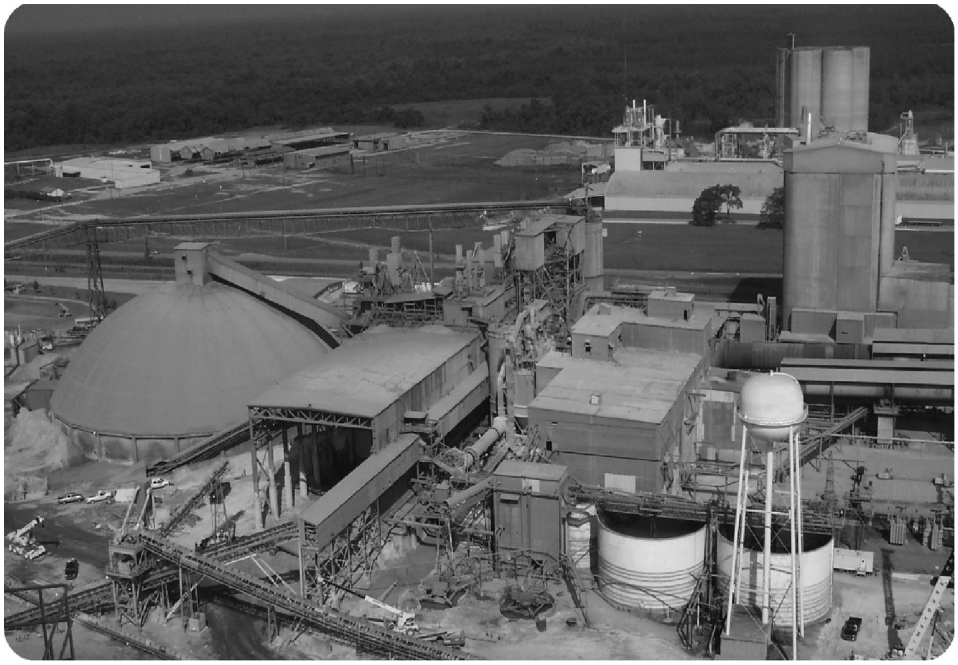
Installation Instructions

Original Instructions

Allen-Bradley

Medium Voltage SMC OEM Components

Bulletin Number 1503E



Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Summary of Changes

This publication contains new and updated information as indicated in this table.

Topic	Page
Changed references from SMC-Flex to SMC-50	Throughout
Updated VSB graphic	26
Inserted new Interface Board mounting and dimensions graphic	29
Inserted new Interface Board graphic	30
Inserted updated schematic diagram	50
Inserted updated schematic diagram	51

About this Publication

This document pertains to the Bulletin 1503E Medium Voltage SMC™ OEM components.

Most of the components described herein are provided in various 1503E kits. However, some of the devices described are not provided. These must be acquired separately.

The power stack frame is a complete three-phase power system used in solid-state reduced voltage motor controllers. Power stacks are also available as a set of loose three-phase components. Each form of power stack assembly (frame, loose) is applied with other Bulletin 1503E control components and power devices, in forming a complete solution.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Bulletin 1503VC IntelliVAC Contactor Control Module User Manual, publication 1503-UM060	Provides information on receiving and storage, installation, setup, monitoring, and spare parts for the IntelliVAC Contactor Control Module
CENTERLINE Medium Voltage SMC-50 Motor Controller User Manual, publication 1560F-UM001	Provides information on installation, programming, troubleshooting, and maintaining SMC-50 controllers
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website: rok.auto/certifications	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page.

Notes:

Receiving and General Information

Receiving

Publication MV-QS050 is included with your shipment and contains information regarding receiving, unpacking, initial inspection, handling, storage, and site preparation.

ATTENTION: Printed circuit boards contain components that can be damaged by electrostatic charges that build up on personnel during normal activities. Exercise the following precautions when handling electrostatic sensitive devices. Failure to do so may damage the device and render it inoperable.

Handling Procedures for Electrostatic Sensitive Devices

To guard against electrostatic damage (ESD) to equipment, the following precautions should be observed when handling electrostatic sensitive devices.

1. Use a grounding wrist strap to minimize the build up of static charges on personnel.
2. Handle the module by the edges and avoid touching components or printed circuit paths.
3. Store devices with sensitive components in the conductive packaging that the module is shipped in.

These precautions are the minimum requirements for guarding against ESD. For more information, see publication 8000-SB001.

Standards and Codes

IMPORTANT It is recommended that you are familiar with the following safety and design standards and codes, and any additional local codes that apply to medium voltage controllers.

- CEC (Canadian Electrical Code)
- CSA 22.2 No. 14 (Canadian Standards Association) - Industrial Control Equipment
- NEC (National Electrical Code)
- NEMA ICS Standards (National Electrical Manufacturers' Association)
- OSHA (Occupational Safety and Health Administration)
- UL 50 (Underwriters Laboratories) - Enclosures for Electrical Equipment
- UL 347 (Underwriters Laboratories) - High Voltage Industrial Control Equipment
- UL 508 (Underwriters Laboratories) - Industrial Control Equipment
- IEC 60204-1 - Safety of Machinery - Electrical Equipment of Machines, Part 1: General Requirements
- IEC 62271-200 - AC Metal Enclosed Switchgear and Control Gear for Rated Voltages Above 1kV and up to 52 kV (formerly IEC 60298)
- IEC 60470 - High Voltage Alternating Current Contactors
- IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code)
- IEC 60694 - Common Clauses for High Voltage Switchgear and Control Gear Standards
- ICS1- Industrial Control and Systems General Requirements
- ICS3 Part 2 - Industrial Control and Systems - Medium Voltage Controllers Rated 2001-7200V AC

Power Stack Frame Installation

Identification

A power stack frame is shown in Figure 1 (3300/4160V frame shown).

Figure 1 - Medium Voltage SMC OEM Power Stack Frame

Verify the voltage and current rating of the OEM frame using the information located on the nameplate at the front of the frame (Figure 2).

See Table 1 for the frame description and catalog numbers.

Figure 2 - MV SMC OEM Frame Nameplate Data

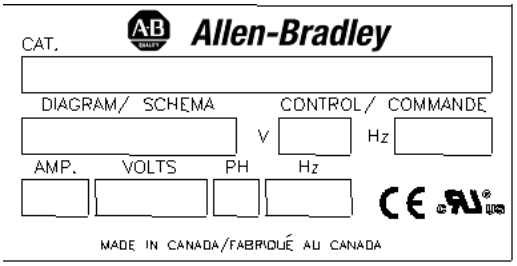


Table 1 - Catalog Number Explanation(1)

Description of Frame Options	Catalog Number	Part Number
1000V, 180 A, 3 PH, 50/60 Hz	1503E-FRZ1T	80187-547-51
1000V, 360 A, 3 PH, 50/60 Hz	1503E-FRZ1A	80187-547-52
2300V, 180 A, 3 PH, 50/60 Hz	1503E-FRAT	80187-547-53
2300V, 360 A, 3 PH, 50/60 Hz	1503E-FRAA	80187-547-54
3300V, 180 A, 3 PH, 50/60 Hz	1503E-FRCT	80187-547-55
3300V, 360 A, 3 PH, 50/60 Hz	1503E-FRCA	80187-547-56
4160V, 180 A, 3 PH, 50/60 Hz	1503E-FRET	80187-547-57
4160V, 360 A, 3 PH, 50/60 Hz	1503E-FREA	80187-547-58

(1) Voltage ranges:1000 = 800…1449V, 2300 = 1450…2499V, 3300/4160 = 2500…4799V

Specifications

Table 2 - Power Stack Frame Specifications

Description	180A		360 A	
Input Voltages (50/60 Hz)(1)	1000V AC, 3 PH, +10% -15% 2300V AC, 3 PH, +10% -15% 3300V AC, 3 PH, +10% -15% 4160V AC, 3 PH, +10% -15%			
Ambient Temperature	0…40 °C (32…104 °F)(2)			
Power Section	6 SCR at 1000V 6 SCR at 2400V		12 SCR at 3300V 12 SCR at 4160V	
Repetitive Peak Inverse Voltage Rating	1000V - 4500 PIV 2300V - 6500 PIV		3300V - 13,000 PIV 4160V - 13,000 PIV	
dv/dt Protection	R.C. Snubber Network			
Maximum Heat Dissipation (kW)	Start or Stop Cycle (@ 450% FLA)			Continuous
		180 A	360 A	
	800…2499V	7	13	.25
	2500…4799V	14	26	.25
Altitude	0…1000 m (0…3300 ft) See Table 12 on page 47.			
Net Weight (Shipping)	1000…2300V = 116 kg (255 lb) 3300…4160V = 125 kg (276 lb)			

(1) See Table 1 for acceptable input voltage ranges.
(2) For higher ambient conditions, contact the factory.

Sizing the Enclosure

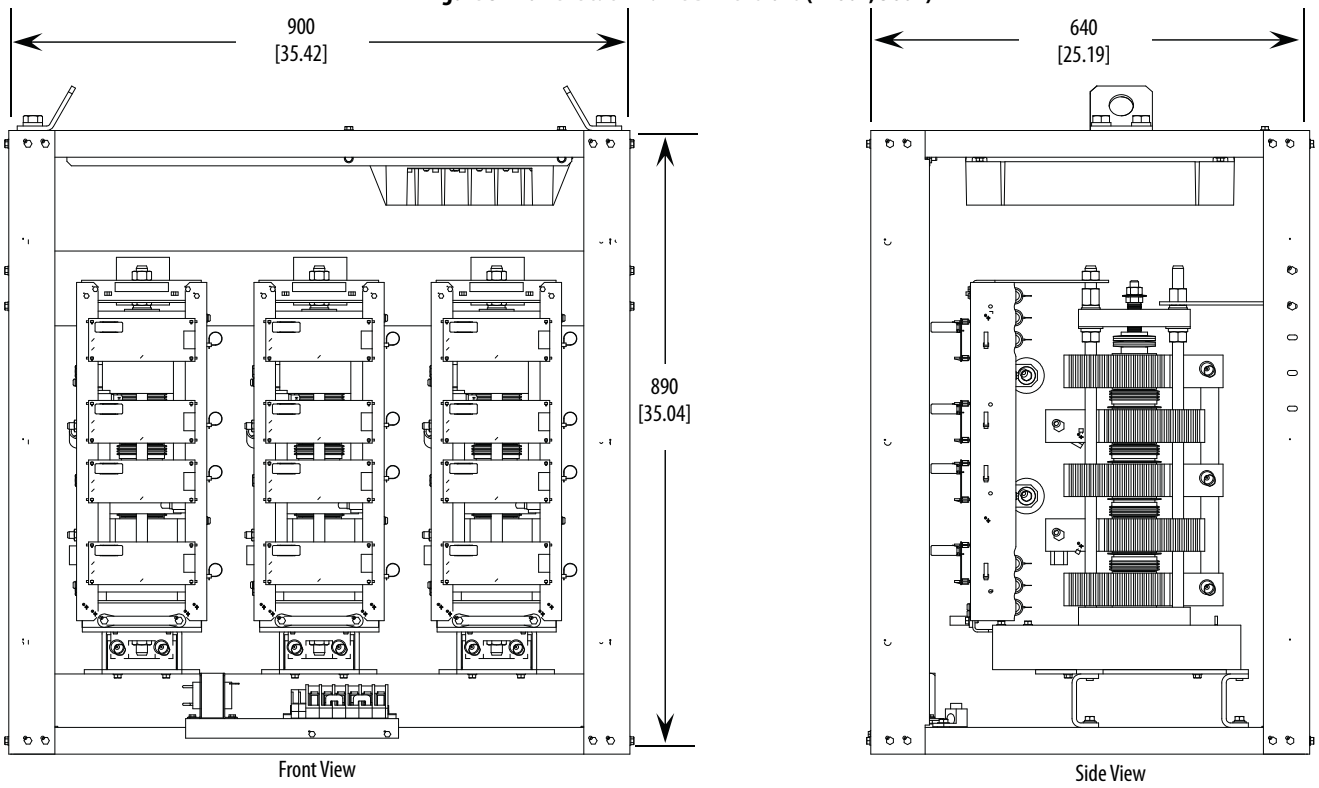
ATTENTION: The enclosure for the power stack frame assembly must be adequately sized to provide sufficient airflow to cool the units. Failure to provide adequate cooling may result in reduced duty cycles or component failure.

Use the information included in Table 2 to assist in determining the enclosure size.

Dimensions

The power stack frame dimensions are shown in Figure 3. The dimensions are the same for all frame catalog numbers.

Figure 3 - Power Stack Frame Dimensions (4160V, 360A)



Approximate dimensions in millimeters [inches].

Frame Components and Layout

See Figure 4 for the main components of the OEM SMC™ frame.

Figure 4 - Frame Layout and Components

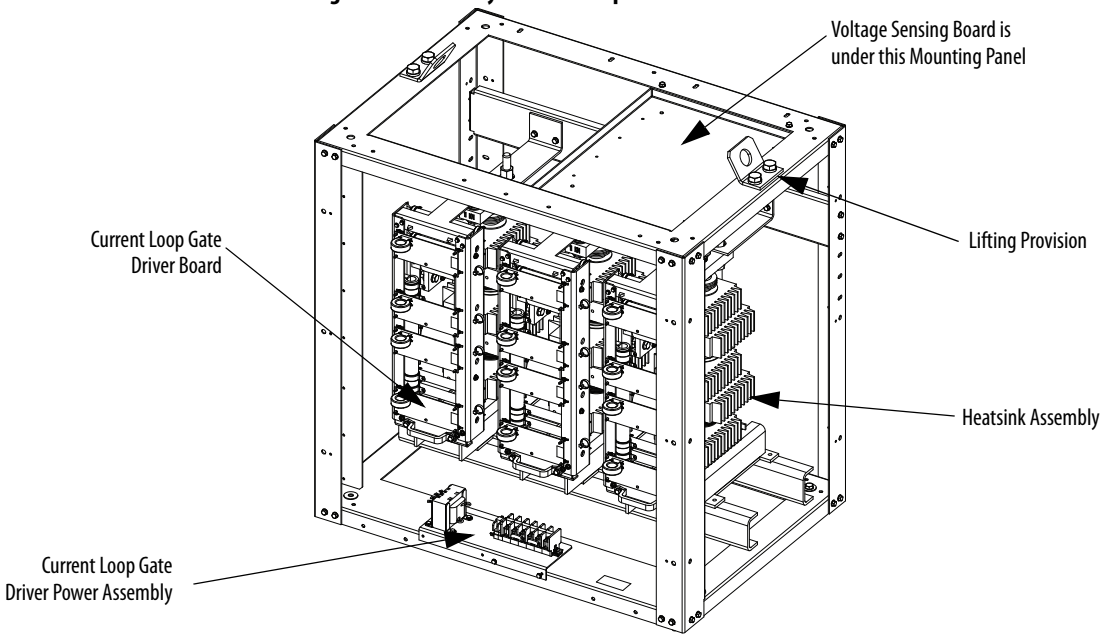
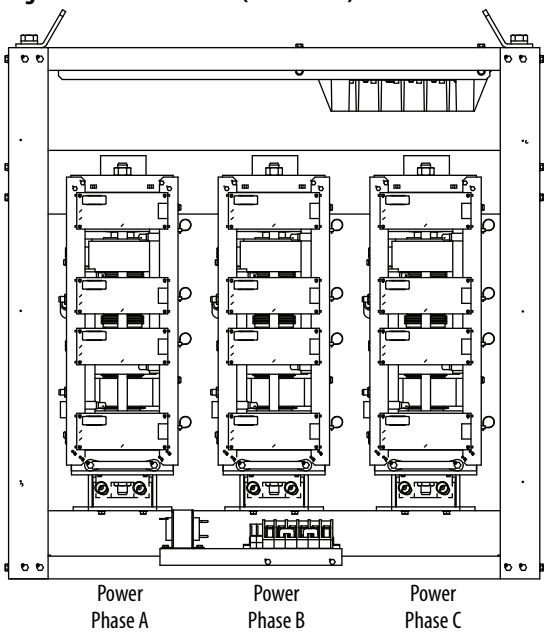


Figure 5 - Phase Location (Front View)

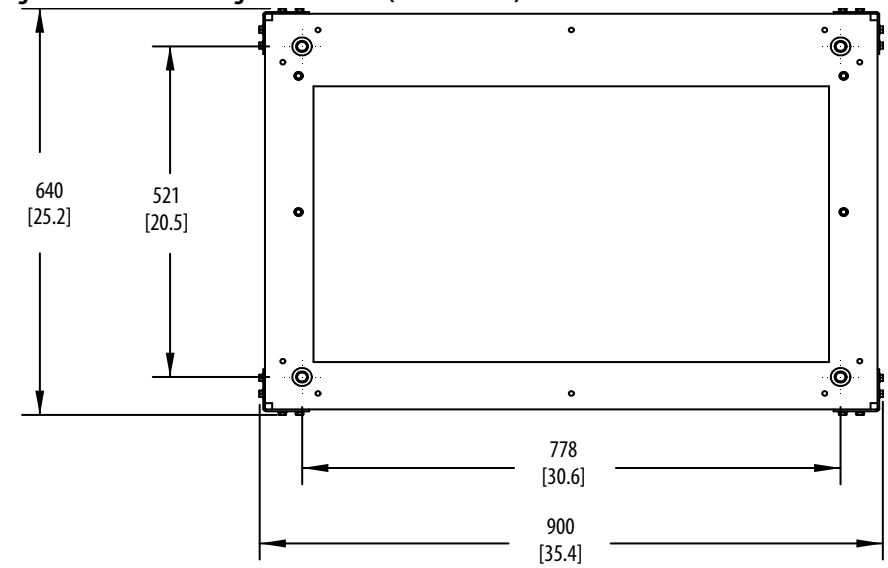


Anchoring

Mounting holes are provided in the frame and are suitable for 0.5 in. (M12) diameter anchor bolts (Figure 6).

