOSTER PILOT	WAGO LOCATION#2 DI3	PCR#3 14	Purple 16 AWG
203	CHARGE #1 PILOT	WAGO LOCATION#2 DI4	PCR#4 14	Orange 16 AWG
204	RETURN #1 PILOT	WAGO LOCATION#3 DI1	PCR#5 14	Orange 16 AWG
205	CHARGE #2 PILOT	WAGO LOCATION#3 DI2	PCR#6 14	Orange 16 AWG
206	RETURN #2 PILOT	WAGO LOCATION#3 DI3	PCR#7 14	White 16 AWG
207	CHARGE #3 PILOT	WAGO LOCATION#3 DI4	PCR#8 14	Pink 16 AWG
208	RETURN #3 PILOT	WAGO LOCATION#4 DI1	PCR#9 14	Wht/Blu 16 AWG
209	LARGE HEAD AUX CONTACT	WAGO LOCATION#4 DI2	MC1 14	Blu/Blk 16 AWG
210	CUTTER AUX CONTACT	WAGO LOCATION#4 DI3	MC2 14	Pink 16 AWG
211	BOOSTER AUX CONTACT	WAGO LOCATION#4 DI4	MC3 14	Purple 16 AWG
212	CHARGE #1 AUX CONTACT	WAGO LOCATION#5 DI1	MC4 14	Orange 16 AWG
213	RETURN #1 AUX CONTACT	WAGO LOCATION#5 DI2	MC5 14	Orange 16 AWG
214	CHARGE #2 AUX CONTACT	WAGO LOCATION#5 DI3	MC6 14	Black 16 AWG
215	RETURN #2 AUX CONTACT	WAGO LOCATION#5 DI4	MC7 14	Purple 16 AWG
216	CHARGE #3 AUX CONTACT	WAGO LOCATION#6 DI1	MC8 14	Pink 16 AWG
217	RETURN #3 AUX CONTACT	WAGO LOCATION#6 DI2	MC9 14	Orange 16 AWG
218	ABOVE GROUND FEED AUX CONTACT	WAGO LOCATION#6 DI3	MC10 14	Blu/Blk 16 AWG
219	PIT RETURN AUX CONTACT	WAGO LOCATION#6 DI4	MC11 14	Blu/Wht 16 AWG
220	COOLING AUX CONTACT	WAGO LOCATION#7 DI1	MC12 14	Purple 16 AWG
221	JETTING CONTACTOR	WAGO LOCATION#7 DI2	BHC#13 PIN 1	Pink 16 AWG
222	E-STOP 120V SUPPLY	ESC1 - 14	WAGO LOCATION#10 DI1	
			WAGO LOCATION#12 120V	
			WAGO LOCATION#17 120V	
223	E-STOP SUPPLY CONTROL	WAGO LOCATION#11 DO1	ESC1 A1	Blu/Blk 16 AWG
			ESC2 A1	
224	LARGE HEAD POWER COIL	WAGO LOCATION#13 DO1	MC1 A1	Blu/Blk 16 AWG
225	CUTTER COIL	WAGO LOCATION#12 DO2	MC2 A1	Blu/Wht 16 AWG
226	BOOSTER COIL	WAGO LOCATION#14 DO1	MC3 A1	Blu/Wht 16 AWG
227	CHARGE#1 COIL	WAGO LOCATION#14 DO2	MC4 A1	Blu/Blk 16 AWG
228	RETURN#1 COIL	WAGO LOCATION#15 DO1	MC5 A1	Blu/Wht 16 AWG
229	CHARGE#2 COIL	WAGO LOCATION#15 DO2	MC6 A1	Pink 16 AWG
230	RETURN#2 COIL	WAGO LOCATION#16 DO1	MC7 A1	Purple 16 AWG
231	CHARGE#3 COIL	WAGO LOCATION#16 DO2	MC8 A1	Blu/Wht 16 AWG
232	RETURN#3 COIL	WAGO LOCATION#18 DO1	MC9 A1	Wht/Blu 16 AWG
233	ABOVE GROUND FEED COIL	WAGO LOCATION#18DO2	MC10 A1	Orange 16 AWG
234	PIT RETURN COIL	WAGO LOCATION#19 DO1	MC11 A1	Wht/Blu 16 AWG
235	COOLING COIL	WAGO LOCATION#19 DO2	MC12 A1	Pink 16 AWG
236	JETTING COIL	WAGO LOCATION#20 DO1	MC13 A1	Purple 16 AWG
237	E-Stop	SW#1	WAGO LOCATION#7 DI3	White 16 AWG
238	E-STOP 24VDC SUPPLY	ESC2 - 14	various	Purple 16 AWG
239	LARGE HEAD POWER PILOT GROUND	BHC#1	PCR#1 A2	
240	CUTTER PILOT GROUND	BHC#2	PCR#2 A2	Orange 16 AWG
241	BOOSTER PILOT GROUND	BHC#3	PCR#3 A2	Purple 16 AWG
242	CHARGE#1 PILOT GROUND	BHC#4	PCR#4 A2	Pink 16 AWG
243	RETURN#1 PILOT GROUND	BHC#5	PCR#5 A2	Orange 16 AWG
244	CHARGE#2 PILOT GROUND	BHC#6	PCR#6 A2	
245	RETURN#2 PILOT GROUND	BHC#7	PCR#7 A2	
246	CHARGE#3 PILOT GROUND	BHC#8	PCR#8 A2	
247	RETURN#3 PILOT GROUND	BHC#9	PCR#9 A2	
248	SMALL HEAD PILOT GROUND	BHC#14	PCR#10 A2	
249	SMALL HEAD POWER COIL	WAGO LOCATION#20 DO2	MC14 A1	Orange 16 AWG
250	SMALL HEAD PILOT	WAGO LOCATION#8 DI1	PCR#10 14	Blu/Blk 16 AWG

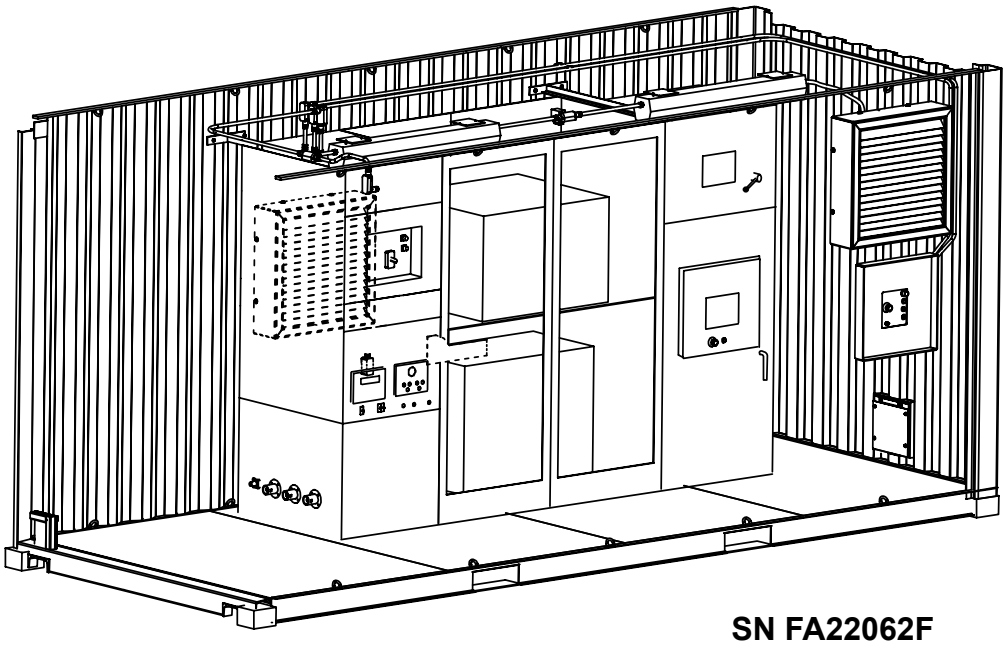
Power Container

The Main Drive Power Container offers increased voltage to run the periphery drive, face access MTBM's main drive.

Power Container SN FA22062F
Electrical Schematic 4-2

Power Container SN FA22080F
Electrical Schematic 4-6

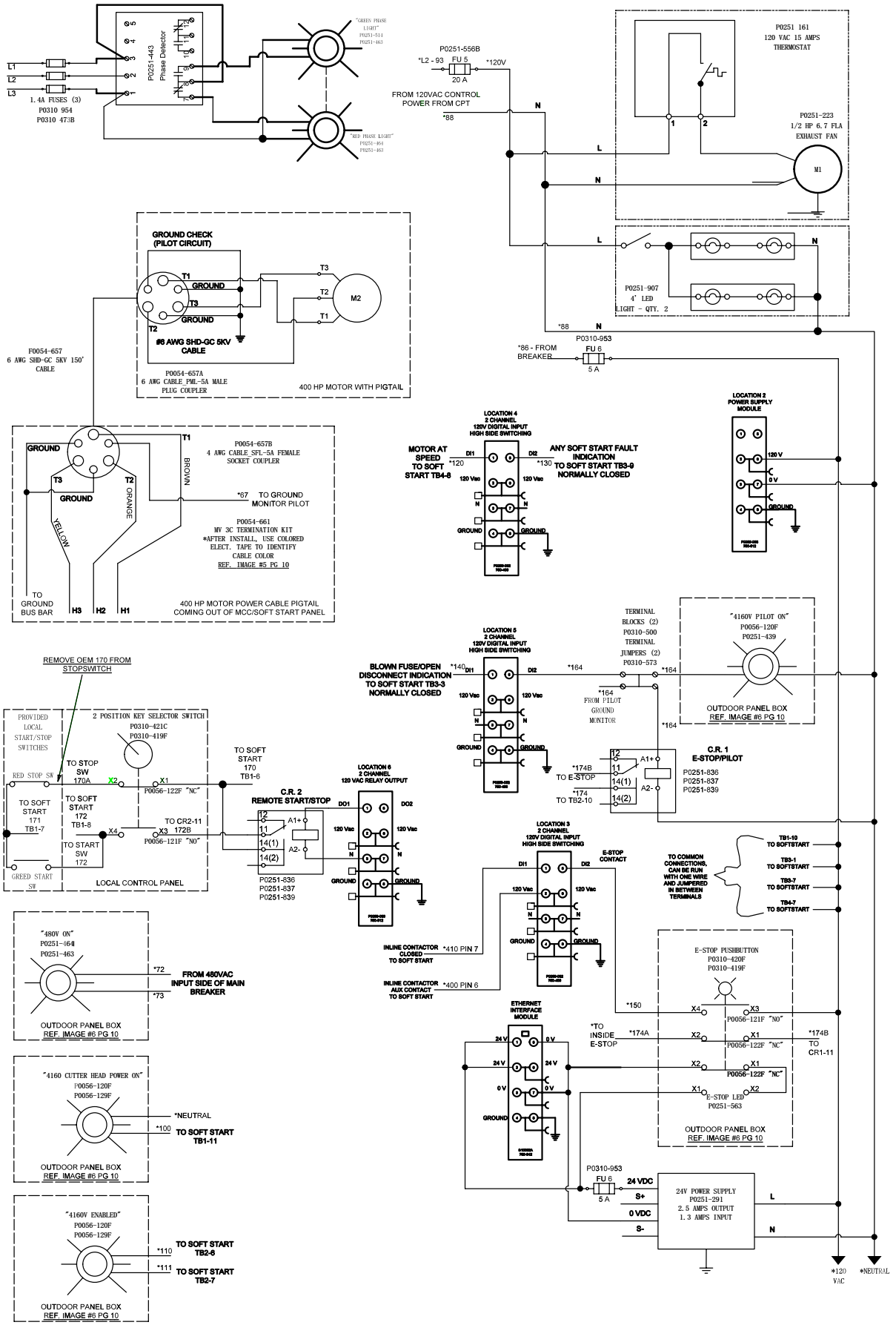
Power Container SN FA22244F
Electrical Schematic 4-10



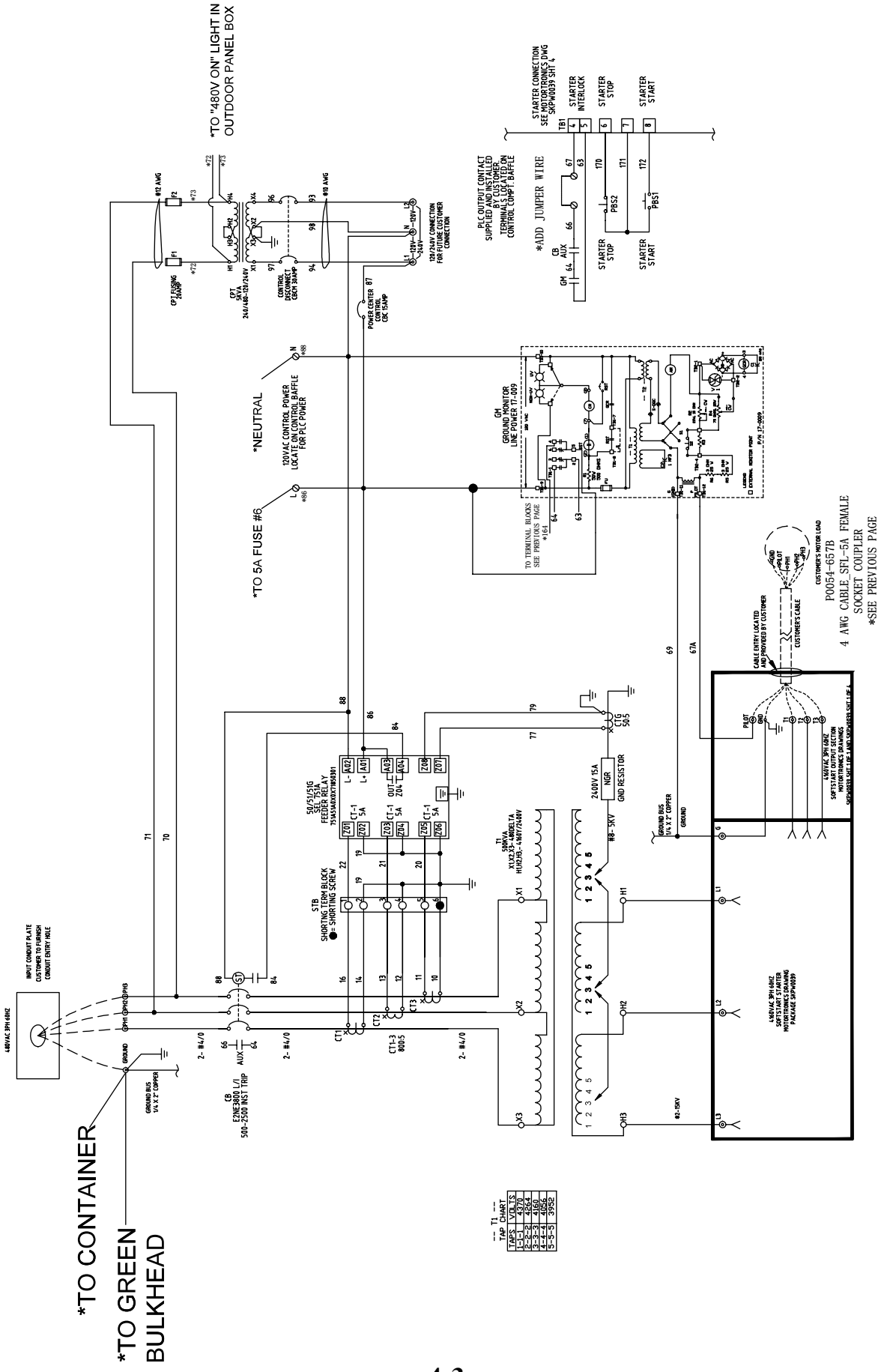
SN FA22062F

POWER CONTAINER ELECTRICAL SCHEMATICS - SN FA22062F

Electrical Schematic - Part 1 of 4

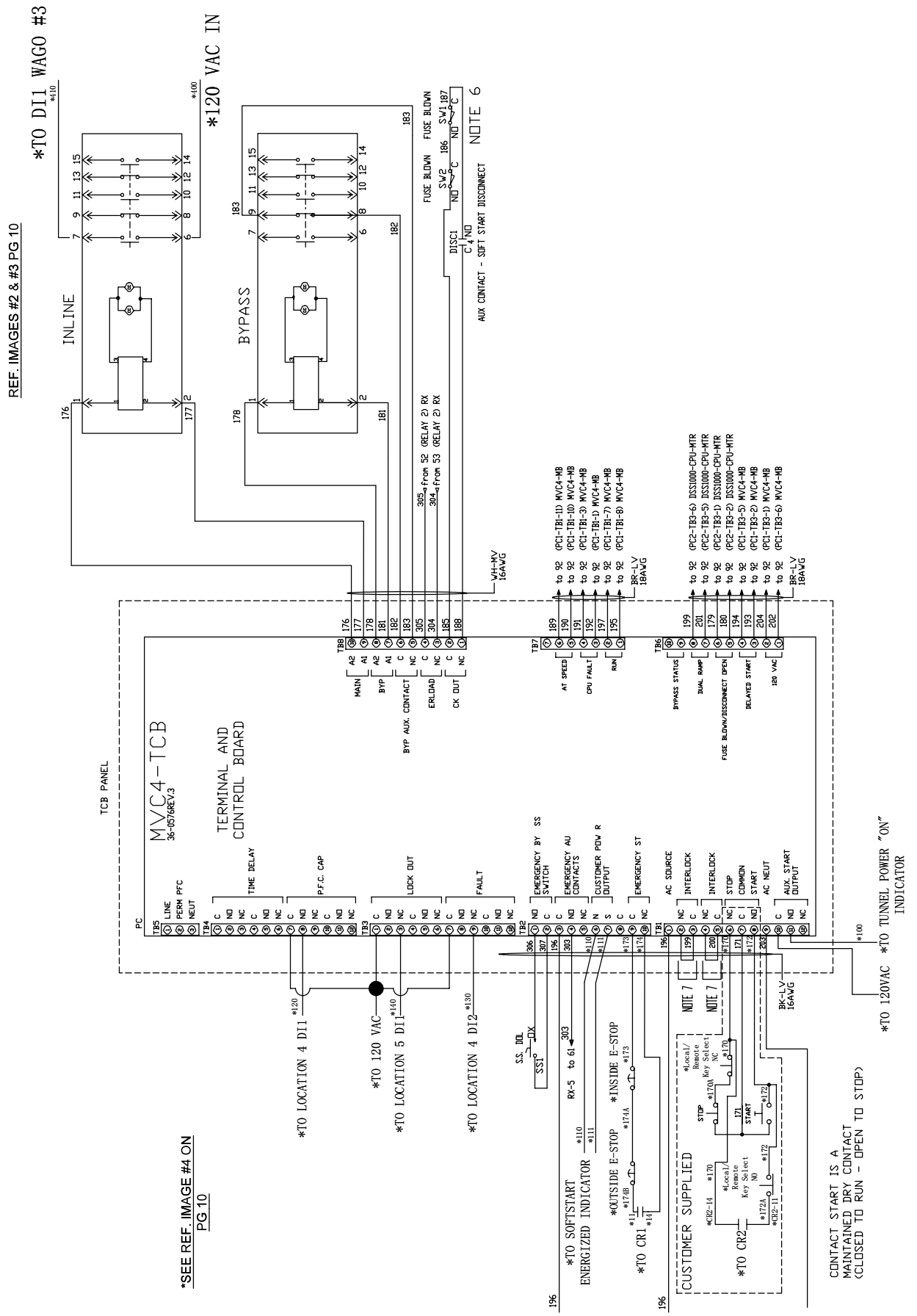


Power Container Electrical Schematics (continued)
Electrical Schematic - Part 2 of 4



Power Container Electrical Schematics (continued)

Electrical Schematic - Part 3 of 4

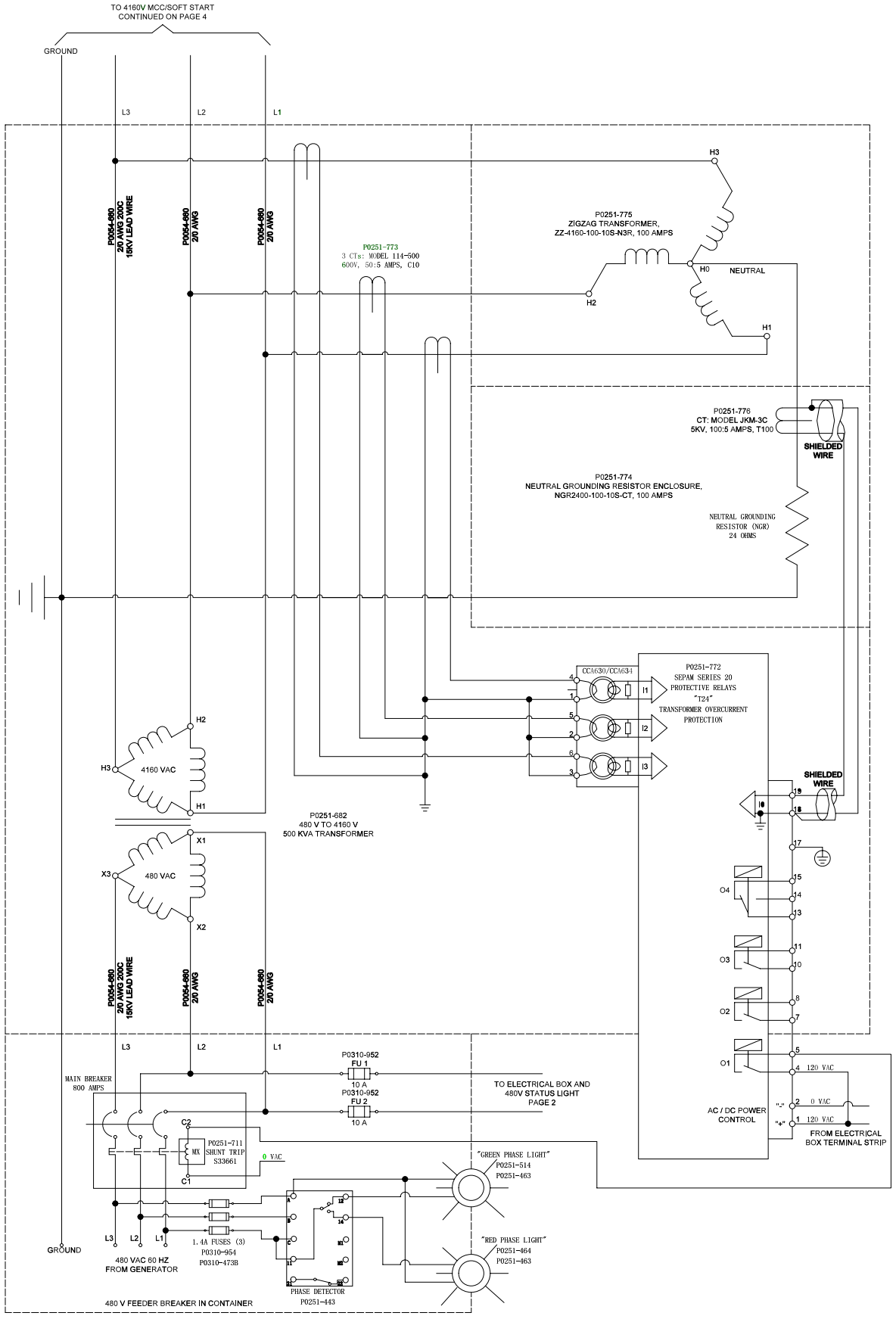


Power Container Electrical Schematics (continued)
Electrical Schematic - Part 4 of 4

WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
0v	Ground	various	various	Wht/Blu 16 AWG
24v	24 Volt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	Low Voltage Section	Outside Control Box	White 16 AWG
120 L	120VAC Line	Low Voltage Section	Outside Control Box	Black 16 AWG
120 N	120VAC Neutral	Low Voltage Section	Lights & Fan	White 12 AWG
120 L	120VAC Line	Low Voltage Section	Lights & Fan	Black 12 AWG
70	480V Power On	High Voltage L2	Outside Control Box LIT#1	Black 16 AWG
71	480V Power On	High Voltage L3	Outside Control Box LIT#1	Black 16 AWG
100	Tunnel Power On	MV Soft Start TB1-11	Outside Control Box LIT#2	RED/WHITE 16 AWG
110	Soft Start Energised	MV Soft Start TB2-6	Outside Control Box LIT#3	RED 16 AWG
111	Soft Start Energised	MV Soft Start TB2-7	Outside Control Box LIT#3	ORANGE 16 AWG
120	Motor At Speed	MV Soft Start TB4-8	LV Section Wago#4 DI1	YELLOW 16 AWG
130	Soft Start Fault	MV Soft Start TB3-9	LV Section Wago#4 DI1	ORANGE 16 AWG
140	Soft Start Fuse Blown - Disconnect	MV Soft Start TB3-3	LV Section Wago#5 DI1	WHITE 16 AWG
150	Soft Start E-Stop NO	Outside Control Box E-Stop NO	LV Section Wago#3 DI2	BLUE 16 AWG
164	Ground Monitor Output	Low Voltage Section Term	LV Section Term,CR1,Wago#5 DI2 - Outside Box LIT#4	RED/BLACK 16 AWG
170	Soft Start Local/Remote 1	MV Soft Start TB1-6	LV Section Key Switch NC	WHITE 16 AWG
170A	Soft Start Local/Remote 2	LV Section Key Switch NC	LV Section Stop Sw NC	WHITE 16 AWG
170B	Soft Start Local/Remote 3	LV Section Key Switch NC	LV Section CR2 14	WHITE 16 AWG
172	Soft Start Local/Remote 4	LV Section Start Sw N0	MV Soft Start TB1-8	WHITE 16 AWG
172A	Soft Start Local/Remote 5	LV Section Start Sw N0	LV Section Key Switch N0	WHITE 16 AWG
172B	Soft Start Local/Remote 6	LV Section Key Switch N0	LV Section CR2 11	WHITE 16 AWG
173	Soft Start E-Stop Common	MV Soft Start TB2-9	Inside E-Stop NC	WHITE 16 AWG
174A	E-Stop NC 1	Inside Control Box E-Stop NC	Outside Control Box E-Stop NC	ORANGE 16 AWG
174B	E-Stop NC 2	Outside Control Box E-Stop NC	LV Section CR1 11	YELLOW 16 AWG
174	E-Stop CR1 Input	MV Soft Start TB2-10	LV Section CR1 14	YELLOW 16 AWG
400	Inline Contactor NO Supply	Low Voltage Section 120VAC	MV Soft Start Inline Contactor	WHITE 16 AWG
410	Inline Contactor NO Output	MV Soft Start Inline Contactor	LV Section Wago#3 DI1	WHITE 16 AWG

POWER CONTAINER ELECTRICAL SCHEMATICS - SN FA22080F

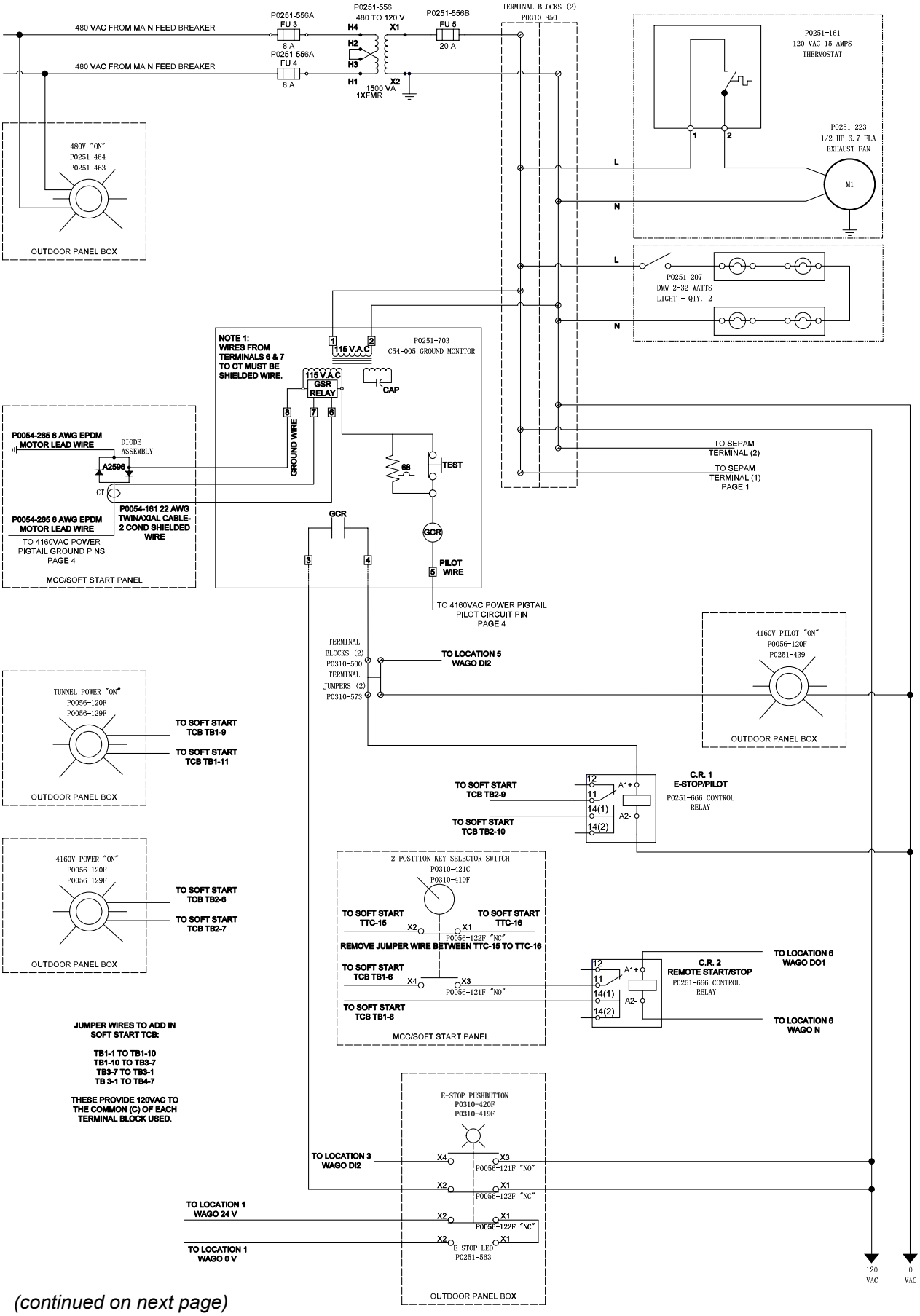
Electrical Schematic - Part 1 of 4



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Power Container Electrical Schematics (continued)

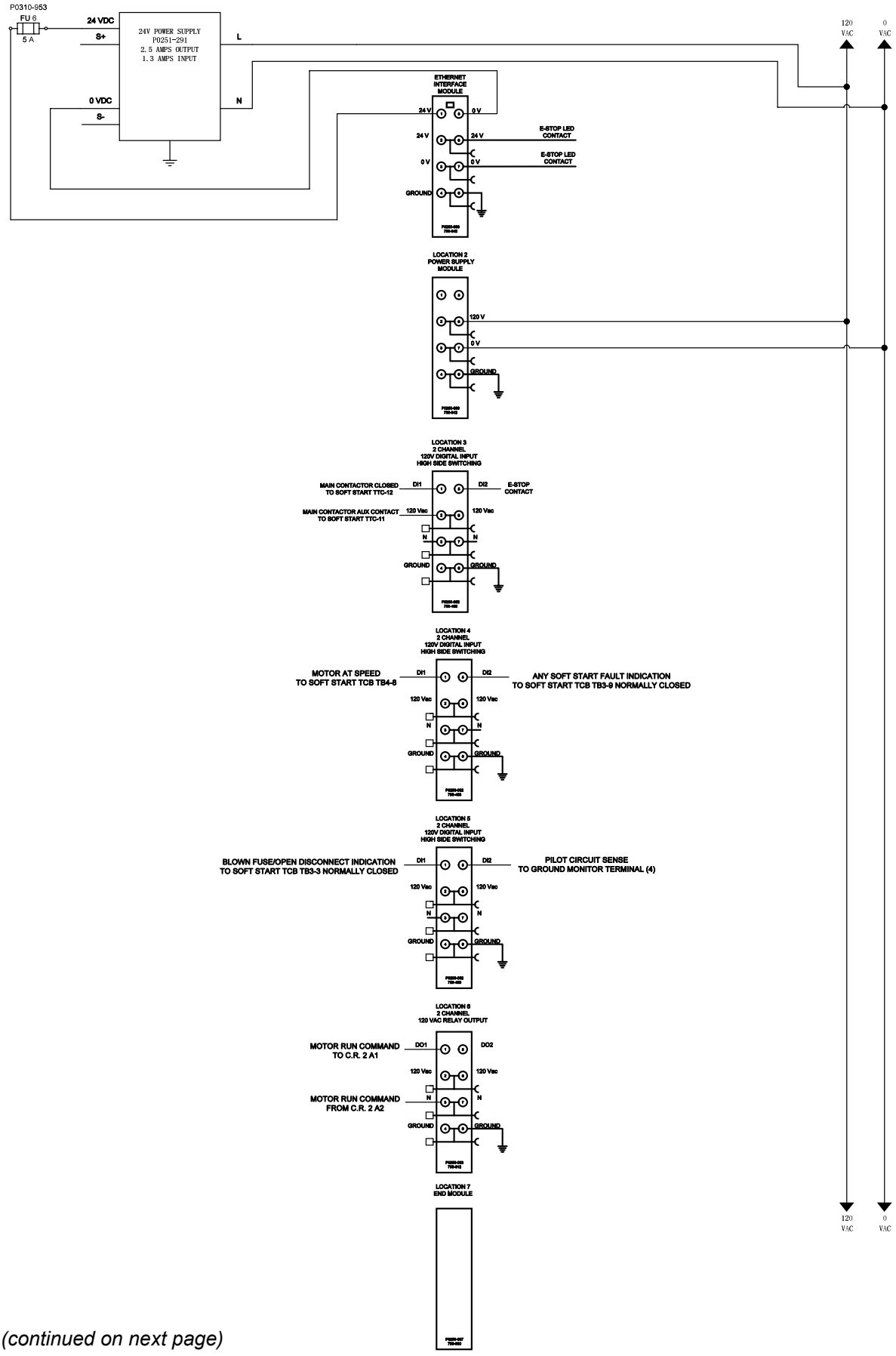
Electrical Schematic - Part 2 of 4



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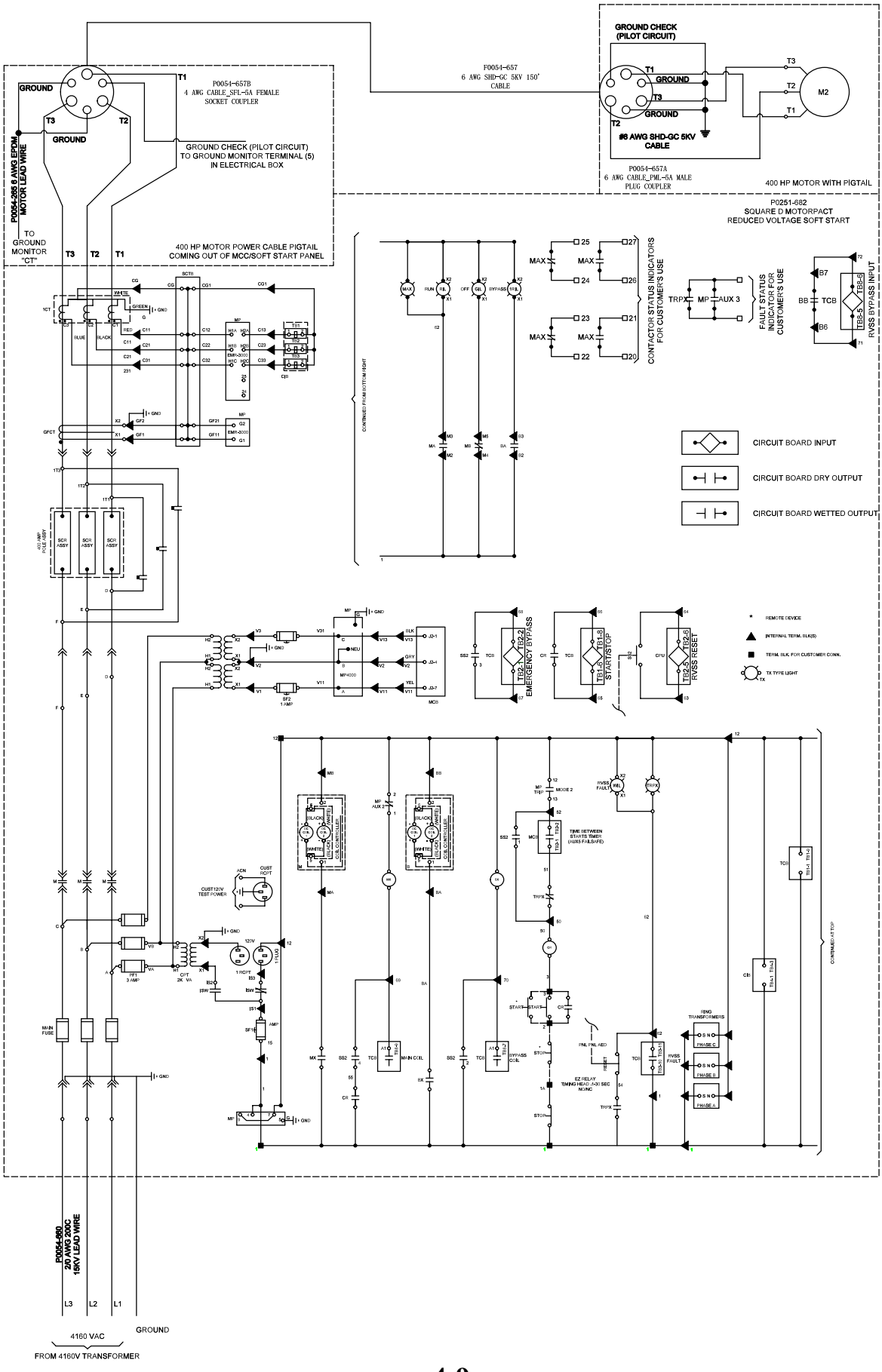
Power Container Electrical Schematics (continued)

Electrical Schematic - Part 3 of 4



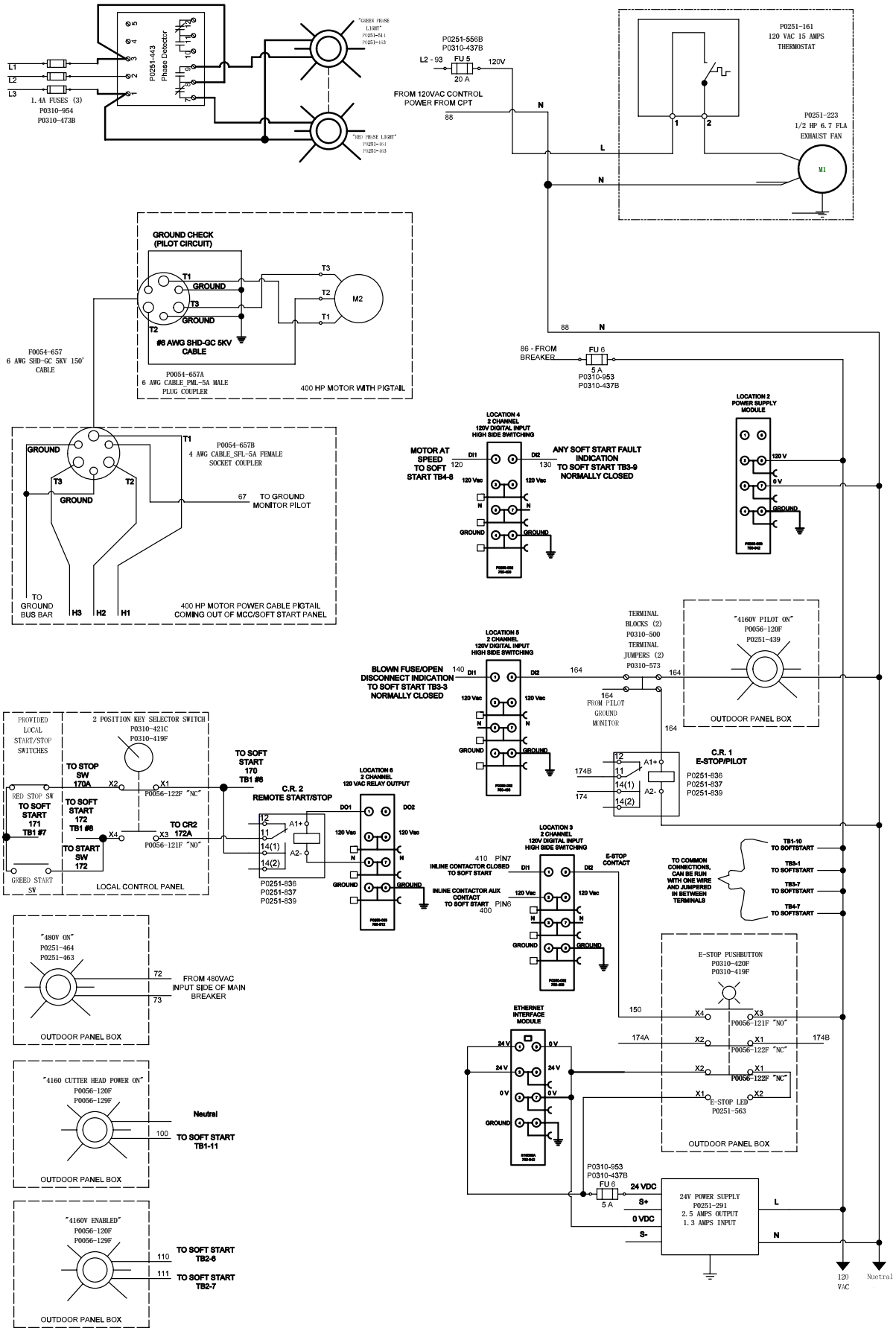
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Power Container Electrical Schematics (continued)
Electrical Schematic - Part 4 of 4



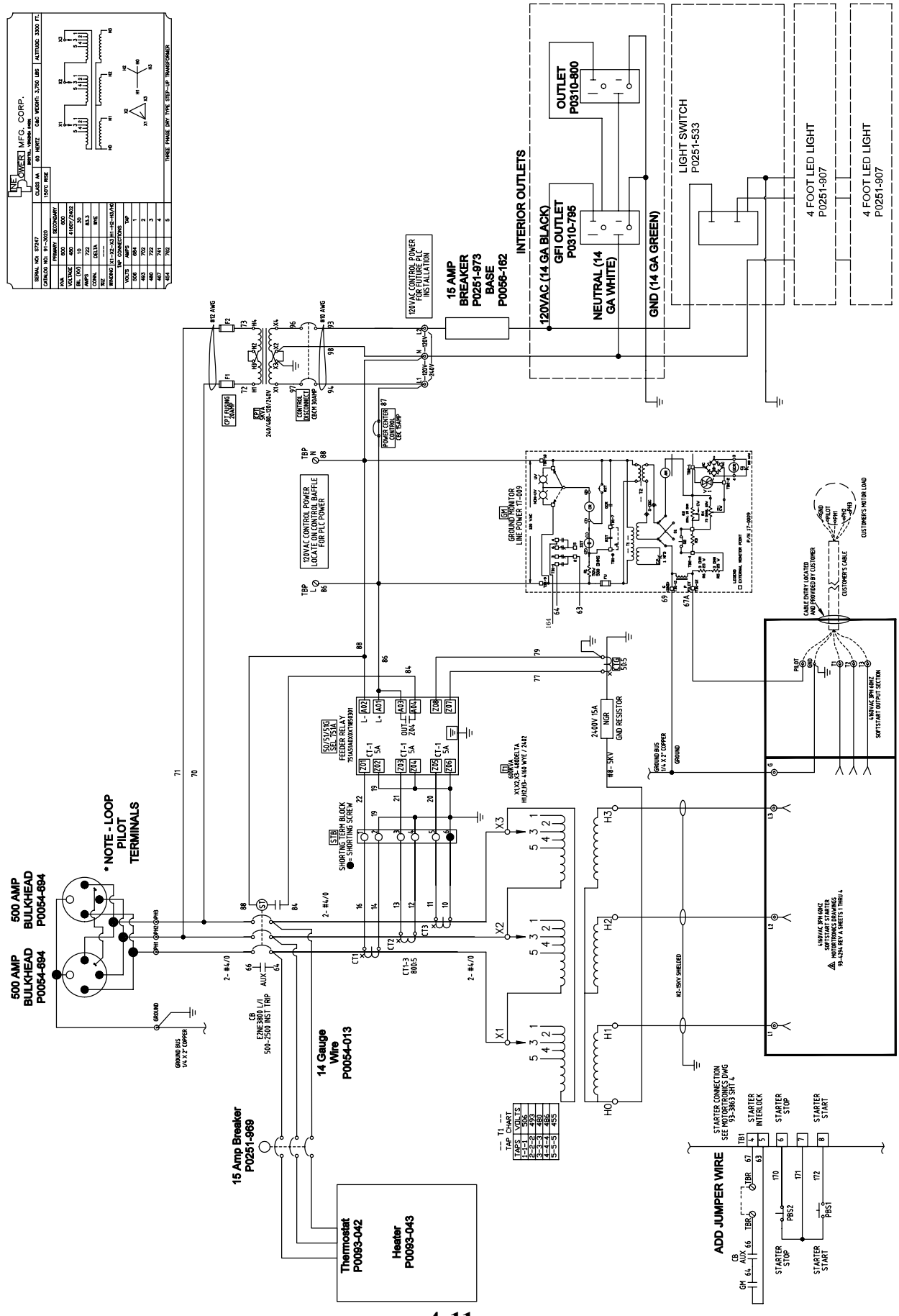
POWER CONTAINER ELECTRICAL SCHEMATICS - SN FA22244F

Electrical Schematic - Part 1 of 4



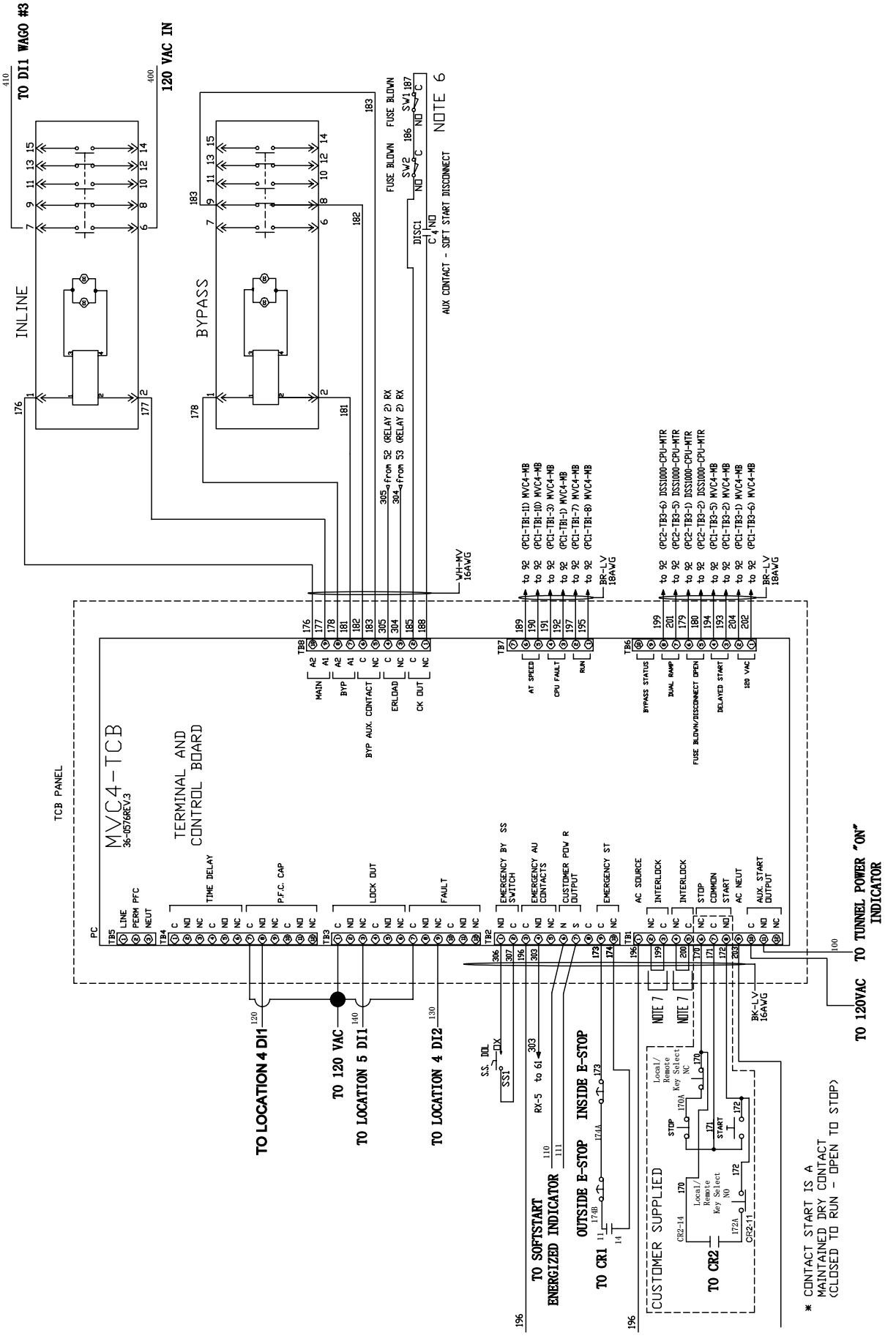
Power Container Electrical Schematics (continued)

Electrical Schematic - Part 2 of 4



Power Container Electrical Schematics (continued)

Electrical Schematic - Part 3 of 4



Power Container Electrical Schematics (continued)
Electrical Schematic - Part 4 of 4

WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
0v	Ground	various	various	Wht/Blu 16 AWG
24v	24 Volt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	Low Voltage Section	Outside Control Box	White 16 AWG
120 L	120VAC Line	Low Voltage Section	Outside Control Box	Black 16 AWG
120 N	120VAC Neutral	Low Voltage Section	Lights & Fan	White 12 AWG
120 L	120VAC Line	Low Voltage Section	Lights & Fan	Black 12 AWG
70	480V Power On	High Voltage L2	Outside Control Box LIT#1	Black 16 AWG
71	480V Power On	High Voltage L3	Outside Control Box LIT#1	Black 16 AWG
100	Tunnel Power On	MV Soft Start TB1-11	Outside Control Box LIT#2	RED/WHITE 16 AWG
110	Soft Start Energised	MV Soft Start TB2-6	Outside Control Box LIT#3	RED 16 AWG
111	Soft Start Energised	MV Soft Start TB2-7	Outside Control Box LIT#3	ORANGE 16 AWG
120	Motor At Speed	MV Soft Start TB4-8	LV Section Wago#4 DI1	YELLOW 16 AWG
130	Soft Start Fault	MV Soft Start TB3-9	LV Section Wago#4 DI1	ORANGE 16 AWG
140	Soft Start Fuse Blown - Disconnect	MV Soft Start TB3-3	LV Section Wago#5 DI1	WHITE 16 AWG
150	Soft Start E-Stop NO	Outside Control Box E-Stop NO	LV Section Wago#3 DI2	BLUE 16 AWG
164	Ground Monitor Output	Low Voltage Section Term	LV Section Term,CR1,Wago#5 DI2 - Outside Box LIT#4	RED/BLACK 16 AWG
170	Soft Start Local/Remote 1	MV Soft Start TB1-6	LV Section Key Switch NC	WHITE 16 AWG
170A	Soft Start Local/Remote 2	LV Section Key Switch NC	LV Section Stop Sw NC	WHITE 16 AWG
170B	Soft Start Local/Remote 3	LV Section Key Switch NC	LV Section CR2 14	WHITE 16 AWG
172	Soft Start Local/Remote 4	LV Section Start Sw N0	MV Soft Start TB1-8	WHITE 16 AWG
172A	Soft Start Local/Remote 5	LV Section Start Sw N0	LV Section Key Switch N0	WHITE 16 AWG
172B	Soft Start Local/Remote 6	LV Section Key Switch N0	LV Section CR2 11	WHITE 16 AWG
173	Soft Start E-Stop Common	MV Soft Start TB2-9	Inside E-Stop NC	WHITE 16 AWG
174A	E-Stop NC 1	Inside Control Box E-Stop NC	Outside Control Box E-Stop NC	ORANGE 16 AWG
174B	E-Stop NC 2	Outside Control Box E-Stop NC	LV Section CR1 11	YELLOW 16 AWG
174	E-Stop CR1 Input	MV Soft Start TB2-10	LV Section CR1 14	YELLOW 16 AWG
400	Inline Contactor NO Supply	Low Voltage Section 120VAC	MV Soft Start Inline Contactor	WHITE 16 AWG
410	Inline Contactor NO Output	MV Soft Start Inline Contactor	LV Section Wago#3 DI1	WHITE 16 AWG

NOTES

Remote Hydraulic Power Pack / Hydraulic Container

The Remote Hydraulic Power Pack / Hydraulic Container provides hydraulic oil for the jacking frame and microtunneling auxiliary functions (IJS stations).

Remote Hydraulic Power Pack

SN FA21945F & FA21965F

Electrical Schematics 5-2

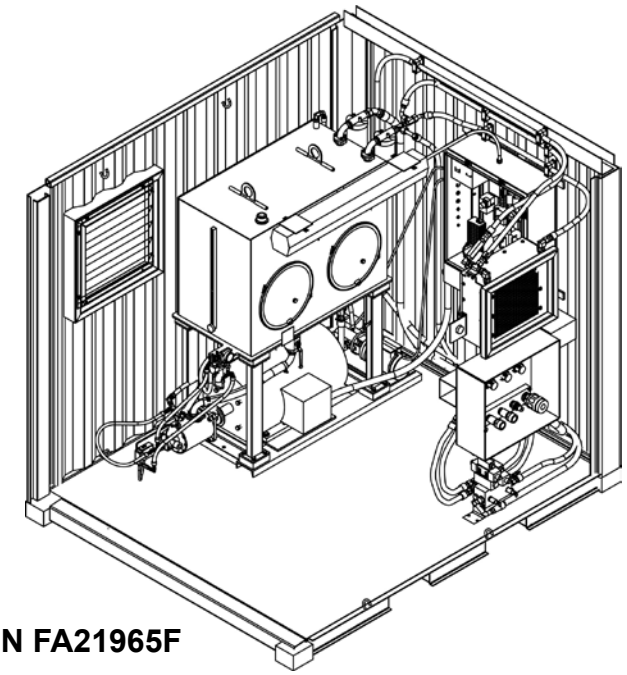
Hydraulic Schematic 5-8

Hydraulic Container

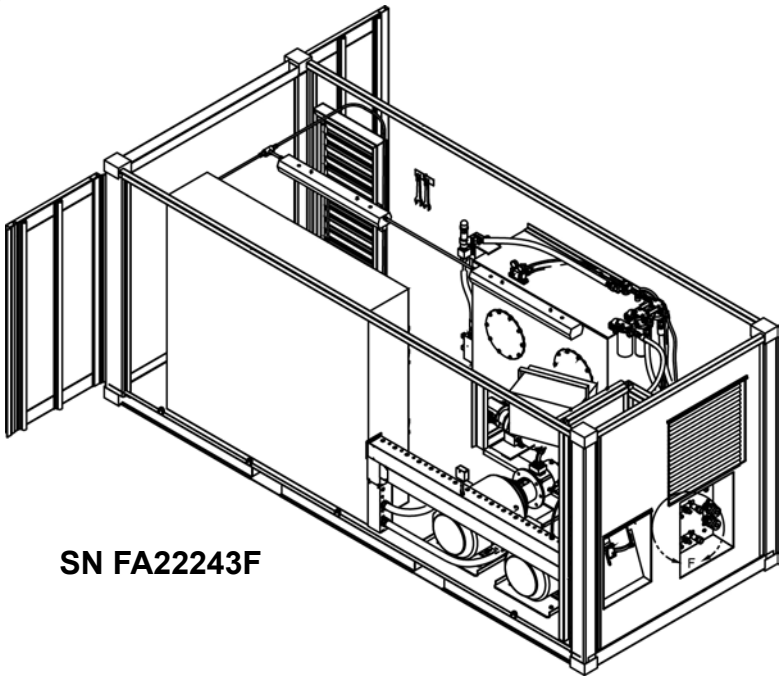
SN FA22243F

Electrical Schematics 5-9

Hydraulic Schematic 5-24



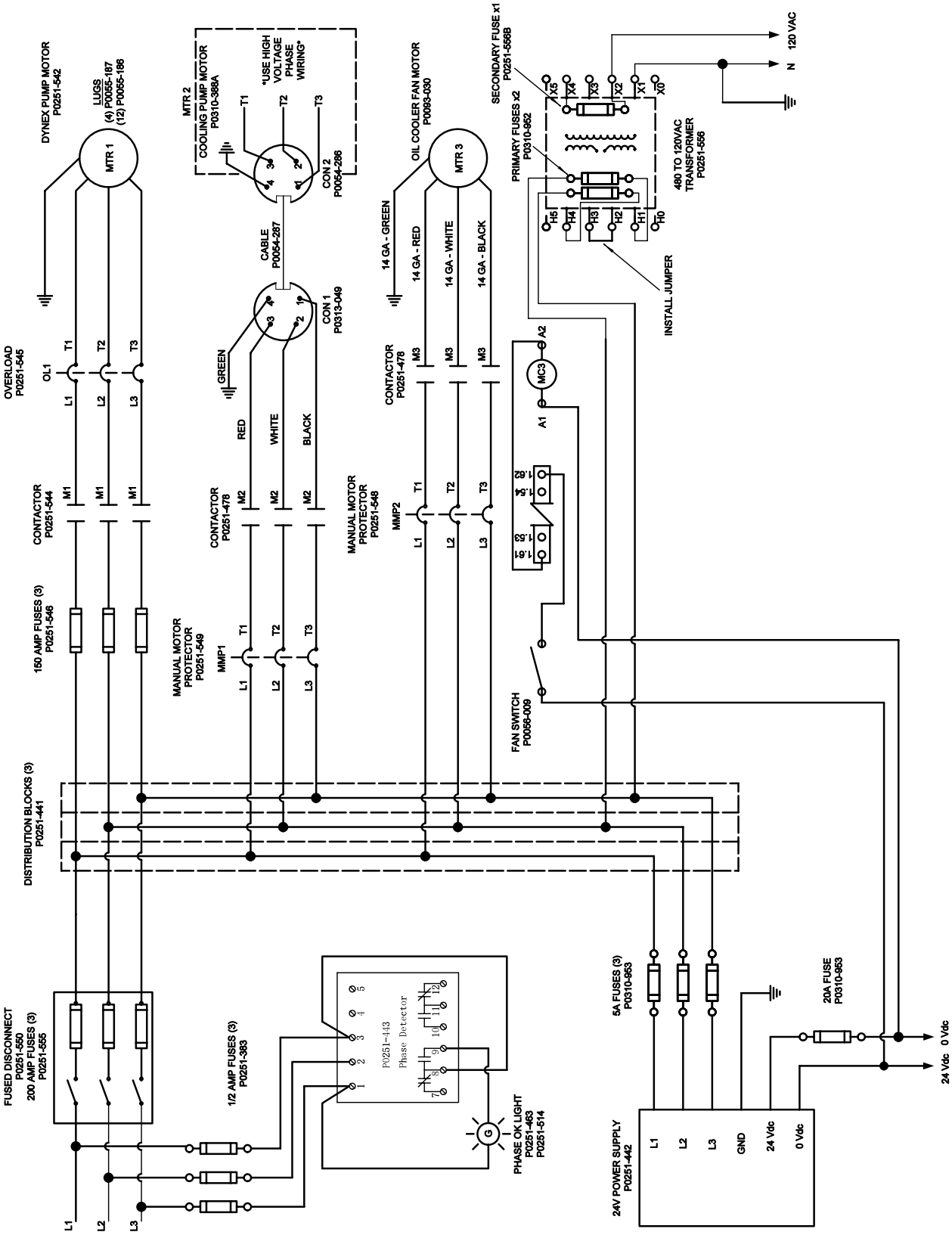
SN FA21965F



SN FA22243F

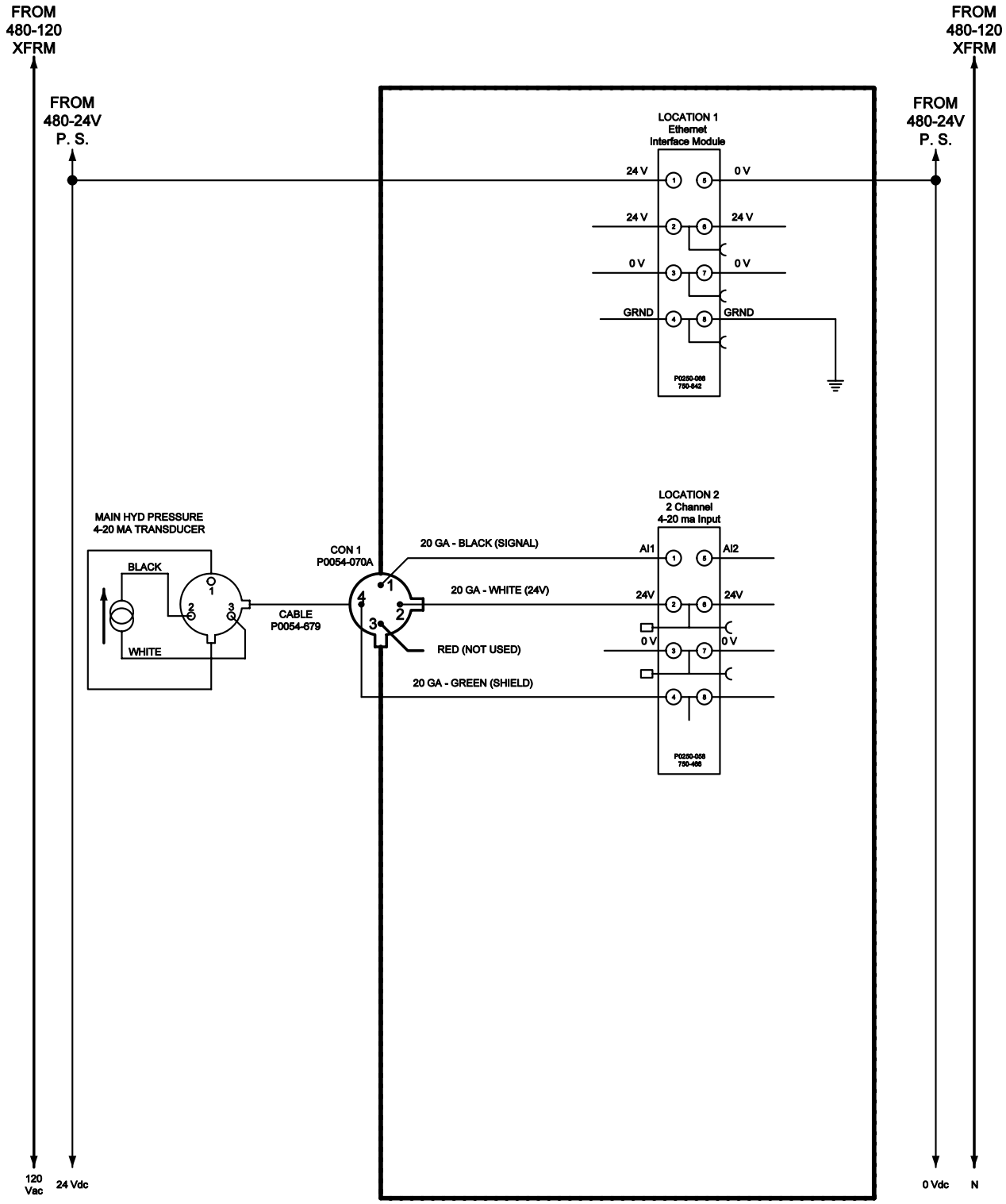
REMOTE HYDRAULIC POWER PACK ELECTRICAL SCHEMATICS - SN: FA21945F & FA21965F

Electrical Schematic - Part 1 of 6



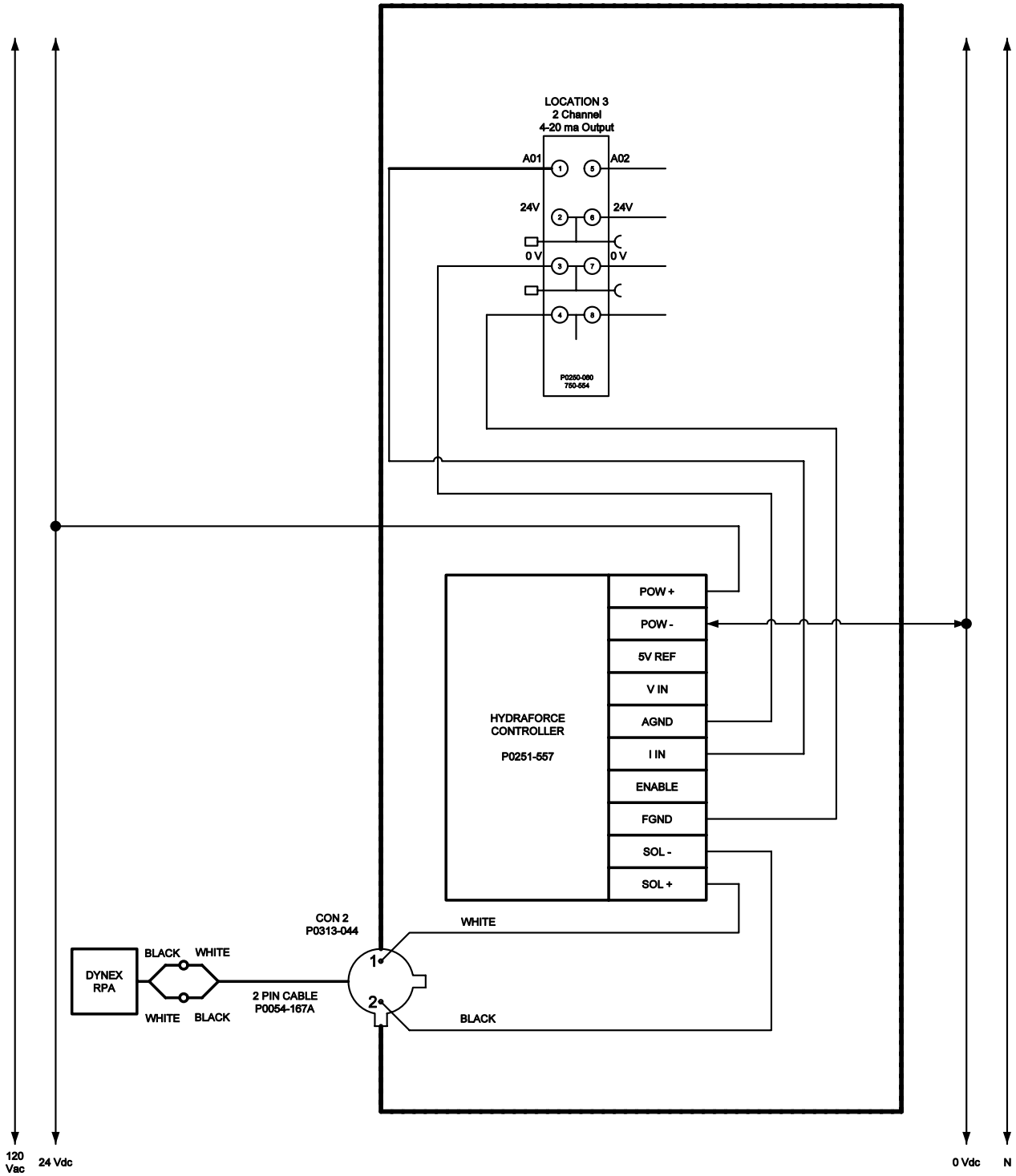
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 2 of 6



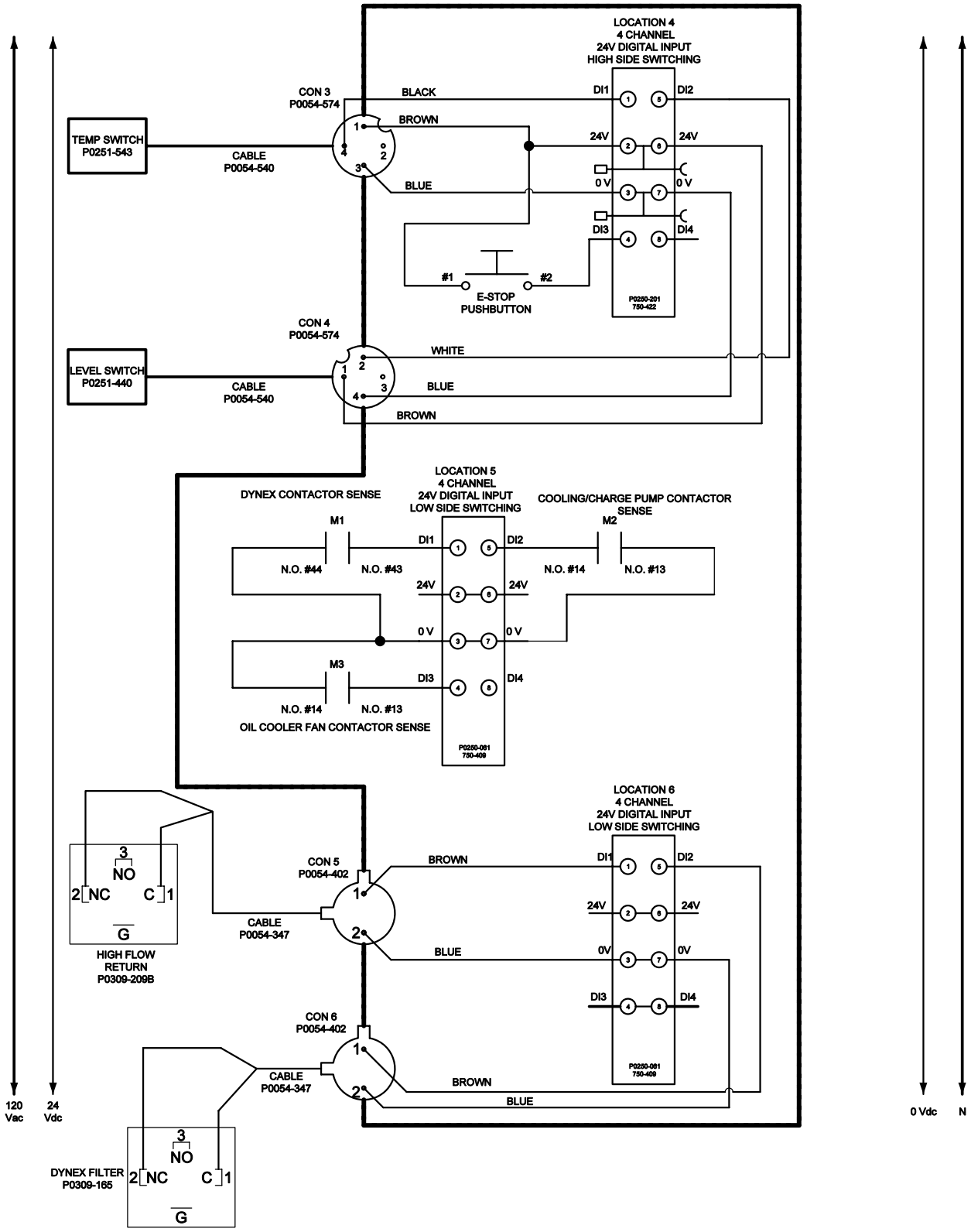
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 3 of 6



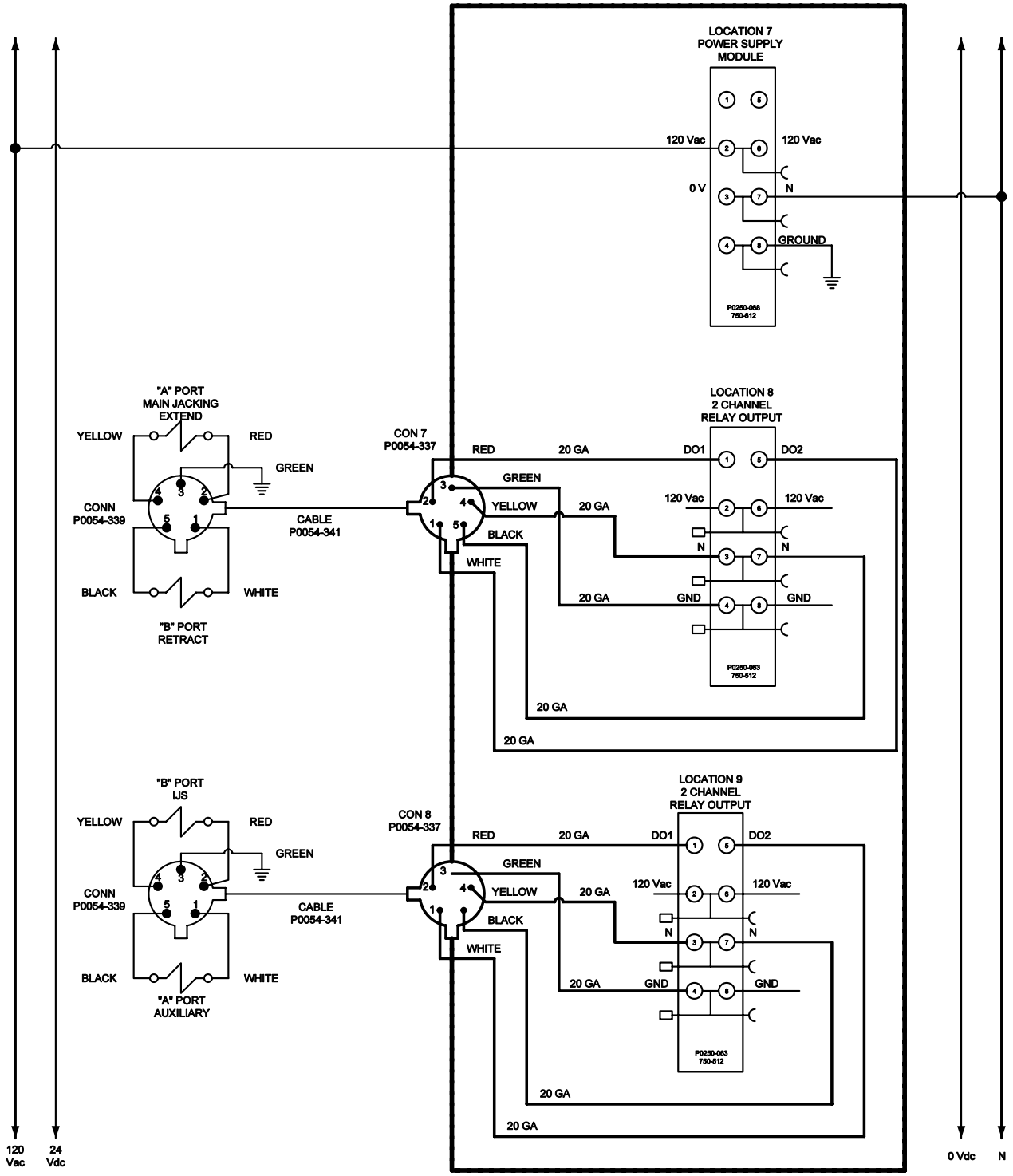
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 4 of 6



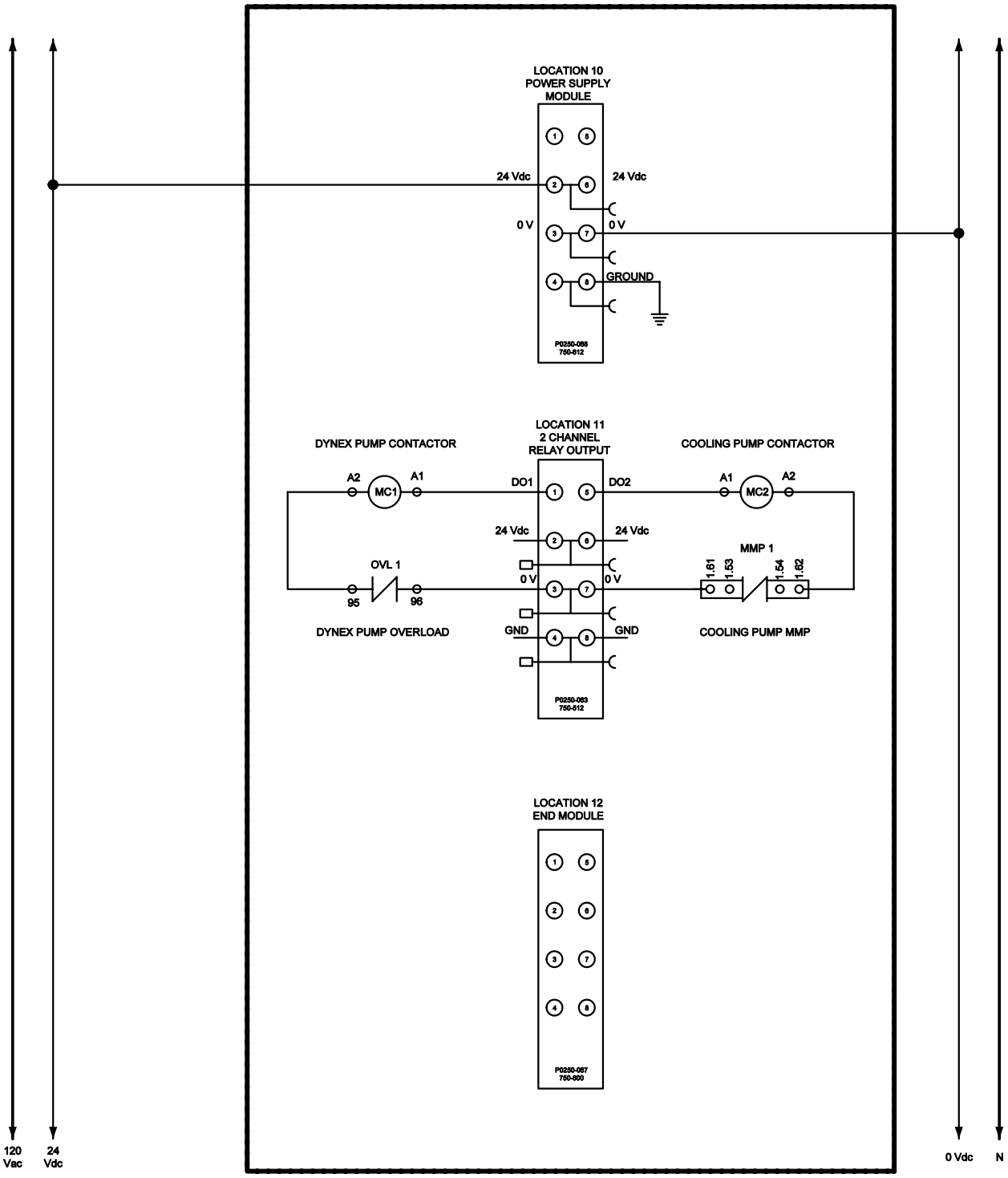
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 5 of 6

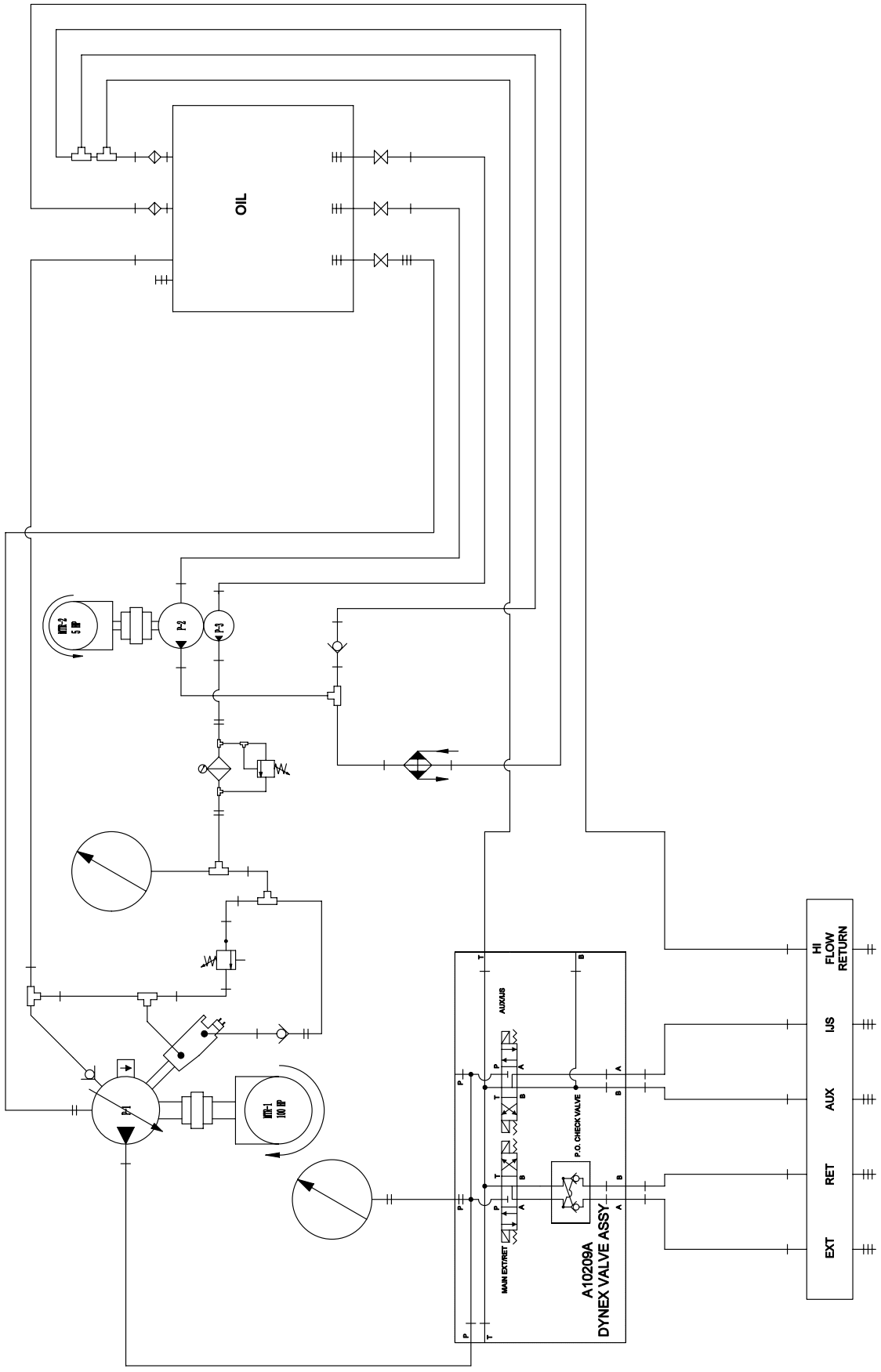


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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 6 of 6

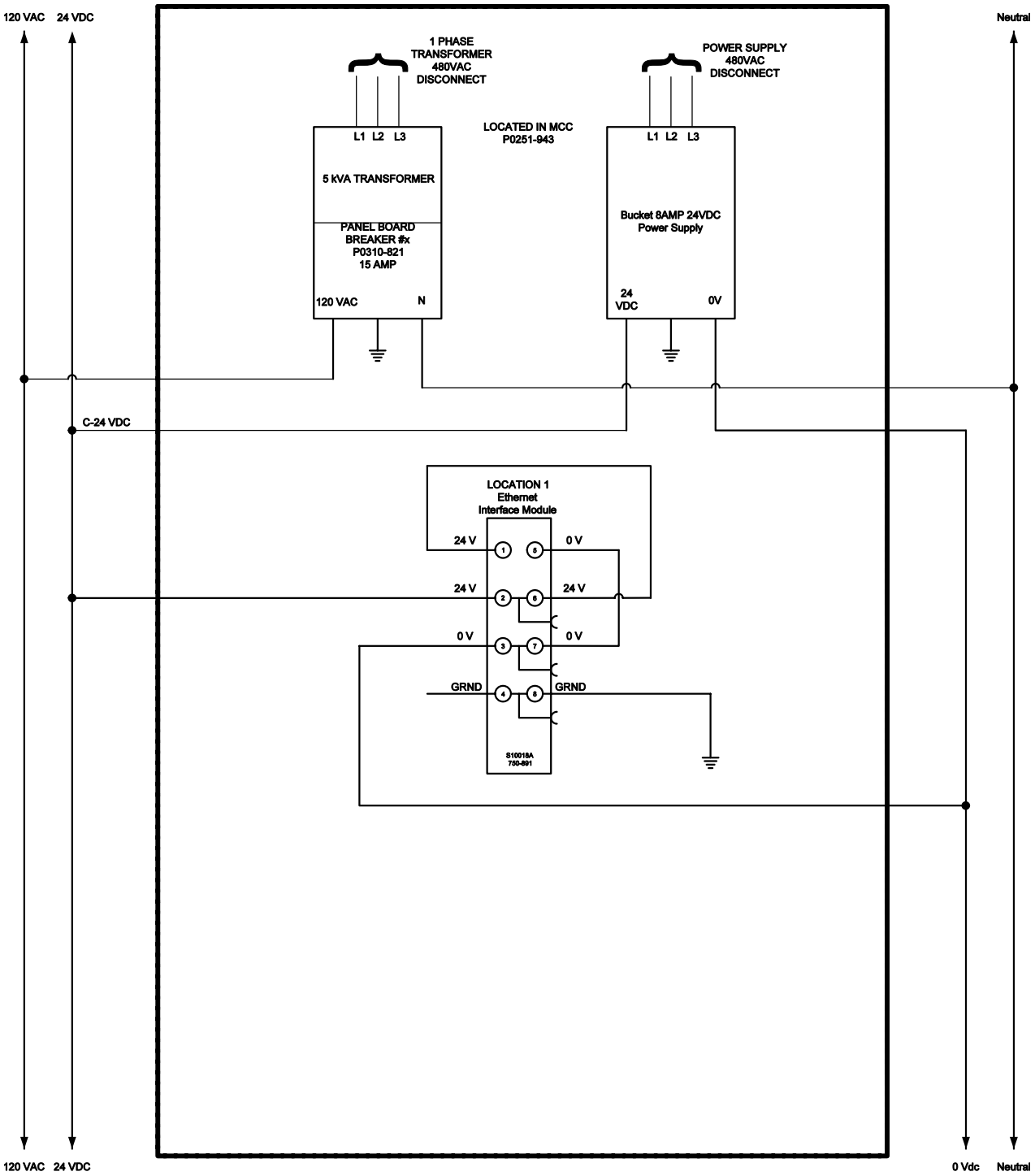


REMOTE HYDRAULIC POWER PACK HYDRAULIC SCHEMATIC - SN: FA21945F & FA21965F



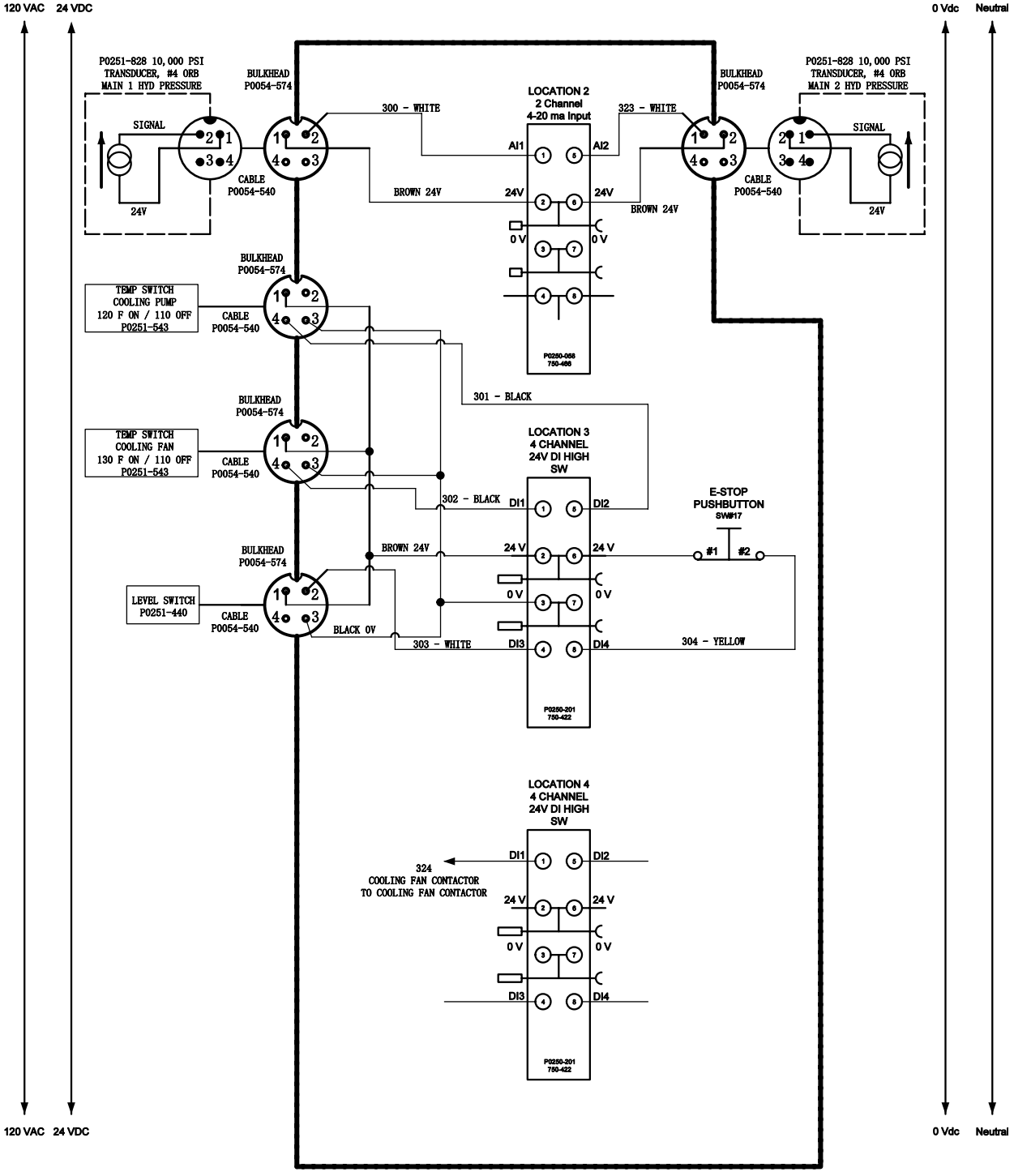
REMOTE HYDRAULIC POWER PACK ELECTRICAL SCHEMATICS - SN: FA22243F

Electrical Schematic - Part 1 of 15



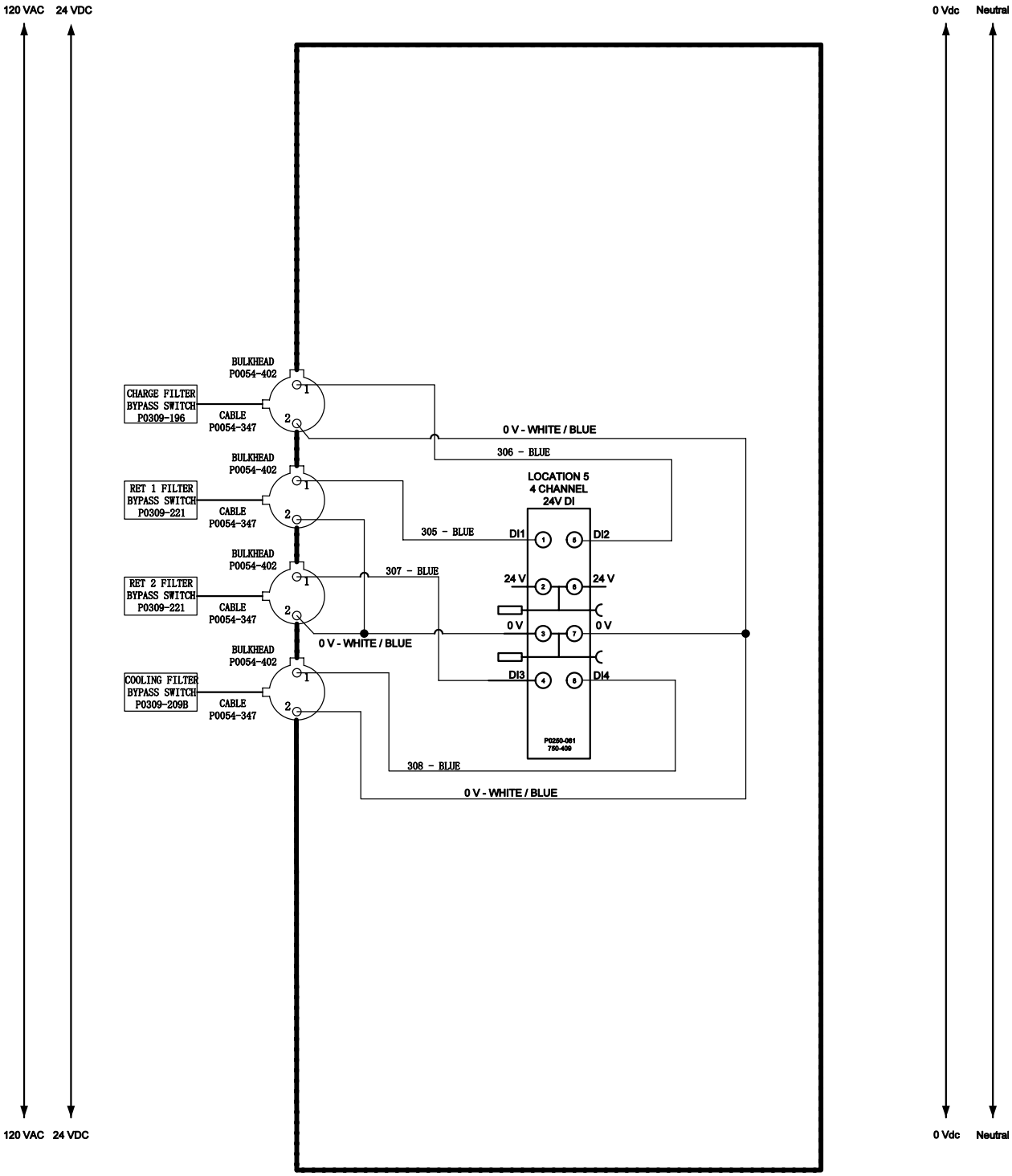
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 2 of 15



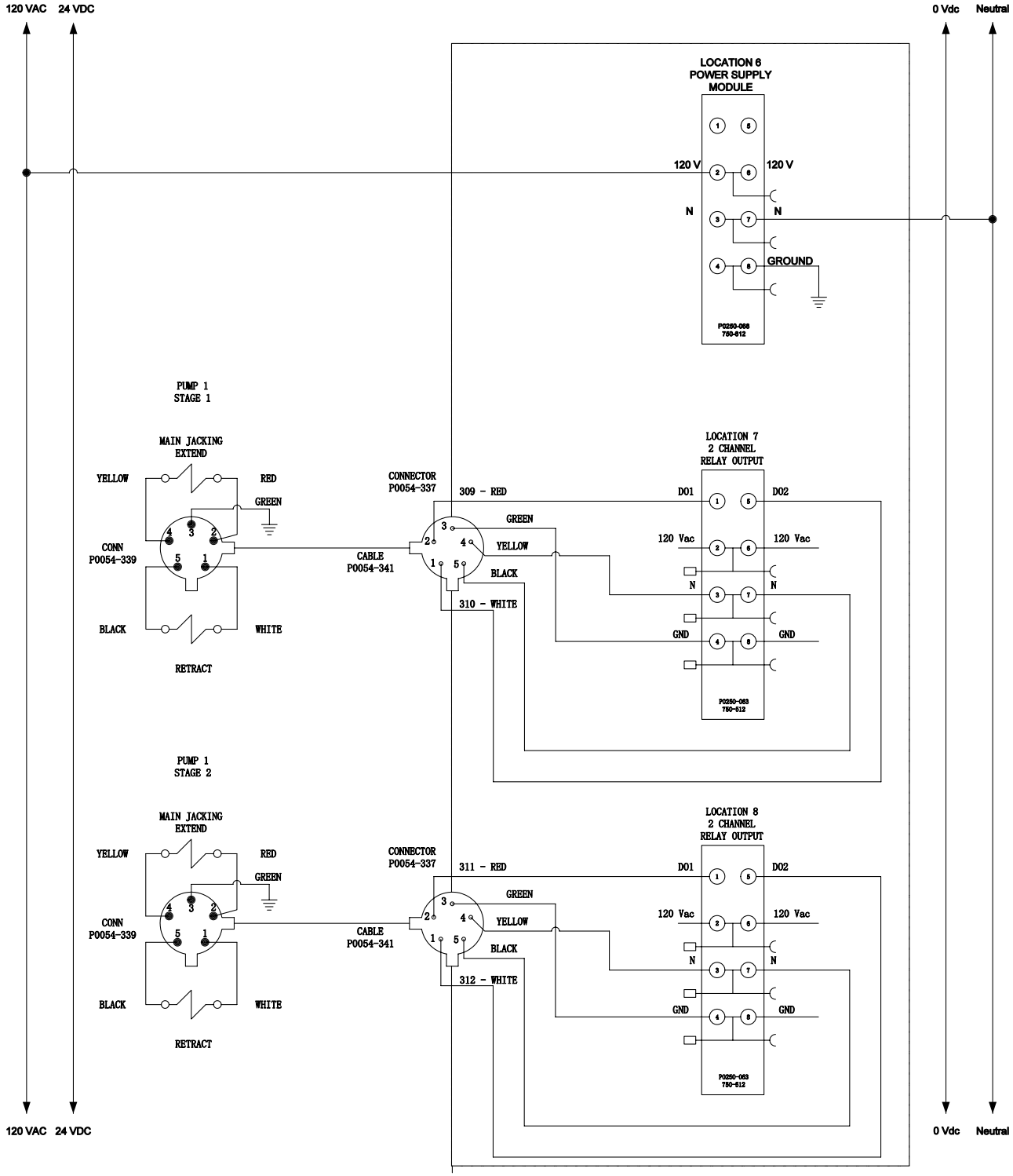
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 3 of 15