ATTENTION: The frame is designed to be anchored in the upright position and on a level surface. Do not attempt to mount the frame upside down or at any angle that is not level. Improper anchoring may cause injury to personnel and/or damage to the equipment.

Figure 6 - Frame Mounting Hole Locations (Bottom View)



(All dimensions in millimeters [inches]).

Torque Requirements

All electrical connections must be torqued to the specifications in Table 3.

ATTENTION: All electrical connections must be torqued to the correct specification. Failure to do so may result in damage to the equipment and/or injury to personnel.

Table 3 - Torque Requirements

Hardware	Recommended Torque
1/4 in.	6 ft•lb (8 N•m)
5/16 in.	11 ft•lb (15 N•m)
3/8 in.	20 ft•lb (27 N•m)
1/2 in.	48 ft•lb (65 N•m)
Control Wire Terminals	2.0…3.3 in•lb (0.2…0.4 N•m)
CLGD Power Assembly Terminals	50 in•lb (5.6 N•m)
SMC-50 Control Module Terminals	5 in•lb (0.6 N•m)

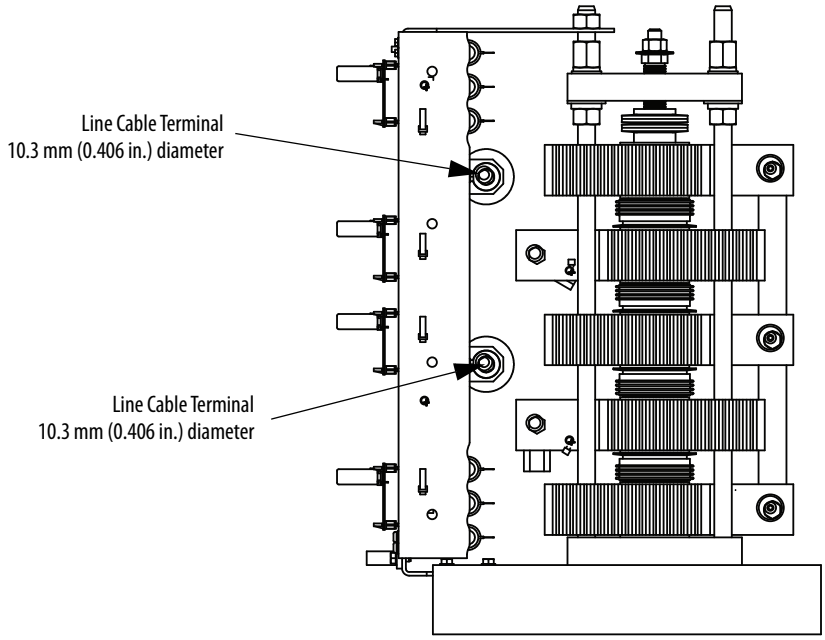
Power Connections

ATTENTION: To avoid shock hazard, lock out incoming power to power cables when completing connections. Failure to do so may result in severe burns, injury or death.

IMPORTANT It is the responsibility of the OEM to ensure that suitable line and load cables are used to satisfy the requirements of the equipment and meet local electrical codes.

1. Use appropriate cable lugs to attach suitable line cables to the line cable terminal (upper power terminal) of the heatsink assembly. The terminal is predrilled with a mounting hole with a diameter of 10.3 mm (0.406 in.). The holes are suitable for M10 (3/8 in.) hardware. See Figure 7 for the terminal location. Torque the fastening hardware to the specifications in Table 3.
2. Use cable lugs to attach suitable load cables to the load cable terminal (lower power terminal) of the heatsink assembly. See Figure 7 for the terminal location. Torque the fastening hardware to the specifications in Table 3.
3. See Chapter 6 for a typical wiring diagram to determine the required connections. Appendix B includes a typical schematic for a complete soft starter unit.

Figure 7 - Heatsink Assembly Power Connections, Right Side (4160V, 360A heatsink shown)



All stacks in SMC frame have similar configurations.

Grounding

ATTENTION: It is the responsibility of the OEM to ensure that the final enclosure is suitably bonded to ground, and that provisions for grounding are made according to local electrical codes and standards.

Current Loop Gate Driver Power Assembly (CLGD)

The CLGD power assembly is mounted on the front bottom of the frame (Figure 4). All secondary connections are pre-wired for the power stack frame. It requires a 110/120 or 220/240V AC (50/60 Hz), 50 VA, primary source of power.

See Chapter 6 for typical wiring diagrams.

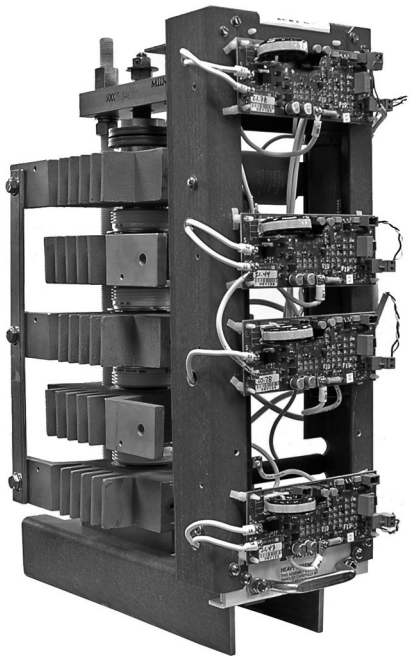
ATTENTION: There are three individual cable loops (one for each phase) connected in series. The cable length must be 6.4 m (21 ft). Do not cut the extra length from these cables, as they represent the load for the transformer in the above power assembly. If they are shortened, the loop current will be incorrect, and the CLGD boards may not function properly during stop maneuvers.

Power Stack Installation

Identification

A power stack (single-phase, 3300/4160V) power stack is shown in Figure 8.

Figure 8 - Single-phase Power Stack



Verify the voltage and current rating of the OEM power stacks by examining the label and referencing it to the information in Table 4.

Table 4 - Power Stack Options and Catalog Numbers

Voltage[1]	Current (A)	Catalog Number	Part Number
1000V, 3 PH, 50/60 Hz	180	1503E-PPZ1T	80258-011-51
	360	1503E-PPZ1A	80258-011-52
2300V, 3 PH, 50/60 Hz	180	1503E-PPAT	80258-011-53
	360	1503E-PPAA	80258-011-54
	600	1503E-PPAC	80258-011-55
3300V, 3 PH, 50/60 Hz	180	1503E-PPCT	80258-011-56
	360	1503E-PPCA	80258-011-57
	600	1503E-PPCC	80258-011-58
4160V, 3 PH, 50/60 Hz	180	1503E-PPET	80258-011-59
	360	1503E-PPEA	80258-011-60
	600	1503E-PPEC	80258-011-61

Table 4 - Power Stack Options and Catalog Numbers (Continued)

Voltage[1]	Current (A)	Catalog Number	Part Number
6900V, 3 PH, 50/60 Hz	180	1503E-PPKT	80258-011-62
	360	1503E-PPKA	80258-011-63
	360	1503E-PPKC	80258-011-64

(1) Voltage ranges:
1000 = 800…1449V
2300 = 1450…2499V
3300/4160 = 2500…4799V
6900 = 4800…7200V

In addition to the power stacks, a voltage sensing board is connected in the power circuit. Table 5 lists the voltage sensing board part number, which is used for all power stacks.

Table 5 - Voltage Sensing Board Catalog Number

Line Voltage (3 PH, 50/60 Hz)	Catalog Number	Part Number
800…1500V	1503E-VSZ1	80258-016-52
1501…2500V	1503E-VSA	80258-016-53
2501…4800V	1503-VSE	80258-016-54
4801…7200V	1503E-VSK	80258-016-55

Sizing the Enclosure

ATTENTION: The enclosure for the power stack assemblies must be adequately sized to provide sufficient airflow to cool the units. Failure to provide adequate cooling may result in reduced duty cycles or component failure.

Use the data in Table 6 to assist in calculating the enclosure size.

Table 6 - Power Stack Specifications

Description	180 A, 360 A, 600 A				
Input Voltages(1) (50/60 Hz)	1000V AC, 3 PH, +10%, -15%(2) 2300V AC, 3 PH, +10%, -15% 3300V AC, 3 PH, +10%, -15% 4160V AC, 3 PH, +10%, -15% 6900V AC, 3 PH, +10%, -15%				
Ambient Temperature	0…40 °C (32…104 °F)(3)				
Power Section (for 3 PH)	6 SCR at 1000/2300V 12 SCR at 4160V 12 SCR at 3300V 18 SCR at 6900V				
Repetitive Peak Inverse Voltage Rating	1000V – 4500 PIV 3300/4160V – 13000 PIV 2400V – 6500 PIV 6900V – 19500 PIV				
Thermal Capacity	600% of FLA, 10 s 450% of FLA, 30 s				
dv/dt Protection	R.C. Snubber Network				
Maximum Heat Dissipation (kW)	Start or Stop Cycle (@ 450% FLA)				Continuous
		180 A	360 A	600 A	
	0…2499V	7	13	22	.25
	2401…4799V	14	26	44	.25
	4800…7200V	21	39	66	.25
Altitude	0…1000 m (0…3300 ft) See Table 12 on page 47 for component deratings.				
Net Shipping Weight (3 PH)	Rating	1000 / 2300 V	3300 / 4160 V	6900 V	
	180A / 360A	105 kg (231 lb)	113 kg (249 lb)	126 kg (278 lb)	
	600 A	132 kg (29 0 lb)	154 kg (339 lb)	170 kg (374 lb)	

(1) See Table 4 for acceptable input voltage ranges.
(2) 180 A and 360 A ratings only for 1000V power stack.
(3) For other ambient ranges, refer to factory.

Torque Requirements

All electrical connections must be torqued to the specifications in Table 7.

ATTENTION: All electrical connections must be torqued to the correct specification. Failure to do so may result in damage to the equipment and/or injury to personnel.

Table 7 - Torque Requirements

Hardware	Recommended Torque
1/4 in.	6 ft•lb (8 N•m)
5/16 in.	11 ft•lb (15 N•m)
3/8 in.	20 ft•lb (27 N•m)
1/2 in.	48 ft•lb (65 N•m)
Control Wire Terminals	2.0…3.3 in•lb (0.2…0.4 N•m)
CLGD Power Assembly Terminals	50 in•lb (5.6 N•m)
SMC-50 Control Module Terminals	5 in•lb (0.6 N•m)

Dimensions

See Figure 9 through Figure 14 for the dimensions of the power stacks.

Power Stack Mounting

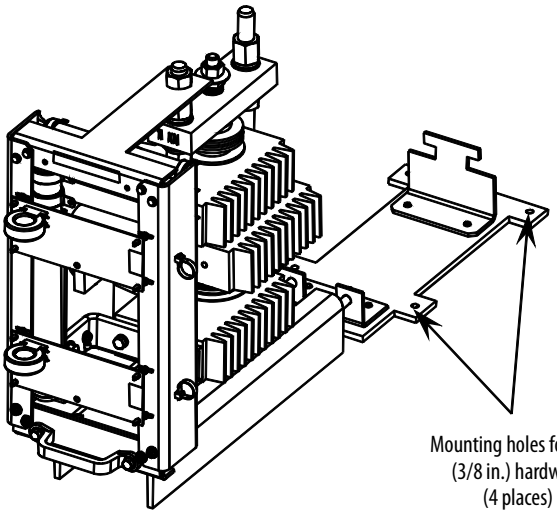
Power stacks are to be mounted in a vertical orientation in order to provide adequate component cooling. Mount the heatsink in a suitable location using the mounting holes provided in the assembly. Use M10 (3/8 in.) or similar hardware for the mounting hole dimensions of 10.7 x 15.9 mm (0.421 x 0.625 in.).

Power stacks rated 180/360 A, up to 4799V, are provided with mounting brackets (as shown in Figure 9 and Figure 11). The mounting brackets should be affixed to a horizontal surface, and the power stacks slide into and bolt to the mounting brackets.

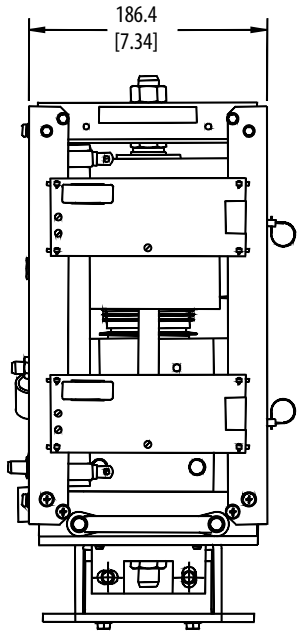
Maintain sufficient clearance between the power phases and between phases and grounded surfaces. Refer to local electrical codes to determine the required clearance. Failure to do so may result in injury to personnel or damage to the equipment.

Figure 9 - Power Stack Dimensions - 1000/2300V, 180/360A

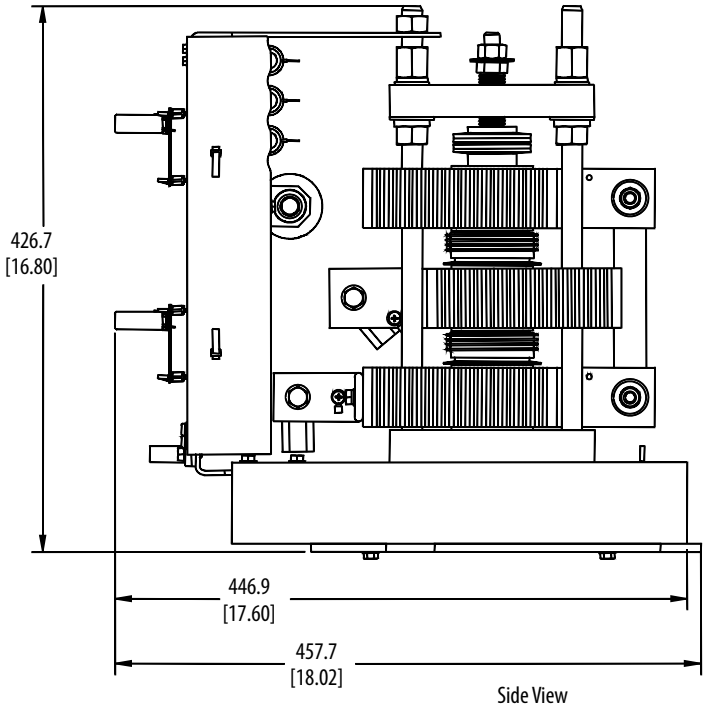
Overall Dimensions
Width: 186.4 [7.34]
Height: 426.7 [16.8]
Depth: 457.7 [18.02]
Weight: 35 kg [77 lb]
Dimensions in mm [in.].
All dimensions include mounting bracket.



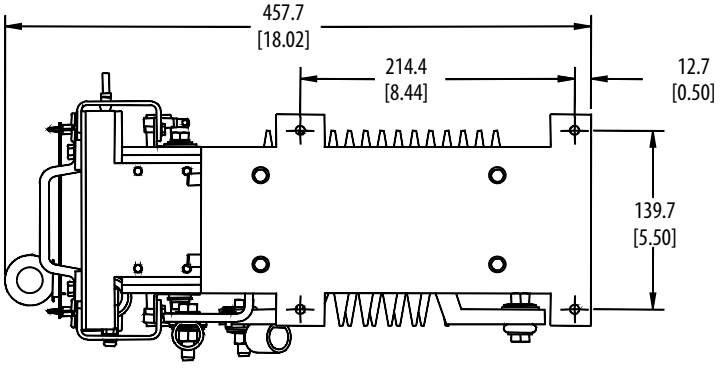
Mounting holes for M10
(3/8 in.) hardware
(4 places)



Front View



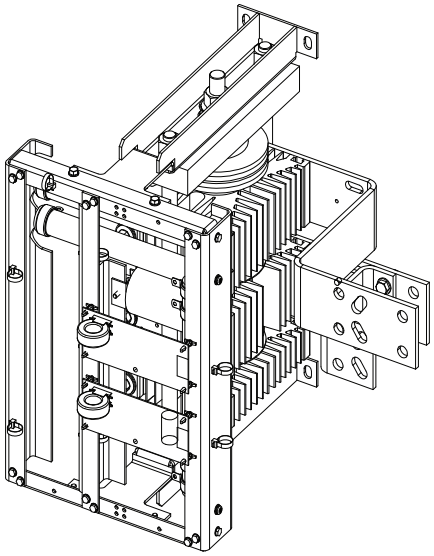
Side View



Bottom View

Figure 10 - Power Stack Dimensions - 2300V, 600A

Overall Dimensions
Width: 501.2 [14.73]
Height: 444.1 [17.49]
Depth: 461.5 [18.17]
Weight: 44 kg [97 lb]
Dimensions in mm [in.].
All dimensions include mounting bracket.



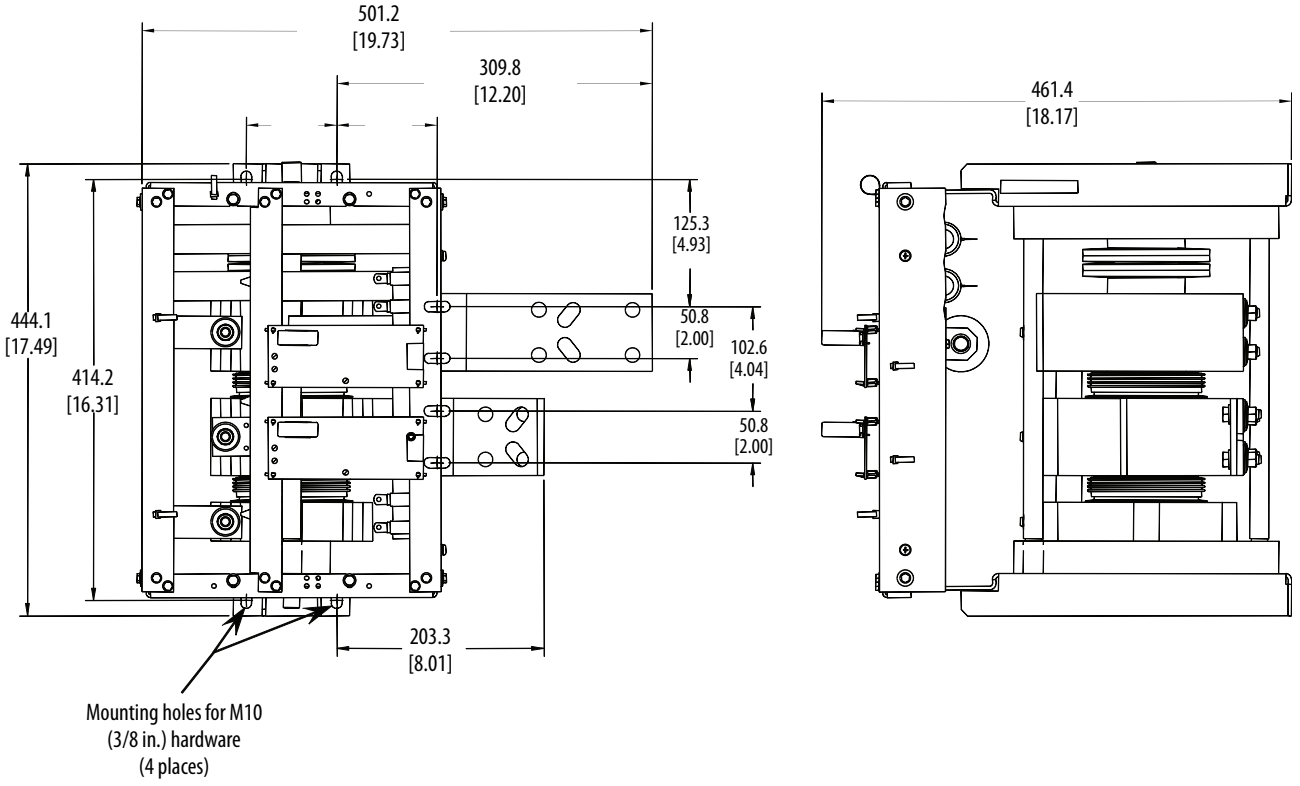


Figure 11 - Power Stack Dimensions - 3300/4160V, 180/360A

Overall Dimensions
Width: 186.7 [7.35]
Height: 582.2 [22.92]
Depth: 454.4 [17.89]
Weight: 38 kg [83 lb]
Dimensions in mm [in.].
All dimensions include mounting bracket.

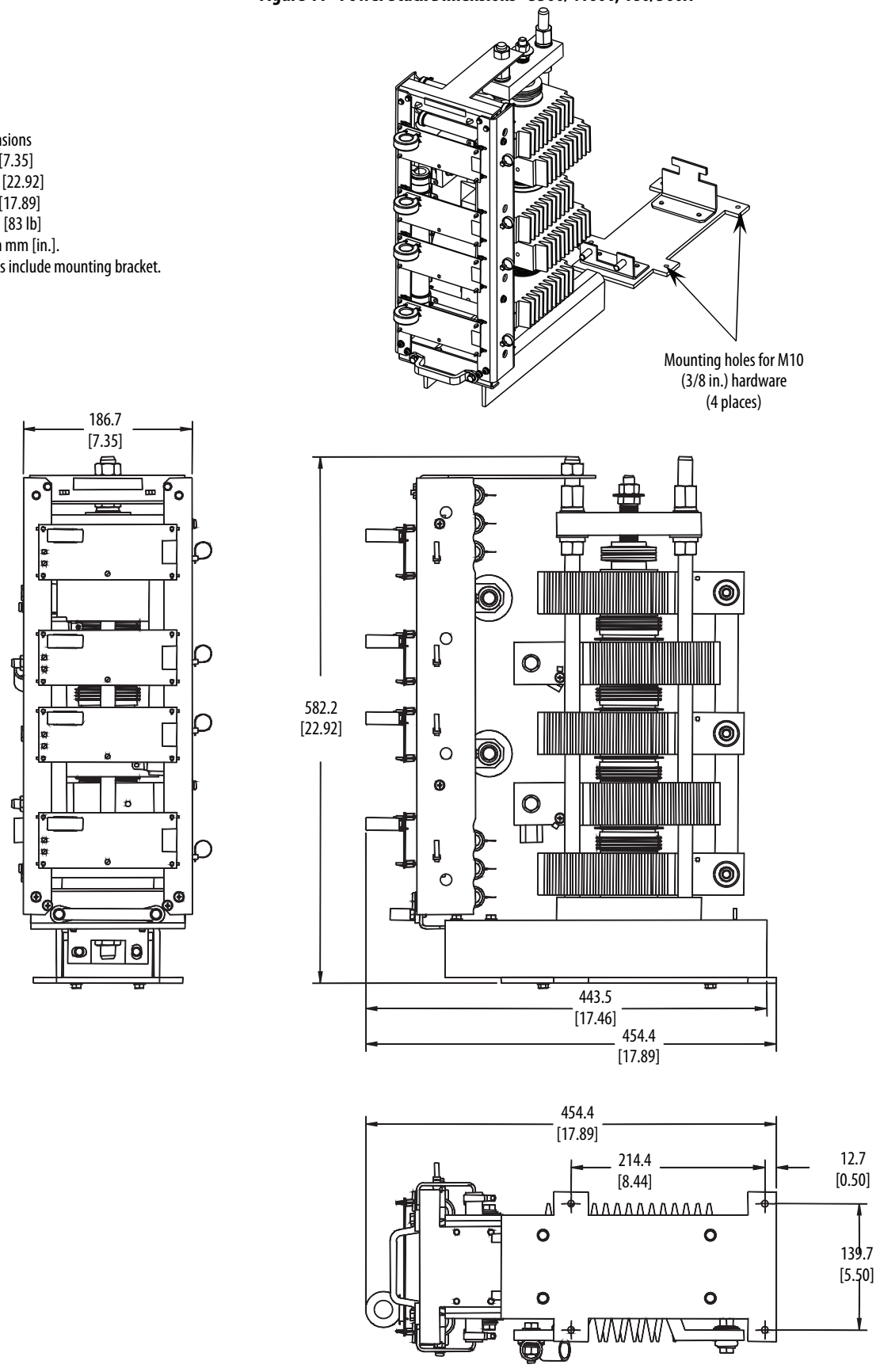
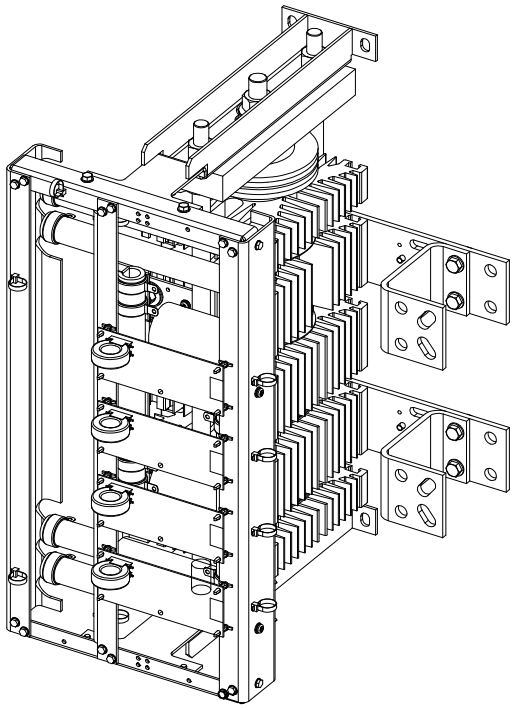


Figure 12 - Power Stack Dimensions - 3300/4160V, 600A

Overall Dimensions
Width: 394.7 [15.54]
Height: 611.2 [24.06]
Depth: 461.4 [18.17]
Weight: 51kg [113 lb]
Dimensions in mm [in.].
All dimensions include mounting bracket.



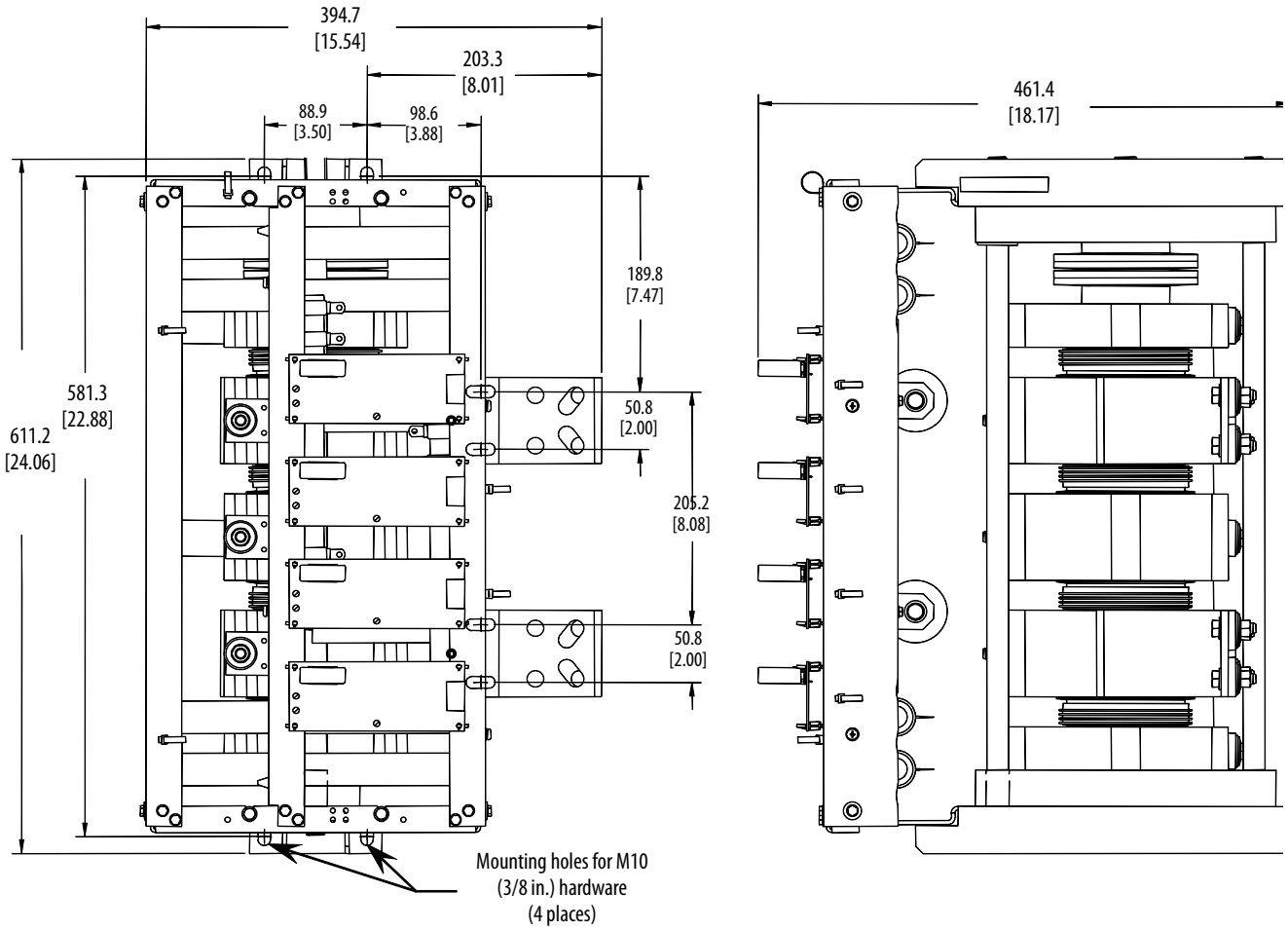
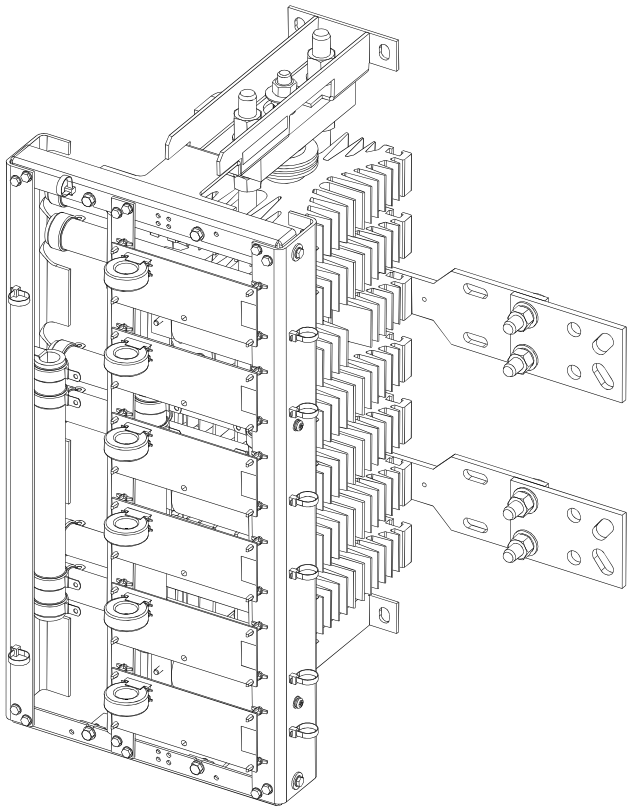


Figure 13 - Power Stack Dimensions - 6900V, 180/360A



Overall Dimensions
Width: 451.9 [17.79]
Height: 617.0 [24.29]
Depth: 399.3 [15.72]
Weight: 42 kg [93 lb]
Dimensions in mm [in.].
All dimensions include mounting bracket.