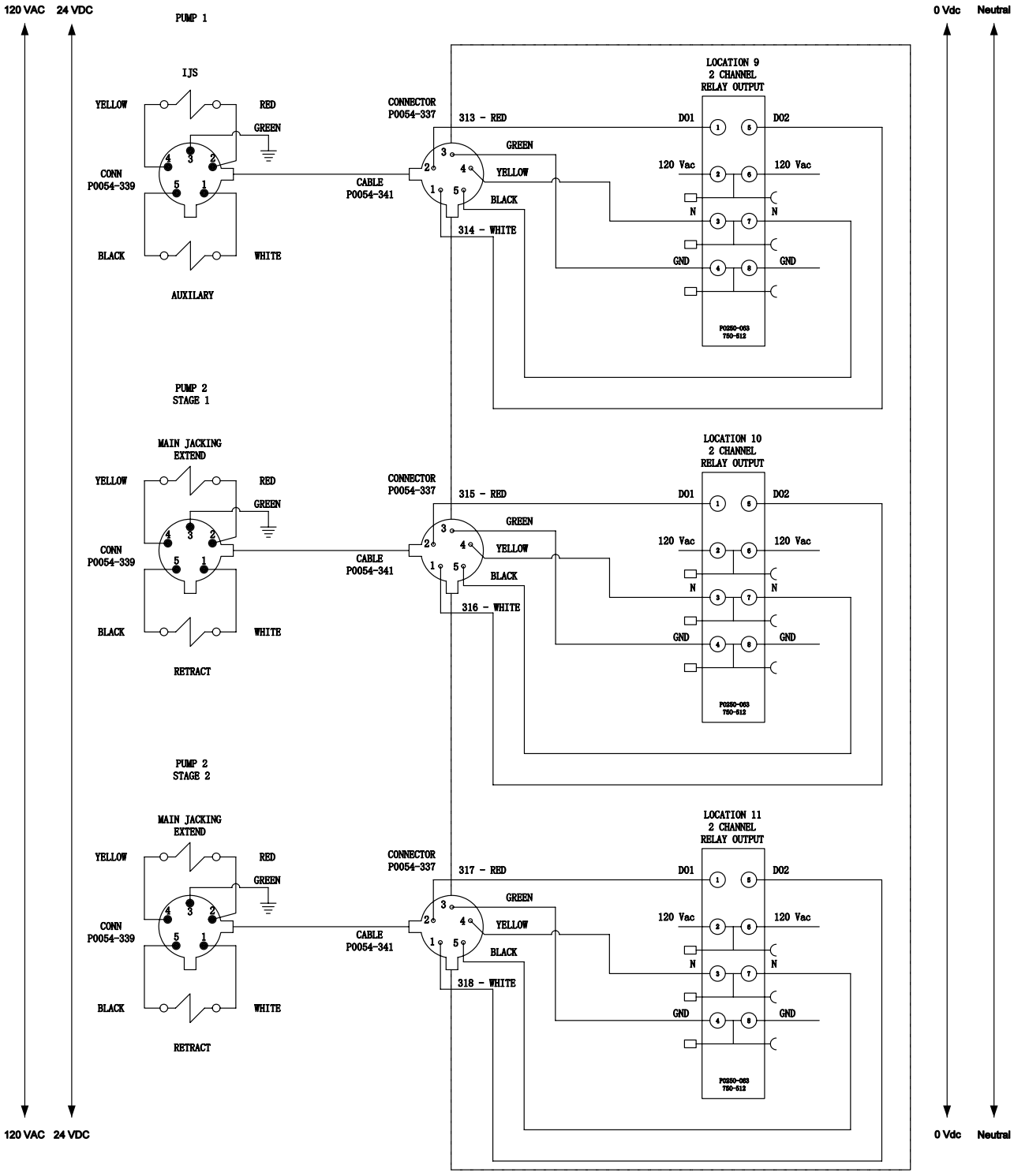
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 4 of 15



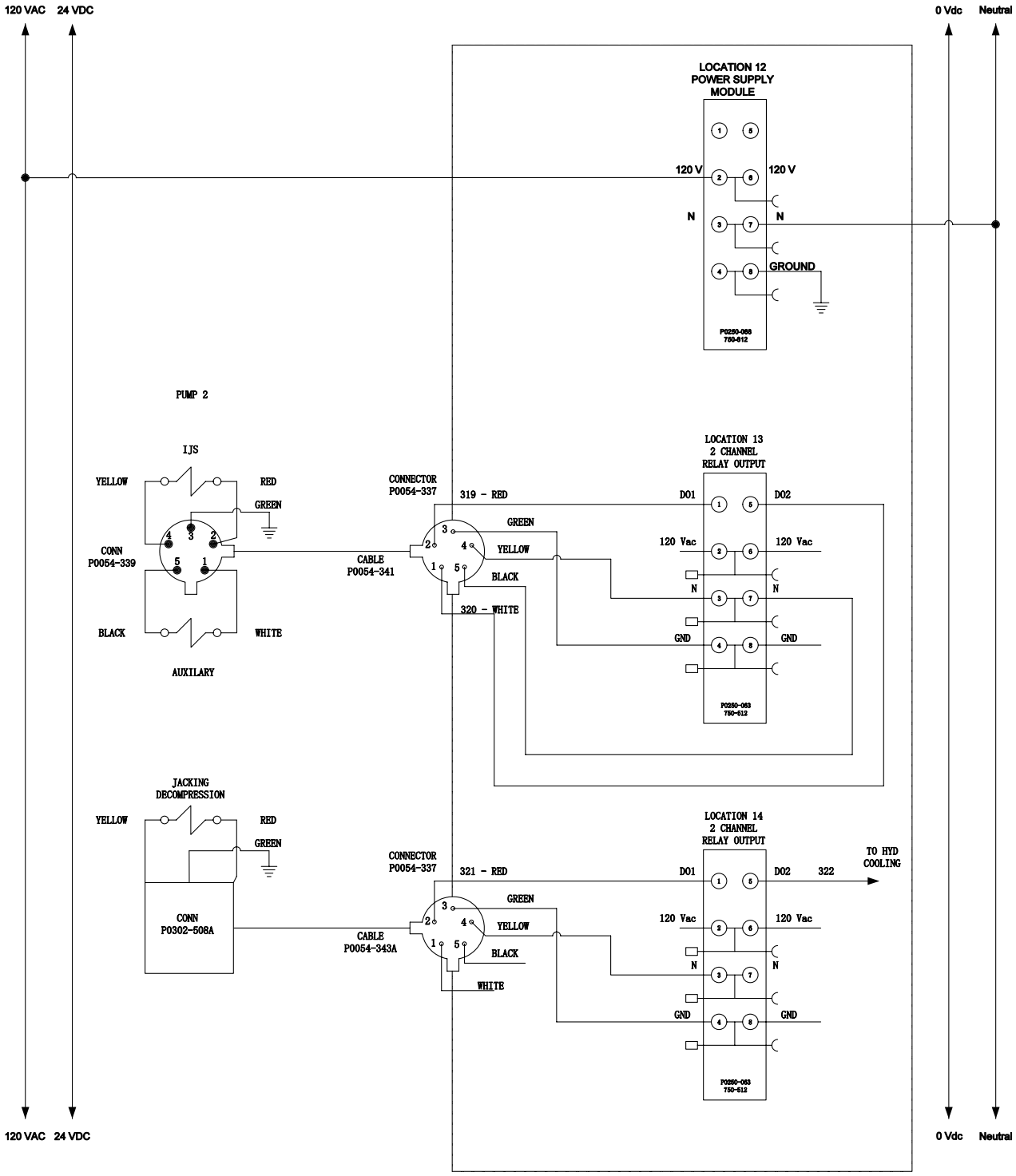
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 5 of 15



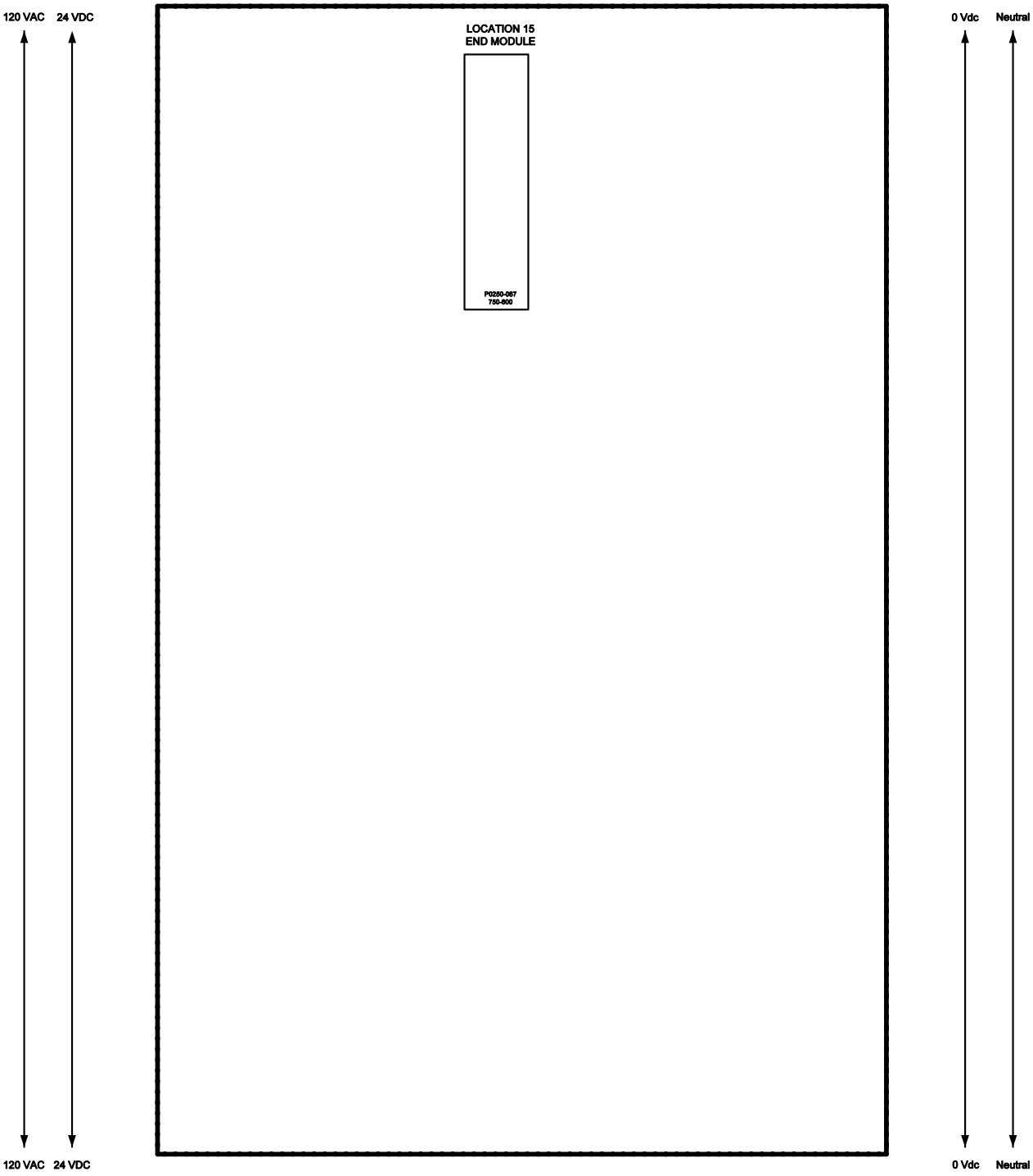
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 6 of 15



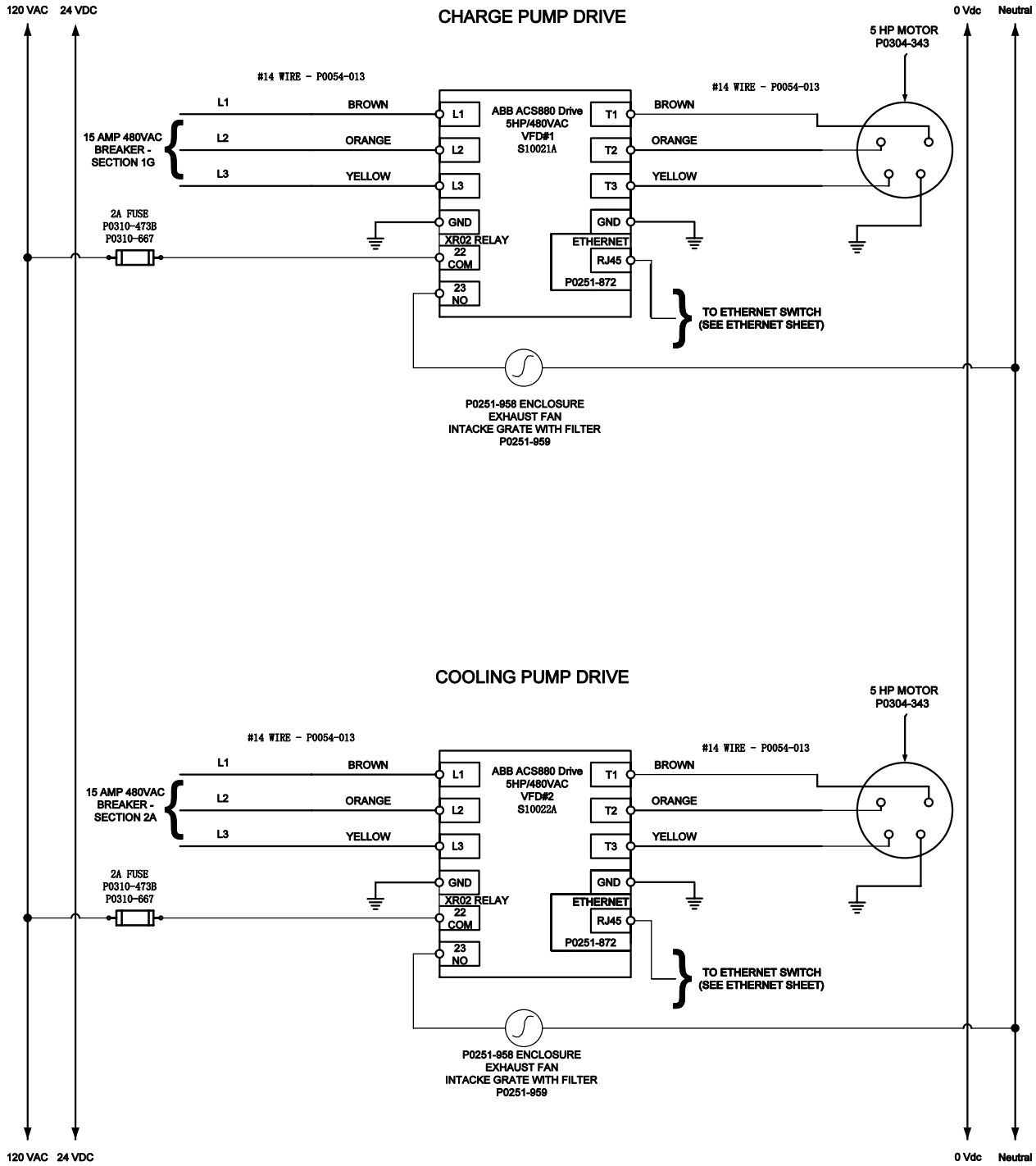
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 7 of 15



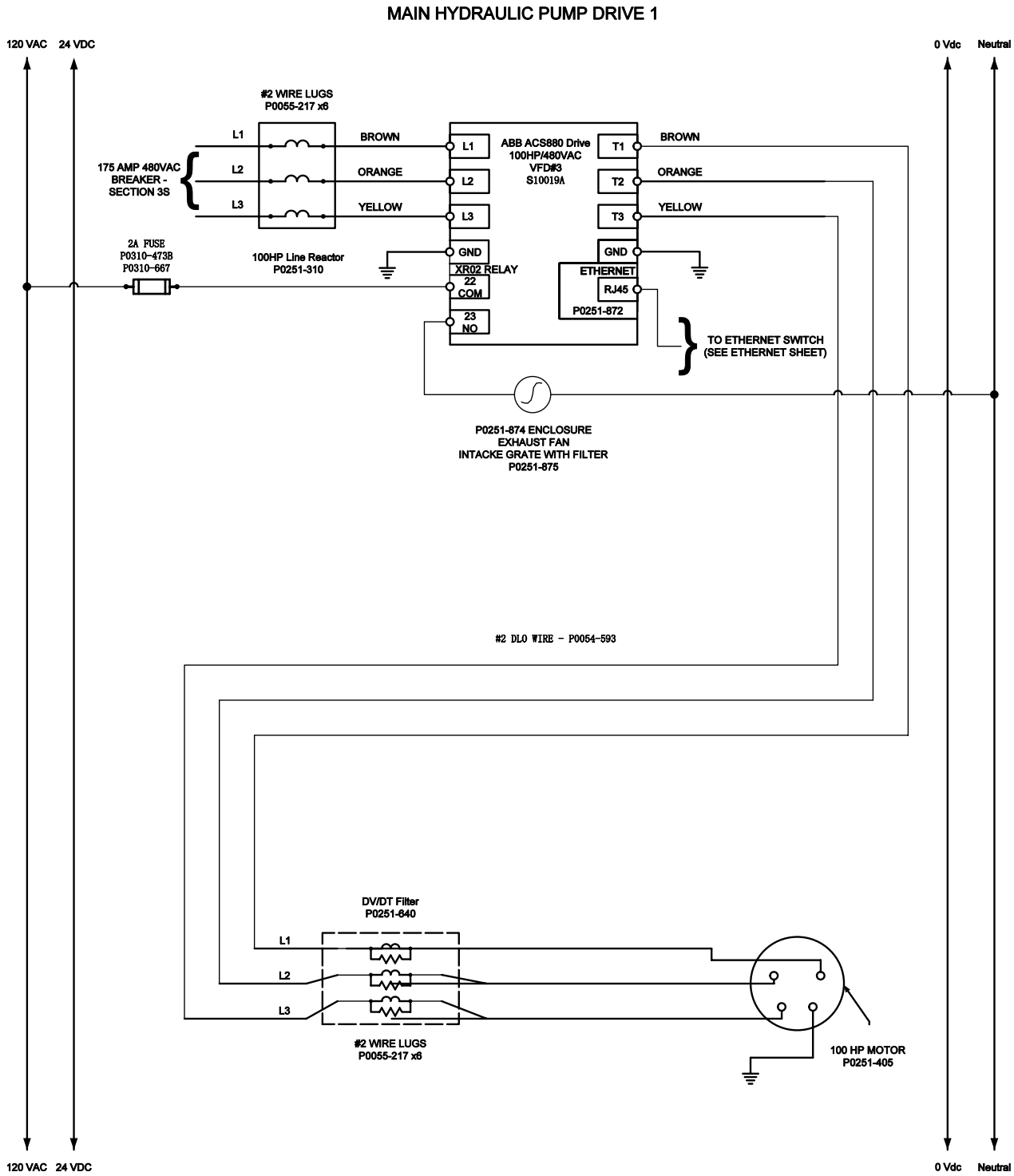
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 8 of 15



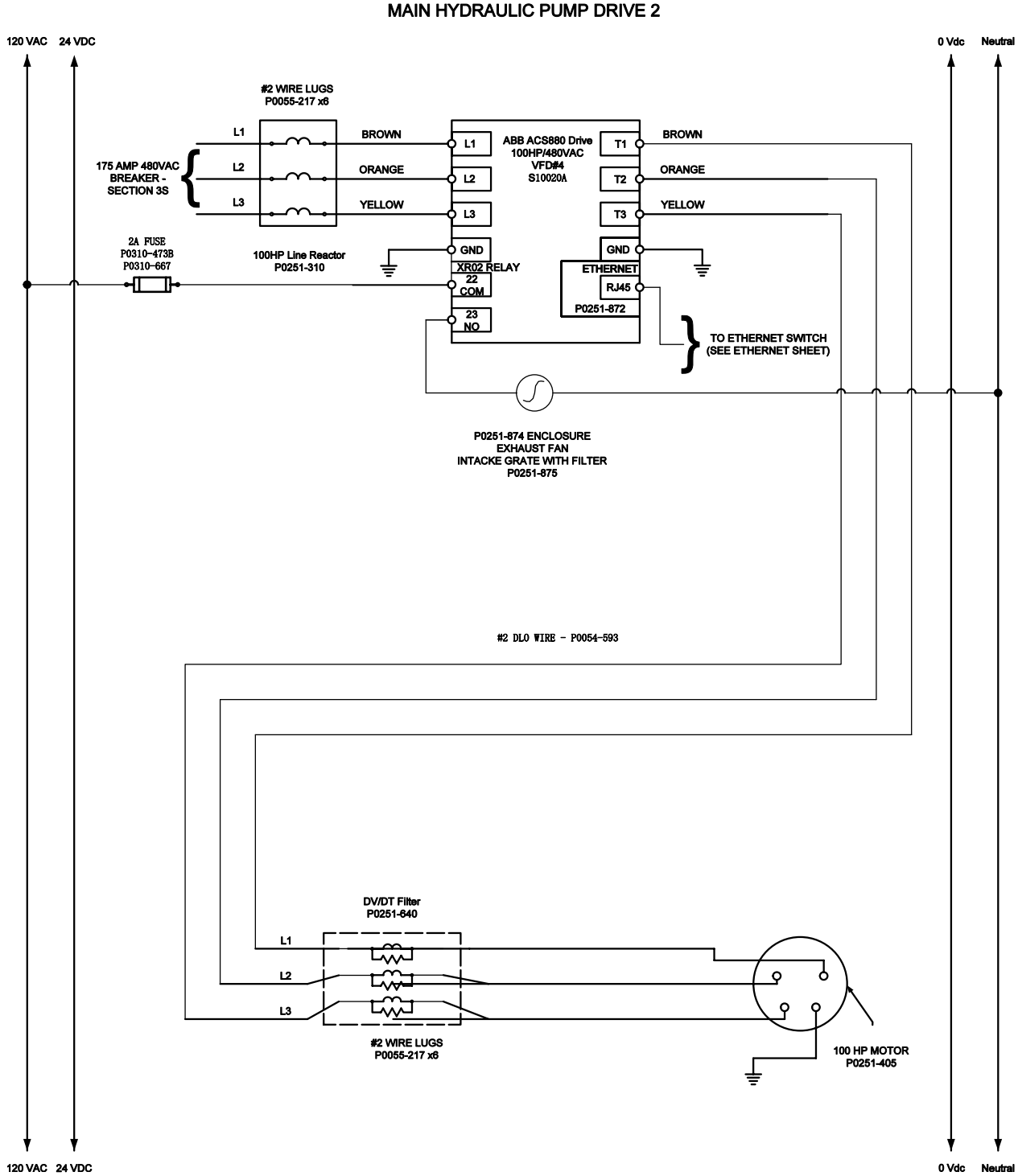
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 9 of 15



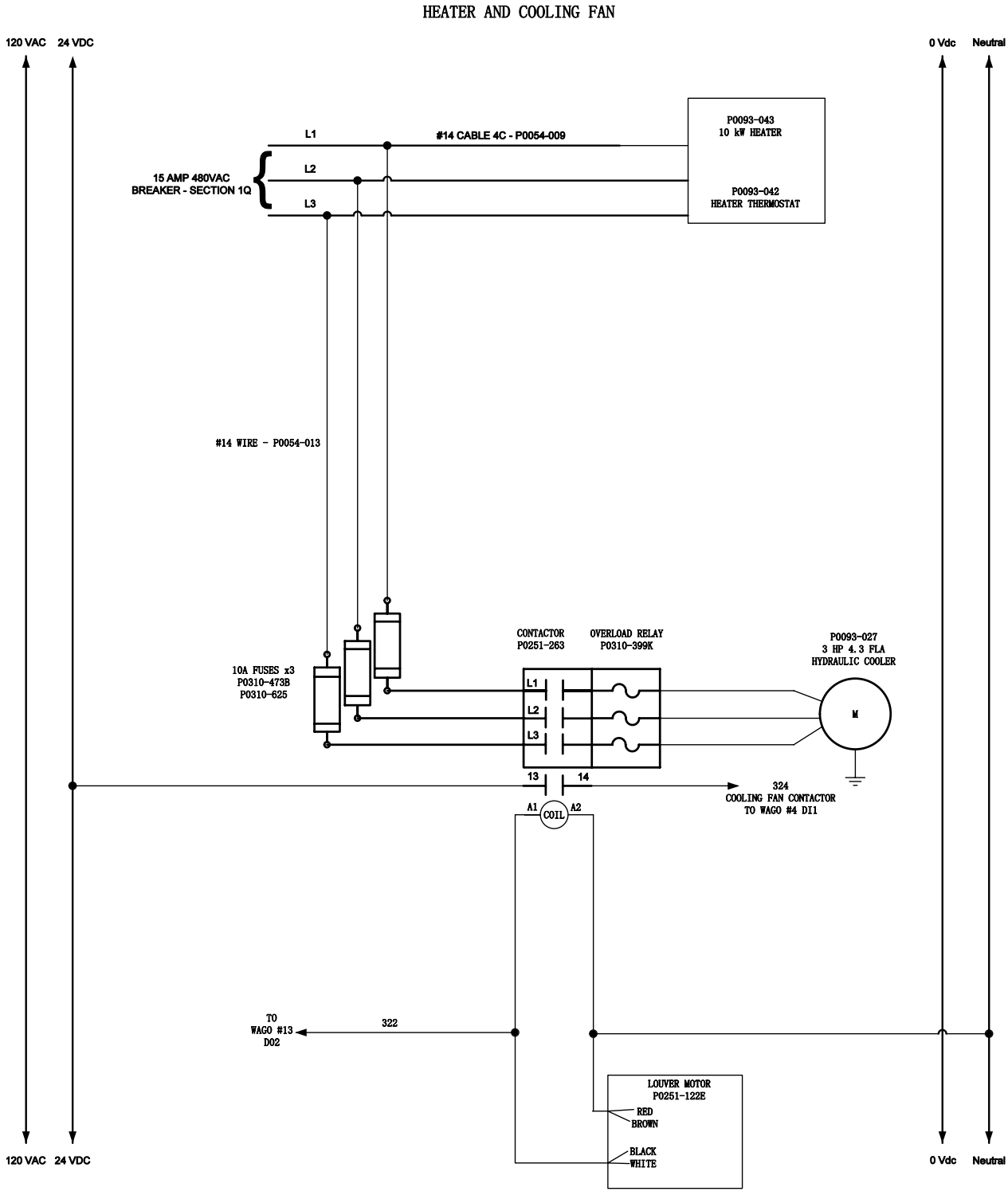
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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 10 of 15



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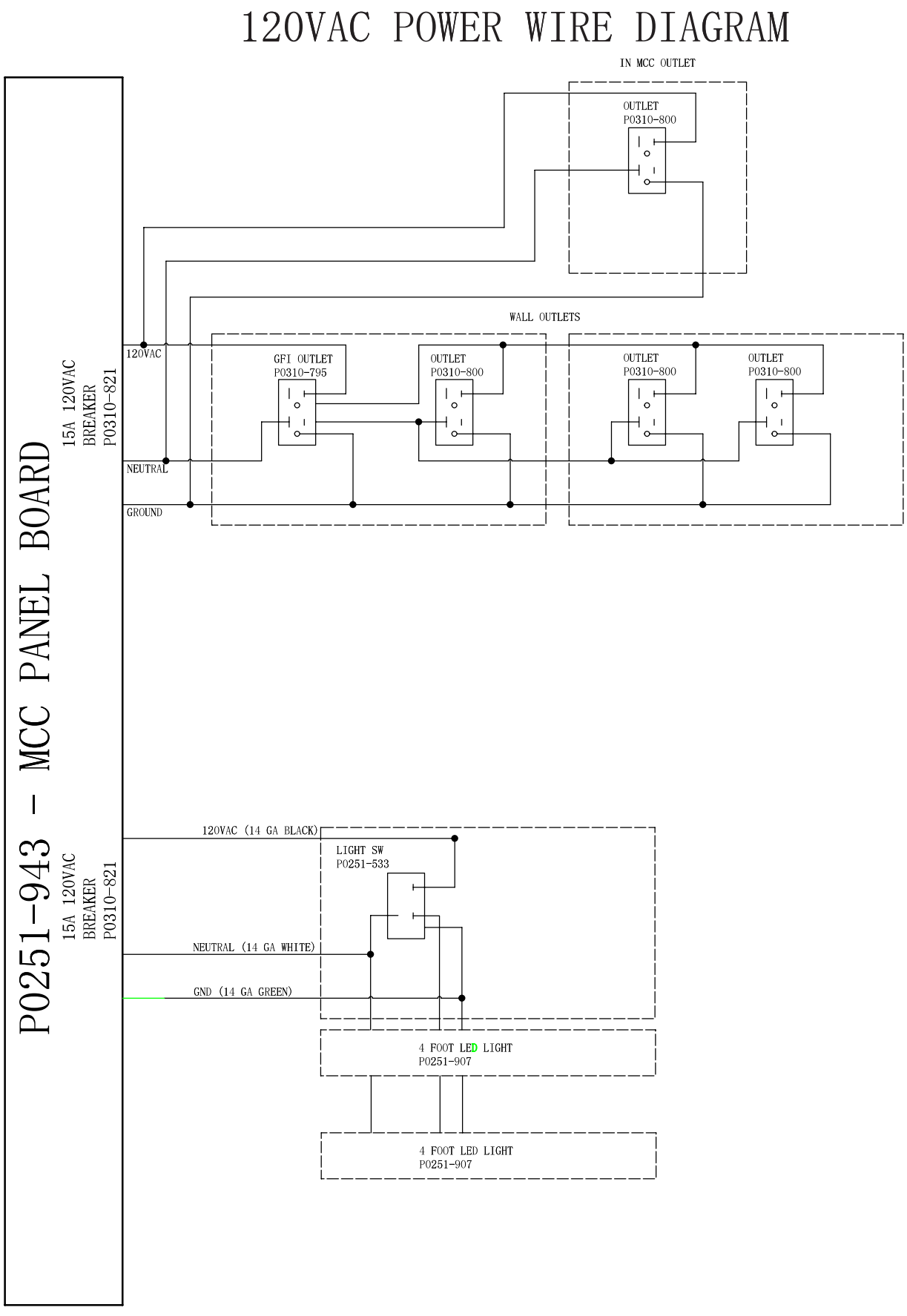
Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 11 of 15



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Remote Hydraulic Power Pack Electrical Schematics (continued)

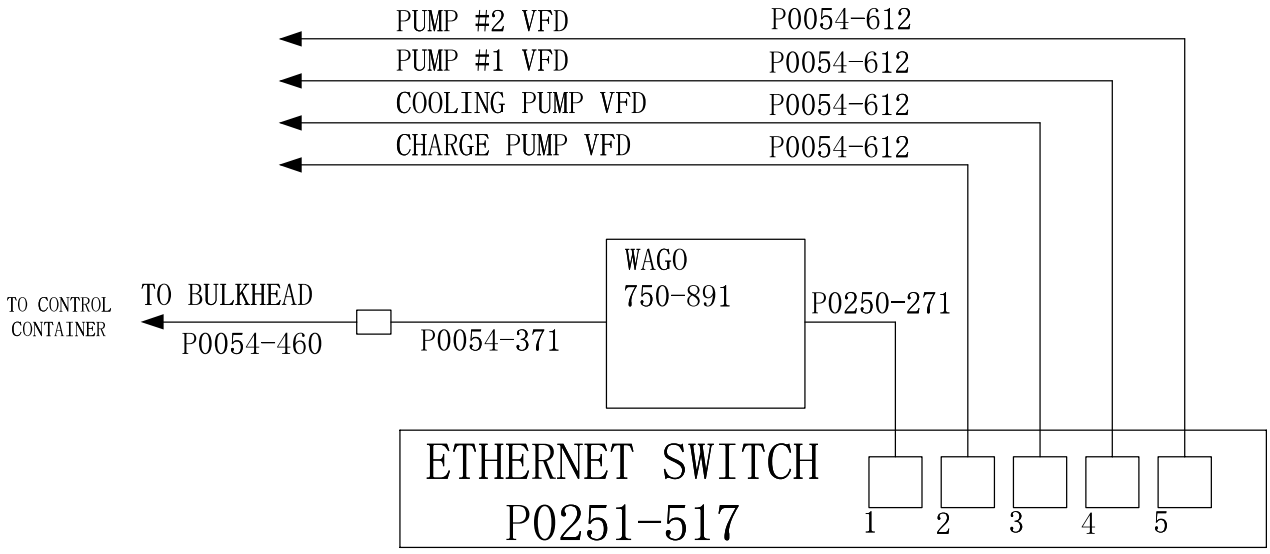
Electrical Schematic - Part 12 of 15



(continued on next page)

Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 13 of 15

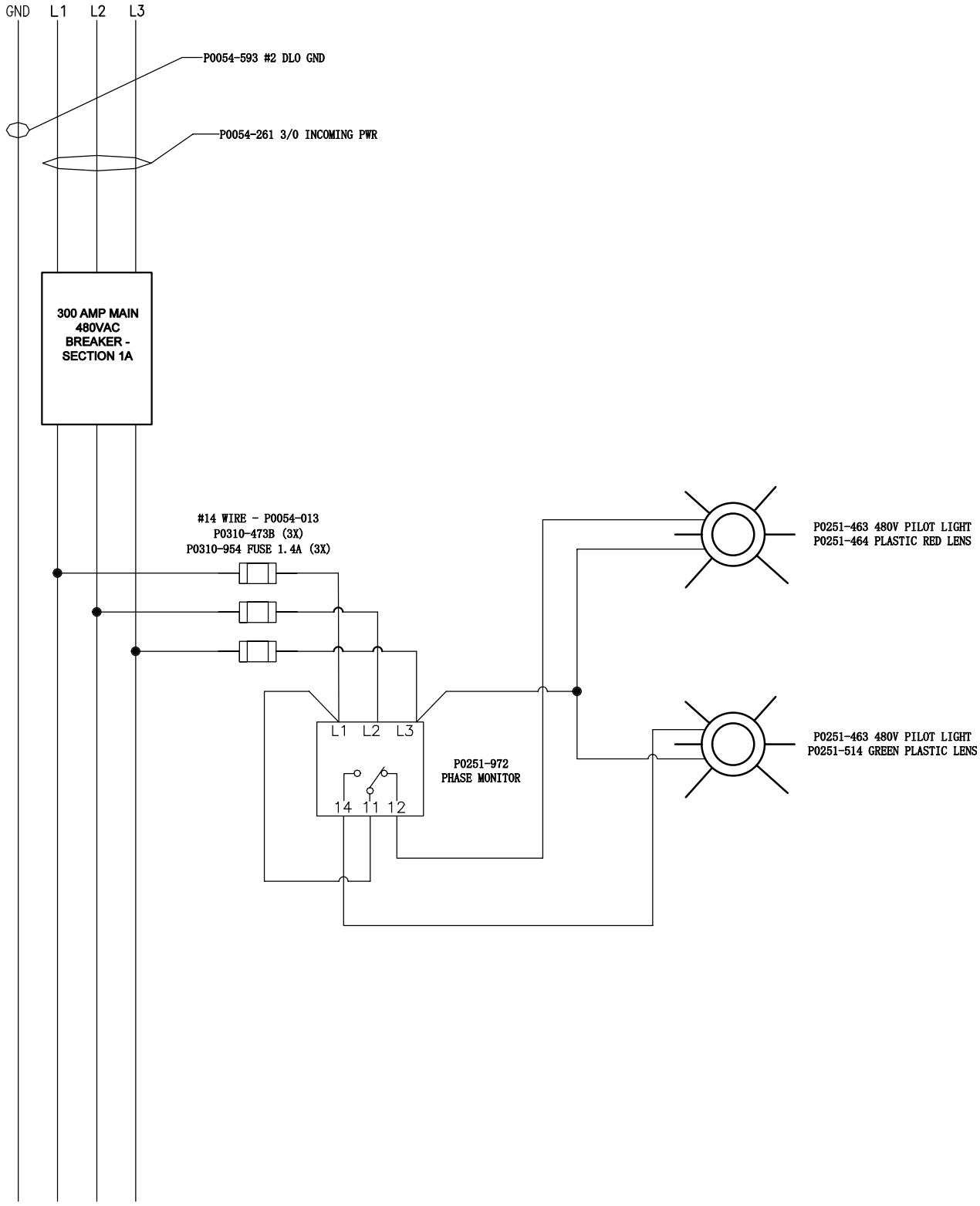
HYDRAULIC POWER PACK CONTAINER ETHERNET NETWORK WIRING



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Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 14 of 15

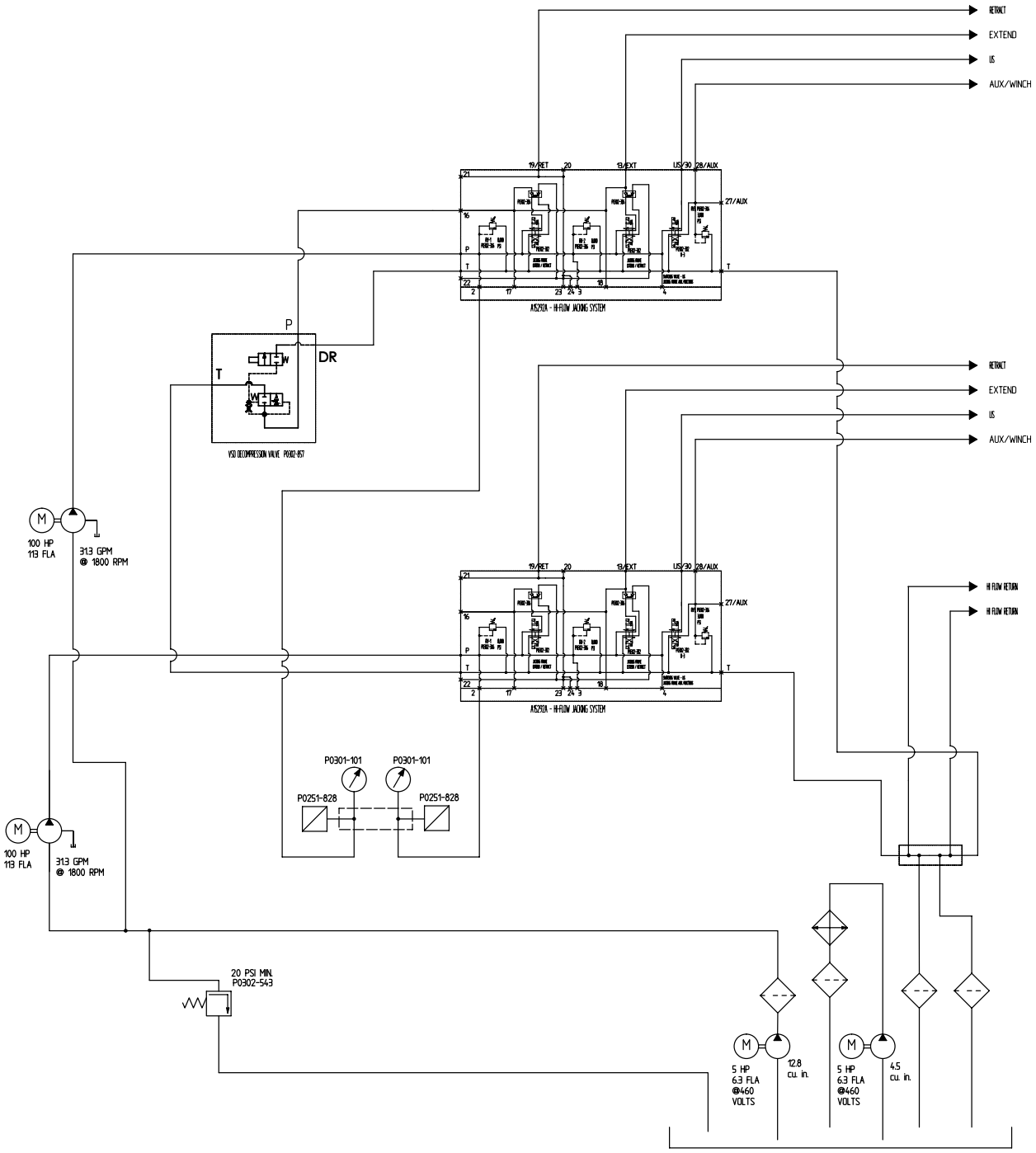
INCOMING POWER, PHASE MONITOR, PILOT INDICATORS 480VAC MCC



Remote Hydraulic Power Pack Electrical Schematics (continued)
Electrical Schematic - Part 15 of 15

WIRE NUMBER	DESCRIPTION	FROM LOCATION #1	TO LOCATION #2	WIRE COLOR/GAUGE
0v	Ground	various	various	Wht/Blu 16 AWG
24v	24 Volt	various	various	Blu/Wht 16 AWG
120 N	120VAC Neutral	various	various	White 16 AWG
120 L	120VAC Line	various	various	Black 16 AWG
300	MAIN 1 HYDRAULIC PRESSURE SIGNAL	MAIN 1 HYD PSI	WAGO LOCATION 2 AI1	WHITE 20 AWG
301	COOLING PUMP TEMERATURE SWITCH	COOLING PUMP TEMP SENSOR	WAGO LOCATION 3 DI2	BLACK 20 AWG
302	COOLING FAN TEMPERATURE SWITCH	COOLING FAN TEMP SENSOR	WAGO LOCATION 3 DI1	BLACK 20 AWG
303	OIL LEVEL SWITCH	OIL LEVEL SWITCH	WAGO LOCATION 3 DI3	WHITE 20 AWG
304	E-STOP	ESW	WAGO LOCATION 3 DI4	YELLOW 20 AWG
305	RETURN FILTER 1 BYPASS SWITCH	RETURN FILTER 1	WAGO LOCATION 5 DI1	BLUE 20 AWG
306	CHARGE FILTER BYPASS	CHARGE FILTER	WAGO LOCATION 5 DI2	BLUE 20 AWG
307	RETURN FILTER 2 BYPASS SWITCH	RETURN FILTER 2	WAGO LOCATION 5 DI3	BLUE 20 AWG
308	RETURN FILTER 3 BYPASS SWITCH	RETURN FILTER 3	WAGO LOCATION 5 DI4	BLUE 20 AWG
309	PUMP 1 STAGE 1 EXTEND	PUMP 1 STAGE 1 VALVE	WAGO LOCATION 7 DO1	RED 18 AWG
310	PUMP 1 STAGE 1 RETRACT	PUMP 1 STAGE 1 VALVE	WAGO LOCATION 7 DO2	WHITE 18 AWG
311	PUMP 1 STAGE 2 EXTEND	PUMP 1 STAGE 2 VALVE	WAGO LOCATION 8 DO1	RED 18 AWG
312	PUMP 1 STAGE 2 RETRACT	PUMP 1 STAGE 2 VALVE	WAGO LOCATION 8 DO2	WHITE 18 AWG
313	PUMP 1 IJS	PUMP 1 IJS/AUX VALVE	WAGO LOCATION 9 DO1	RED 18 AWG
314	PUMP 1 AUX	PUMP 1 IJS/AUX VALVE	WAGO LOCATION 9 DO2	WHITE 18 AWG
315	PUMP 2 STAGE 1 EXTEND	PUMP 2 STAGE 1 VALVE	WAGO LOCATION 10 DO1	RED 18 AWG
316	PUMP 2 STAGE 1 RETRACT	PUMP 2 STAGE 1 VALVE	WAGO LOCATION 10 DO2	WHITE 18 AWG
317	PUMP 2 STAGE 2 EXTEND	PUMP 2 STAGE 2 VALVE	WAGO LOCATION 11 DO1	RED 18 AWG
318	PUMP 2 STAGE 2 RETRACT	PUMP 2 STAGE 2 VALVE	WAGO LOCATION 11 DO2	WHITE 18 AWG
319	PUMP 2 IJS	PUMP 2 IJS/AUX VALVE	WAGO LOCATION 13 DO1	RED 18 AWG
320	PUMP 2 AUX	PUMP 2 IJS/AUX VALVE	WAGO LOCATION 13 DO2	WHITE 18 AWG
321	PUMP DECOMPRESSION	Decomp VALVE	WAGO LOCATION 14 DO1	RED 18 AWG
322	HYDRAULIC COOLING FAN	PUMP 2 IJS/AUX VALVE	WAGO LOCATION 14 DO2	WHITE 18 AWG
323	MAIN 2 HYDRAULIC PRESSURE SIGNAL	MAIN 2 HYD PSI	WAGO LOCATION 2 AI2	WHITE 20 AWG
324	COOLING FAN CONTACTOR CLOSED SWITCH	COOLING FAN CONTACTOR	WAGO LOCATION 4 DI1	BLUE 20 AWG
325				
326				

REMOTE HYDRAULIC POWER PACK HYDRAULIC SCHEMATIC - SN: FA22243F



MTBM

Face access, periphery drive Microtunneling Boring Machines (MTBMs) are used to accurately complete extended and curved (with AZ100 TGS) tunnels with exceptional drive and cutting torque. The peripheral drive, face access MTBM family features an onboard electric over hydraulic power pack for cutter head drive with low, medium, and high torque modes for accurate control in changeable geology. Back-loaded tooling mounts on the cutter head make access and replacement of worn tooling a simple process without the need for a planned maintenance intervention. Soft ground dual-gage, mixed ground, rock and project specific cutter heads are available.

MTBM Front Section Control Box

Front Section Control Box 6-2

MTBM SL86P SN: FA09100F

Electrical Schematics
- Trailing Section Control Box
  - SL86P SN FA09100F-01 6-14
  - SL86P SN FA09100F-02 & After 6-17
- Motor RTD Box (SN FA09100F-01) 6-20
- Drive Motor 400 HP (SL86P SN FA09100F-02 & After) 6-21
- MTBM 86” Jack Can Control Box SN: FA09399F 6-22
- Speedway I/O Module (SL86P SN FA09100F-01) 6-29
- Asco I/O Module (SL86P SN FA09100F-02 & After) 6-41

Hydraulic Schematics
- MTBM Main Hydraulics 6-53
- MTBM Auxiliary Hydraulics 6-54

MTBM Main Seal Grease Schematics
- SL86P SN FA09100F-01 6-57
- SL86P SN FA09100F-02 & After 6-58

MTBM Water Cooling System Schematic 6-59

MTBM SL82P SN: FA09600F

Electrical Schematics
- Trailing Section Control Box
  - SL82P SN: FA09600F-01 6-60
  - SL82P SN: FA09600F-02 & After 6-63
- Motor RTD Box SN: FA09600F-01 6-66
- Drive Motor 400 HP (SL82P SN FA09600F-02 & After) 6-67
- MTBM 82” Jack Can Control Box SN: FA09640F 6-68
- Speedway I/O Module (SL82P SN: FA09600F-01 & 02) 6-75
- Asco I/O Module (SL82P SN: FA09600F-03 & After) 6-87

Hydraulic Schematics
- MTBM Main Hydraulics 6-99
- MTBM Auxiliary Hydraulics 6-100

MTBM Main Seal Grease Schematic
- SL82P SN FA09600F-01 6-103
- SL82P SN FA09600F-02 & After 6-104

MTBM Water Cooling System Schematic 6-105

MTBM SL74P SN: FA16175F

Electrical Schematics
- Trailing Section Control Box 6-106
- Drive Motor 400 HP 6-109
- Asco I/O Module 6-110

Hydraulic Schematics
- MTBM Main Hydraulics 6-122
- MTBM Auxiliary Hydraulics 6-123

MTBM Main Seal Grease Schematic 6-126

MTBM Water Cooling System Schematic 6-127

MTBM SL60P SN: FA14960F

Electrical Schematics
- Trailing Section Control Box 6-128
- Drive Motor 250 HP 6-131
- Asco I/O Module 6-132

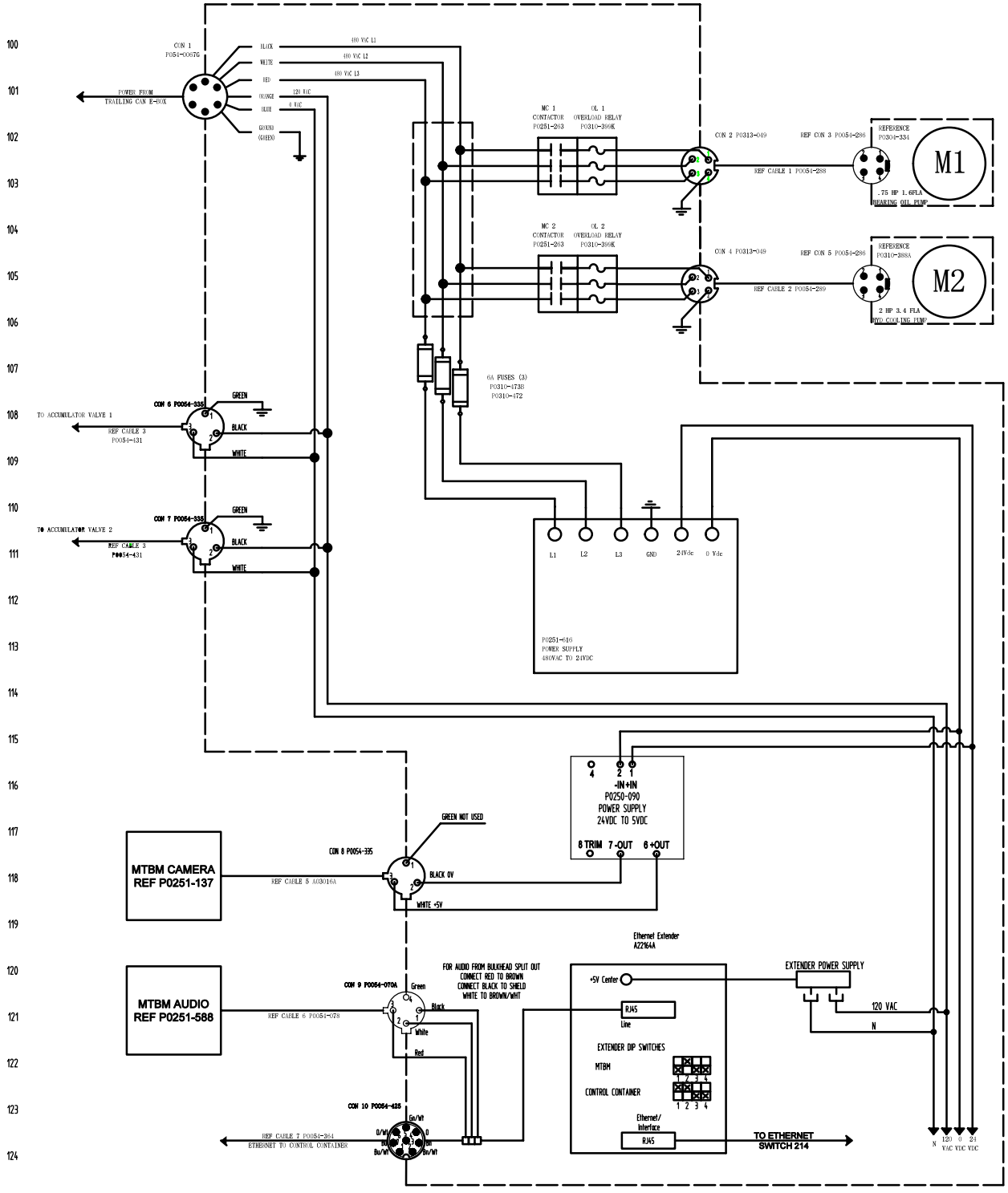
Hydraulic Schematics
- MTBM Main Hydraulics 6-144
- MTBM Auxiliary Hydraulics 6-145

MTBM Main Seal Grease Schematic 6-148

MTBM Water Cooling System Schematic 6-149

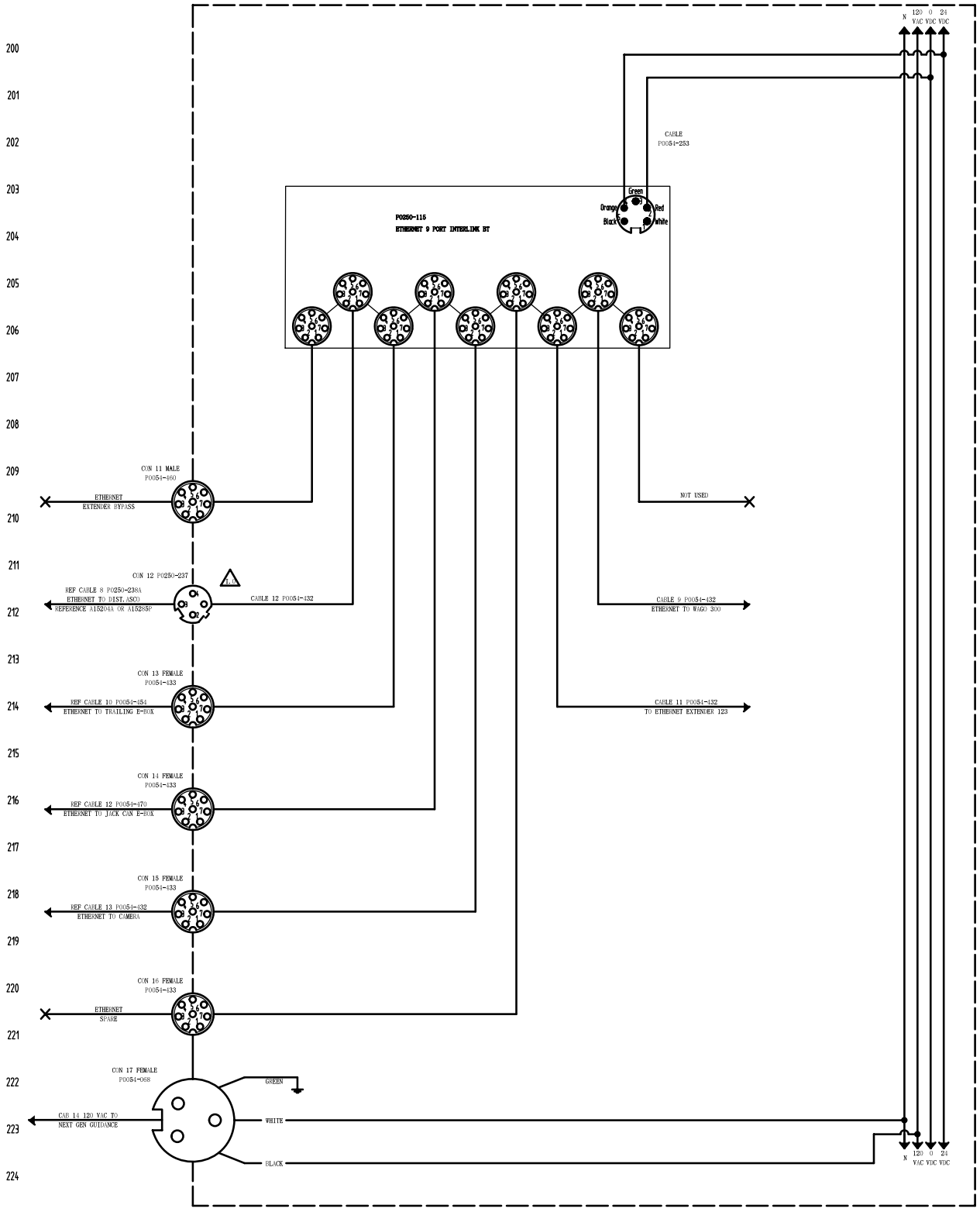
MTBM FRONT SECTION CONTROL BOX ELECTRICAL SCHEMATICS

Electrical Schematic - Part 1 of 12



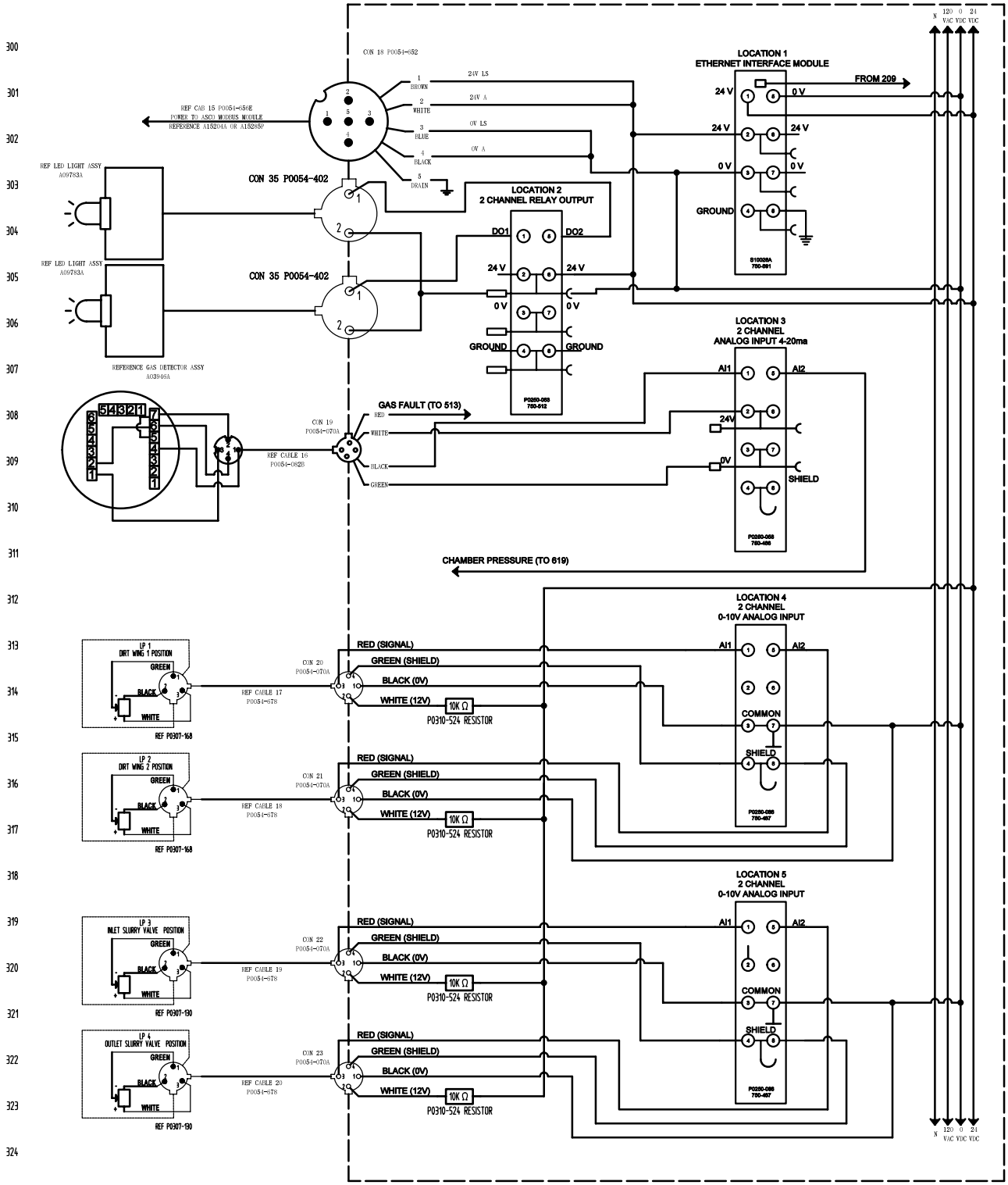
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 2 of 12



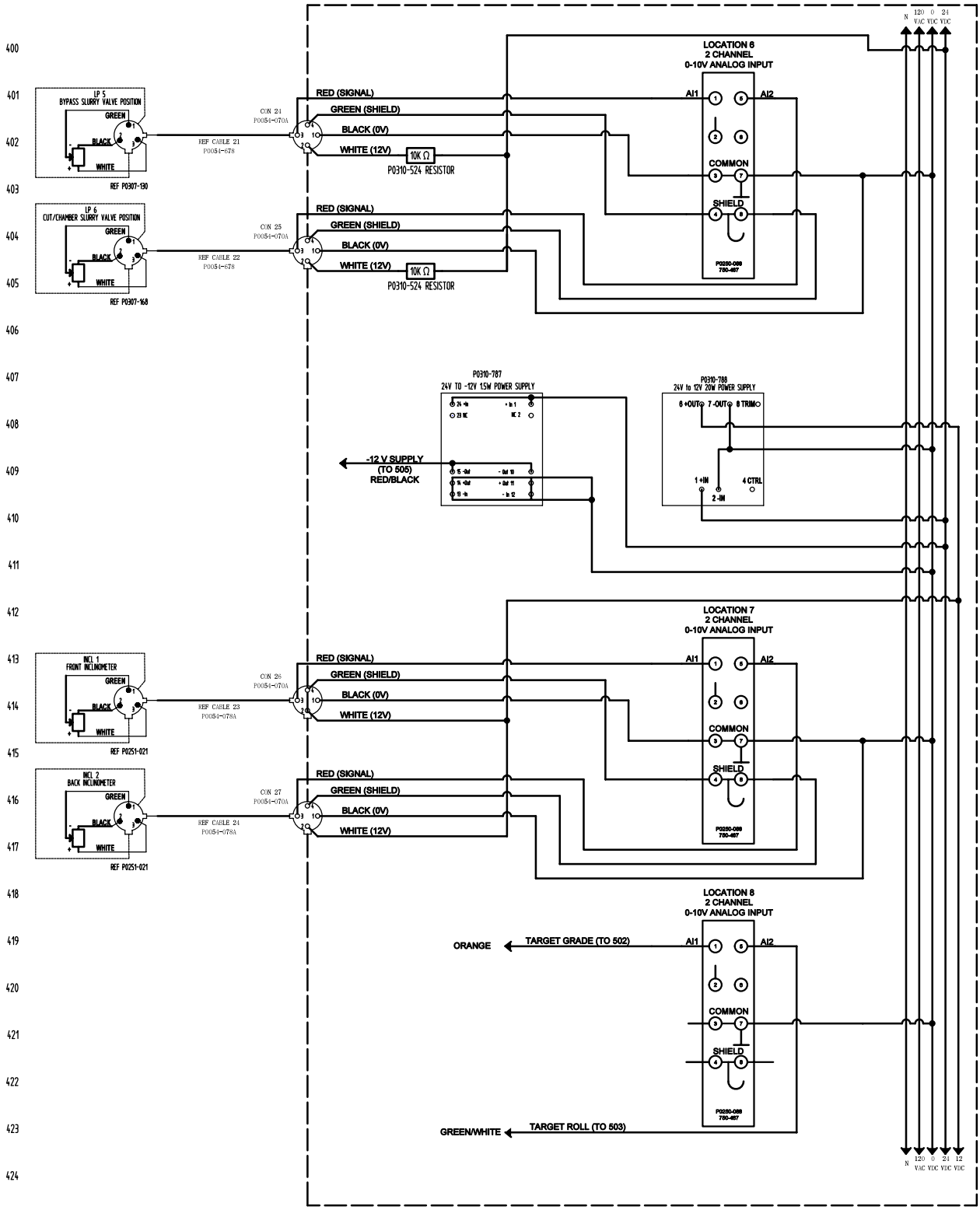
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 3 of 12



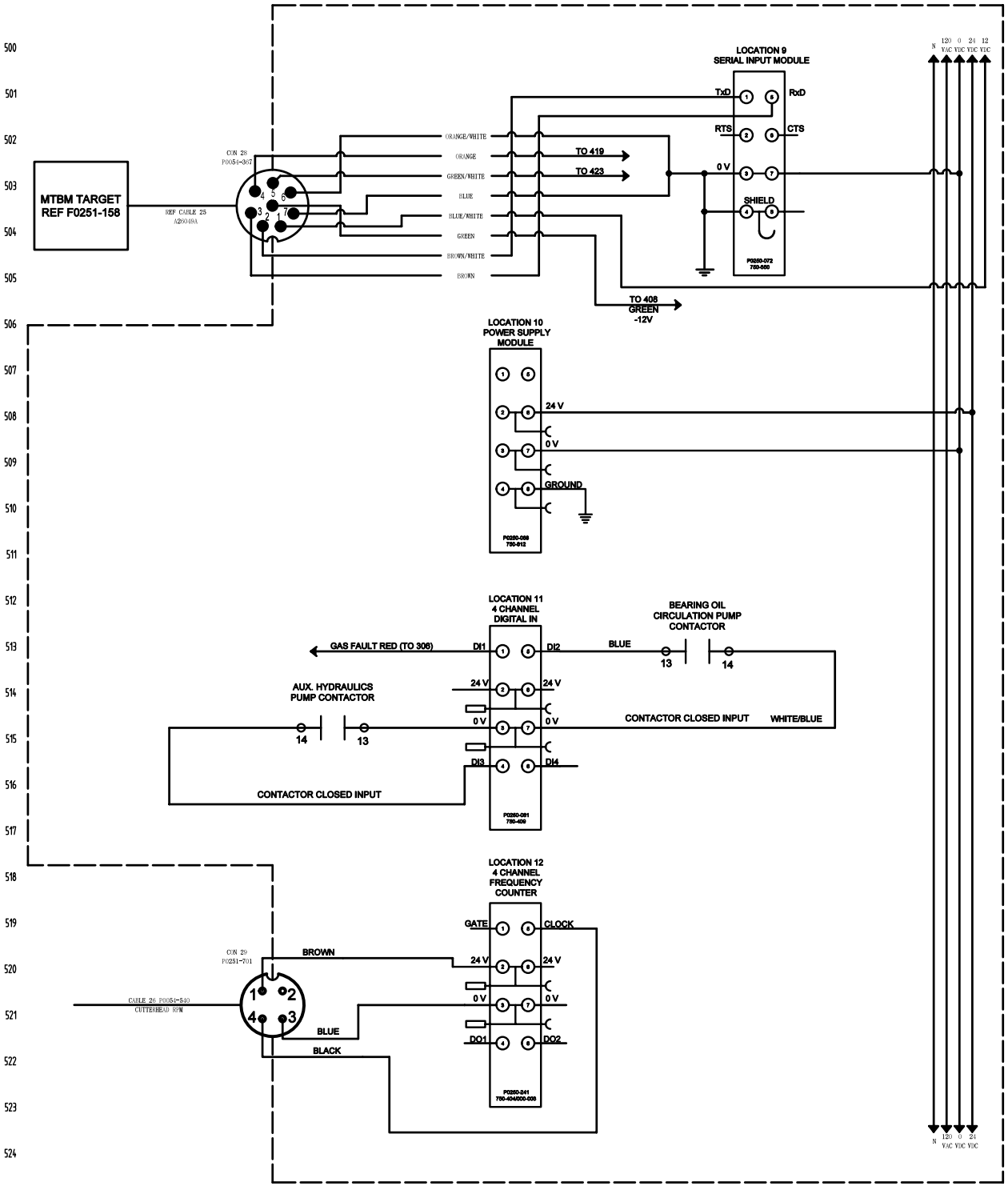
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 4 of 12



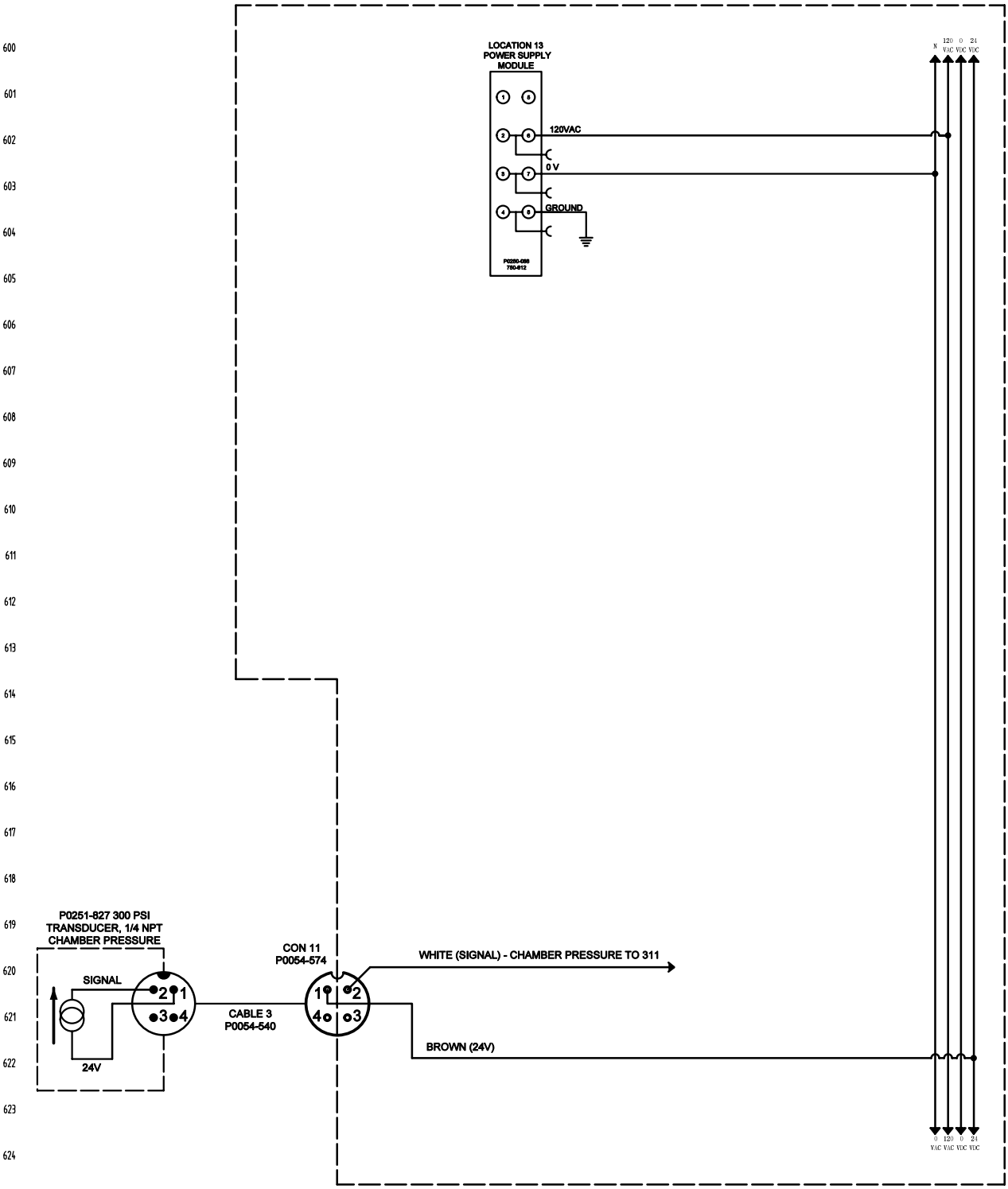
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 5 of 12



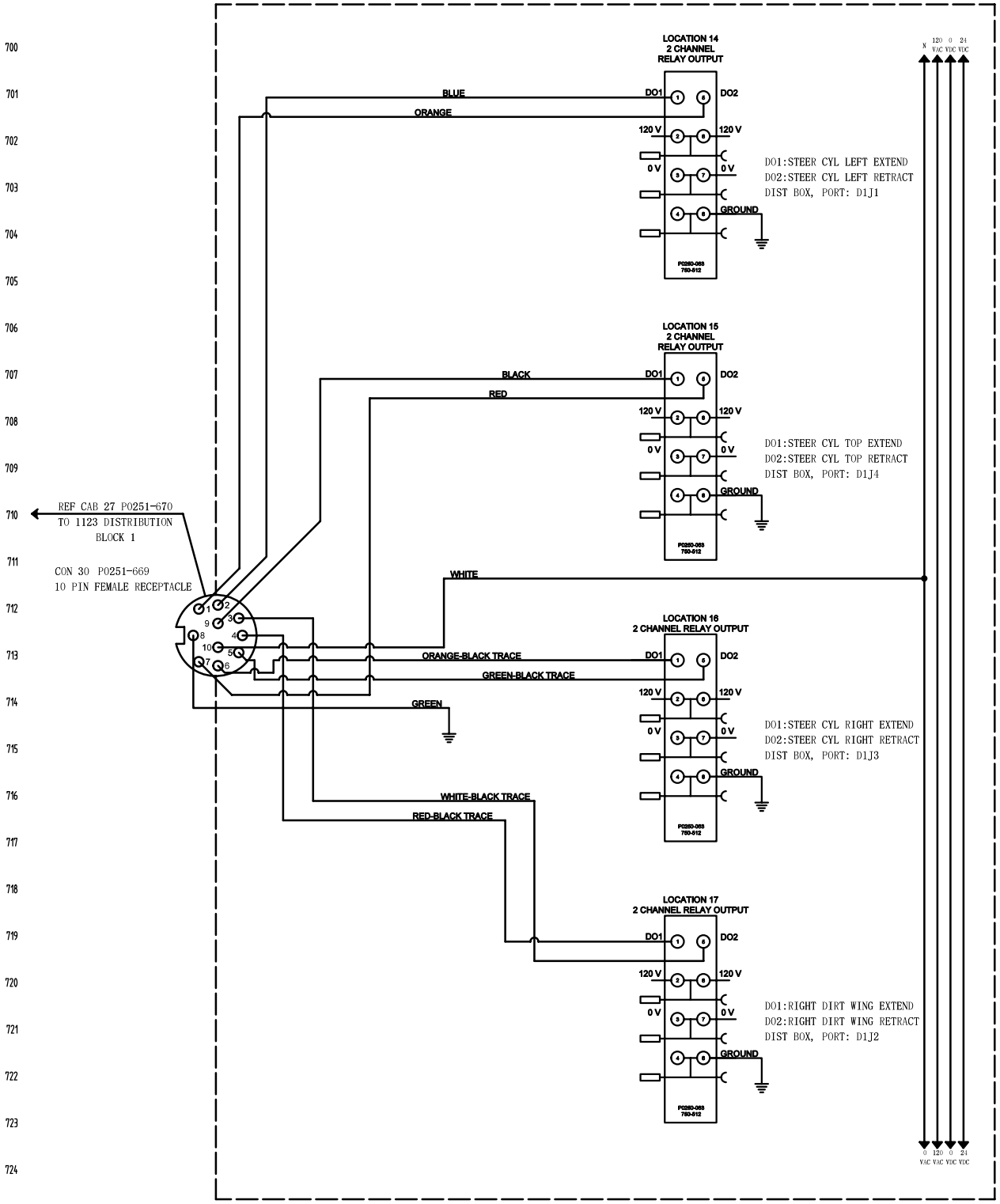
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 6 of 12



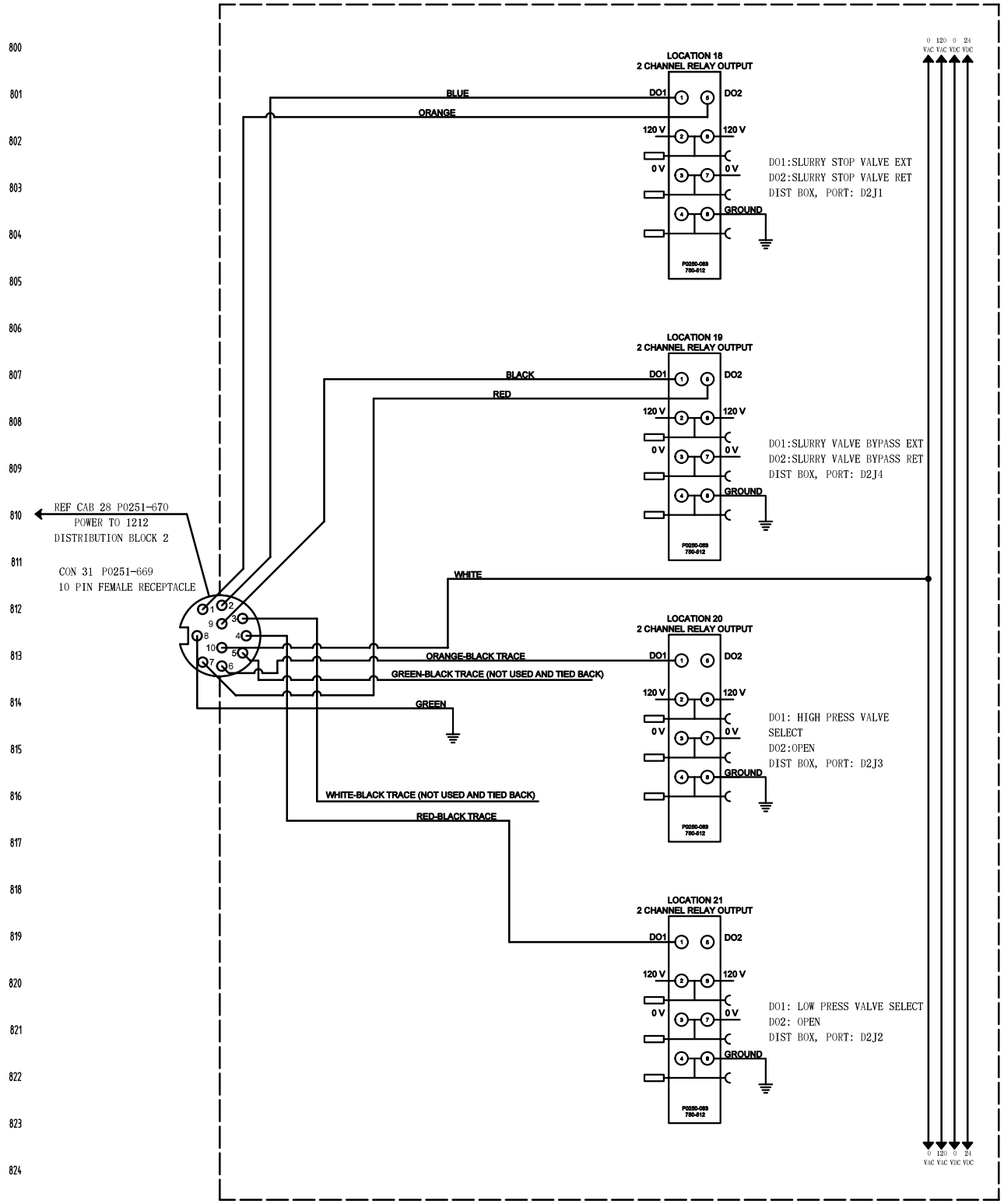
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 7 of 12



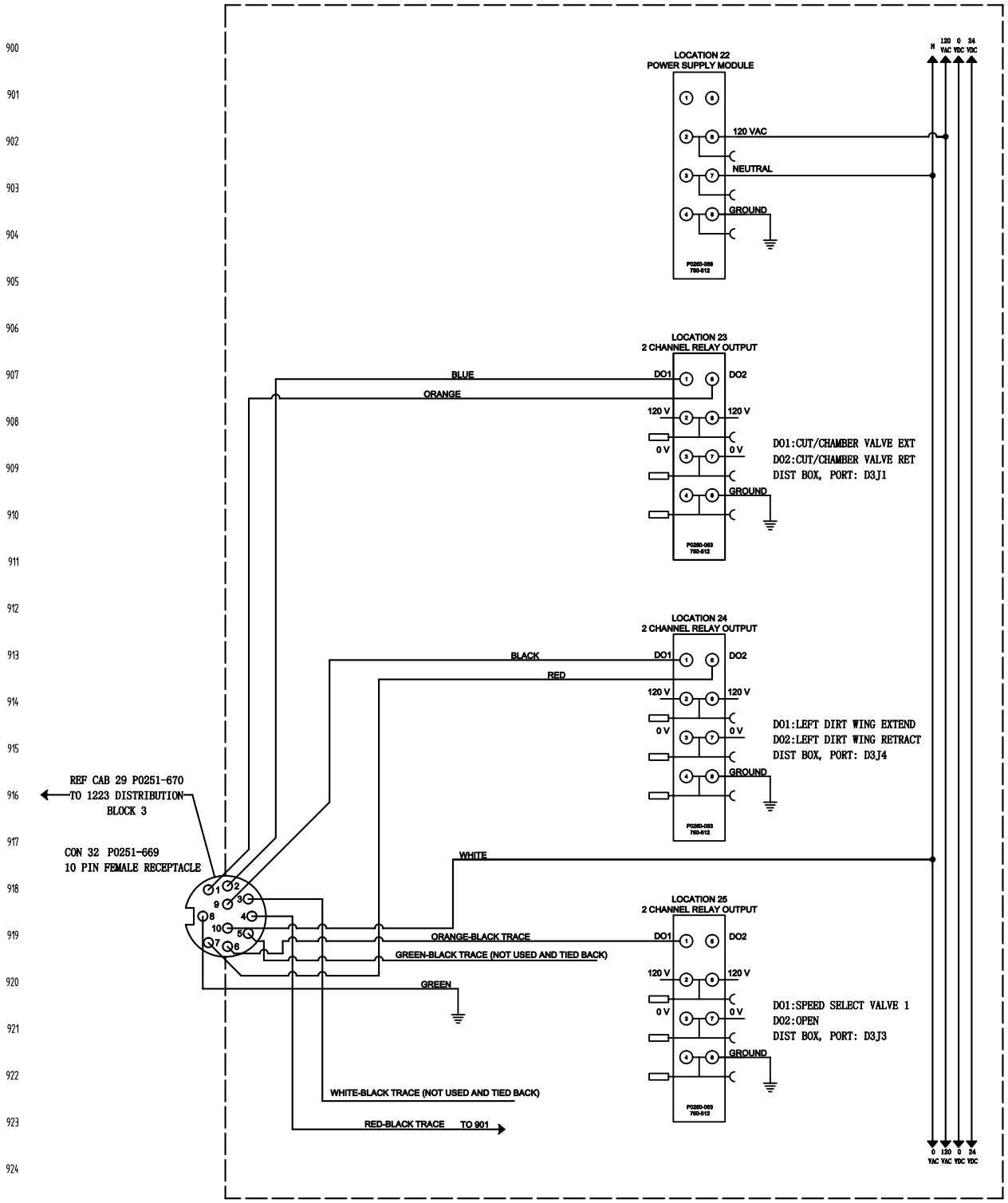
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 8 of 12



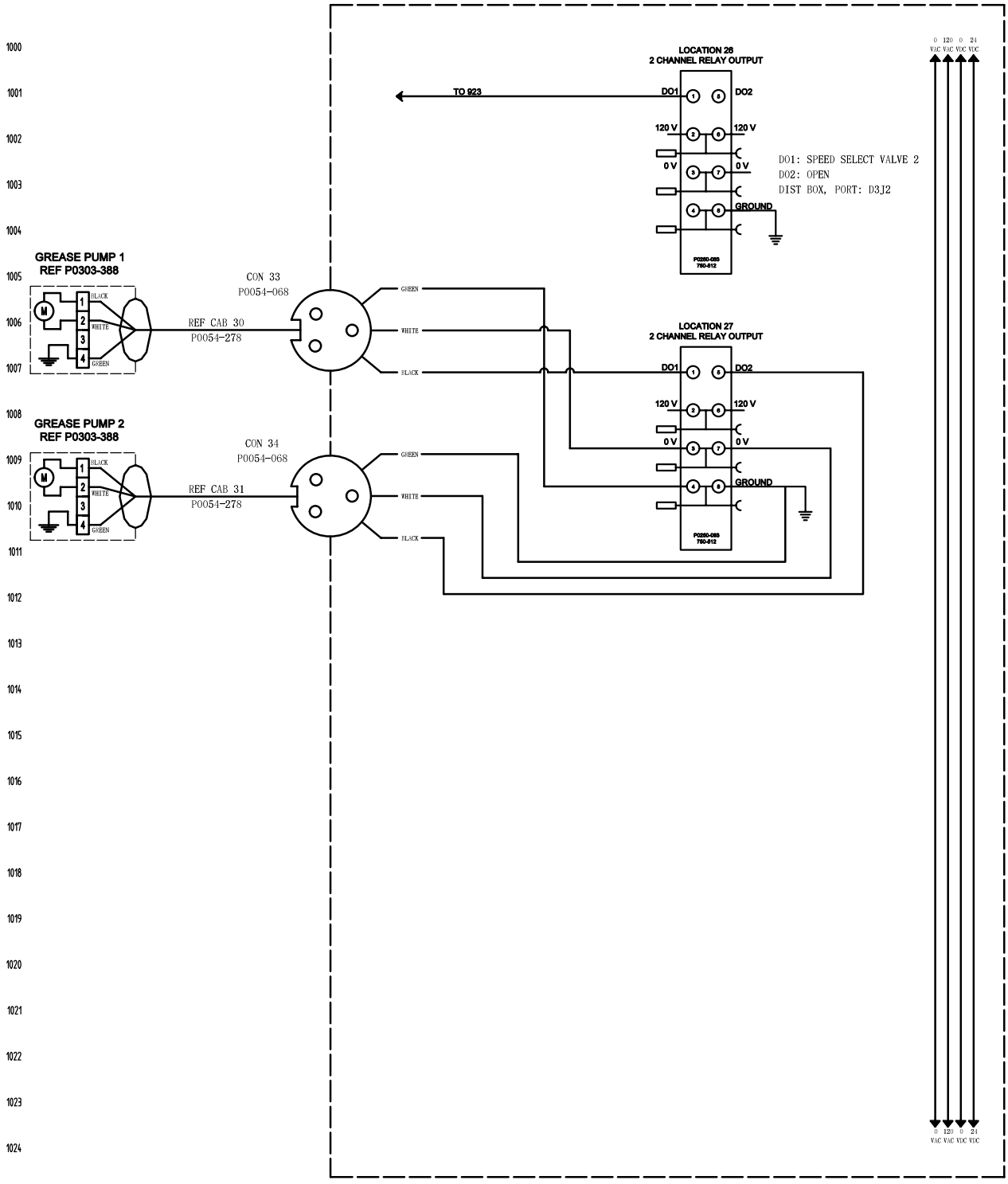
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 9 of 12



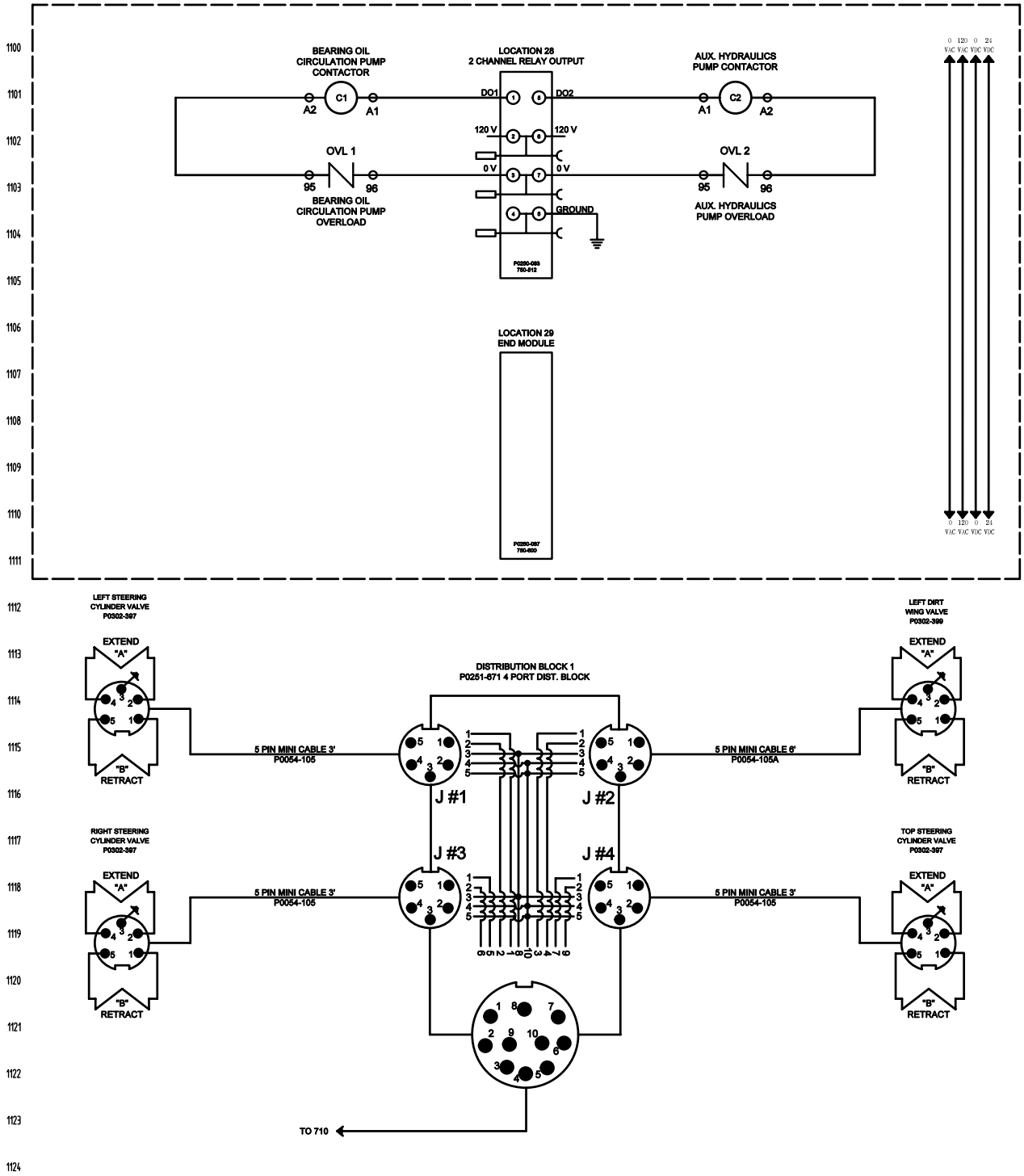
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 10 of 12



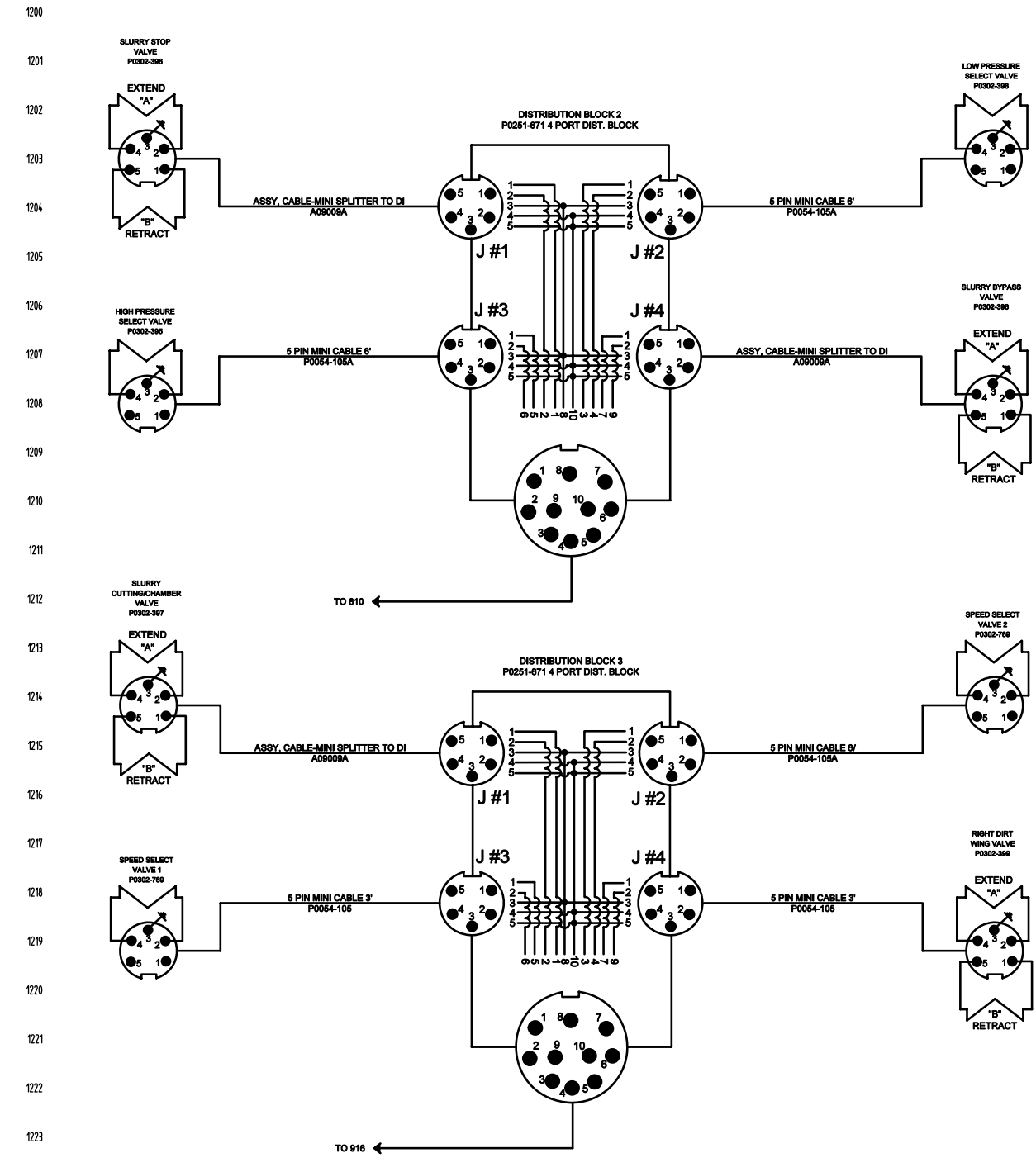
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 11 of 12



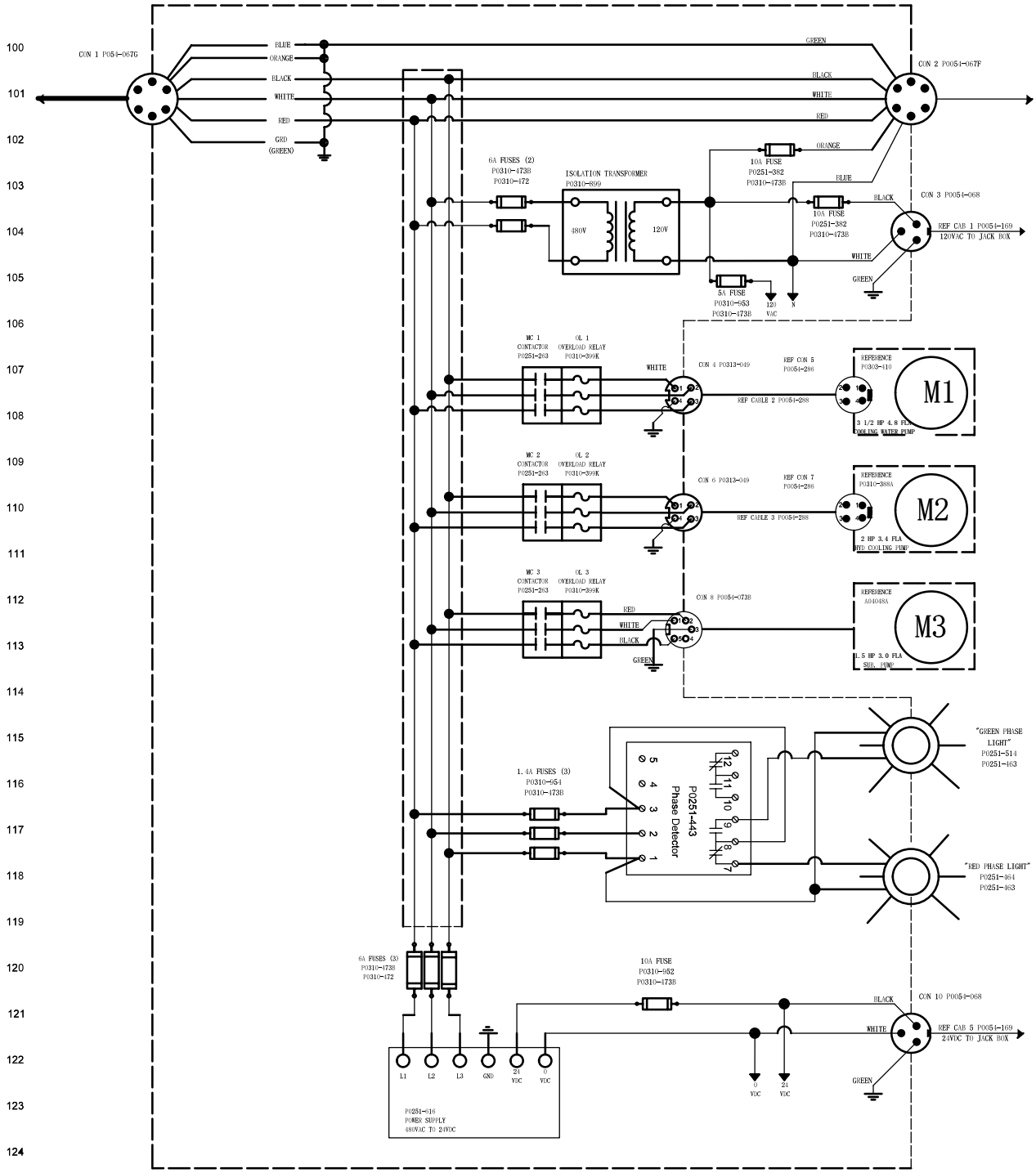
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MTBM Front Section Control Box Electrical Schematics (continued)
Electrical Schematic - Part 12 of 12