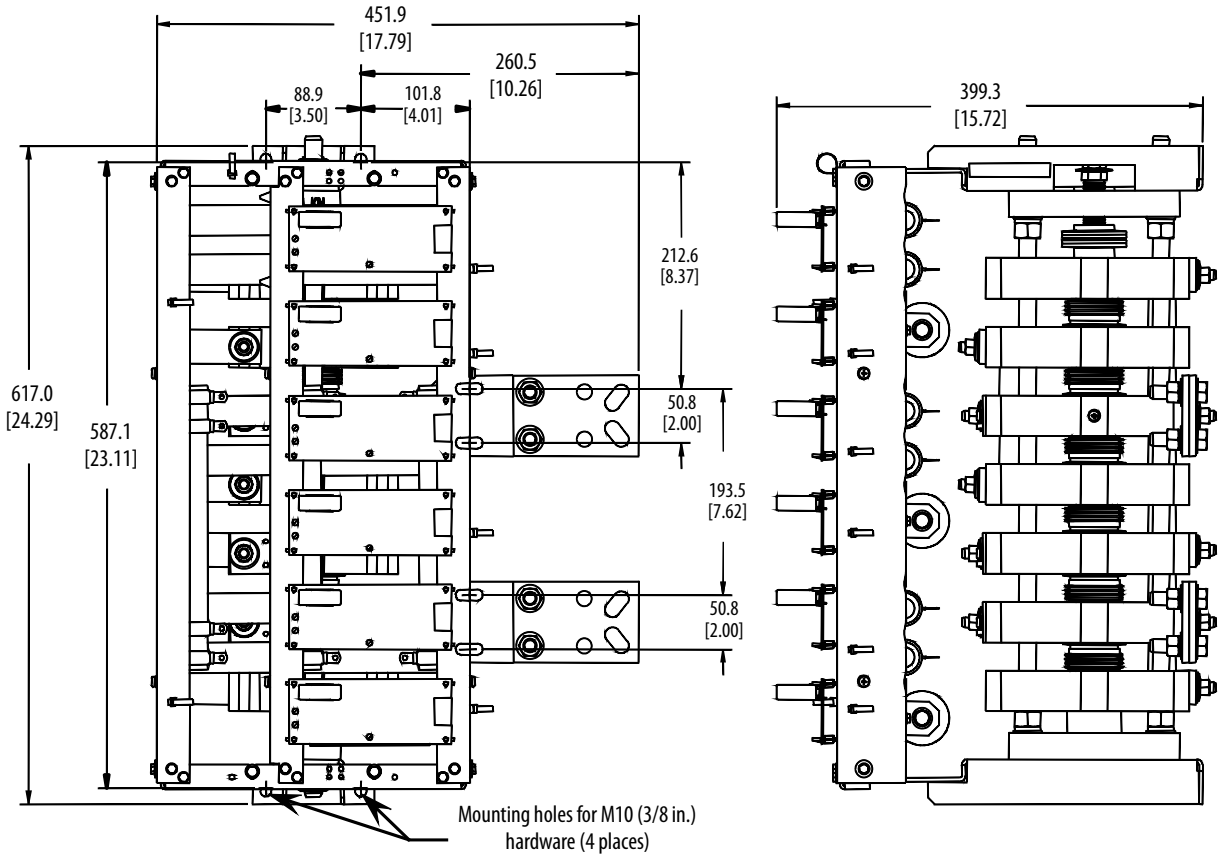
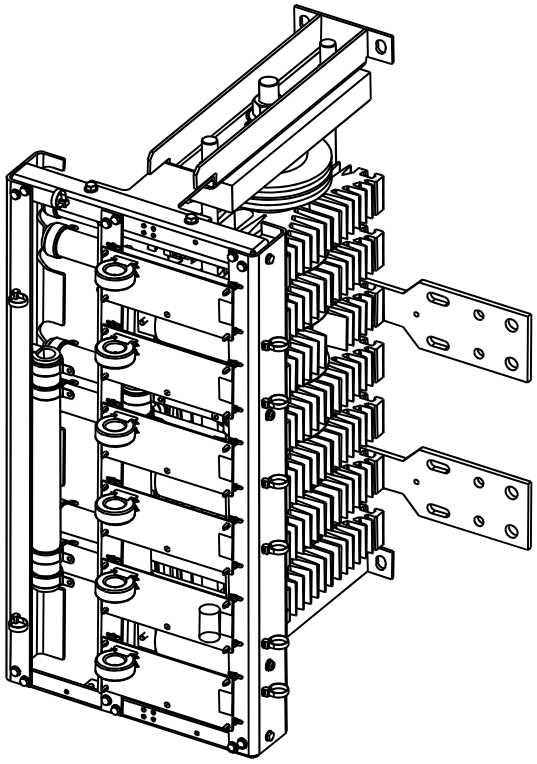
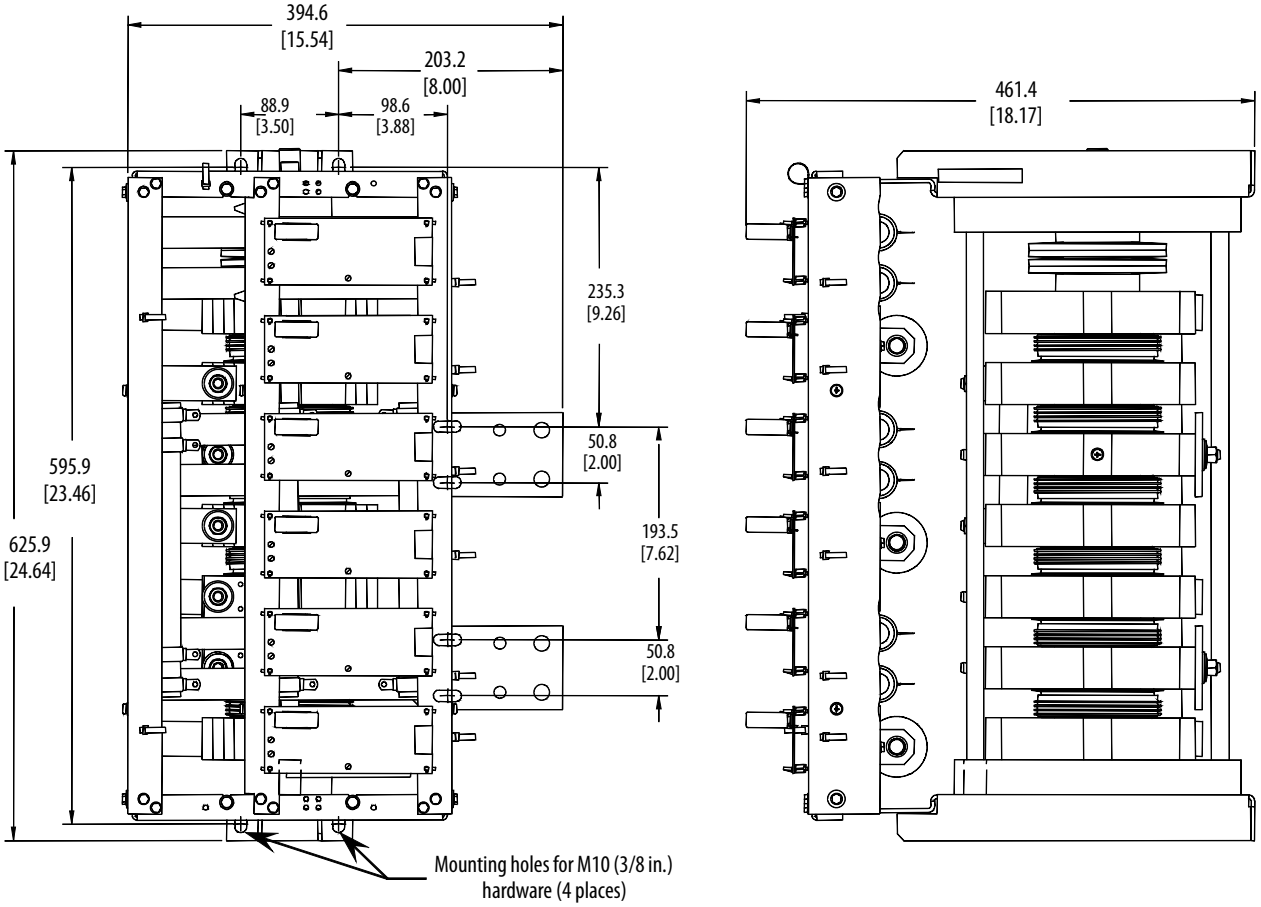


Figure 14 - Power Stack Dimensions - 6900V, 600A

Overall Dimensions
Width: 451.9 [17.79]
Height: 617.0 [24.29]
Depth: 399.3 [15.72]
Weight: 42 kg [93 lb]
Dimensions in mm [in.].
All dimensions include mounting bracket.





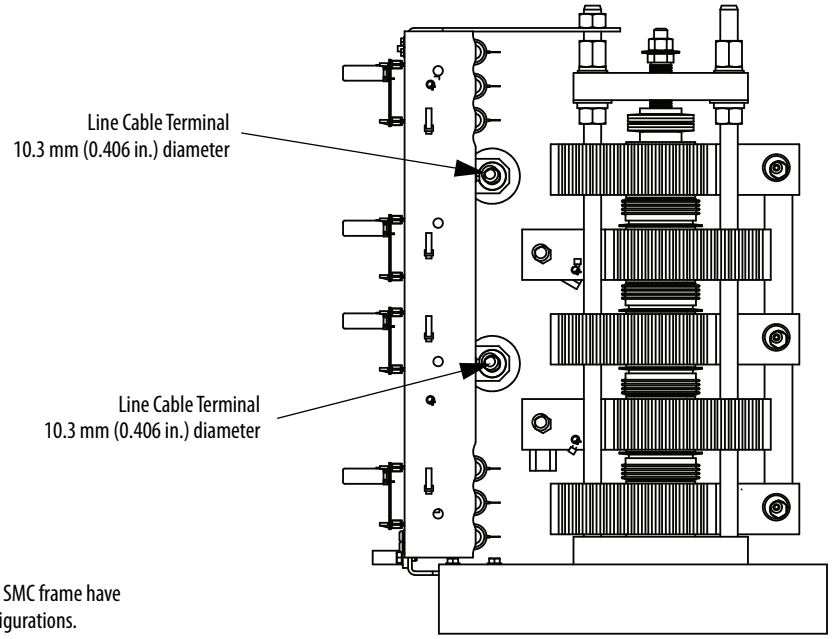
Power Connections

ATTENTION: To avoid shock hazard, lock out incoming power to power cables when completing connections. Failure to do so may result in severe burns, injury or death.

IMPORTANT It is the responsibility of the OEM to ensure that suitable line and load cables are used to satisfy the requirements of the equipment and meet local electrical codes.

1. Use appropriate cable lugs to attach suitable line cables to the line cable terminal (upper power terminal) of the heatsink assembly. The terminal is predrilled with a mounting hole with a diameter of 10.3 mm (0.406 in.). The holes are suitable for M10 (3/8 in.) hardware. See Figure 15 for the terminal location. Torque the fastening hardware to the specifications in Table 7.
2. Use cable lugs to attach suitable load cables to the load cable terminal (lower power terminal) of the heatsink assembly. See Figure 15 for the terminal location. Torque the fastening hardware to the specifications in Table 7.
3. See Chapter 6 for a typical wiring diagram to determine the required connections. Appendix B includes a typical schematic for a complete soft starter unit.

Figure 15 - Heatsink Assembly Power Connections, Right Side (4160V, 360A heatsink shown)



All stacks in SMC frame have similar configurations.

Grounding

ATTENTION: It is the responsibility of the OEM to ensure that the final enclosure is suitably bonded to ground, and that provisions for grounding are made according to local electrical codes and standards.

Power Stack Operating Restrictions

The SCRs in the power stacks are not intended for continuous operation. Observe the following operating restrictions for the SMC™ when operating at 450% FLC and maximum ambient (40°C [104 °F]).

- Power stacks must be bypassed using a separate contactor when motor is up to speed.
- Do not operate the power stacks for more than 60 seconds per hour.
- Do not exceed 30 seconds for any individual duty cycle of the power stacks.
- Do not operate the power stacks for at least five minutes between a start or a stop cycle.

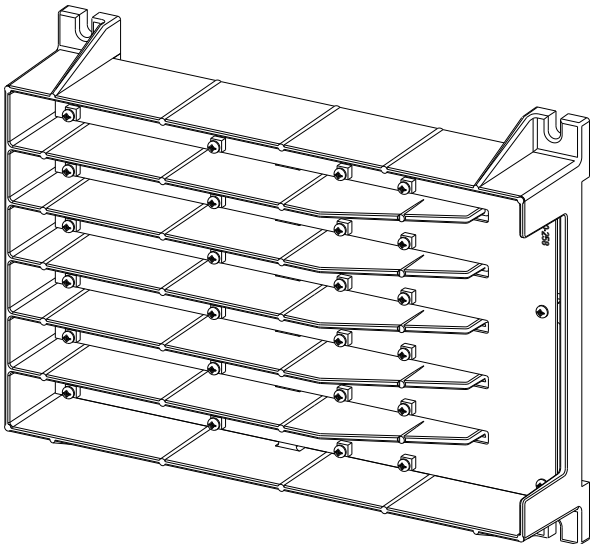
IMPORTANT It may be possible to exceed some of the above restrictions if all maximum ratings are not attained. For example, higher ambient conditions can be supported when the % FLC and/or start time are reduced. Please consult factory for details.

ATTENTION: The operating restrictions for the SMC must be adhered to. Failure to observe the recommended precautions may result in injury to personnel or damage to the equipment.

Voltage Sensing Board

The voltage sensing board (VSB) should be mounted adjacent to the power stacks (Figure 16). All connection points are to be made accessible. The same VSB is used regardless of the system voltage.

Figure 16 - Voltage Sensing Board



Connect the voltage sensing board to the L1 to L3 and T1 to T3 terminals of the power stack (see Chapter 6). Observe the connection points at the voltage sensing board per Table 8 and Figure 17.

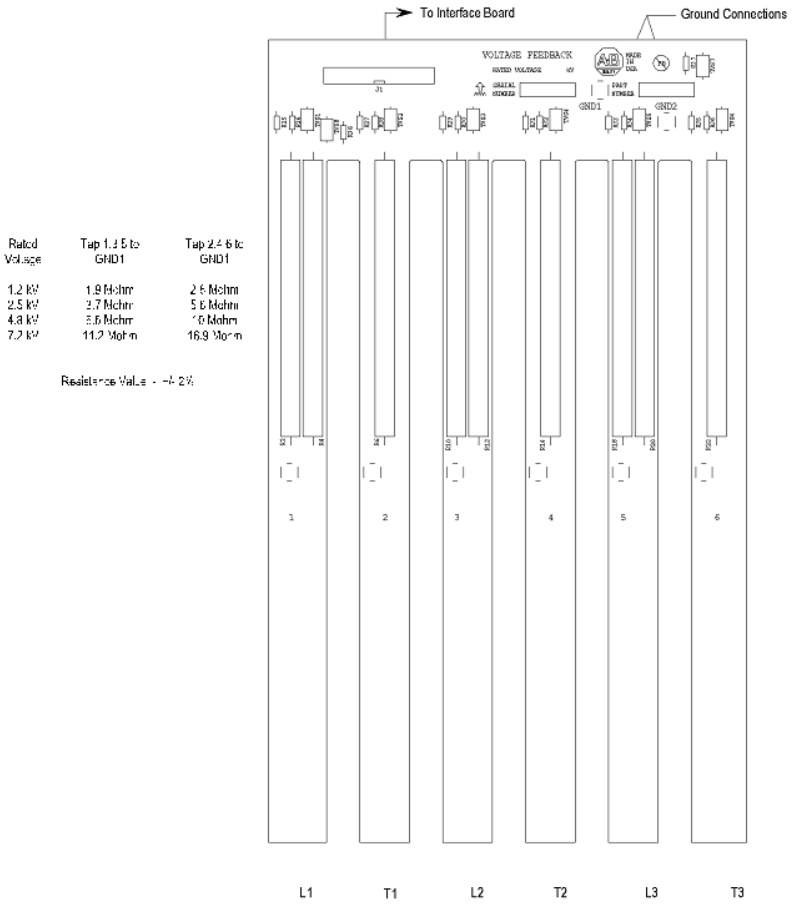
Specifications for wire used on medium voltage connections:

- UL style 3239
- #18AWG
- 40 KVDC silicone rubber insulated wire

Table 8 - Voltage Sensing Board Connections

System Voltage (V_{LL})	VSB Taps
800…1500	D
1501…2500	C
2501…4800	B
4801…7200	A

Figure 17 - Voltage Sensing Board

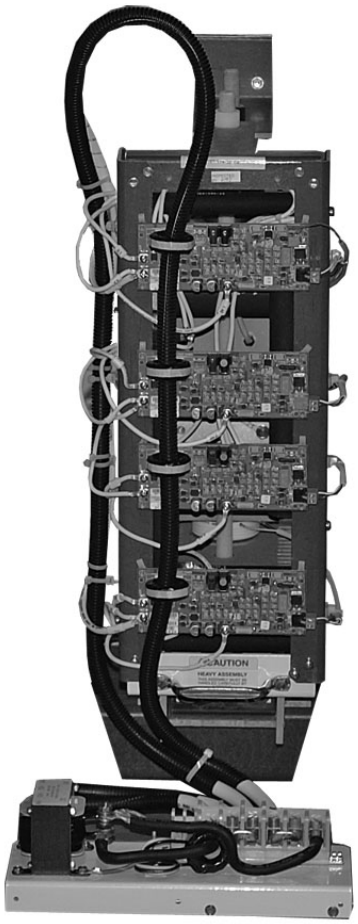


Current Loop Gate Drive Power Assembly (CLGD)

The CLGD power assembly is provided as a loose component with the power stacks. It should be mounted adjacent to the power stacks in a manner that allows the secondary cable assembly to be correctly installed (see below). The CLGD power assembly requires a 110/120 or 220/240V AC (50/60 Hz), 50VA, primary source of power.

Use the supplied three-phase cable assembly to make the secondary connections. Route the cable through the CLGD board CTs, as shown in Figure 18. See Chapter 6 for typical wiring diagram.

Figure 18 - Installation of Cable through CLGD CTs



The supplied cable comes with a protective sheath that should also be installed. It protects the cable and enhances the system insulation level.

IMPORTANT There are three individual cable loops (one for each phase) connected in series. The cable length must be 6.4 m (21 ft). Do not cut the extra length from these cables, as they represent the load for the transformer in the above power assembly. If they are shortened, the loop current will be incorrect, and the CLGD boards may not function properly during stop maneuvers.

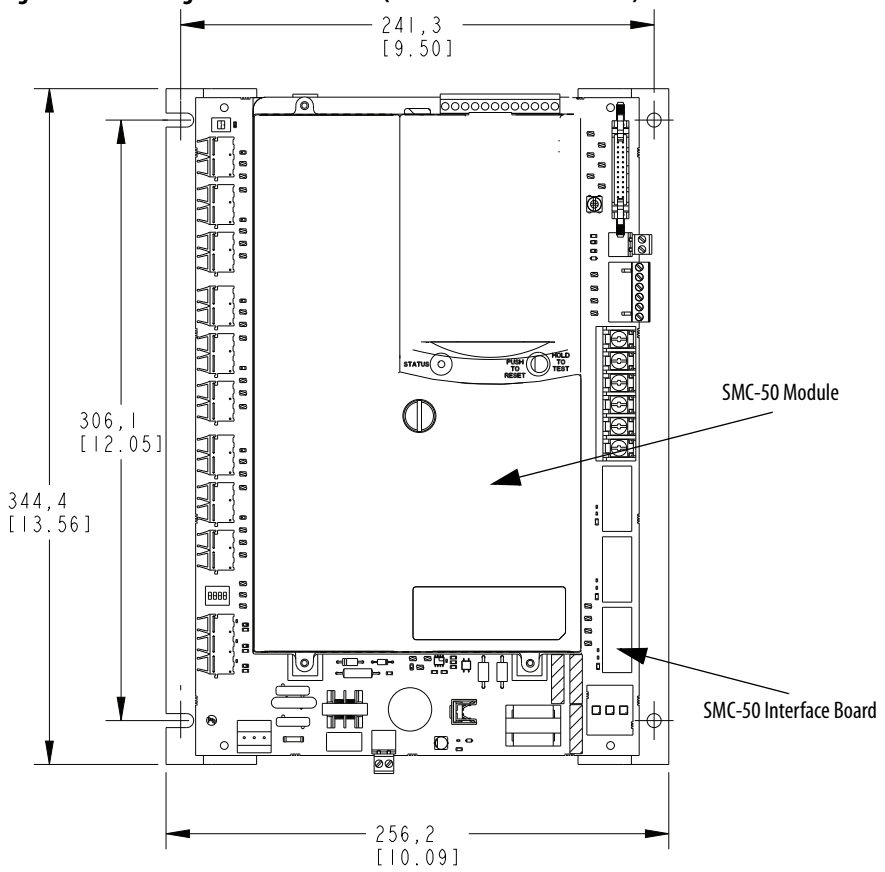
Control Component Installation

Interface Board Installation

Mount the Interface Board in a suitable location within a low voltage compartment, using the appropriate hardware. Use the interface board mounting bracket (see Figure 19).

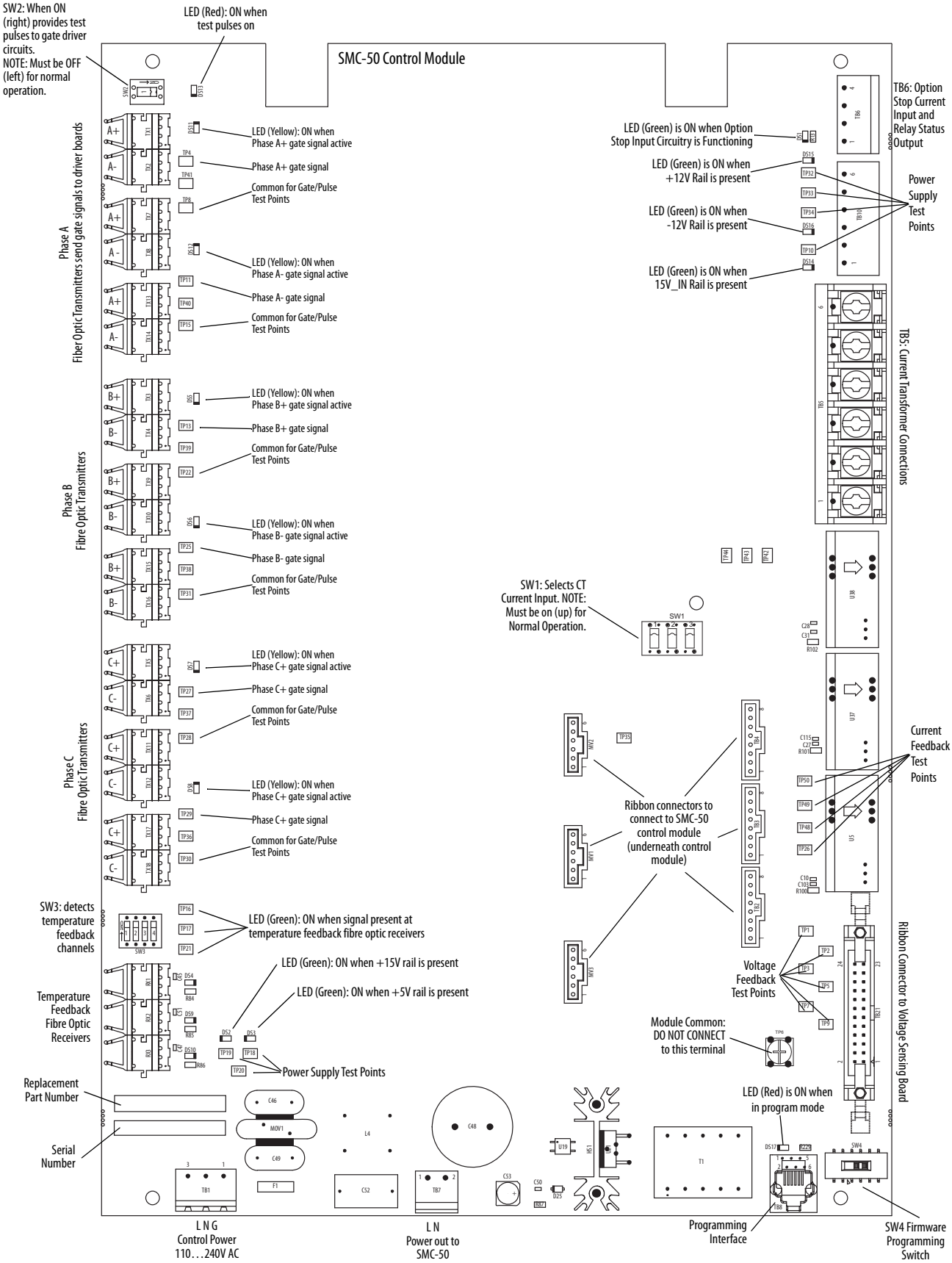
ATTENTION: Do not mount the interface board in the same compartment as high voltage components. Ensure that barriers are provided in the final application to prevent access to any live high-voltage parts, including insulated conductors located in enclosures with low voltage parts and wiring. Failure to do so may result in severe burns, injury or death.

Figure 19 - Mounting the Interface Board (SMC™-50 module installed)



ATTENTION: Do not touch or bend the connectors on the Interface Board when handling it. Damage to the connectors may result in loss of communication signals from the MV SMC-50 to other components.

Figure 20 - Interface Board Layout



IMPORTANT
- 800…2499V - Two fiber optic transmitters per phase are used.
- 2500…4799V - Four fiber optic transmitters per phase are used.
- 4800…6900V - Six fiber optic transmitters per phase are used.

Interface Board Connections

Connect control power to the interface board. Use a grounded supply source from 110...240V AC, +10, -15%, 50/60 Hz, 15VA.

Connect 5A current transformer (CT) secondary signals to the interface board, noting the required CT polarity. Three-phase CTs are required.

Connect the interface board module common (upper right) to a suitable ground location in the control compartment, as required.

IMPORTANT Only ground the module common connection if the power system is solidly or resistively connected to ground. If the power system is ungrounded, do not ground this connection.

Ensure that Ground Instruction Tag (part number 80006-346-01) is affixed to the ground connection to alert the final customer of this requirement.

SMC-50 Control Module

1. Connect the ribbon cables (5) to the back of the SMC-50 control module.
2. Align the ribbon cables (5) from the SMC-50 control module with the connectors on the Interface Board. Push the ribbon connectors into the mating connectors on the interface board.
3. Use the supplied screws to securely fasten the module to the board mounting bracket.
4. Supply power to the SMC-50 control module and make the required control connections.

Refer to publication 1560E-UM051 for detailed instructions on wiring and programming the unit.

Connecting Interface Board to Voltage Sensing Board

Use the wire harness provided to connect the Voltage Sensing Board and the Interface Board. See Figure 20 for the location of the connector on the interface board, and Figure 17 for the connector on the voltage sensing board.

Connecting Interface Board to Gate Driver Board

Use the fiber optic cables (Cat. No. 1503E-XXFOXX) to connect each fiber optic receiver from the gate driver boards to the interface board (see Figure 20). Ensure that the gate driver boards of each power phase are connected to the correct terminals on the Interface Board. Observe the minimum bend radius of at least 45 mm (1.75 in.) for the fiber optic cables.

ATTENTION: Do not sharply bend or strike the fiber optic cables when handling them. A minimum bend radius of at least 45 mm (1.75 in.) should be maintained throughout the system. Damaging the cables may result in signal loss to the components and improper functioning of the unit.

IMPORTANT Fiber optic components are color coded for easier connections. Receiver terminals are dark blue, and transmitter terminals are grey or black. The cables have a grey connector at one end and a blue one at the other. When connecting to the gate driver boards, the dark blue connector must plug into the dark blue receiver and the grey connector must plug into the black transmitter

See the appropriate wiring diagram in Chapter 6.

IMPORTANT It is acceptable to connect the fiber optic transmitter cables to any port within a particular power phase. Note that the cables for the temperature feedback ports should be connected to the correct phase. Refer to Figure 5.2 for the Interface Board layout.

Connect the temperature feedback fiber optic receivers for each phase to the appropriate gate driver board. See Chapter 6 for the appropriate diagram for the temperature feedback fiber optic connections.

Additional Control Components

Additional control components are required to complete the circuit, depending on the application. Some of these control components are outlined in Chapter 6 and Appendix B.

It is the responsibility of the OEM to ensure that all required control components are supplied and functional.

Contactor Installation

Introduction

The MV SMC™ components are designed for intermittent starting duty. A bypass contactor must be used to bypass the power stacks once the motor is at full speed.

A line contactor is also required in order to isolate the power stacks from line voltage. A suitable medium voltage circuit breaker may be substituted for the line contactor.

Main Bypass Contactor

A bypass contactor must be used in the SMC configuration to bypass the SCRs once the motor is up to speed.

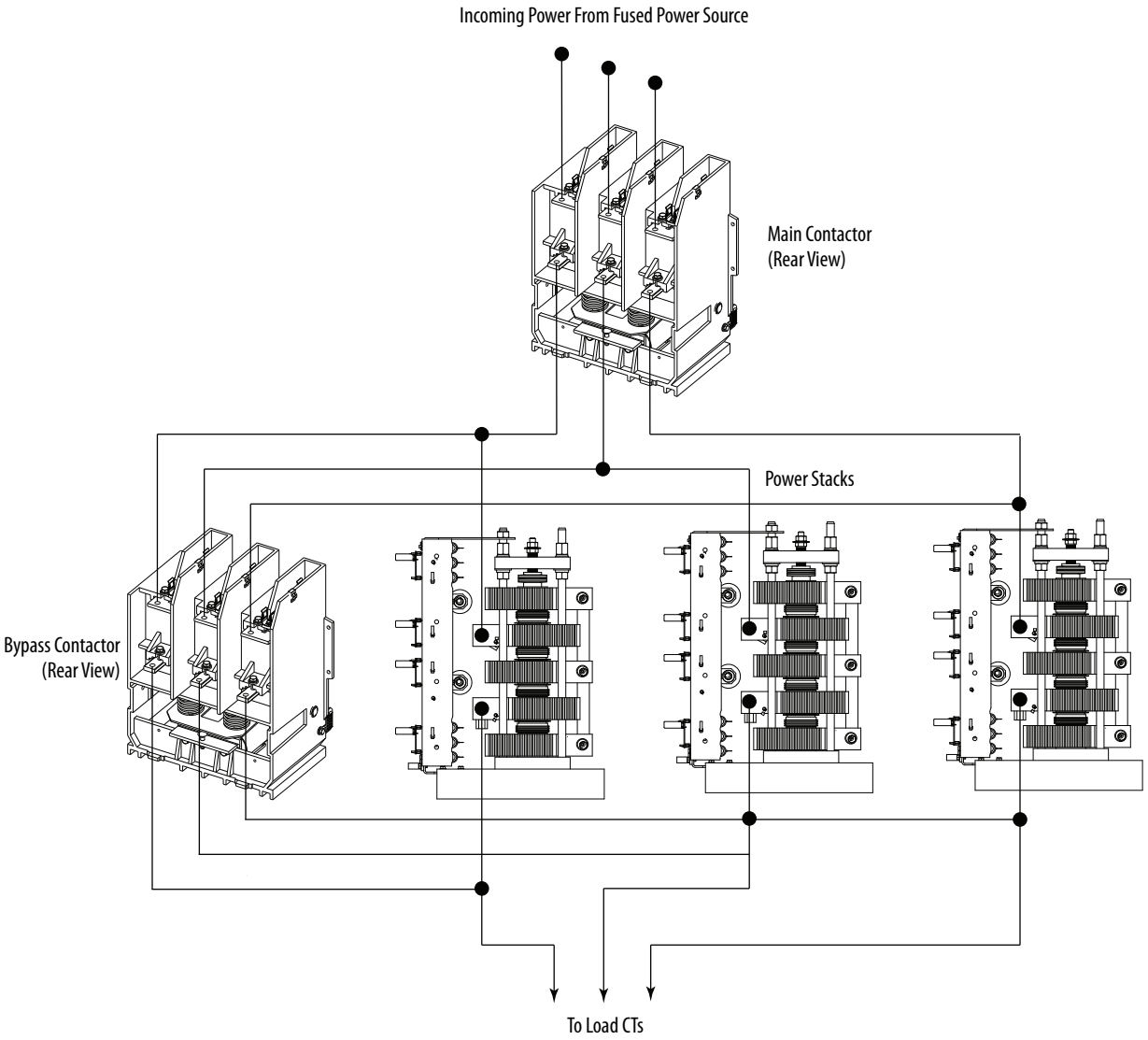
ATTENTION: A bypass contactor must be installed to complete the SMC configuration. SCRs are not rated for continuous duty. The duty cycle is limited to 60 seconds per hour. This can be a combination of starting and stopping cycles that does not exceed 30 seconds per cycle. Failure to install a bypass contactor may result in damage to components from overheating.