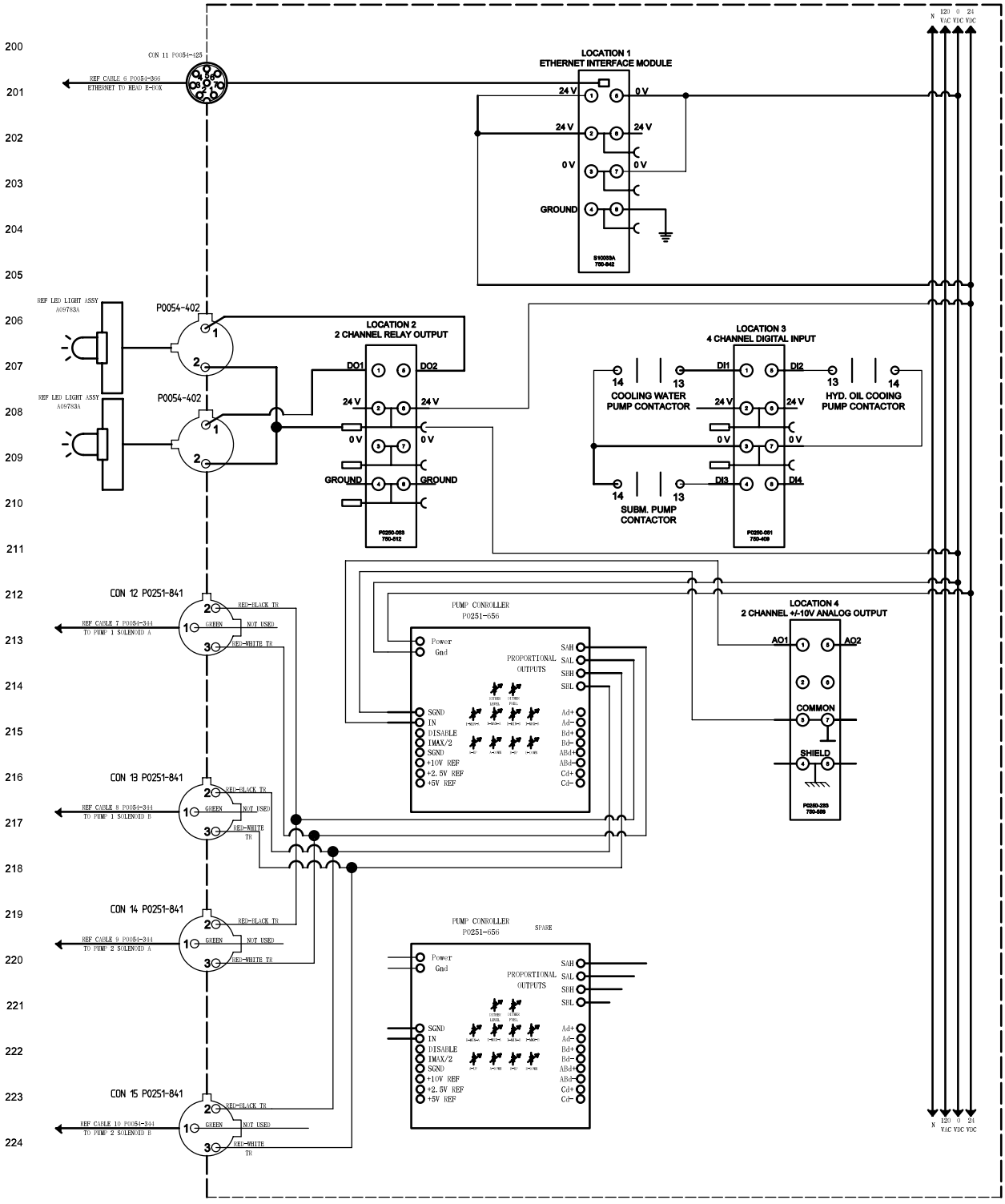
MTBM TRAILING SECTION CONTROL BOX ELECTRICAL SCHEMATICS - SL86P SN FA09100F-01

Electrical Schematic - Part 1 of 3



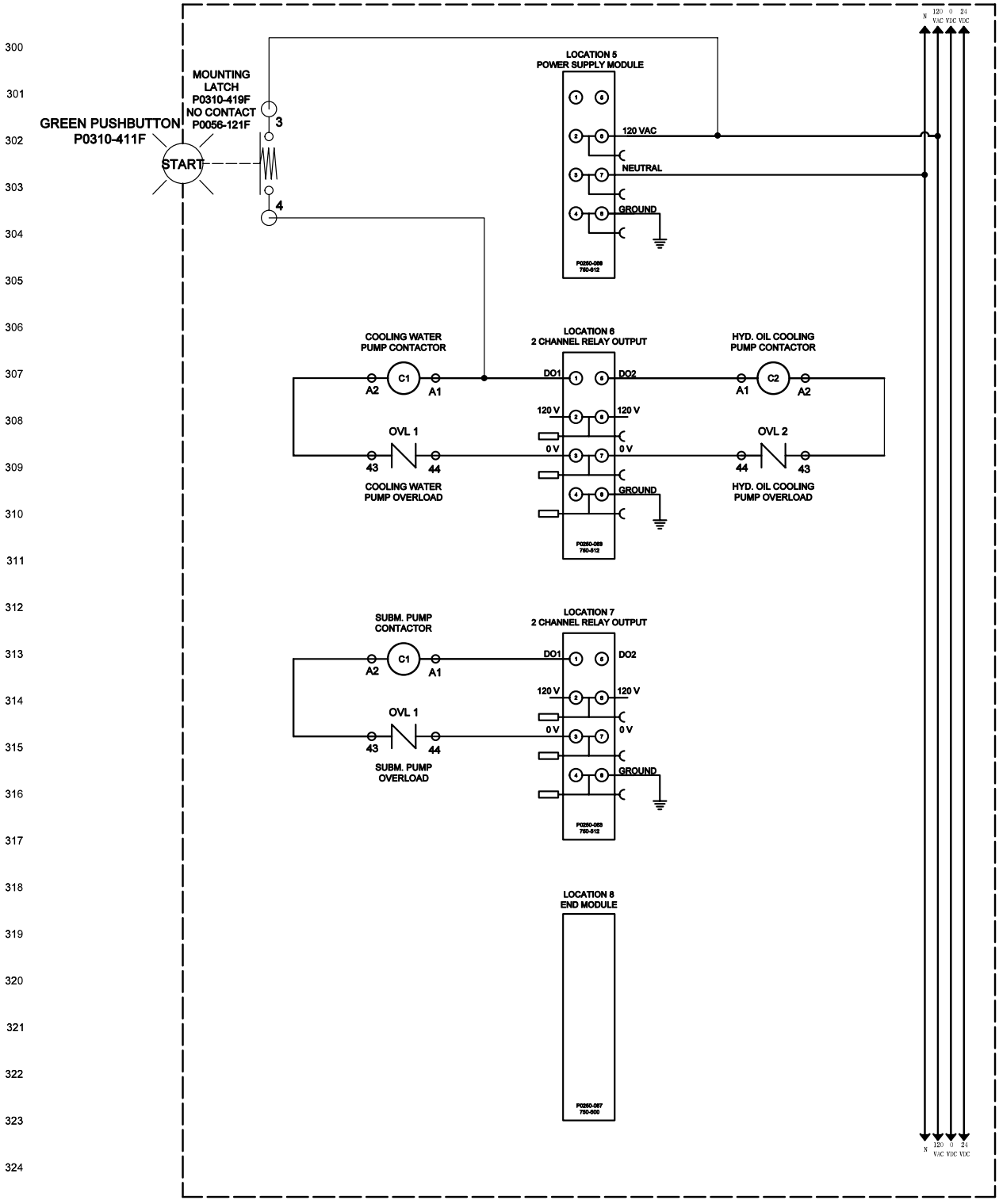
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MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 2 of 3



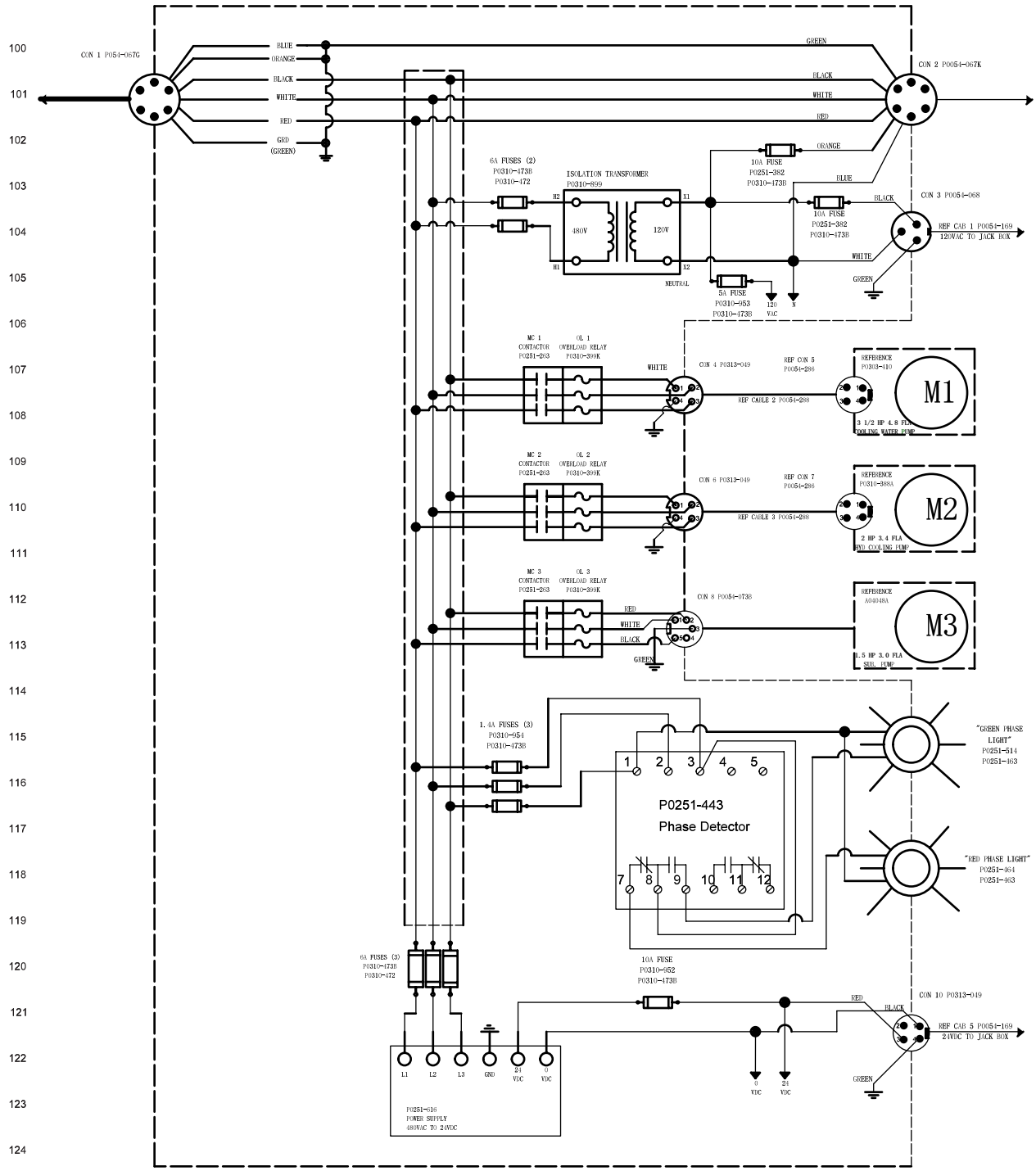
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MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 3 of 3

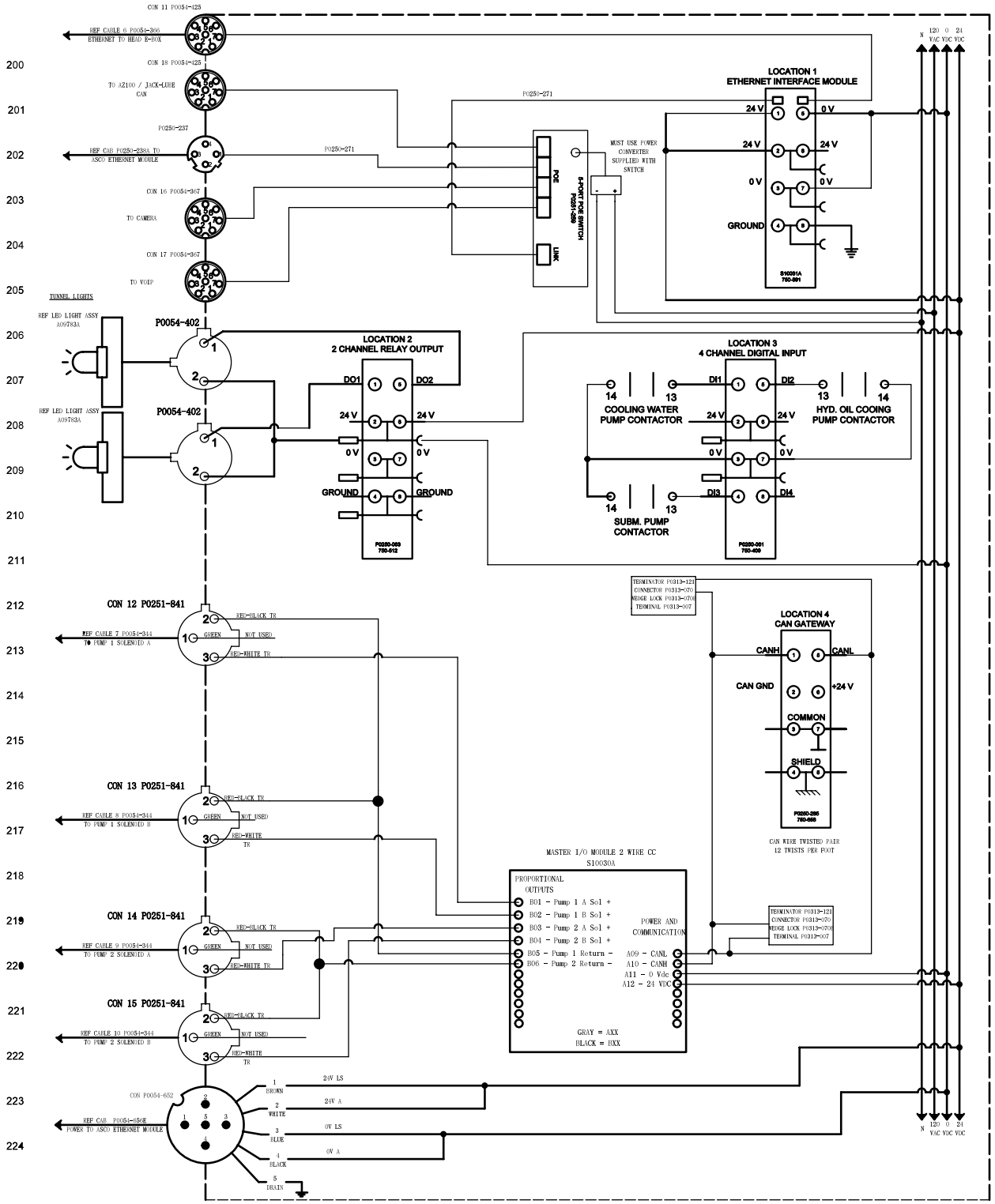


MTBM TRAILING SECTION CONTROL BOX ELECTRICAL SCHEMATICS - SL86P SN: FA09100F-02 & AFTER

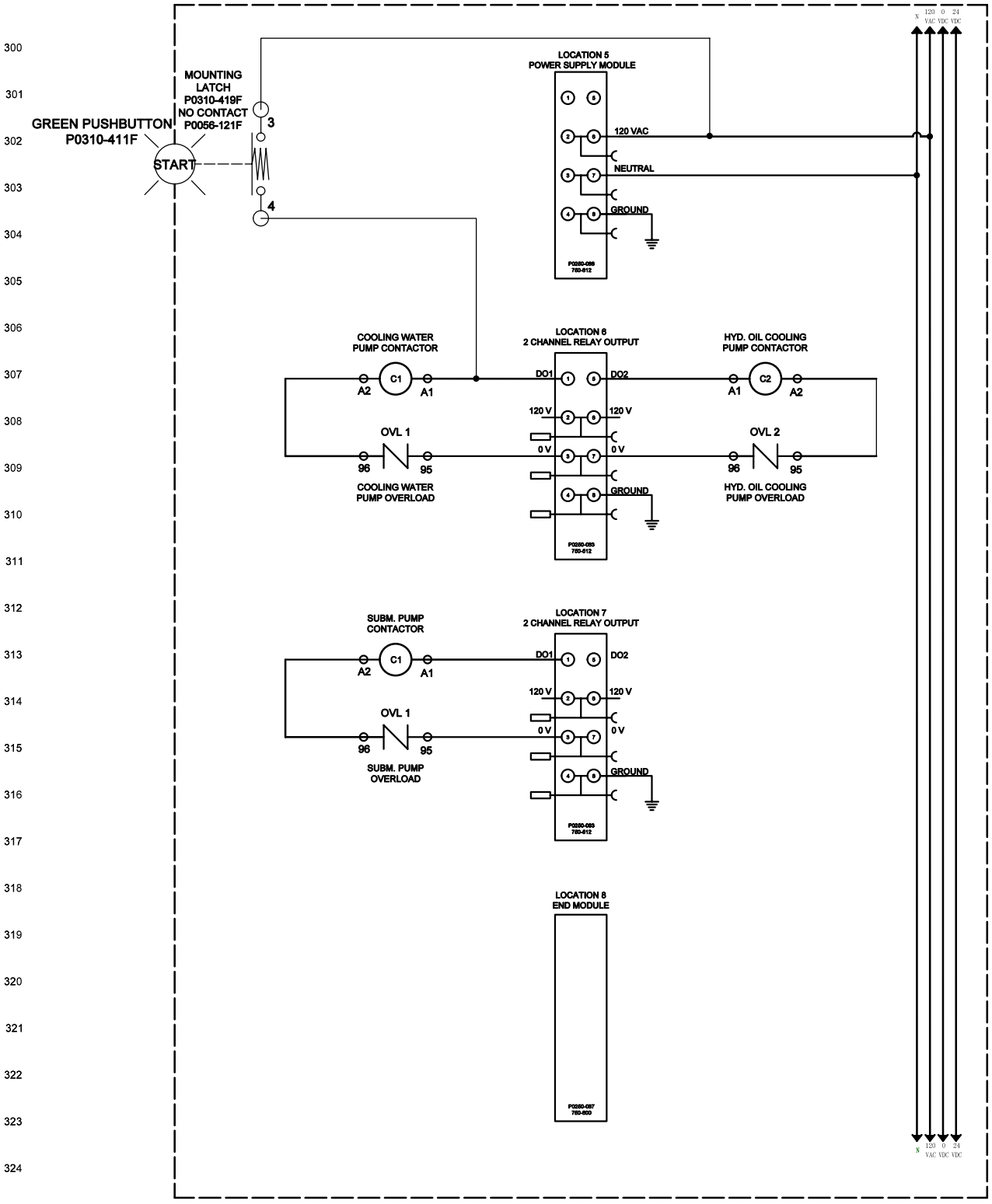
Electrical Schematic - Part 1 of 3



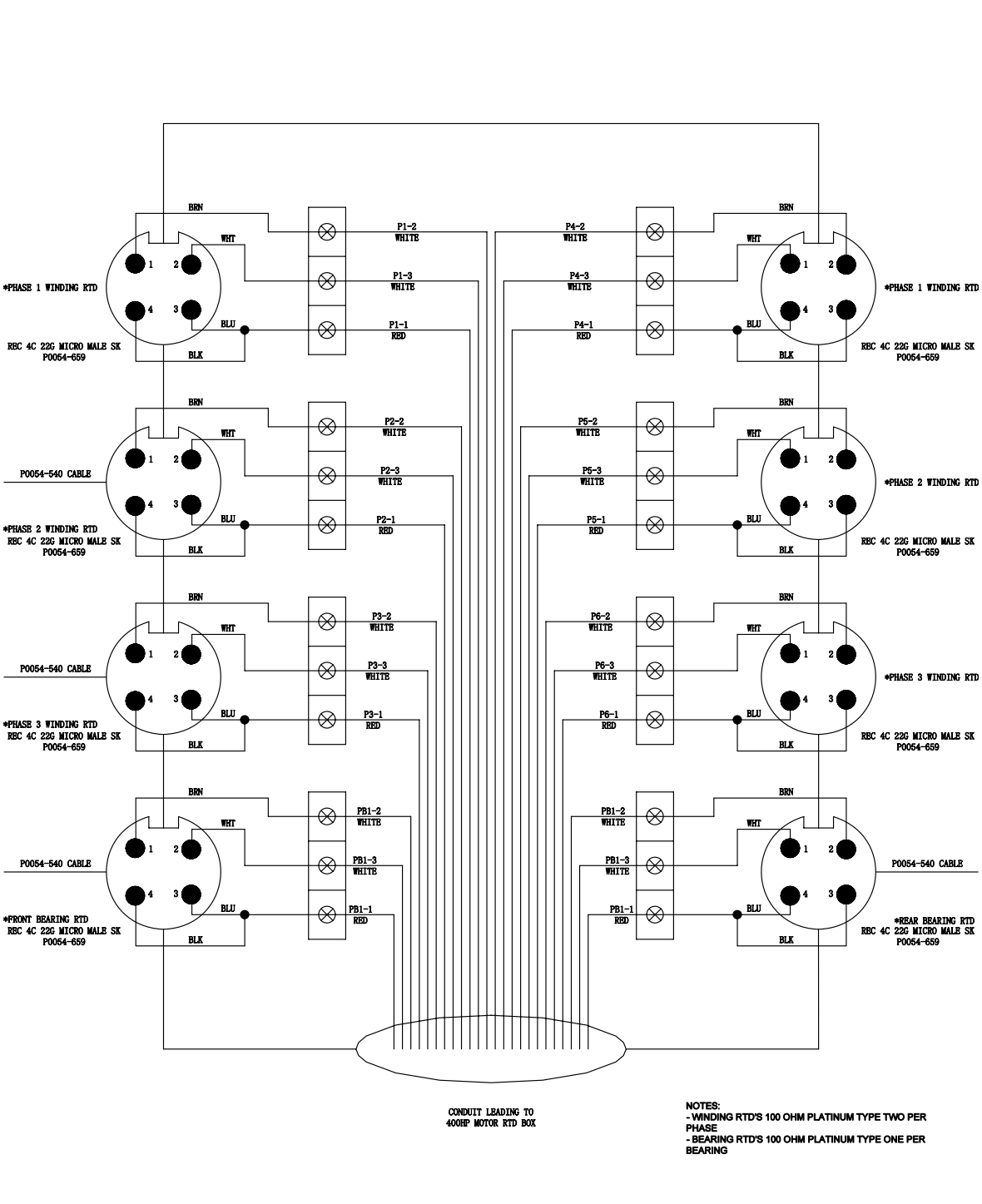
MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 2 of 3



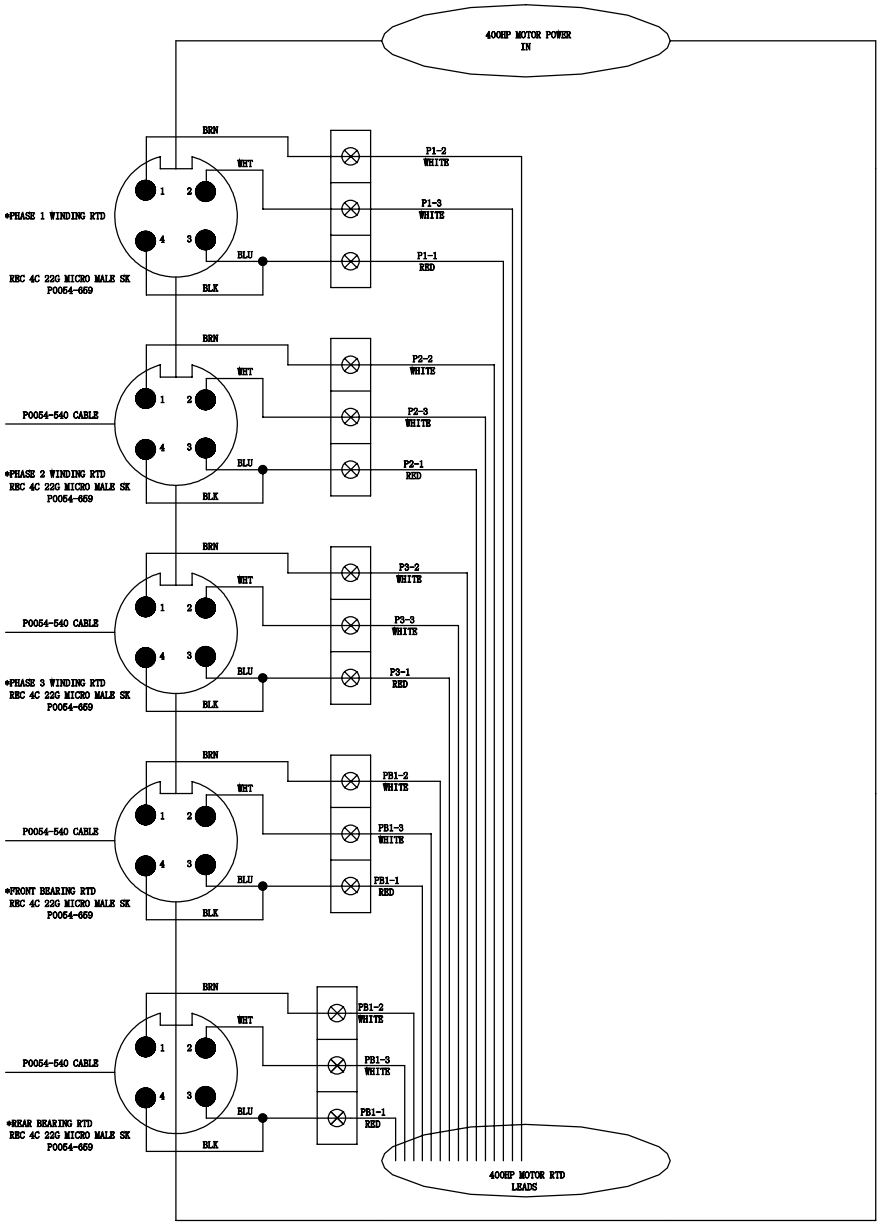
MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 3 of 3

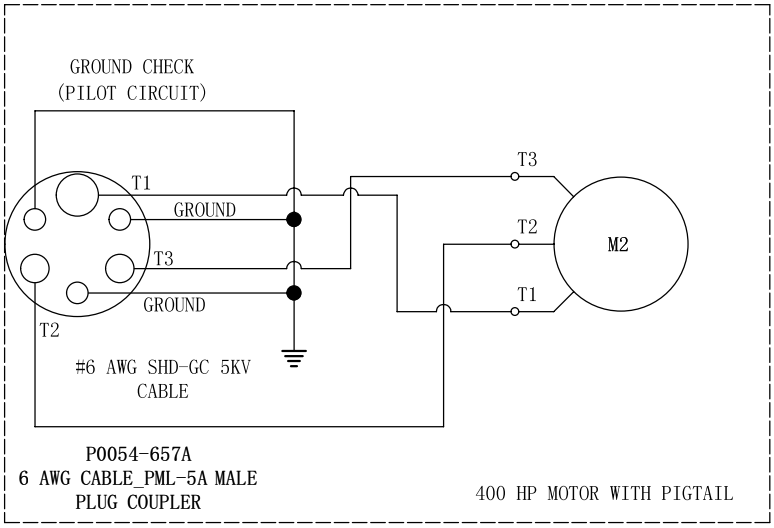


MTBM MOTOR RTD BOX ELECTRICAL SCHEMATIC - SL86P SN: FA09100F-01



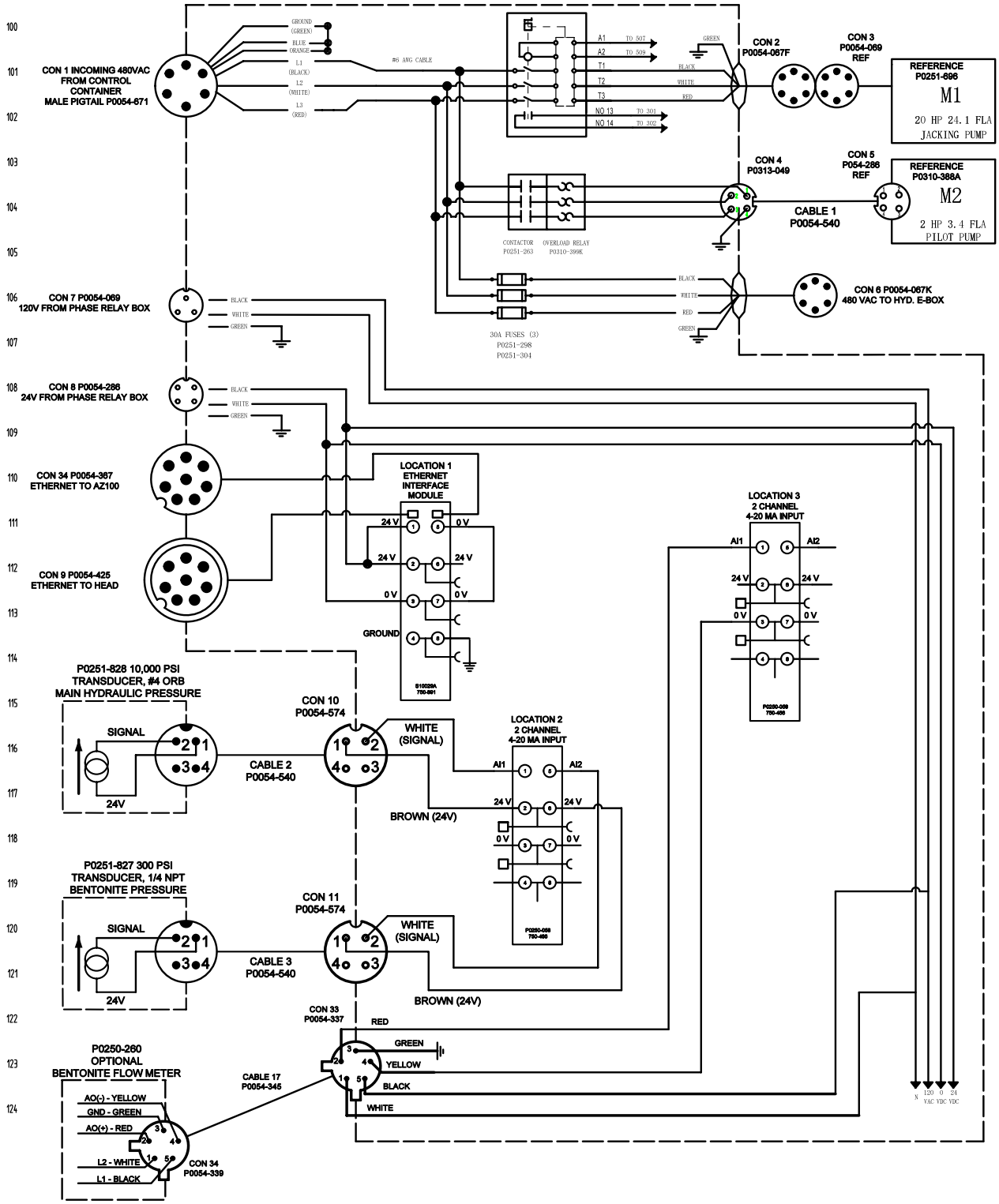
MTBM DRIVE MOTOR 400 HP ELECTRICAL SCHEMATIC - SL86P SN: FA09100F-02 & AFTER





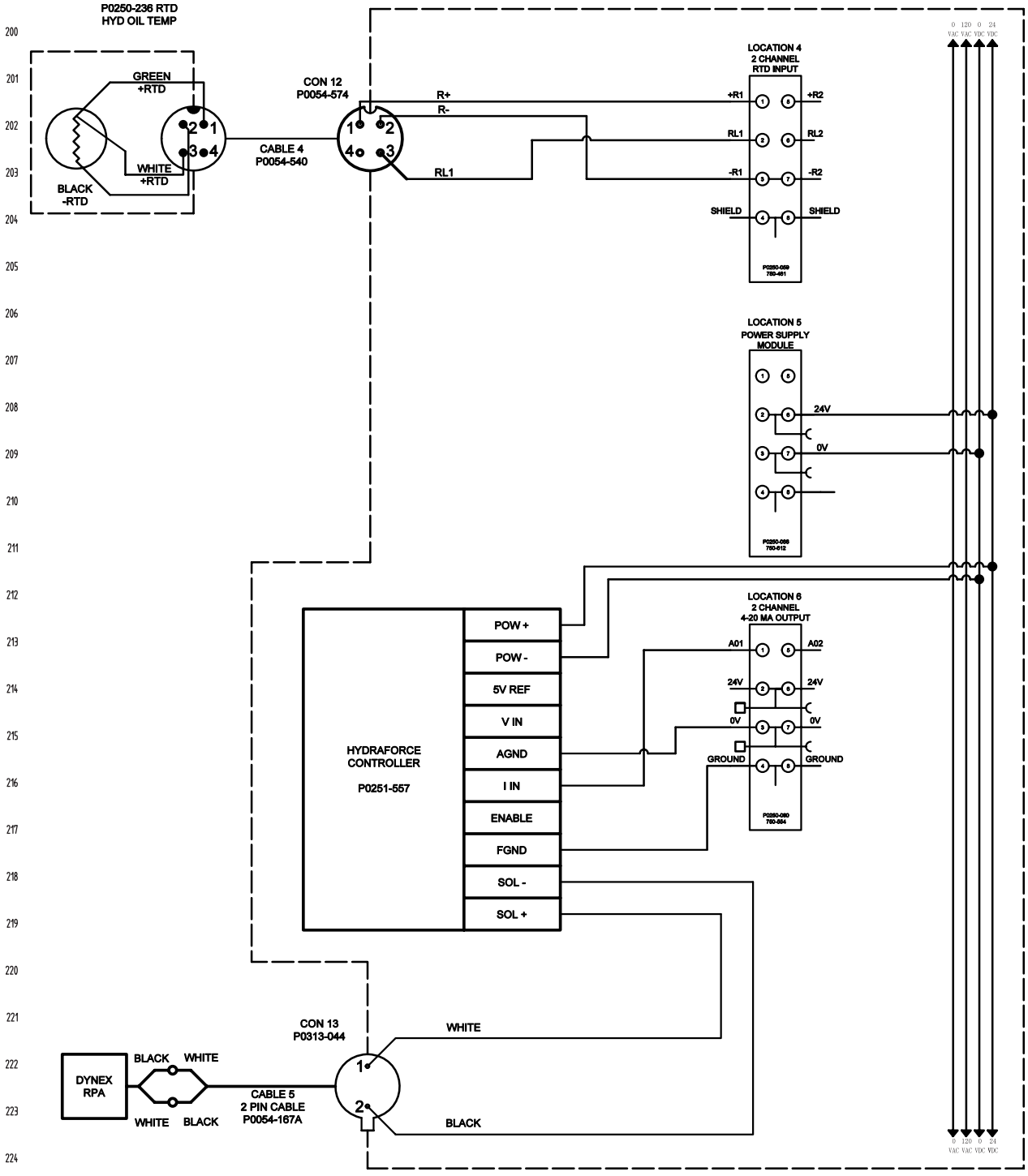
MTBM JACK CAN CONTROL BOX ELECTRICAL SCHEMATICS - 86” SN: FA09399F

Electrical Schematic - Part 1 of 7



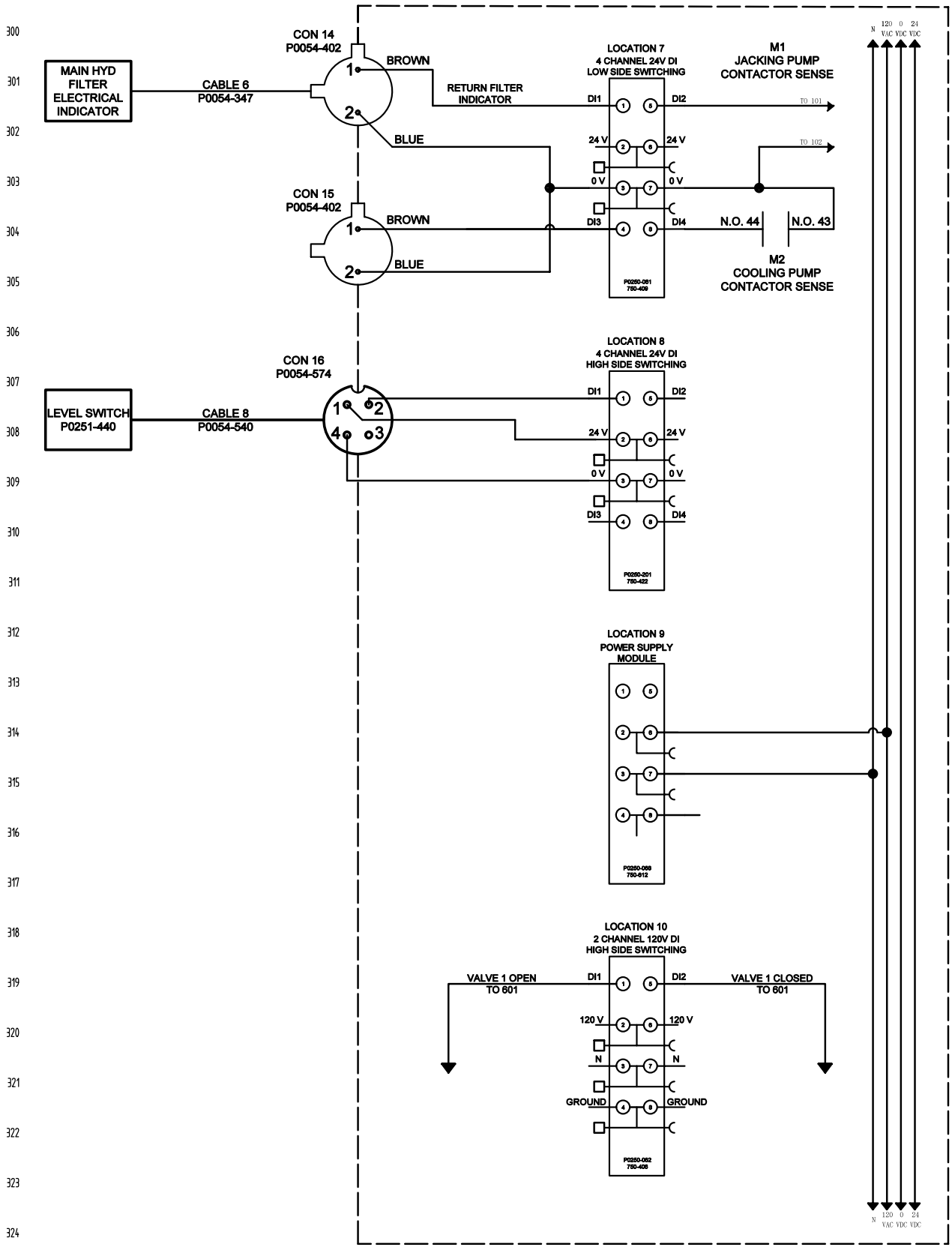
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MTBM 86” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 2 of 7



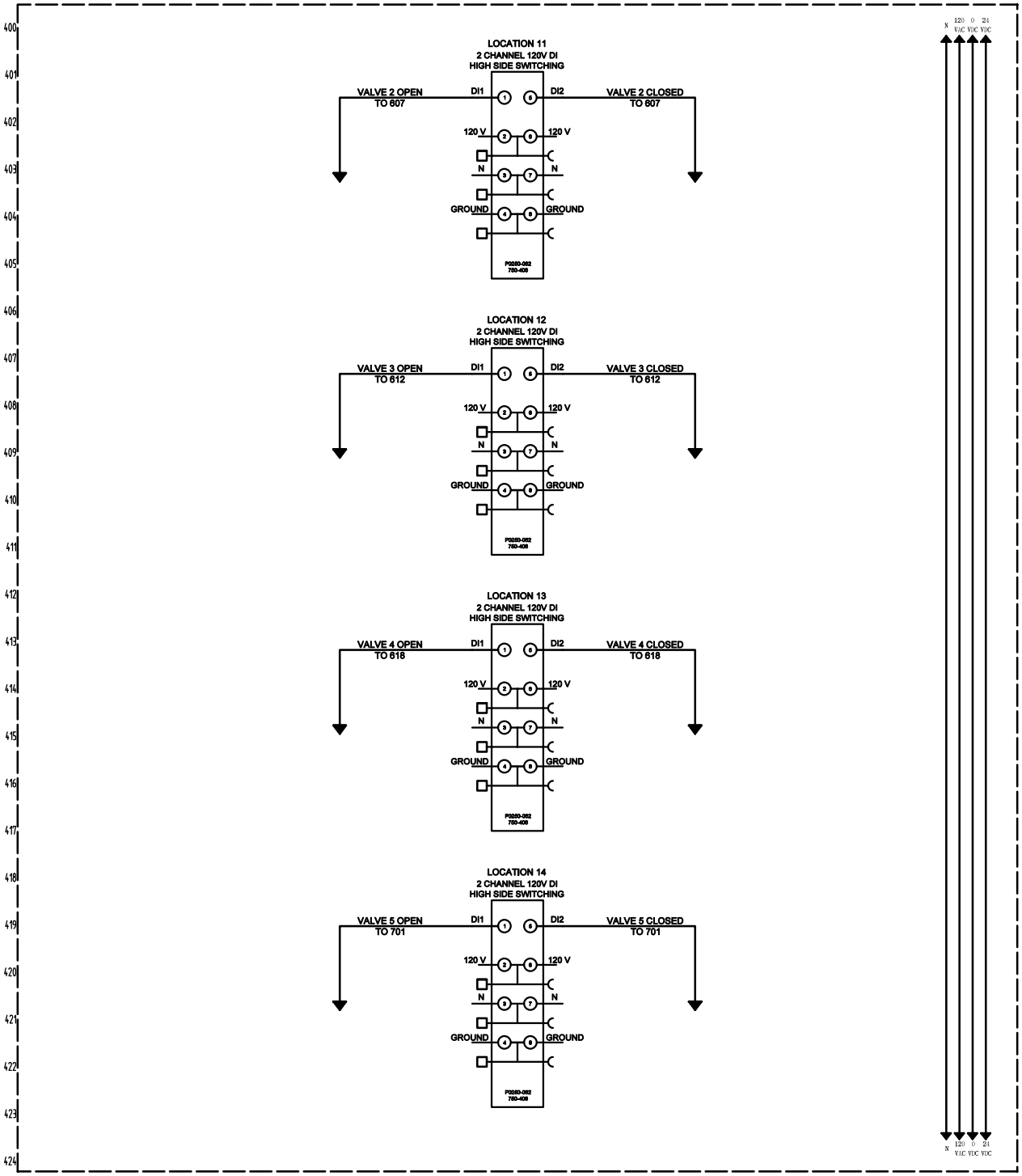
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MTBM 86” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 3 of 7



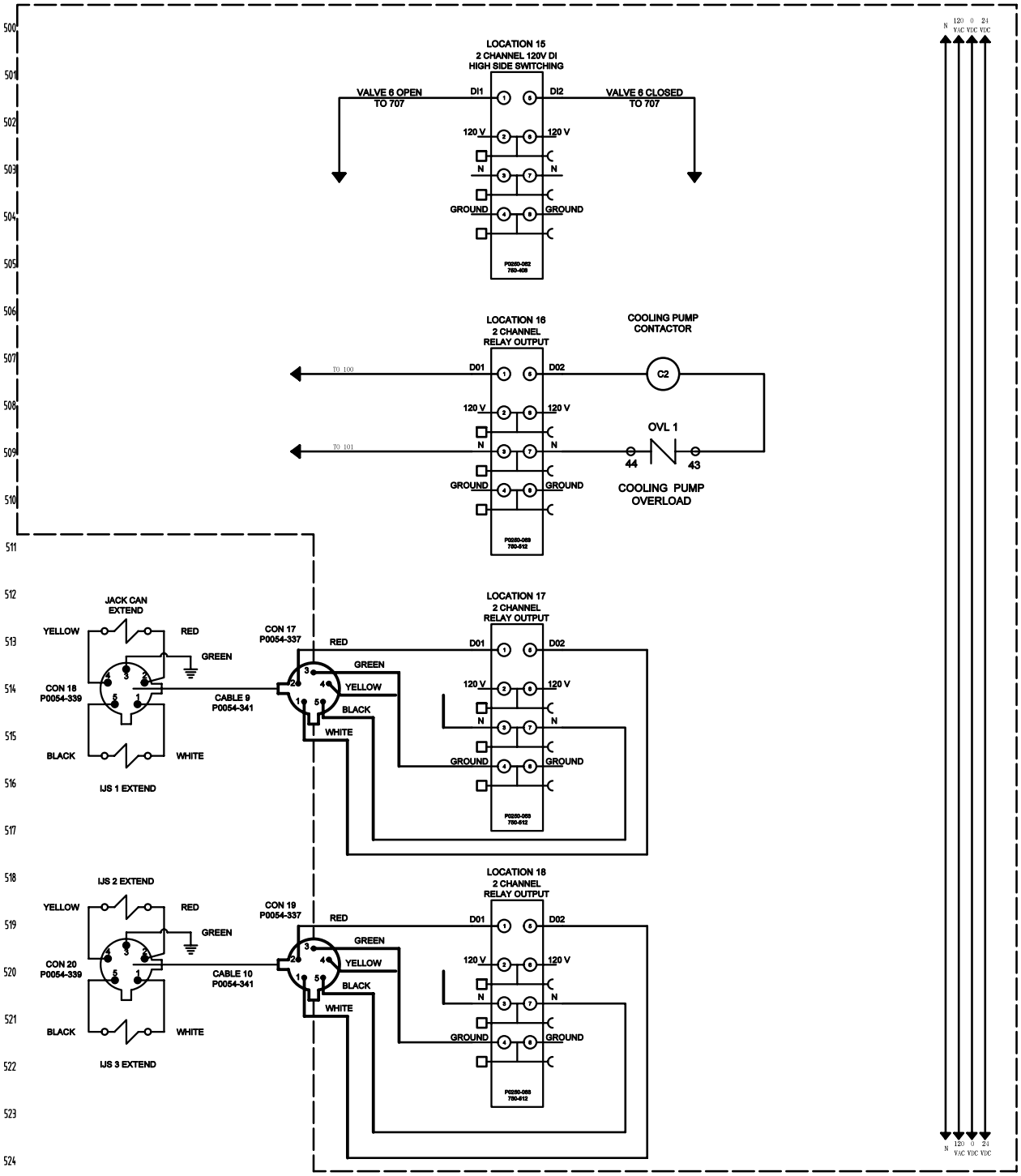
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MTBM 86” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 4 of 7



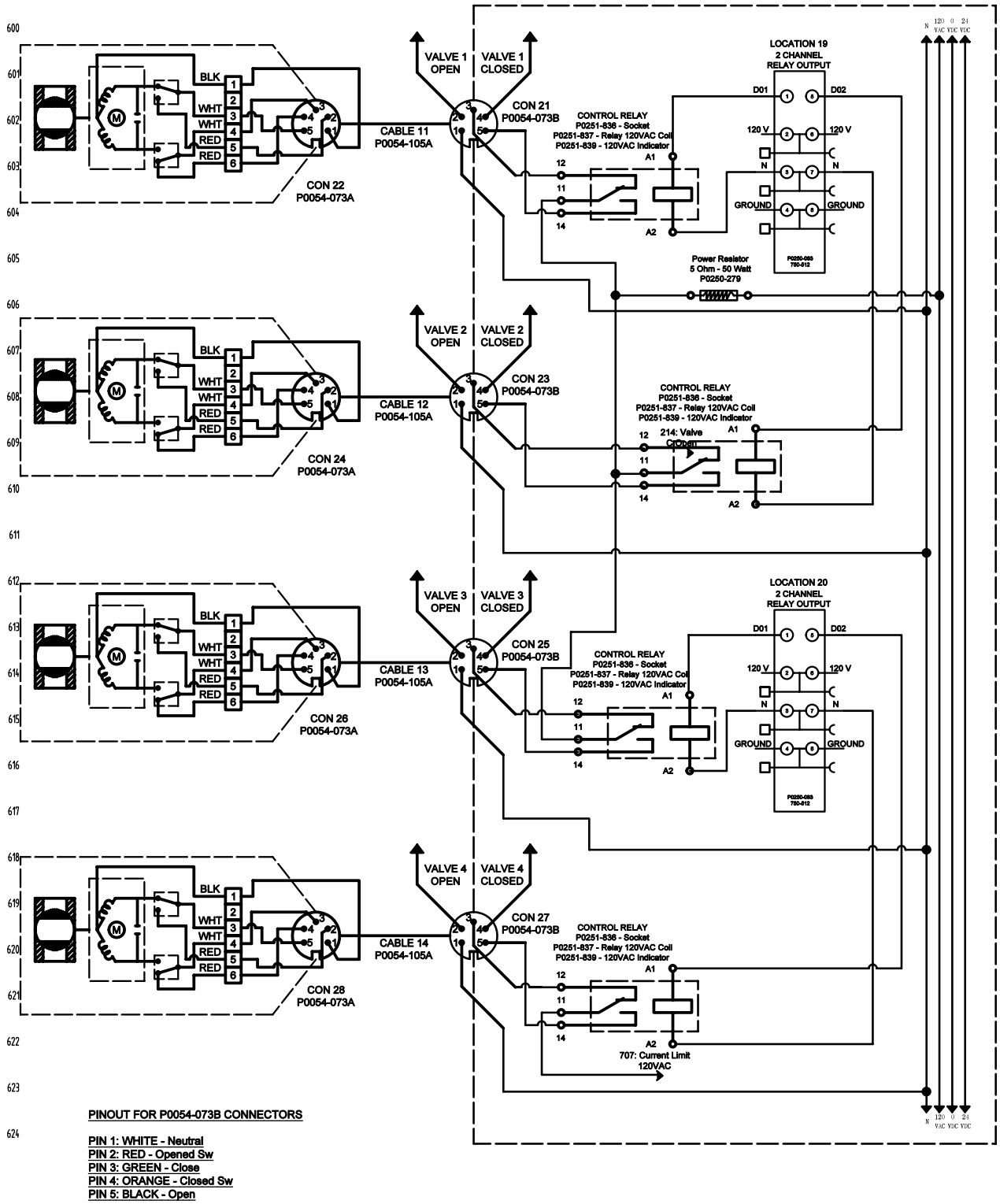
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MTBM 86” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 5 of 7



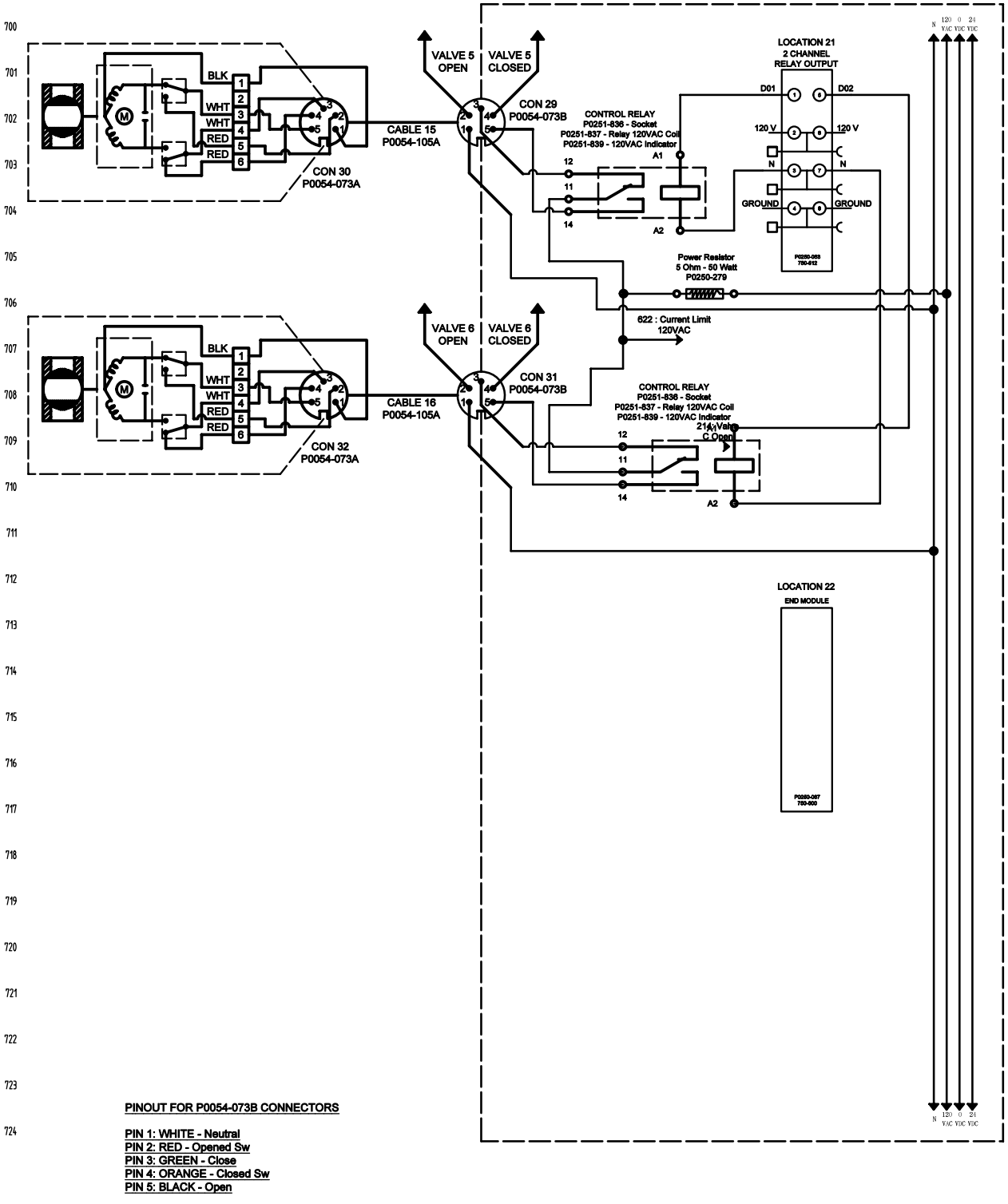
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MTBM 86” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 6 of 7



MTBM 86” Jack Can Control Box Electrical Schematics (continued)

Electrical Schematic - Part 7 of 7

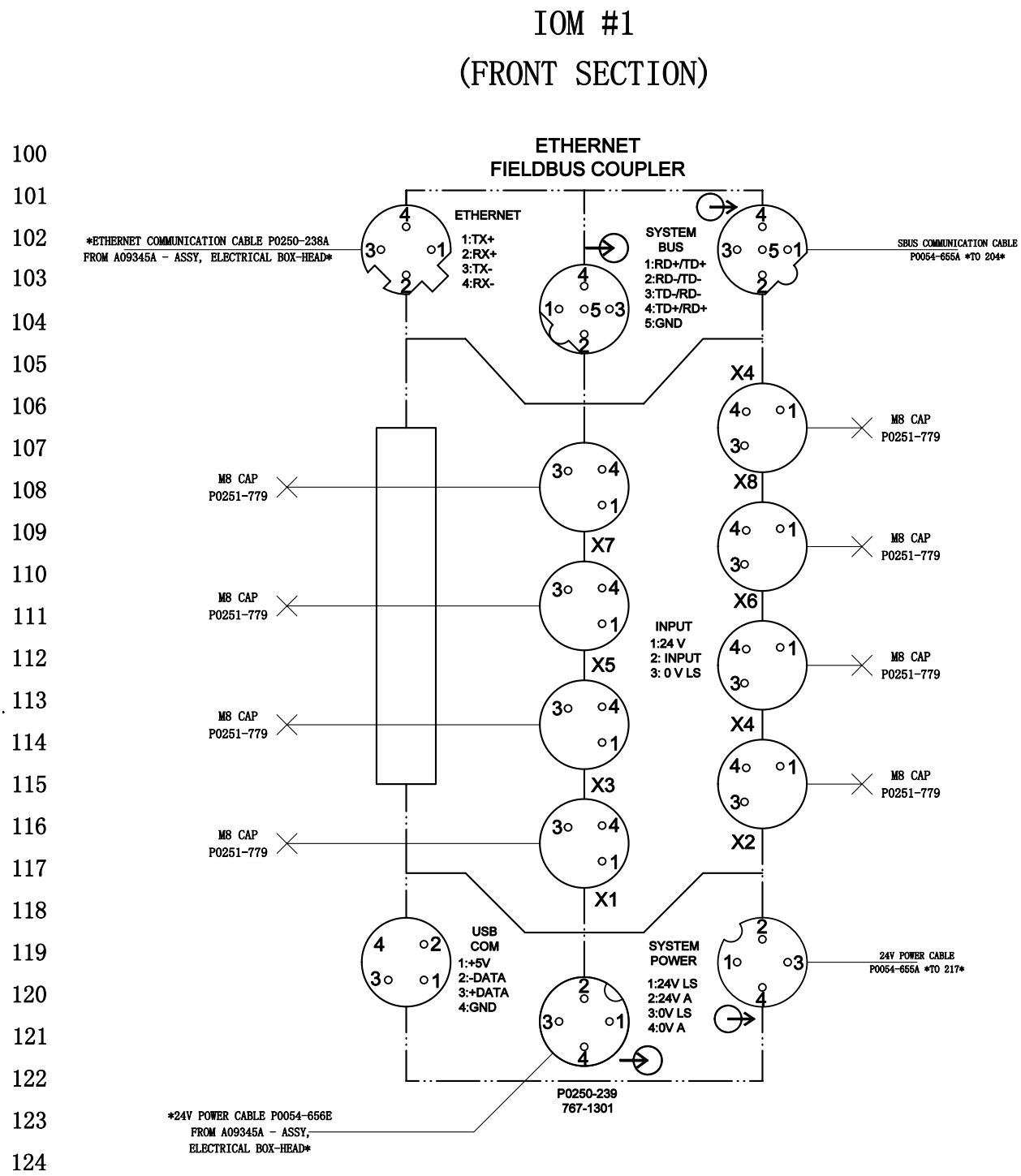


PINOUT FOR P0054-073B CONNECTORS

PIN 1: WHITE - Neutral
PIN 2: RED - Opened Sw
PIN 3: GREEN - Close
PIN 4: ORANGE - Closed Sw
PIN 5: BLACK - Open

MTBM SPEEDWAY I/O MODULE SCHEMATICS - SL86P SN: FA09100F-01

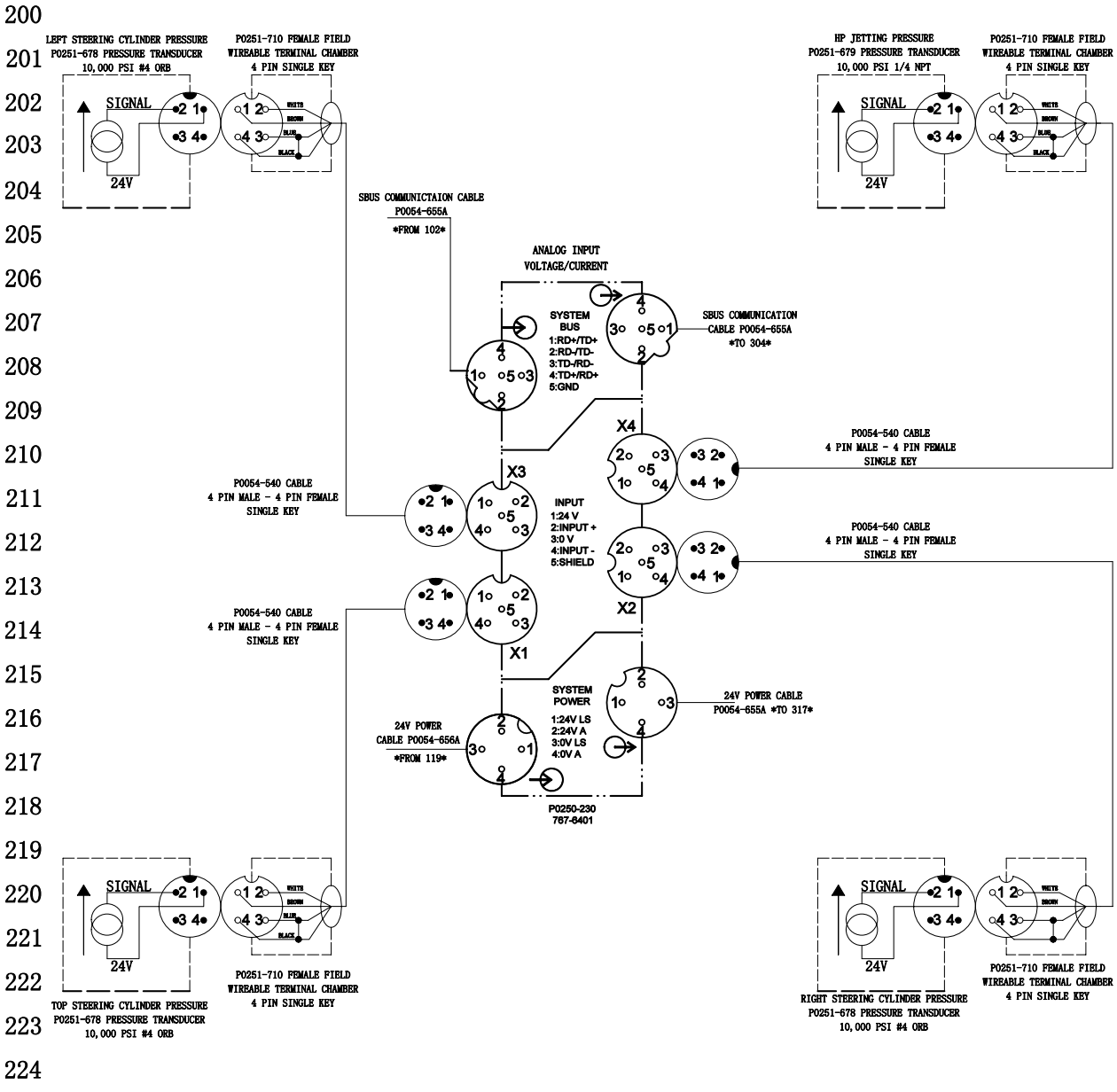
Module Schematic - Part 1 of 12



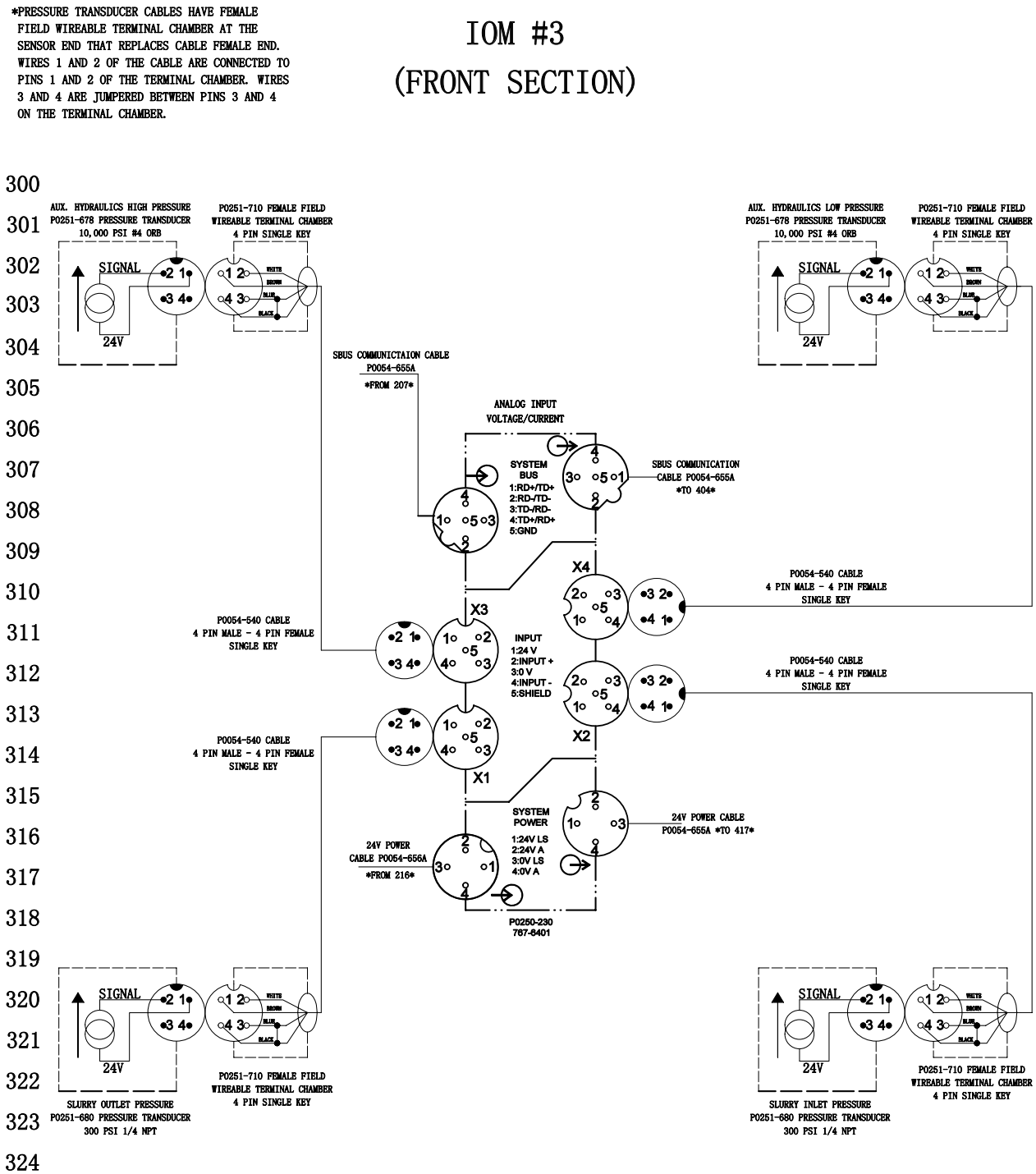
SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 2 of 12

*PRESSURE TRANSDUCER CABLES HAVE FEMALE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END THAT REPLACES CABLE FEMALE END. WIRES 1 AND 2 OF THE CABLE ARE CONNECTED TO PINS 1 AND 2 OF THE TERMINAL CHAMBER. WIRES 3 AND 4 ARE JUMPERED BETWEEN PINS 3 AND 4 ON THE TERMINAL CHAMBER.

IOM #2
(FRONT SECTION)



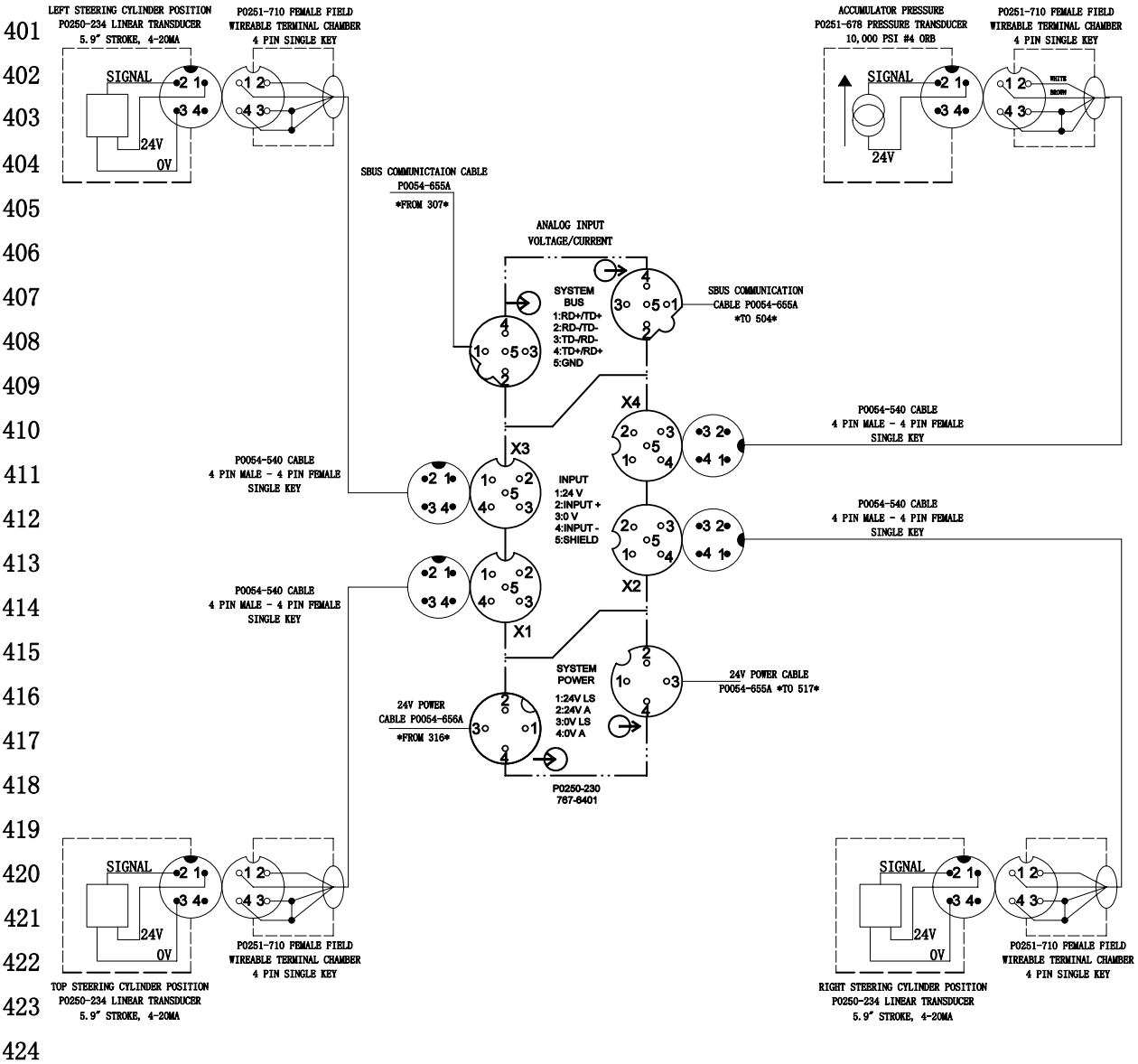
SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 3 of 12



SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 4 of 12

*PRESSURE TRANSDUCER CABLES HAVE FEMALE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END THAT REPLACES CABLE FEMALE END. WIRES 1 AND 2 OF THE CABLE ARE CONNECTED TO PINS 1 AND 2 OF THE TERMINAL CHAMBER. WIRES 3 AND 4 ARE JUMPERED BETWEEN PINS 3 AND 4 ON THE TERMINAL CHAMBER.

IOM #4
(FRONT SECTION)

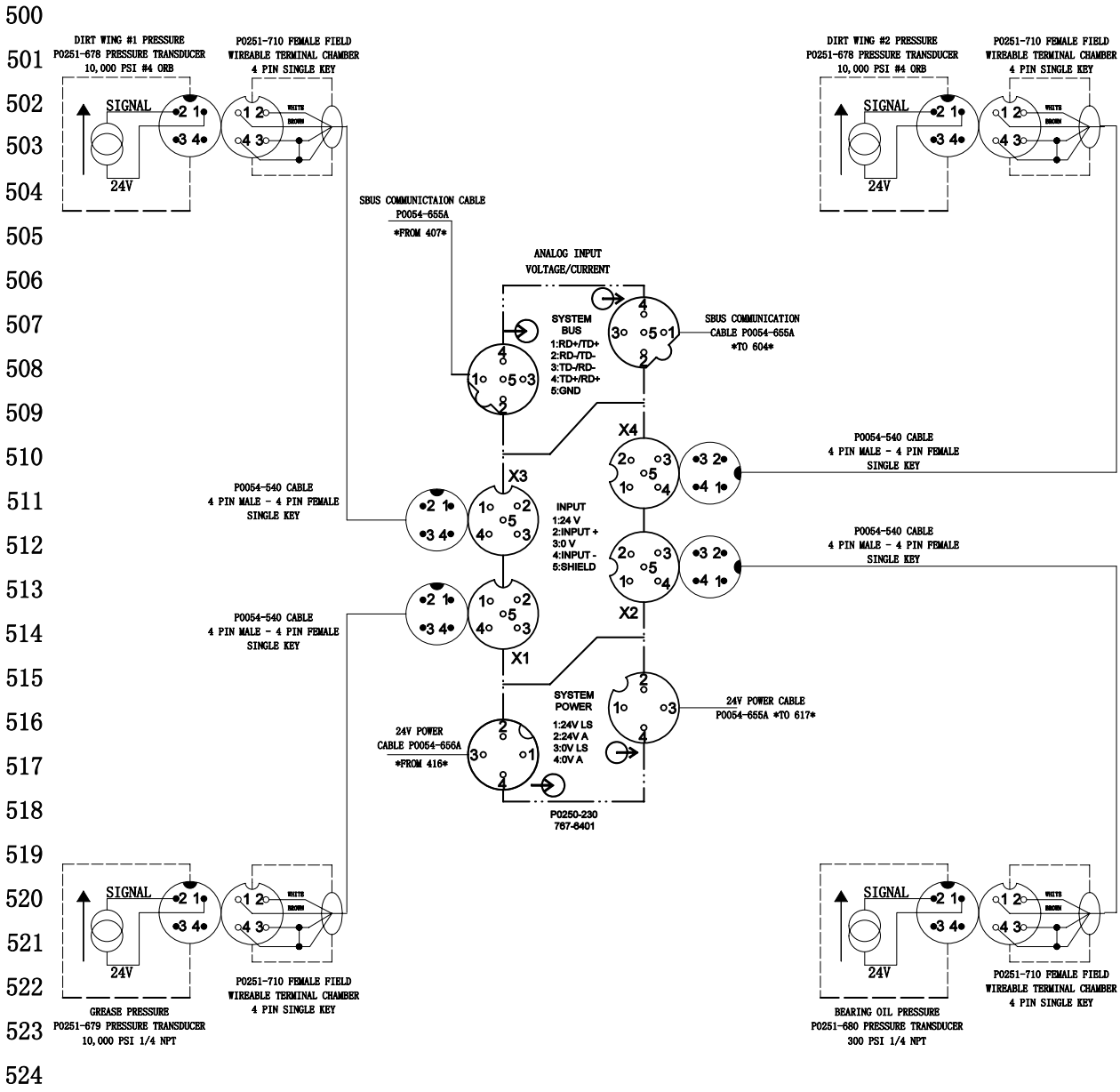


*LINEAR TRANSDUCER CABLES HAVE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END. CABLES WIRES ARE CONNECTED TO THE CORRESPONDING TERMINAL CHAMBER PIN, I.E., 1-1, 2-2, 3-3, & 4-4. TERMINAL CHAMBER PINS 3 AND 4 SHOULD ALSO BE JUMPERED TOGETHER.

SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 5 of 12

*PRESSURE TRANSDUCER CABLES HAVE FEMALE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END THAT REPLACES CABLE FEMALE END. WIRES 1 AND 2 OF THE CABLE ARE CONNECTED TO PINS 1 AND 2 OF THE TERMINAL CHAMBER. WIRES 3 AND 4 ARE JUMPERED BETWEEN PINS 3 AND 4 ON THE TERMINAL CHAMBER.

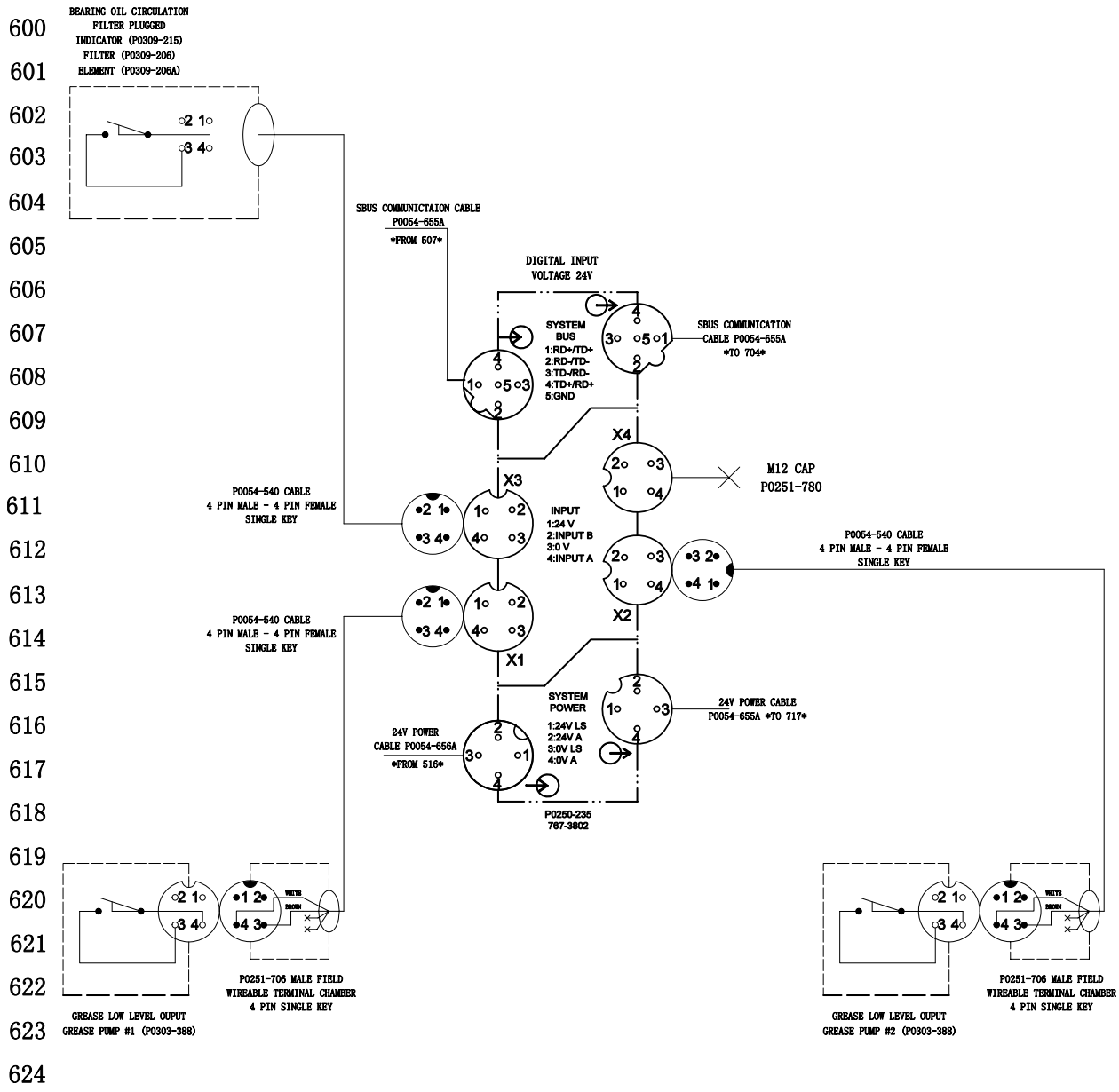
IOM #5
(FRONT SECTION)



SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 6 of 12

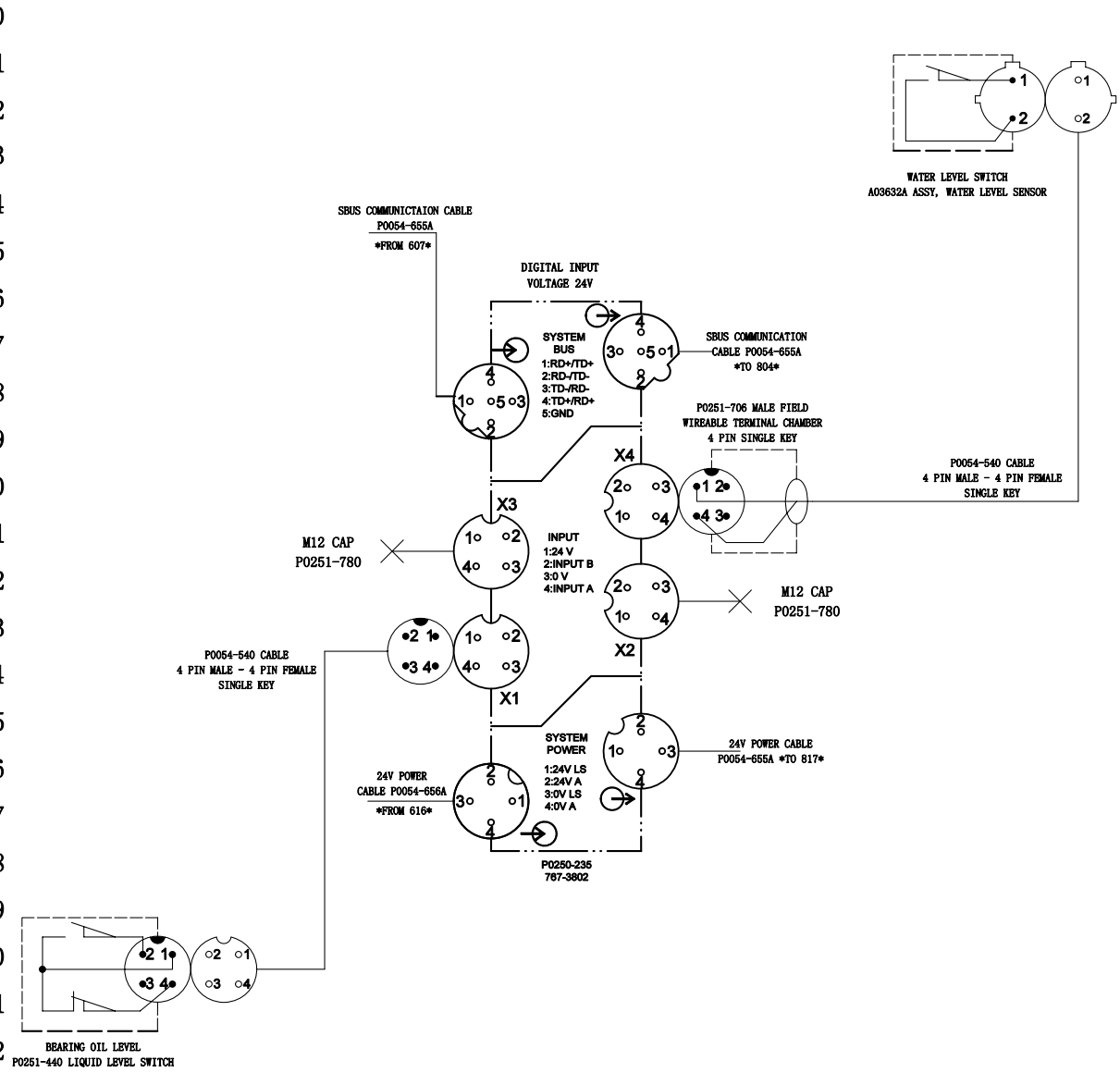
*GREASE PUMP LOW LEVEL SWITCH CABLES HAVE MALE FEILD WIREABLE TERMINAL CHAMBER AT THE PUMP END THAT REPLACES CABLE FEMALE END. WIRES 1 AND 2 OF THE CABLE ARE CONNECTED TO PINS 3 AND 4 OF THE TERMINAL CHAMBER AND CABLE WIRES 3 AND 4 ARE NOT USED

IOM #6
(FRONT SECTION)



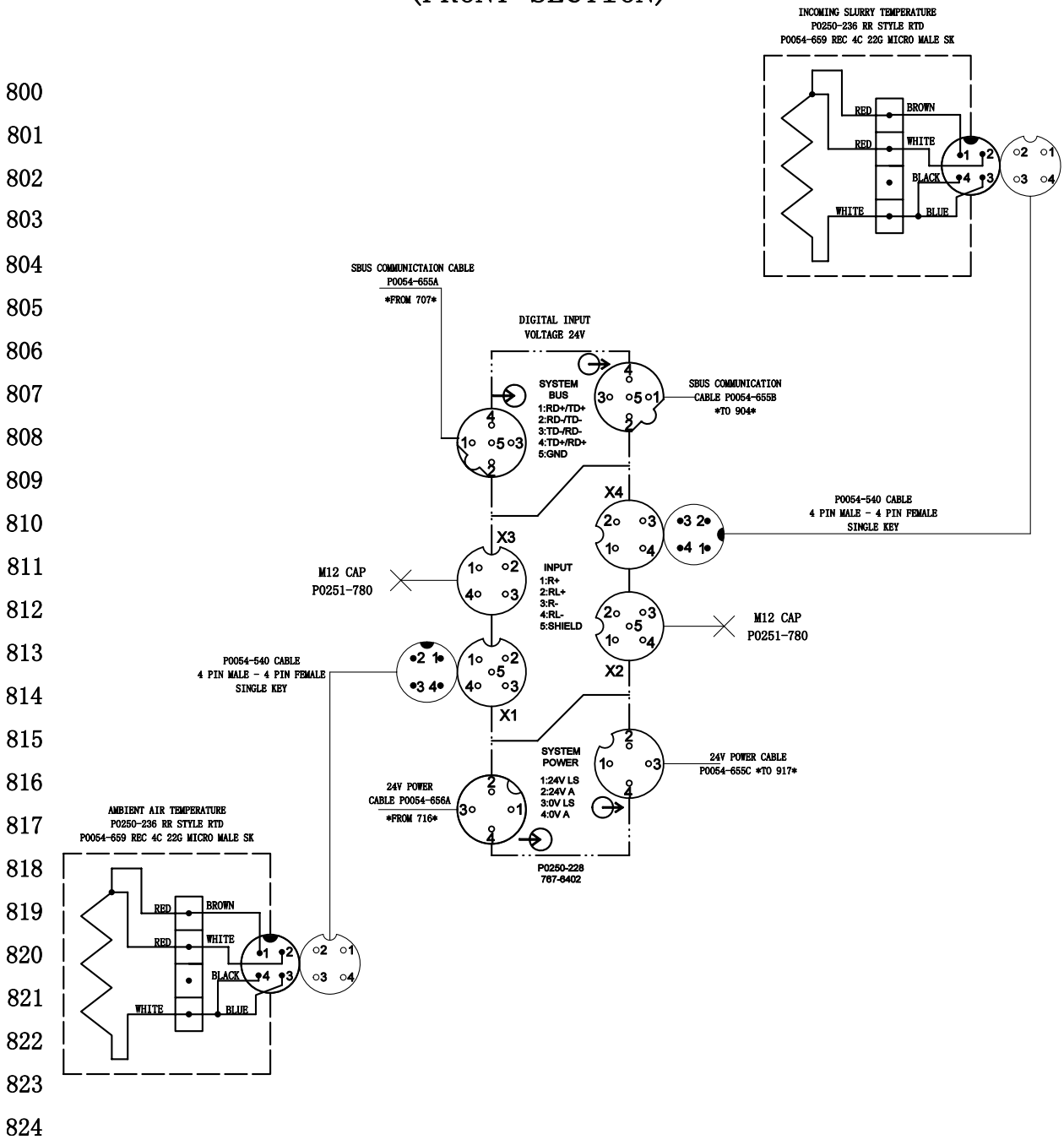
SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 7 of 12

IOM #7
(FRONT SECTION)



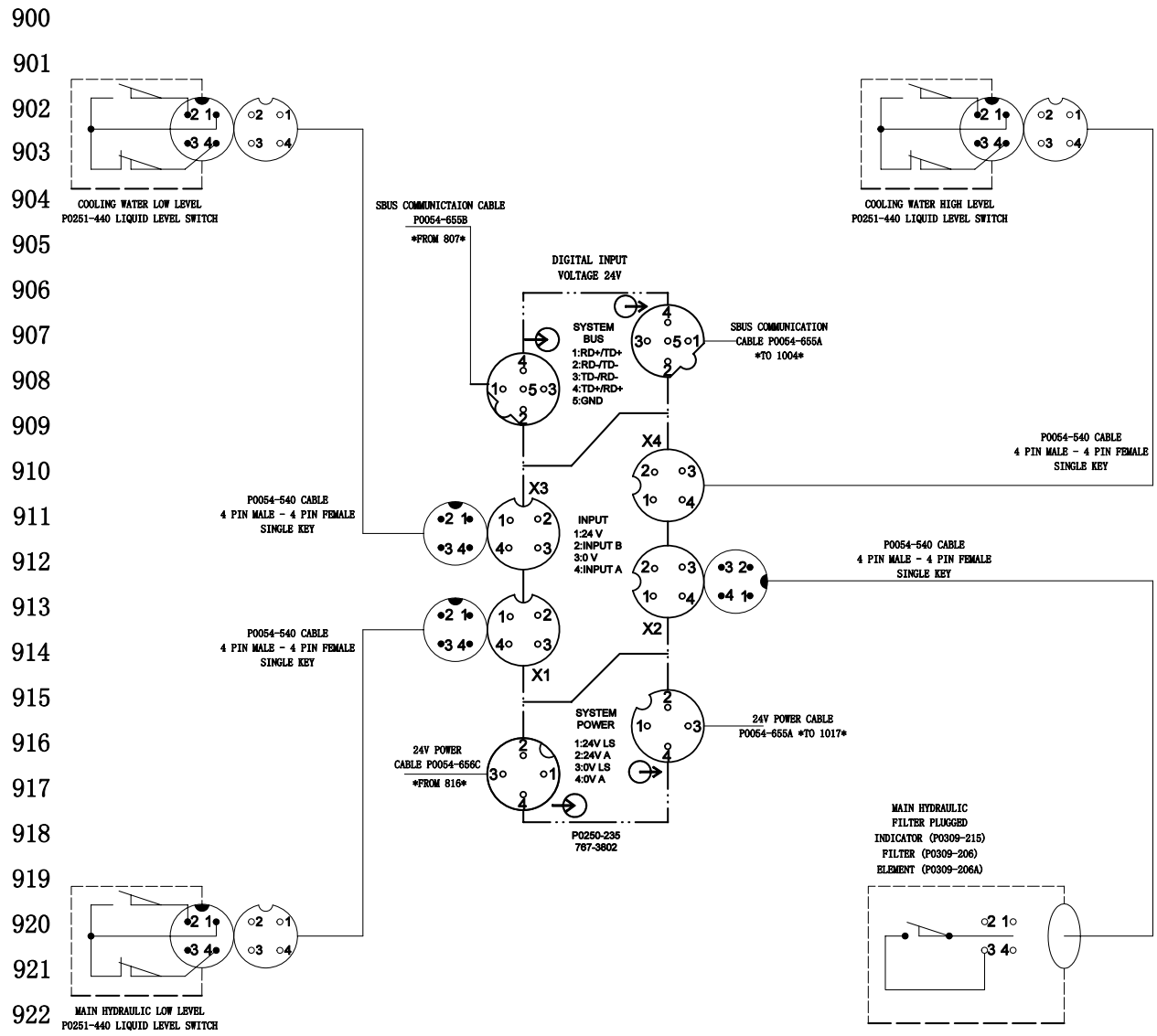
SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 8 of 12

IOM #8
(FRONT SECTION)



SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 9 of 12

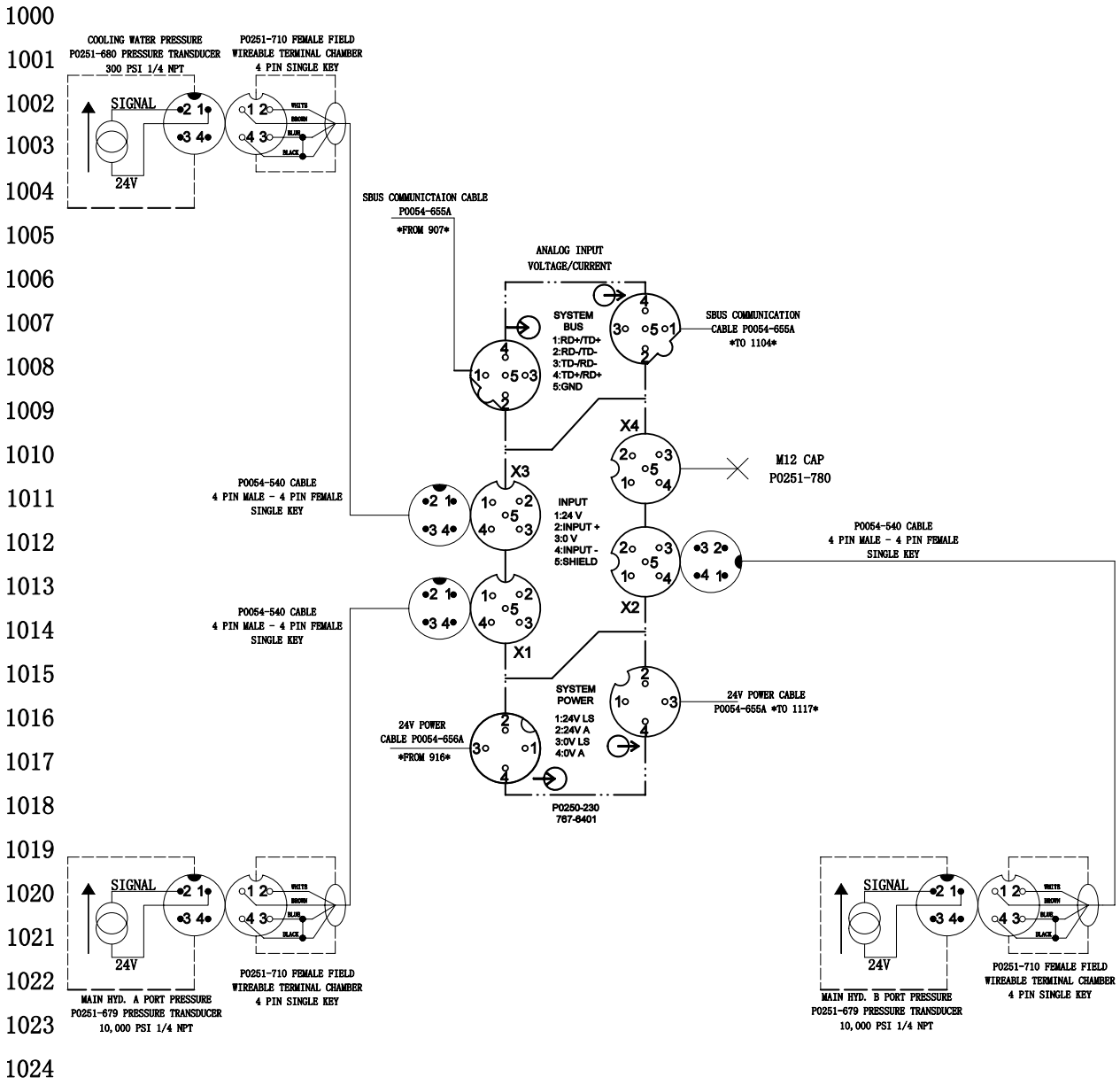
IOM #9
(BACK SECTION)



SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 10 of 12

*PRESSURE TRANSDUCER CABLES HAVE FEMALE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END THAT REPLACES CABLE FEMALE END. WIRES 1 AND 2 OF THE CABLE ARE CONNECTED TO PINS 1 AND 2 OF THE TERMINAL CHAMBER. WIRES 3 AND 4 ARE JUMPERED BETWEEN PINS 3 AND 4 ON THE TERMINAL CHAMBER.

IOM #10
(BACK SECTION)

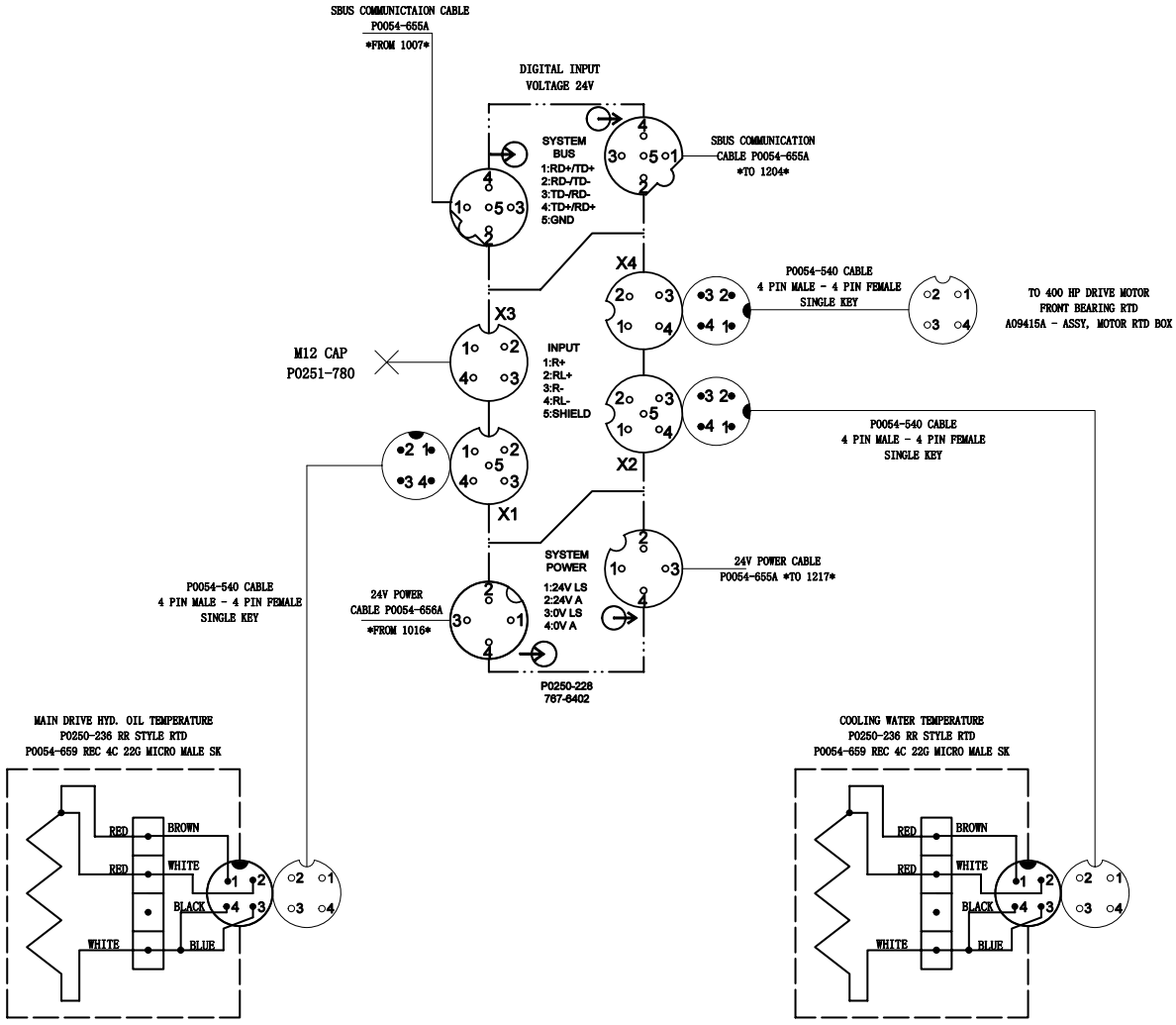


SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 11 of 12

*SEE DRAWING A09415A - ASSY, MOTOR RTD BOX-SL86 MTBM FOR TERMINAL LAYOUT OF THE 400 HP MOTOR RTD CONNECTIONS.

IOM #11
(BACK SECTION)

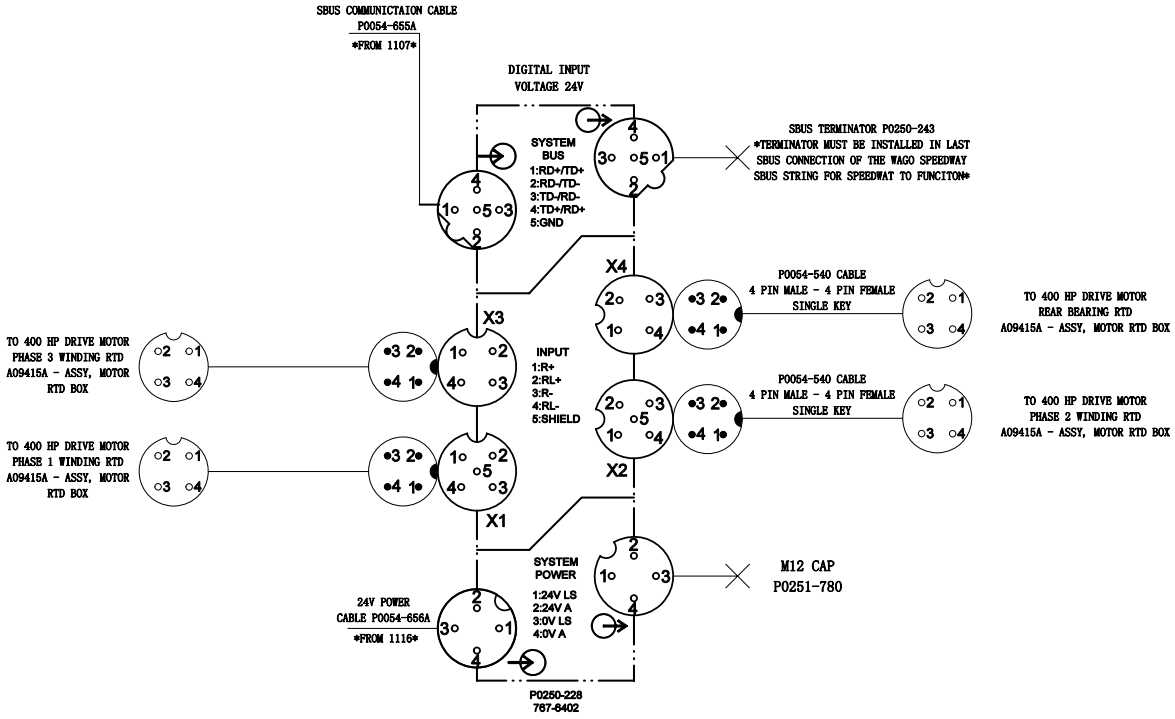
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1124



SL86P MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 12 of 12

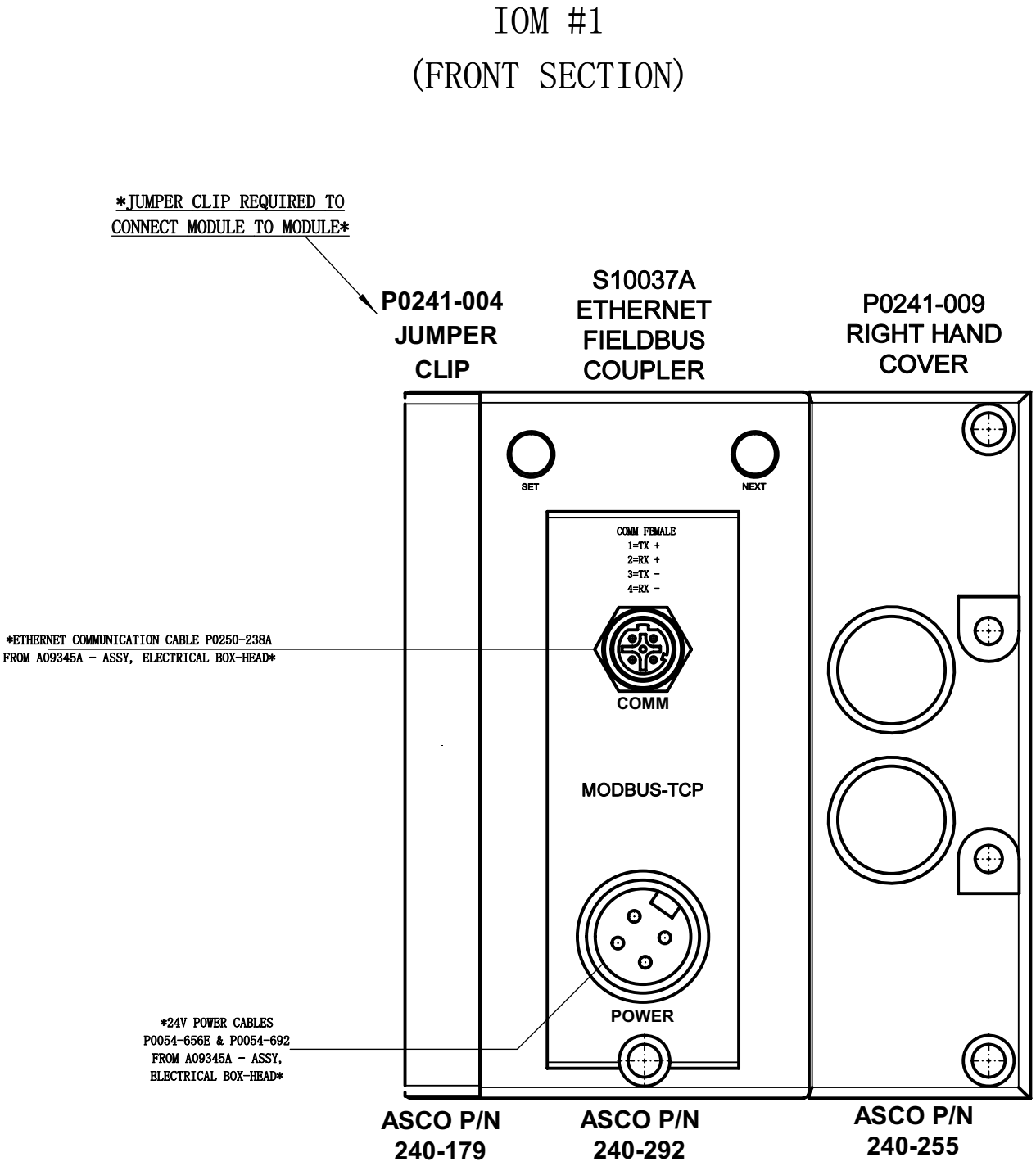
*SEE DRAWING A09415A - ASSY, MOTOR RTD BOX-SL86 MTBM FOR TERMINAL LAYOUT OF THE 400 HP MOTOR RTD CONNECTIONS.

IOM #12
(BACK SECTION)



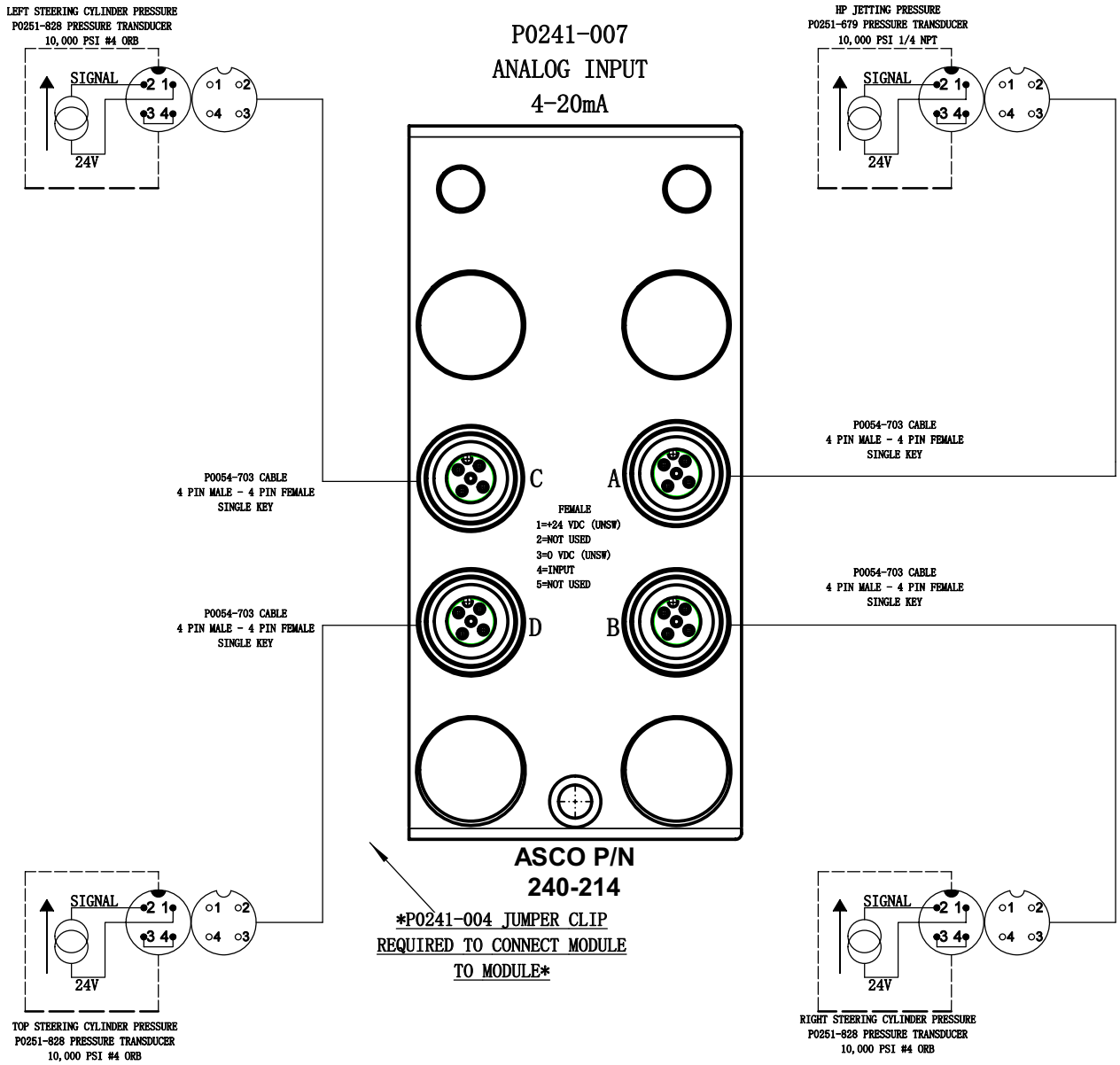
SL86P (SN: FA09100F-02 & AFTER) MTBM ASCO I/O MODULE SCHEMATICS

Module Schematic - Part 1 of 12



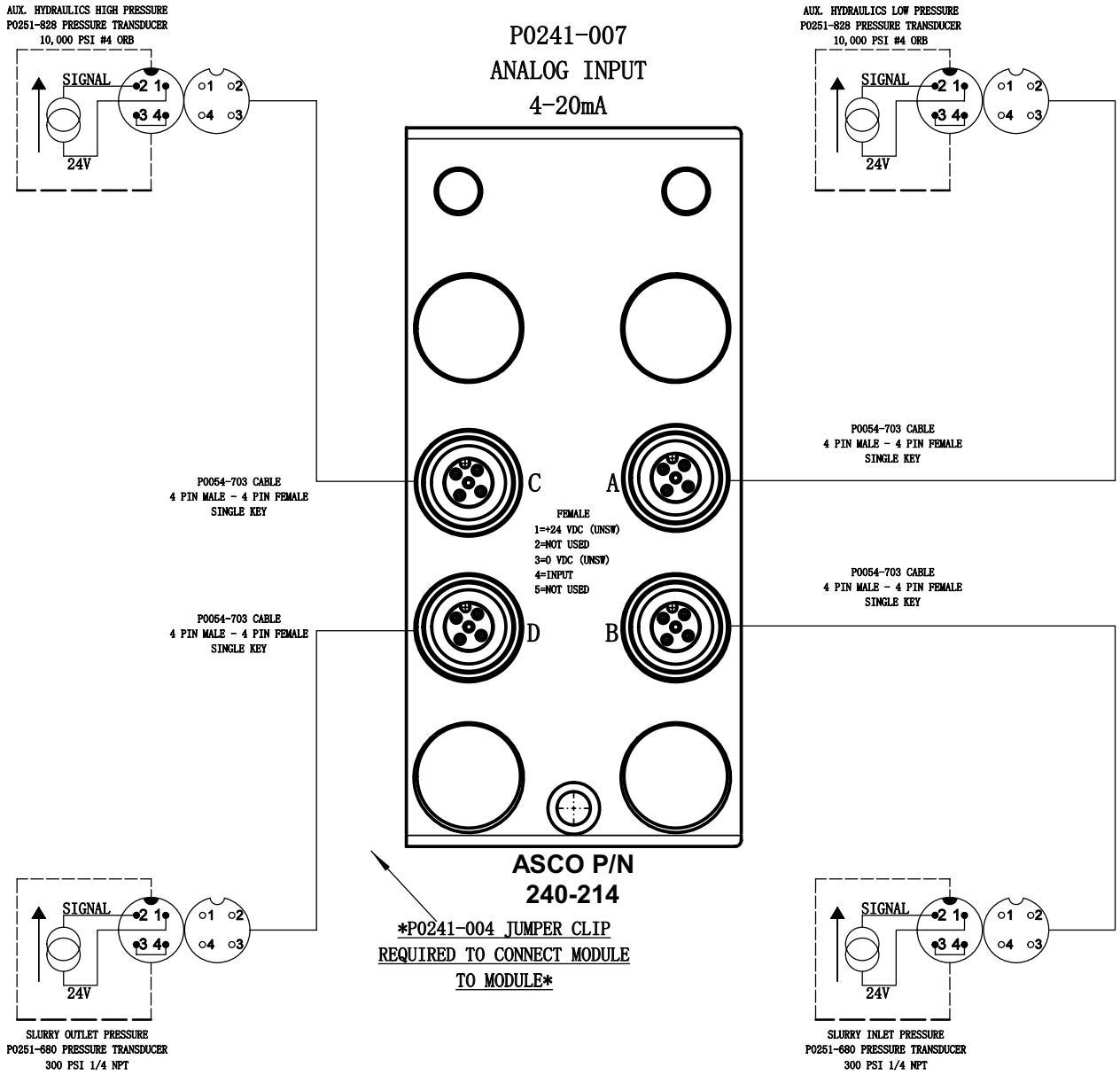
SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 2 of 12

IOM #2
(FRONT SECTION)



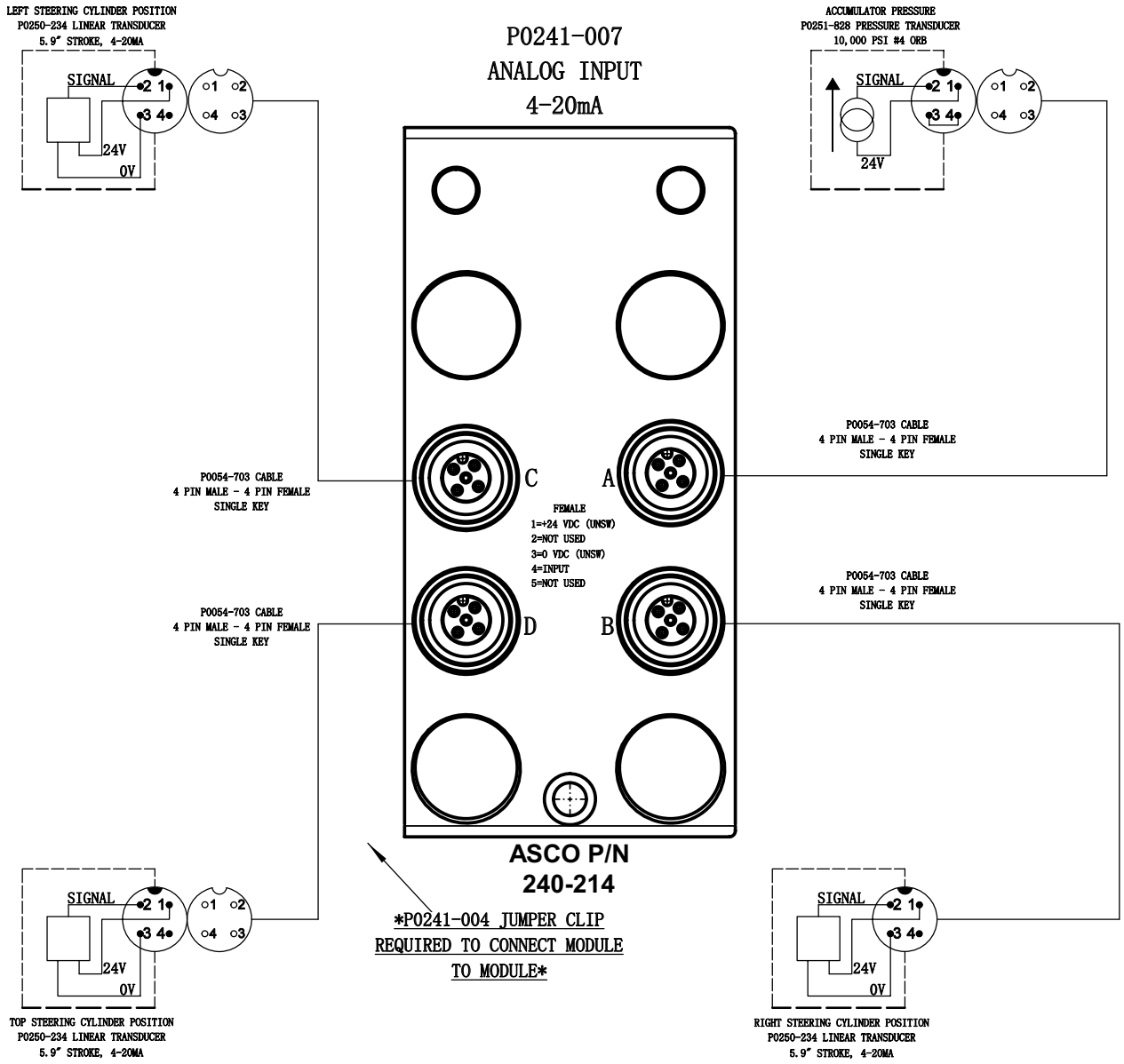
SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 3 of 12

IOM #3
(FRONT SECTION)



SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 4 of 12

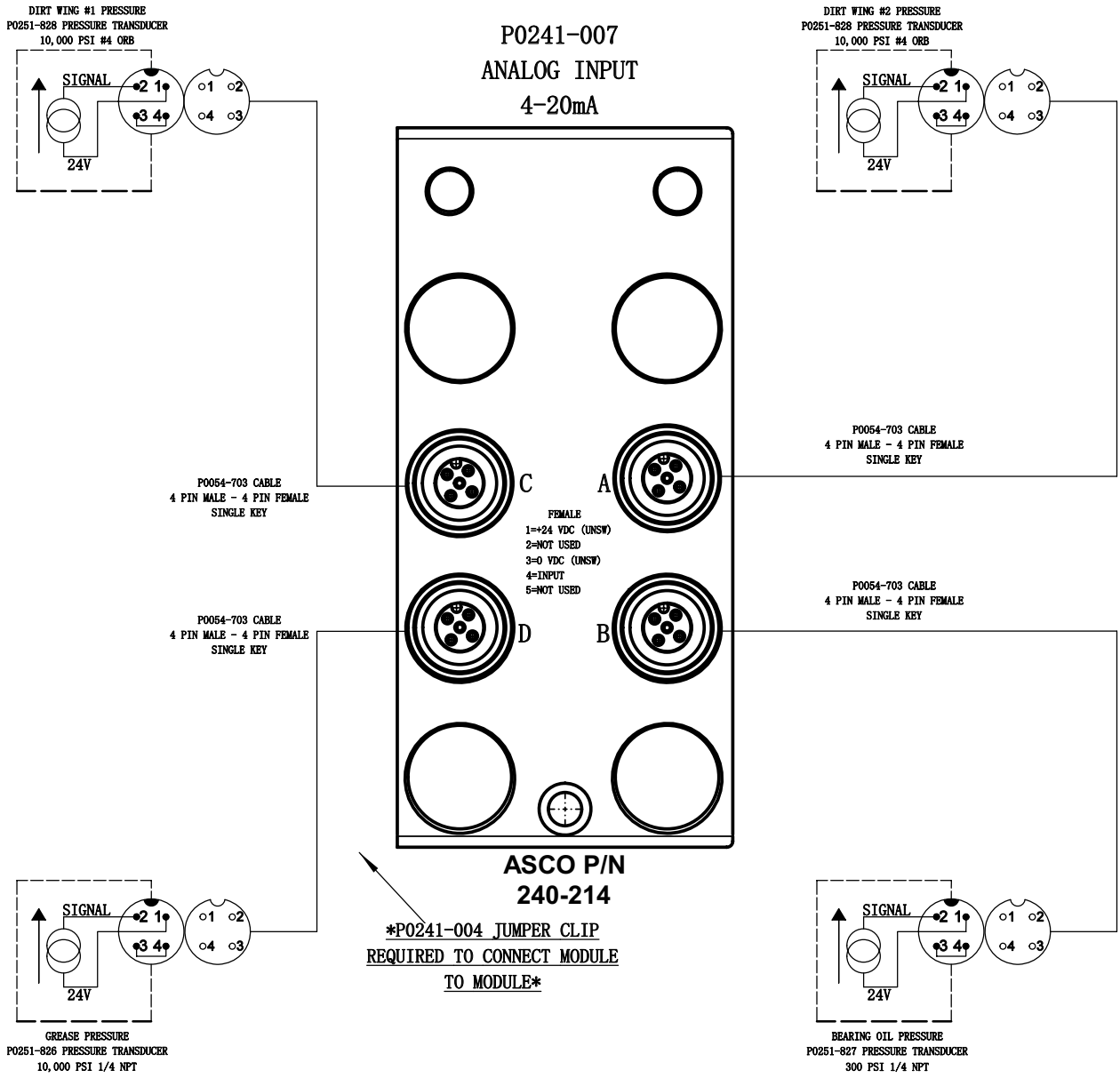
IOM #4
(FRONT SECTION)



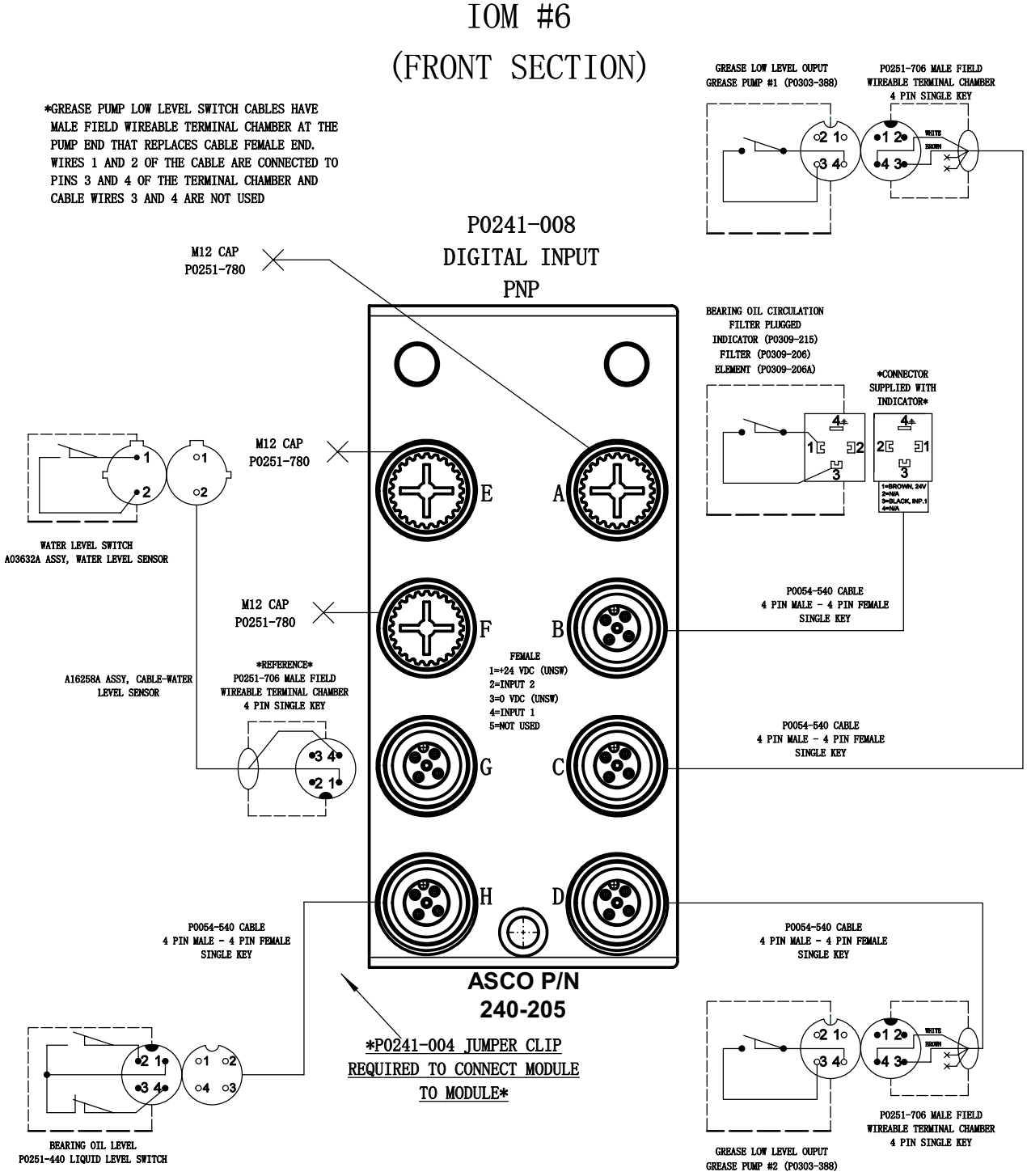
*LINEAR TRANSDUCER CABLES HAVE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END. CABLES WIRES ARE CONNECTED TO THE CORRESPONDING TERMINAL CHAMBER PIN, I.E., 1-1, 2-2, 3-3, & 4-4. TERMINAL CHAMBER PINS 3 AND 4 SHOULD ALSO BE JUMPERED TOGETHER.

SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 5 of 12

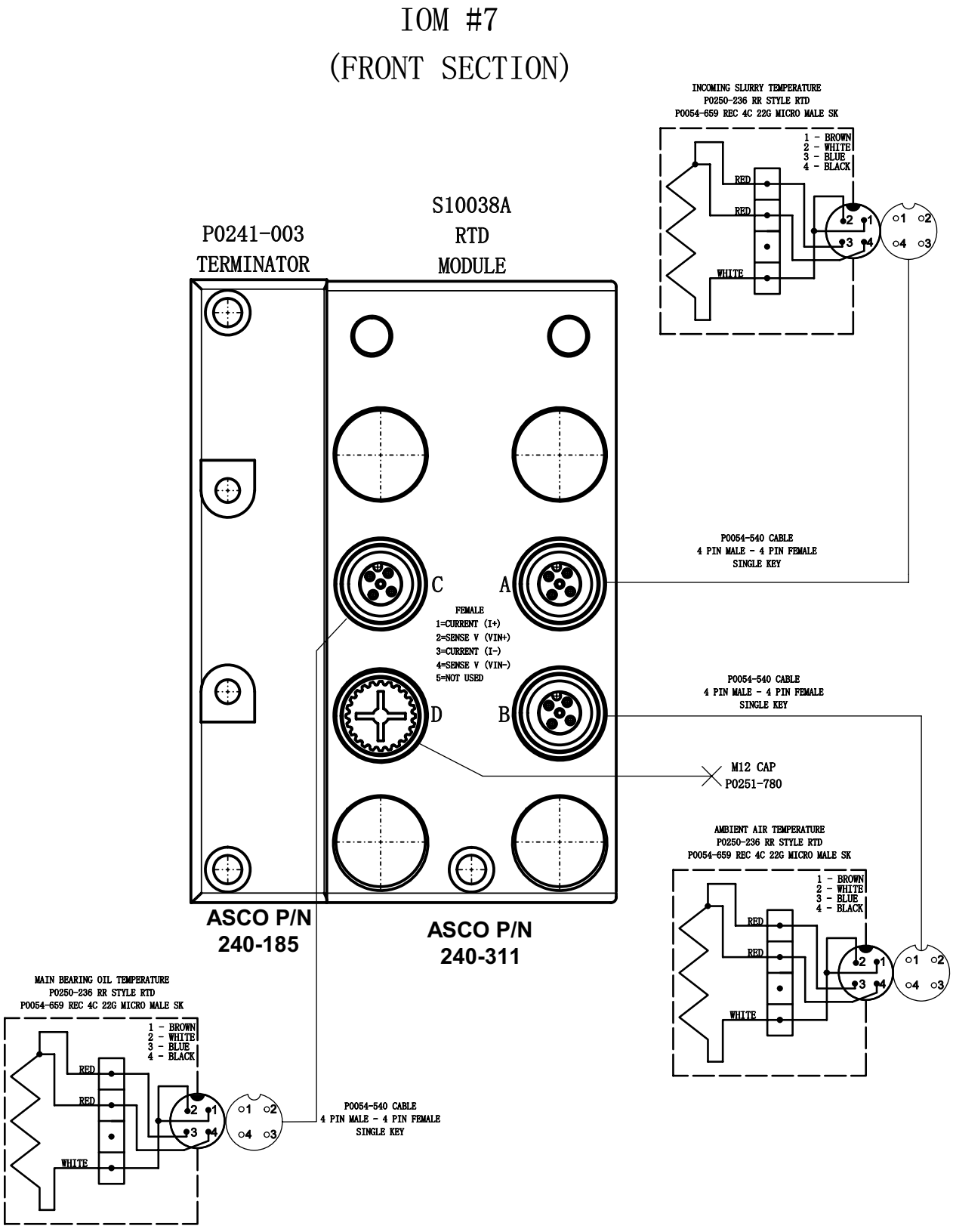
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(FRONT SECTION)



SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 6 of 12

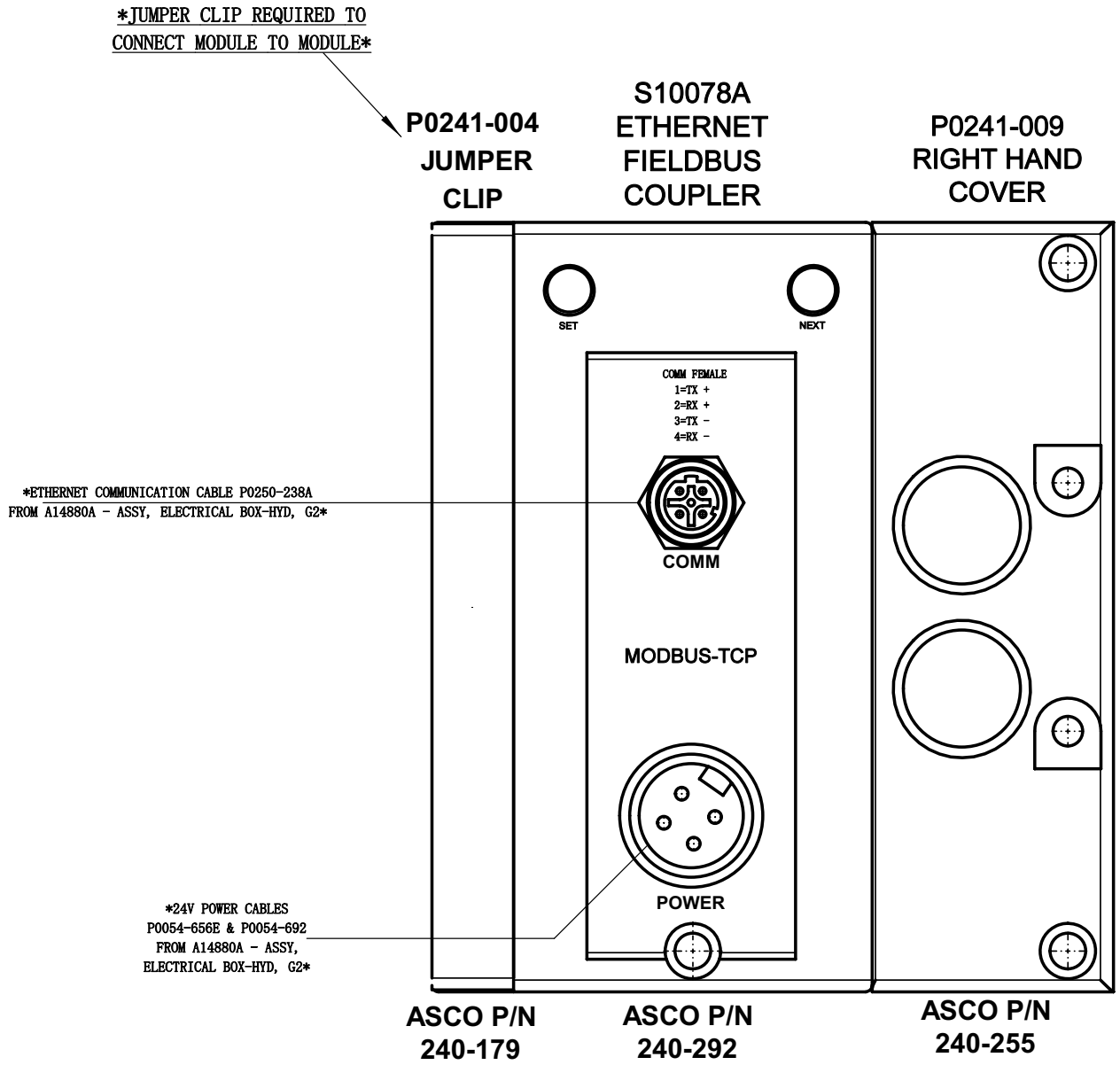


SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 7 of 12

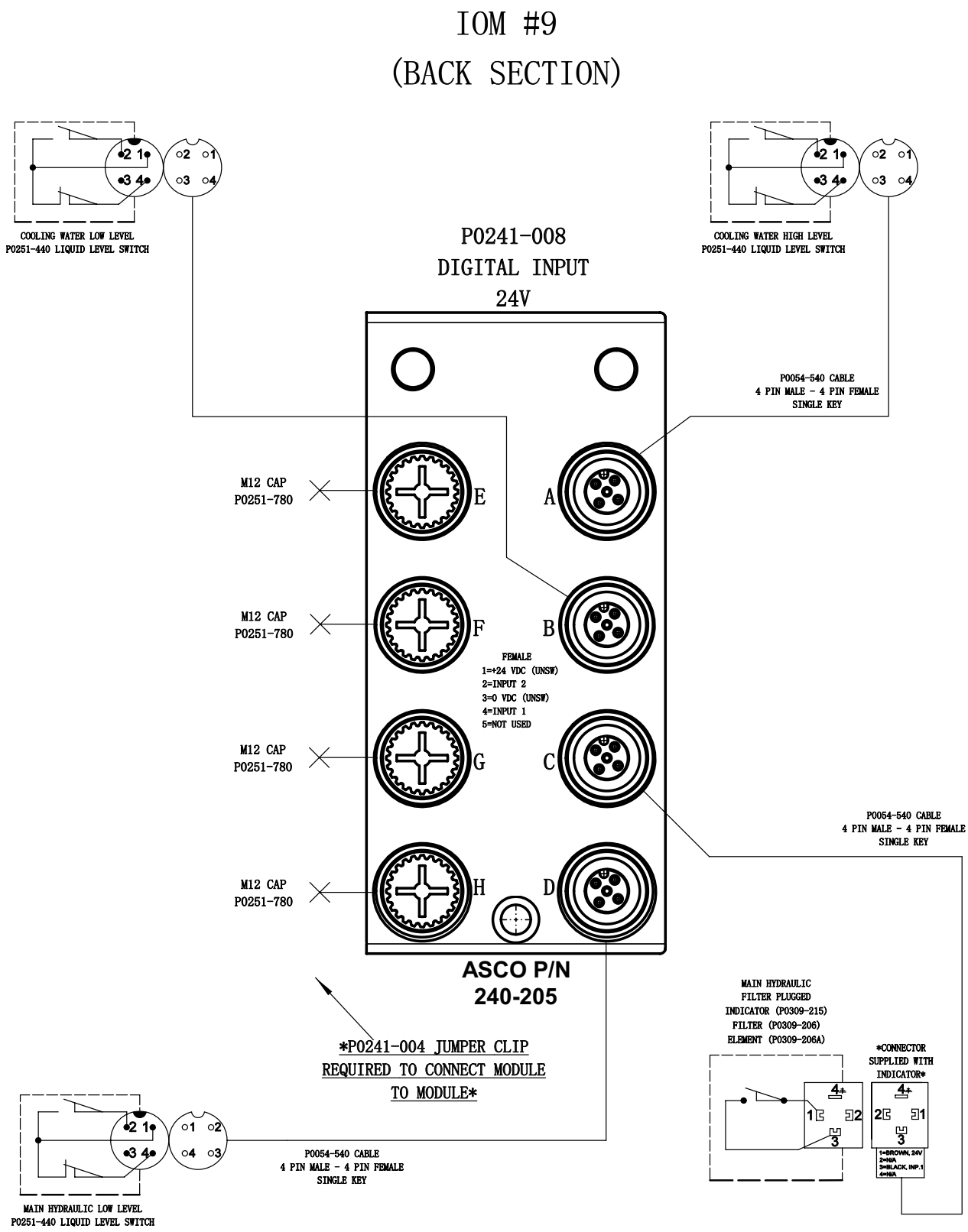


SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 8 of 12

IOM #8
(BACK SECTION)

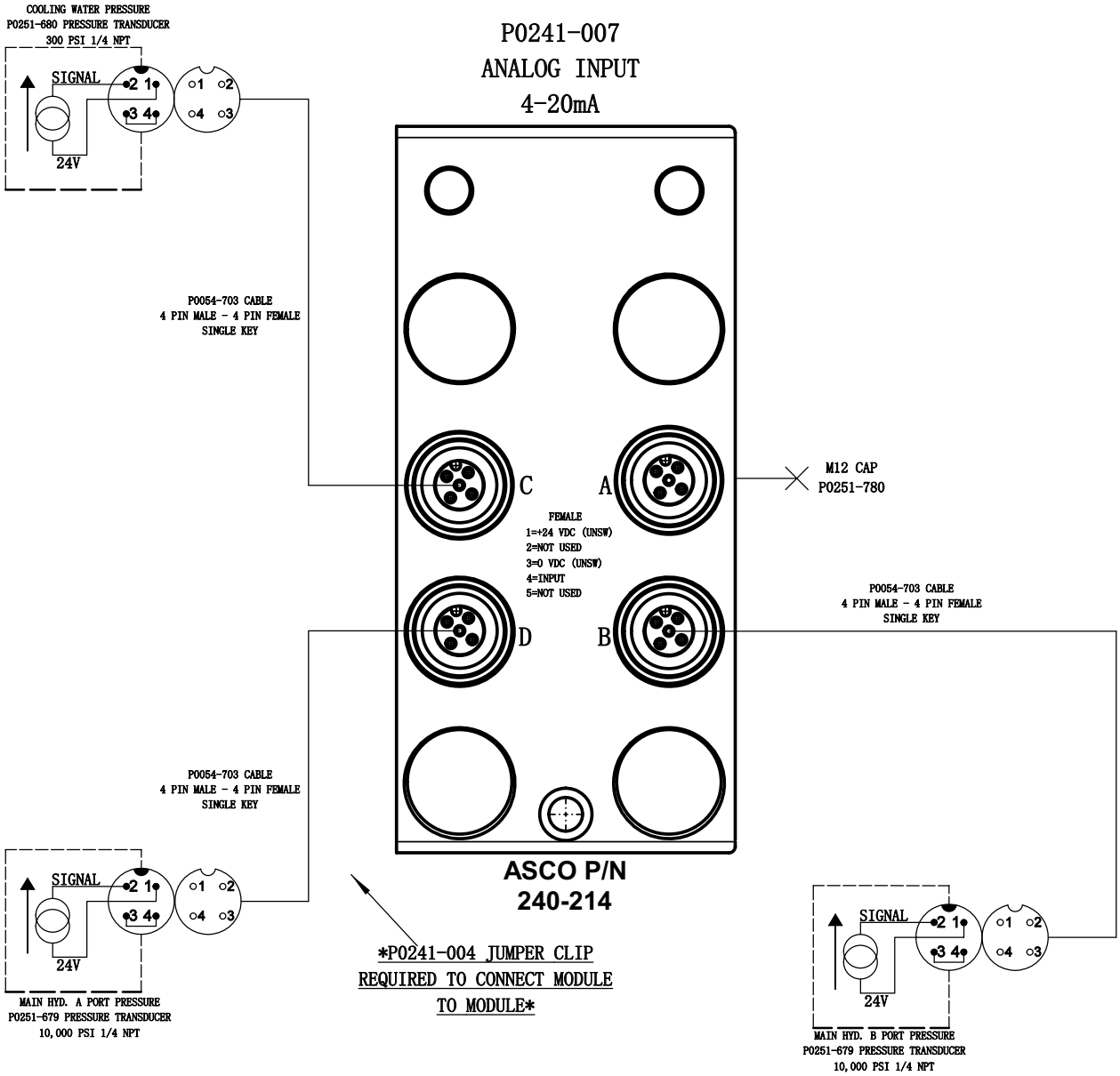


SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 9 of 12



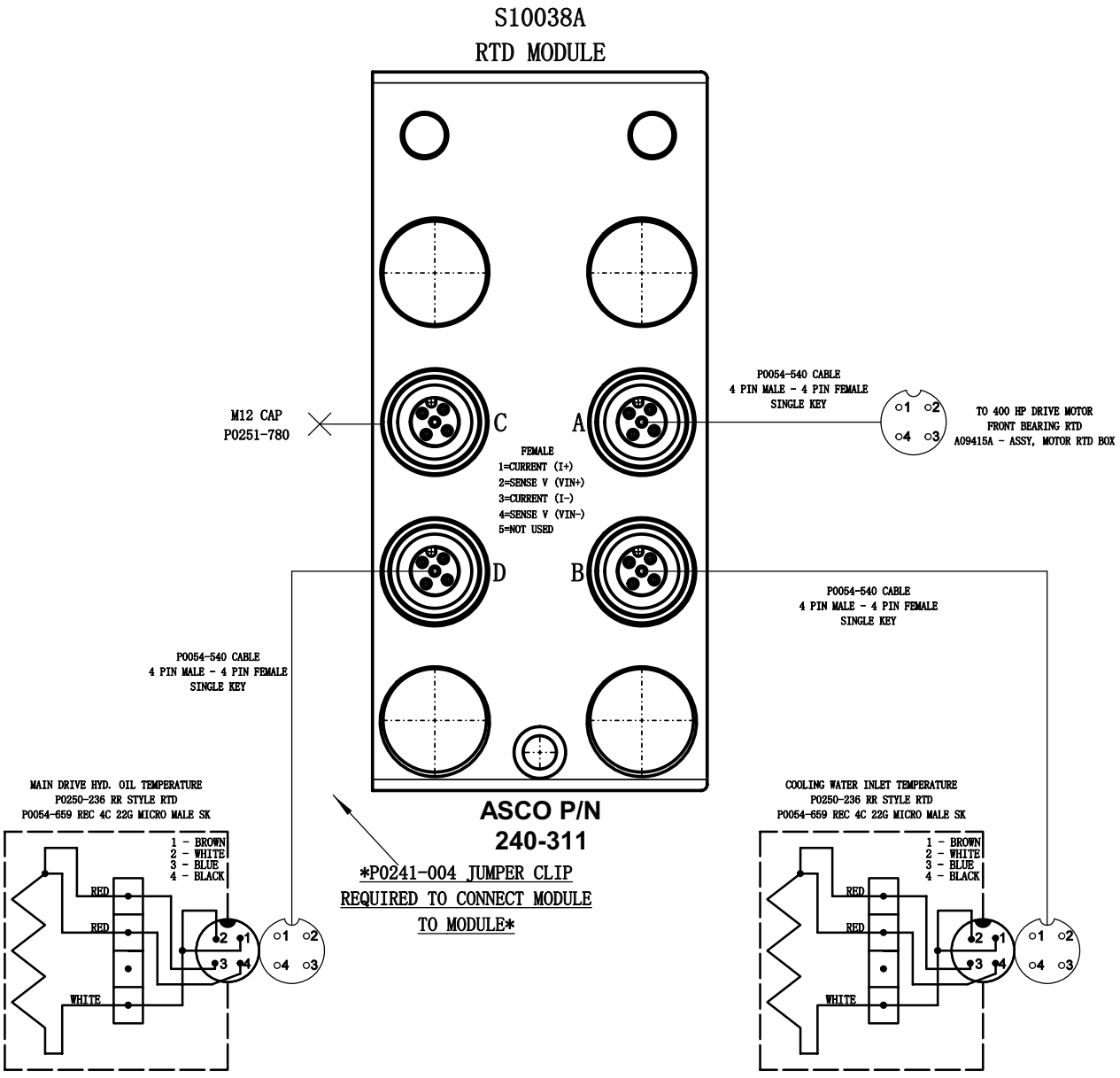
SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 10 of 12

IOM #10
(BACK SECTION)

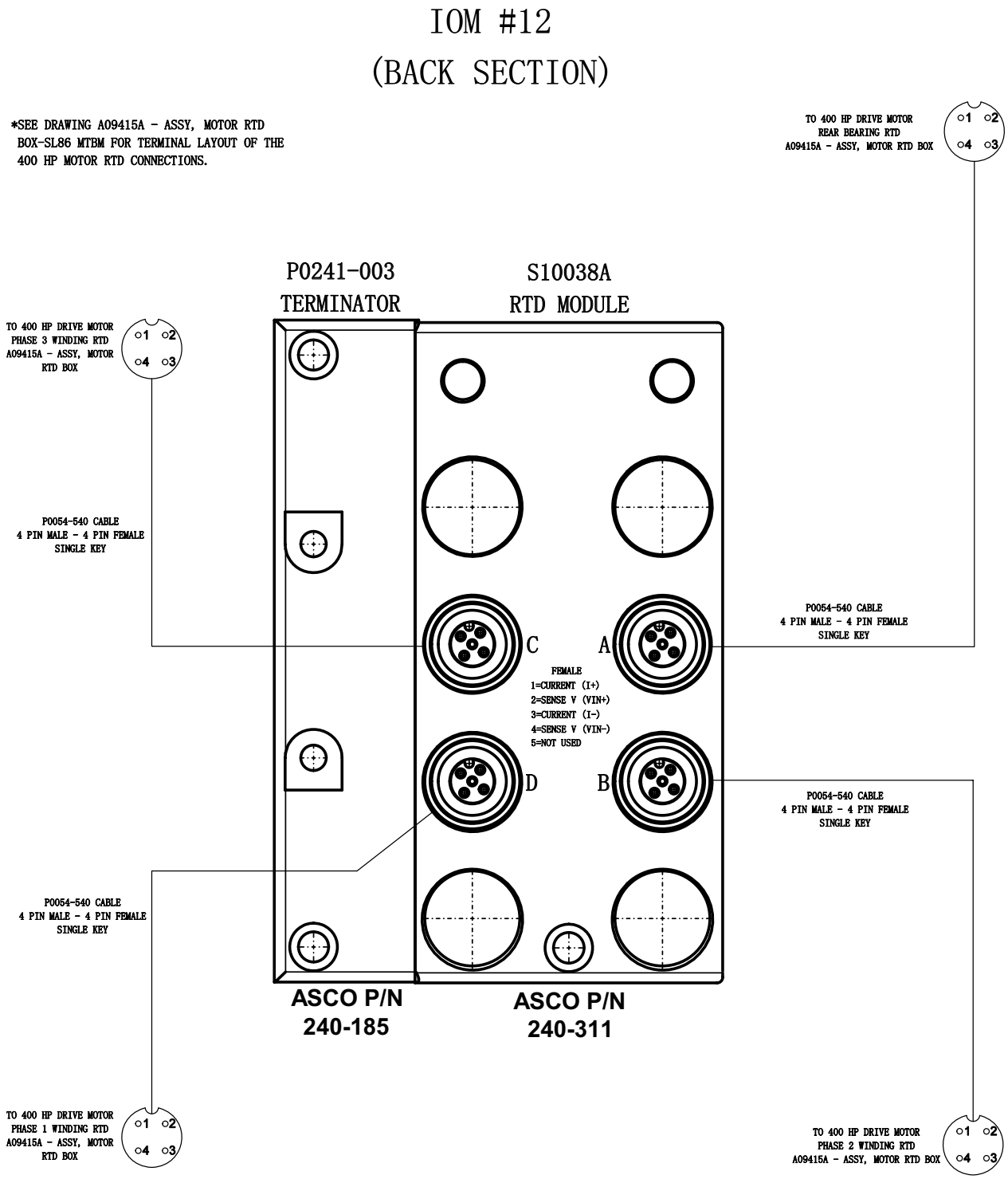


SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 11 of 12

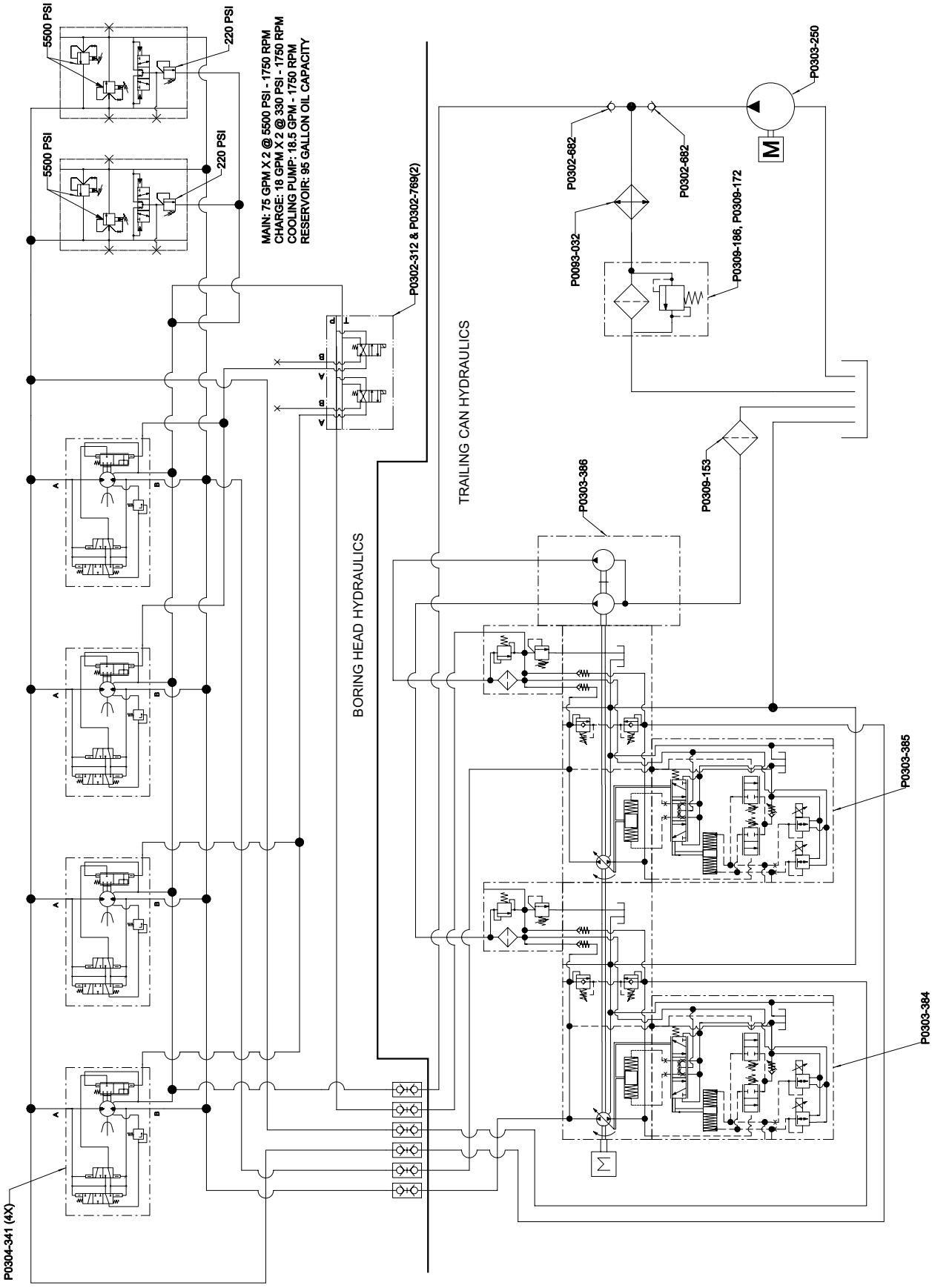
IOM #11
(BACK SECTION)



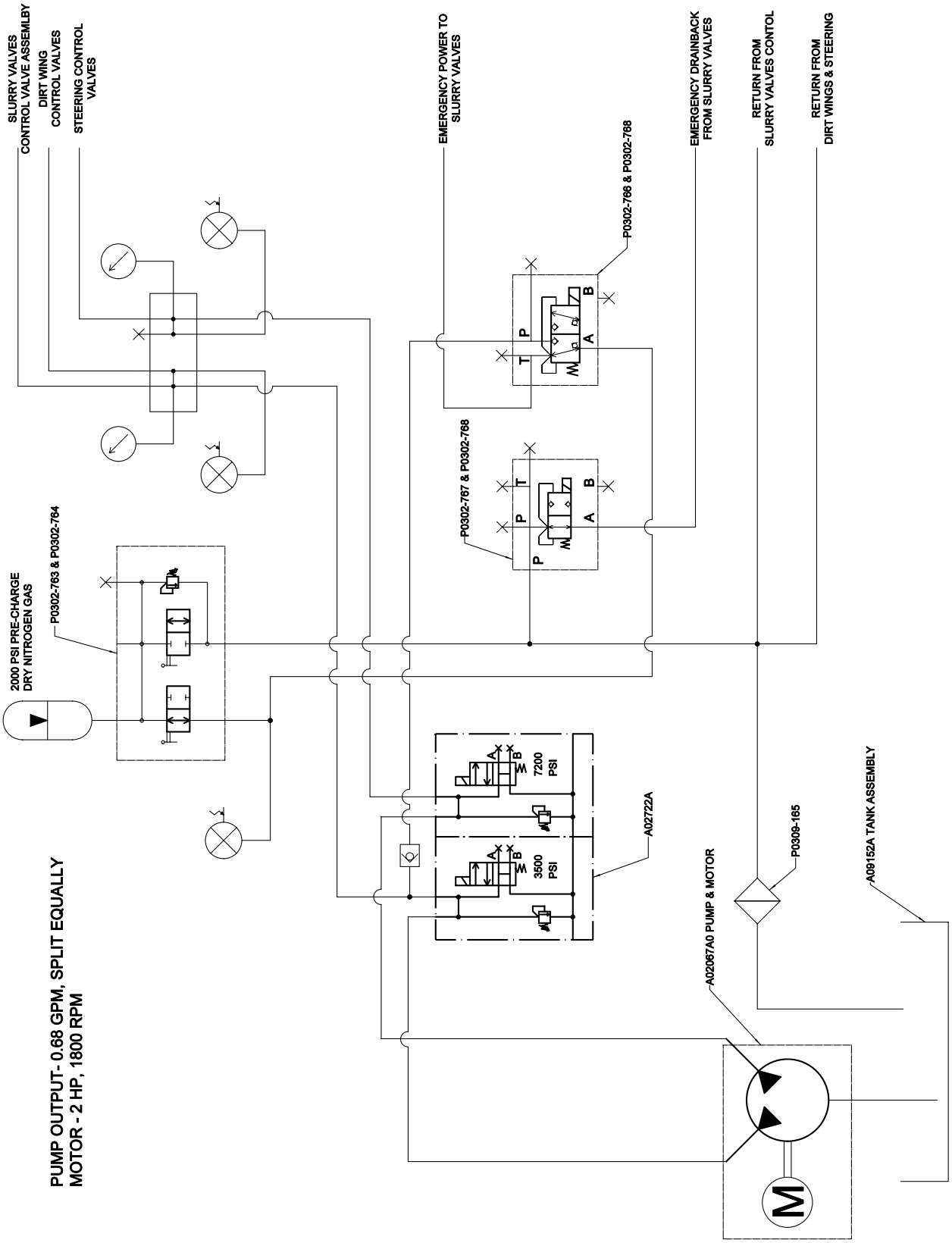
SL86P (SN FA09100F-02 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 12 of 12



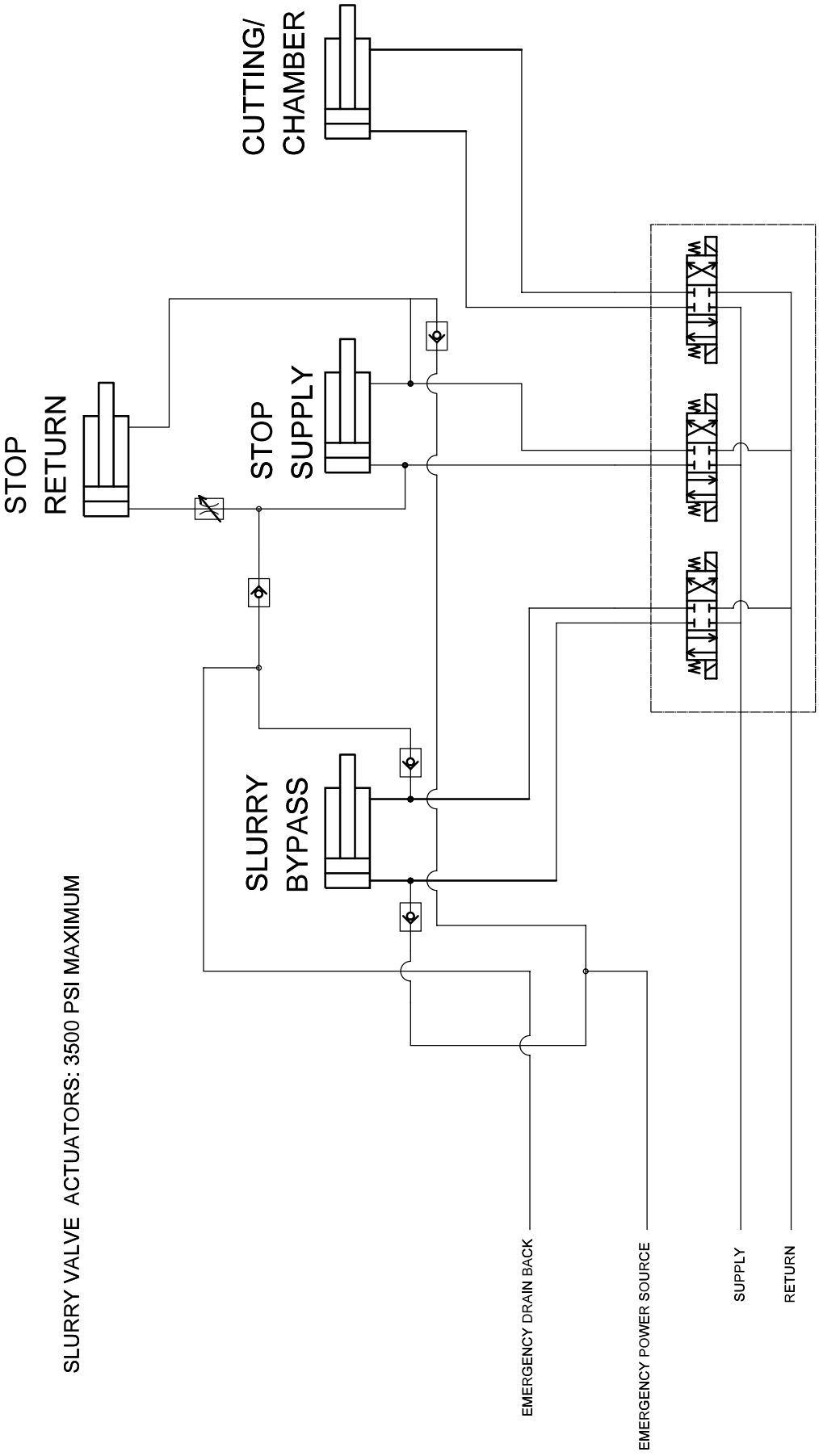
SL86P MTBM MAIN HYDRAULIC SCHEMATICS



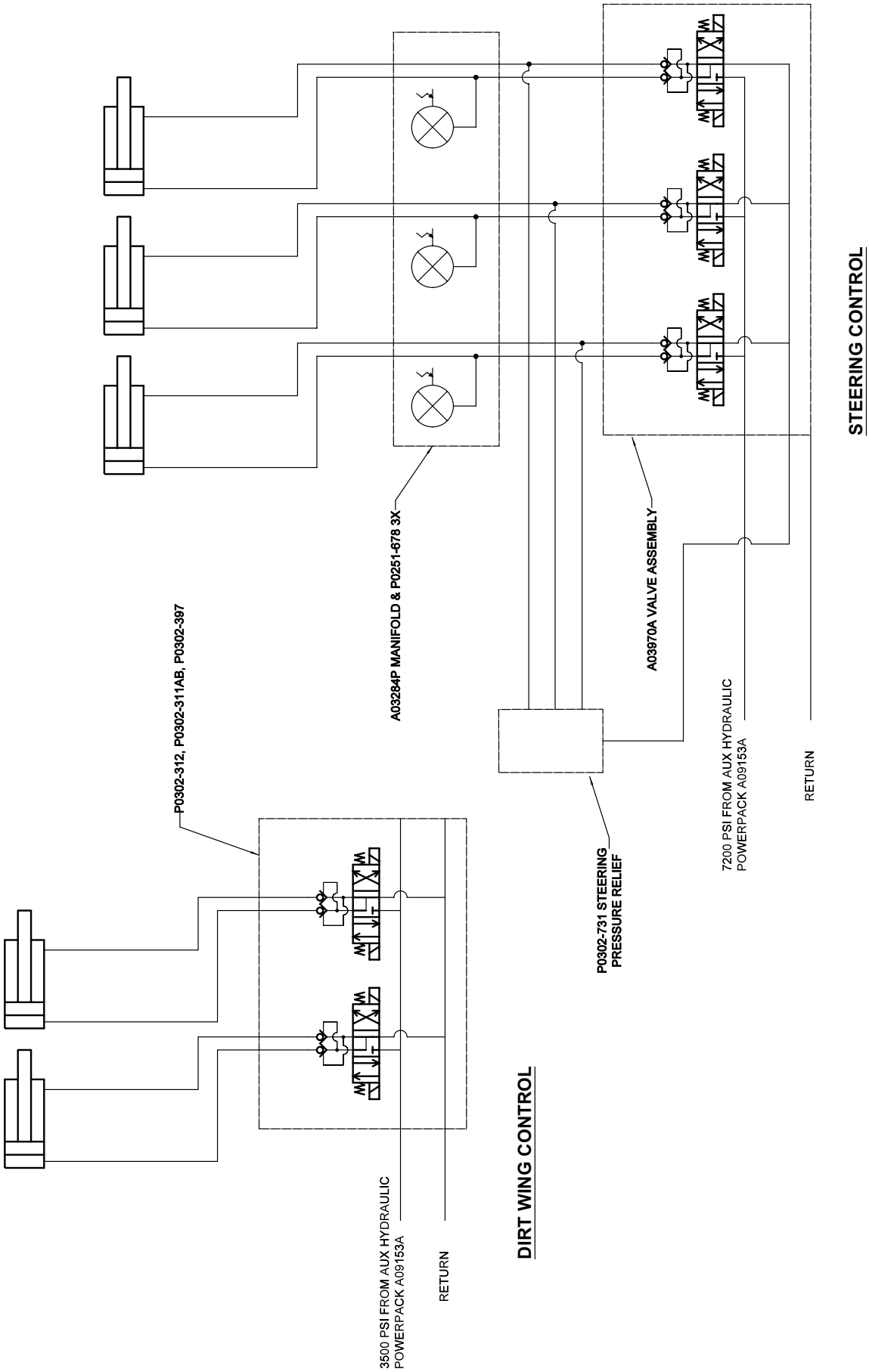
SL86P MTBM AUXILIARY HYDRAULIC SCHEMATIC



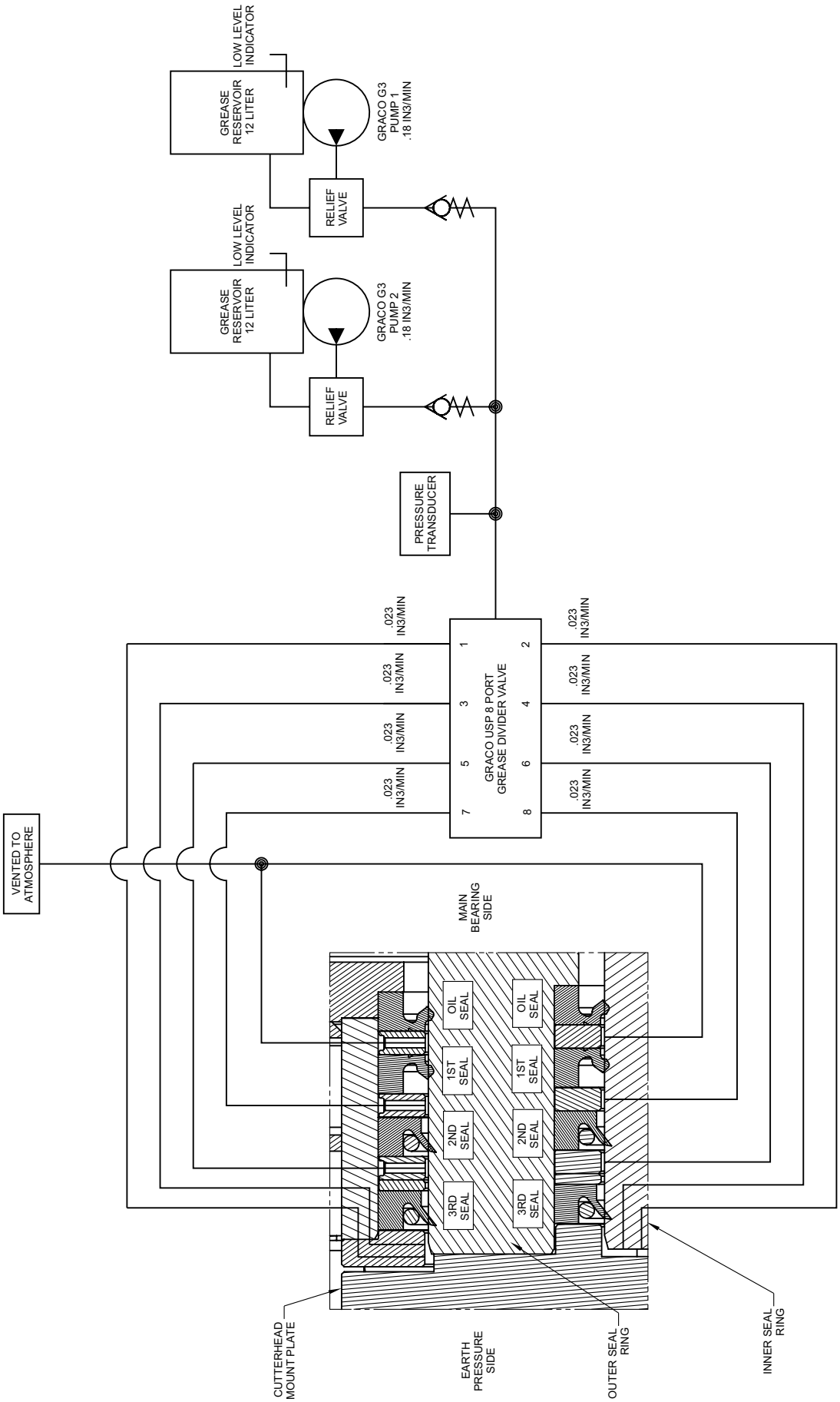
MTBM Auxiliary Hydraulic Schematic - Part 2 of 3



MTBM Auxiliary Hydraulic Schematic - Part 3 of 3

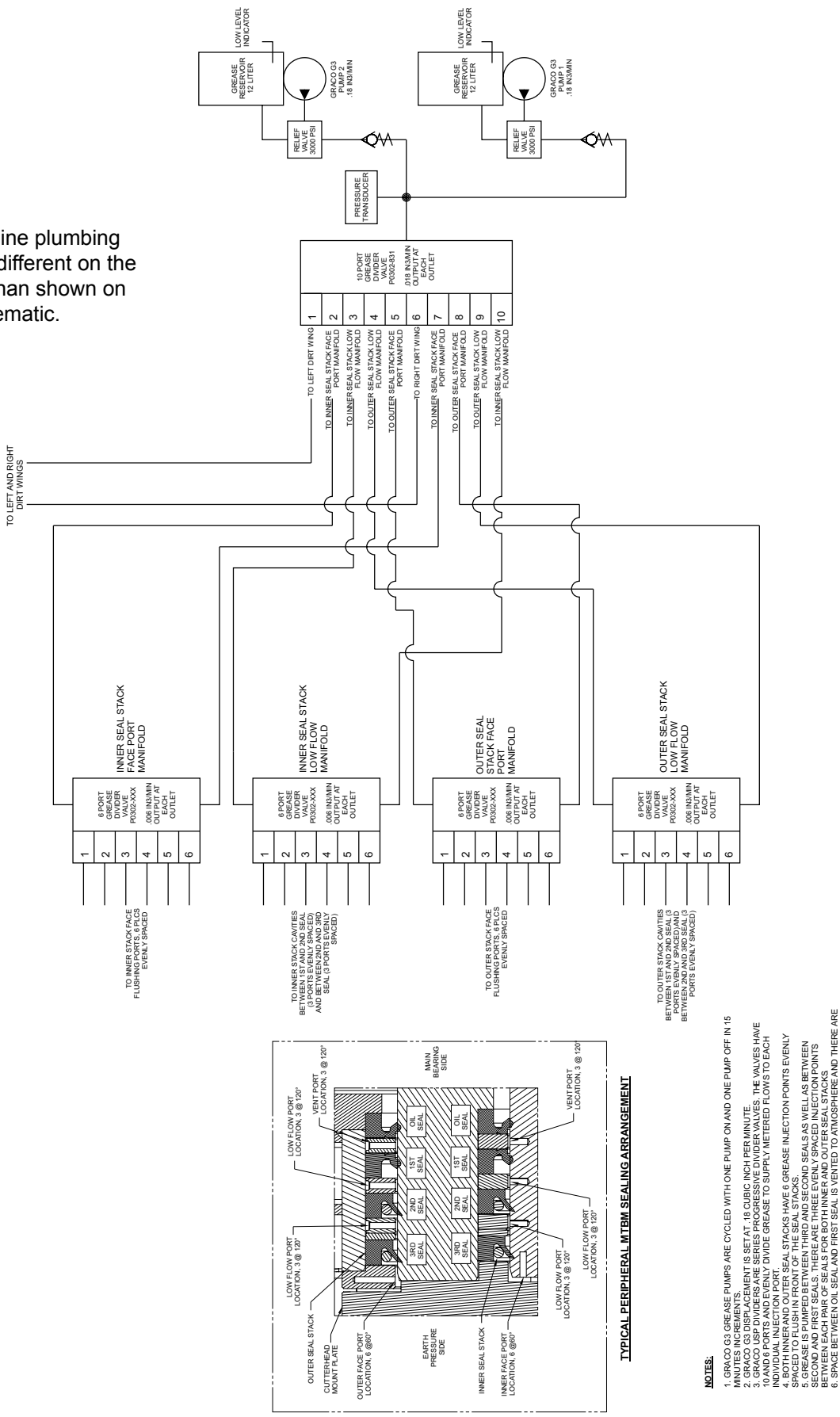


SL86P MAIN SEAL GREASE SCHEMATIC - SN: FA09100F-01



SL86P MAIN SEAL GREASE SCHEMATIC - SN: FA09100F-02 & AFTER

NOTE:
Grease line plumbing may be different on the MTBM than shown on this schematic.

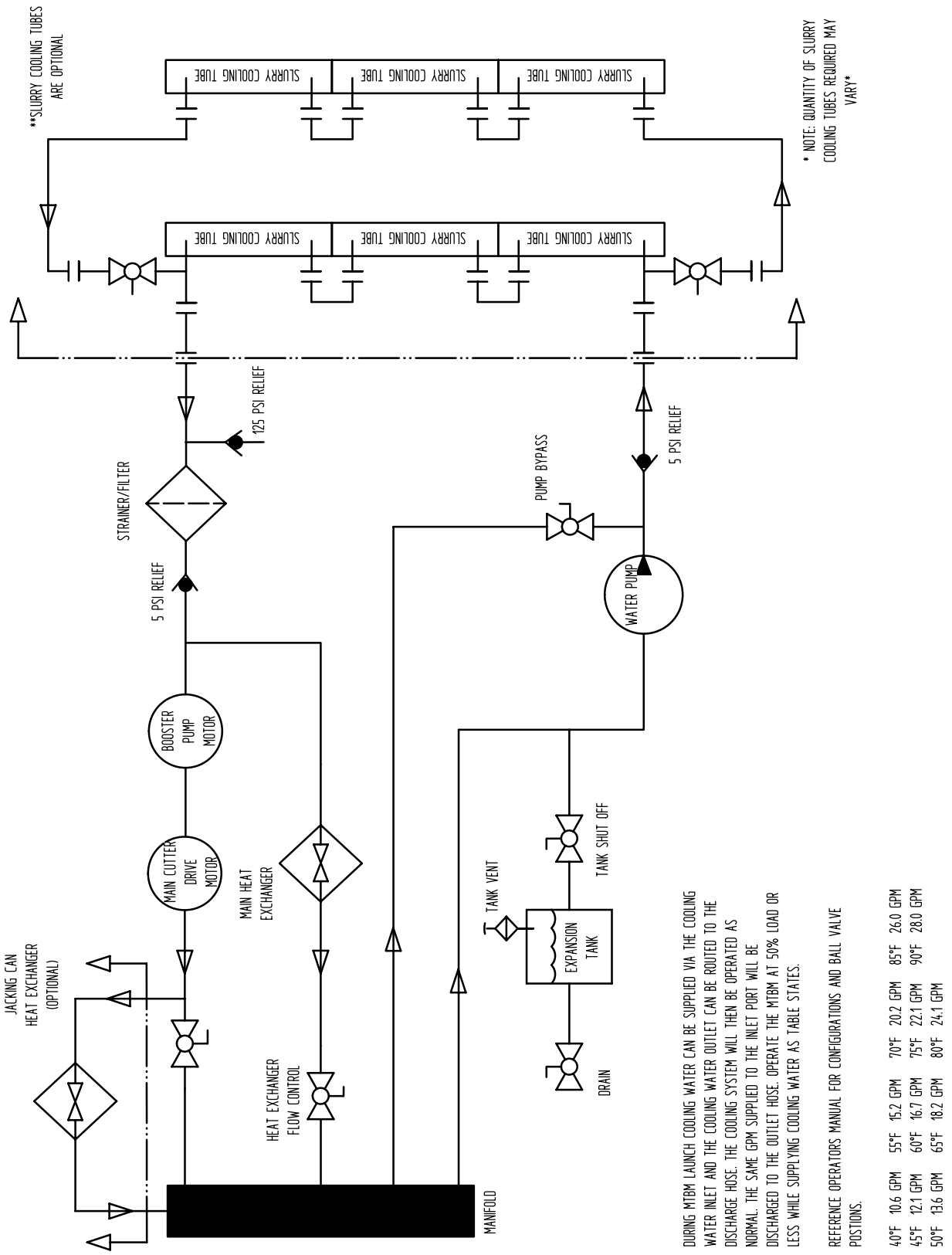


TYPICAL PERIPHERAL MTBM SEALING ARRANGEMENT

NOTES:

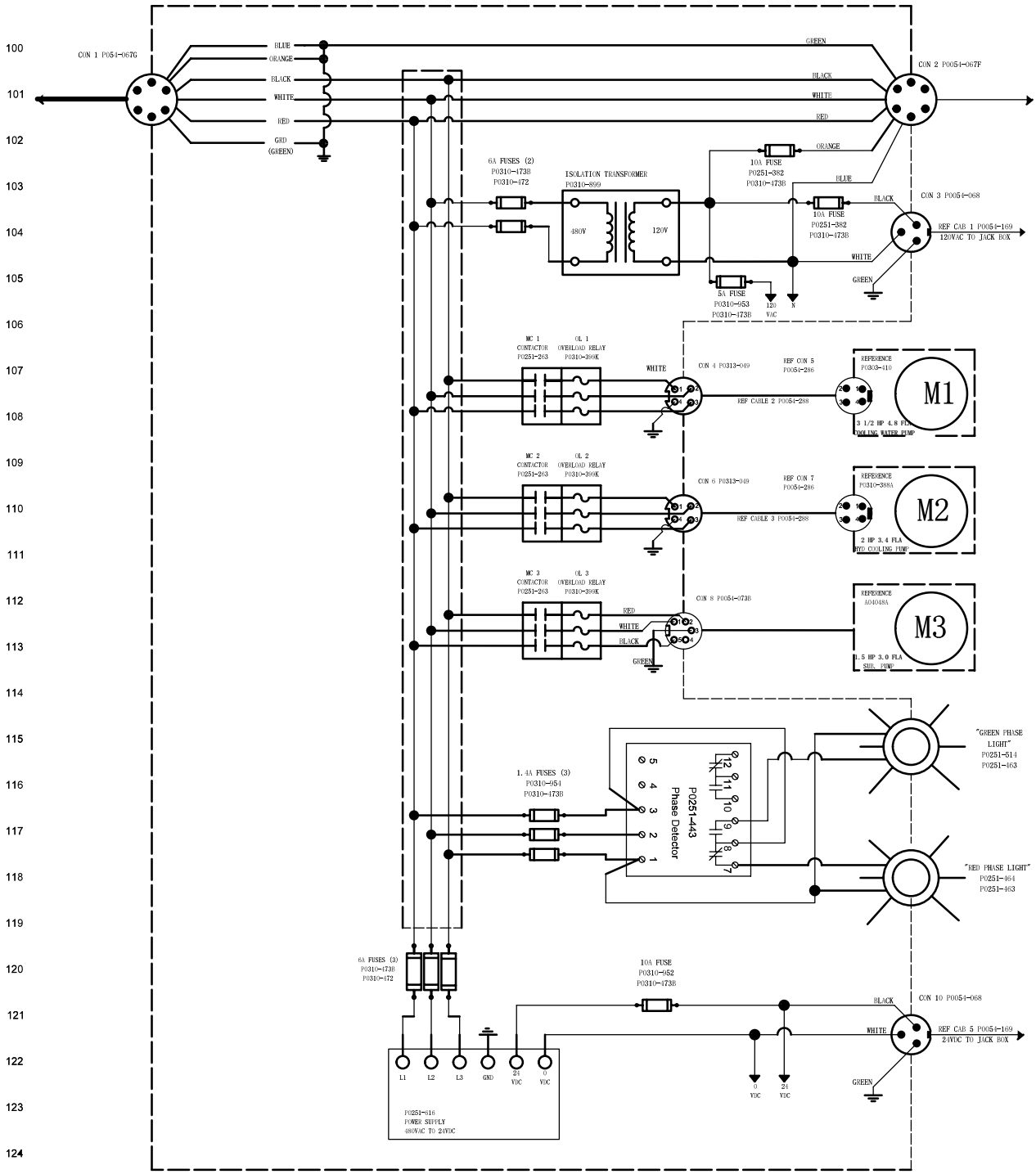
1. GRACO G3 GREASE PUMPS ARE CYCLED WITH ONE PUMP ON AND ONE PUMP OFF IN 15 MINUTES INCREMENTS.
2. GRACO G3 DISPLACEMENT IS SET AT .18 CUBIC INCH PER MINUTE.
3. GRACO G3 DIVIDER VALVE SERIES PROGRESSIVE DIVIDER VALVES. THE VALVES HAVE 10 AND 6 PORTS AND EQUALLY DIVIDE GREASE TO SUPPLY METERED FLOWS TO EACH INDIVIDUAL INJECTION PORT.
4. BOTH INNER AND OUTER SEAL STACKS HAVE 6 GREASE INJECTION POINTS EVENLY SPACED TO FLUSH IN FRONT OF THE SEAL STACKS.
5. GREASE IS PUMPED BETWEEN THIRD AND SECOND SEALS AS WELL AS BETWEEN SECOND AND FIRST SEALS. THERE ARE THREE EVENLY SPACED INJECTION POINTS BETWEEN EACH PAIR OF SEALS FOR BOTH INNER AND OUTER SEAL STACKS
6. SPACE BETWEEN OIL SEAL AND FIRST SEAL IS VENTED TO ATMOSPHERE AND THERE ARE THREE VENT PORTS EVENLY SPACED FOR BOTH INNER AND OUTER SEALS.

SL86P MTBM WATER COOLING SYSTEM SCHEMATIC



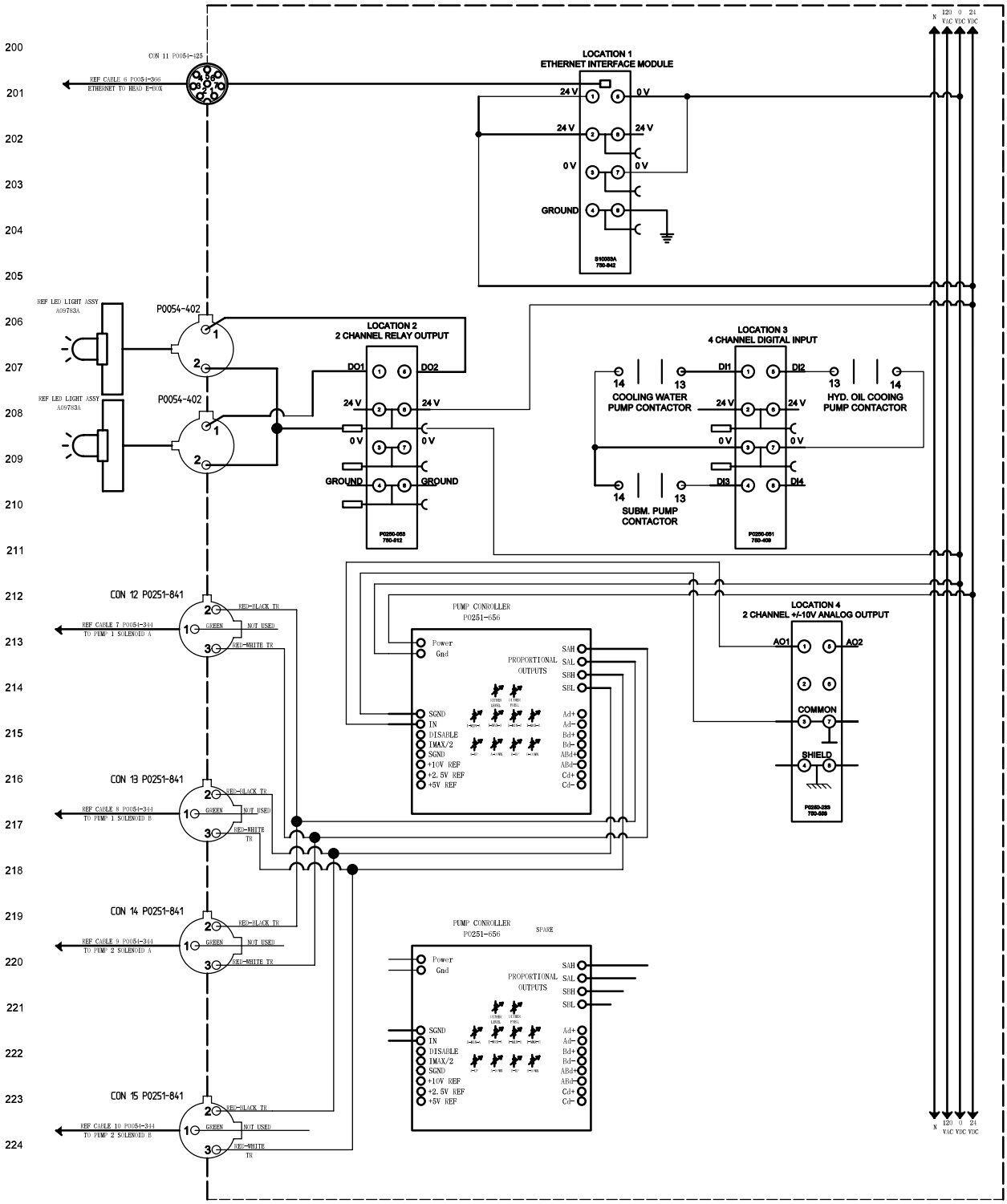
MTBM TRAILING SECTION CONTROL BOX ELECTRICAL SCHEMATICS - SL82P SN FA09600F-01

Electrical Schematic - Part 1 of 3



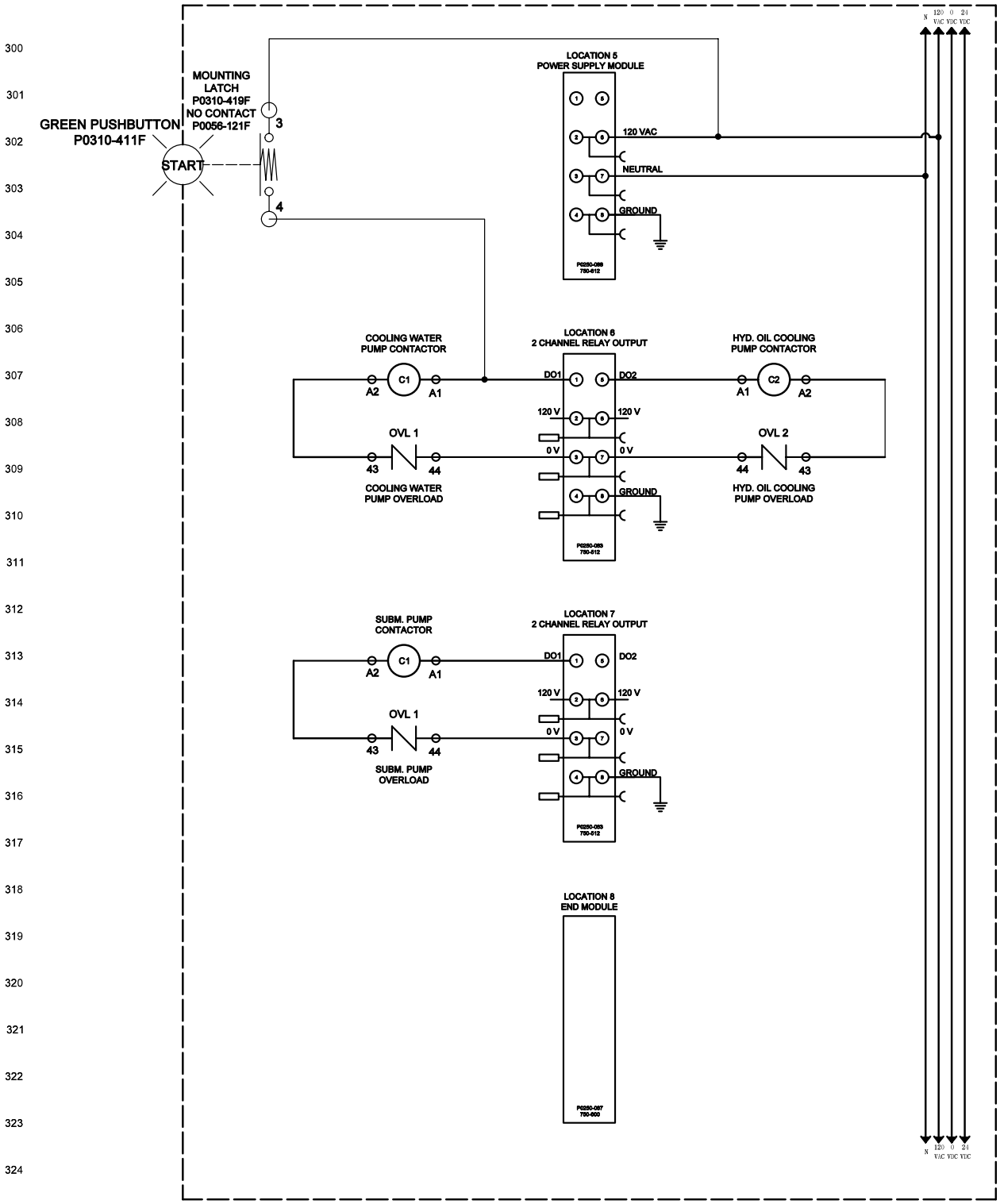
(continued on next page)

MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 2 of 3



(continued on next page)

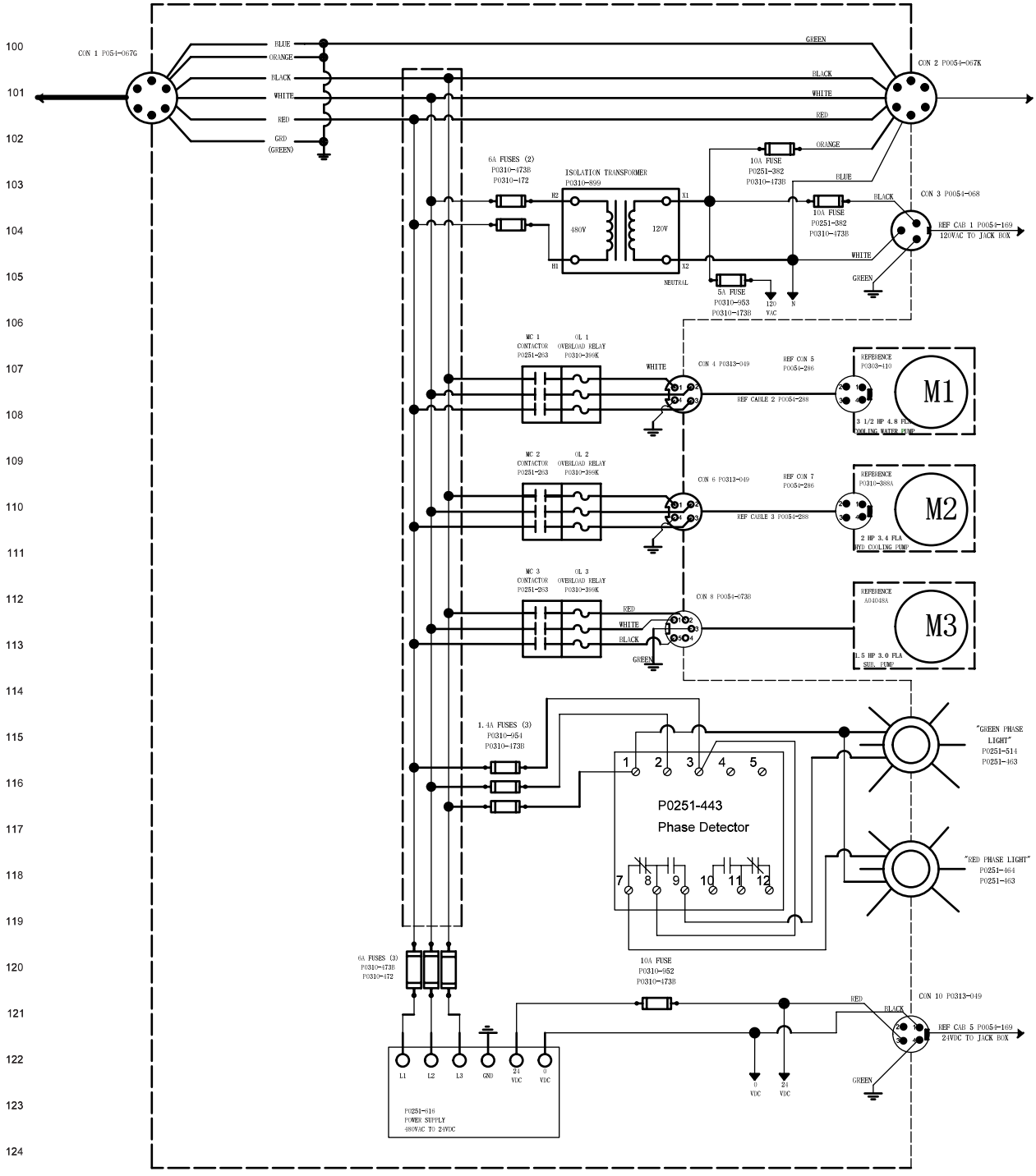
MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 3 of 3



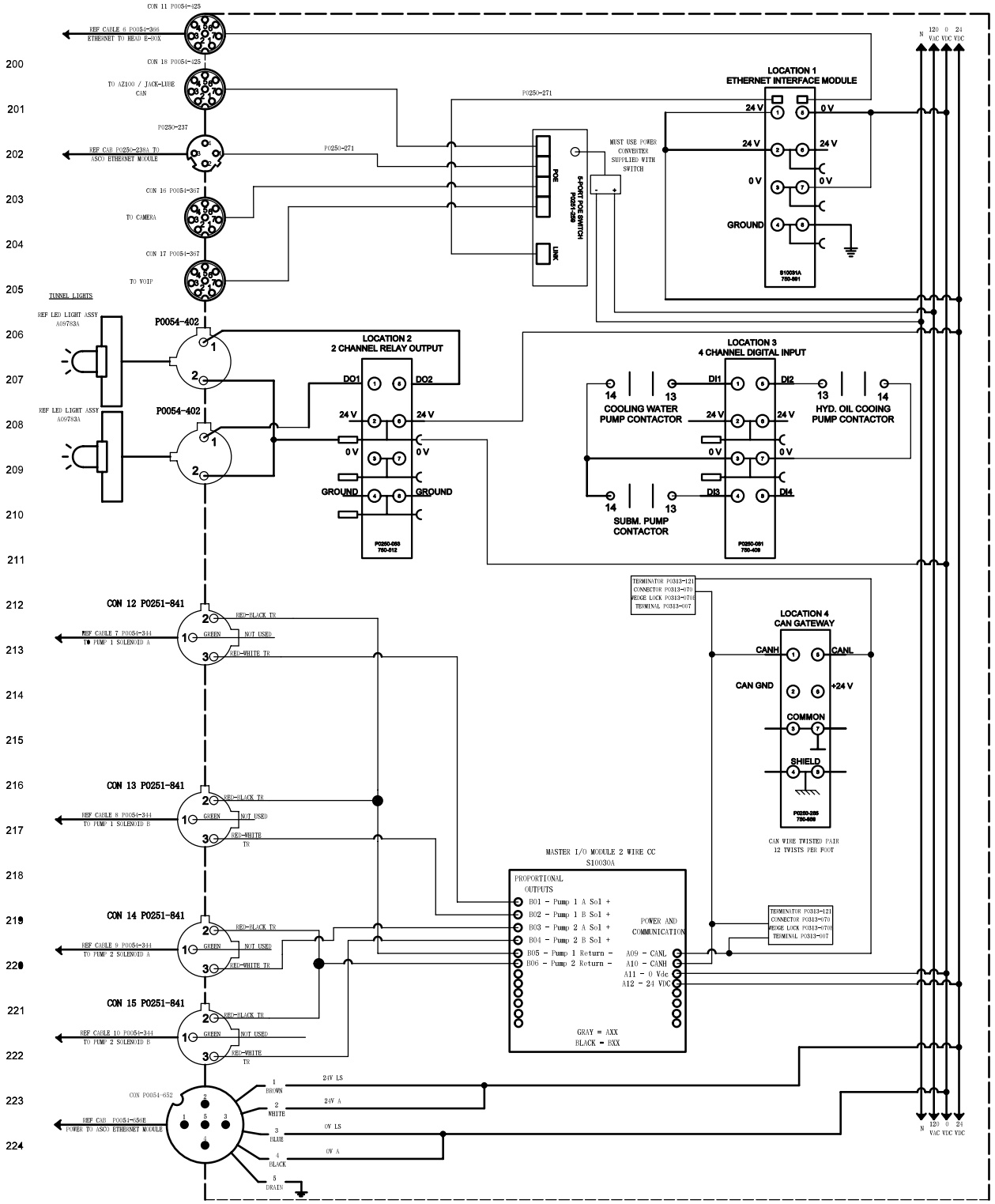
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MTBM TRAILING SECTION CONTROL BOX ELECTRICAL SCHEMATICS - SL82P SN: FA09600F-02 & AFTER

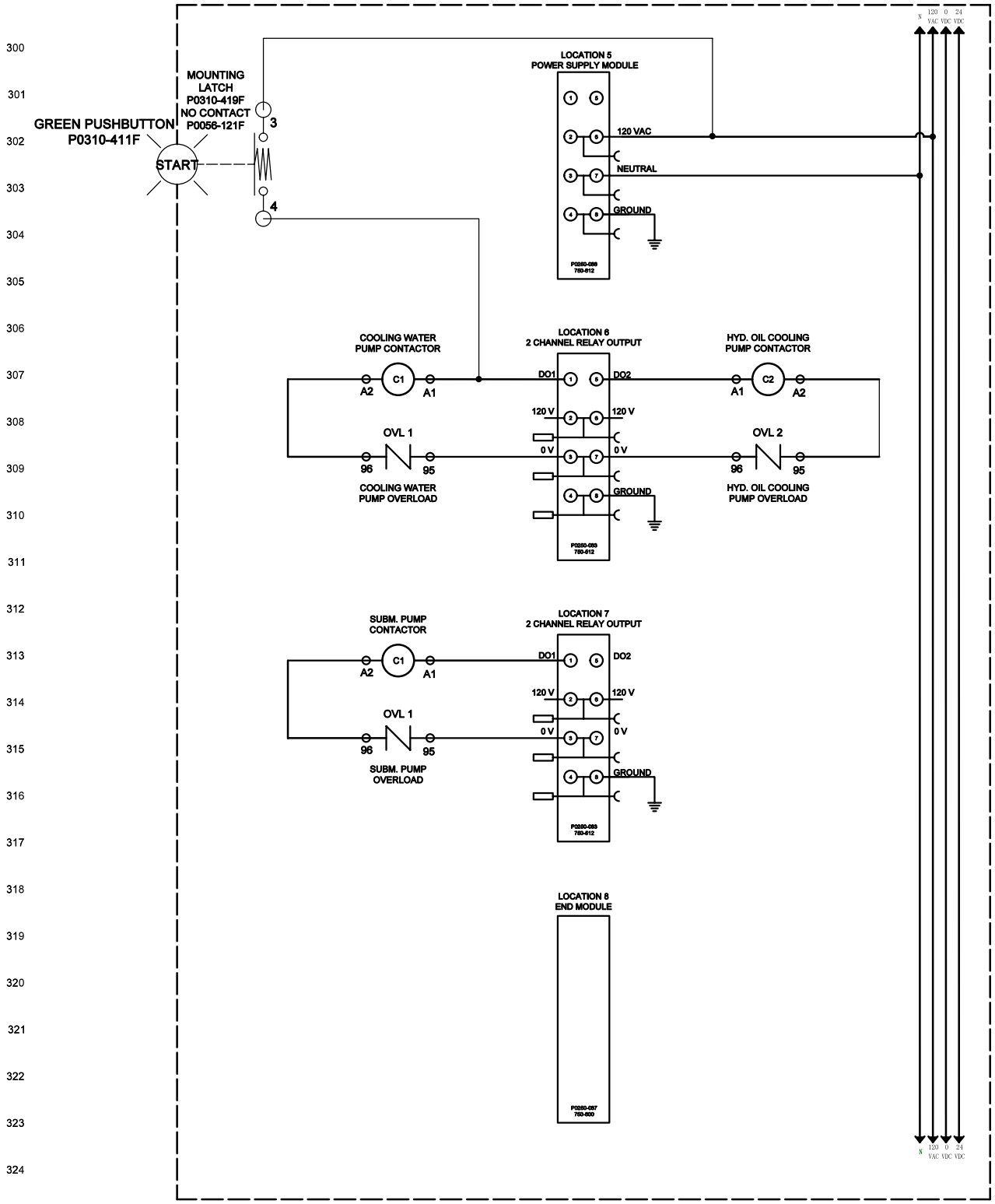
Electrical Schematic - Part 1 of 3



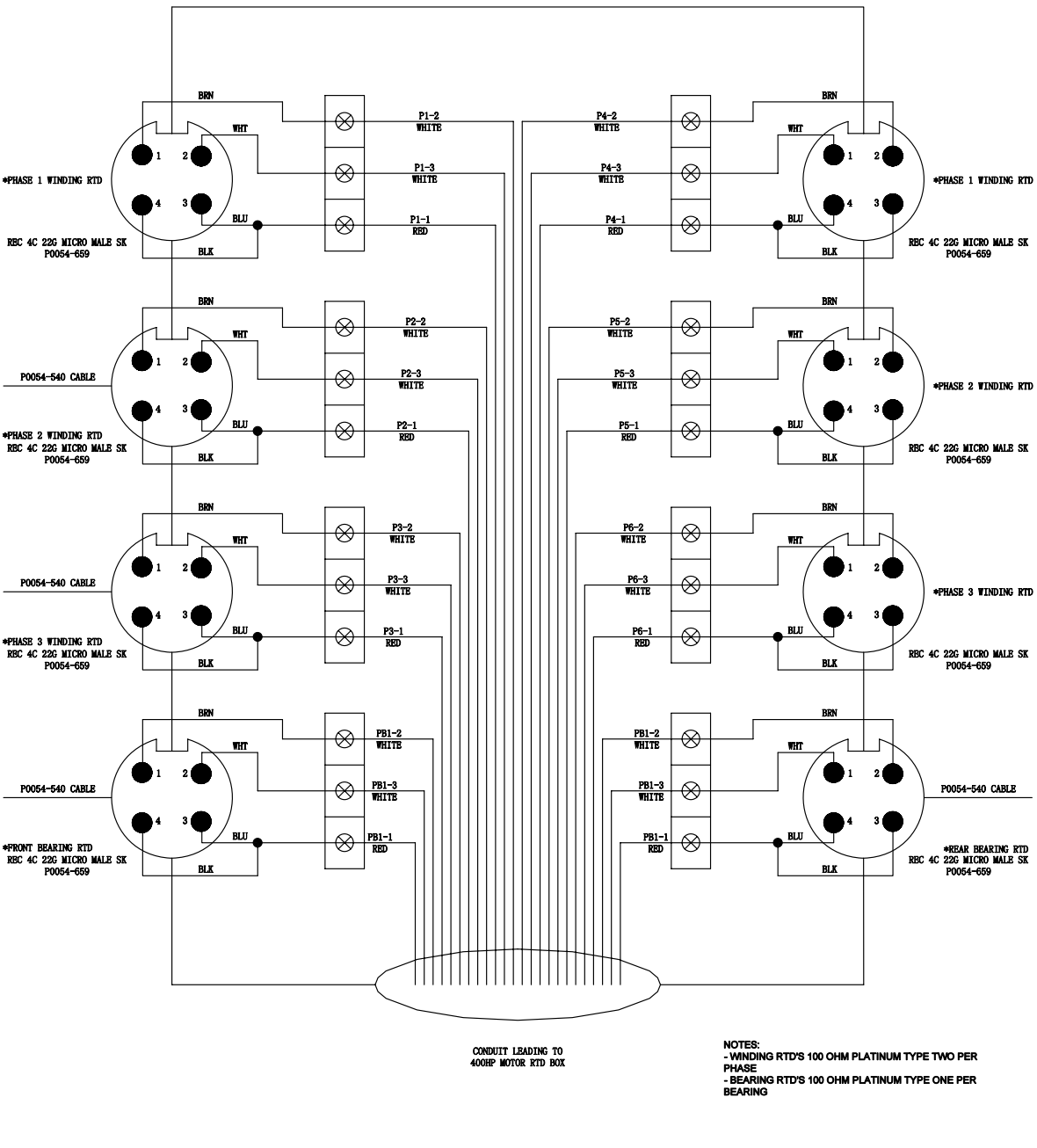
MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 2 of 3