See publication 1560F-UM001 for more information on the bypass contactor and the duty cycle. This publication was included with your shipment.

A typical schematic diagram for the main and bypass contactors is shown in Figure 31 on page 50. Figure 21 shows the point-to-point connections for the main and bypass contactors.

IMPORTANT It is the responsibility of the OEM to ensure that suitable line and load cables are used that satisfy the requirements of the equipment and meet local electrical codes.

Figure 21 - Main and Bypass Contactor Wiring Configuration



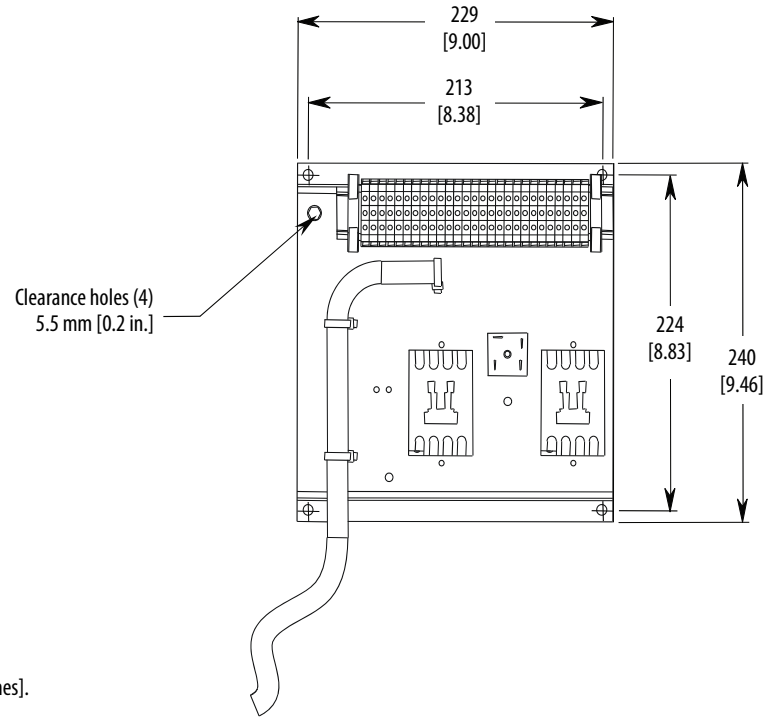
Bypass Contactor Control Panel

Four clearance holes are provided in the control panel for mounting. The holes are 5.5 mm (0.219 in.) in diameter and are suitable for M6 (1/4-20) self-tapping fasteners. See Figure 22 for the control panel dimensions.

1. Mount the control panel in a suitable location that is isolated from medium voltage components. The control plug wiring harness is 3 m (10 ft) in length. Ensure that the wiring harness route still allows for a proper connection to the contactor control plug.

ATTENTION: Do not mount the control panel in the same compartment as high voltage components. Low voltage components must be electrically isolated from high voltage components to ensure access is available when the unit is energized. Failure to do so may result in severe burns, injury or death.

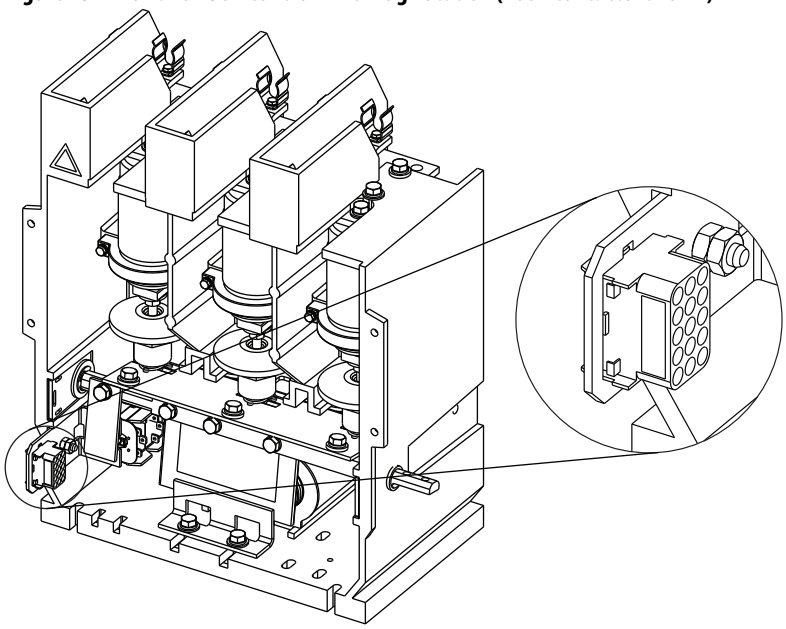
Figure 22 - Bypass Contactor Control Panel Dimensions



All dimensions in millimeters [inches].

2. Connect the control panel harness to the contactor control wire plug on the lower left side of the contactor (Figure 23). Each control wire plug is designed to only connect to a contactor that has a matching voltage and current rating.
3. Use the terminal blocks on the control panel to connect the unit to a 120V or 230V grounded power source (whichever is applicable to the control panel) and to other remote devices. See Appendix B for a typical SMC schematic diagram.

Figure 23 - 120V and 230V Control Wire Plug Location (400A contactor shown)



IntelliVAC Control Module

An IntelliVAC™ control module can be substituted for the control panel to control the main and bypass vacuum contactors (Series E contactors only).

Refer to publication 1503-UM060 for instructions on wiring and set-up of the IntelliVAC control module.

Typical Wiring Diagrams

Wiring Diagrams

The following wiring diagrams illustrate the connections between the main components of the MV SMC™ OEM kits. Some of the connections are pre-made by Rockwell Automation, depending on the type of OEM kit being used. It is the responsibility of the OEM to correctly identify the OEM kit utilized and the connections they must make.

Additional components are typically required to complete the MV SMC. See Appendix B for examples of how these additional components can be implemented to form a complete solution.

ATTENTION: Wires used for connecting the components must be sufficiently insulated to withstand system voltage. See the appropriate wiring diagram for the wire insulation requirements. Failure to use adequately insulated wiring may cause injury to personnel and/or damage to the equipment.

Figure 24 - Power Circuit Wiring Diagram (180/360A, 800…1449V)

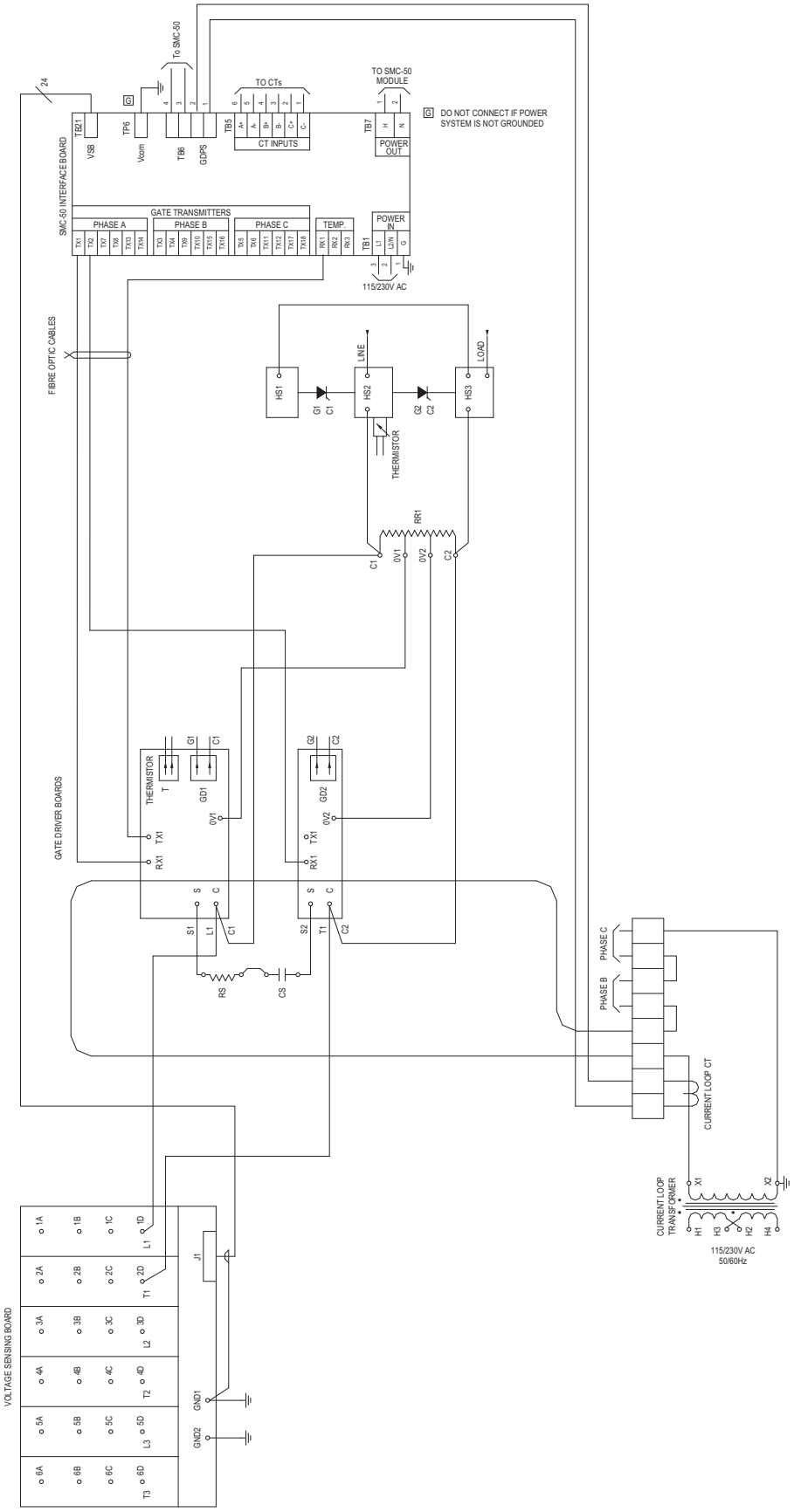


Figure 25 - Power Circuit Wiring Diagram (180/360A, 1450…2499V)

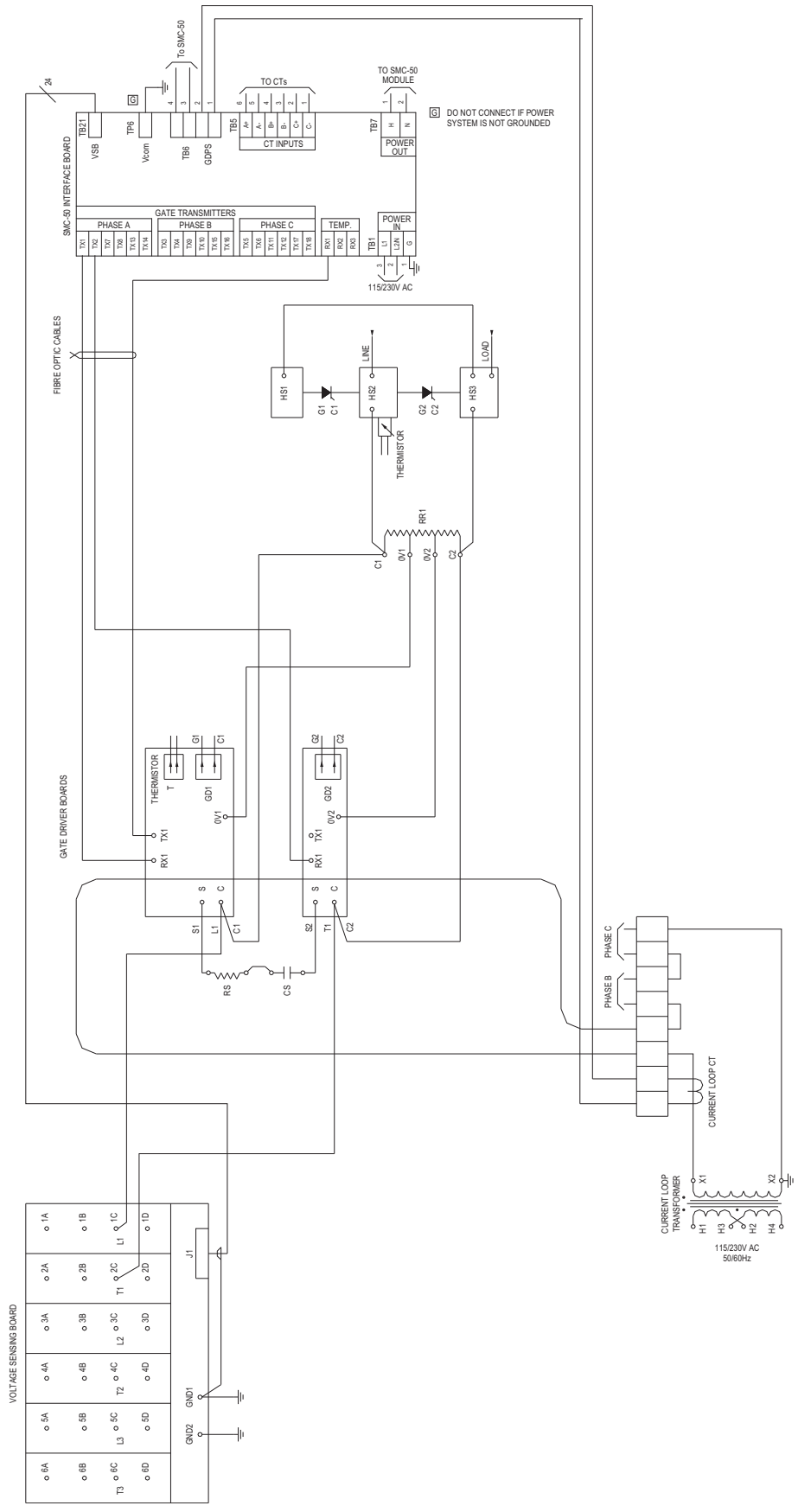


Figure 26 - Power Circuit Wiring Diagram (600A, 1450…2499V)