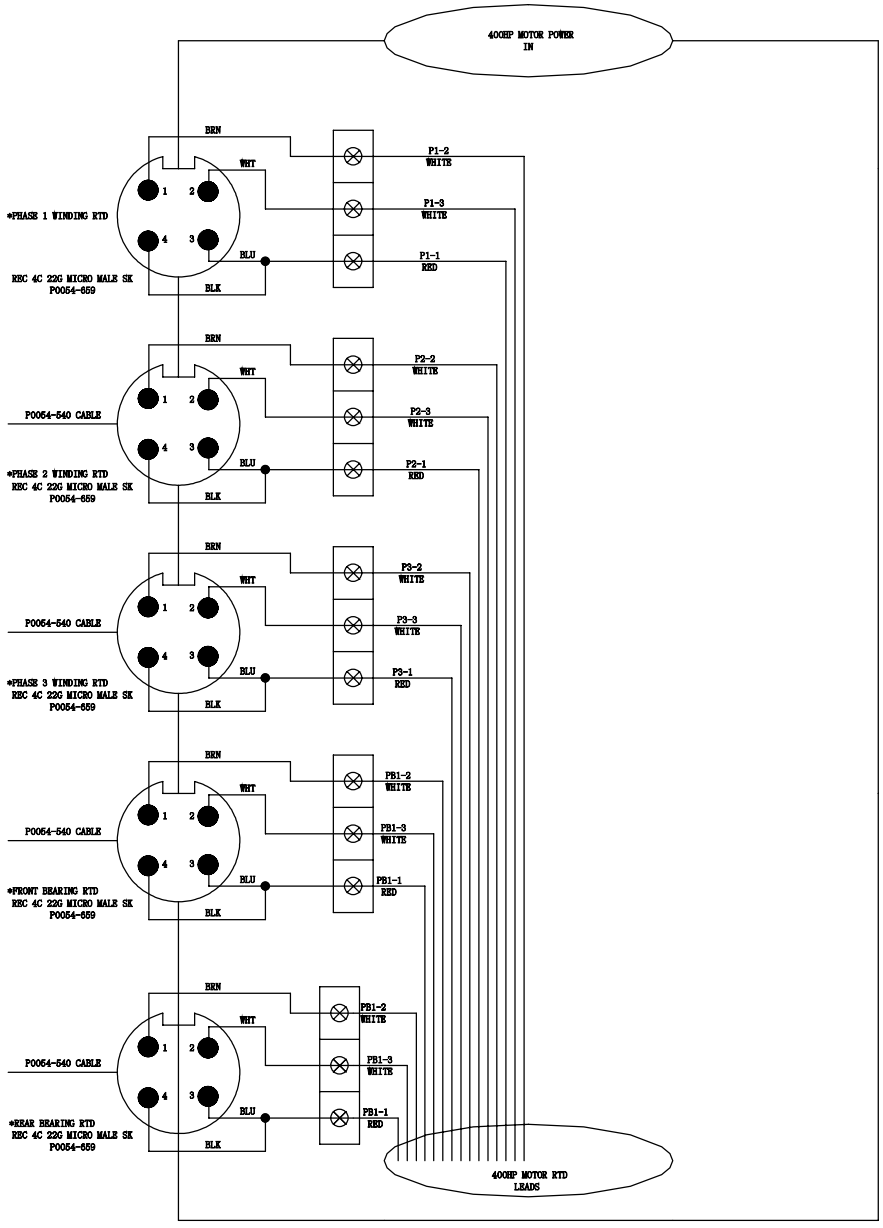
MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 3 of 3

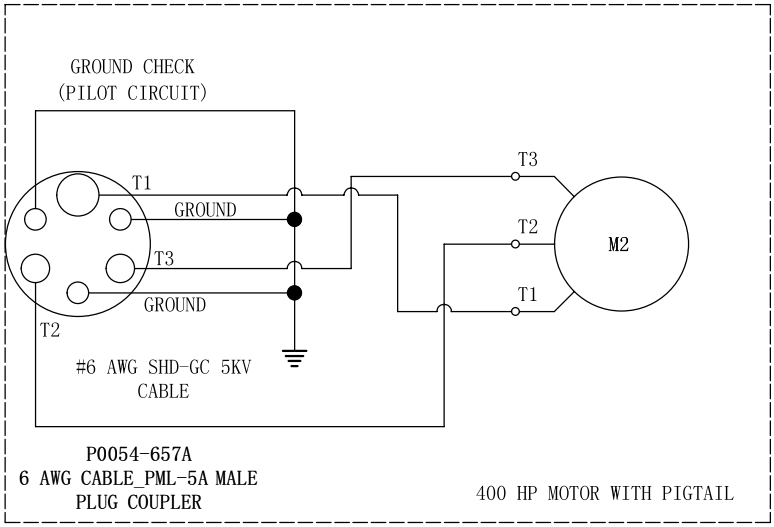


MTBM MOTOR RTD BOX ELECTRICAL SCHEMATIC - SL82P SN: FA09600F-01



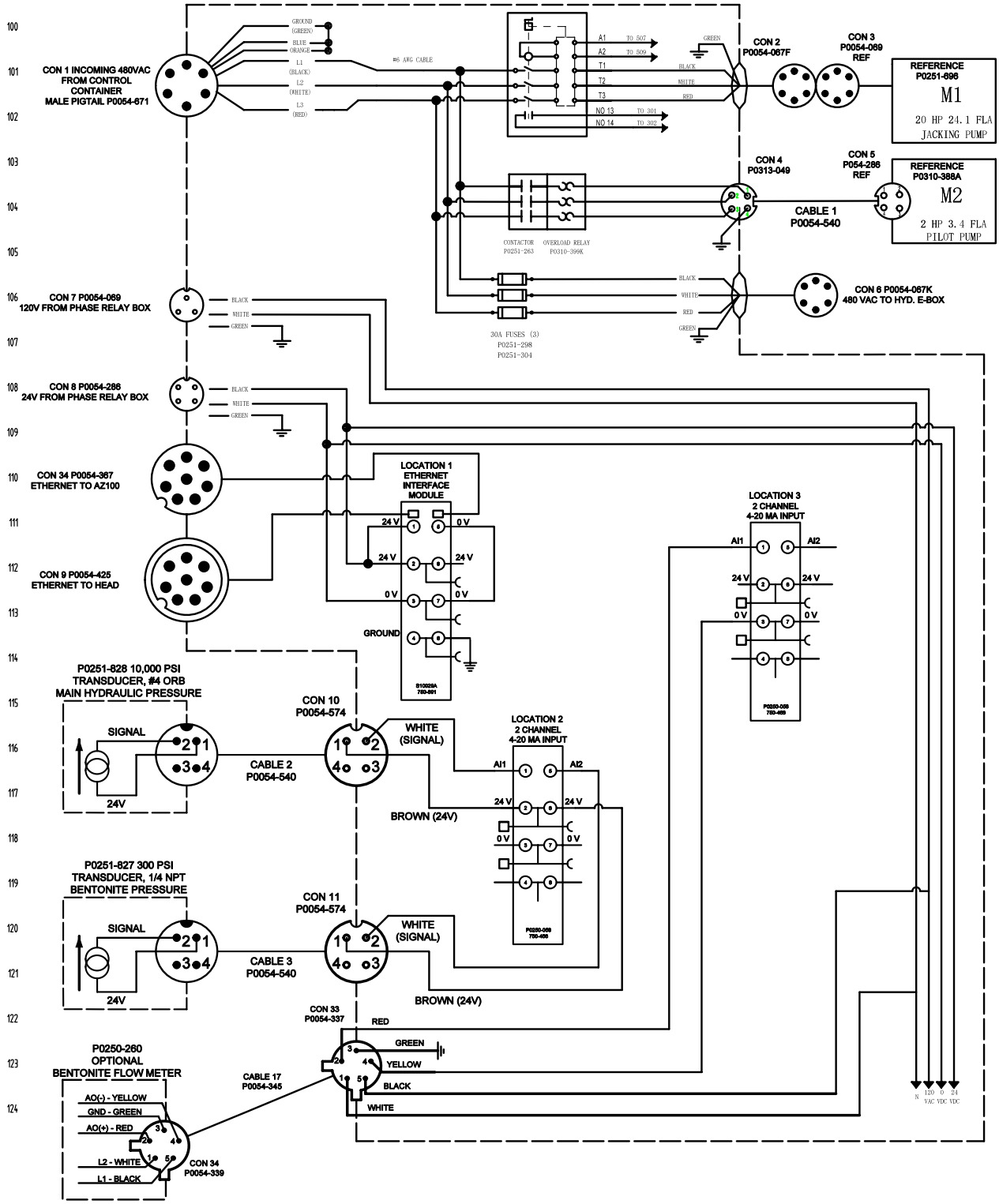
MTBM DRIVE MOTOR 400 HP ELECTRICAL SCHEMATIC - SL82P SN: FA09600F-02 & AFTER





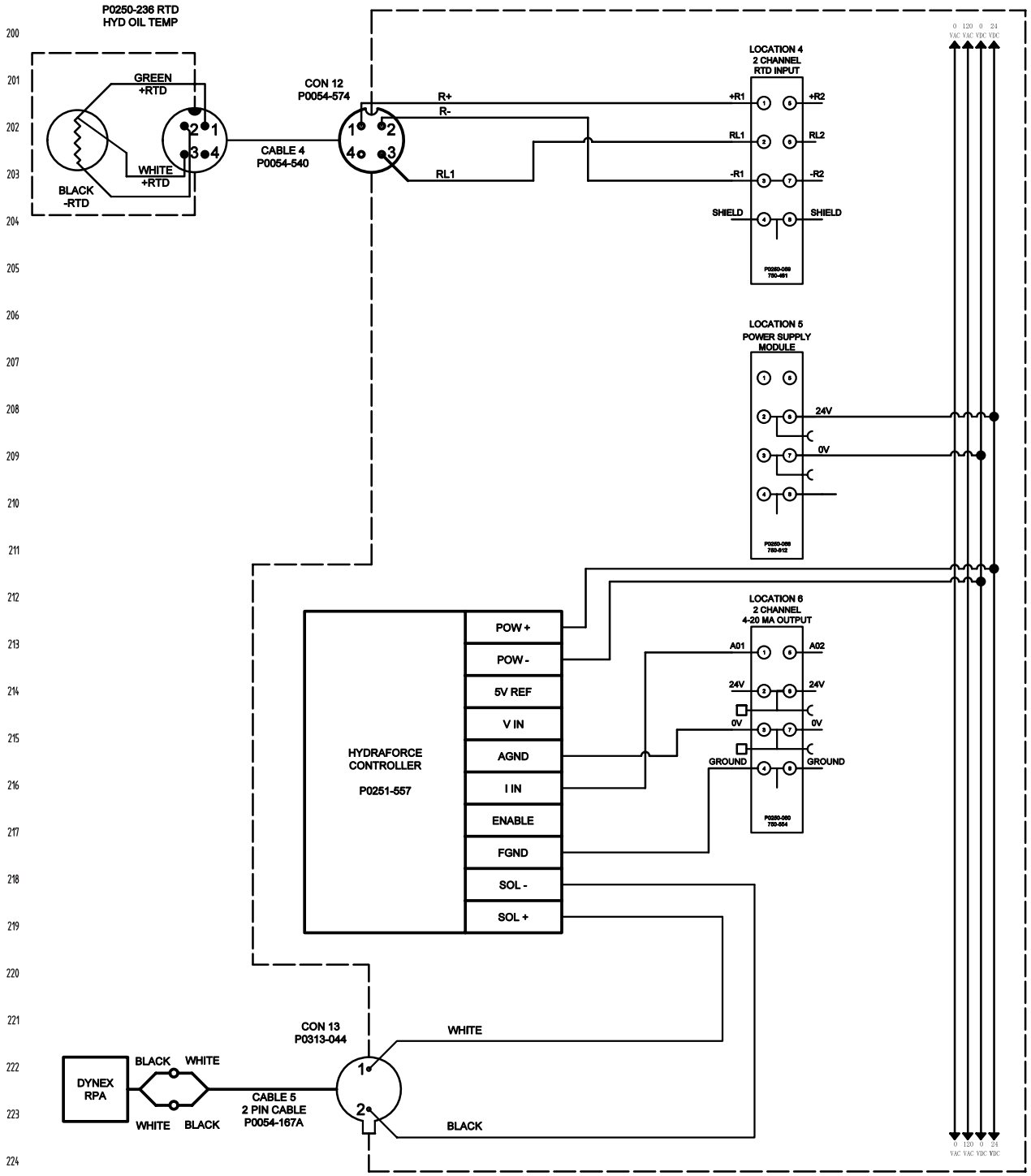
MTBM JACK CAN CONTROL BOX ELECTRICAL SCHEMATICS 82” SN: FA09604F

Electrical Schematic - Part 1 of 7



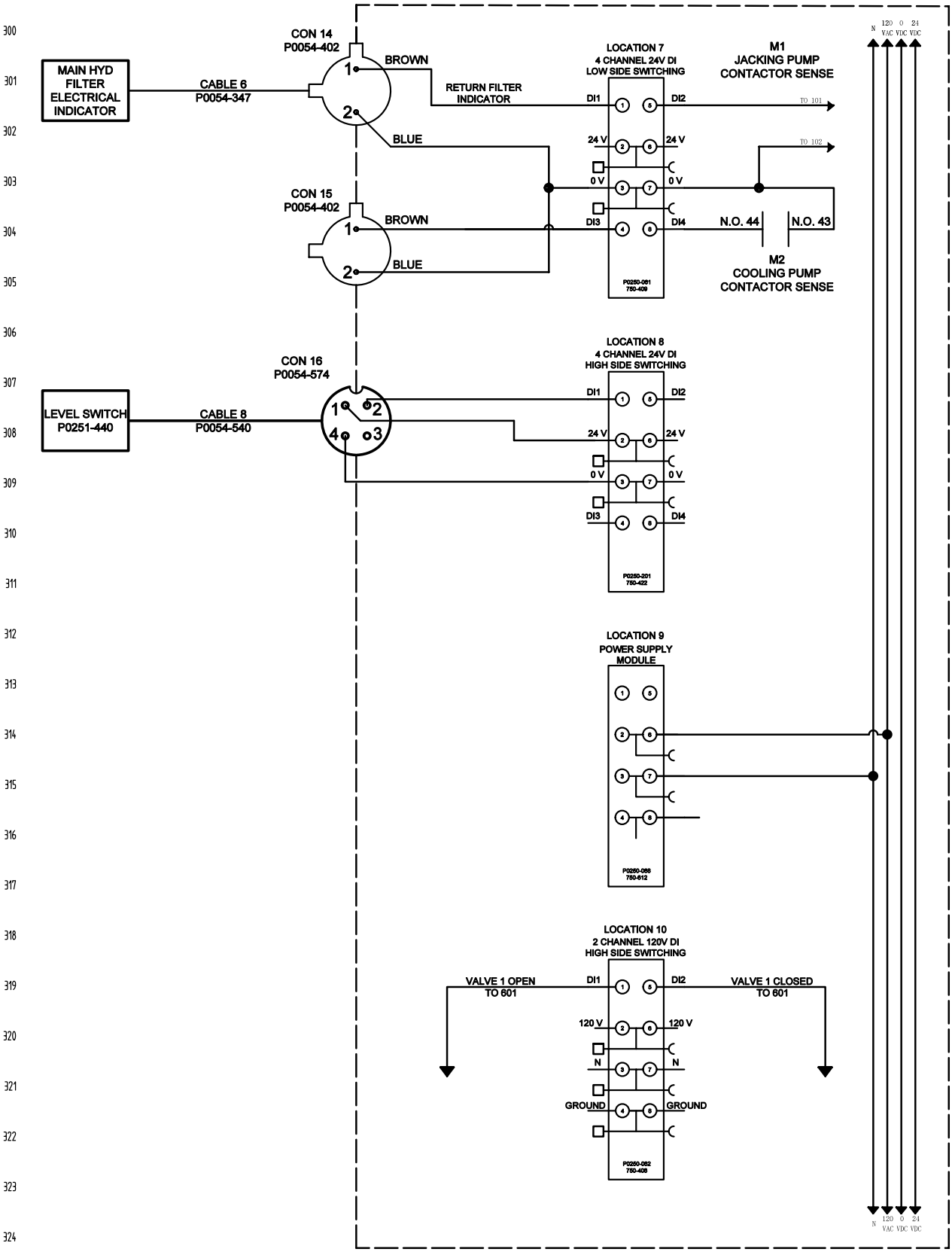
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MTBM 82” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 2 of 7



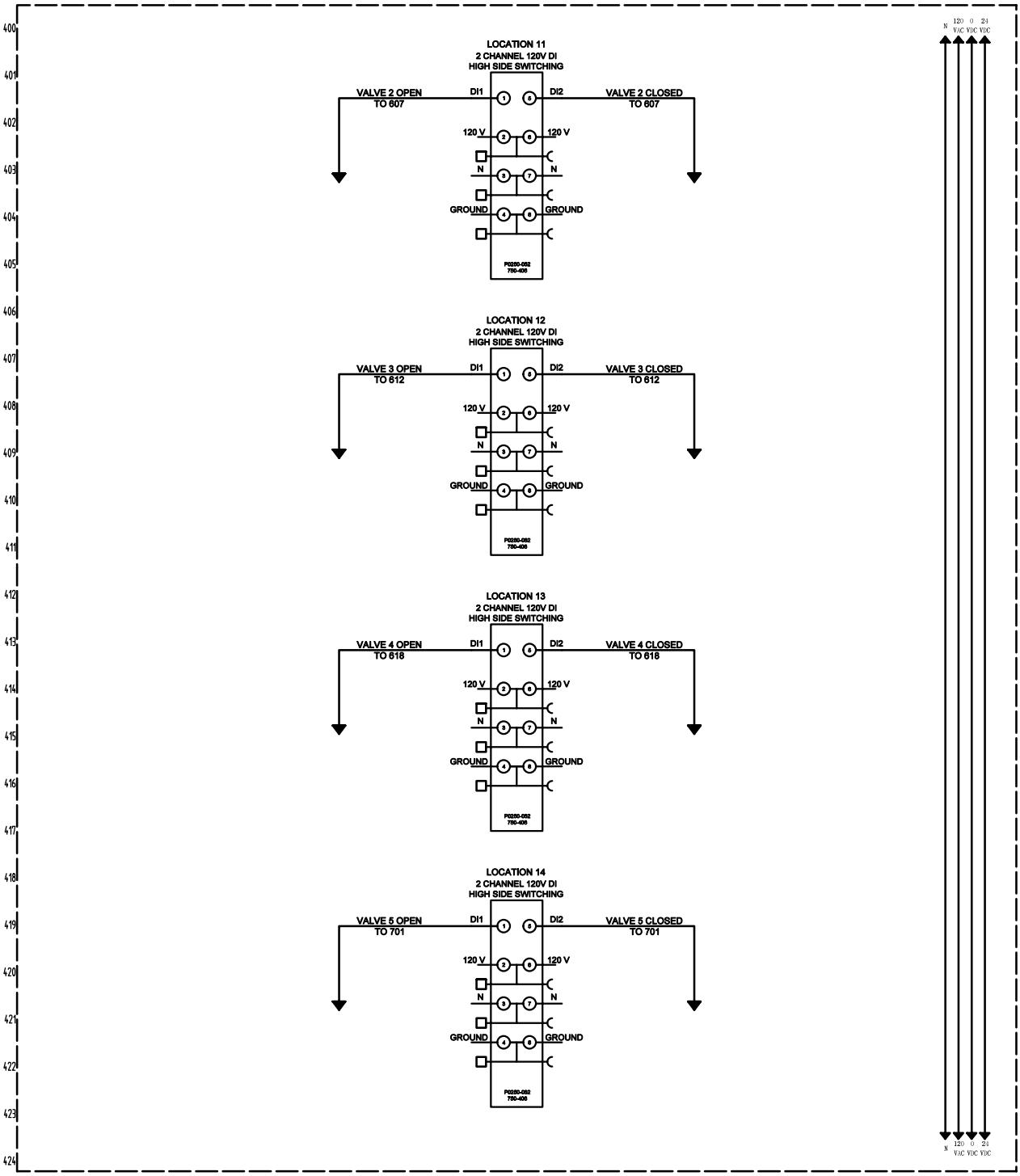
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MTBM 82” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 3 of 7



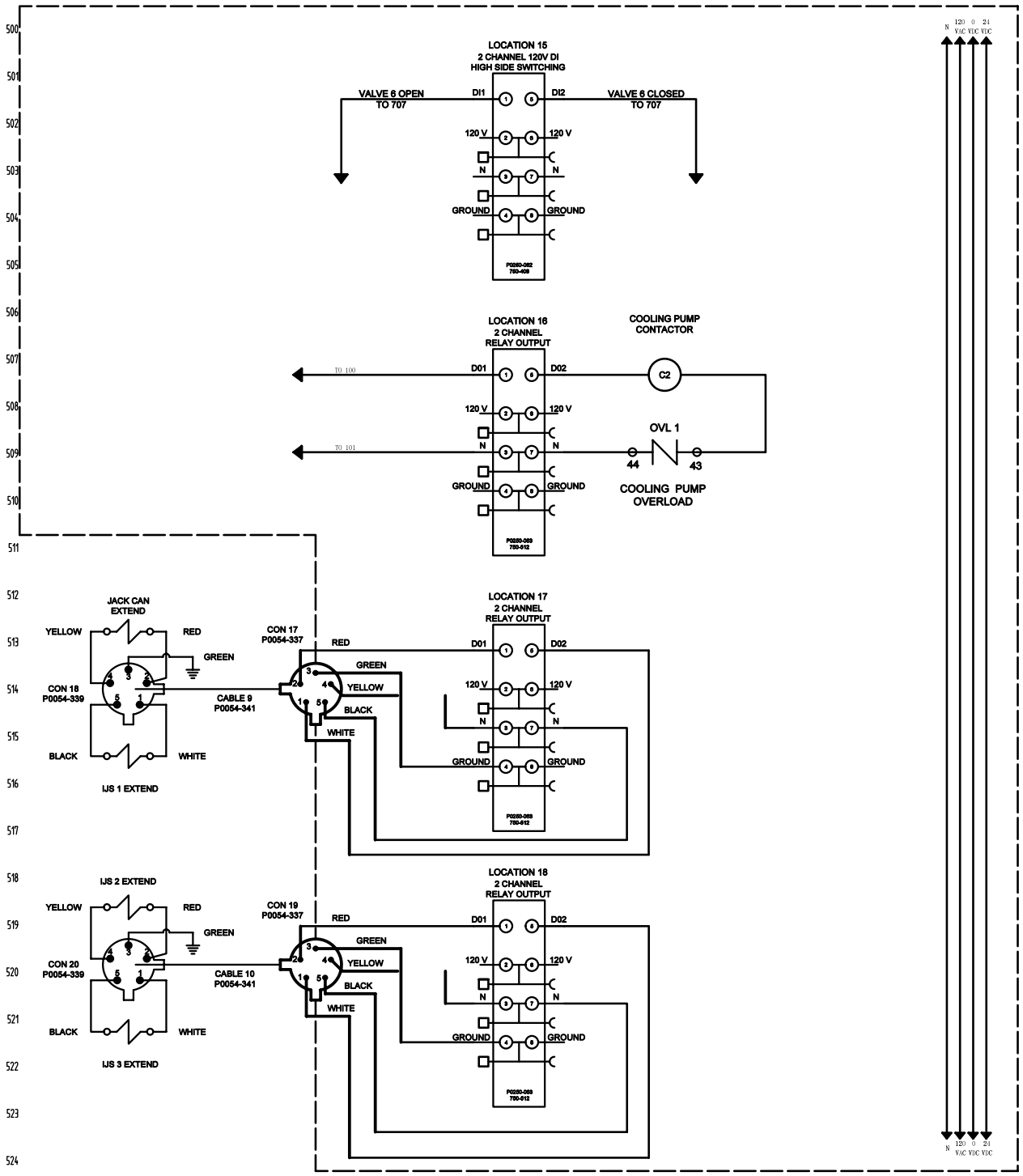
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MTBM 82” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 4 of 7



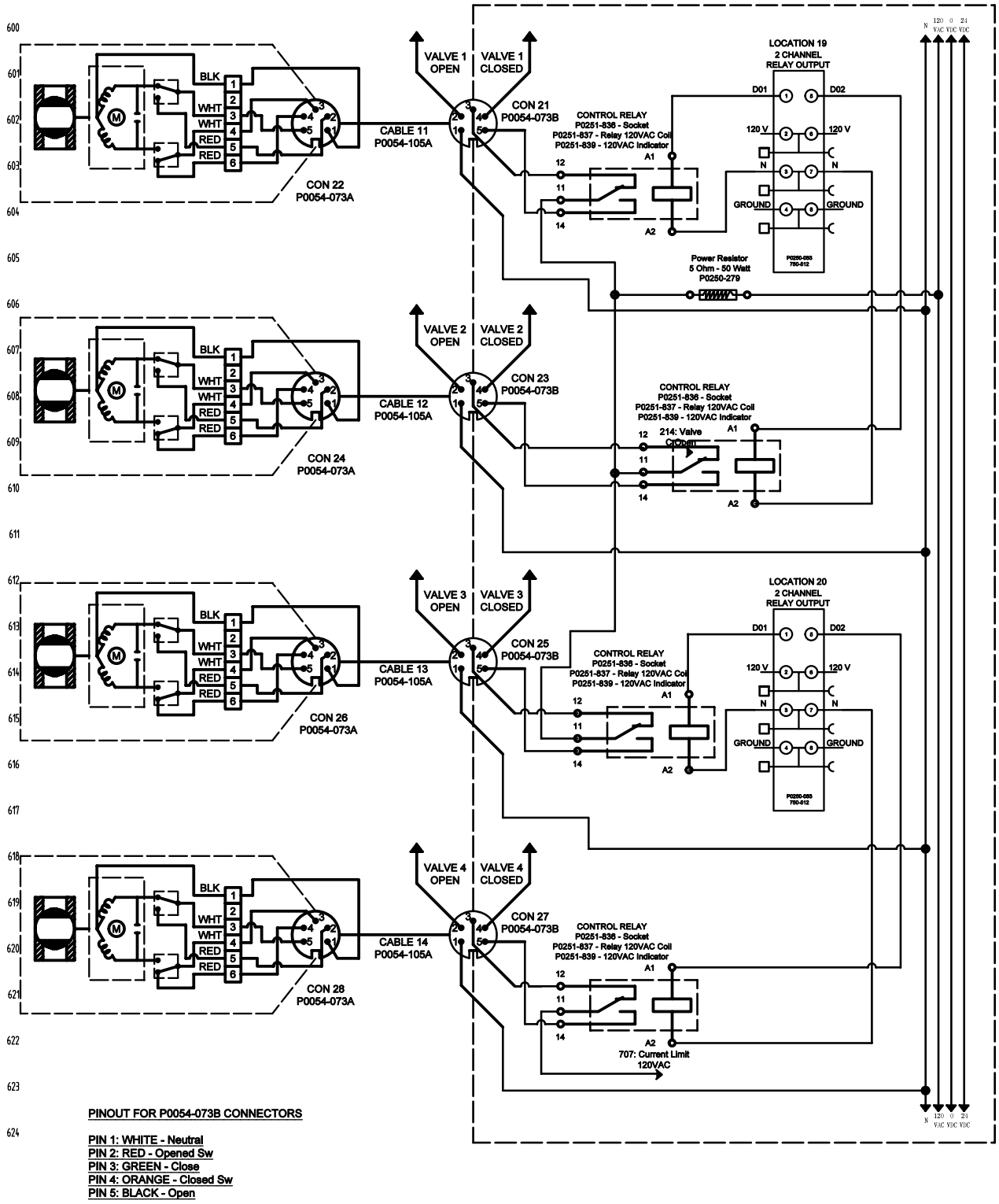
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MTBM 82” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 5 of 7

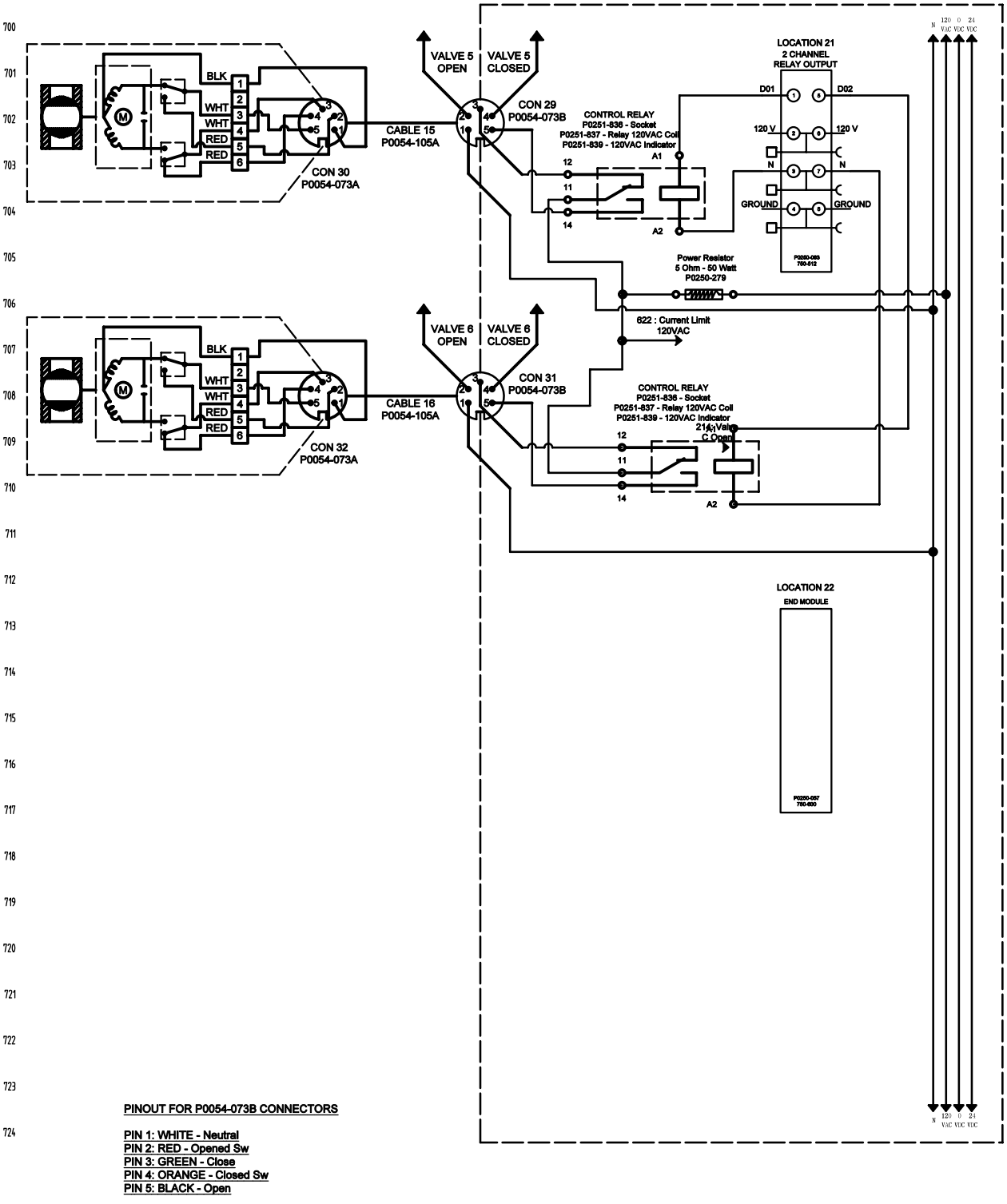


(continued on next page)

MTBM 82” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 6 of 7



MTBM 82” Jack Can Control Box Electrical Schematics (continued)
Electrical Schematic - Part 7 of 7

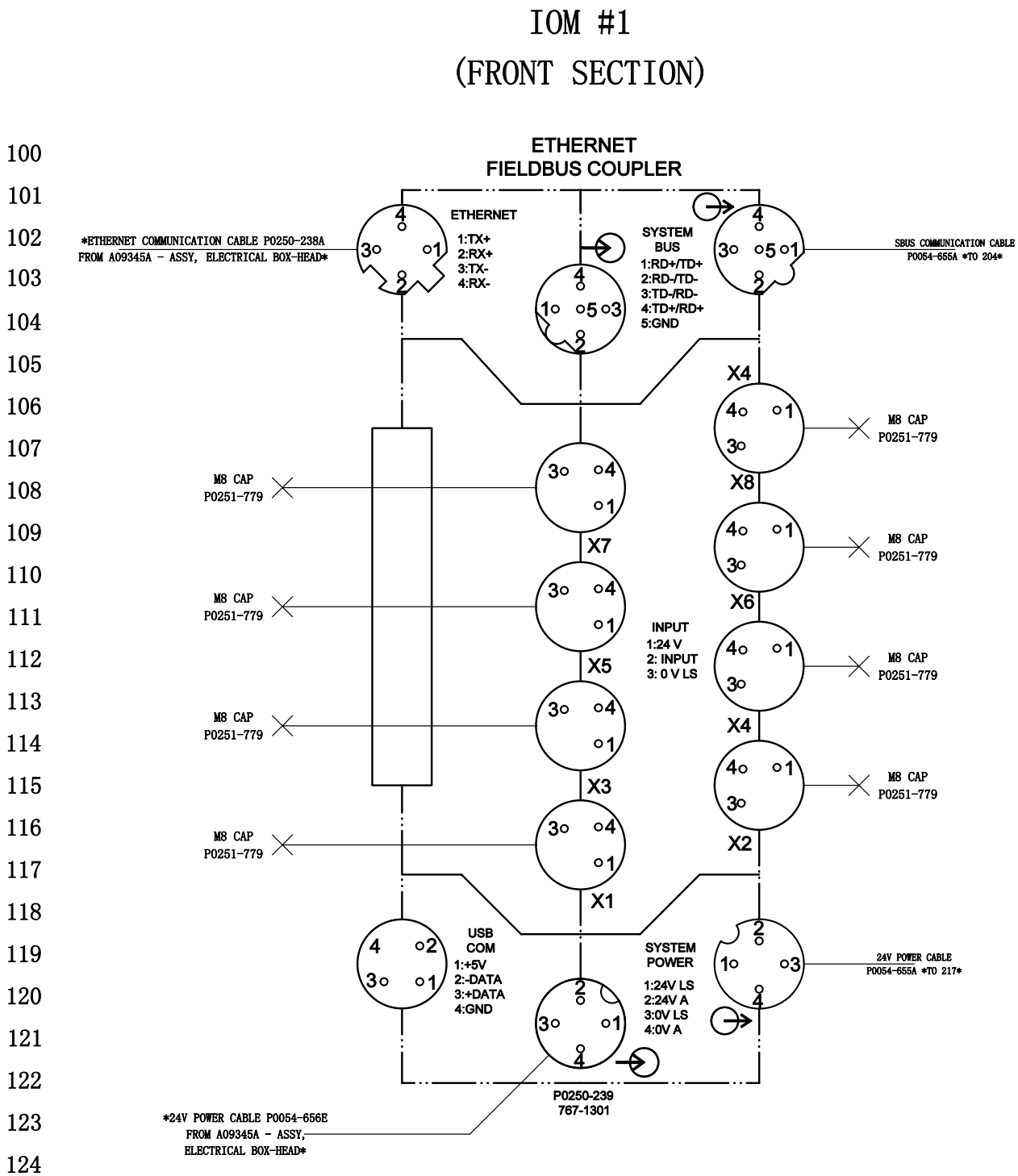


PINOUT FOR P0054-073B CONNECTORS

PIN 1: WHITE - Neutral
PIN 2: RED - Opened Sw
PIN 3: GREEN - Close
PIN 4: ORANGE - Closed Sw
PIN 5: BLACK - Open

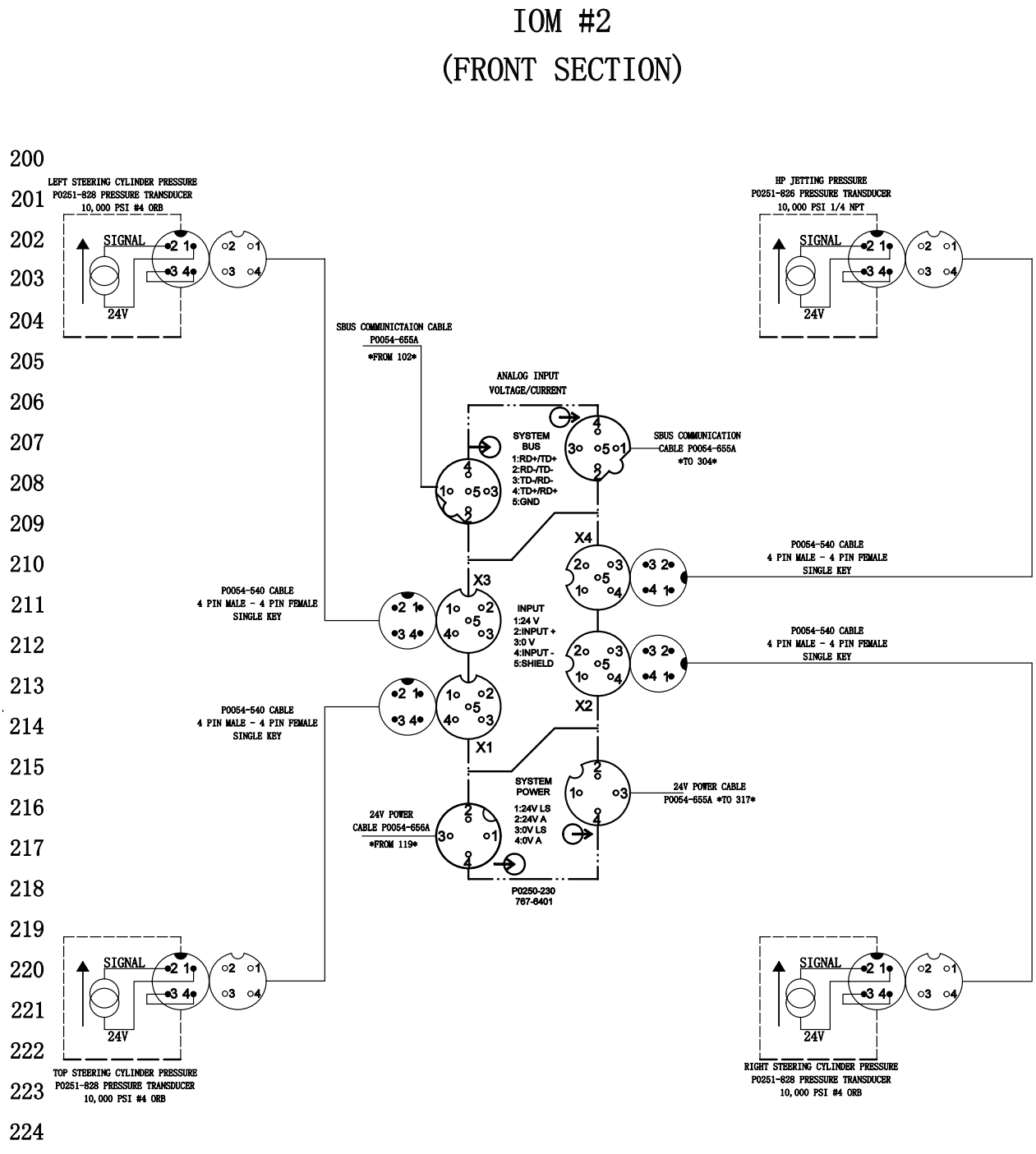
SL82P MTBM SPEEDWAY I/O MODULE SCHEMATICS
SN: FA09600F-01 & 2

Module Schematic - Part 1 of 12



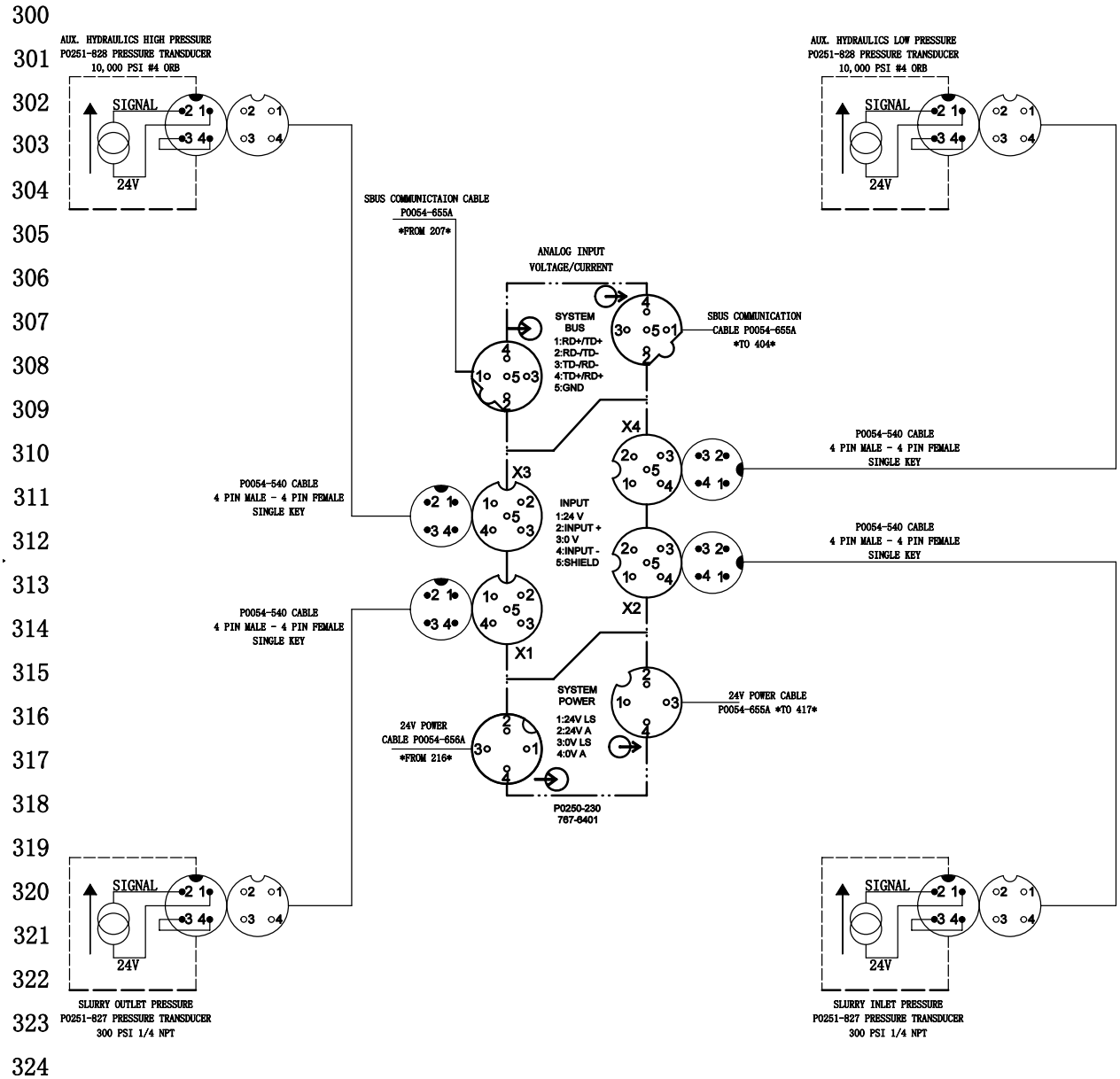
SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)

Schematic - Part 2 of 12



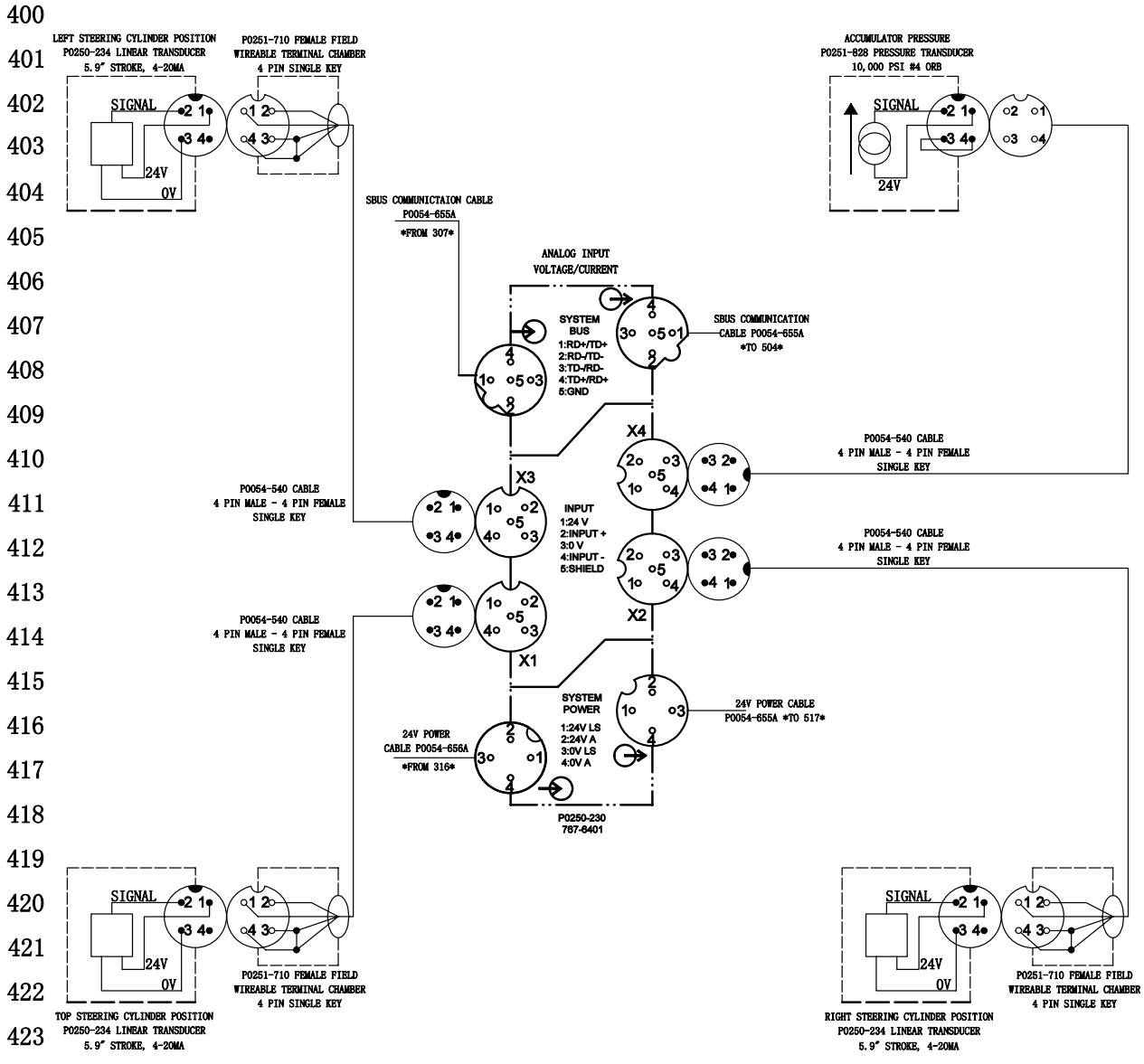
SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 3 of 12

IOM #3
(FRONT SECTION)



SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 4 of 12

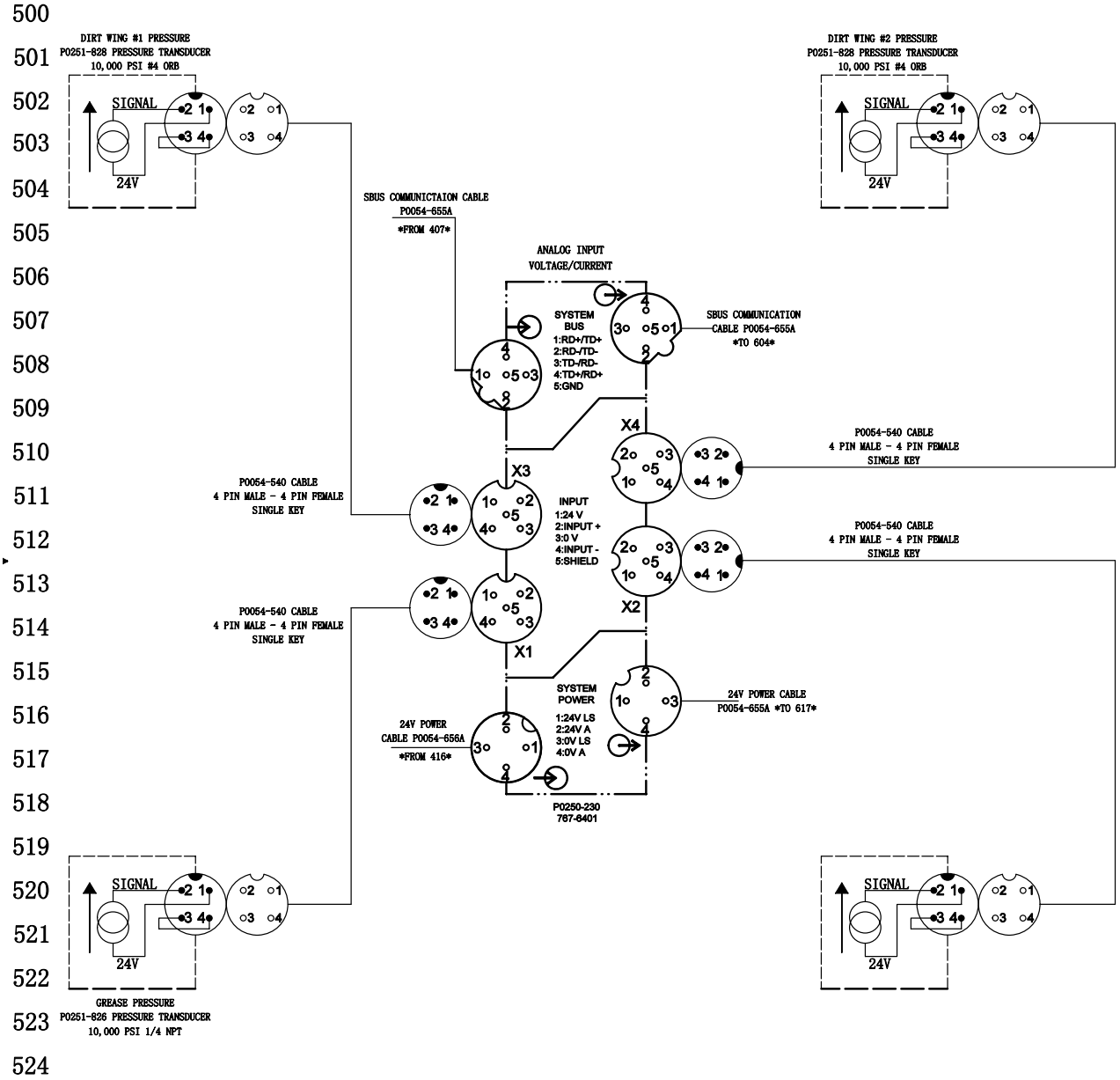
IOM #4
(FRONT SECTION)



*LINEAR TRANSDUCER CABLES HAVE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END. CABLES WIRES ARE CONNECTED TO THE CORRESPONDING TERMINAL CHAMBER PIN, I.E., 1-1, 2-2, 3-3, & 4-4. TERMINAL CHAMBER PINS 3 AND 4 SHOULD ALSO BE JUMPERED TOGETHER.

SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)

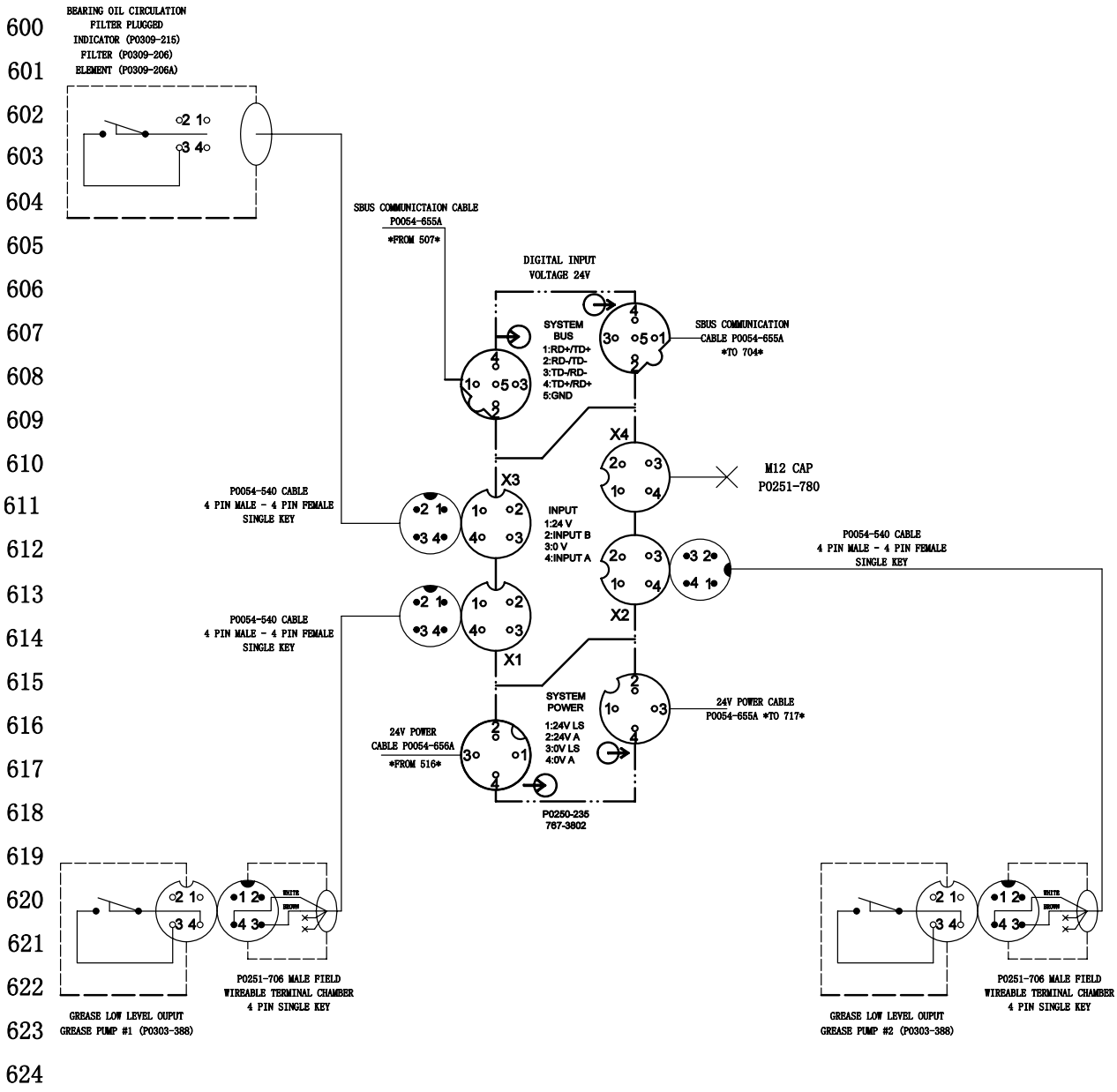
Schematic - Part 5 of 12



SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 6 of 12

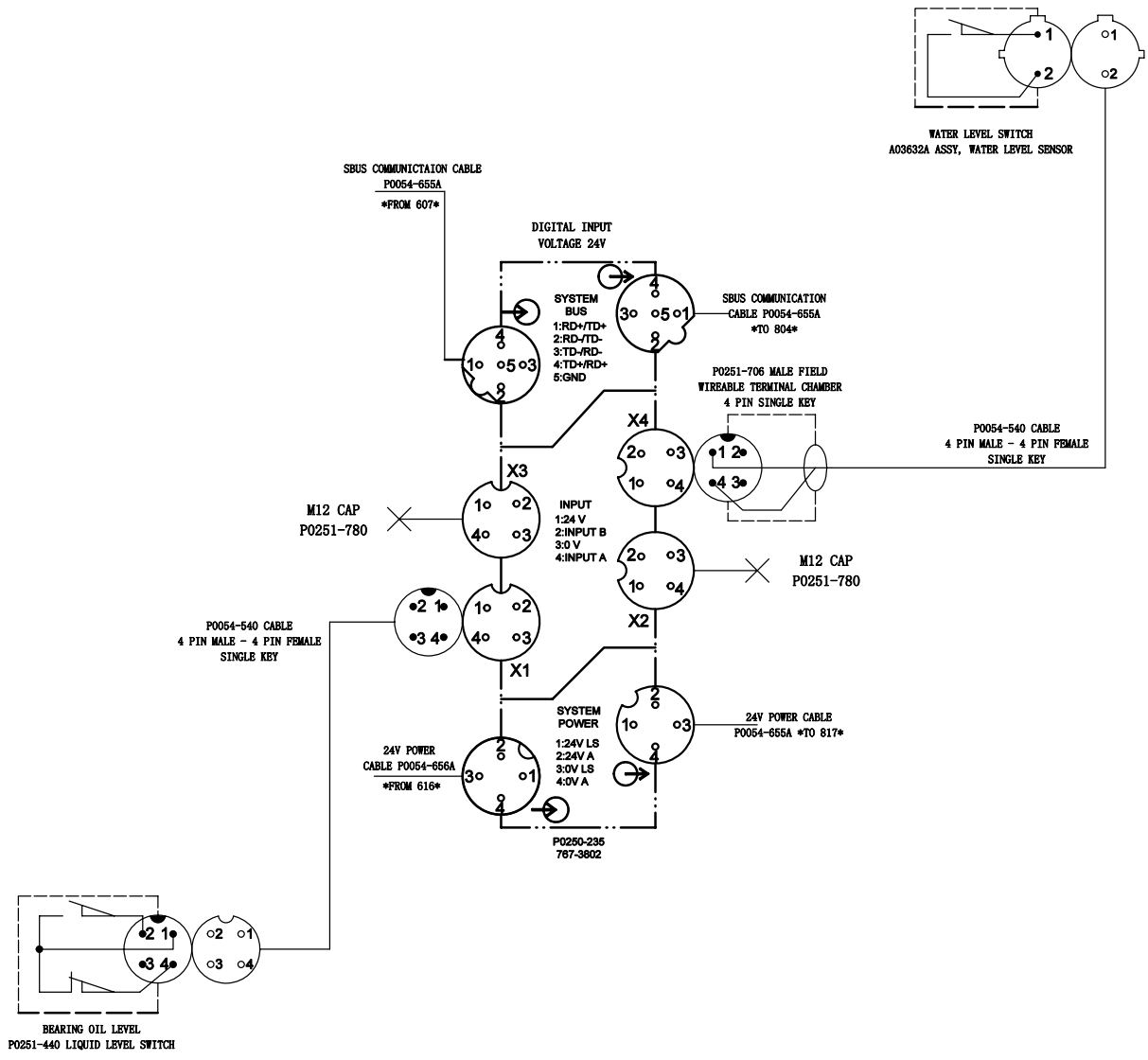
*GREASE PUMP LOW LEVEL SWITCH CABLES HAVE MALE FEILD WIREABLE TERMINAL CHAMBER AT THE PUMP END THAT REPLACES CABLE FEMALE END. WIRES 1 AND 2 OF THE CABLE ARE CONNECTED TO PINS 3 AND 4 OF THE TERMINAL CHAMBER AND CABLE WIRES 3 AND 4 ARE NOT USED

IOM #6
(FRONT SECTION)

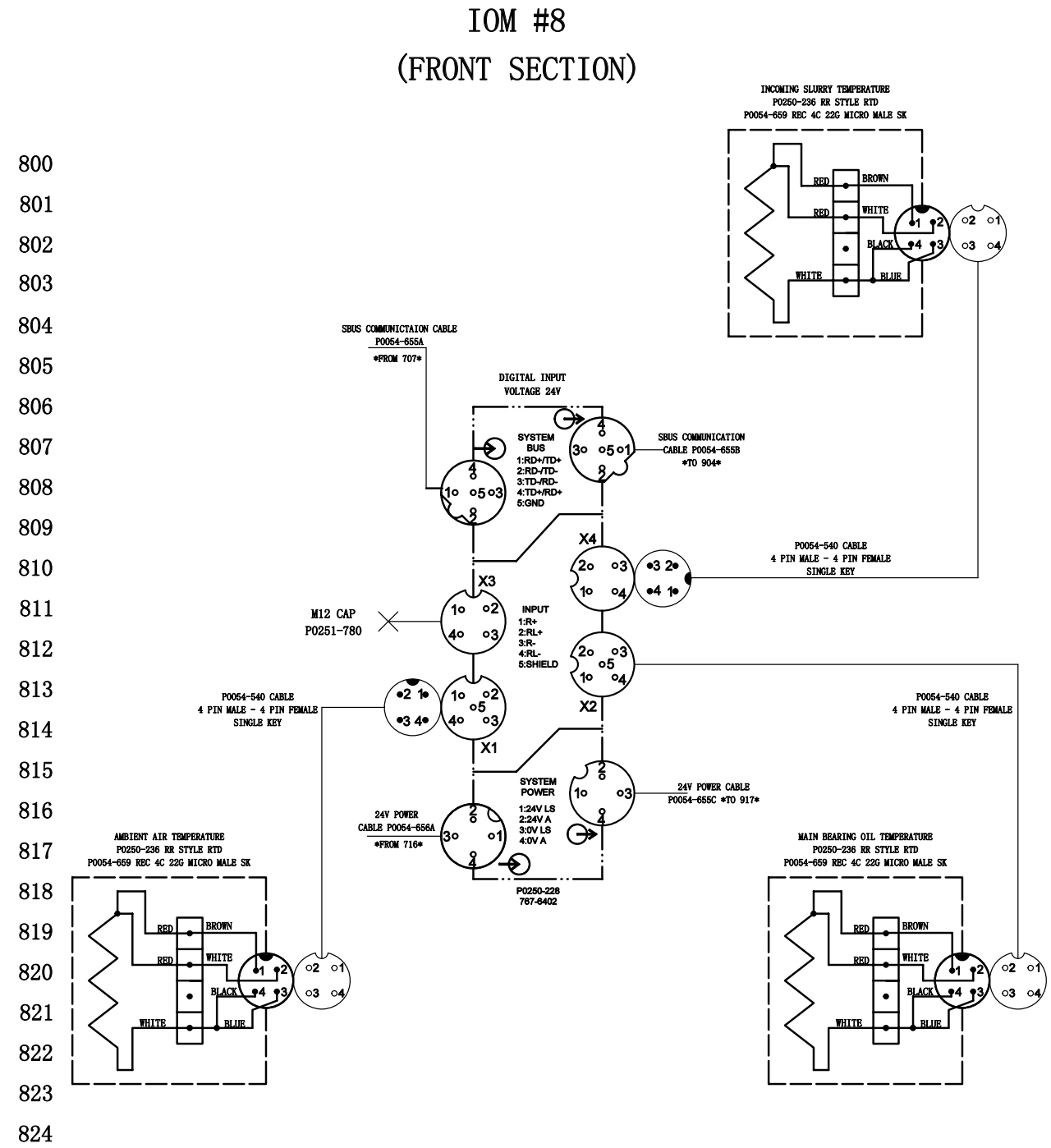


SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 7 of 12

IOM #7
(FRONT SECTION)

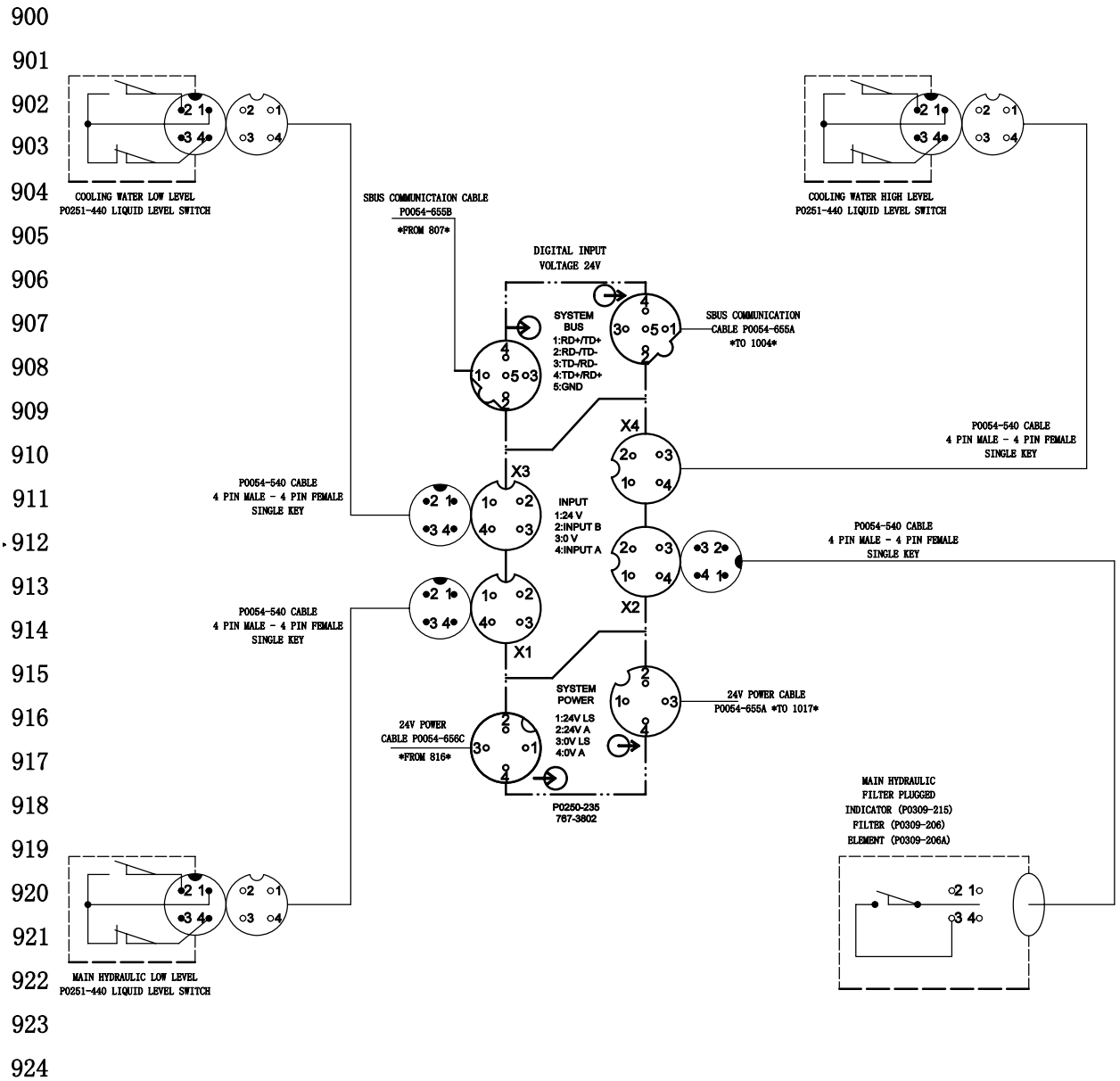


SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 8 of 12



SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 9 of 12

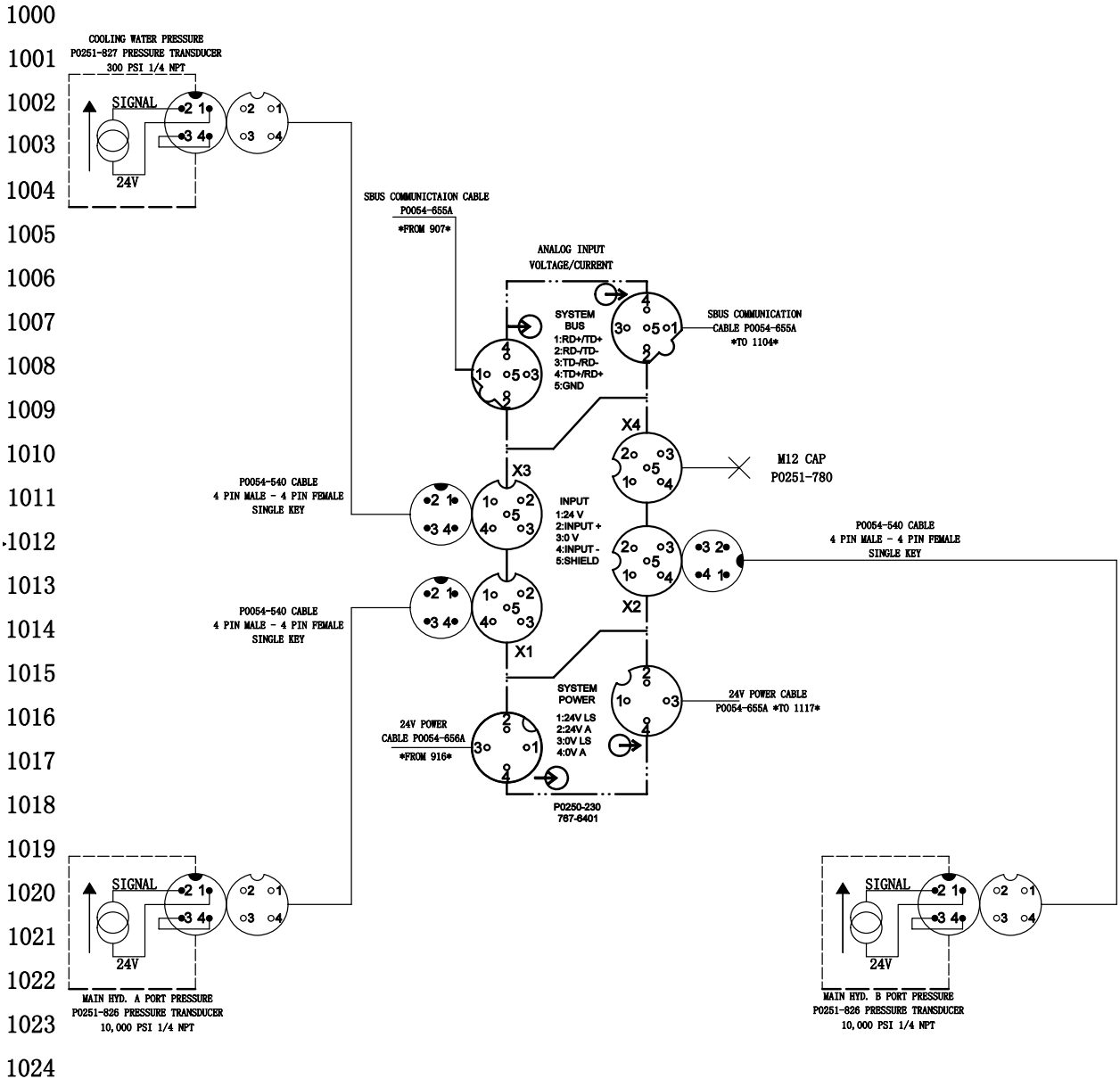
IOM #9
(BACK SECTION)



SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)

Schematic - Part 10 of 12

IOM #10
(BACK SECTION)

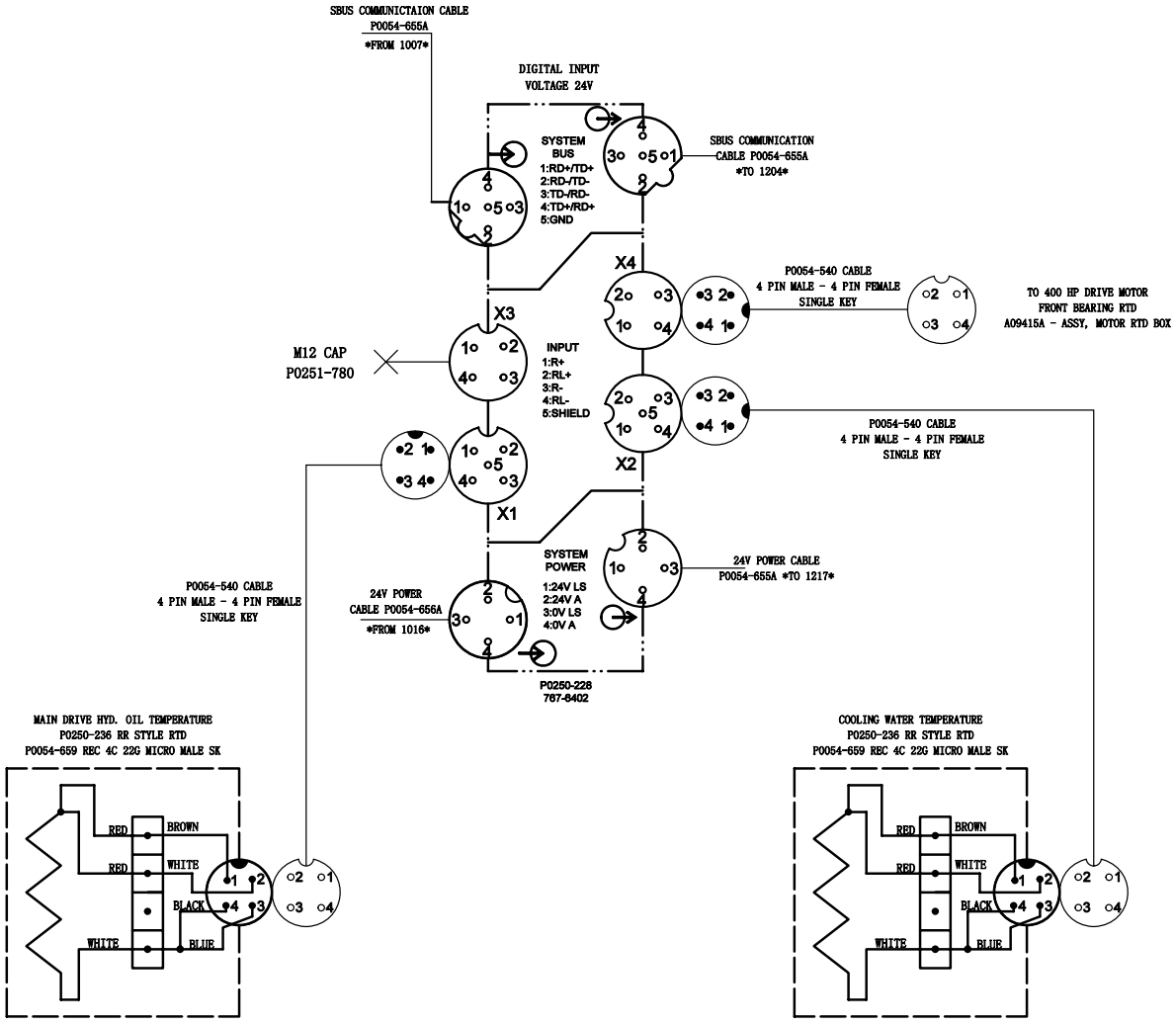


SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 11 of 12

*SEE DRAWING A09415A - ASSY, MOTOR RTD BOX-SL86 MTBM FOR TERMINAL LAYOUT OF THE 400 HP MOTOR RTD CONNECTIONS.

IOM #11
(BACK SECTION)

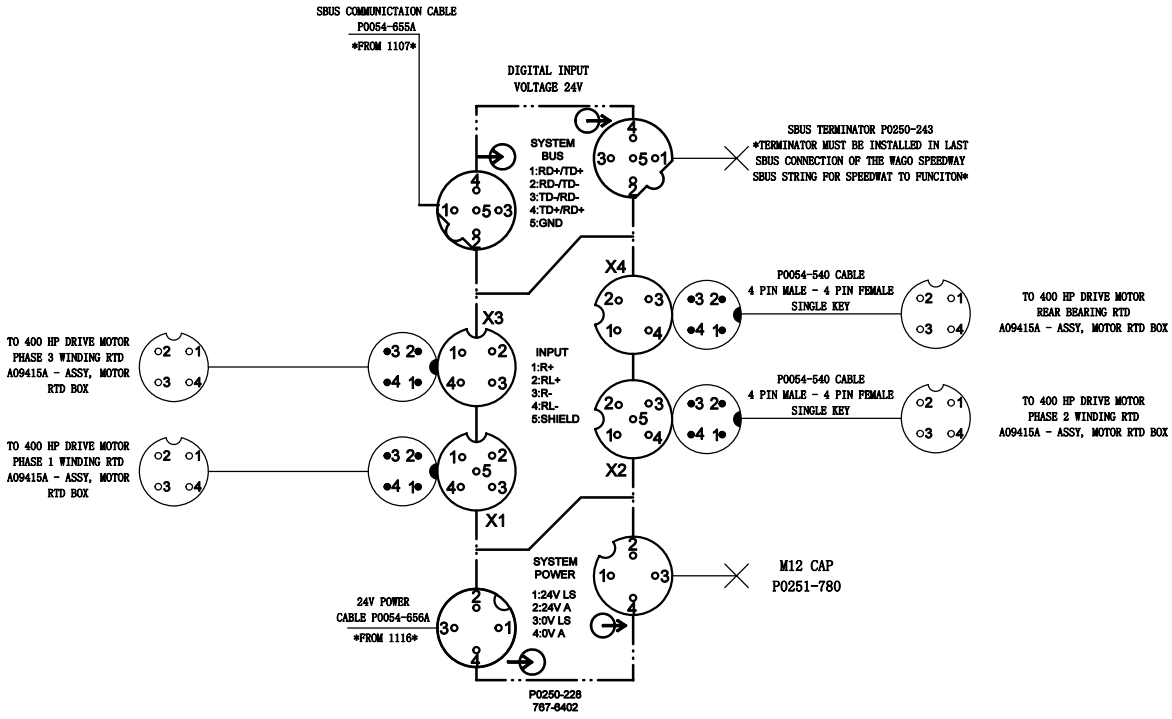
1100
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SL82P (SN FA09600F-01 & 2) MTBM Speedway I/O Module Schematics (continued)
Schematic - Part 12 of 12

*SEE DRAWING A09415A - ASSY, MOTOR RTD BOX-SL86 MTBM FOR TERMINAL LAYOUT OF THE 400 HP MOTOR RTD CONNECTIONS.

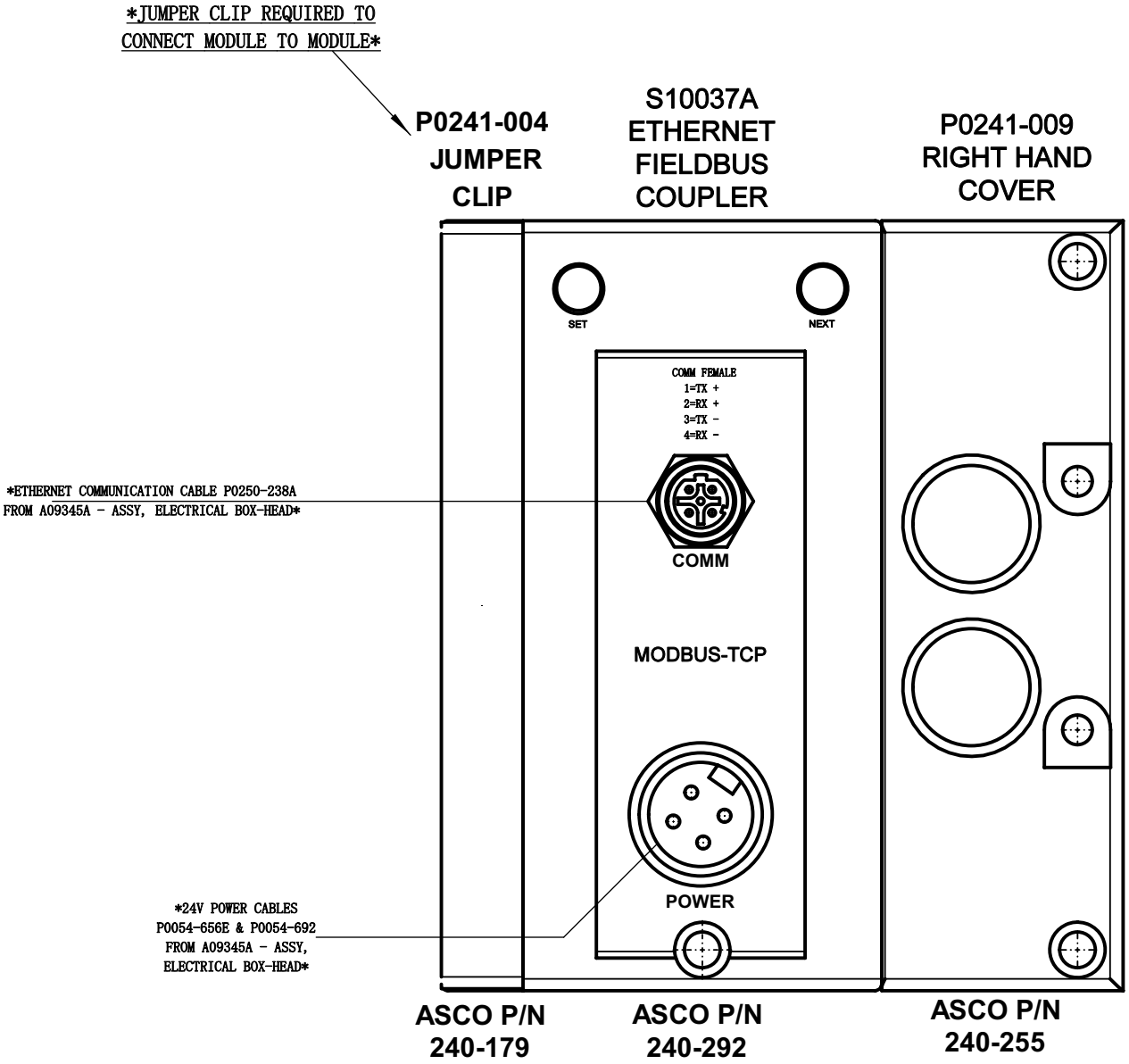
IOM #12
(BACK SECTION)



SL82P MTBM ASCO I/O MODULE SCHEMATICS
SN: FA09600F-03 & AFTER

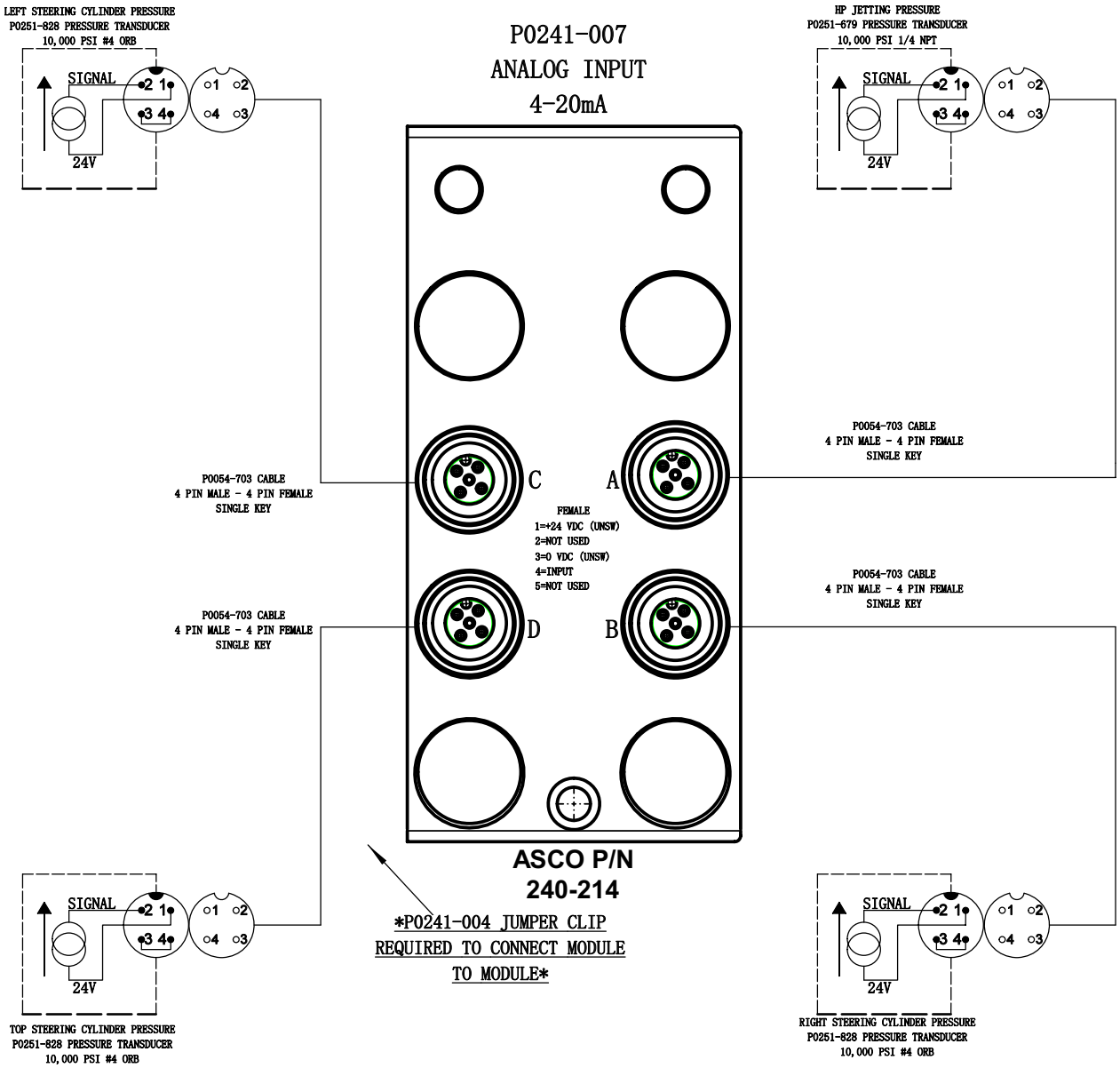
Module Schematic - Part 1 of 12

IOM #1
(FRONT SECTION)



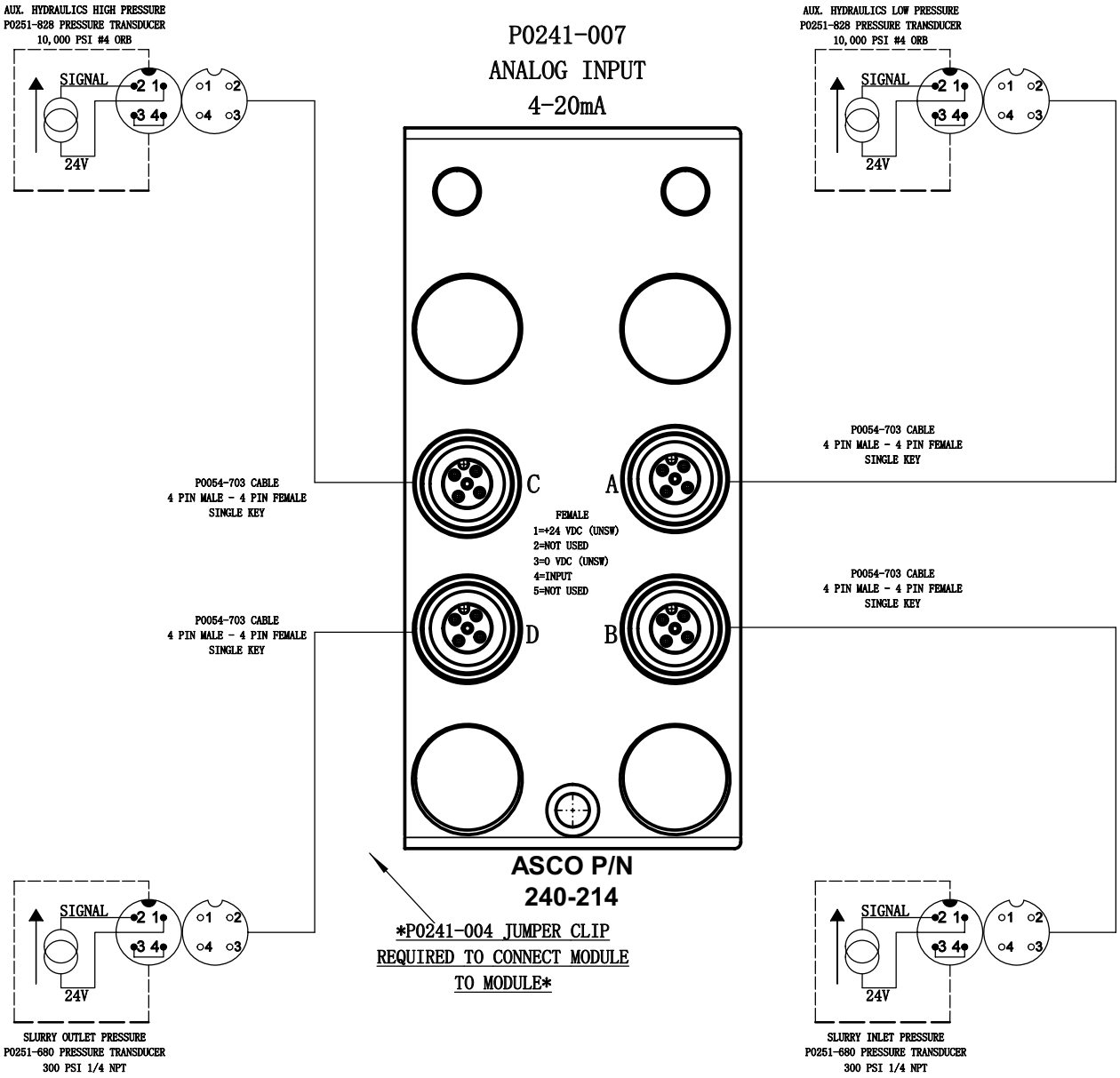
SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 2 of 12

IOM #2
(FRONT SECTION)



SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 3 of 12

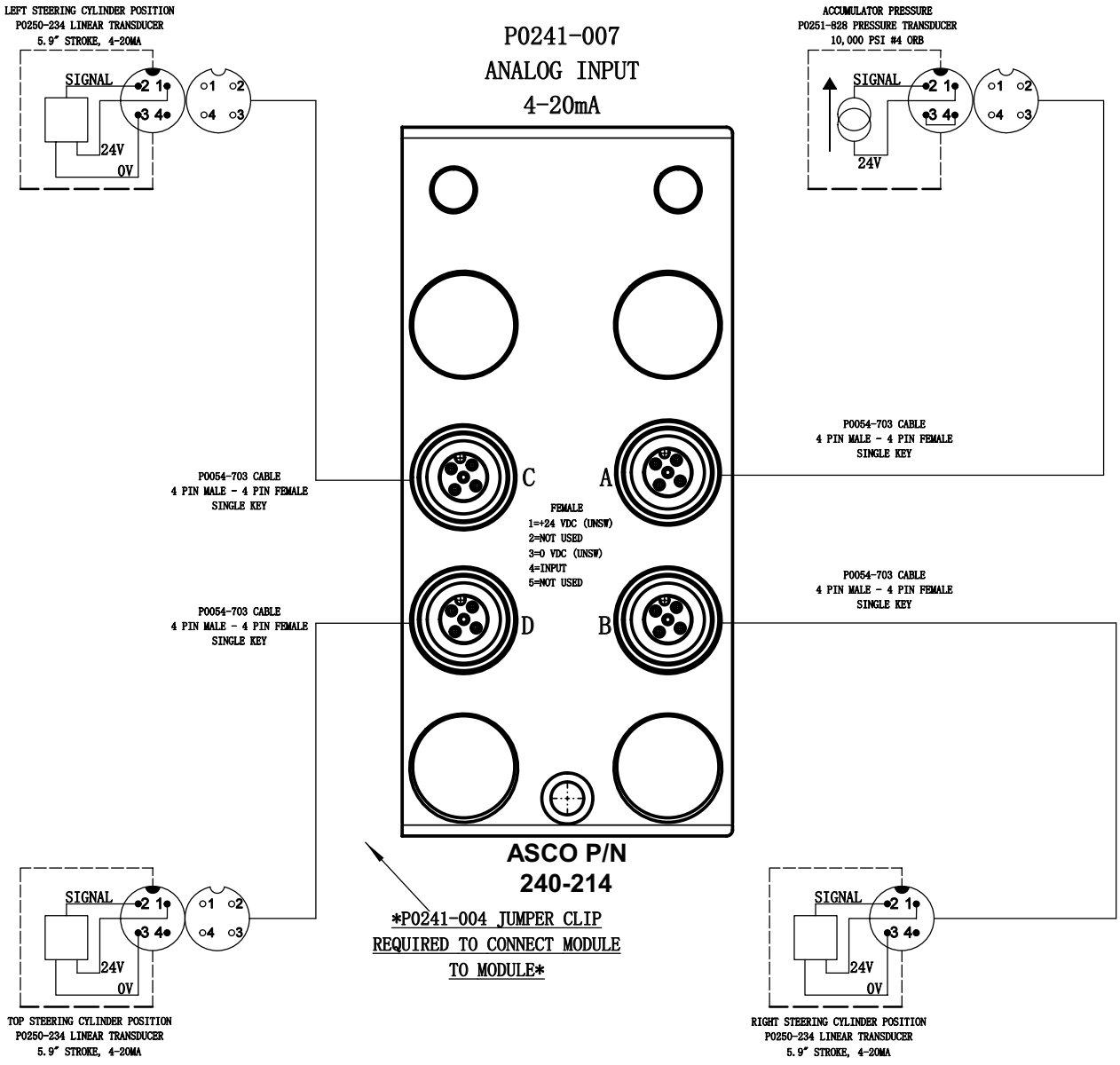
IOM #3
(FRONT SECTION)



SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)

Schematic - Part 4 of 12

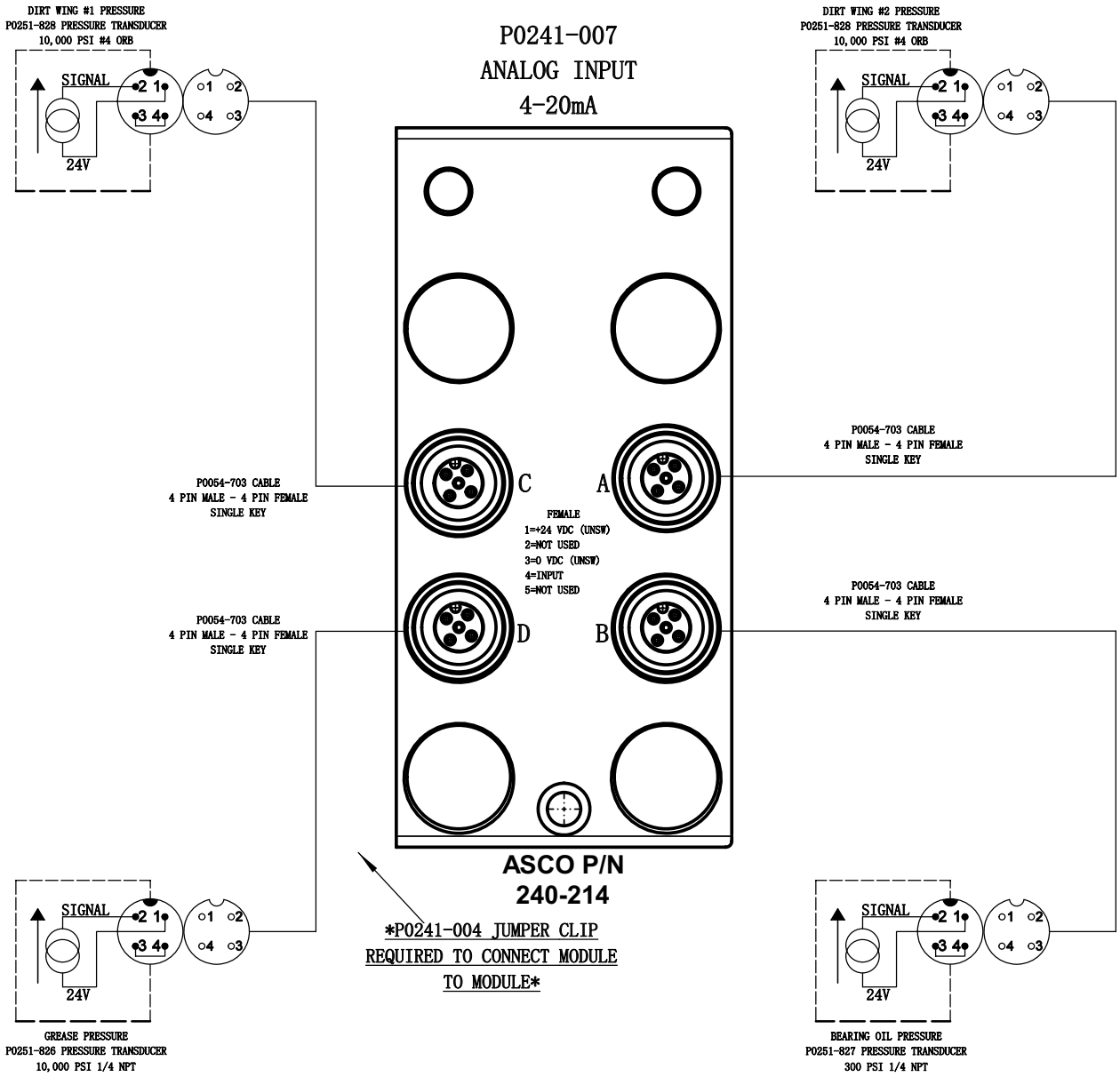
IOM #4
(FRONT SECTION)



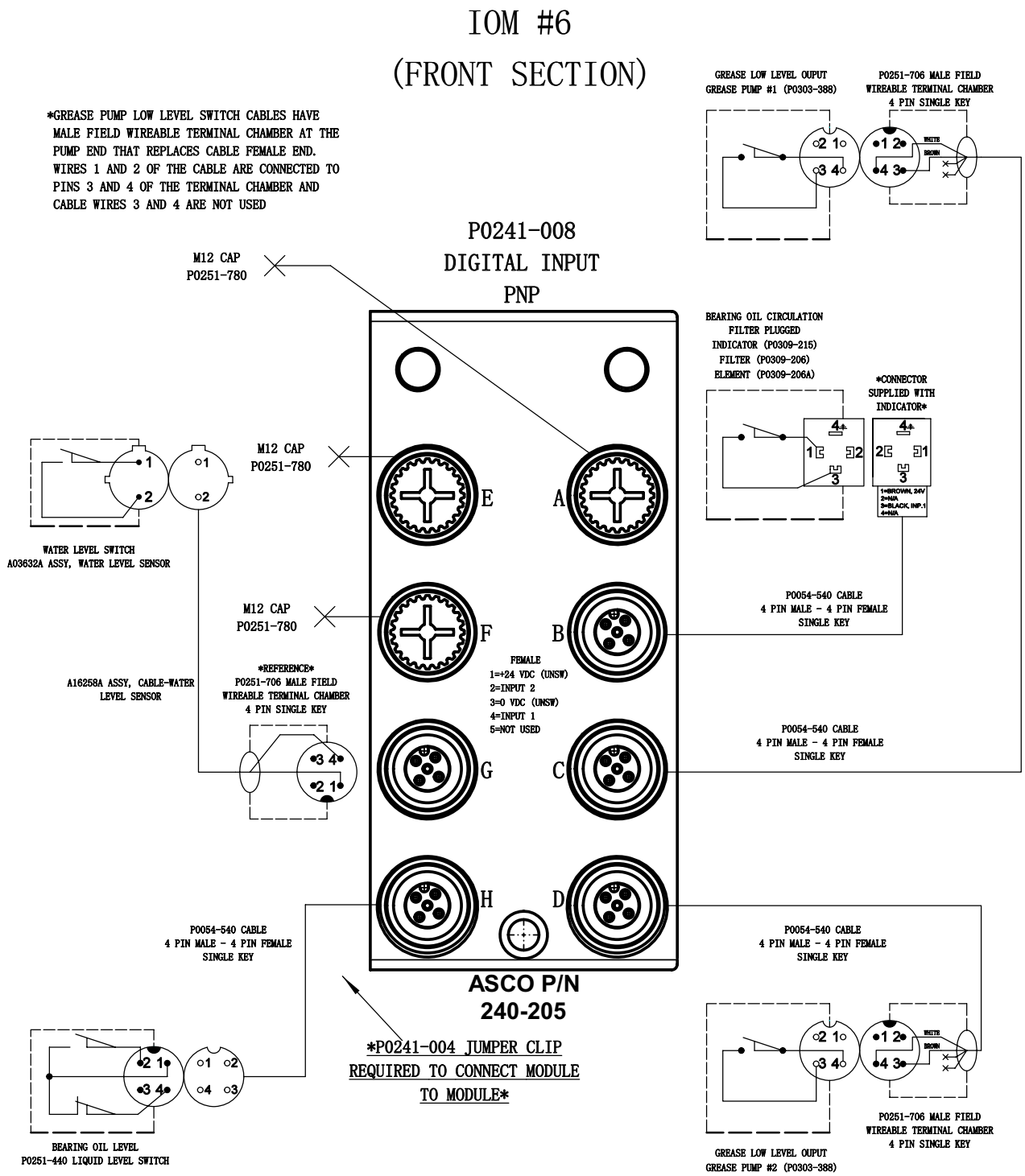
*LINEAR TRANSDUCER CABLES HAVE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END. CABLES WIRES ARE CONNECTED TO THE CORRESPONDING TERMINAL CHAMBER PIN, I.E., 1-1, 2-2, 3-3, & 4-4. TERMINAL CHAMBER PINS 3 AND 4 SHOULD ALSO BE JUMPERED TOGETHER.

SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 5 of 12

IOM #5
(FRONT SECTION)

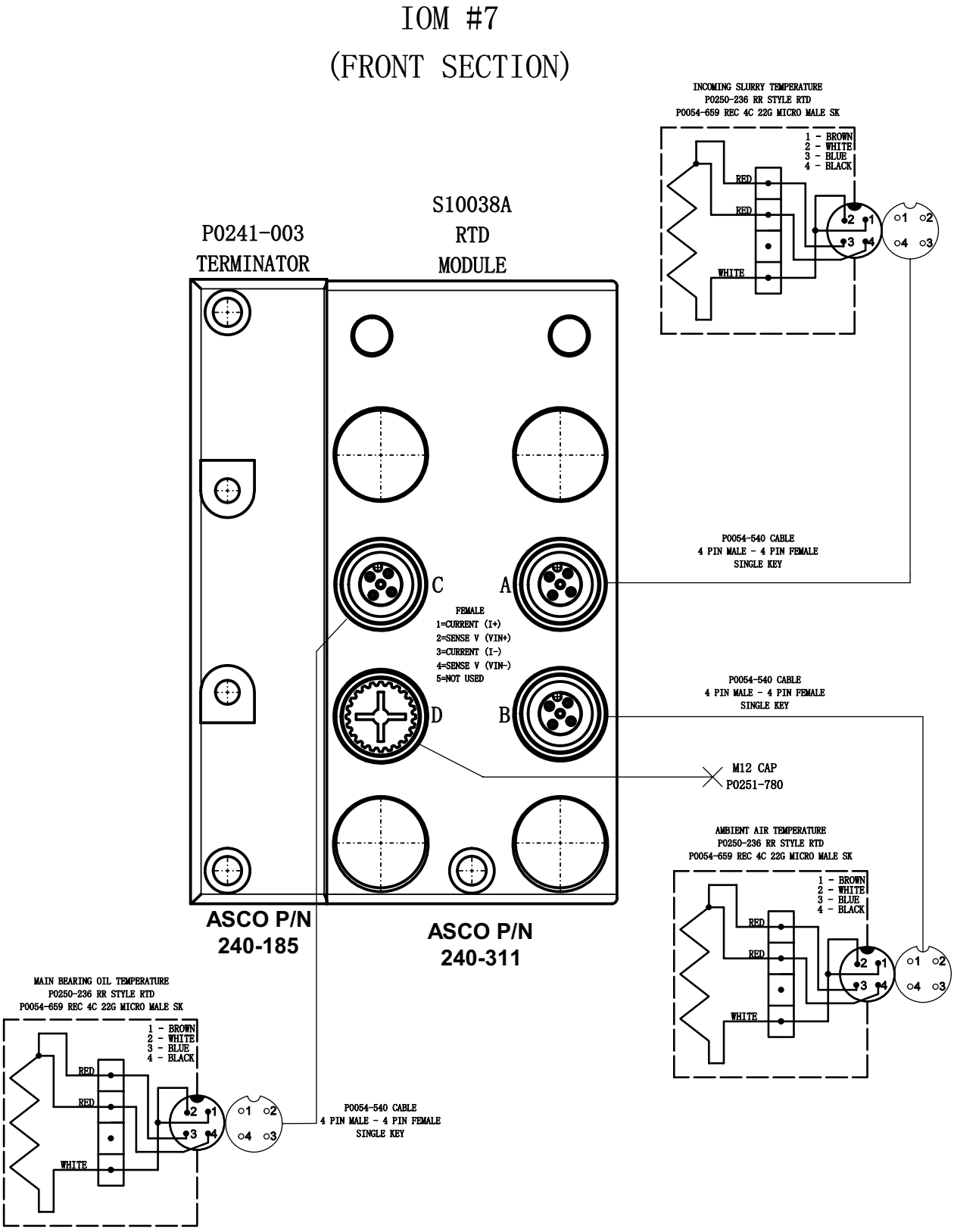


SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 6 of 12



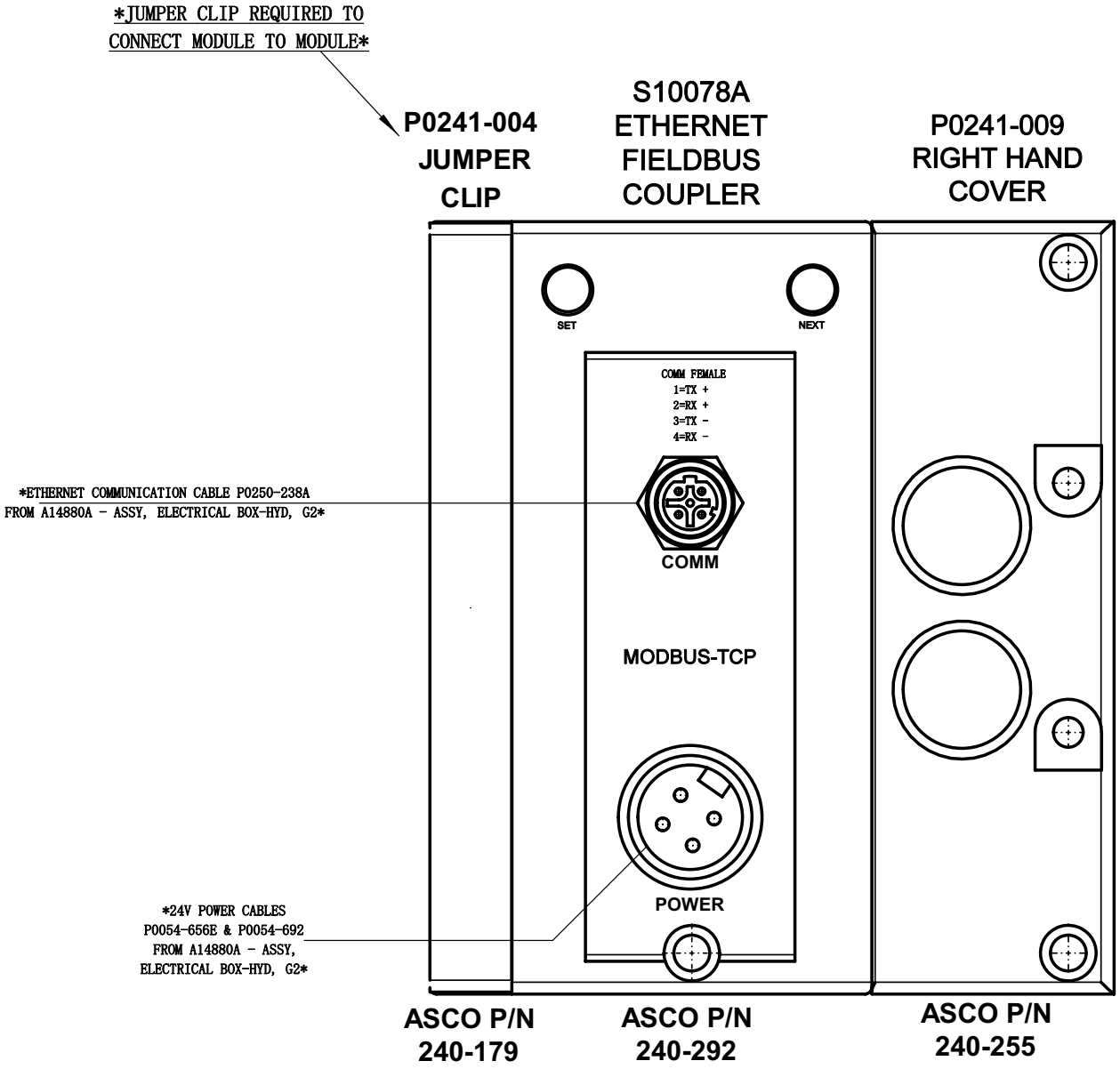
SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)

Schematic - Part 7 of 12

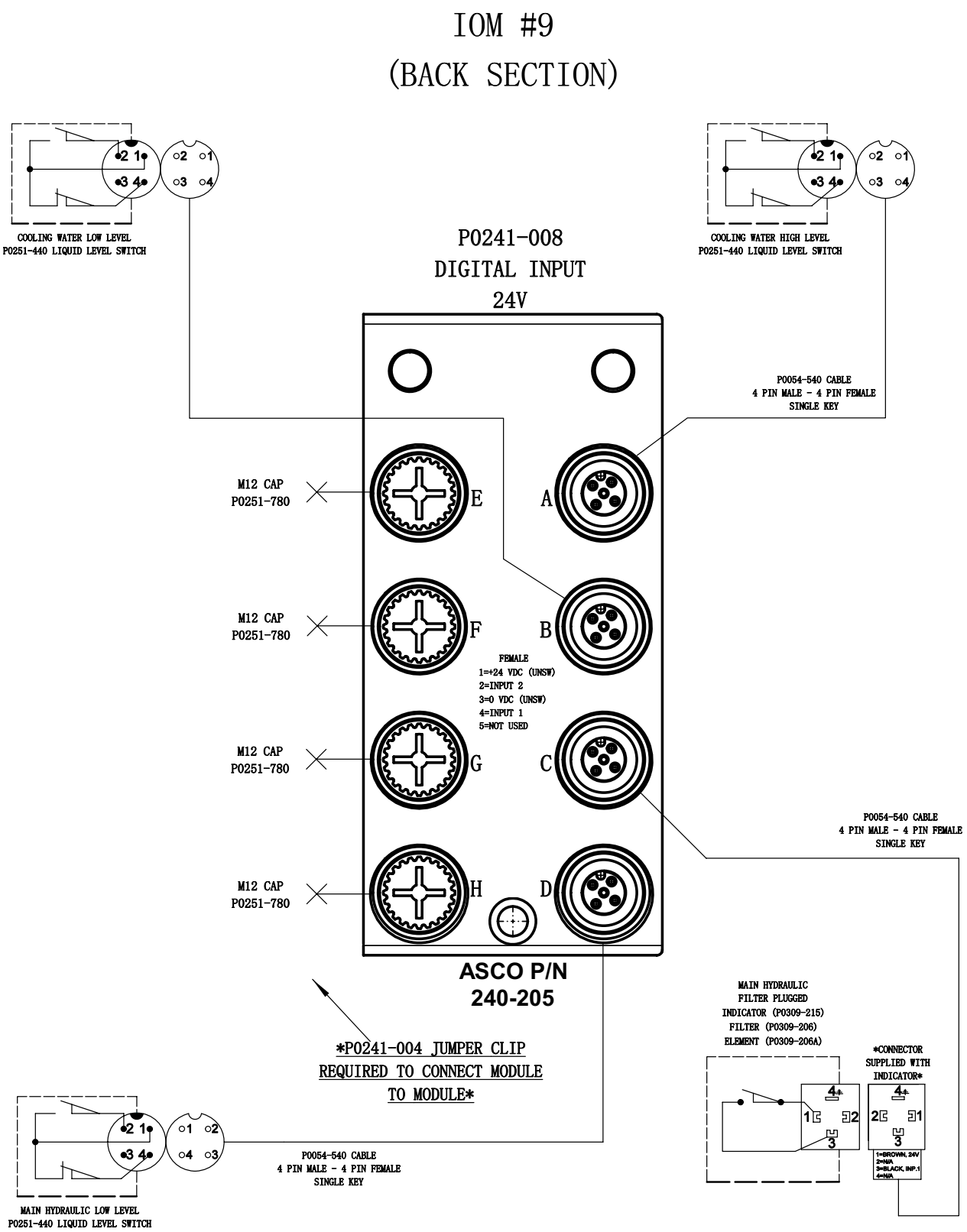


SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 8 of 12

IOM #8
(BACK SECTION)

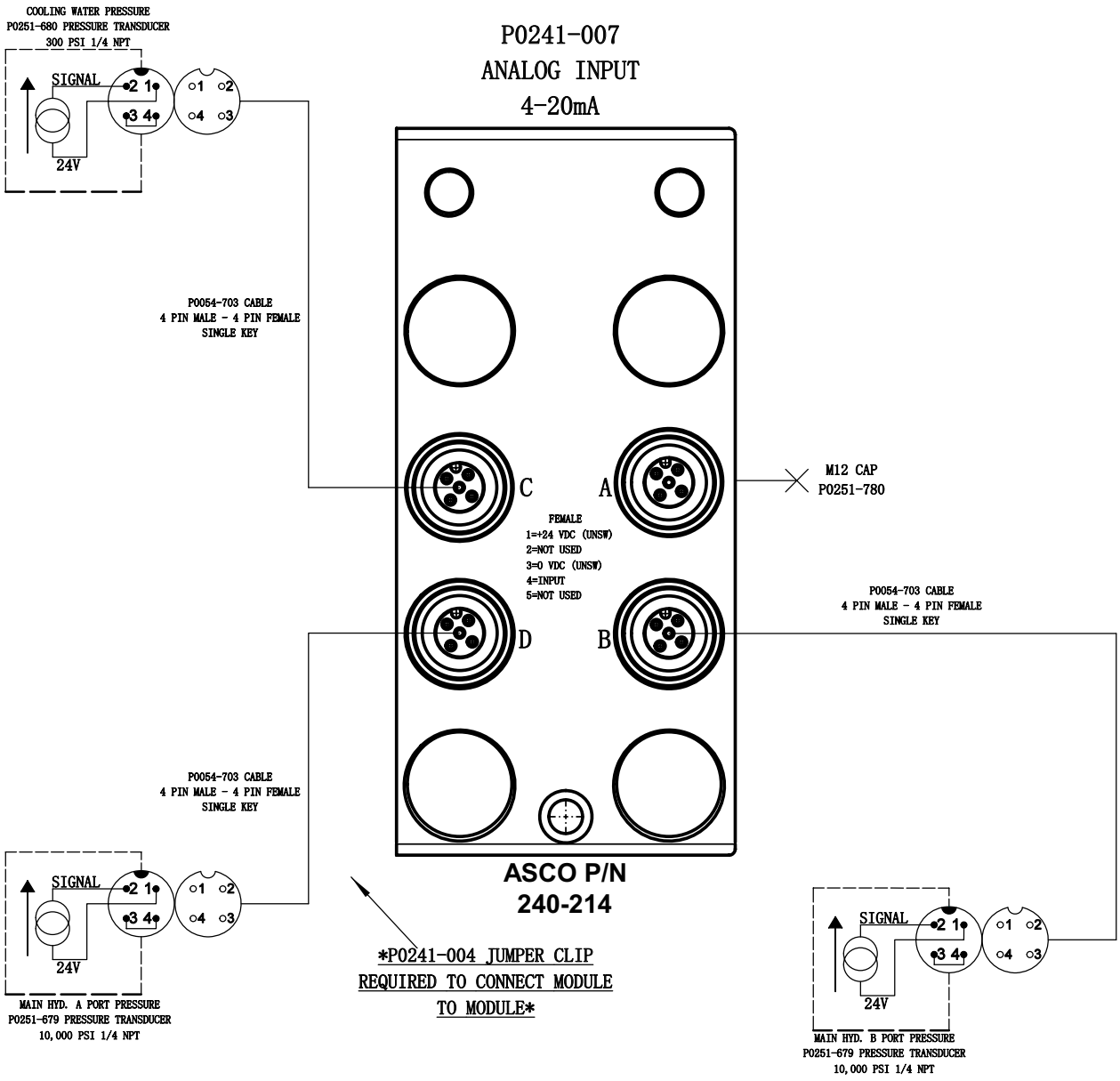


SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 9 of 12



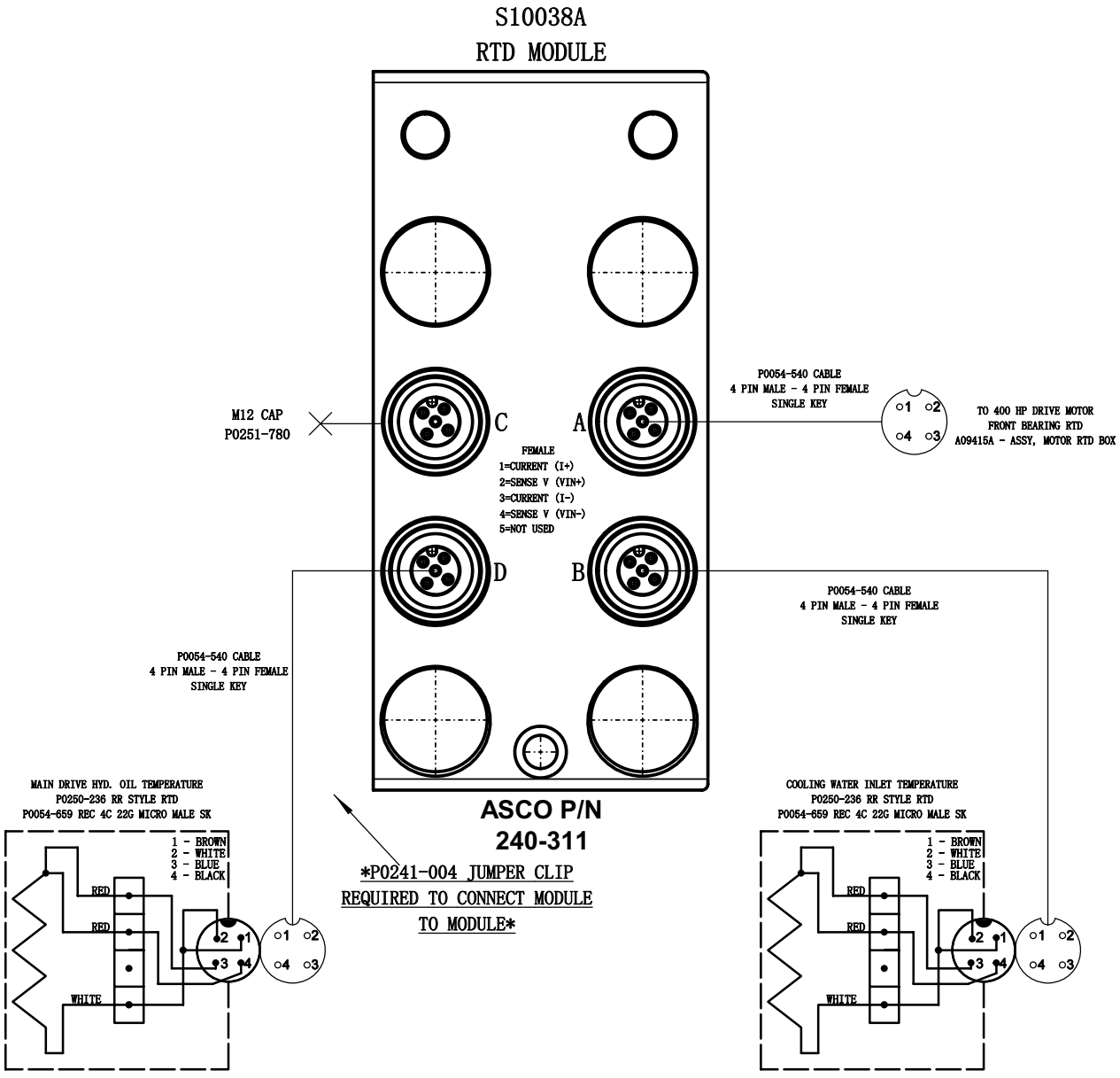
SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 10 of 12

IOM #10
(BACK SECTION)

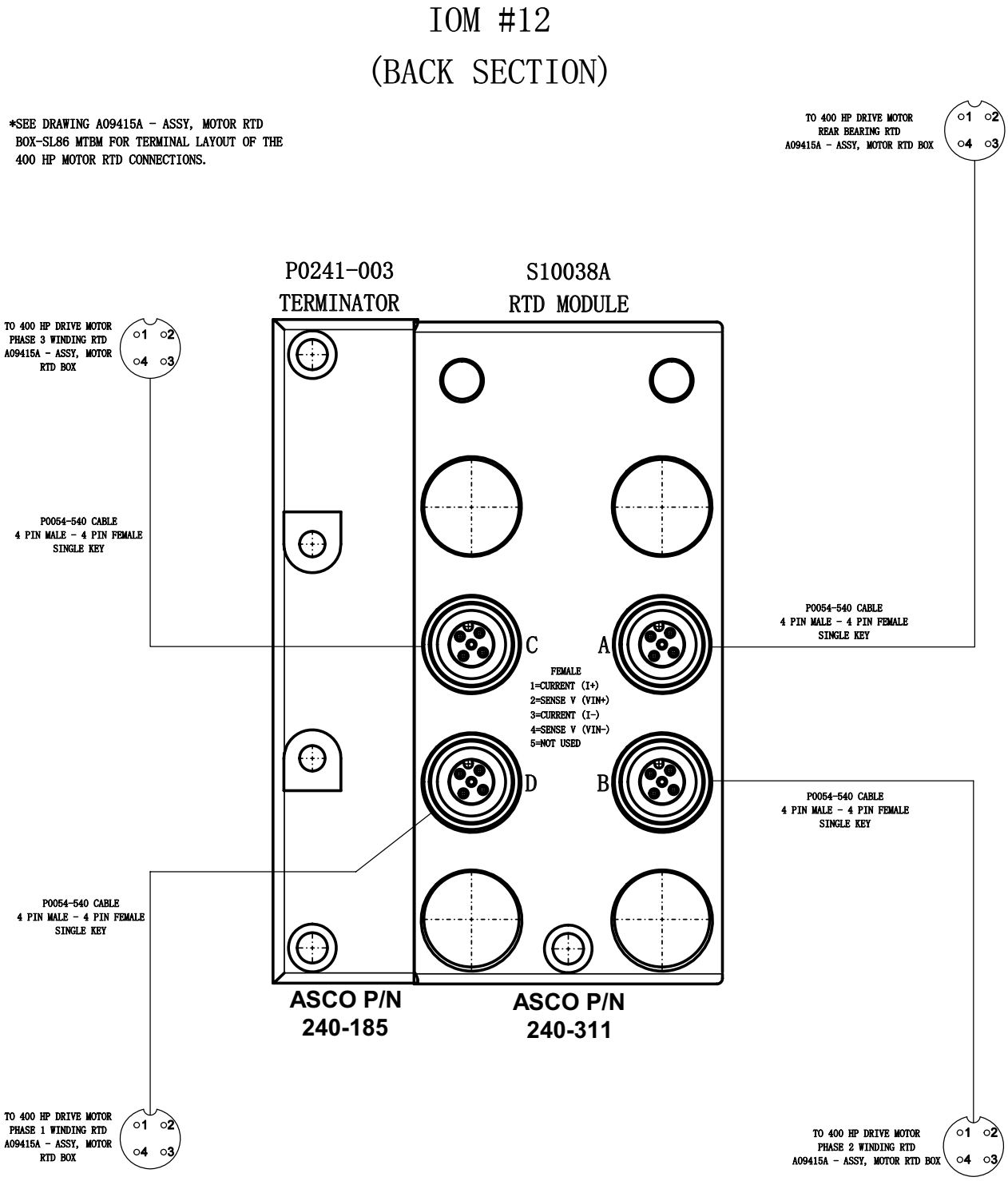


SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 11 of 12

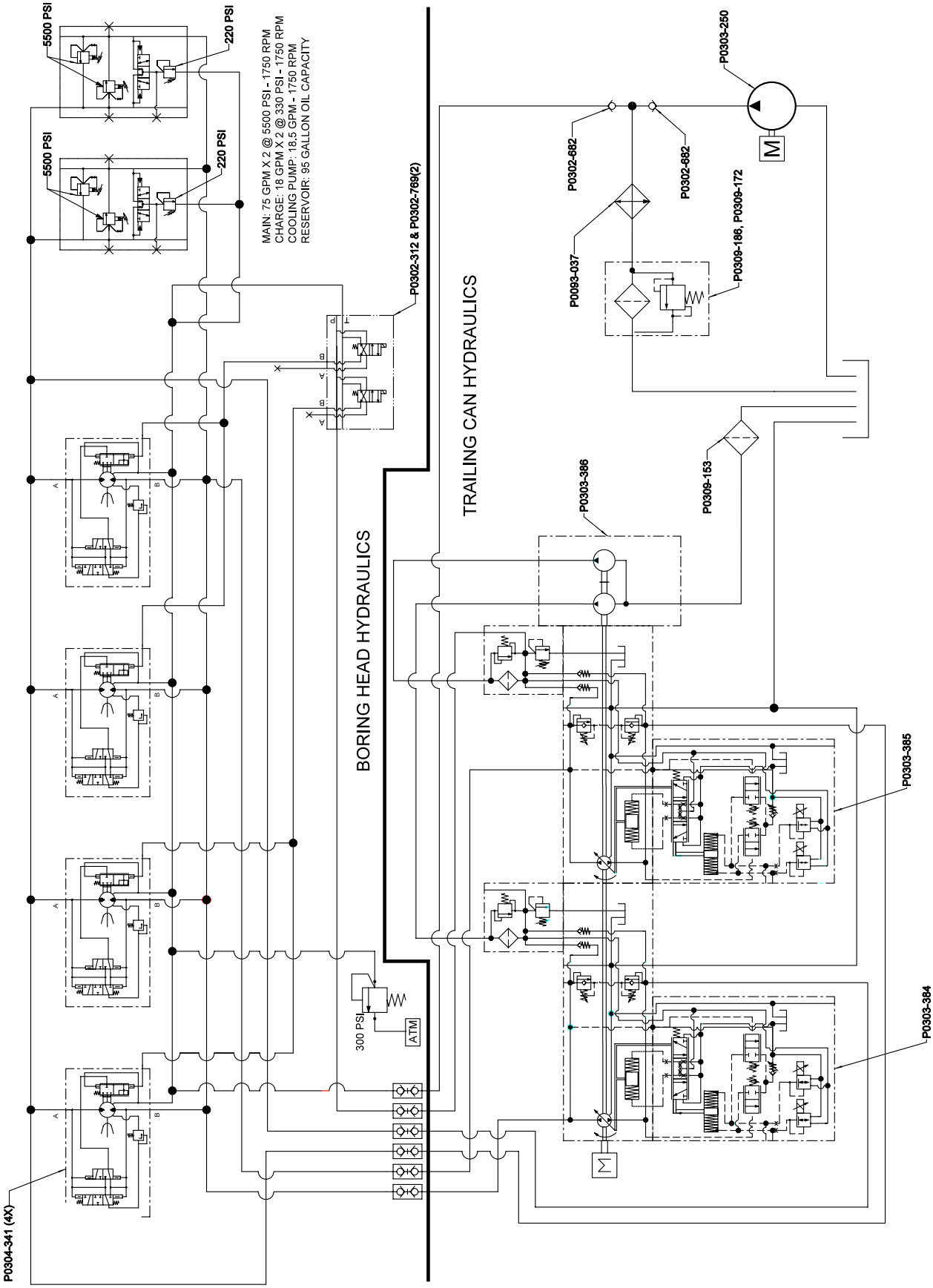
IOM #11
(BACK SECTION)



SL82P (SN FA09600F-03 & After) MTBM Asco I/O Module Schematics (continued)
Schematic - Part 12 of 12

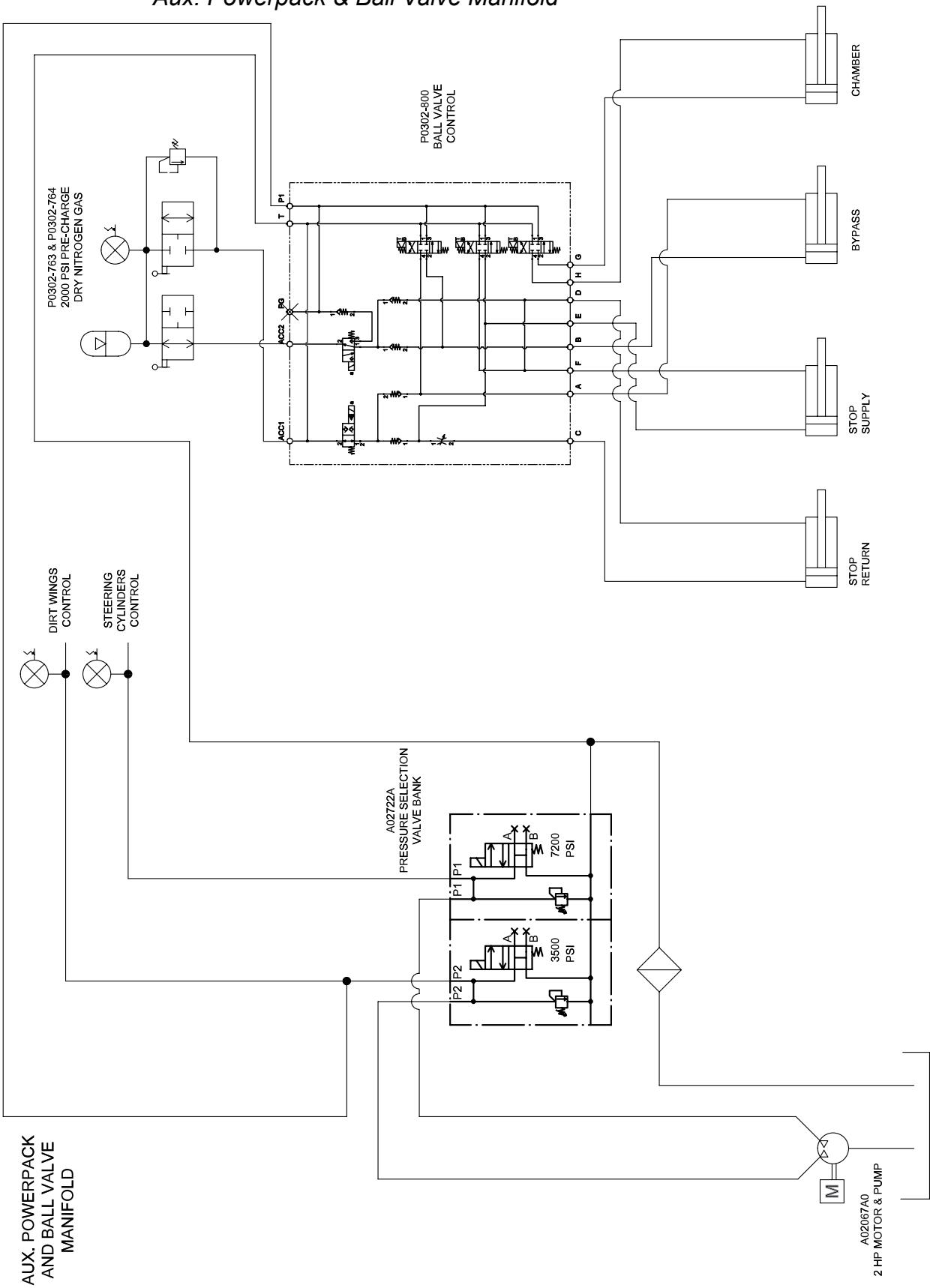


SL82P MTBM MAIN HYDRAULIC SCHEMATICS

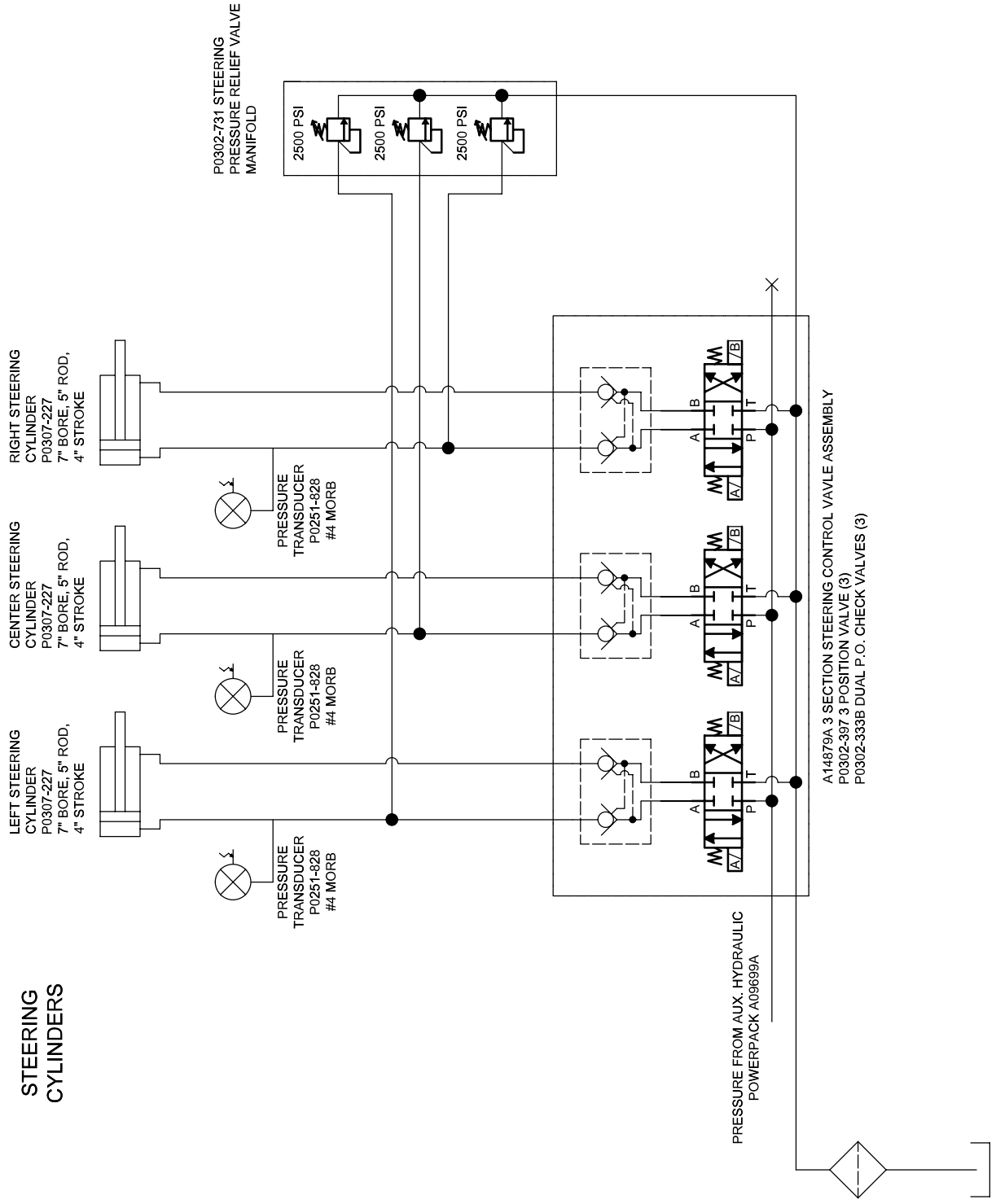


SL82P MTBM AUXILIARY HYDRAULIC SCHEMATIC

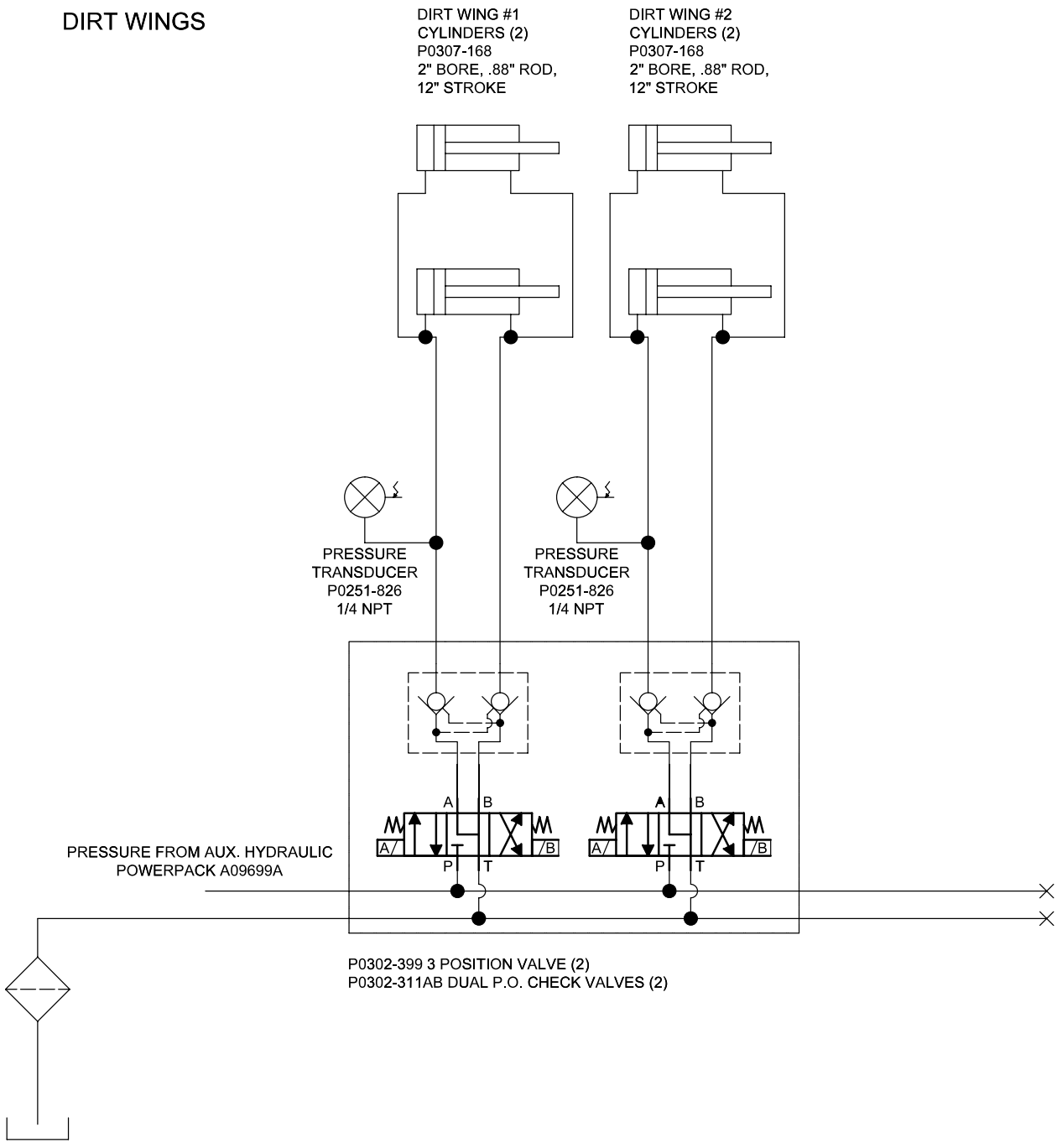
MTBM Auxiliary Hydraulic Schematic - Part 1 of 3
- Aux. Powerpack & Ball Valve Manifold



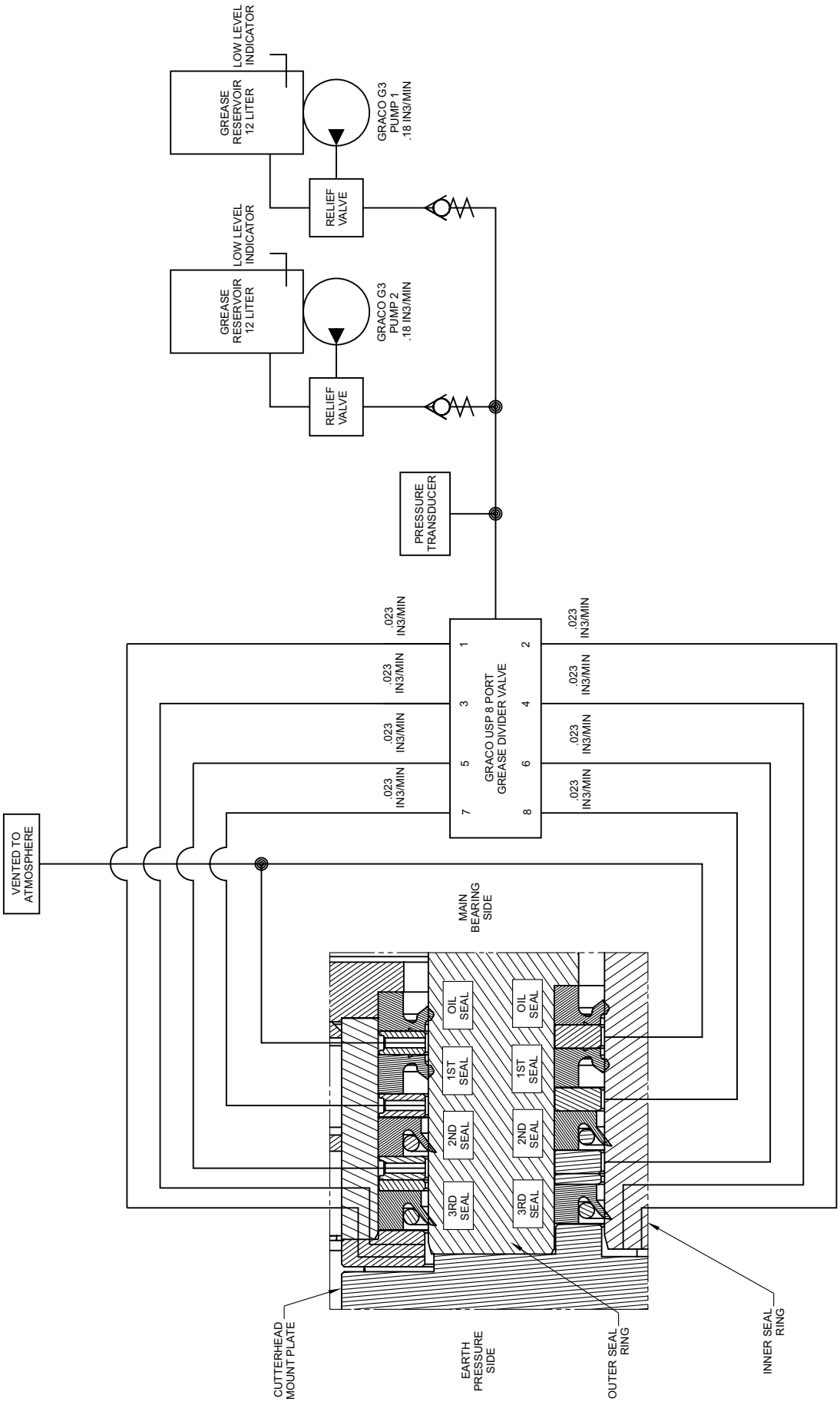
MTBM Auxiliary Hydraulic Schematic - Part 2 of 3 - Steering Cylinders



MTBM Auxiliary Hydraulic Schematic - Part 3 of 3 - Dirt Wings

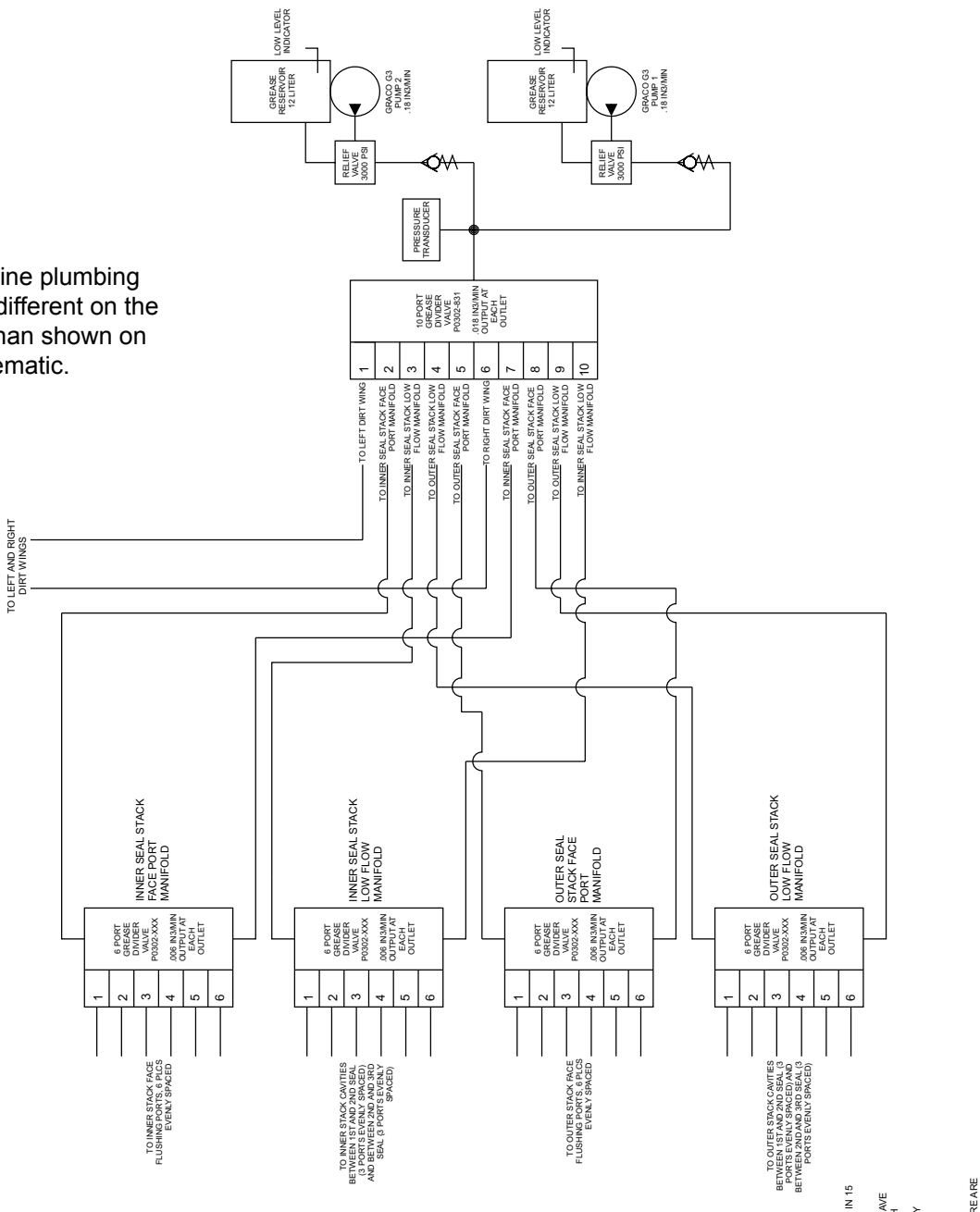


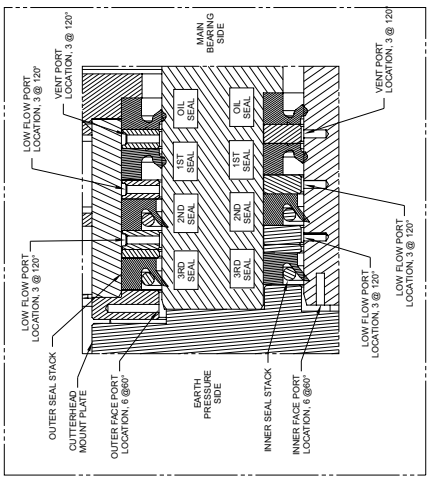
SL82P MAIN SEAL GREASE SCHEMATIC - SN: FA09600F-01



SL82P MAIN SEAL GREASE SCHEMATIC - SN: FA09600F-02 & AFTER

NOTE:
Grease line plumbing may be different on the MTBM than shown on this schematic.



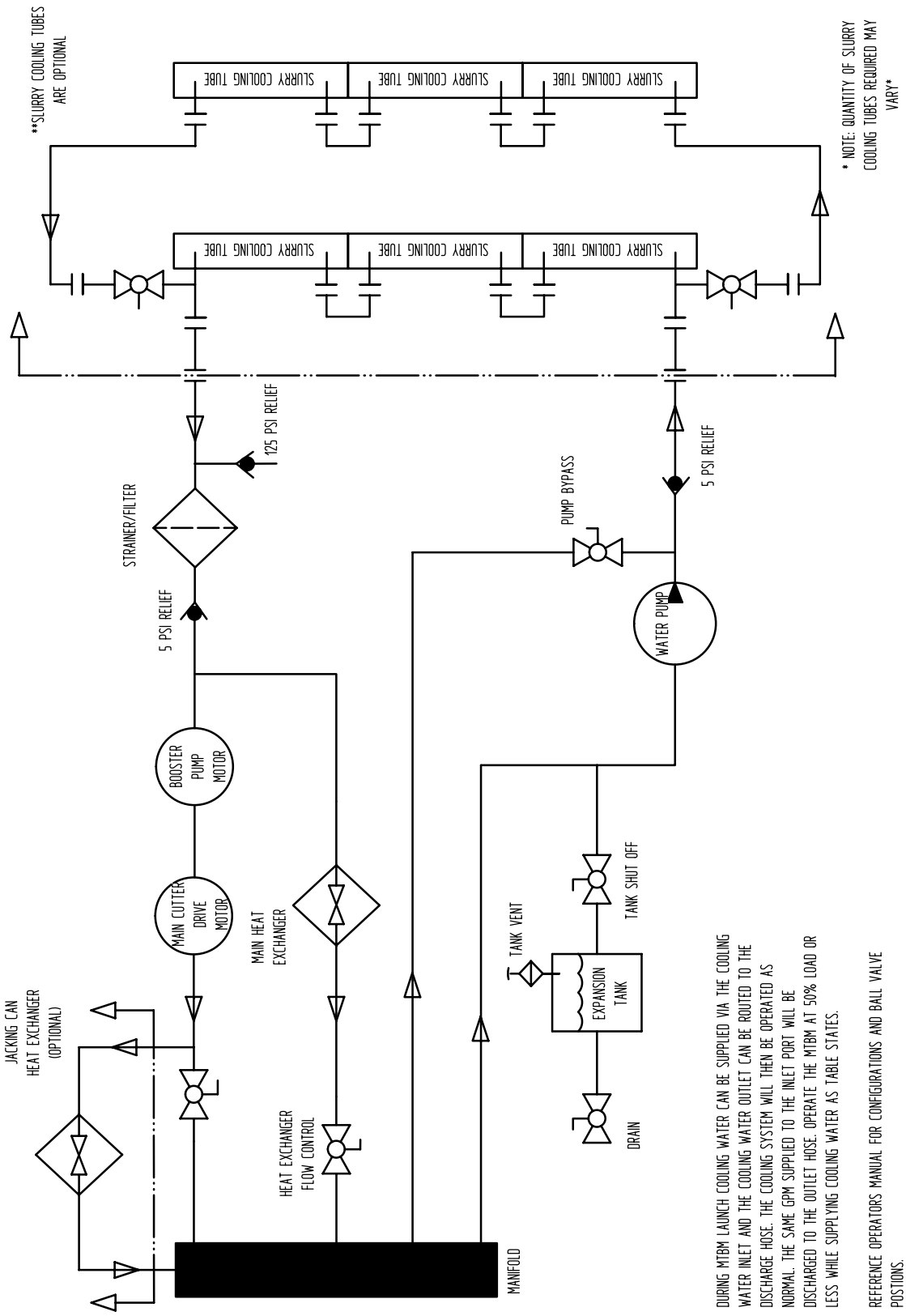


TYPICAL PERIPHERAL MTBM SEALING ARRANGEMENT

NOTES:

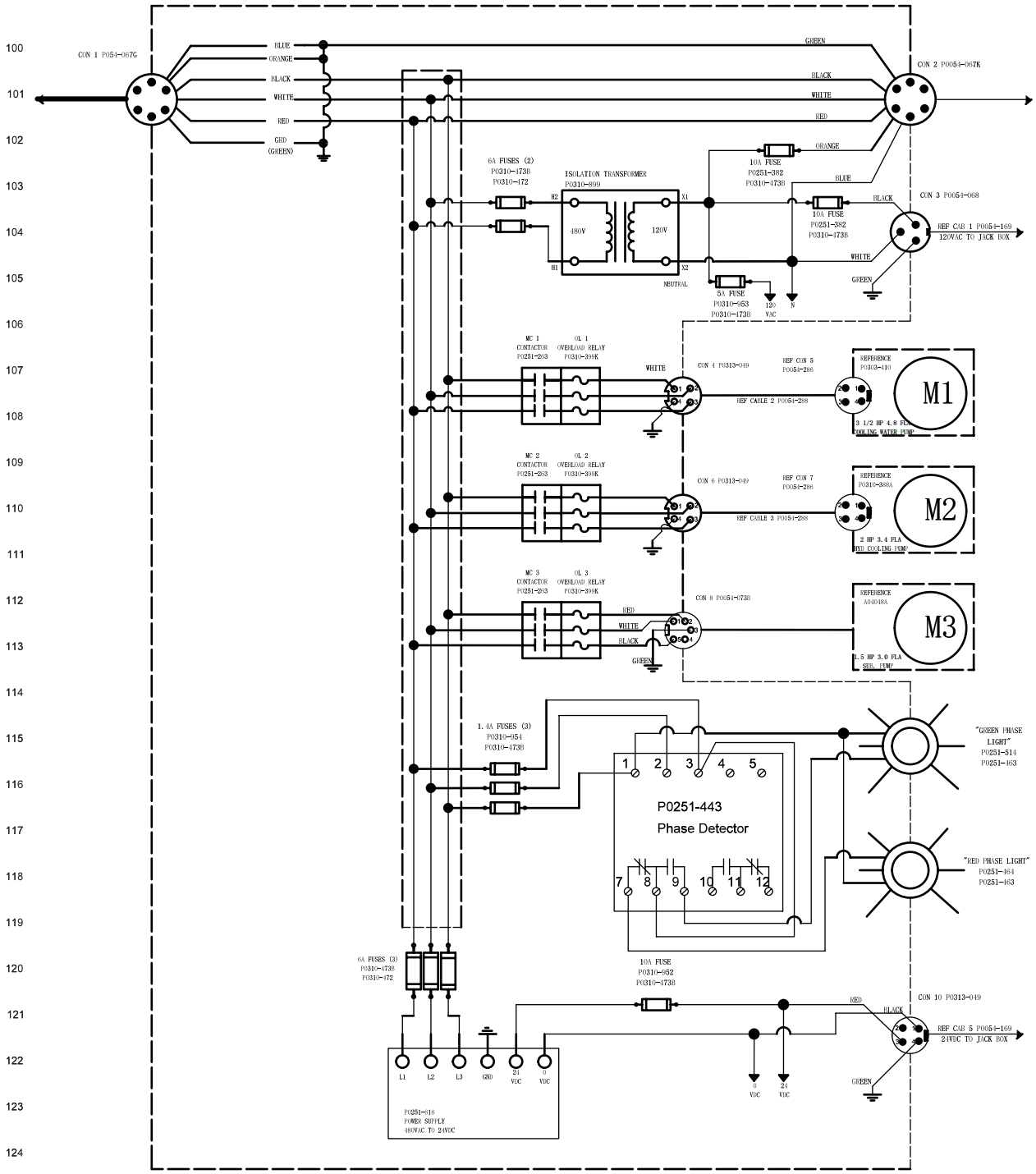
1. GRACO G3 GREASE PUMPS ARE CYCLED WITH ONE PUMP ON AND ONE PUMP OFF IN 15 MINUTES INCREMENTS
2. GRACO G3 DISPLACEMENT IS SET AT .18 CUBIC INCH PER MINUTE.
3. GRACO 10 PORT DIVIDER VALVE SERIES PROGRESSIVE OUTLET VALVES. THE VALVES HAVE 10 AND 6 PORTS AND EVENLY DIVIDE GREASE TO SUPPLY METERED FLOW TO EACH INDIVIDUAL INJECTION PORT.
4. BOTH INNER AND OUTER SEAL STACKS HAVE 6 GREASE INJECTION PONTS EVENLY SPACED TO FLUSH IN FRONT OF THE SEAL STACKS.
5. GREASE IS PUMPED BETWEEN THIRD AND SECOND SEALS AS WELL AS BETWEEN SECOND AND FIRST SEALS. THERE ARE THREE EVENLY SPACED INJECTION POINTS BETWEEN EACH PAIR OF SEALS FOR BOTH INNER AND OUTER SEAL STACKS.
6. GREASE BETWEEN FIRST SEAL AND FIRST SEAL IS PUMPED TO OUTSIDE AND THERE ARE THREE VENT PORTS EVENLY SPACED FOR BOTH INNER AND OUTER SEALS.

SL82P MTBM WATER COOLING SYSTEM SCHEMATIC



MTBM TRAILING SECTION CONTROL BOX ELECTRICAL SCHEMATICS - SL74P SN FA16175F

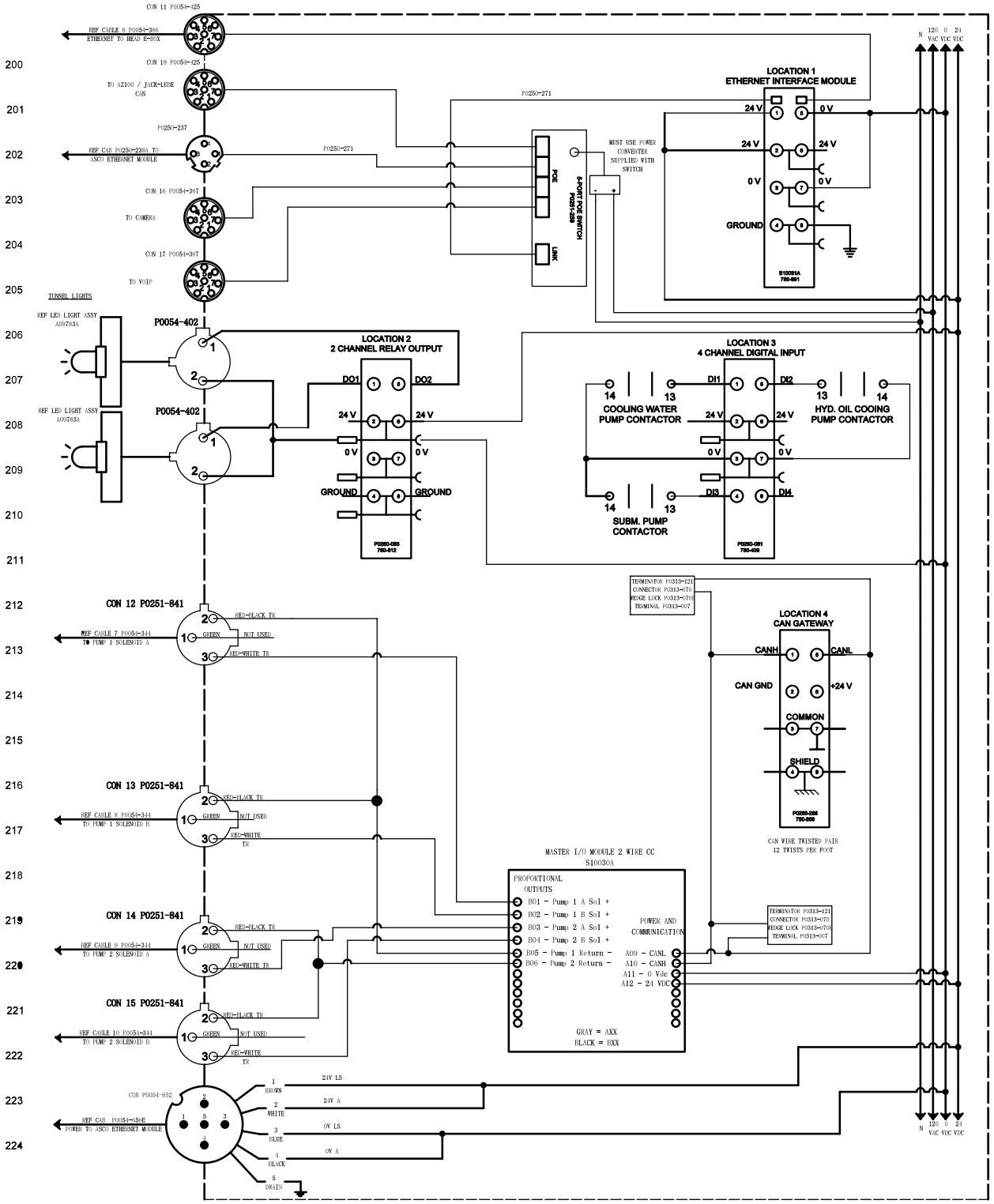
Electrical Schematic - Part 1 of 3



(continued on next page)

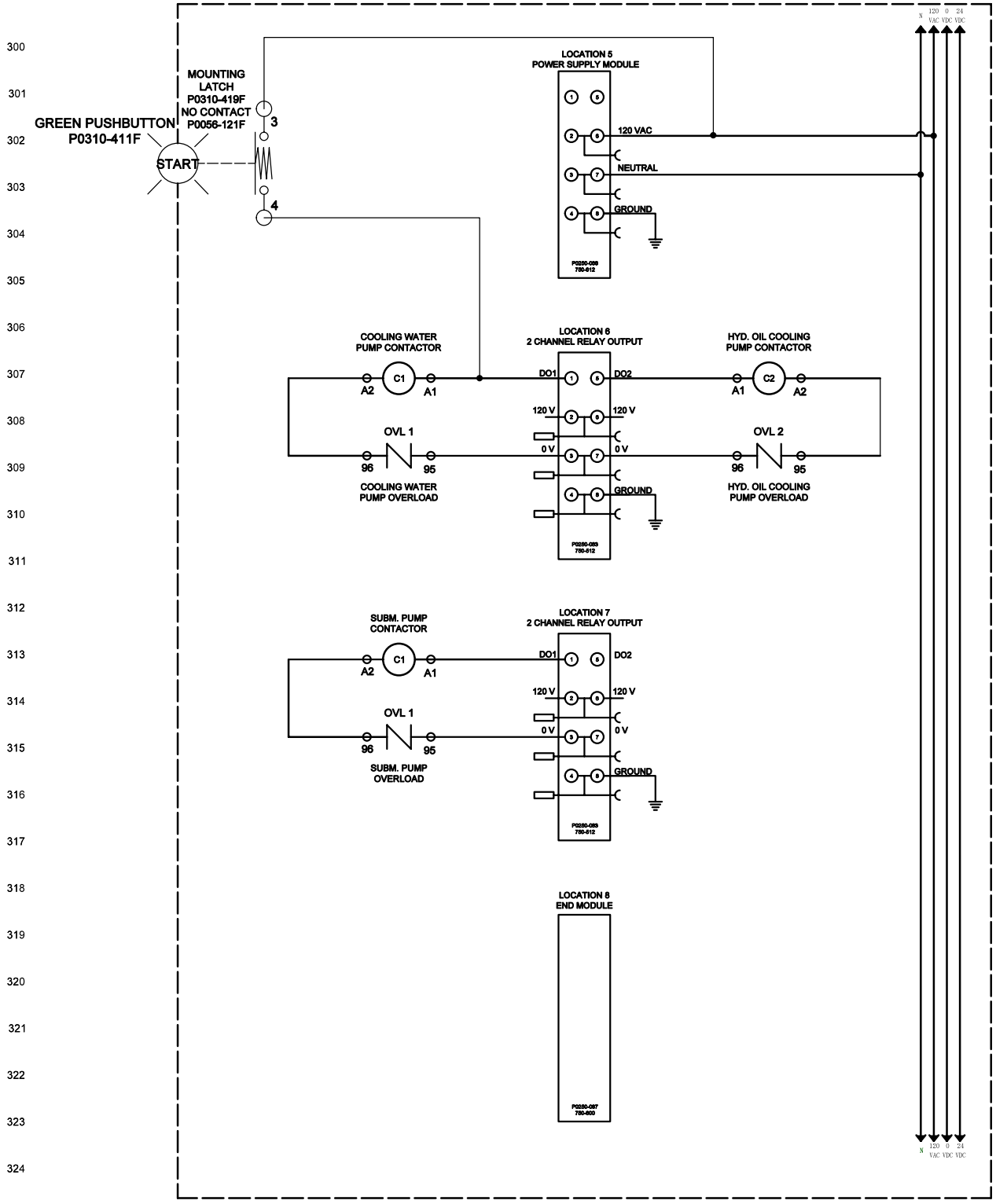
MTBM Trailing Section Electrical Schematics (continued)

Electrical Schematic - Part 2 of 3

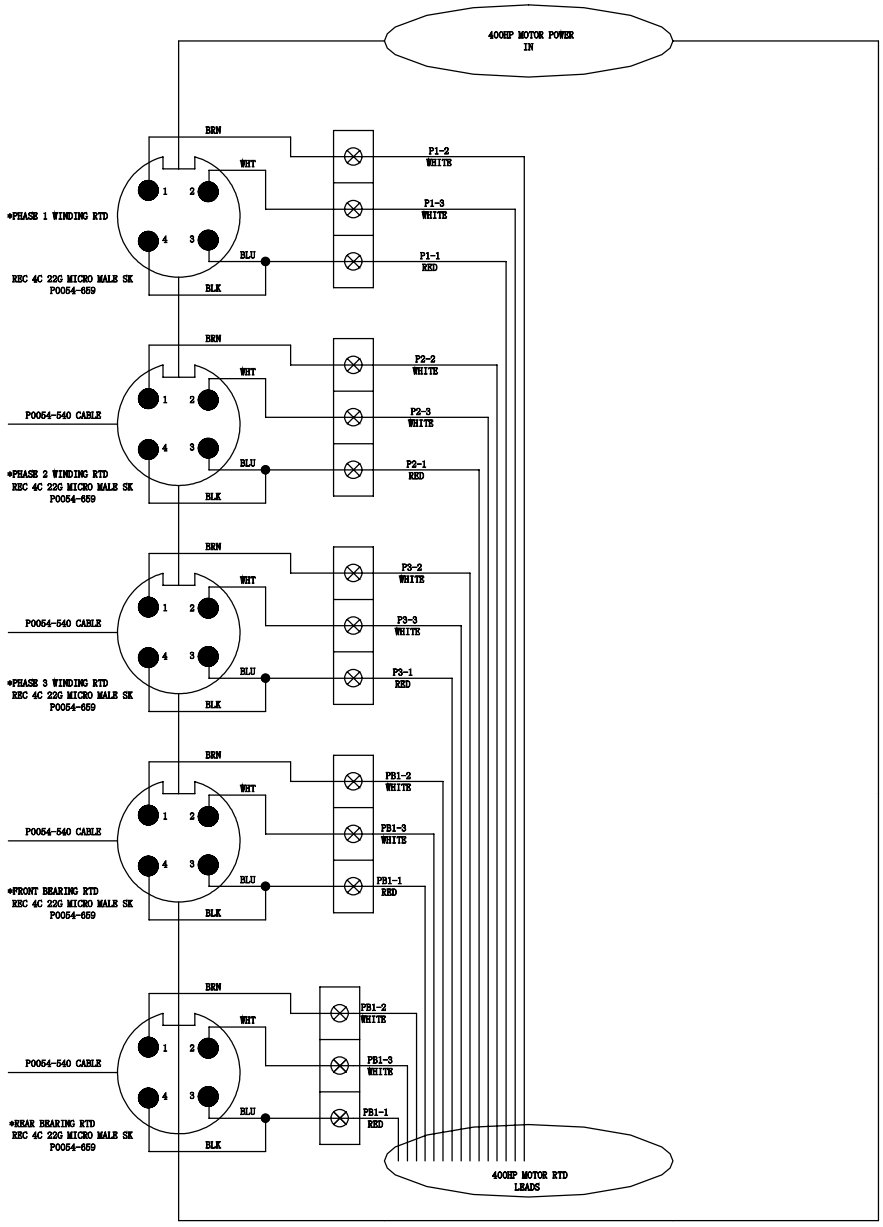


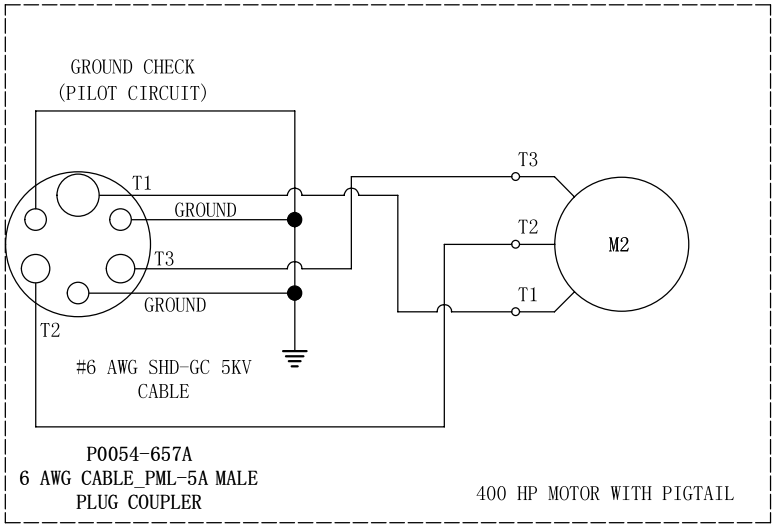
(continued on next page)

MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 3 of 3



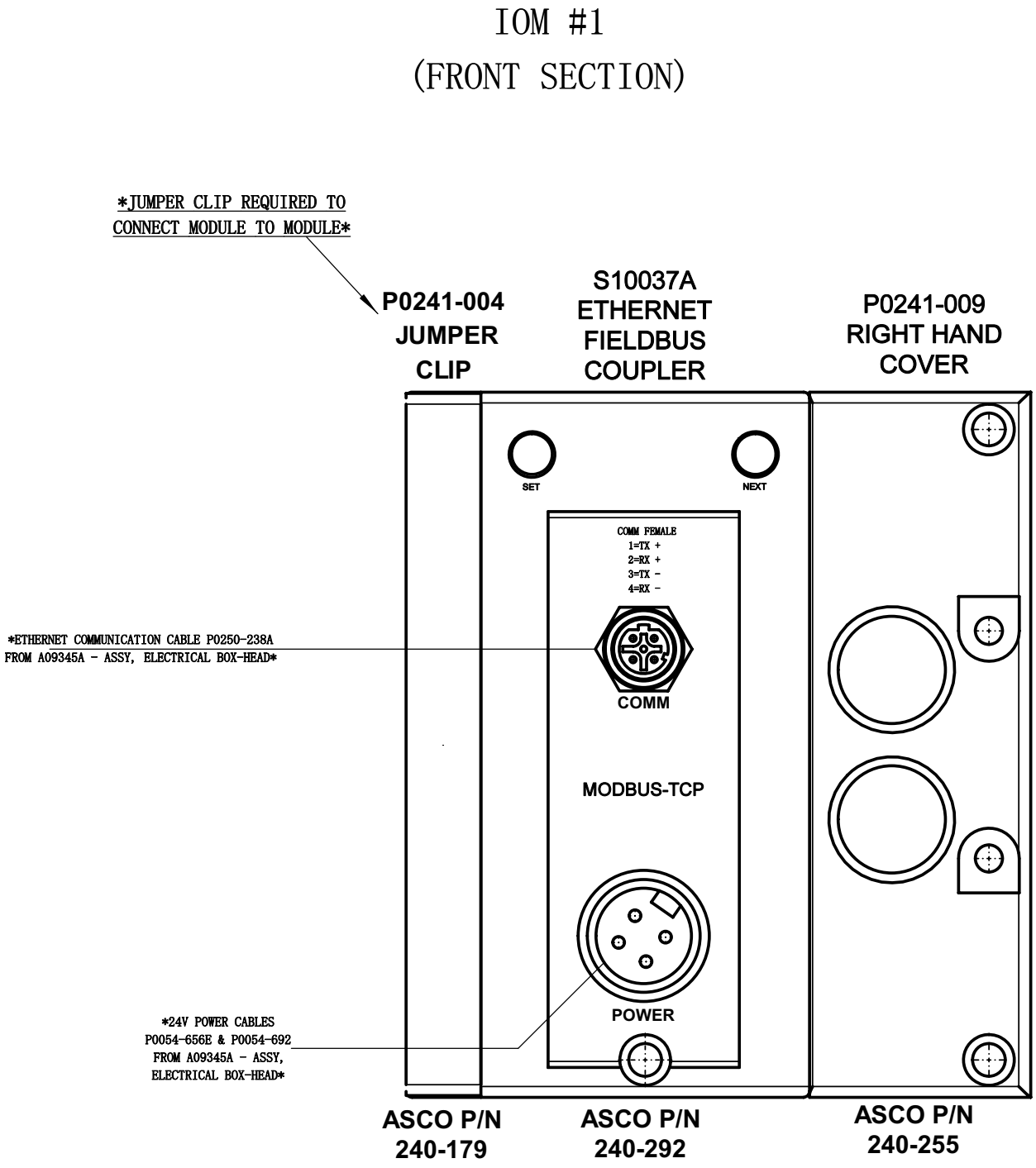
MTBM DRIVE MOTOR 400 HP ELECTRICAL SCHEMATIC - SL74P SN: FA16175F





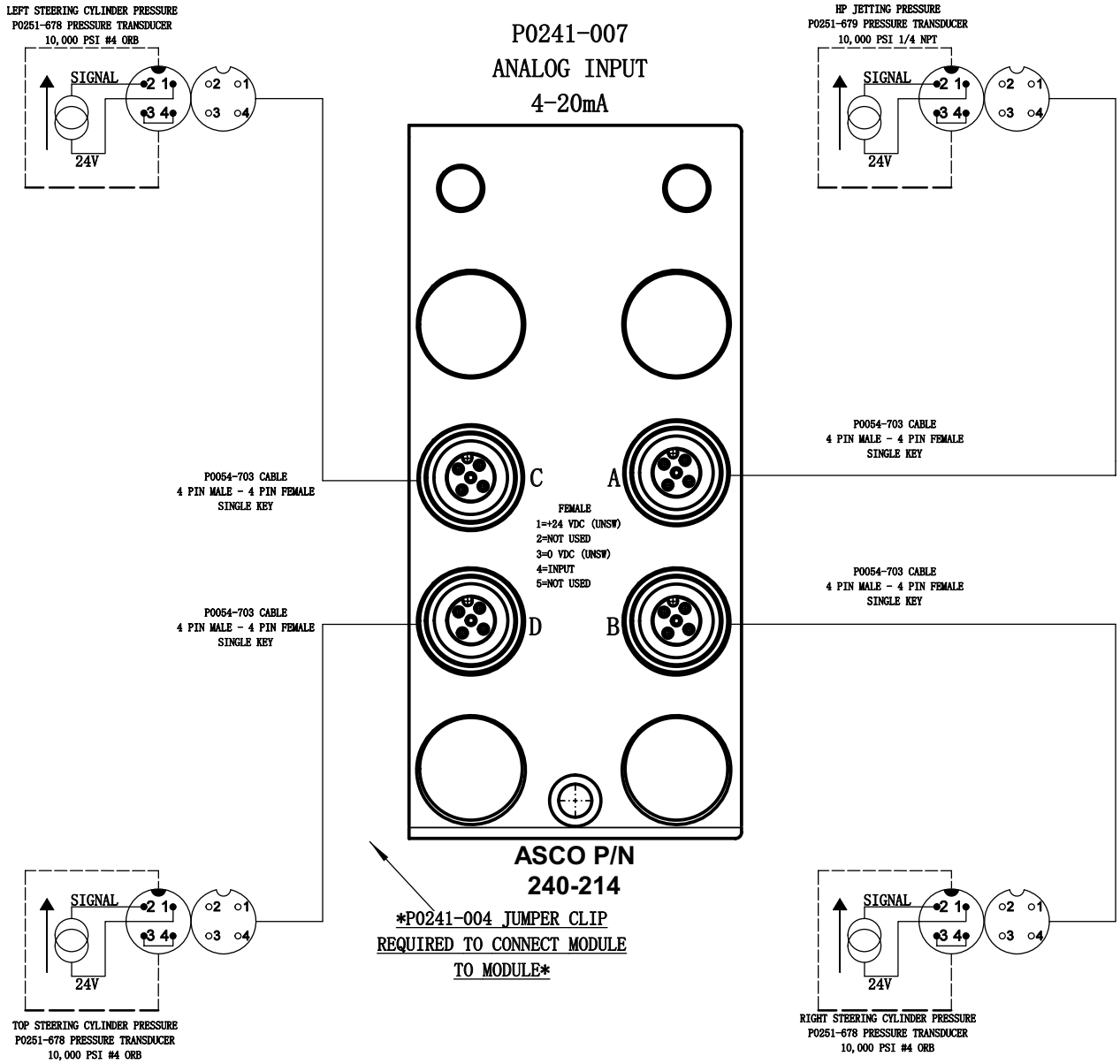
SL74P (SN FA16175F) MTBM ASCO I/O MODULE SCHEMATICS

Schematic - Part 1 of 12



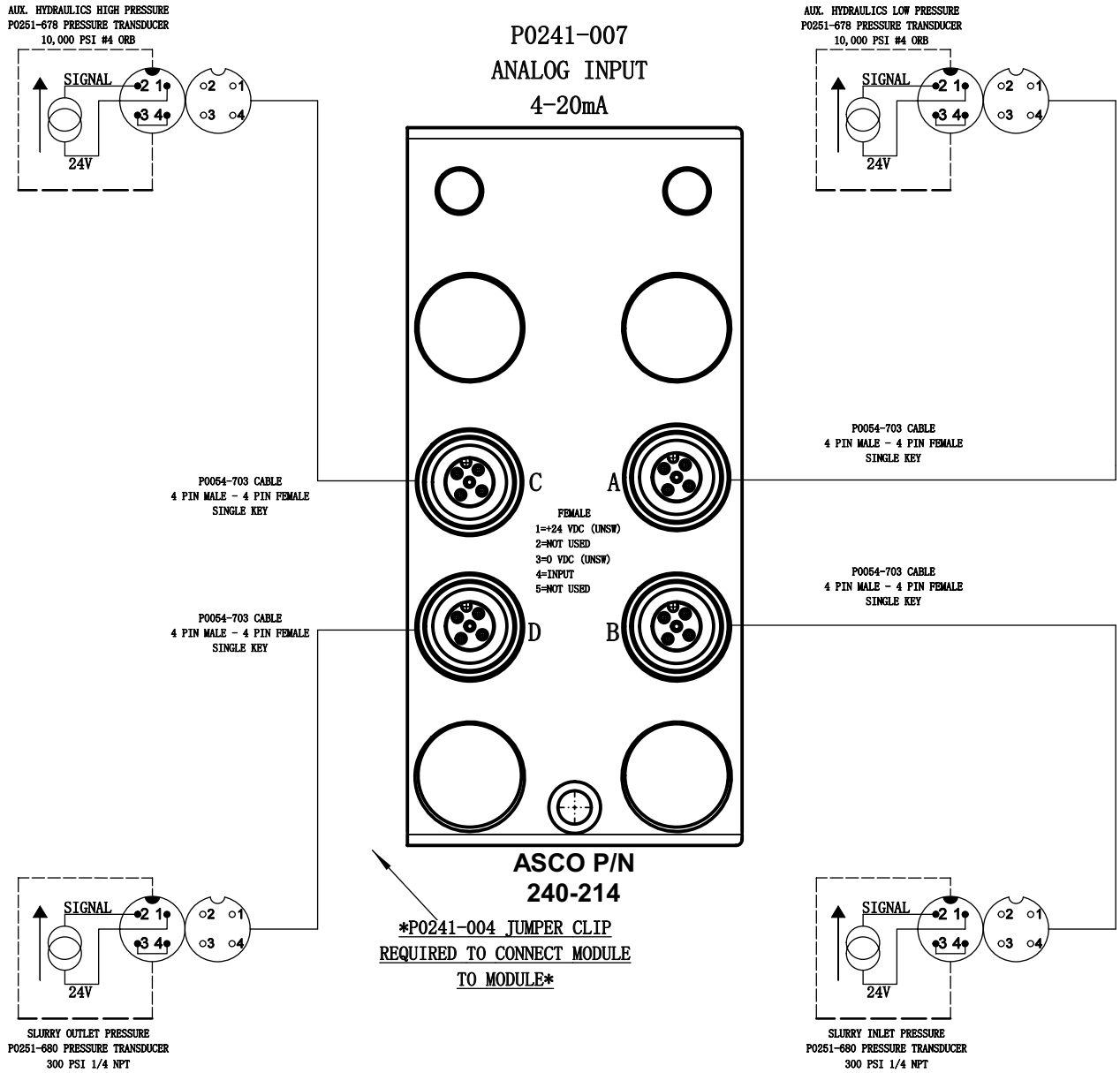
SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 2 of 12

IOM #2
(FRONT SECTION)



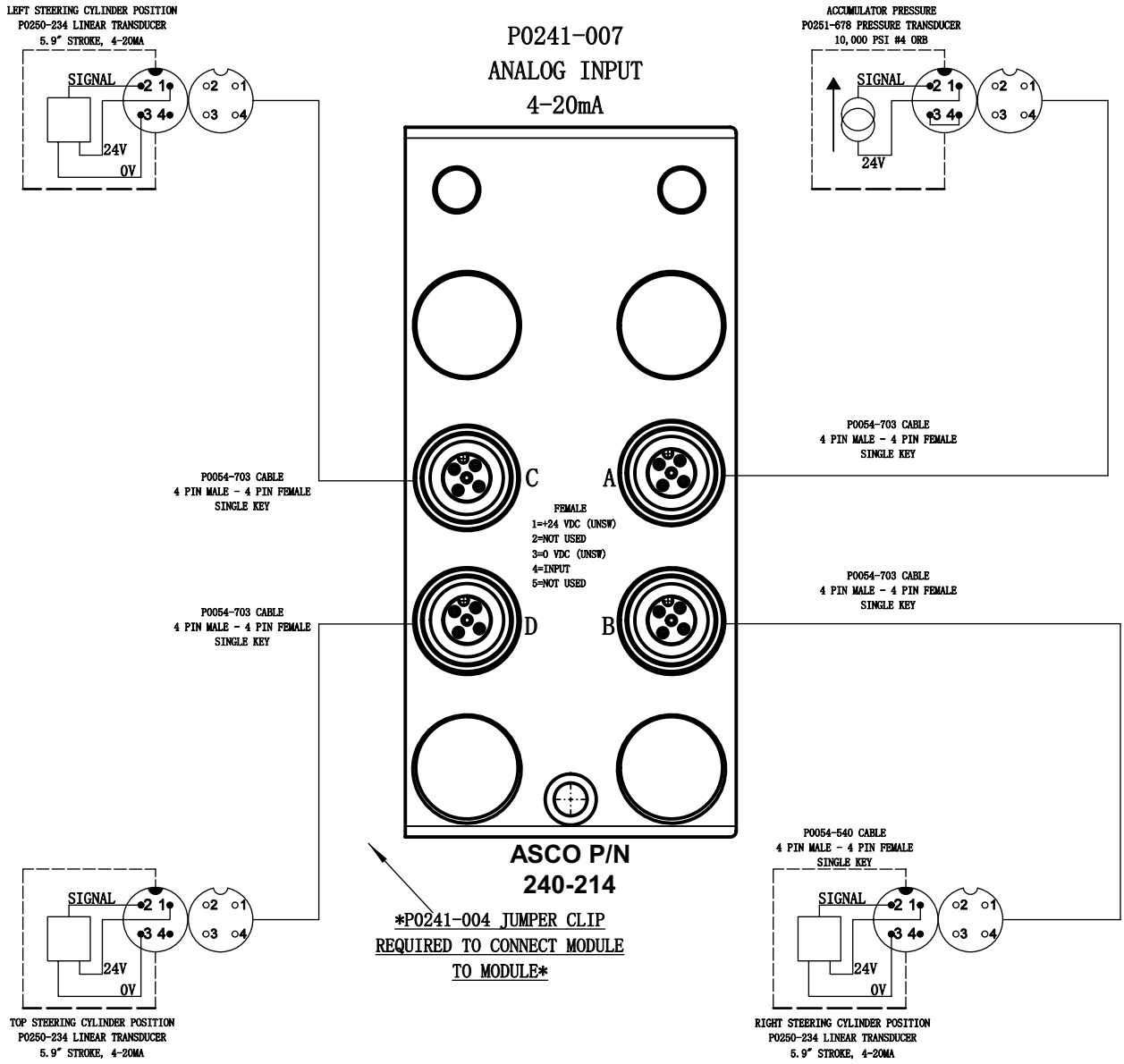
SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 3 of 12

IOM #3
(FRONT SECTION)



SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 4 of 12

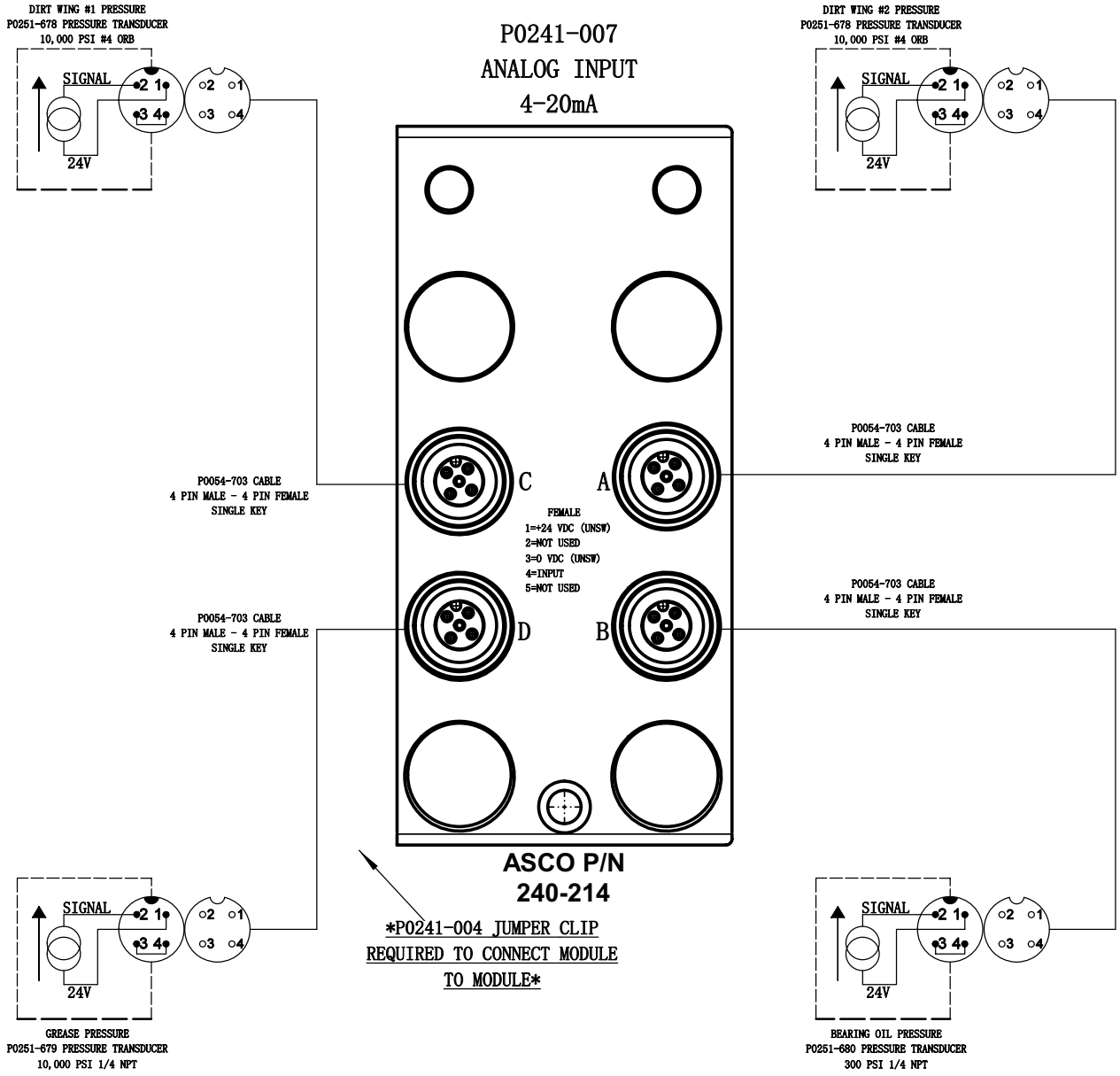
IOM #4
(FRONT SECTION)



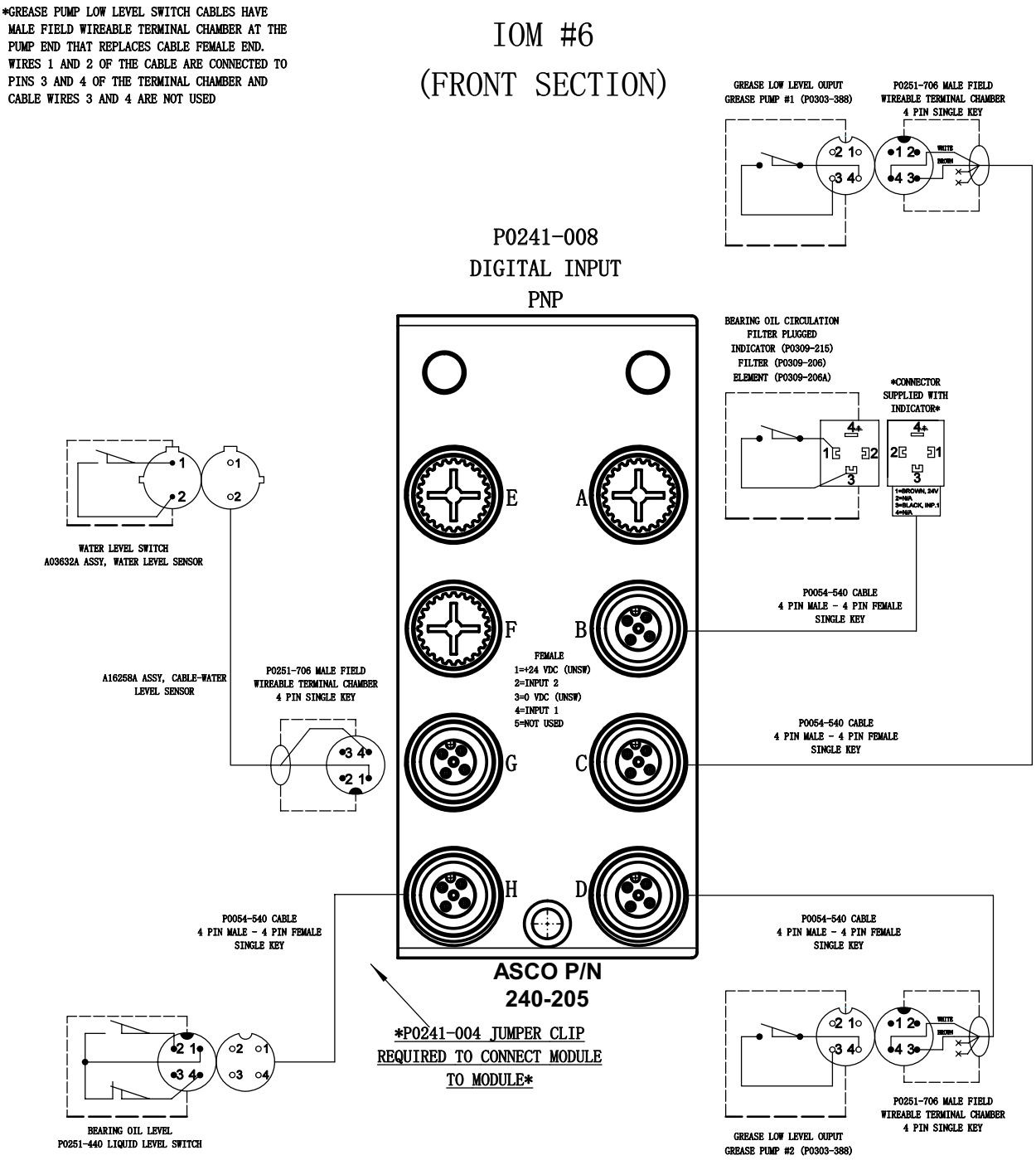
*LINEAR TRANSDUCER CABLES HAVE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END. CABLES WIRES ARE CONNECTED TO THE CORRESPONDING TERMINAL CHAMBER PIN, I.E., 1-1, 2-2, 3-3, & 4-4. TERMINAL CHAMBER PINS 3 AND 4 SHOULD ALSO BE JUMPERED TOGETHER.

SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 5 of 12

IOM #5
(FRONT SECTION)

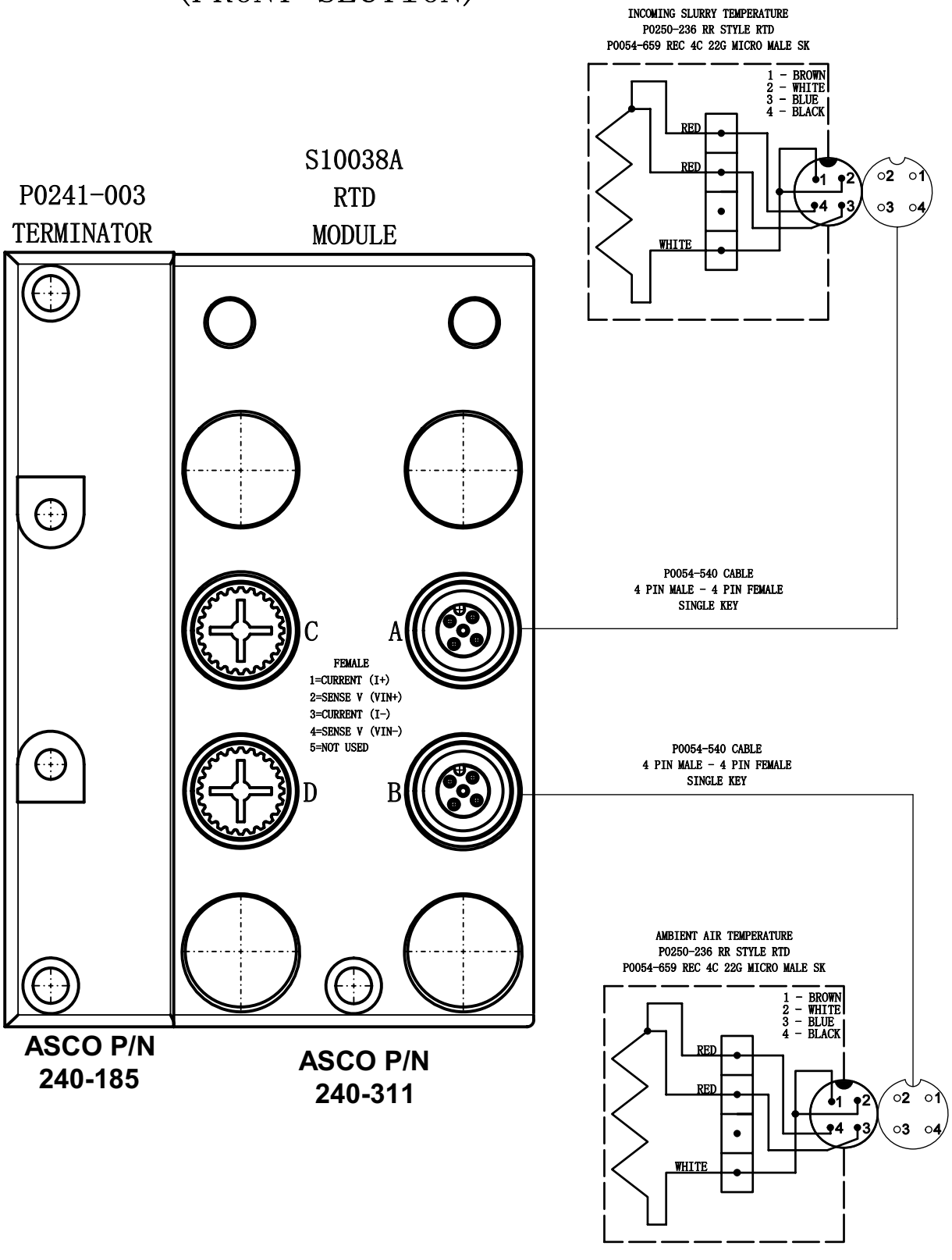


SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 6 of 12



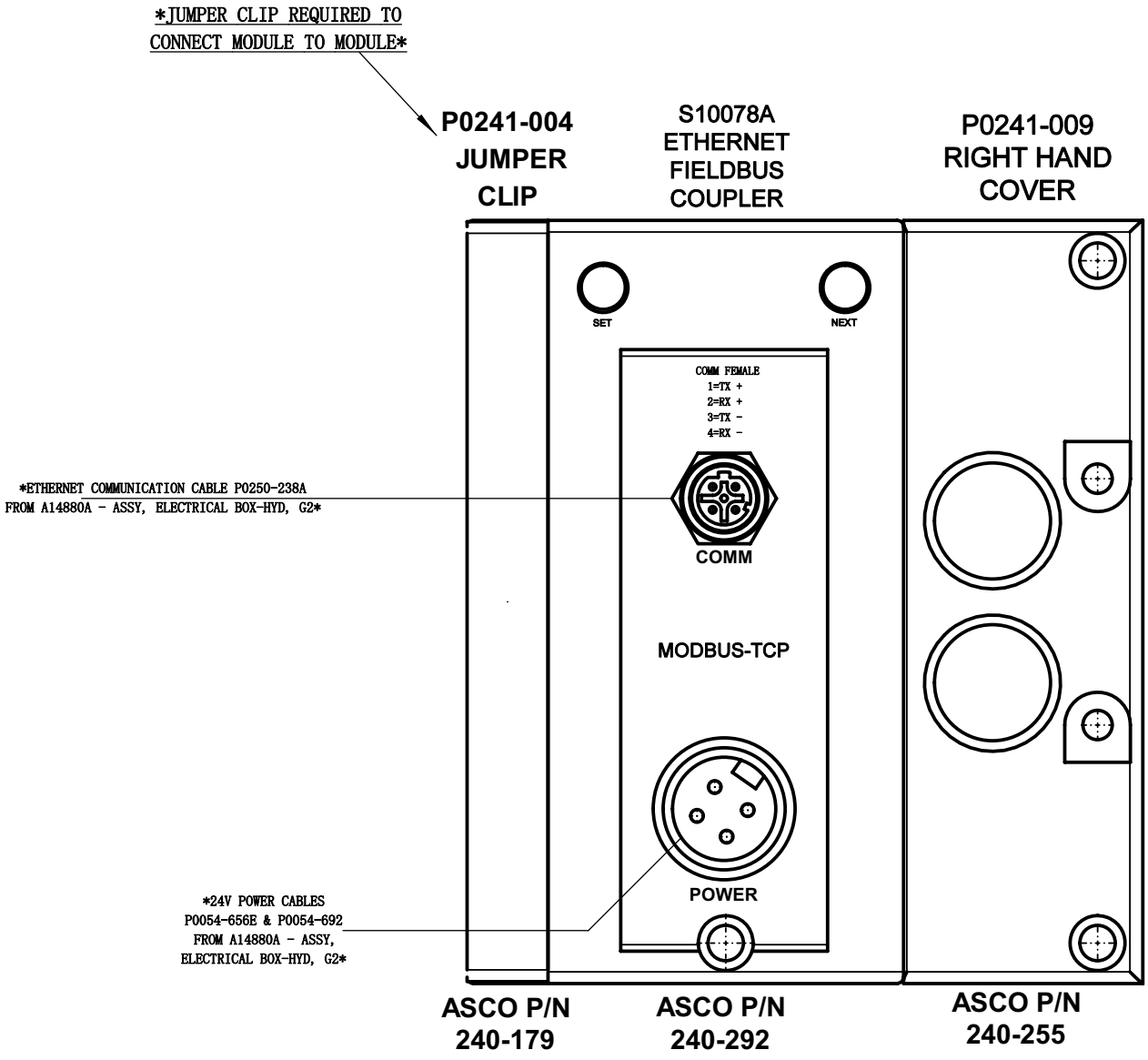
SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 7 of 12

IOM #7
(FRONT SECTION)



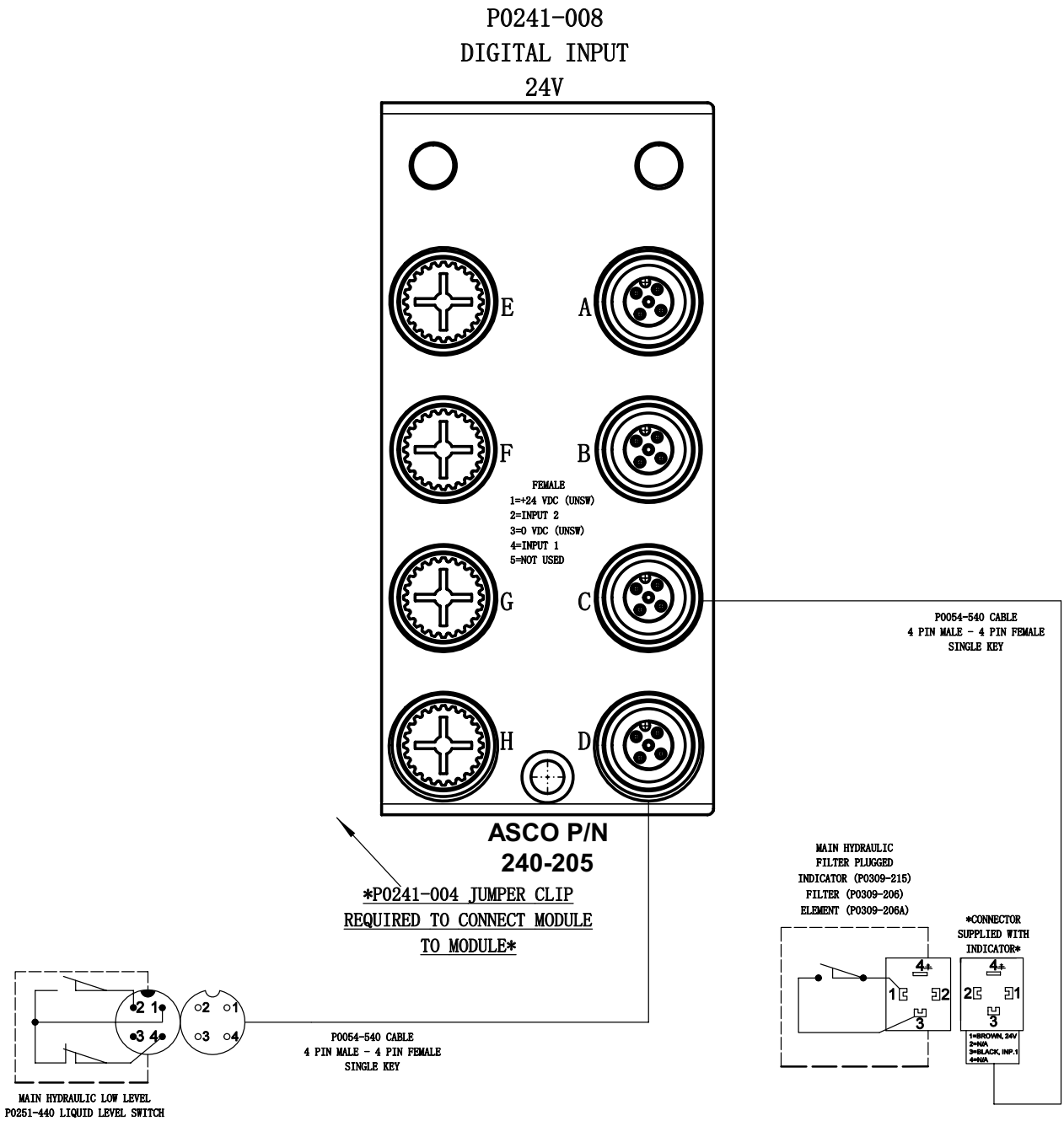
SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 8 of 12

IOM #8
(BACK SECTION)

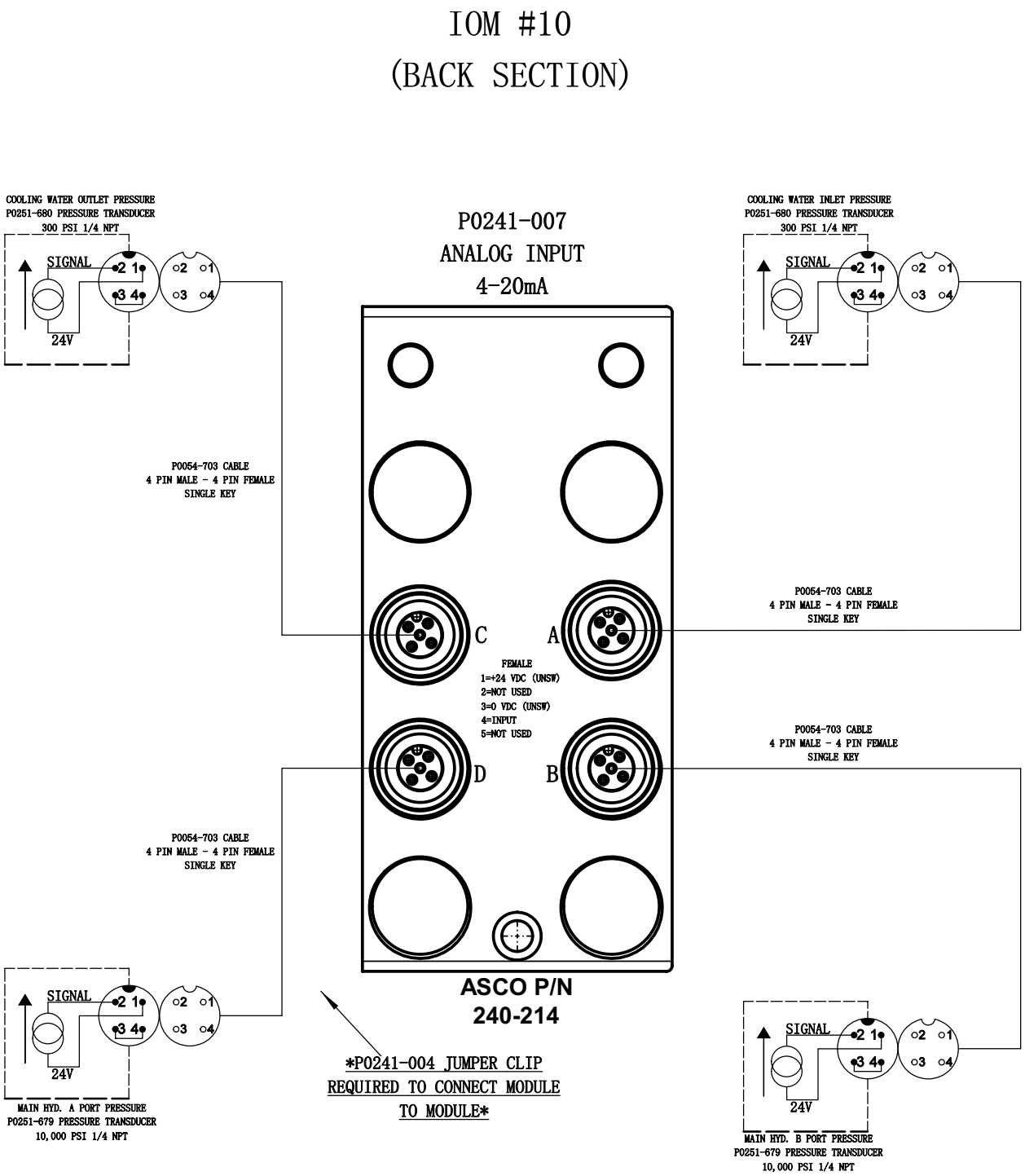


SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 9 of 12

IOM #9
(BACK SECTION)

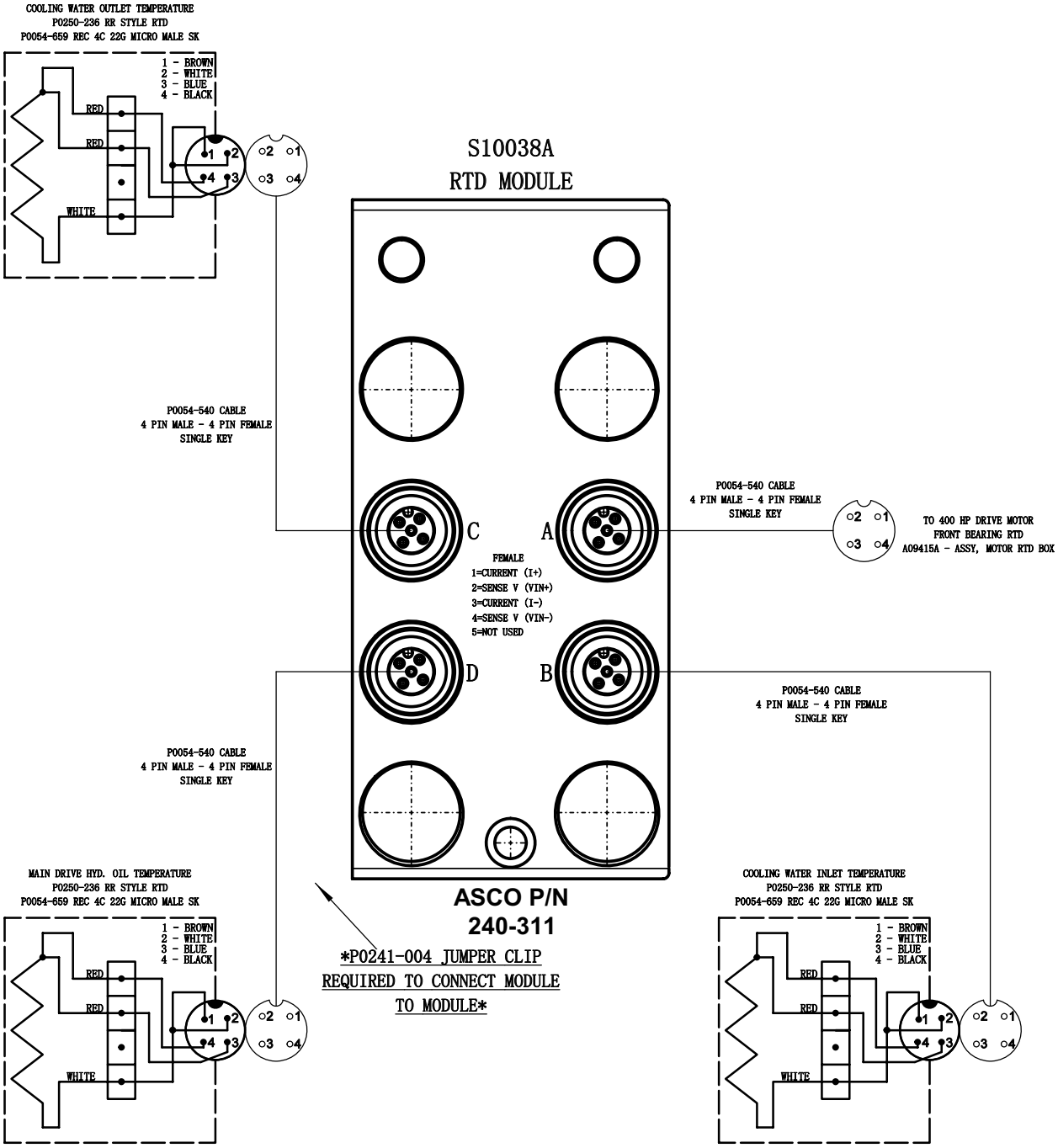


SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 10 of 12



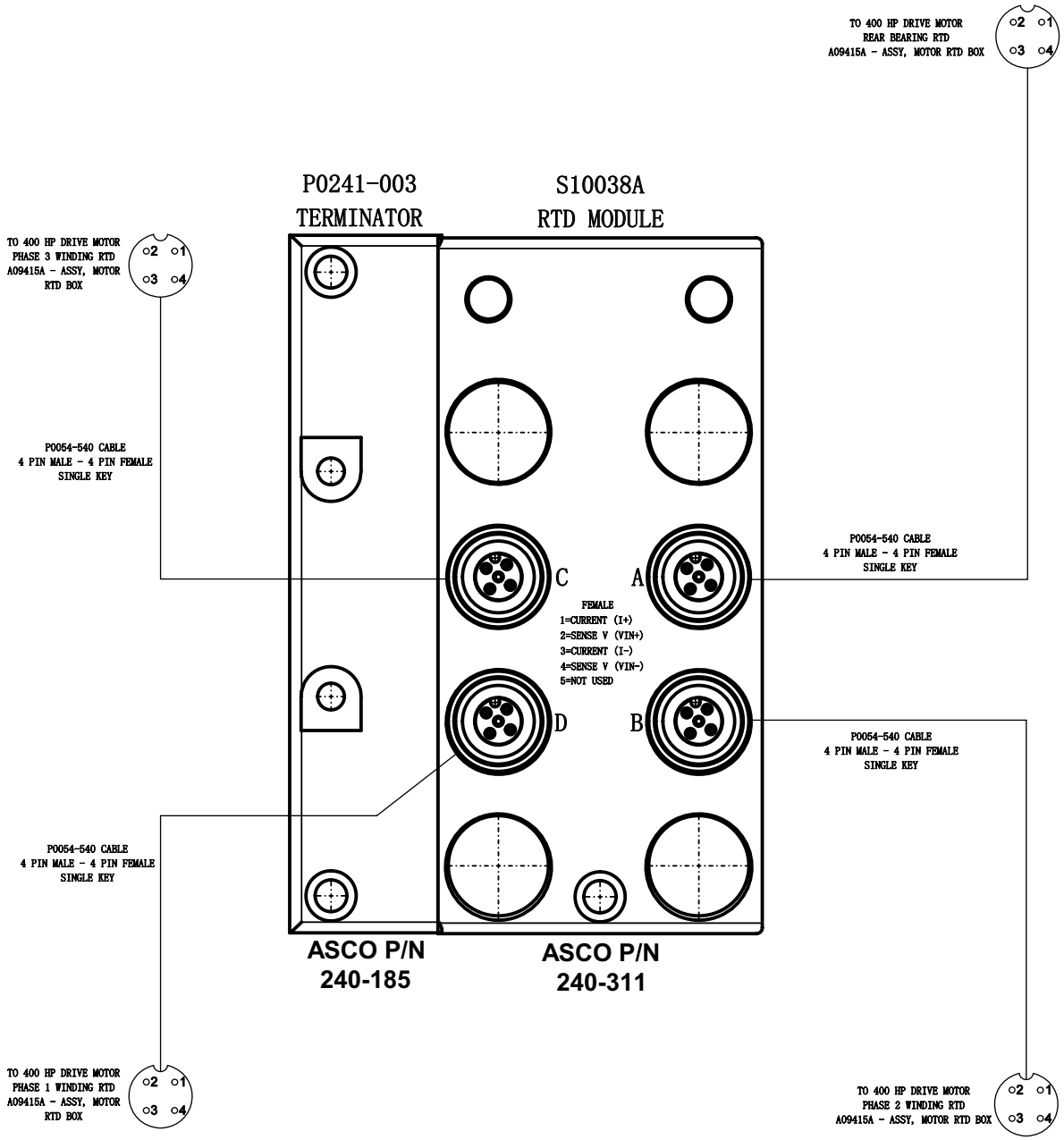
SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 11 of 12

IOM #11
(BACK SECTION)

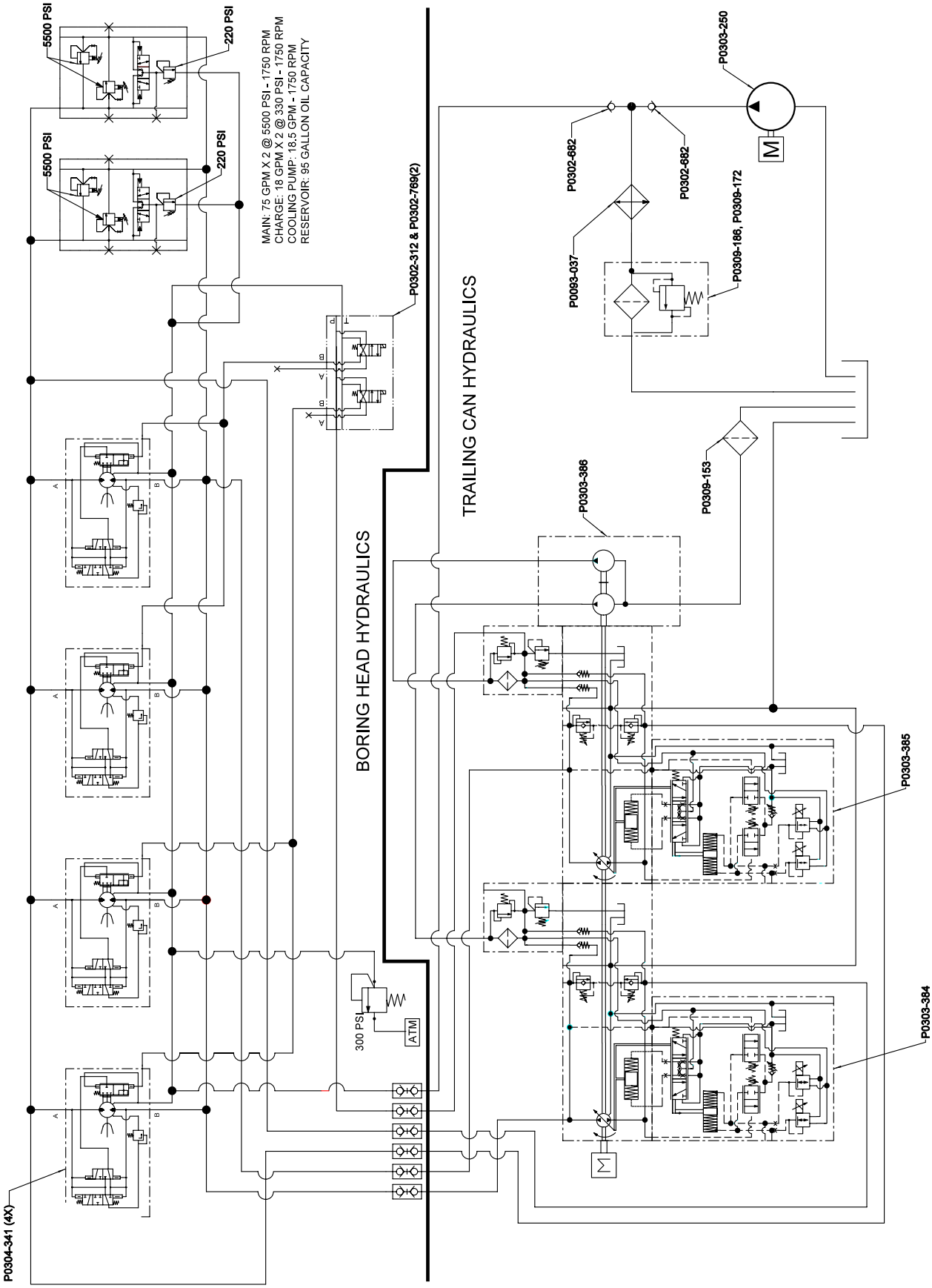


SL74P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 12 of 12

*SEE DRAWING A09415A - ASSY, MOTOR RTD BOX-SL86 MTBM FOR TERMINAL LAYOUT OF THE 400 HP MOTOR RTD CONNECTIONS.

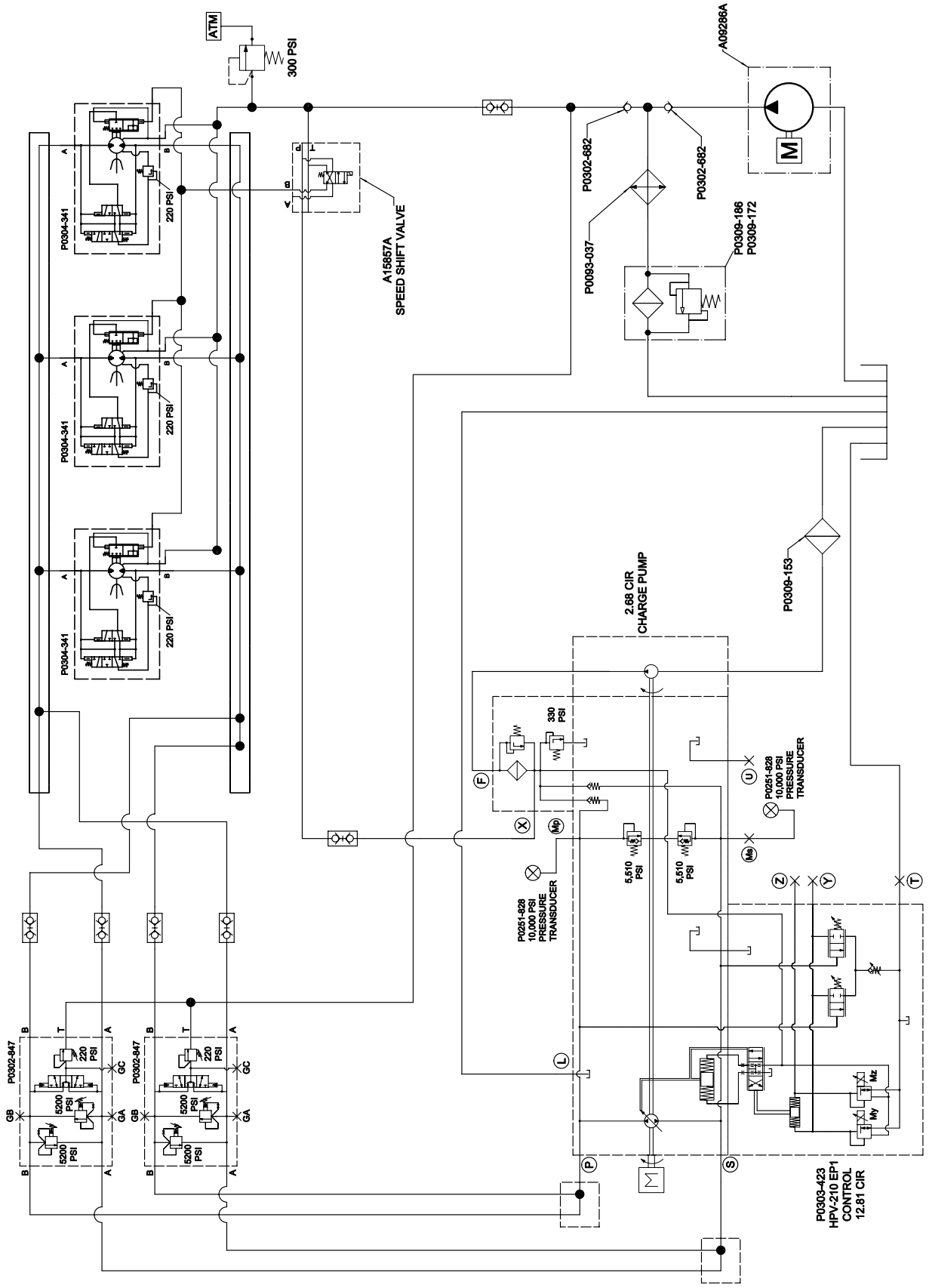


SL74P MTBM MAIN HYDRAULIC SCHEMATICS



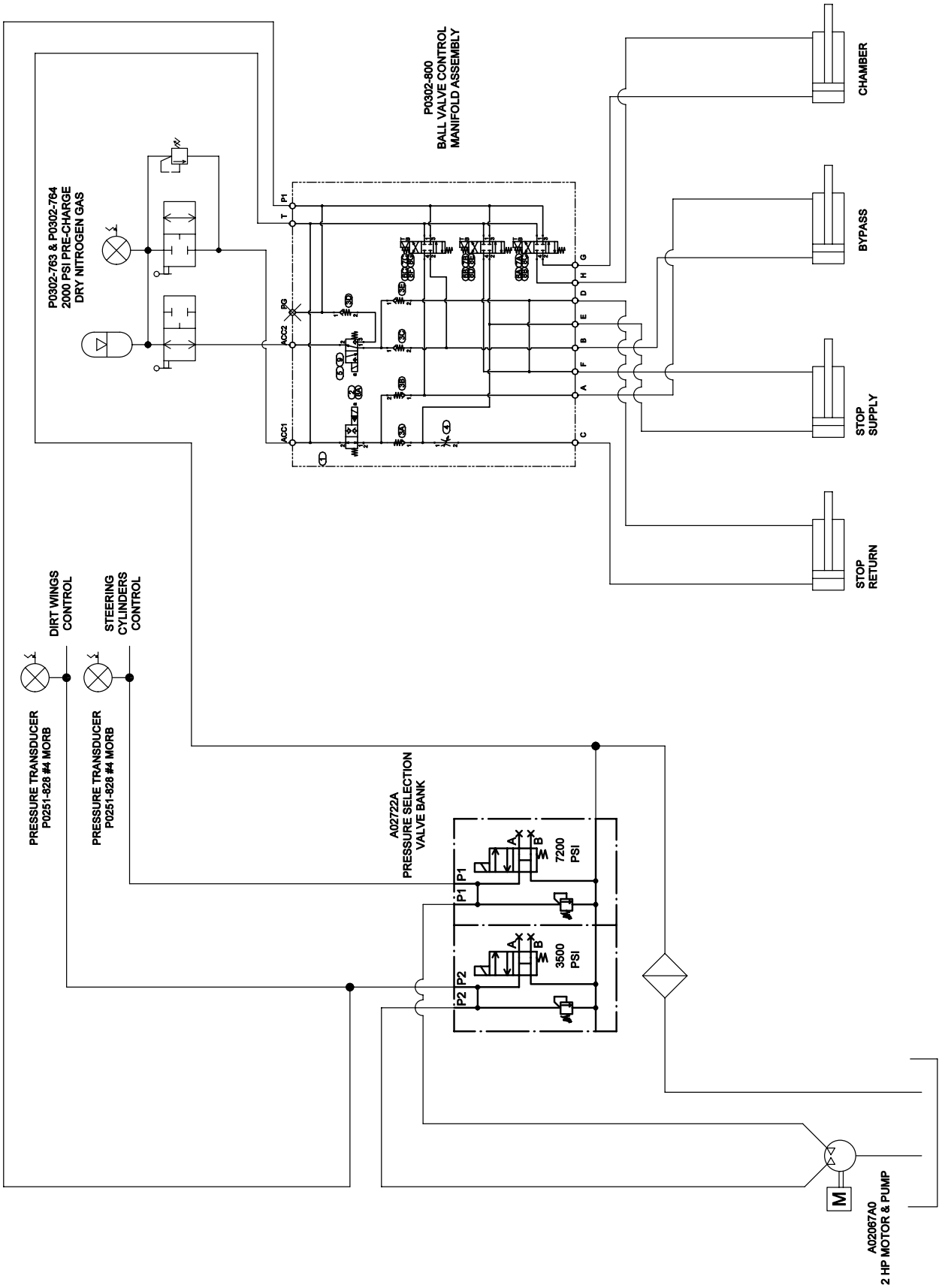
SL74P MTBM AUXILIARY HYDRAULIC SCHEMATIC

MTBM Auxiliary Hydraulic Schematic - Part 1 of 3
- Aux. Powerpack & Ball Valve Manifold



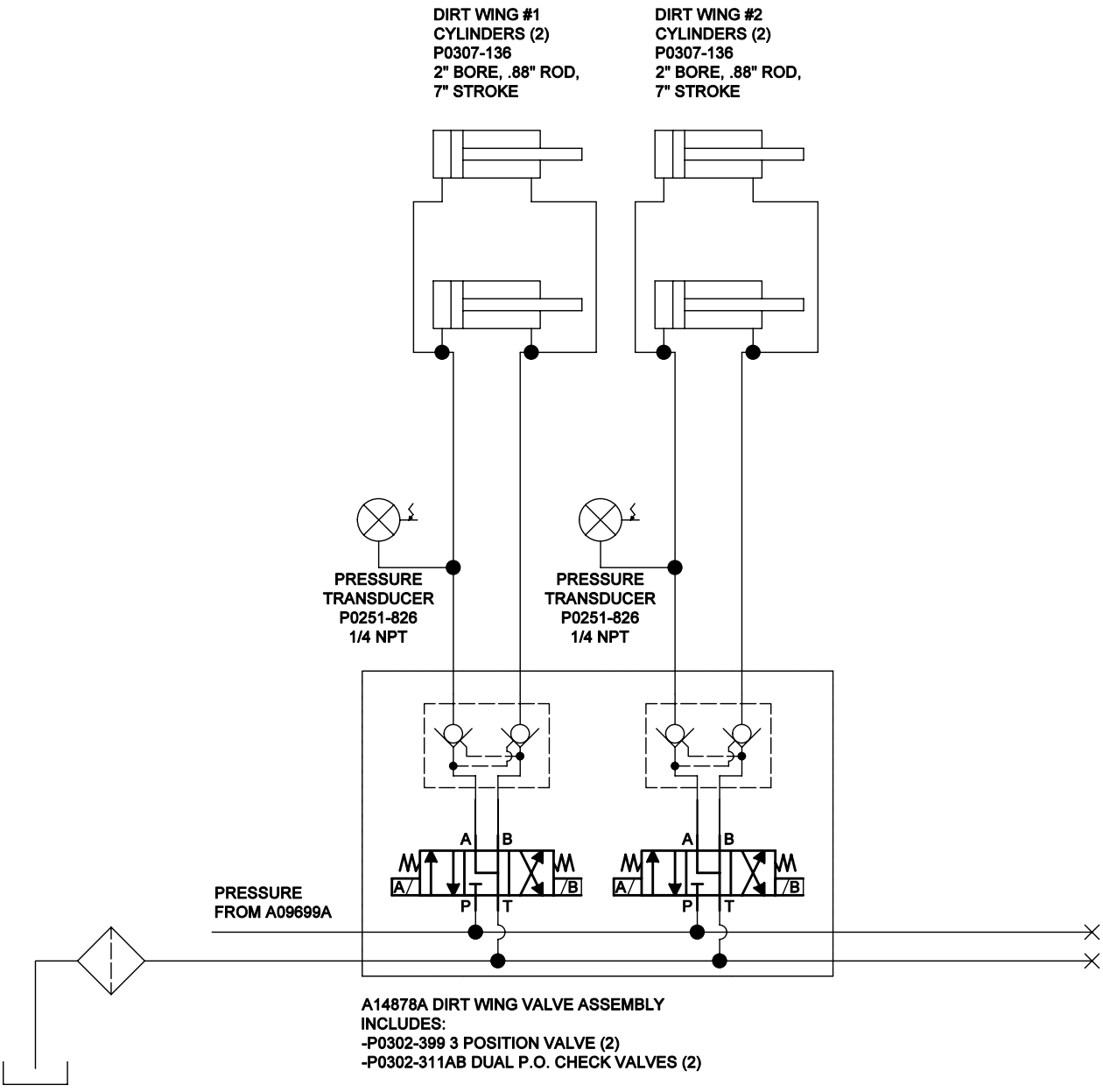
(continued on next page)

MTBM Auxiliary Hydraulic Schematic - Part 2 of 3 - Steering Cylinders



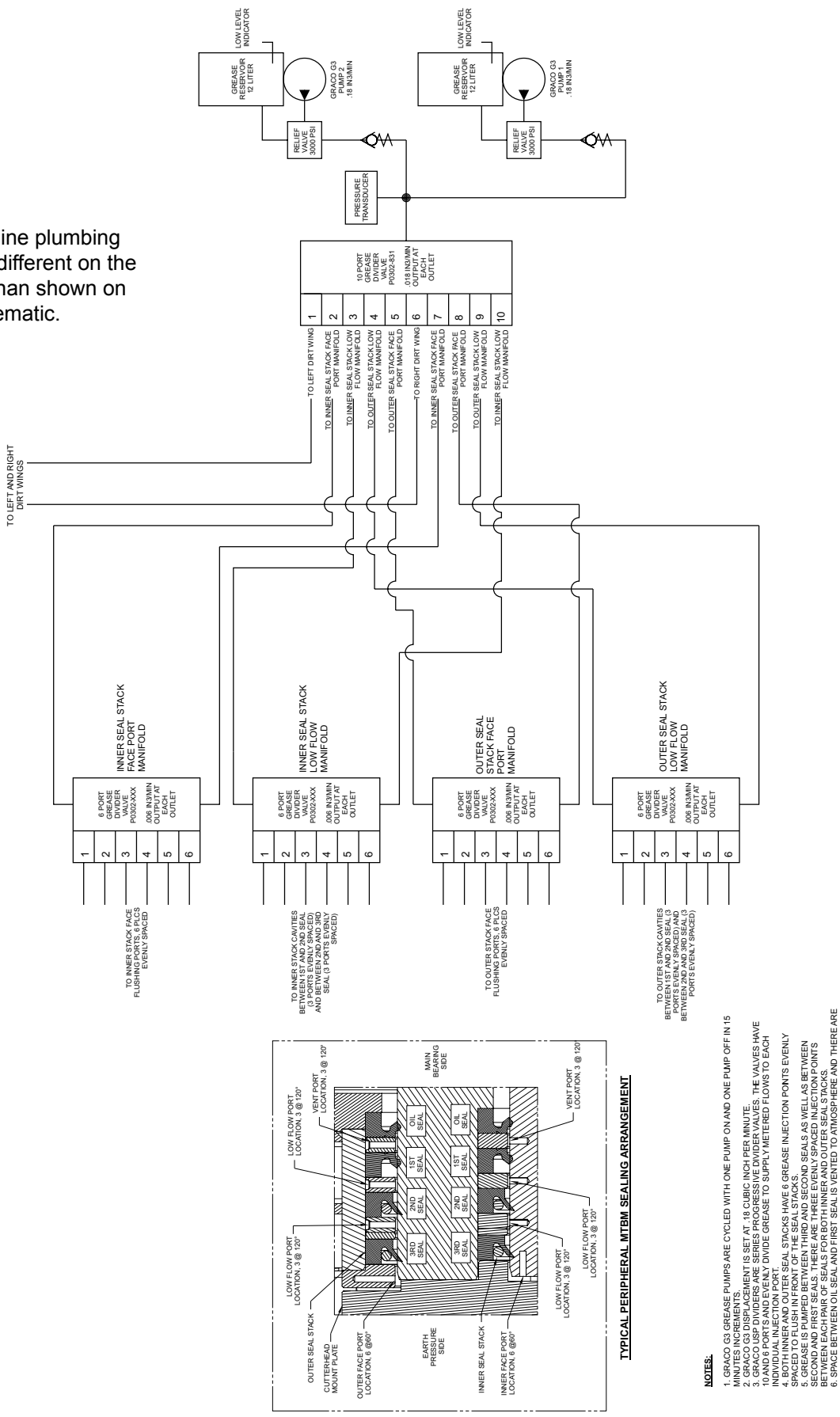
(continued on next page)

MTBM Auxiliary Hydraulic Schematic - Part 3 of 3 - Dirt Wings



SL74P MAIN SEAL GREASE SCHEMATIC

NOTE:
Grease line plumbing may be different on the MTBM than shown on this schematic.

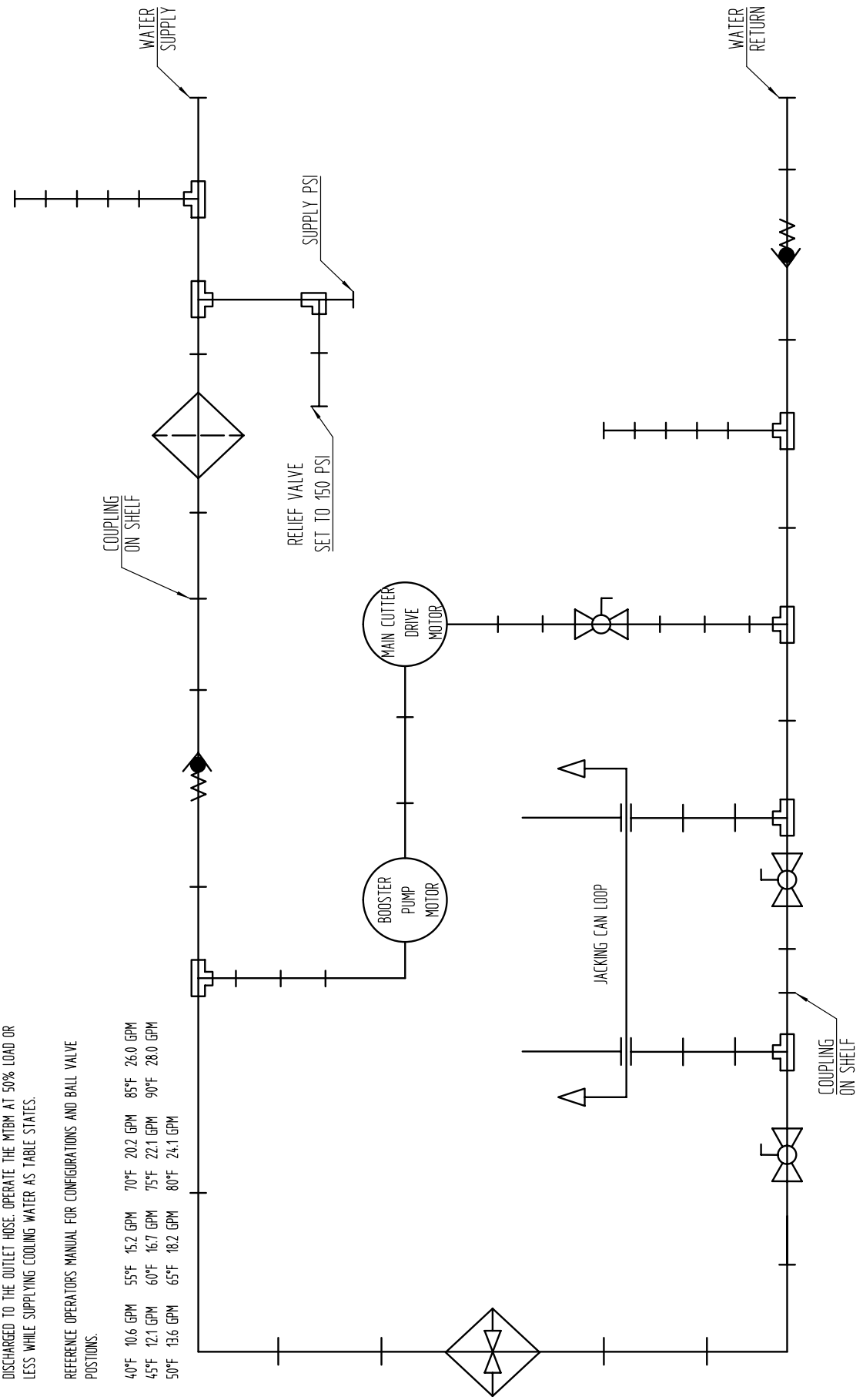


TYPICAL PERIPHERAL MTBM SEALING ARRANGEMENT

NOTES:

1. GRACO G3 GREASE PUMPS ARE CYCLED WITH ONE PUMP ON AND ONE PUMP OFF IN 15 MINUTES INCREMENTS.
2. GRACO G3 DISPLACEMENT IS SET AT .18 CUBIC INCH PER MINUTE.
3. GRACO DIVIDERS ARE SERIES PROGRESSIVE DIVIDER VALVES. THE VALVES HAVE 10 AND 6 PORTS AND EQUALLY DIVIDE GREASE TO SUPPLY METERED FLOWS TO EACH INDIVIDUAL INJECTION PORT.
4. BOTH INNER AND OUTER SEAL STACKS HAVE 6 GREASE INJECTION PONITS EVENLY SPACED TO FLUSH IN FRONT OF THE SEAL STACKS.
5. GREASE IS PUMPED BETWEEN THIRD AND SECOND SEALS AS WELL AS BETWEEN SECOND AND FIRST SEALS. THERE ARE THREE EVENLY SPACED INJECTION POINTS BETWEEN EACH PAIR OF SEALS FOR BOTH INNER AND OUTER SEAL STACKS.
6. SPACE BETWEEN OIL SEAL AND FIRST SEAL IS VENTED TO ATMOSPHERE AND THERE ARE THREE VENT PORTS EVENLY SPACED FOR BOTH INNER AND OUTER SEALS.

SL74P MTBM WATER COOLING SYSTEM SCHEMATIC



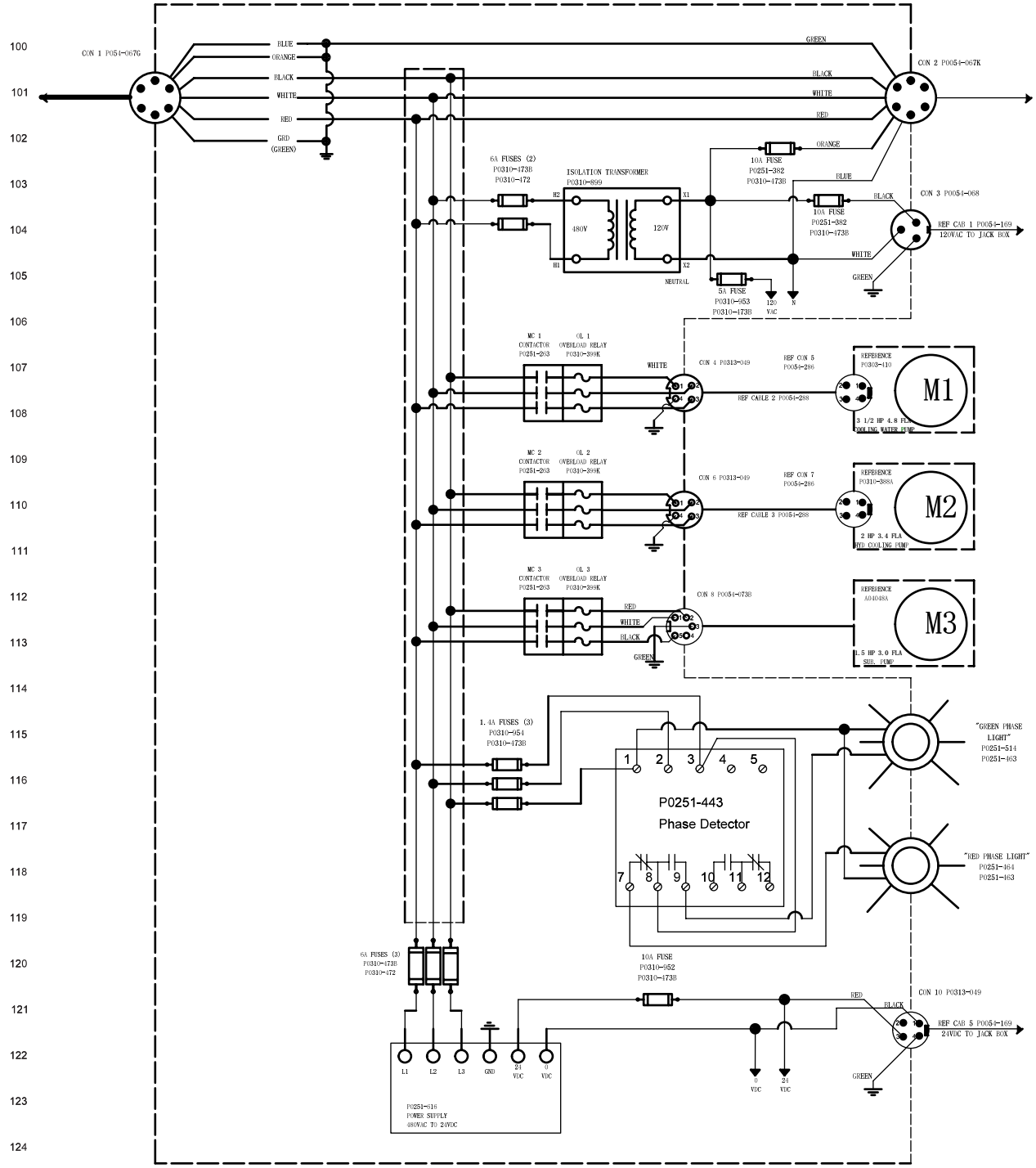
DURING MTBM LAUNCH COOLING WATER CAN BE SUPPLIED VIA THE COOLING WATER INLET AND THE COOLING WATER OUTLET CAN BE ROUTED TO THE DISCHARGE HOSE. THE COOLING SYSTEM WILL THEN BE OPERATED AS NORMAL. THE SAME GPM SUPPLIED TO THE INLET PORT WILL BE DISCHARGED TO THE OUTLET HOSE. OPERATE THE MTBM AT 50% LOAD OR LESS WHILE SUPPLYING COOLING WATER AS TABLE STATES.

REFERENCE OPERATORS MANUAL FOR CONFIGURATIONS AND BALL VALVE POSTIONS.

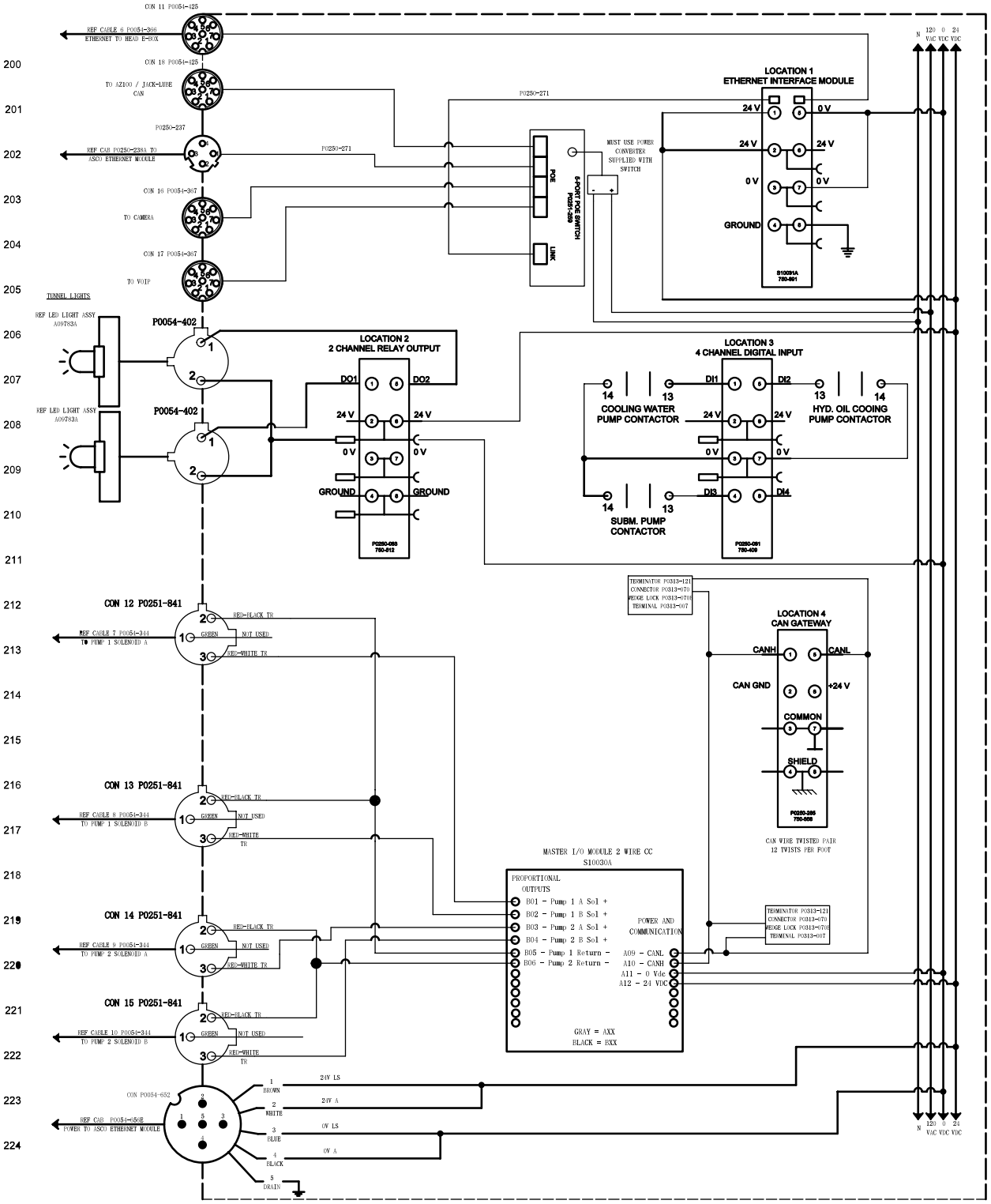
40°F	10.6 GPM	55°F	15.2 GPM	70°F	20.2 GPM	85°F	26.0 GPM
45°F	12.1 GPM	60°F	16.7 GPM	75°F	22.1 GPM	90°F	28.0 GPM
50°F	13.6 GPM	65°F	18.2 GPM	80°F	24.1 GPM		

MTBM TRAILING SECTION CONTROL BOX ELECTRICAL SCHEMATICS - SL60P SN: FA14960F

Electrical Schematic - Part 1 of 3

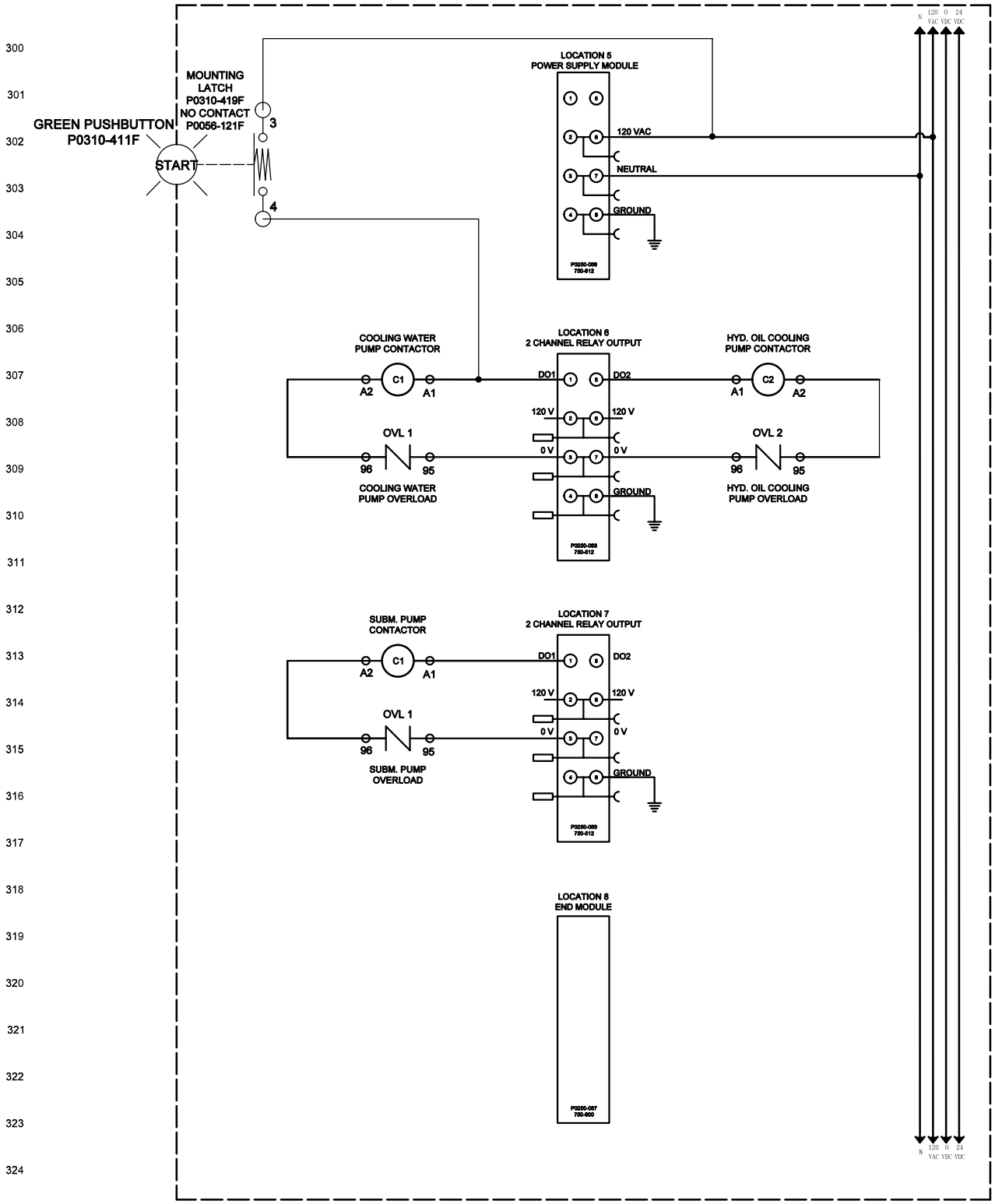


MTBM Trailing Section Electrical Schematics (continued)
Electrical Schematic - Part 2 of 3

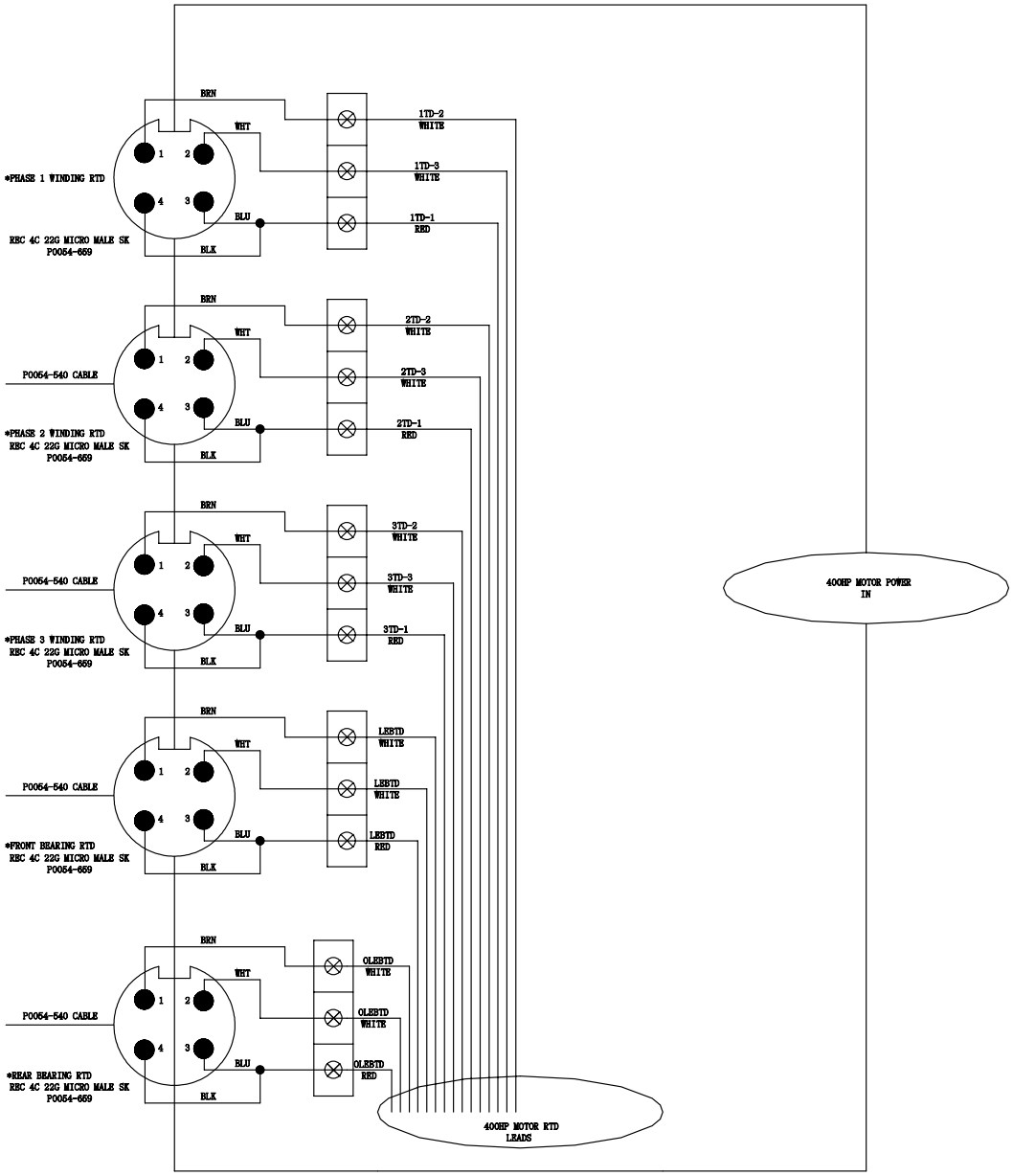


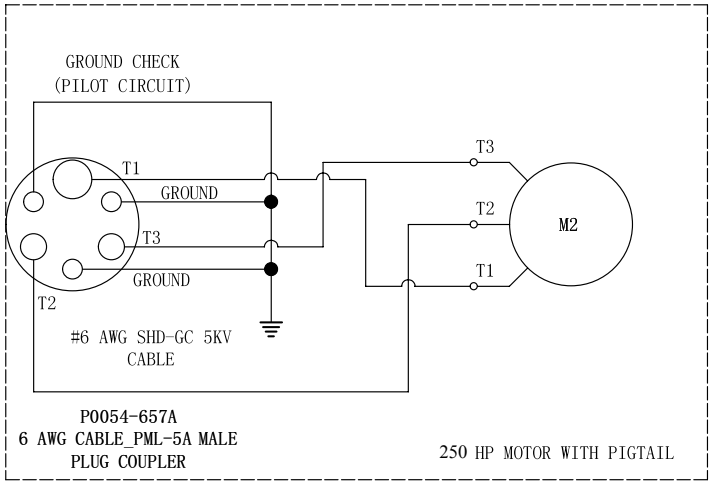
MTBM Trailing Section Electrical Schematics (continued)

Electrical Schematic - Part 3 of 3



MTBM DRIVE MOTOR 250 HP ELECTRICAL SCHEMATIC - SL60P SN: FA14960F

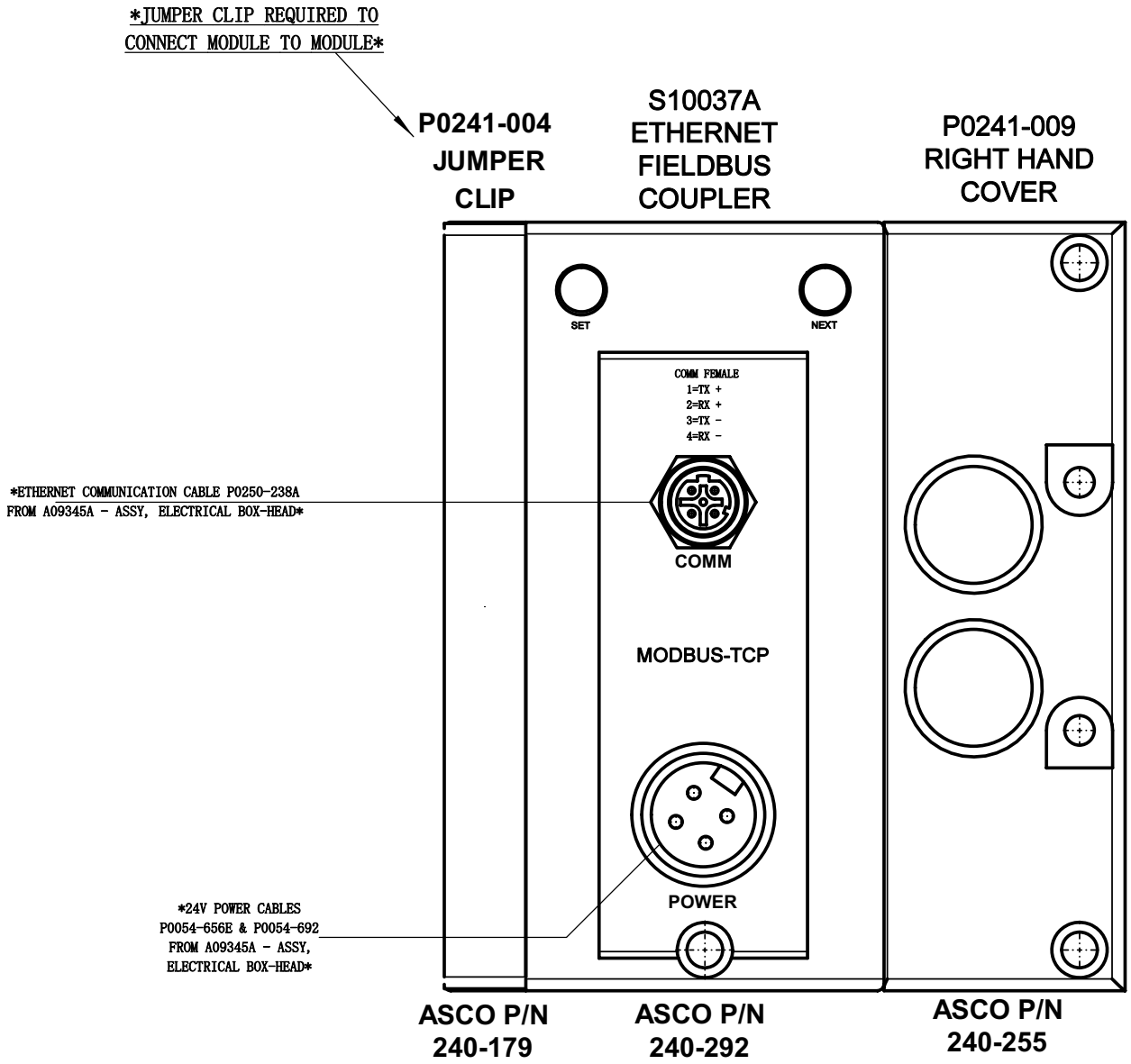




SL60P (SN FA14960F) MTBM ASCO I/O MODULE SCHEMATICS

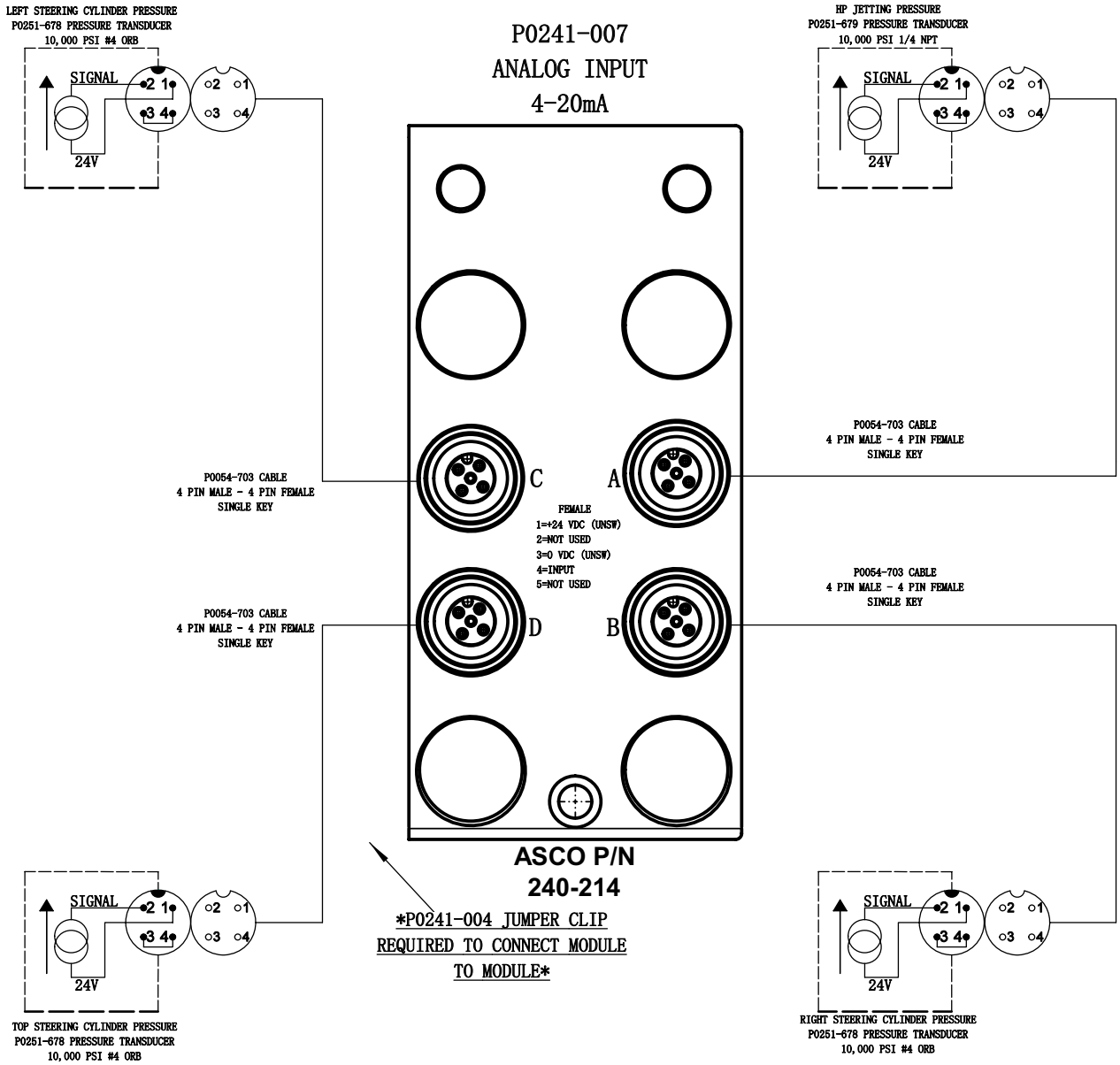
Schematic - Part 1 of 12

IOM #1
(FRONT SECTION)



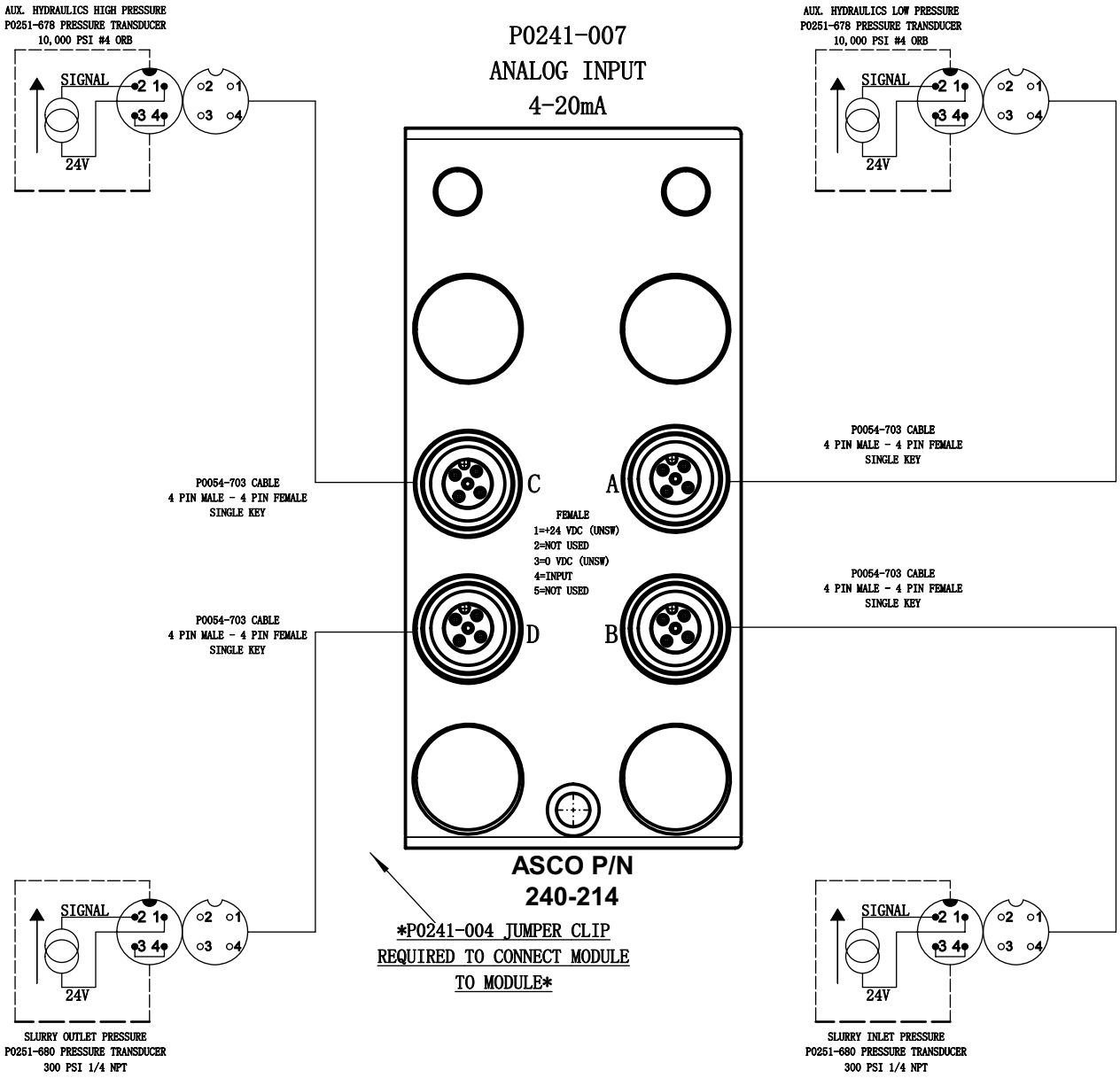
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 2 of 12

IOM #2
(FRONT SECTION)



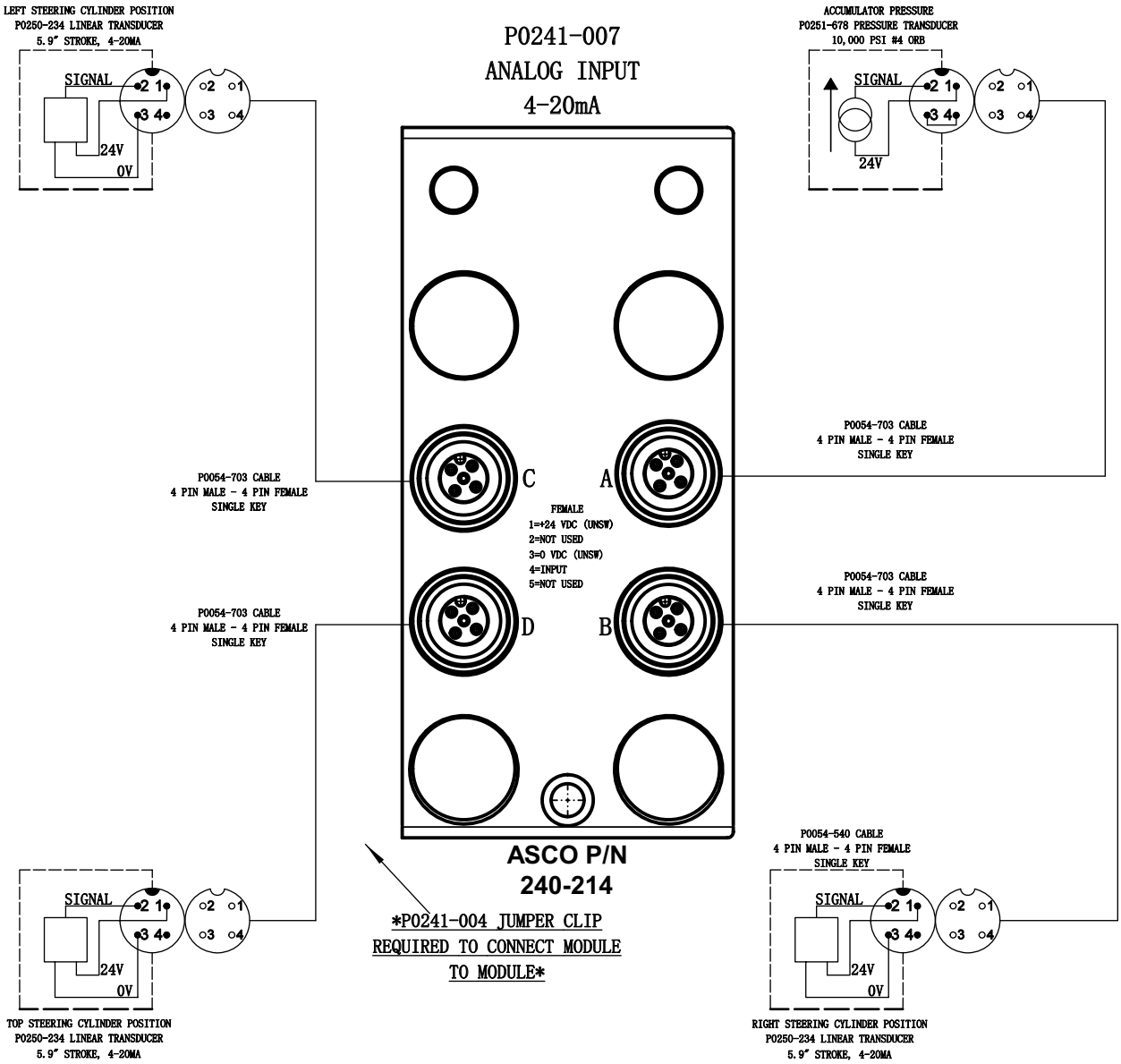
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 3 of 12

IOM #3
(FRONT SECTION)



SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 4 of 12

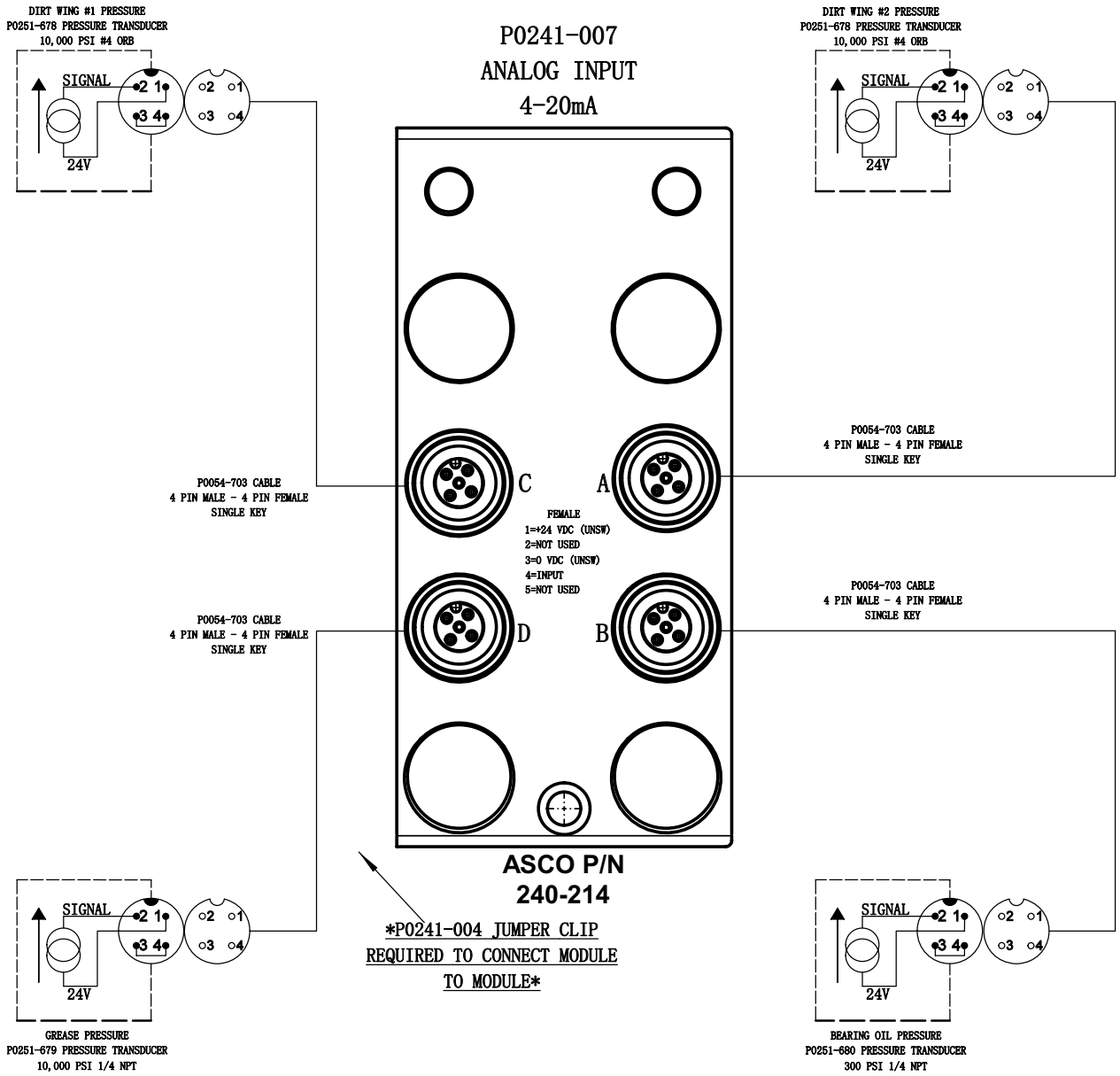
IOM #4
(FRONT SECTION)



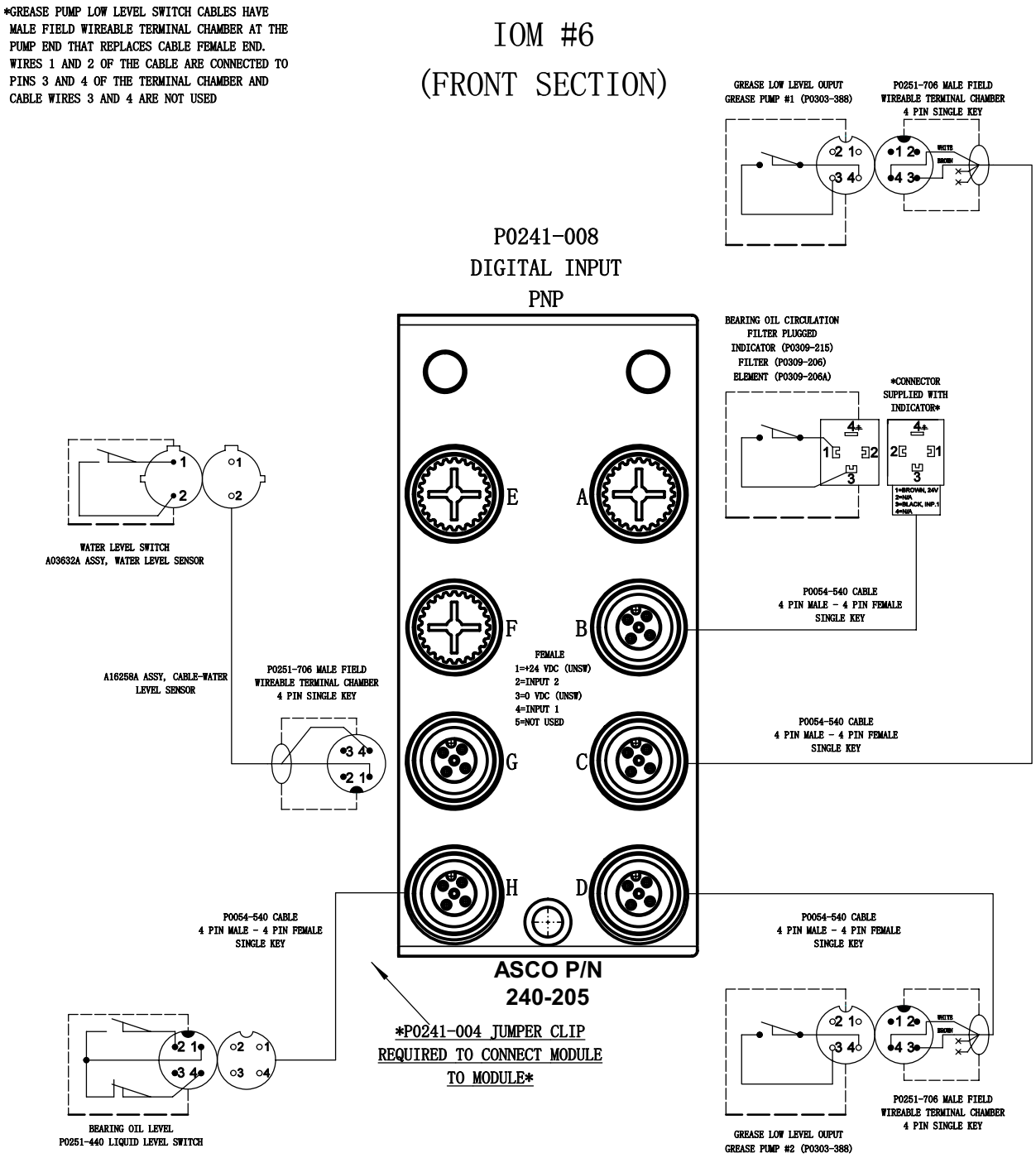
*LINEAR TRANSDUCER CABLES HAVE FIELD WIREABLE TERMINAL CHAMBER AT THE SENSOR END. CABLES WIRES ARE CONNECTED TO THE CORRESPONDING TERMINAL CHAMBER PIN, I.E., 1-1, 2-2, 3-3, & 4-4. TERMINAL CHAMBER PINS 3 AND 4 SHOULD ALSO BE JUMPERED TOGETHER.

SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 5 of 12

IOM #5
(FRONT SECTION)

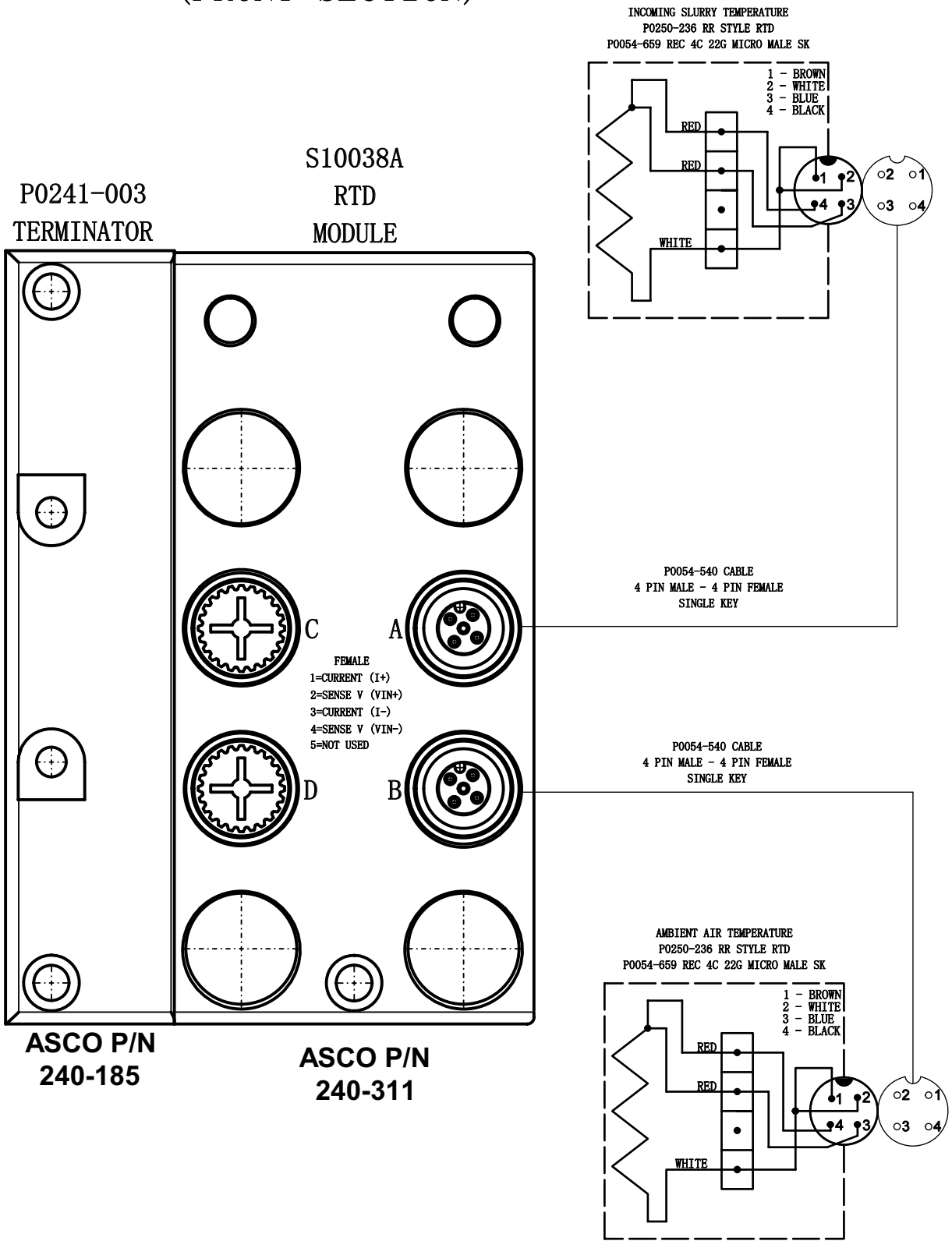


SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 6 of 12



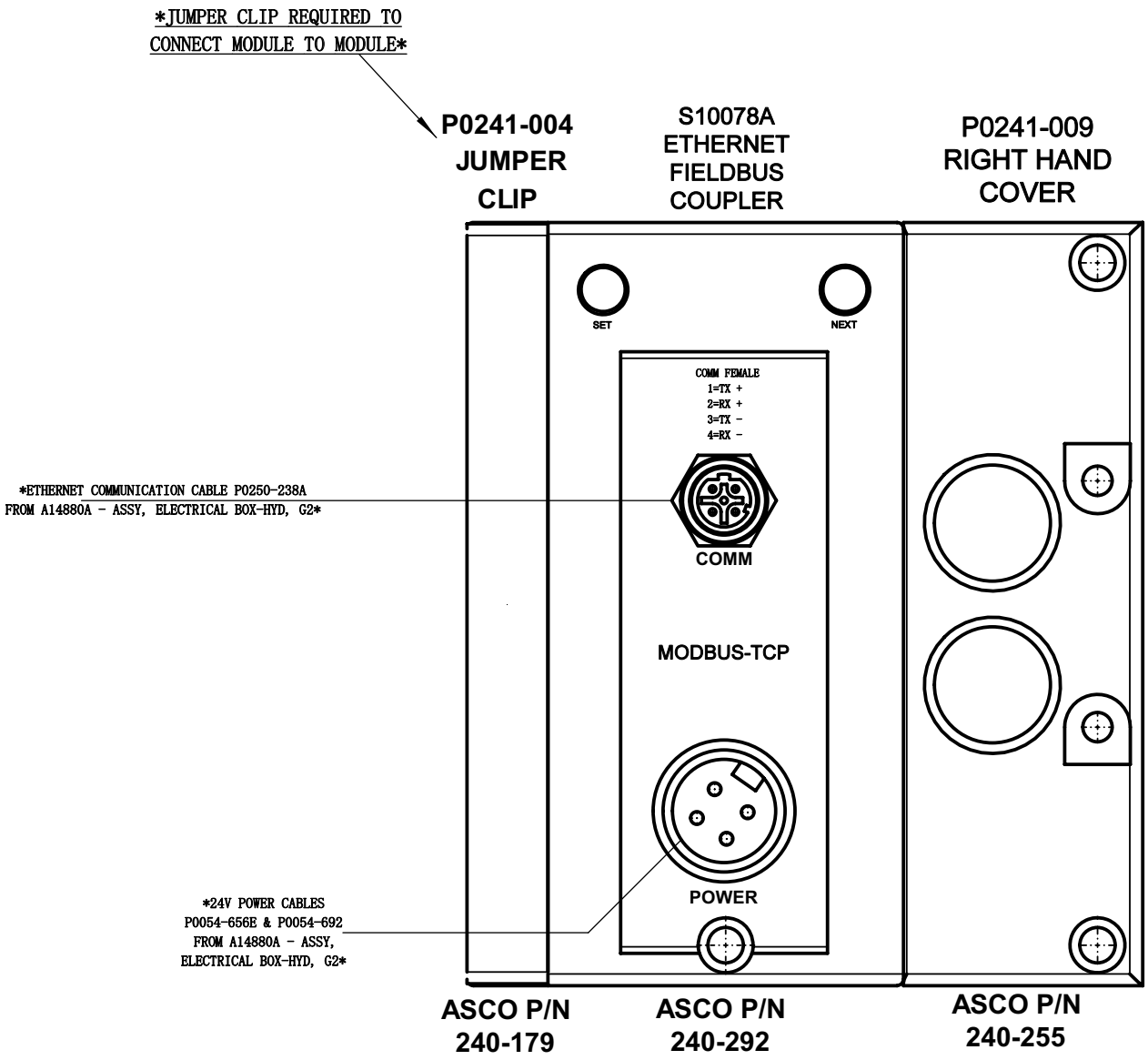
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 7 of 12

IOM #7
(FRONT SECTION)



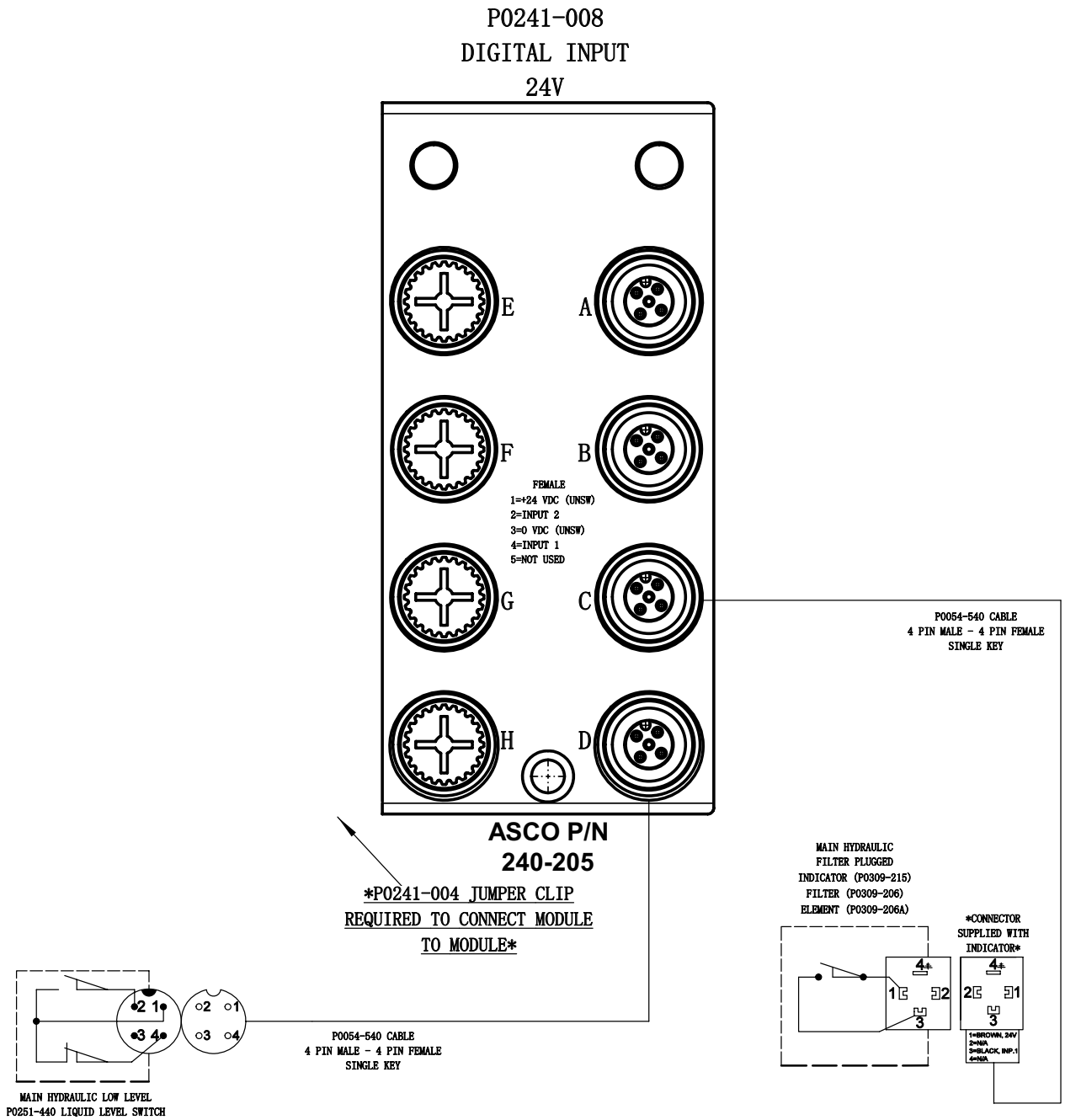
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 8 of 12

IOM #8
(BACK SECTION)



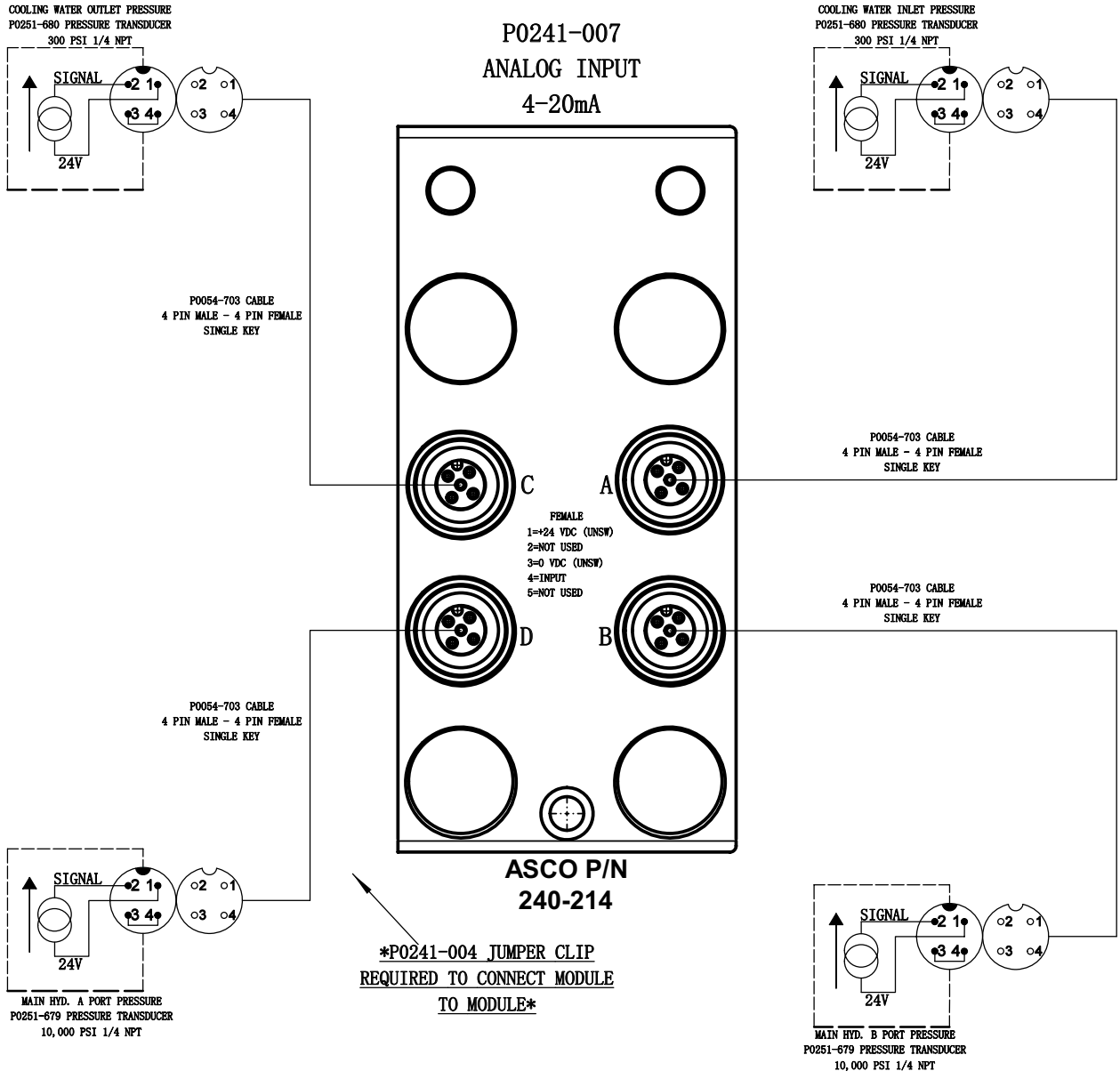
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 9 of 12

IOM #9
(BACK SECTION)



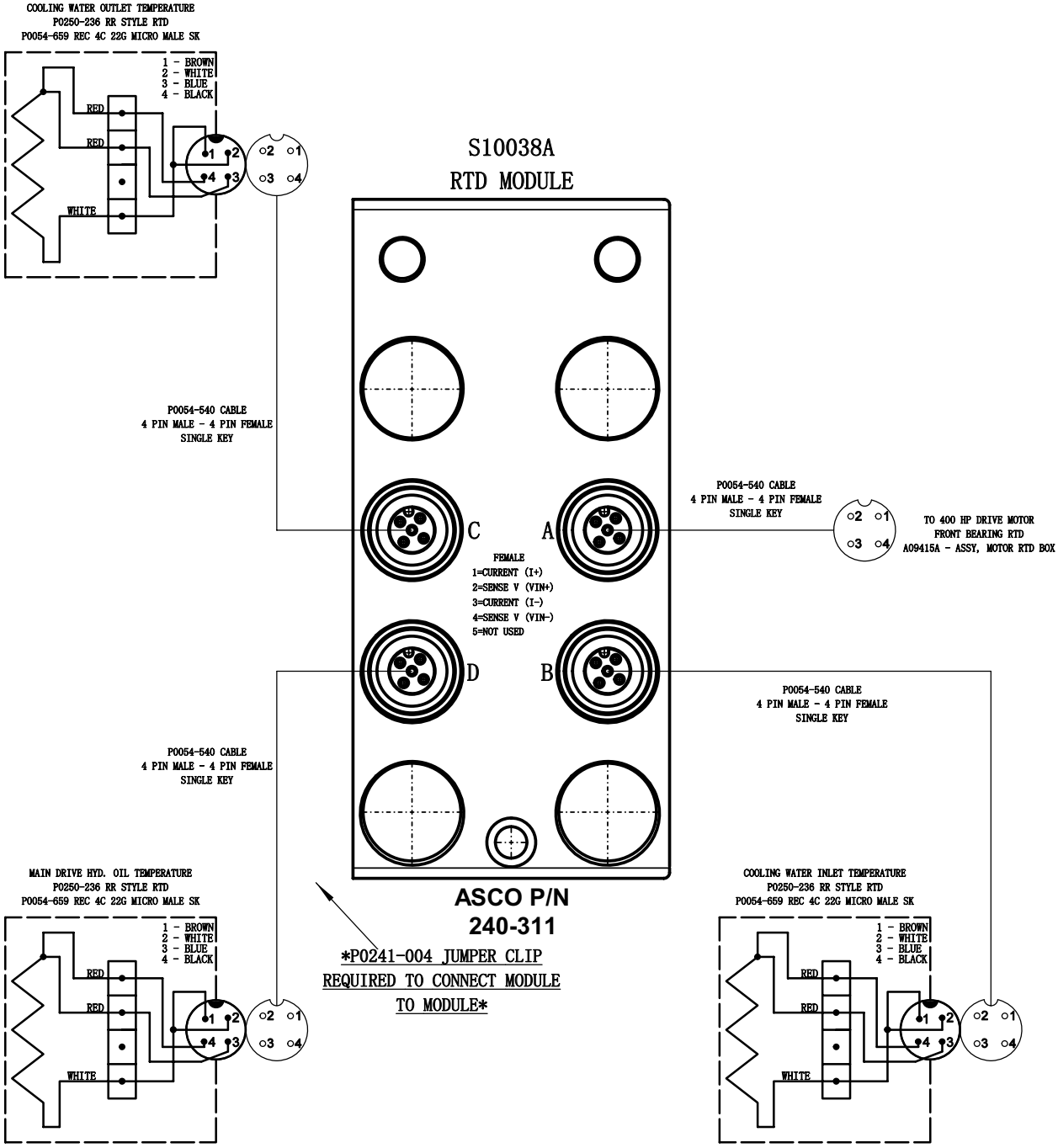
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 10 of 12

IOM #10
(BACK SECTION)



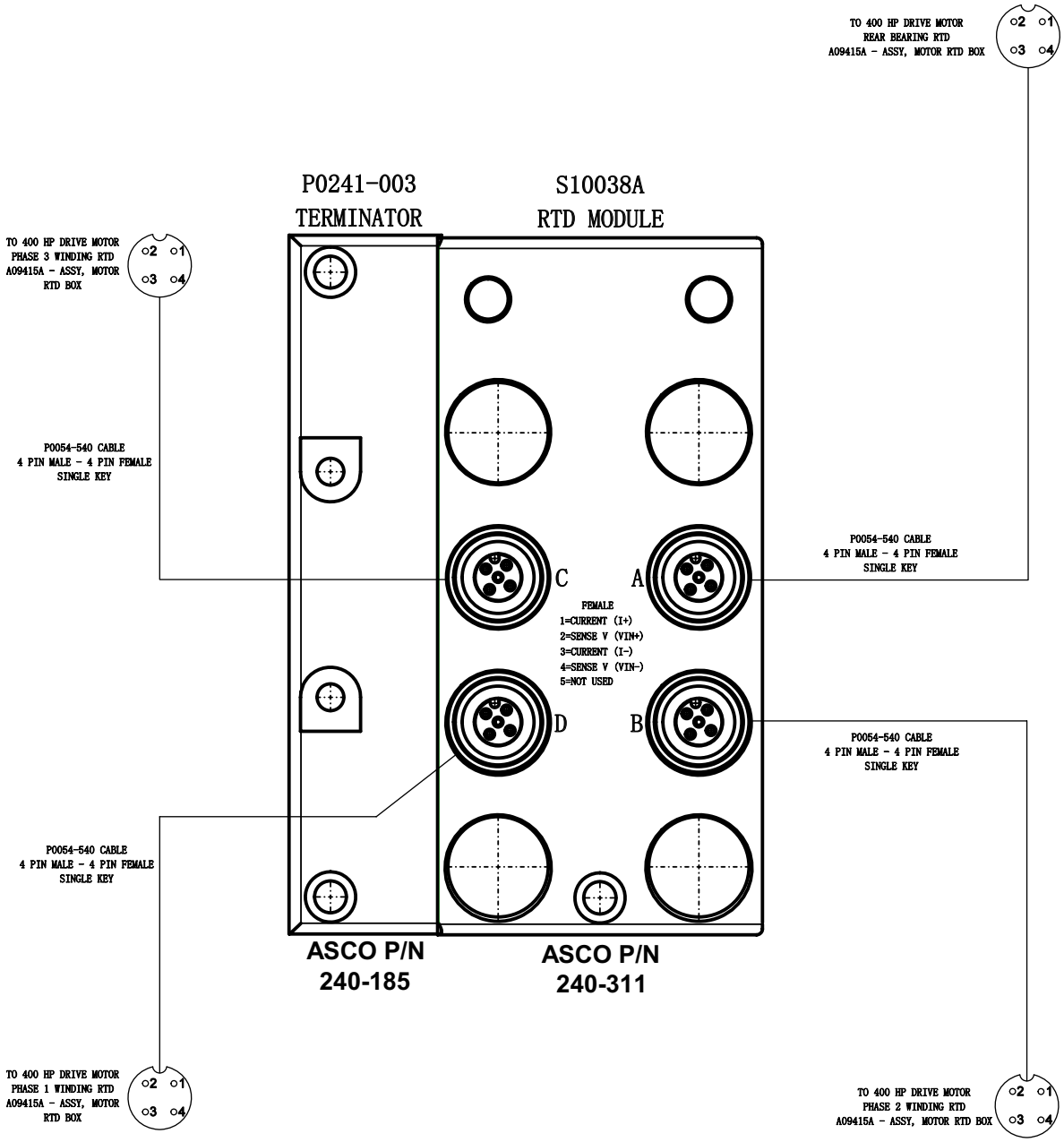
SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 11 of 12

IOM #11
(BACK SECTION)

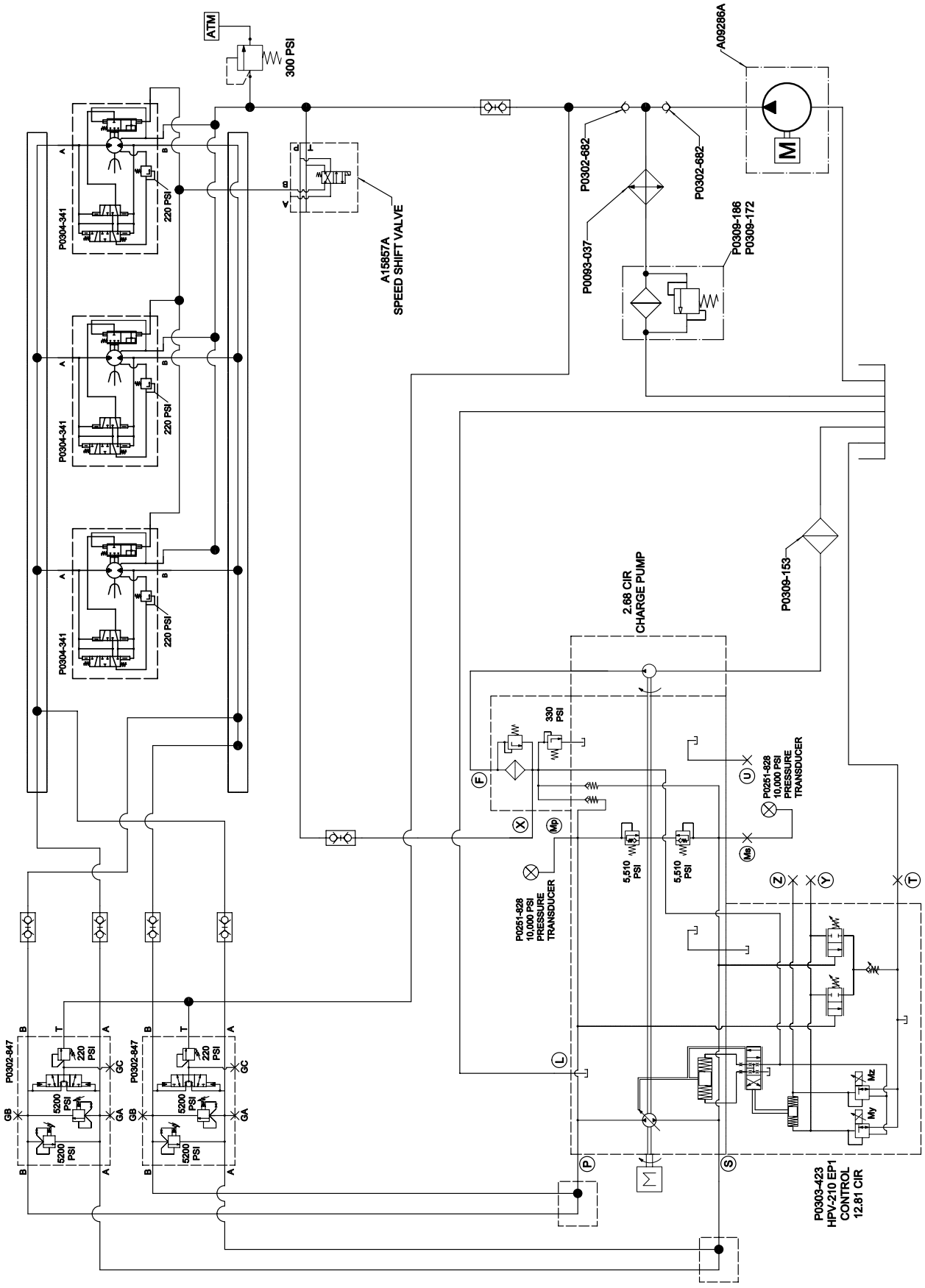


SL60P MTBM Asco I/O Module Schematics (continued)
Schematic - Part 12 of 12

*SEE DRAWING A09415A - ASSY, MOTOR RTD BOX-SL86 MTBM FOR TERMINAL LAYOUT OF THE 400 HP MOTOR RTD CONNECTIONS.

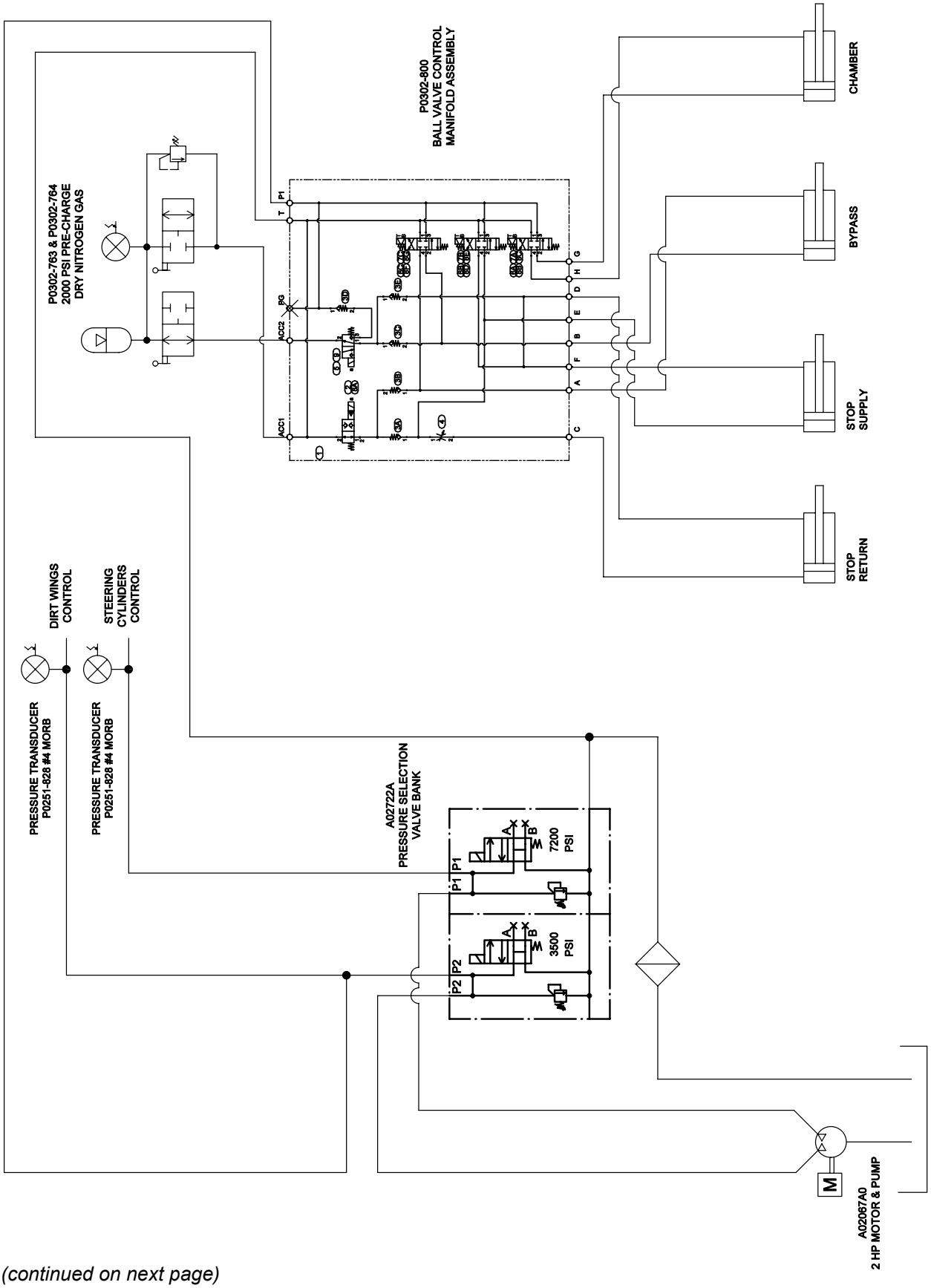


SL60P MTBM MAIN HYDRAULIC SCHEMATICS



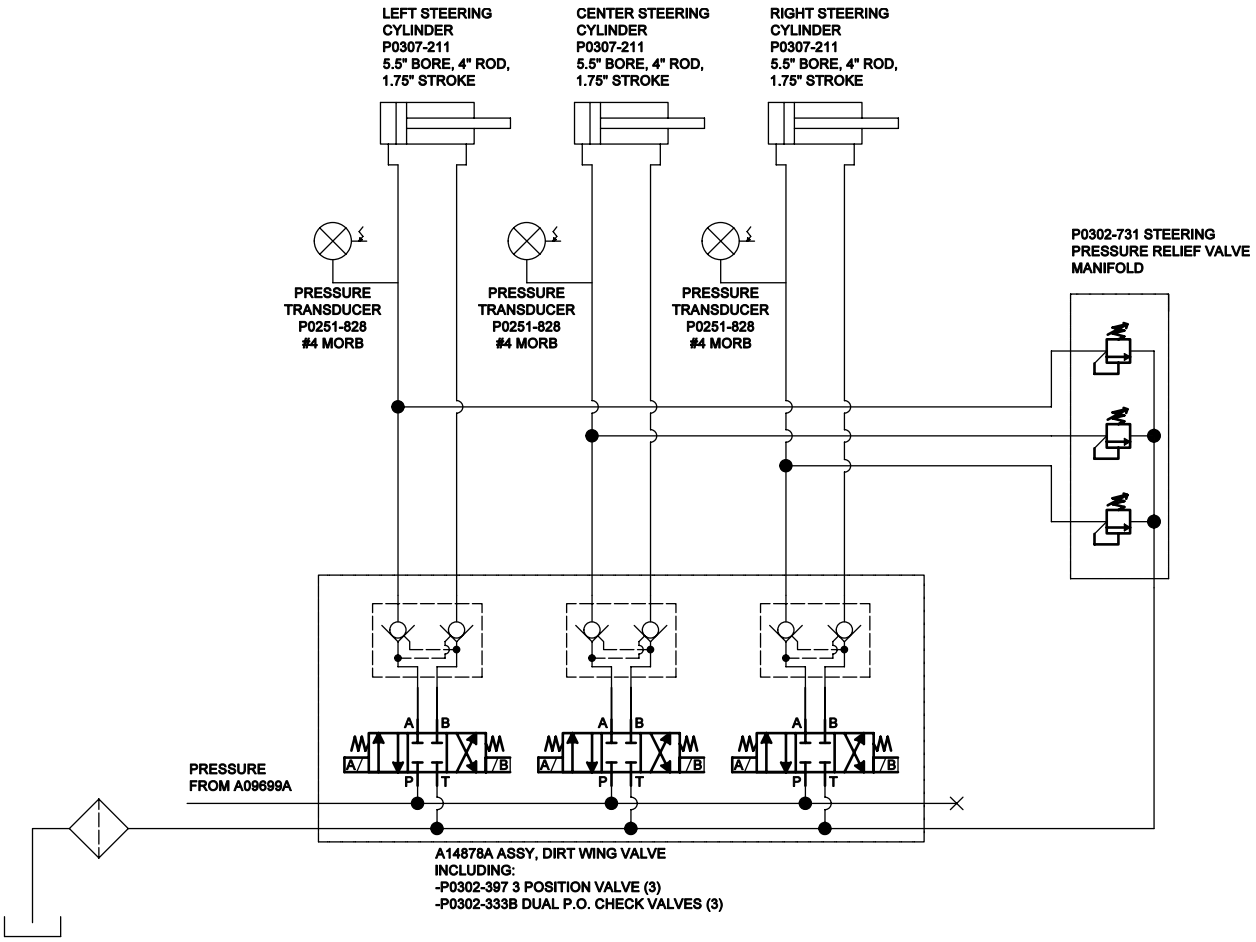
SL60P MTBM AUXILIARY HYDRAULIC SCHEMATIC

MTBM Auxiliary Hydraulic Schematic - Part 1 of 3
- Aux. Powerpack & Ball Valve Manifold



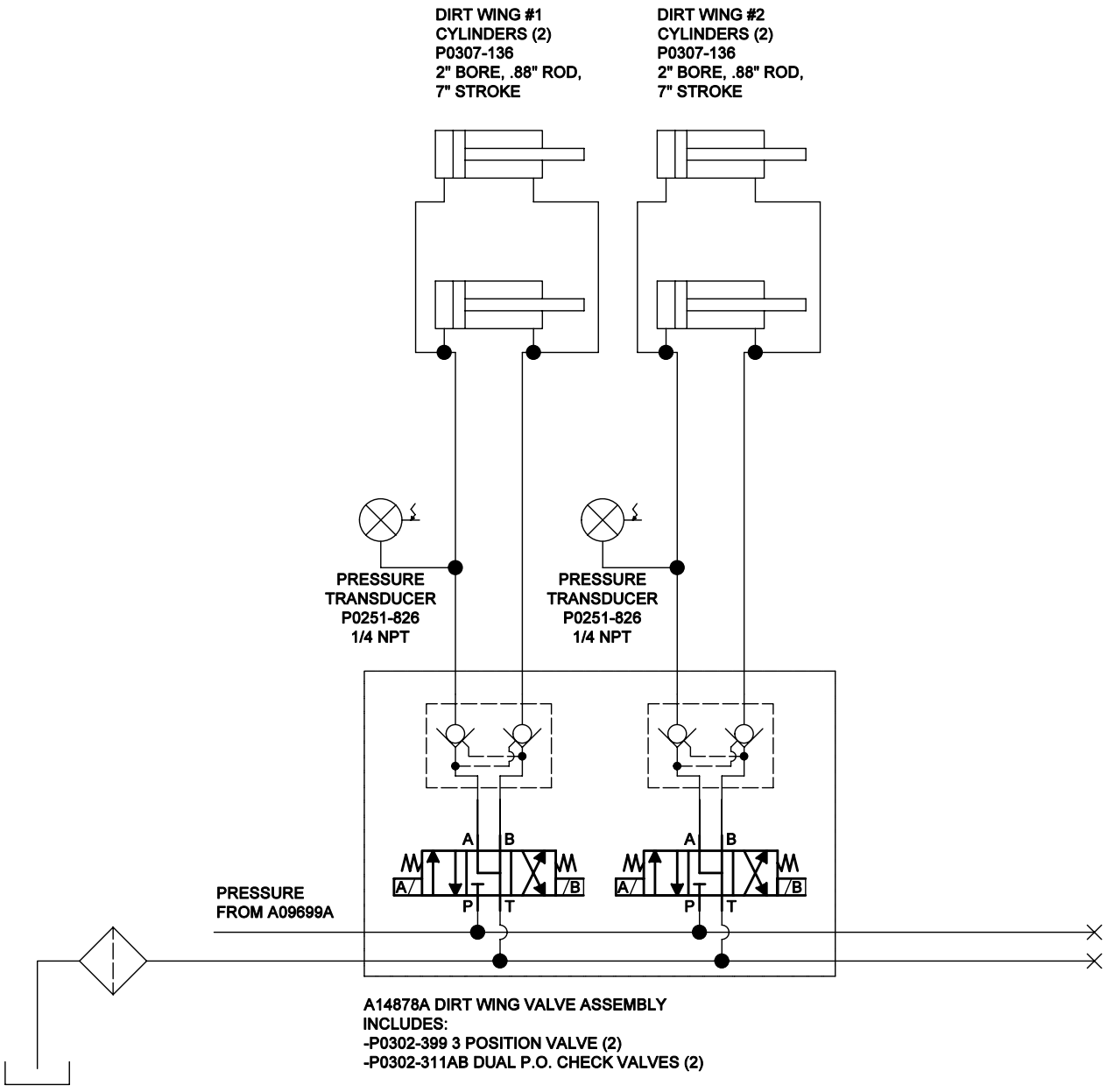
(continued on next page)

MTBM Auxiliary Hydraulic Schematic - Part 2 of 3 - Steering Cylinders

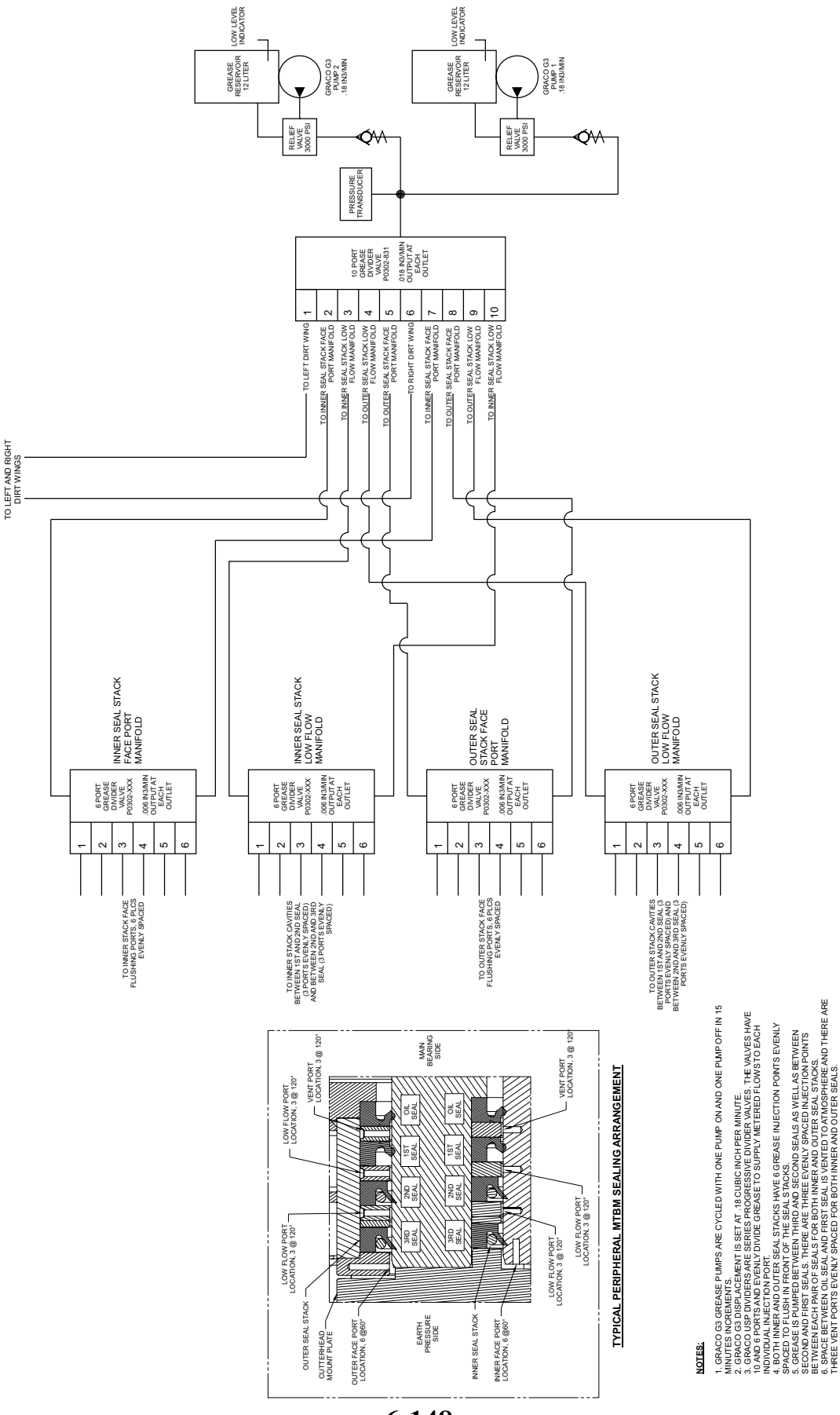


(continued on next page)

MTBM Auxiliary Hydraulic Schematic - Part 3 of 3 - Dirt Wings



SL60P MAIN SEAL GREASE SCHEMATIC

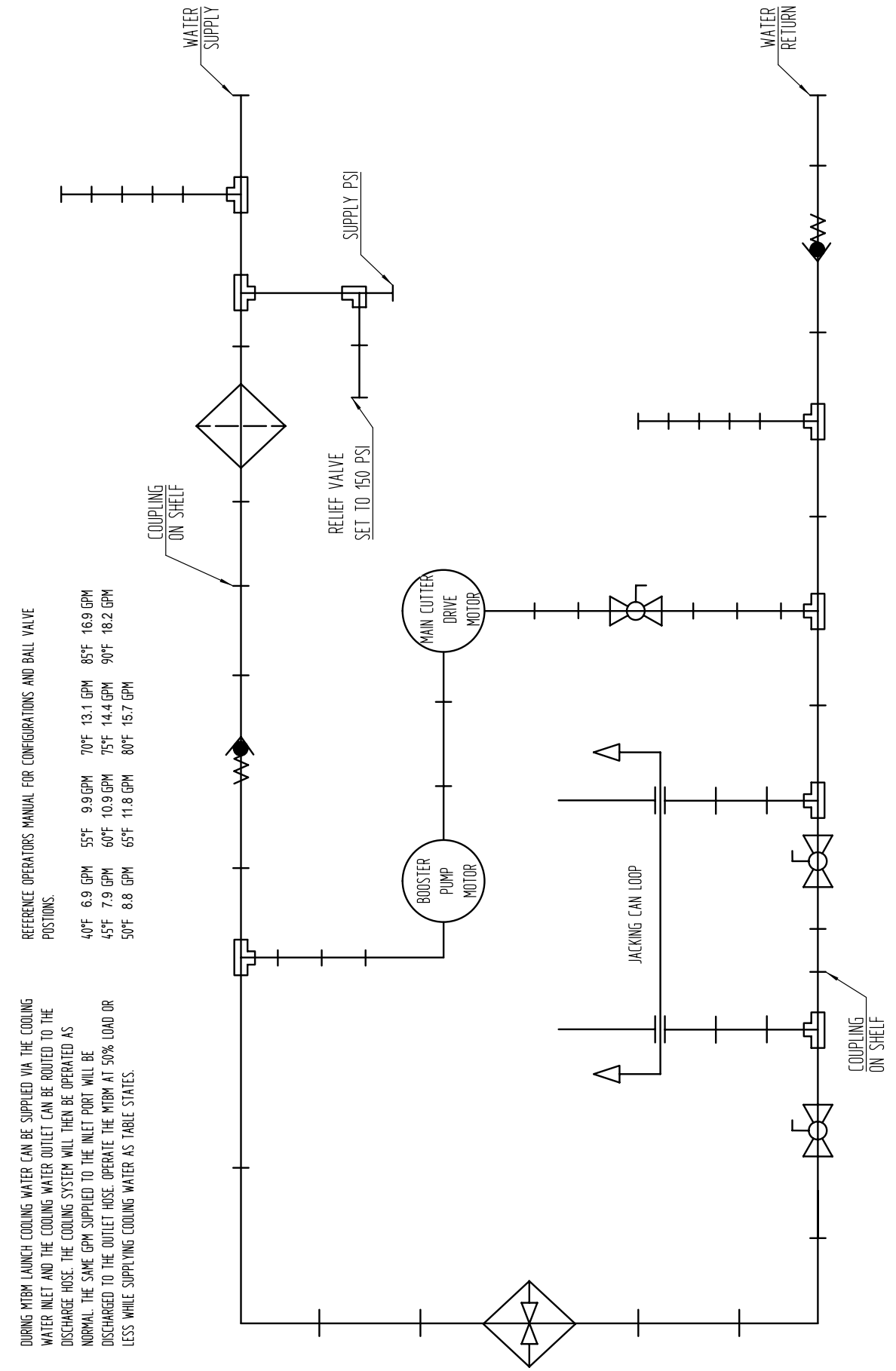


TYPICAL PERIPHERAL MTBM SEALING ARRANGEMENT

NOTES:

1. GRACO G3 GREASE PUMPS ARE CYCLED WITH ONE PUMP ON AND ONE PUMP OFF IN 15 MINUTES INCREMENTS.
2. GRACO G3 DISPLACEMENT IS SET AT .18 CUBIC INCH PER MINUTE.
3. GRACO USP DIVIDERS ARE SERIES PROGRESSIVE DIVIDER VALVES. THE VALVES HAVE 10 AND 6 PORTS AND EVENLY DIVIDE GREASE TO SUPPLY METERED FLOW STO EACH INDIVIDUAL INJECTION POINT.
4. BOTH INNER AND OUTER SEAL STACKS HAVE 6 GREASE INJECTION POINTS EVENLY SPACED TO FLUSH IN FRONT OF THE SEAL STACKS.
5. GREASE IS PUMPED BETWEEN THIRD AND SECOND SEALS AS WELL AS BETWEEN SECOND AND FIRST SEALS. THERE ARE THREE EVENLY SPACED INJECTION POINTS BETWEEN EACH PAIR OF SEALS FOR BOTH INNER AND OUTER SEAL STACKS.
6. SPACE BETWEEN OIL SEAL AND FIRST SEAL IS VENTED TO ATMOSPHERE AND THERE ARE THREE VENT PORTS EVENLY SPACED FOR BOTH INNER AND OUTER SEALS.

SL60P MTBM WATER COOLING SYSTEM SCHEMATIC



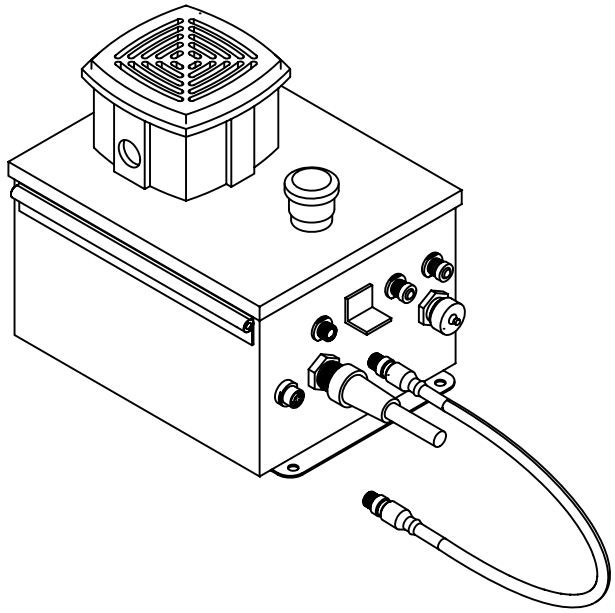
NOTES

Pit Box

The pit box mounted in the launch shaft consists of an emergency stop button and gas detector alarm horn. The pit box is connected to the control container to allow communication to the microtunneling control operator via the MTBM control screen. When the emergency stop button is pushed IN, it will deactivate ALL outgoing electrical and hydraulic power from the Akkerman control container, remote hydraulic power pack, power container and jacking frame. Using the Emergency Stop button will not stop the power from the power source (generator). The power source (generator) must be equipped with an E-Stop. The wheel counter (if used) is also connected to the pit box displaying the pipe count on the MTBM control screen.

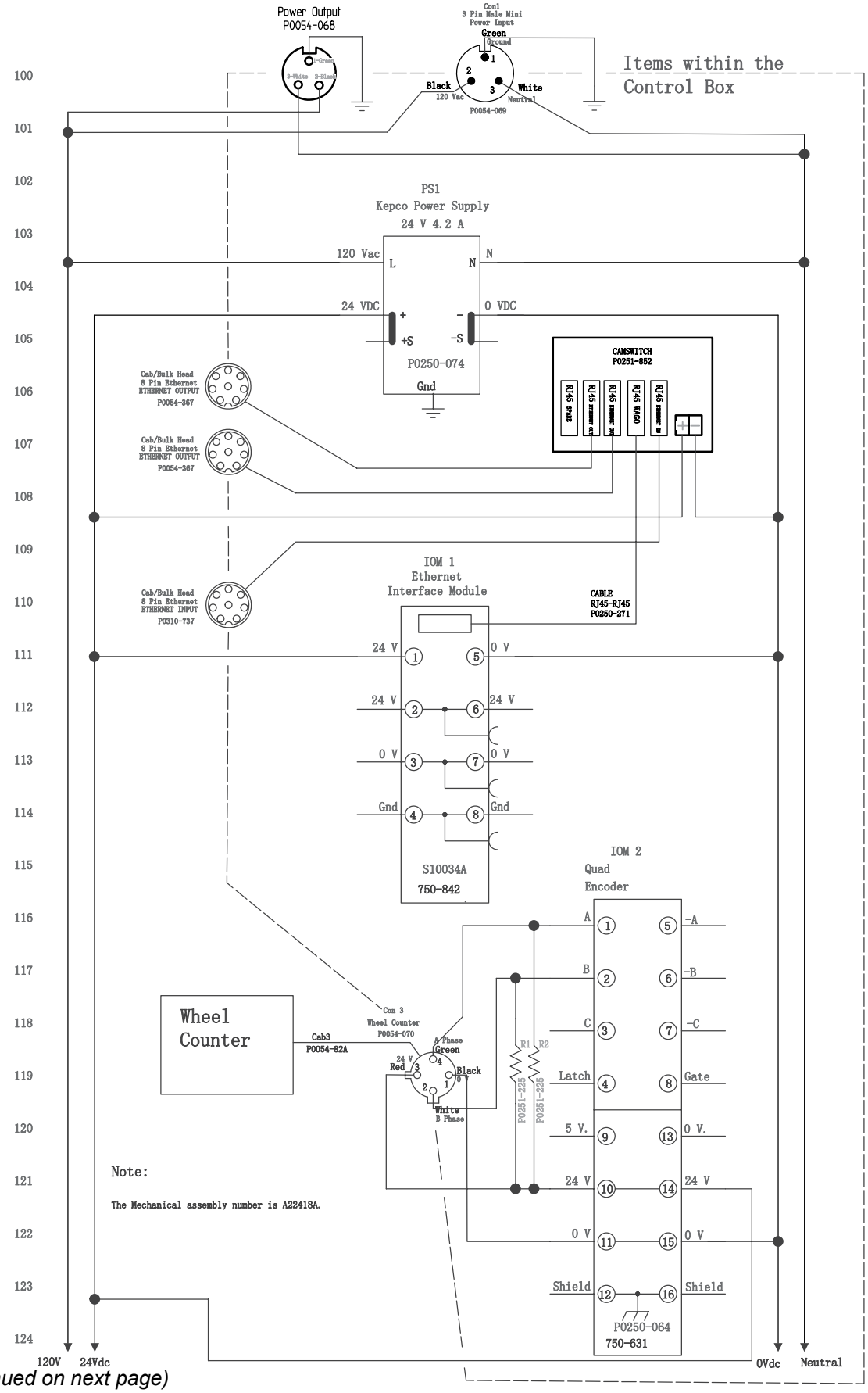
Pit Box

Pit Box 7-2



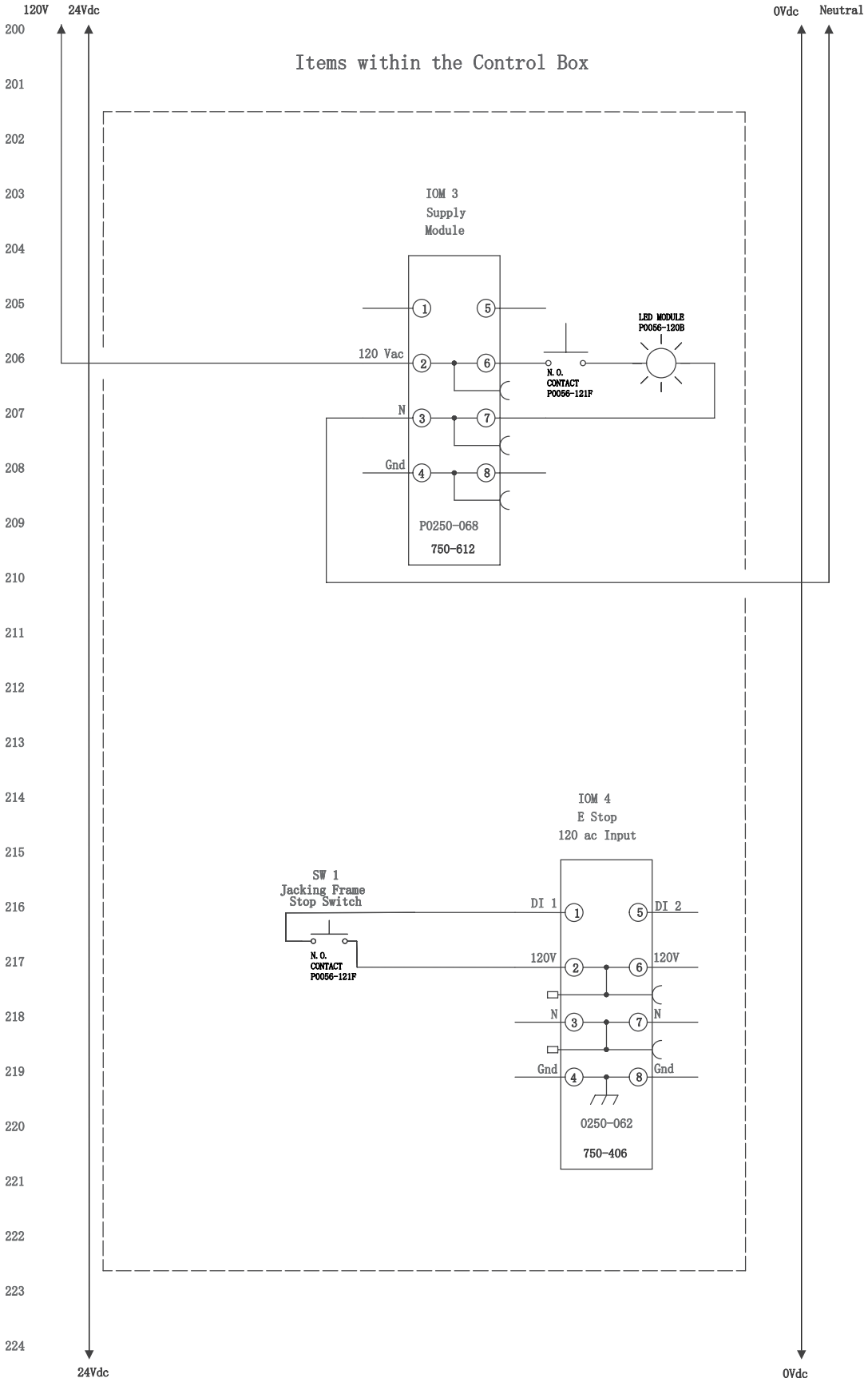
PIT BOX ELECTRICAL SCHEMATICS

Electrical Schematic - Part 1 of 3



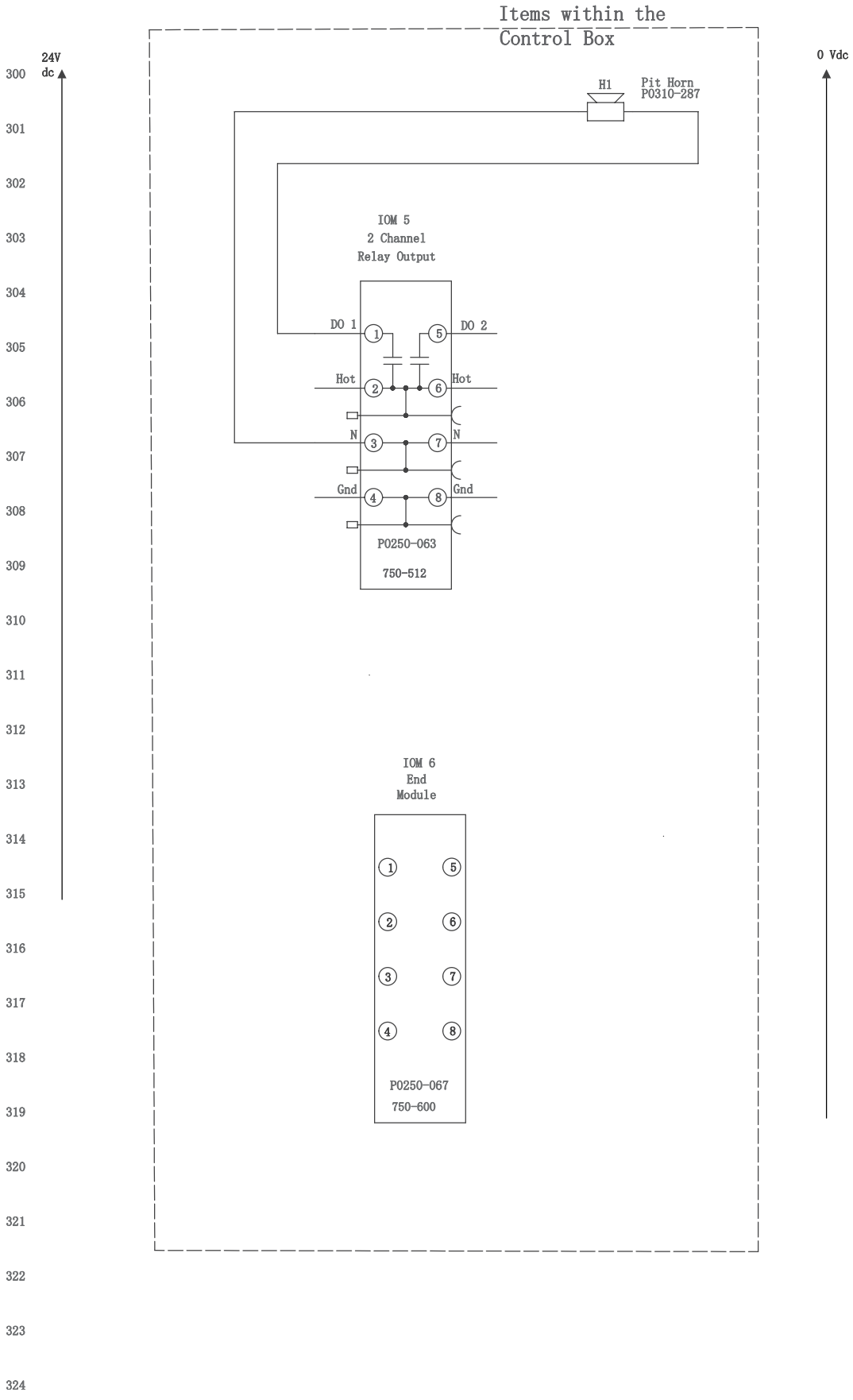
(continued on next page)

Pit Box Electrical Schematics (continued) - Part 2 of 3



(continued on next page)

Pit Box Electrical Schematics (continued) - Part 3 of 3

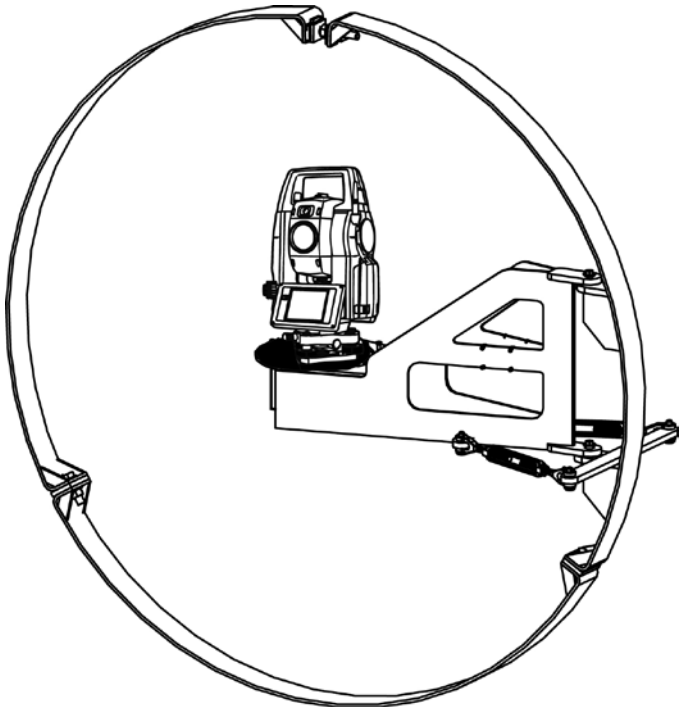


Guidance System - AZ100

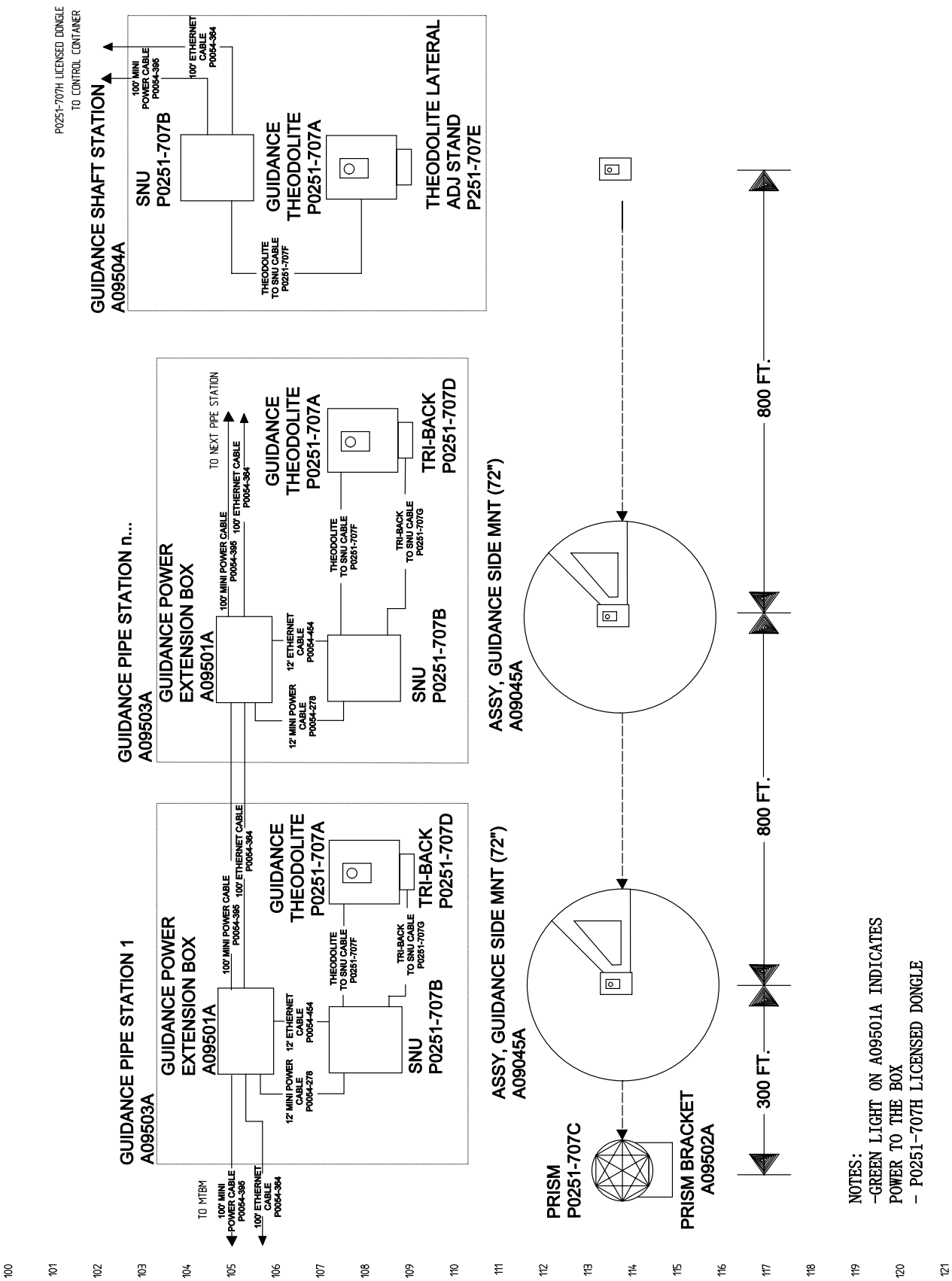
The AZ100 Total Guidance System (TGS) is a monitoring system for extended lengths and alignments with curves. The AZ100 TGS is comprised of individual, self leveling, station units that maintain a surveyed connection throughout the alignment without the need for continuous manual surveying.

Guidance System

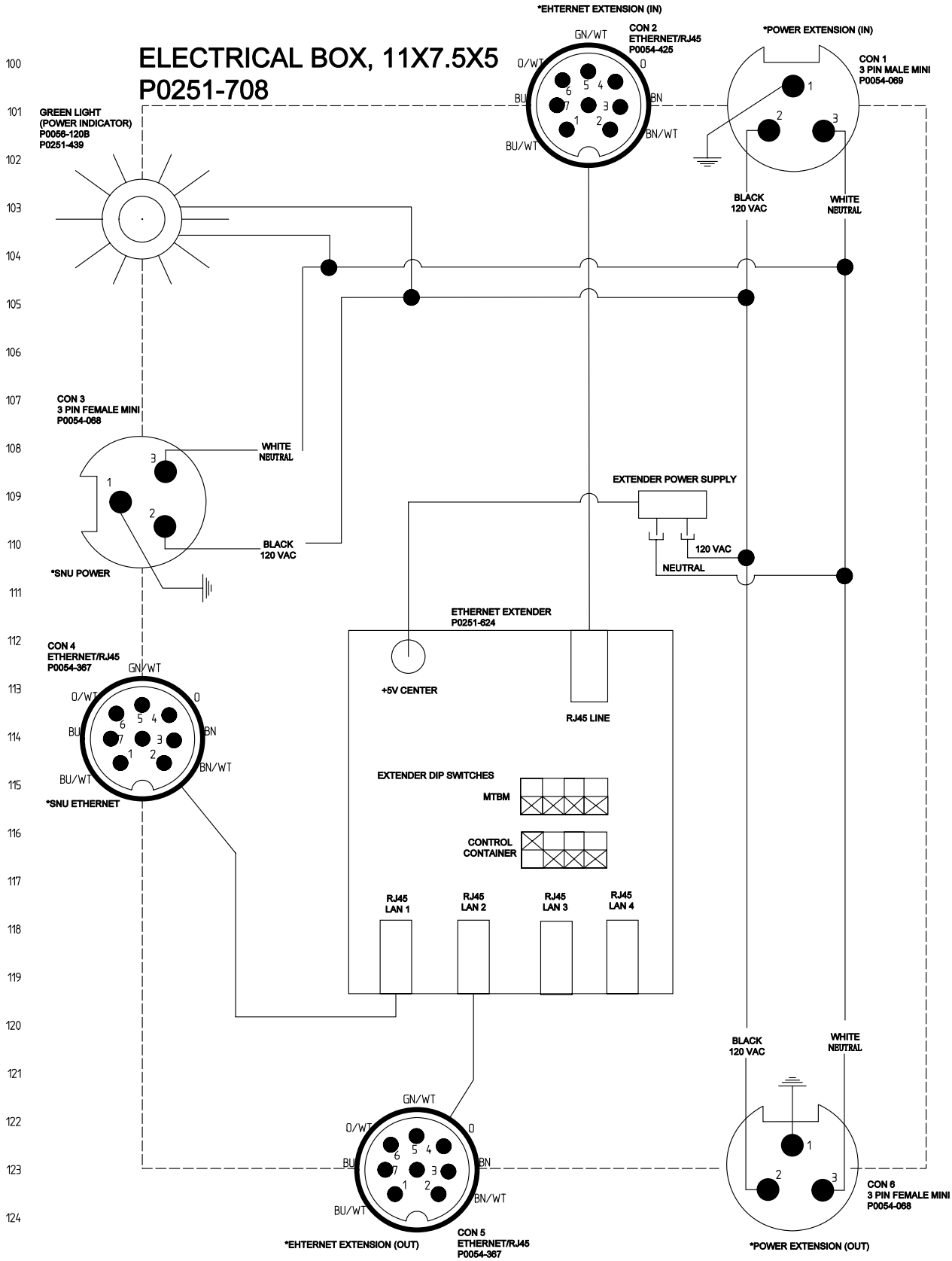
Guidance System Assembly Schematic 8-2
Guidance System Electrical Extension Assembly Schematic 8-3
Guidance System Pipe Station Kit Schematic 8-4
Guidance System Shaft Station Schematic 8-5



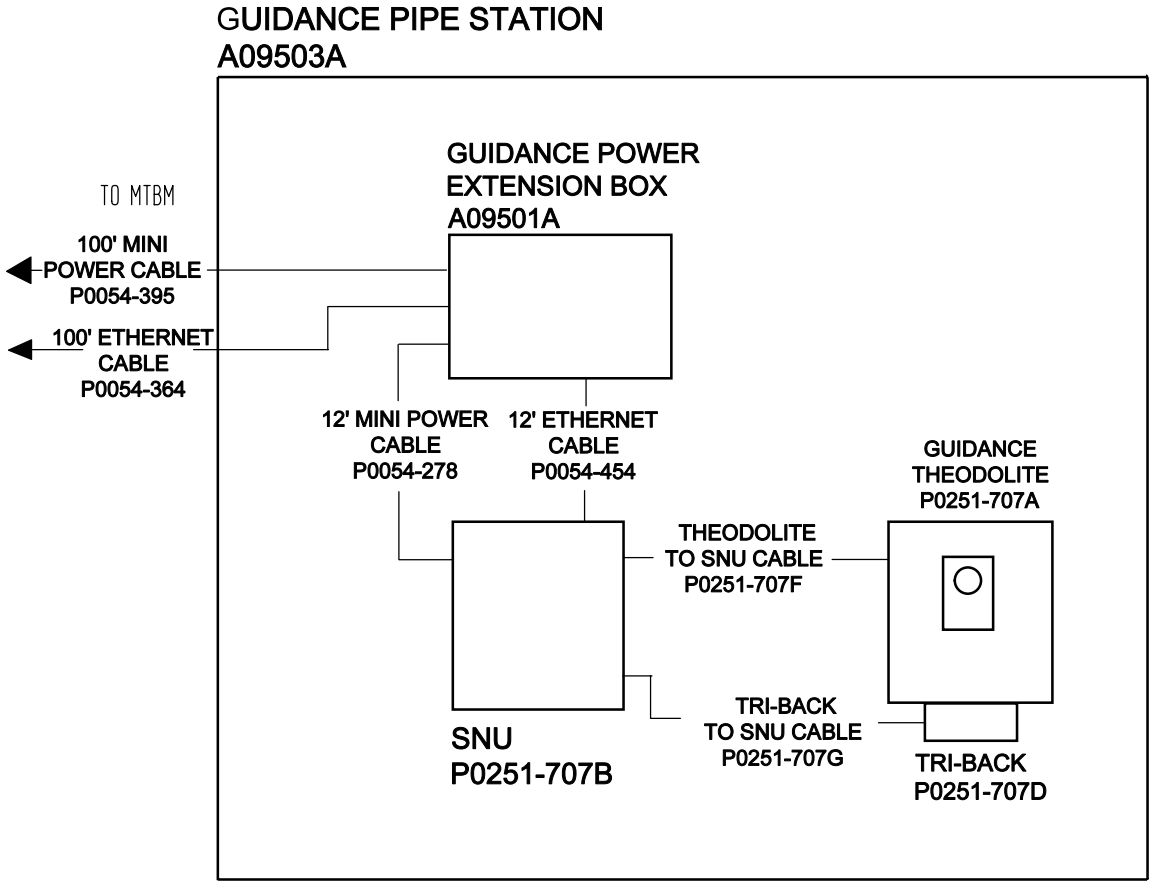
GUIDANCE SYSTEM ASSEMBLY SCHEMATIC



GUIDANCE SYSTEM ELECTRICAL EXTENSION ASSEMBLY SCHEMATIC

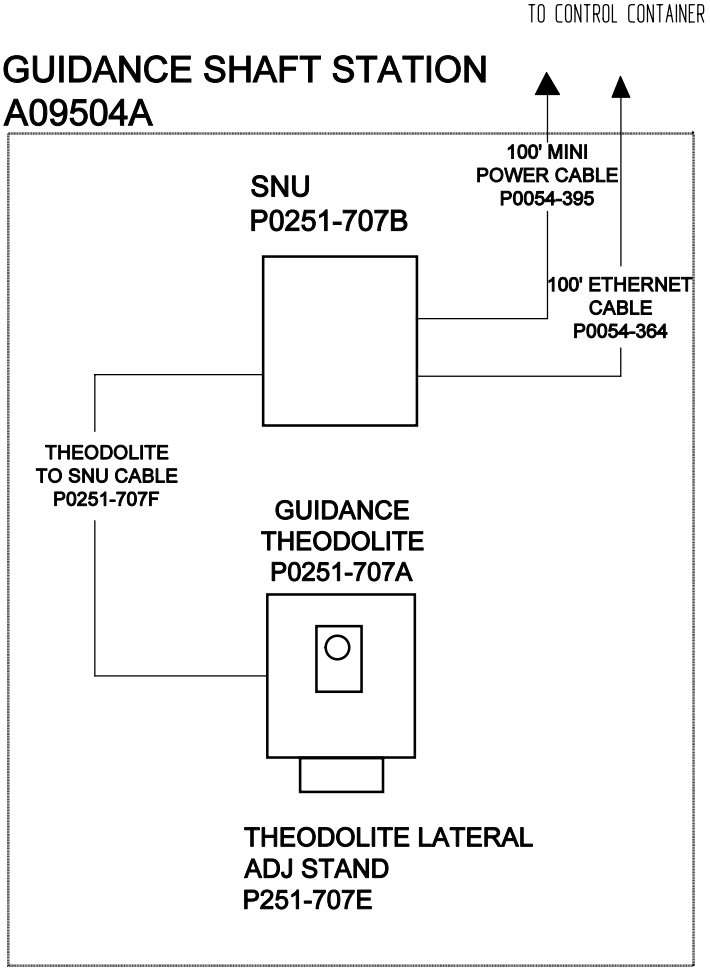


GUIDANCE SYSTEM PIPE STATION KIT SCHEMATIC



NOTES:
-GREEN LIGHT ON A09501A INDICATES
POWER TO THE BOX

GUIDANCE SYSTEM SHAFT STATION SCHEMATIC



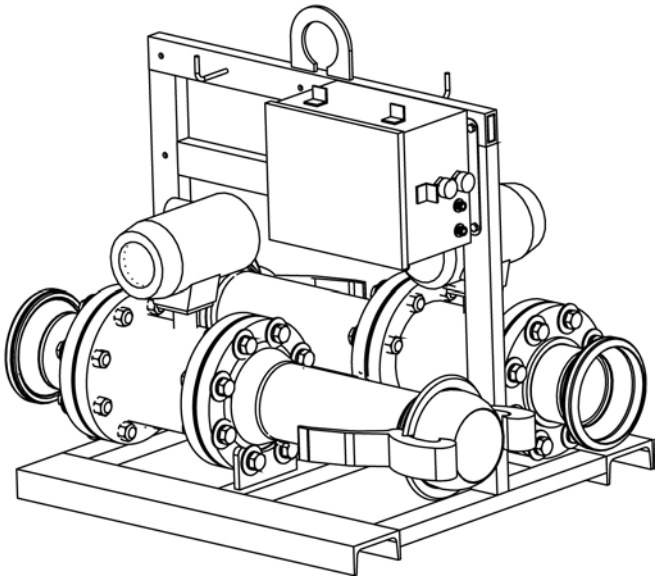
NOTES

Flowmeter

The Dual Flowmeter assembly functions to register slurry feed and return flow rate in gpm for balanced excavation during microtunneling operations. Flow data is assessed at the operator's control console target screen.

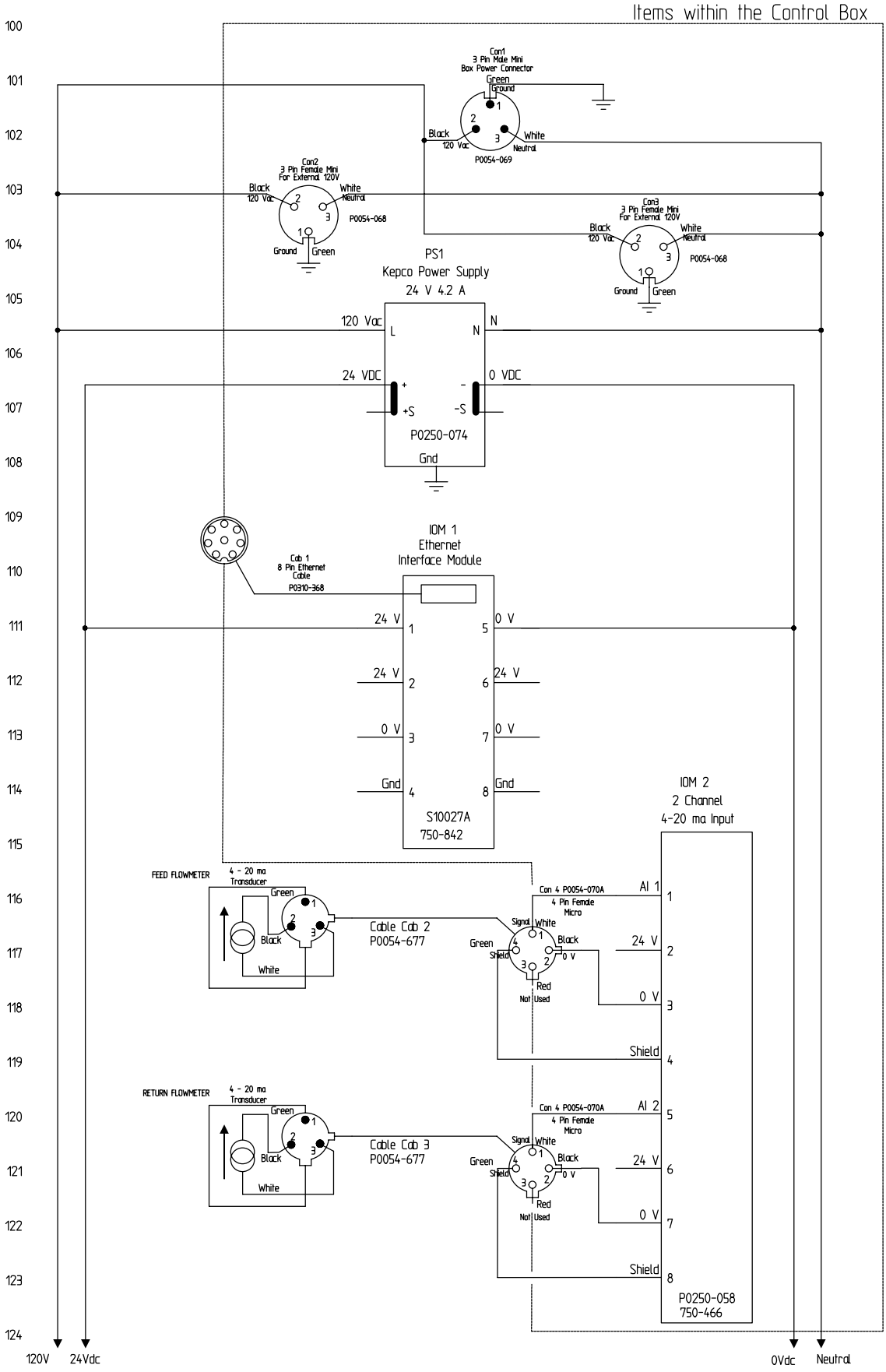
Flowmeter

Flowmeter Electrical Schematic 9-2



SN FA03607F

FLOWMETER ELECTRICAL SCHEMATIC - SN FA03607F, A30831A, FA16964F, FA16965F

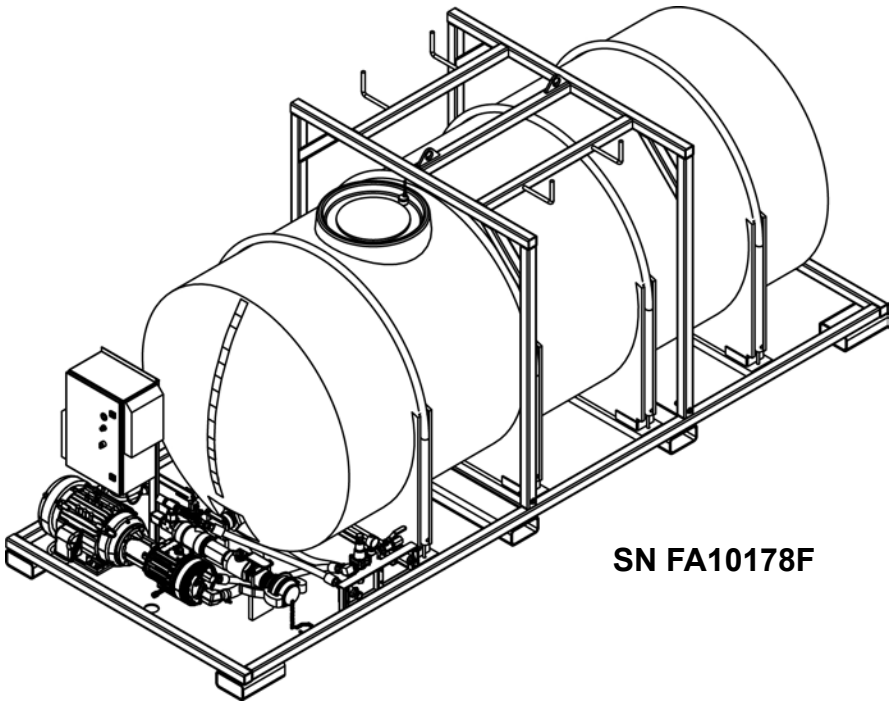


Water Cooling Tank

The Water Cooling Tank provides water to the high pressure jetting pump.

Water Cooling Tank

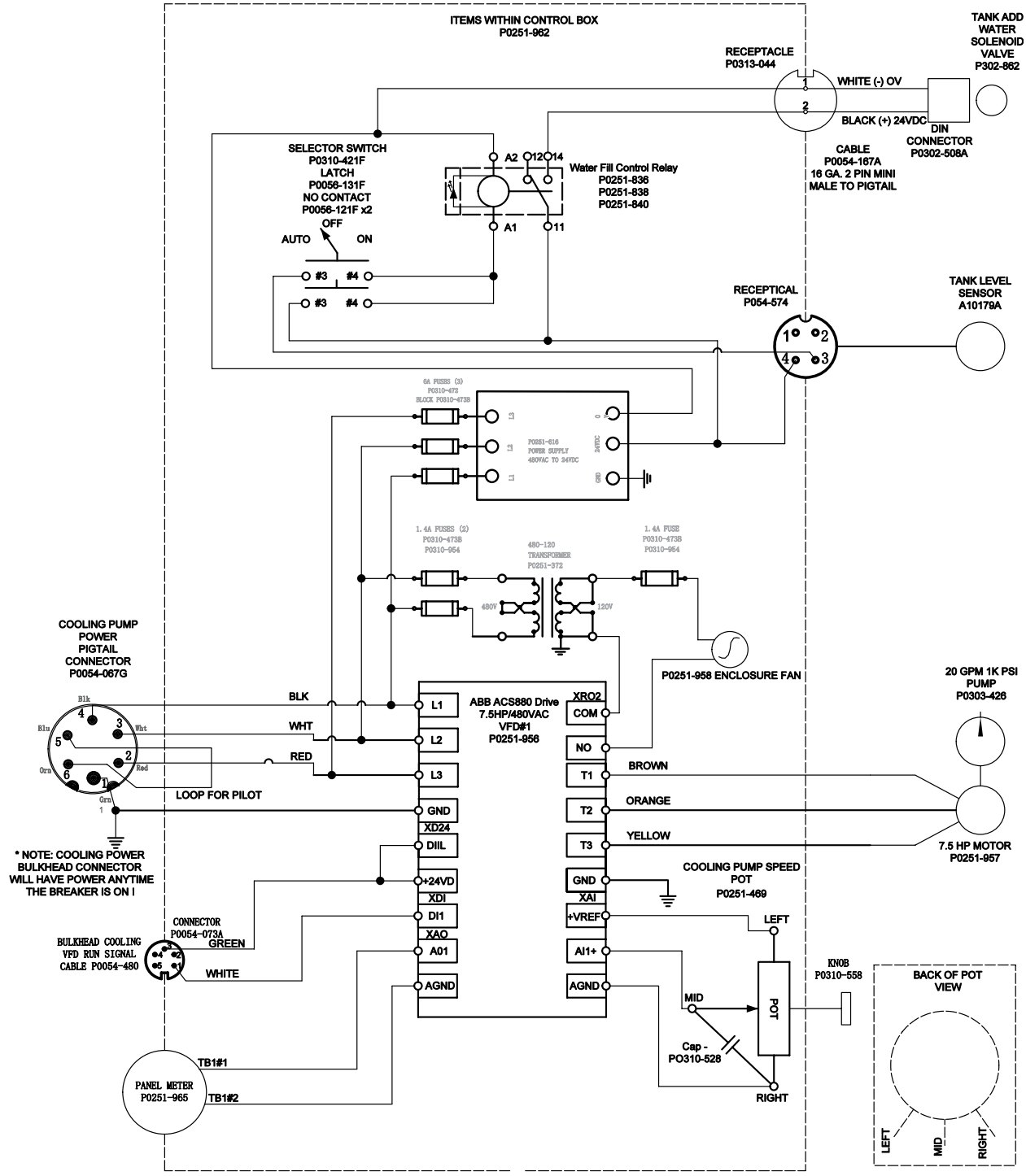
Water Cooling Tank SN FA10178F Electrical Schematics 10-2



SN FA10178F

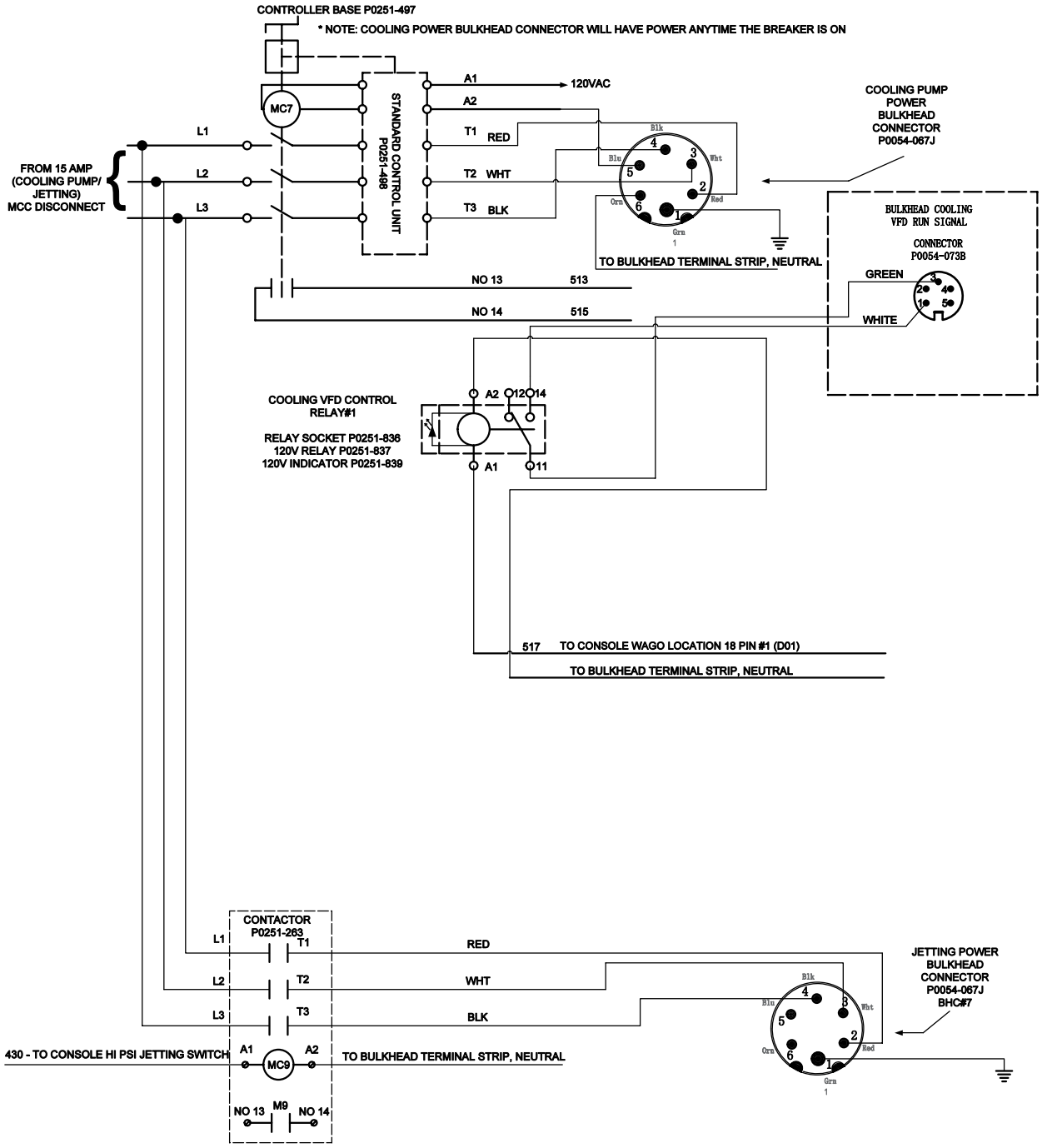
WATER COOLING TANK ELECTRICAL SCHEMATICS - SN: FA10178F

Electrical Schematic - Part 1 of 2



Water Cooling Tank Electrical Schematics (continued)
Electrical Schematic - Part 2 of 2

CONTROL CONTAINER COOLING CIRCUIT MODIFICATION FOR VFD DRIVEN COOLING PUMP FA10178F



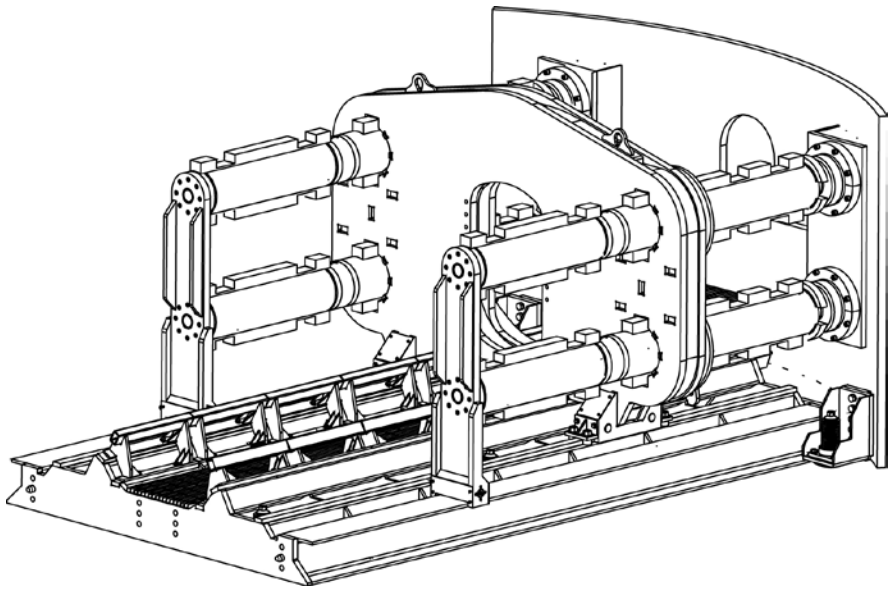
NOTES

Keyhole Jacking Frames

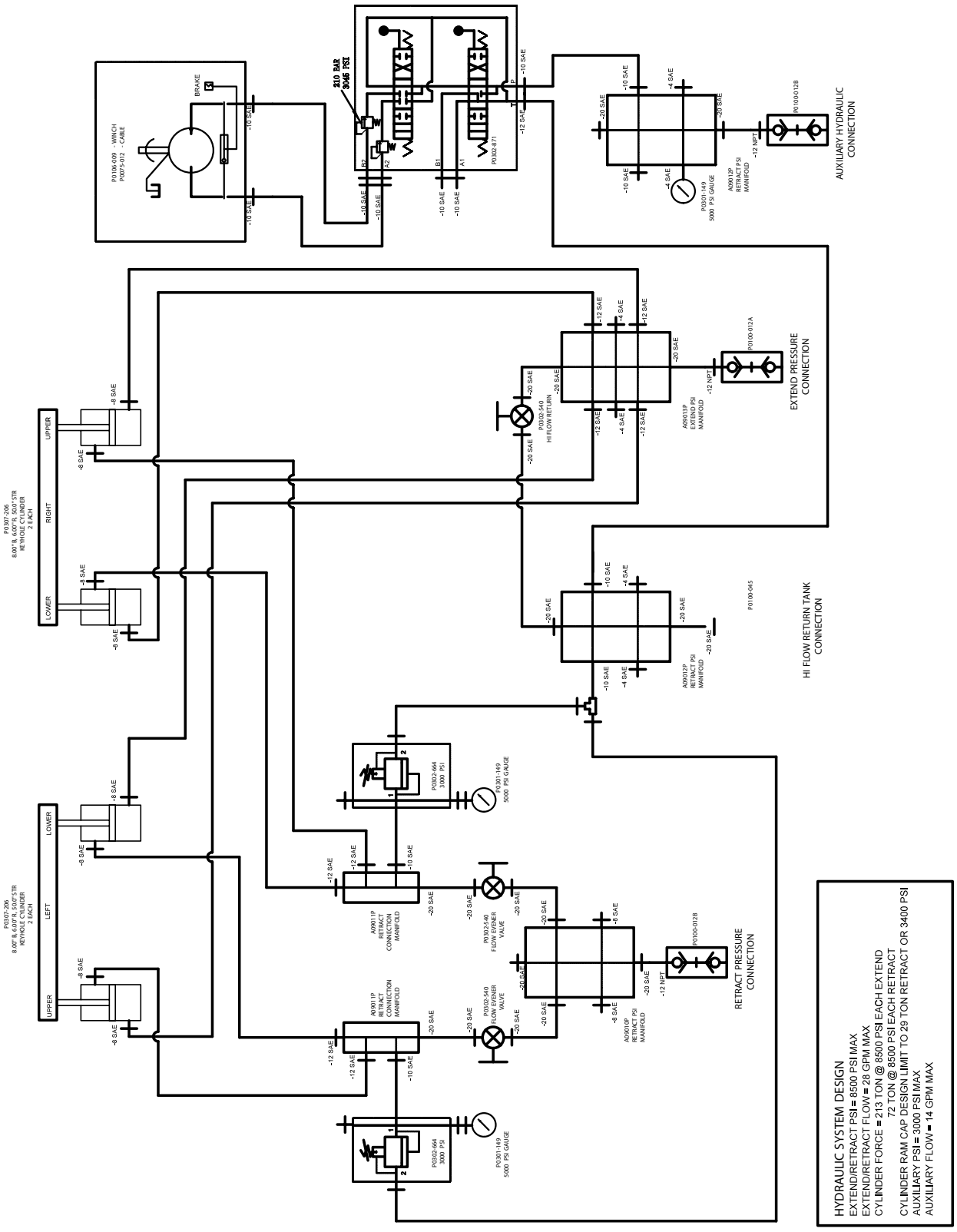
Keyhole Jacking Frames offer a high capacity jacking frame from a 20 - 32-ft. shaft. They feature 800 - 1,200 tons of thrust capacity to advance pipe with a maximum 114-in. OD in 10-ft. lengths. Smaller pipe can be used with a thrust adapter. Keyhole jacking frames are configured with and without a dirt bucket bay for pipe jacking and microtunneling applications. Keyed blocks on the hydraulic jacking cylinders continuously advance the MTBM or TBM and a winch is used to retract the thrust ring.

Keyhole Jacking Frames - Hydraulic Schematics

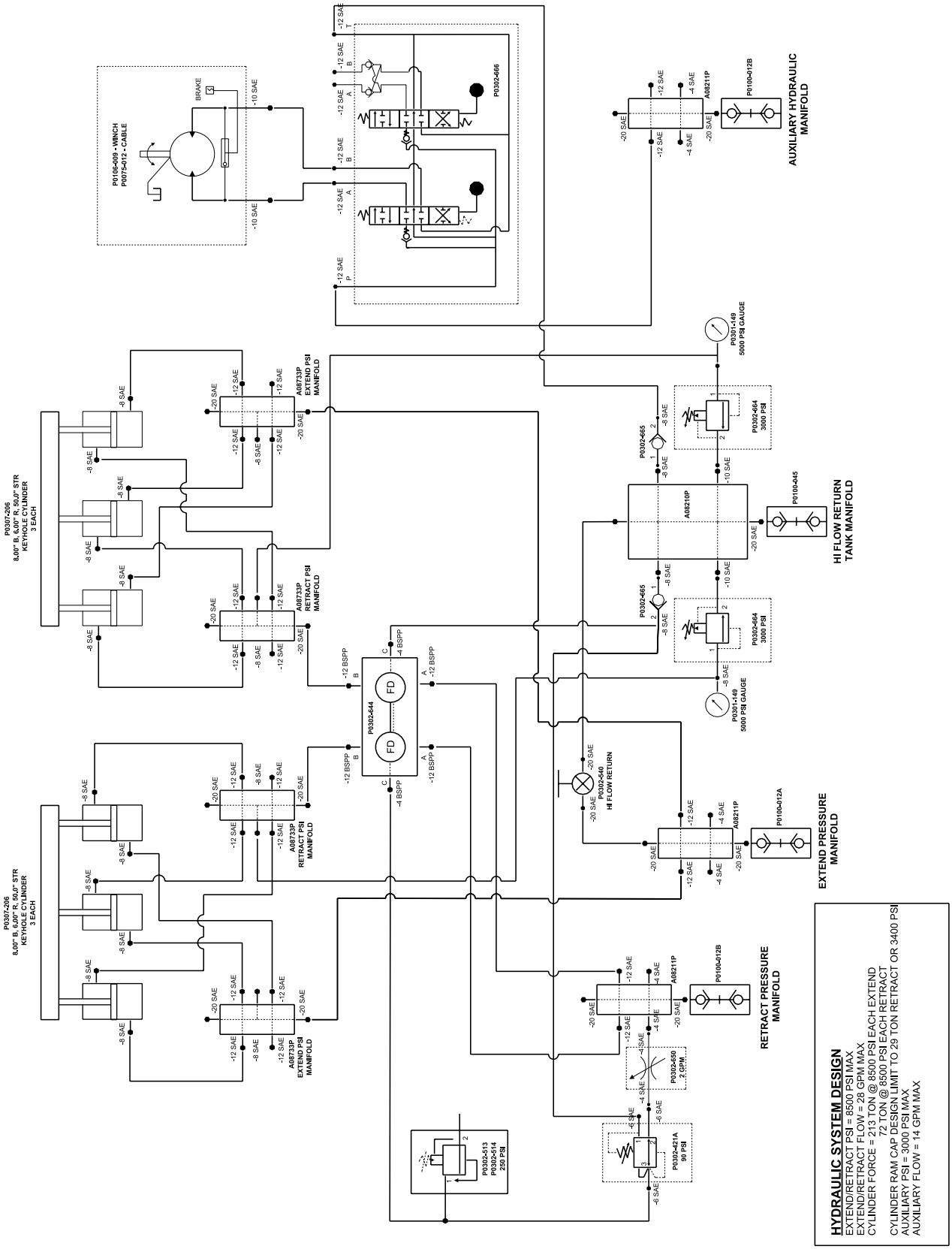
MT875K SN: FA08750F 11-2
MT890K SN: FA08900F / MT8102K SN: FA08104F 11-3
MT460K SN: FA06310F / MT860K SN: FA06303F / MT8102K SN: FA08102F 11-4
MT8108K SN: F31900F 11-5



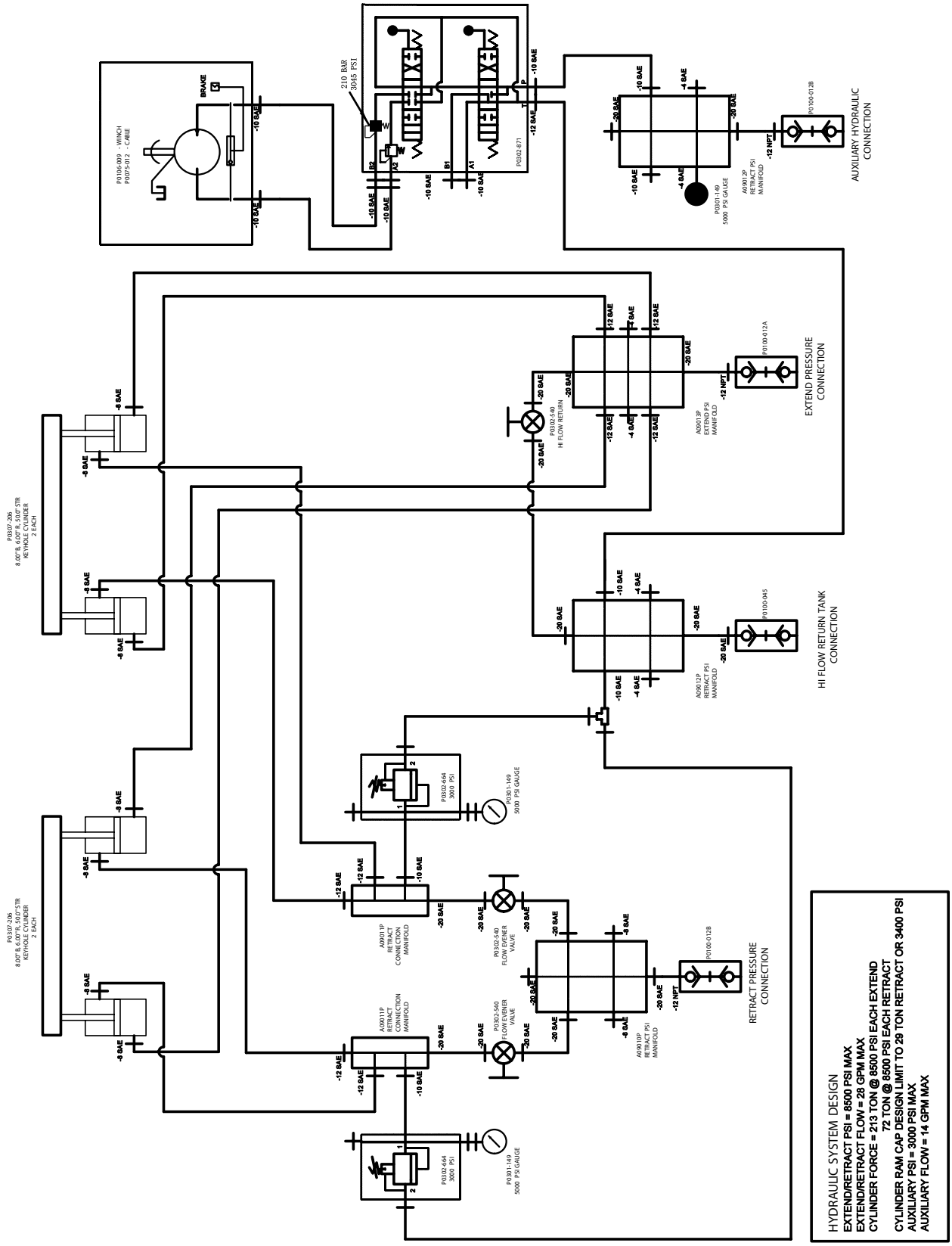
KEYHOLE FRAME HYDRAULIC SCHEMATICS - MT875K (SN: FA08750F)



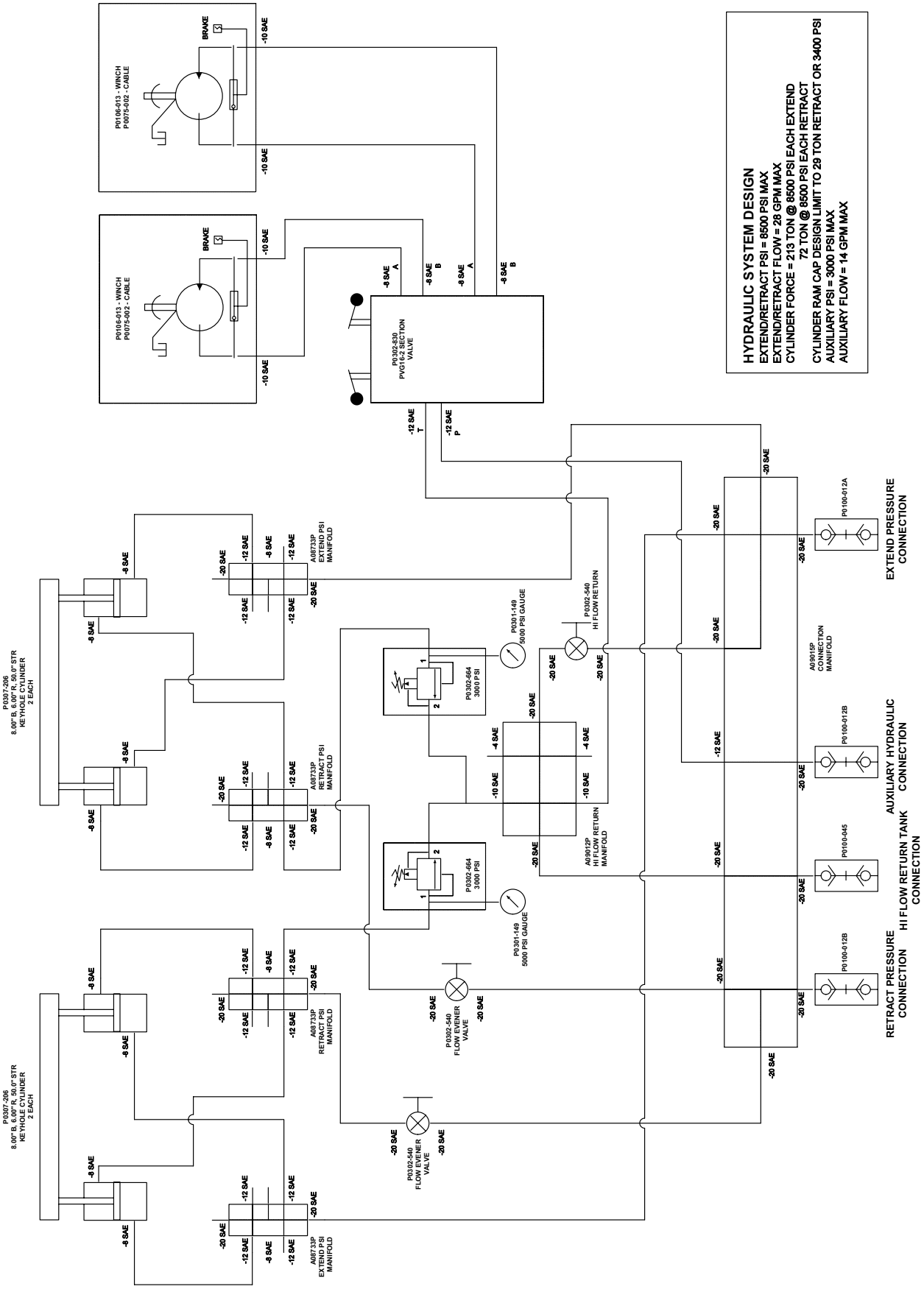
KEYHOLE FRAME HYDRAULIC SCHEMATICS - MT890K (SN: FA08900F) - MT8102K (SN: FA08104F)



KEYHOLE FRAME HYDRAULIC SCHEMATICS
- MT460K (SN: FA06310F) - MT860K (SN: FA06303F) - MT8102K (SN: FA08102F)



KEYHOLE FRAME HYDRAULIC SCHEMATICS - MT8108K SN: F31900F



NOTES