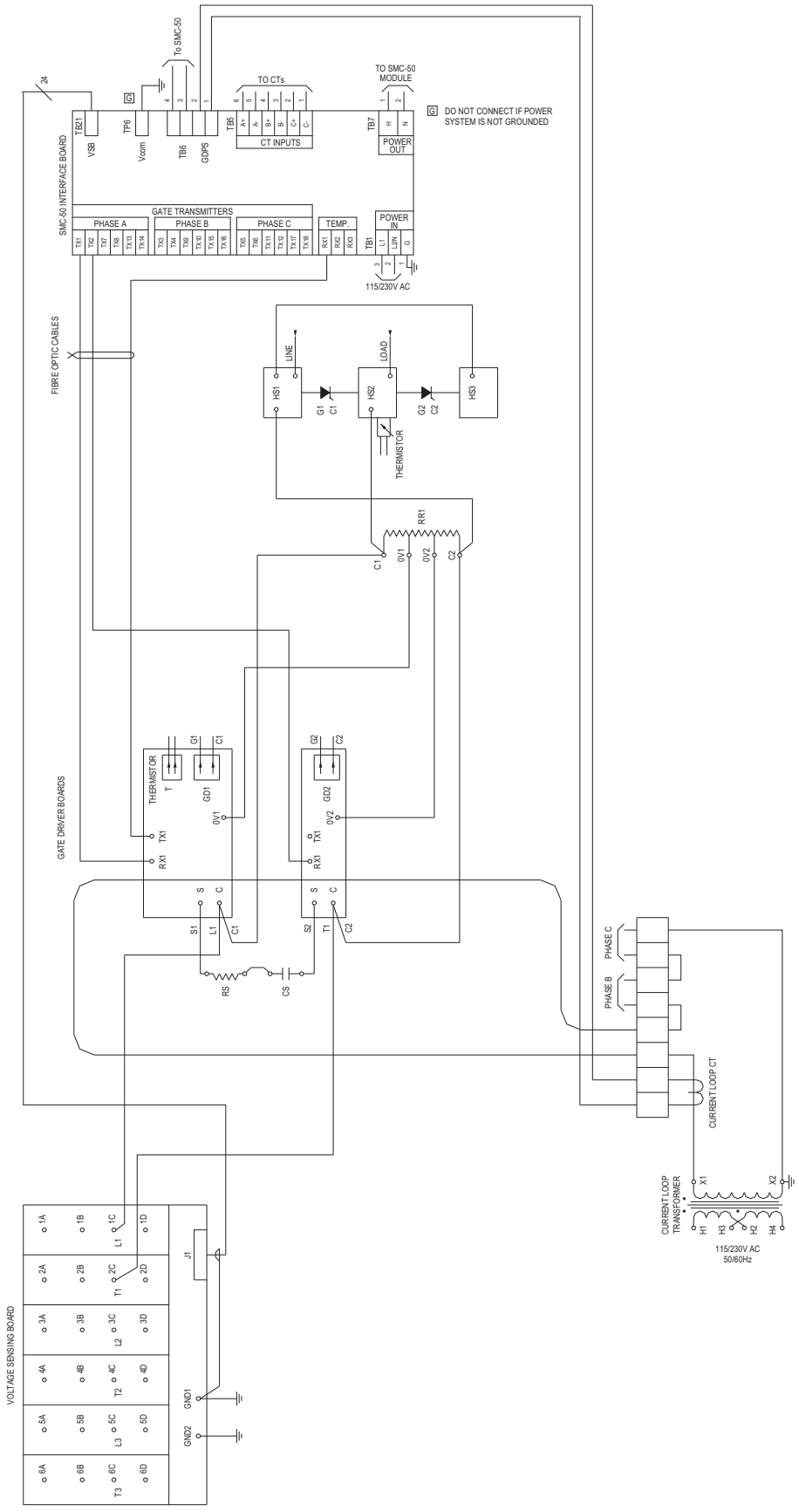


Figure 27 - Power Circuit Wiring Diagram (180/360/600A, 2500…4799V)

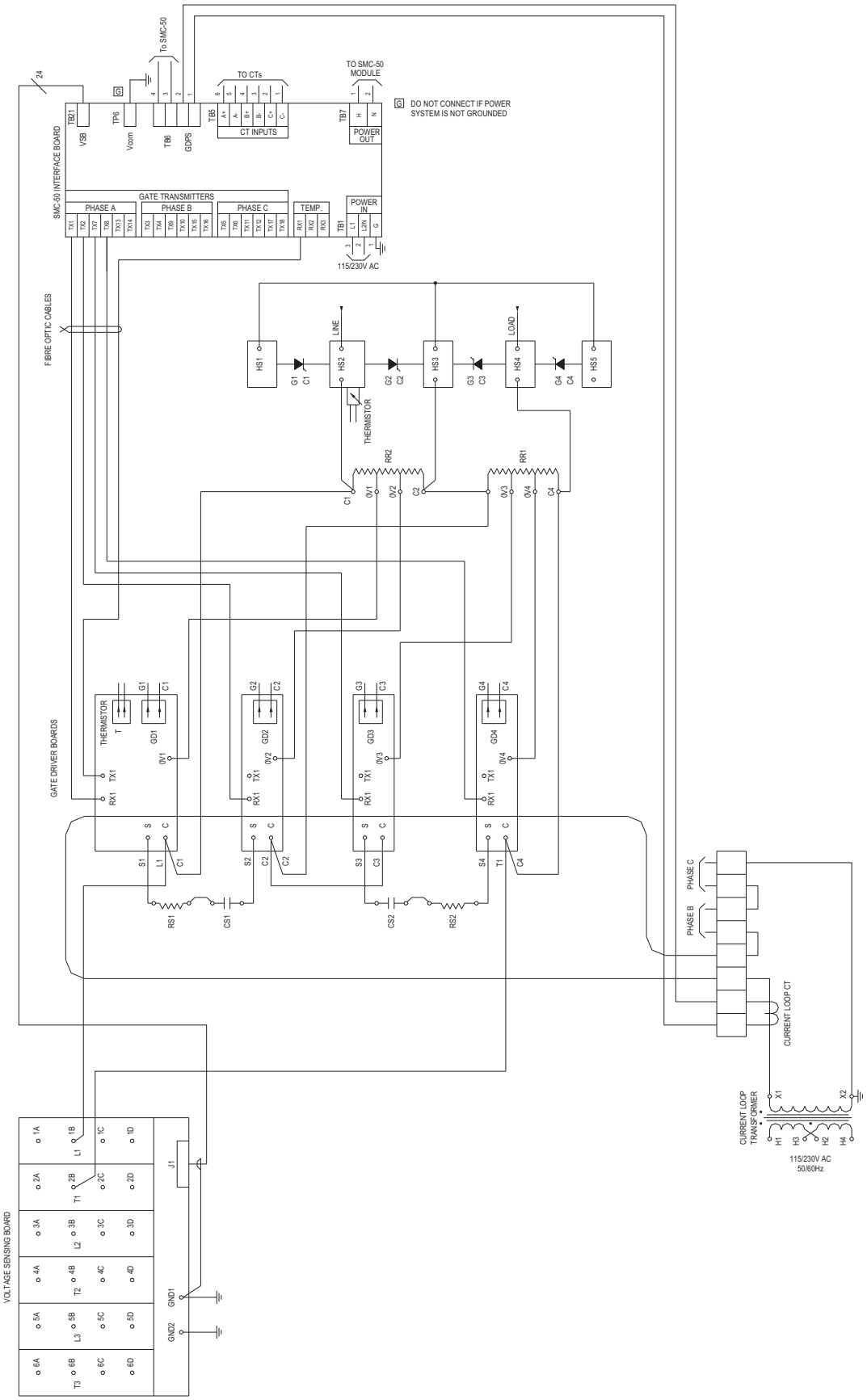
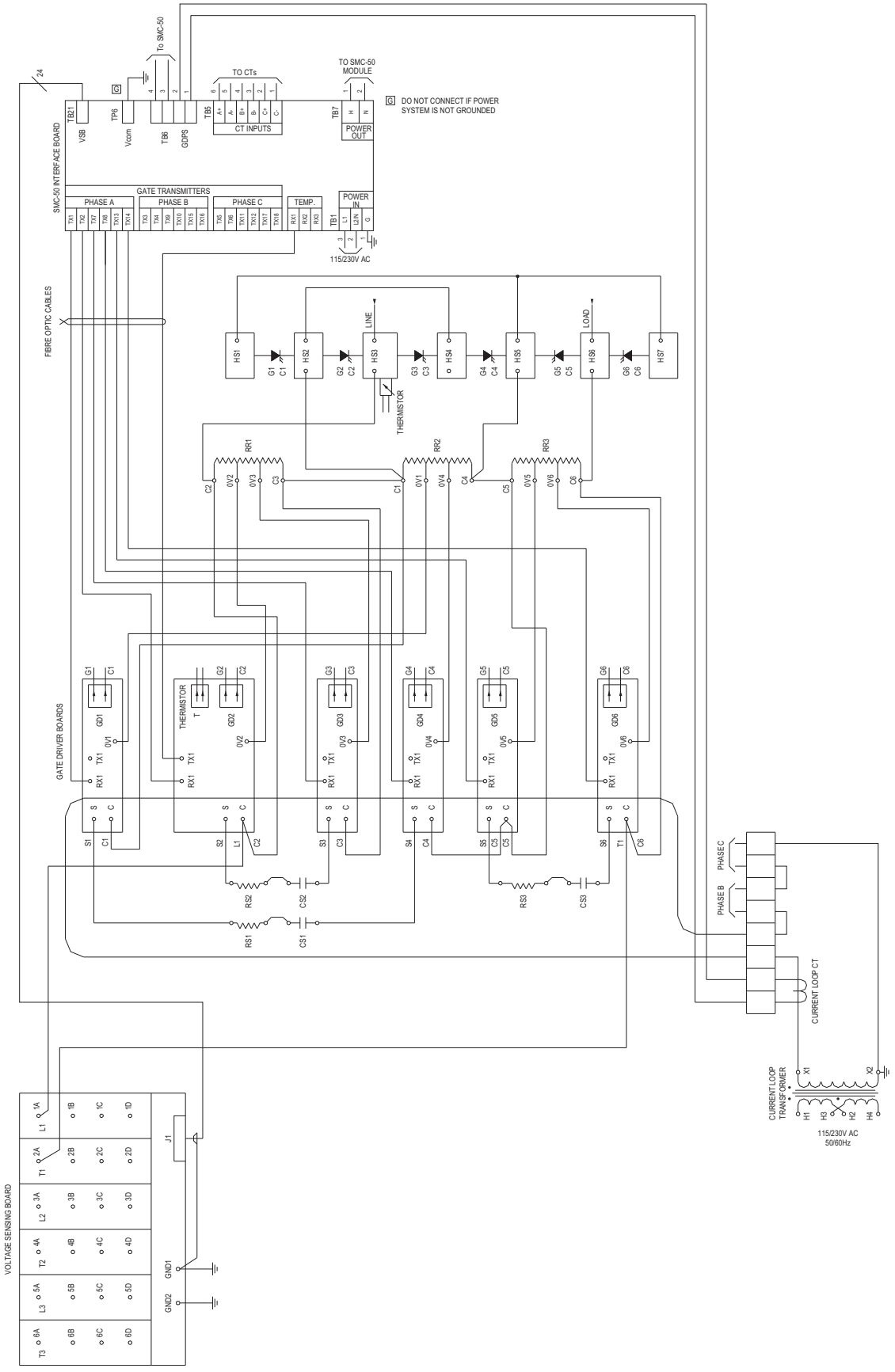


Figure 28 - Power Circuit Wiring Diagram (180/360/600A, 4800…6900V)



Final Test Procedures

Final Test Procedures

- Verify that the enclosure is properly grounded.
- Verify that phase-to-phase and phase-to-ground clearances meet the requirements of the local electrical code.
- Visually check for sufficient electrical clearances, creepage allowances, and bend radii. Refer to the applicable local electrical codes.
- Check the tightness of all power and control connections. See Table 9 for recommended torque values. Gently tug on all wires to ensure that they are properly connected.

Table 9 - Torque Requirements

Hardware	Recommended Torque
1/4 in.	6 ft•lb (8 N•m)
5/16 in.	11 ft•lb (15 N•m)
3/8 in.	20 ft•lb (27 N•m)
1/2 in.	48 ft•lb (65 N•m)
Control Wire Terminals	2.0…3.3 in•lb (0.2…0.4 N•m)
CLGD Power Assembly Terminals	50 in•lb (5.6 N•m)
SMC-50 Control Module Terminals	5 in•lb (0.6 N•m)

ATTENTION: All hardware for electrical connections must be torqued to the above specifications. Failure to do so may result in electrical faults causing personal injury or damage to the equipment.

- Check for cross-threaded hardware. In addition to the regular power connections, check the connections and wiring to the voltage sensing board.
- The high voltage silicone-insulated wires must be identified with tube markers. Avoid routing the wires over any components. If the wires are routed across two heatsinks, there must be enough slack in the wire to allow at least 10 cm (4 in.) of creepage between the heatsinks. Tie wraps must not tightly squeeze the high voltage wires, and must not be put on with a tie-wrap gun.
- Do not remove the plastic plugs from unused fiber optic transmitters on the circuit boards.
- Verify that the fiber optic cables between the interface board and the gate driver boards are connected to the correct power phase.

- Check the routing of the twisted pair of red and white cathode and gate wires from the SCRs. They can safely touch the heatsink on the side of the SCR that they are exiting; however, they must not touch the heatsink on the other side of the SCR. The wires must be properly supported to ensure this condition is met. The gate leads must be arranged in the same sequence - top to bottom - as connected to the gate driver boards. See wiring diagrams in Chapter 6 for the sequences.
- Verify ground wire connection (if required) at the interface board (see Interface Board Connections on page 31).
- Wiring to the voltage sensing board from the power stacks must be rated for the line voltage. Rockwell Automation recommends UL style 3239, #18 AWG, 40 kVDC silicone rubber insulated wire for this application.
- If the bypass vacuum contactor (and capacitor contactor if applicable) is Series D or earlier, then the contactor must have a fast drop-out time (typically 50 milliseconds or less) When using Series E or later vacuum contactors, the drop-out delay is controlled by the IntelliVAC™ module (set for minimum delay of 50 milliseconds).

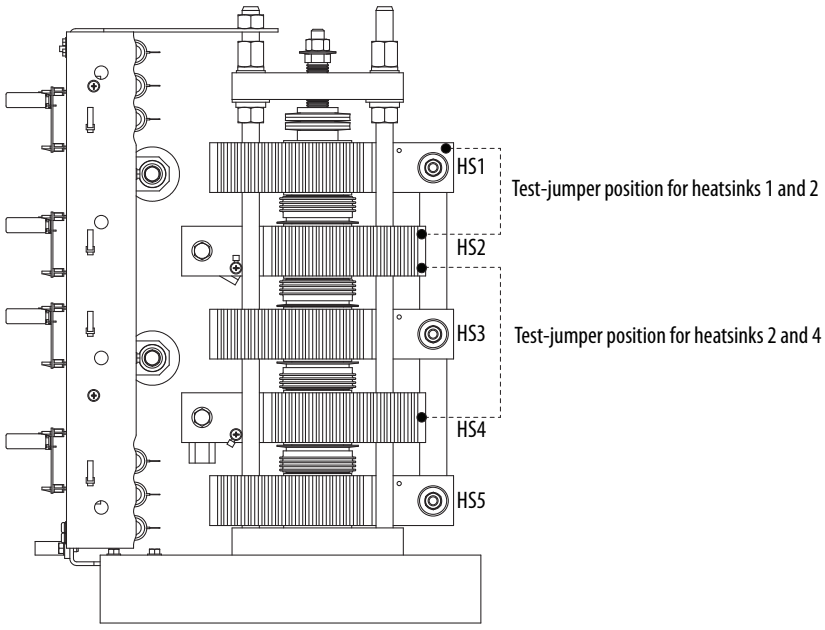
Dielectric Test

1. Remove the six high voltage wires from the voltage sensing board, and isolate the ends to prepare for the Hi-Pot test.
2. Jumper the heatsinks together within each phase as shown in Table 10. See Figure 29 for the jumper positioning on the 4160V, 360 A heatsink.

Table 10 - Jumper Configuration for Hi-Pot Testing

800…2400V Power Stacks	3300/4160V Power Stacks	6900V Power Stacks
Jumper 1, 2	Jumper 1, 2, 4	Jumper 1, 2, 3, 6

Figure 29 - Example of Jumper Positioning for Hi-pot Test (4160V, 360A Heatsink shown)



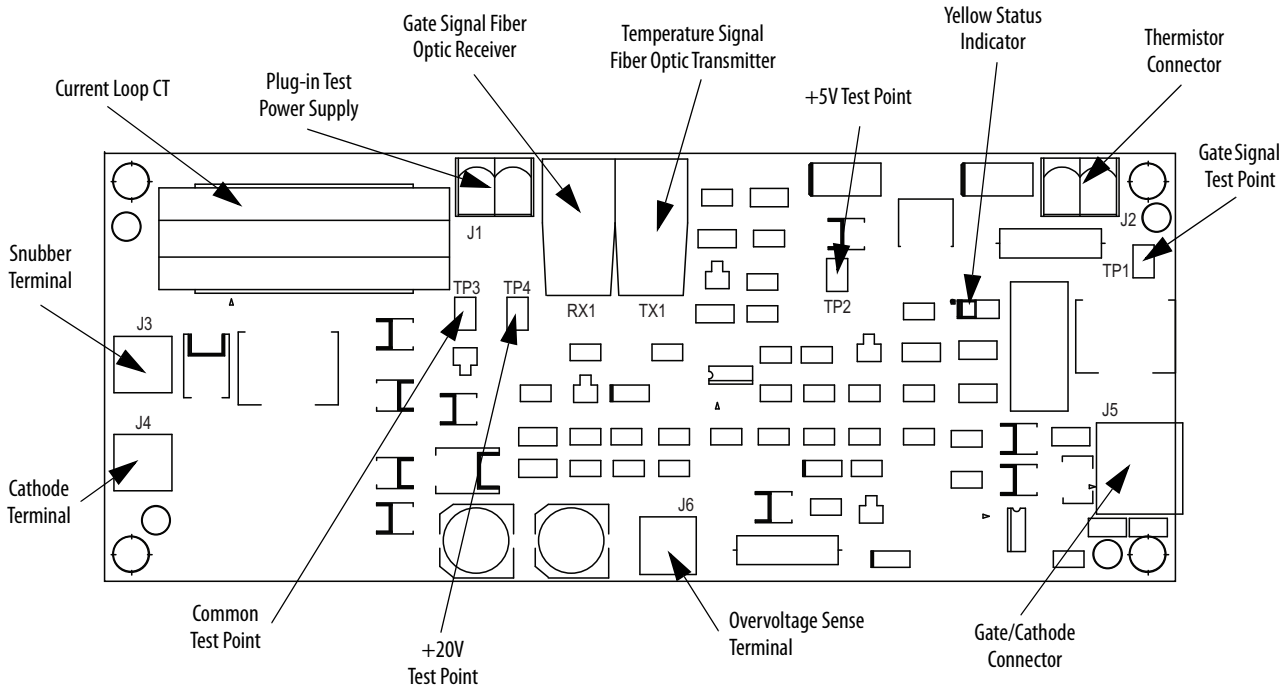
3. Measure the resistance between the line and load sides of each phase to make sure there is zero resistance. This indicates that the jumpers are properly set on the cathodes.
4. Perform a Hi-Pot test as required by the applicable local codes and standards.
5. After the Hi-Pot remove the heatsink jumpers. Re-connect the six feedback board wires.
6. Perform a resistance check for each SCR. The SCR resistance can be checked directly at the device or at the leads on the gate driver board.
   a. The gate-to-cathode resistance should range from 10...40 Ω for all styles.
   b. The cathode-to-cathode resistance can also be checked and compared to the results shown in Table 11. See Figure 30 for the testing points on the gate driver boards.

Table 11 - Power Circuit Resistance Measurements

Location of Probes	1000V	2300V	3300V	4160V	5500V	6900V
Cathode to Cathode (kΩ)(1)	—	—	22…30	23…31	21…29	24…32
Cathode to Cathode (kΩ)(2)	17…23	21…29	40…53	40…53	60…80(3)	64…84(3)
Cathode to Cathode (Ω)	10…40	10…40	10…40	10…40	10…40	10…40

(1) Measured between terminals "Cathode" on CL Boards, upper two or bottom two within a phase.
(2) Measured between terminals "Cathode" on CL Boards, top to bottom within a phase.
(3) Measured between line and load terminals within a phase.

Figure 30 - Current Loop Gate Driver (CLGD) Board Test Points



7. Check all line and load resistances to ground at the interface board. The measurement for all voltages should be within 11...13 kΩ.

Additional Tests

For a complete listing of spare parts, see publication 1560F-UM001, CENTERLINE Medium Voltage SMC-50 Motor Controller user manual.

Spare Parts

For a complete listing of spare parts, see publication 1560F-UM001, CENTERLINE Medium Voltage SMC-50 Motor Controller user manual.

Component Deratings

The components described in this publication may be applied in a wide variety of situations. Some applications may require component derating. For example, at altitudes above 1000 m (3300 ft.), the maximum current and basic impulse level (BIL) are reduced as shown in Table 12.

Table 12 - Component Derating Table

Altitude Rating	Reduce Maximum Continuous Rating By:			Reduct B.I.L. Withstand Rating By:
	180 A	360 A	600 A	
0…1000 m (0…3300 ft)	—	—	—	—
1001…2000 m (3301…6600 ft)	10 A	10 A	15 A	6.0 kV
2001…3000 m (6601…9900 ft)	20 A	20 A	30 A	12.0 kV
3001…4000 m (9901…13,200 ft)	30 A	30 A	45 A	18.0 kV
4001…5000 m (13,201…16,500 ft)	40 A	40 A	60 A	24.0 kV

Notes:

Typical Medium Voltage SMC Schematic Diagrams

Overview

This appendix contains a typical schematic for a complete MV SMC controller.

See publication 1560F-UM001, CENTERLINE Medium Voltage SMC-50 Motor Controller user manual, for additional samples of MV SMC wiring configurations. The examples shown are not a recommendation for the correct wiring configurations, nor is the OEM required to design the SMC exactly as shown.

The OEM must ensure that all wiring for the SMC unit meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

Rockwell Automation does not assume any responsibility or liability for loss or damages caused by failures in the unit manufactured by the OEM.

Figure 31 - Typical MV SMC-50 Schematic Diagram, 3300/4160V

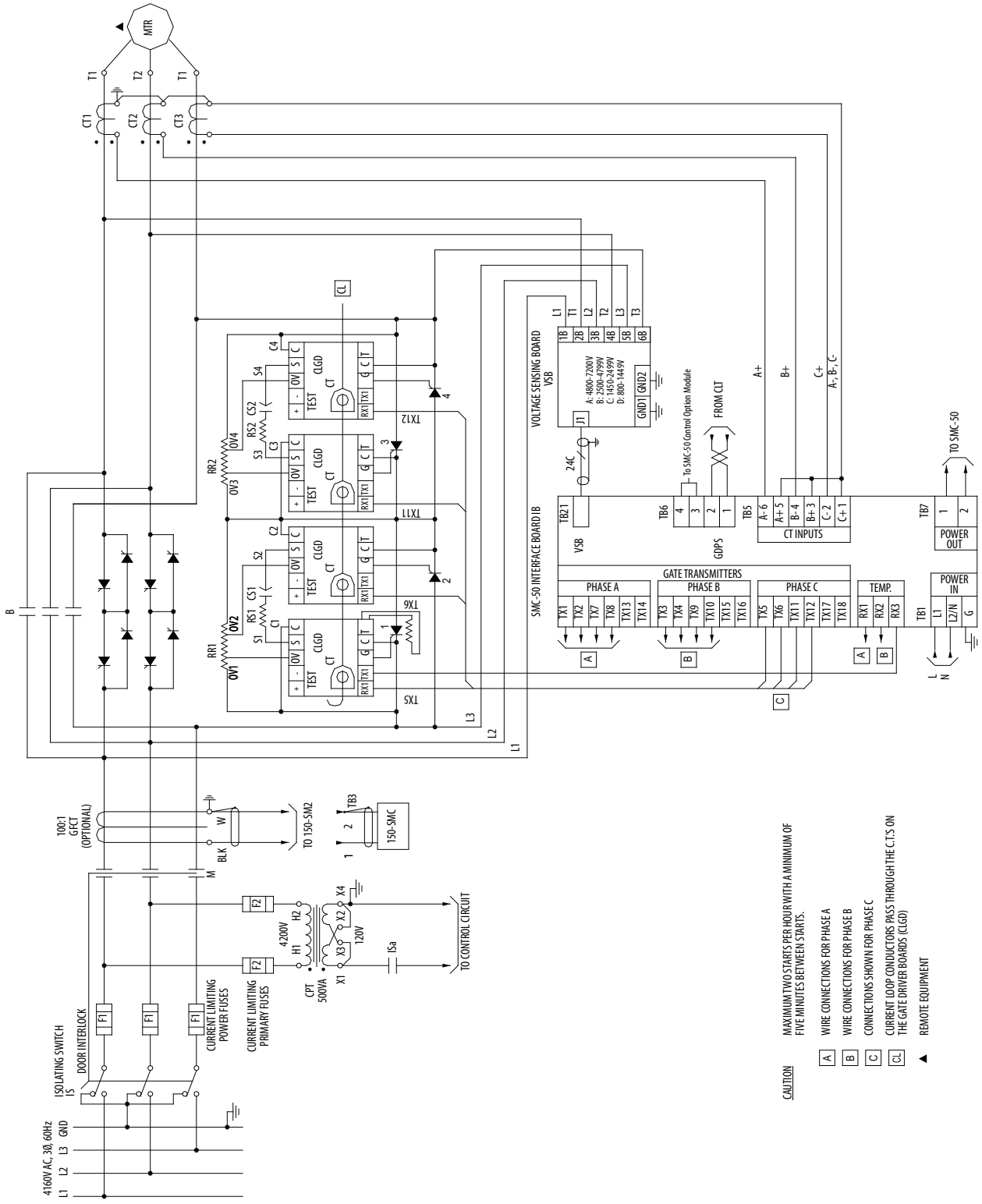
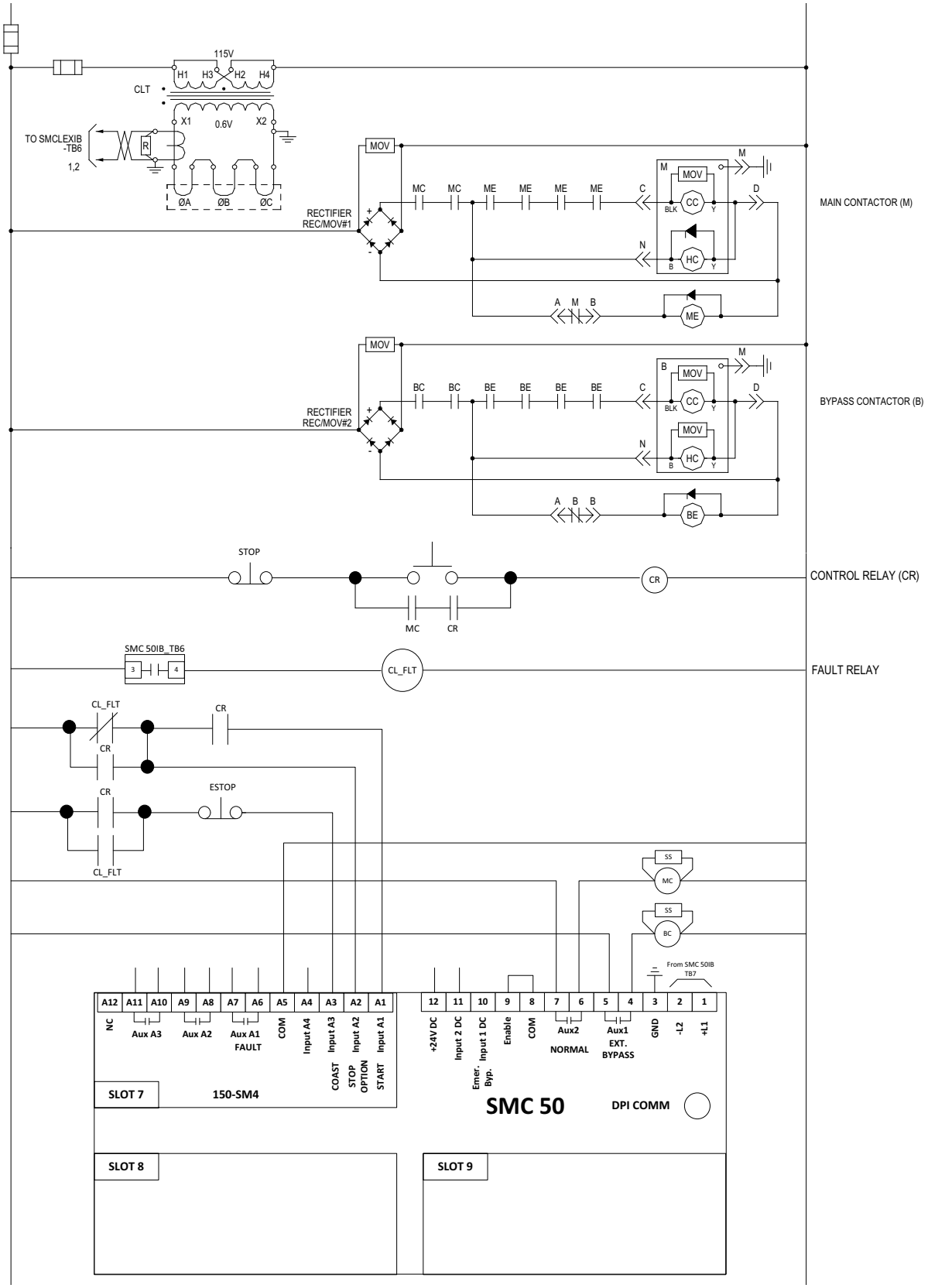


Figure 32 - Typical MV SMC-50 Schematic Diagram, 3300/4160V



Notes:

SMC OEM Power Stack Kit Chart

Table 13 - SMC OEM Power Stack Kit Chart

Final Part Number	Description	RA Internal Part Number	Parts supplied in the RA part number	Qty
1503E-PPZ1T	SMC Power Stack 1000V, 180 A, 3 PH, 50/60 Hz	80258-011-51	80187-513-56	3
			80190-519-01	6
			80013-183-01	24
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPZ1A	SMC Power Stack 1000V, 360 A, 3 PH, 50/60 Hz	80258-011-52	80187-513-55	3
			80190-519-01	6
			80013-183-01	24
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPAT	SMC Power Stack 2300V, 180 A, 3 PH, 50/60 Hz	80258-011-53	80187-513-54	3
			80190-519-01	6
			80013-183-01	24
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPAA	SMC Power Stack 2300V, 360 A, 3 PH, 50/60 Hz	80258-011-54	80187-516-51	3
			80190-519-01	6
			80013-183-01	24
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPAC	SMC Power Stack 2300V, 600 A, 3 PH, 50/60 Hz	80258-011-55	80187-516-51	3
			80190-519-01	6
			90013-183-01	24
			80187-595-52	1
			80018-247-51	1
1503E-PPCT	SMC Power Stack 3300V, 180 A, 3 PH, 50/60 Hz	80258-011-56	80187-514-53	3
			80190-519-01	12
			80013-183-01	48
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3

Table 13 - SMC OEM Power Stack Kit Chart (Continued)

Final Part Number	Description	RA Internal Part Number	Parts supplied in the RA part number	Qty
1503E-PPCA	SMC Power Stack 3300V, 360 A, 3 PH, 50/60 Hz	80258-011-57	80187-514-54	3
			80190-519-01	12
			80013-183-01	48
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPCC	SMC Power Stack 3300 V, 600 A, 3 PH, 50/60 Hz	80258-011-58	80187-517-51	3
			80190-519-01	12
			80013-183-01	48
			80187-595-52	1
			80018-247-51	1
1503E-PPET	SMC Power Stack 4160V, 360 A, 3 PH, 50/60 Hz	80258-011-59	80187-514-53	3
			80190-519-01	12
			80013-183-01	48
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPEA	SMC Power Stack 4160V, 360 A, 3 PH, 50/60 Hz	80258-011-60	80187-514-54	3
			80190-519-01	12
			80013-183-01	48
			80187-595-52	1
			80018-247-51	1
			80157-846-51	3
1503E-PPEC	SMC Power Stack 4160V, 600 A, 3 PH, 50/60 Hz	80258-011-61	80187-517-51	3
			80187-625-52	1
			80190-519-01	12
			80013-183-01	48
			80187-595-52	1
			80018-247-51	1
1503E-PPKT	SMC Power Stack 6900V, 180 A, 3 PH, 50/60 Hz	80258-011-62	80187-515-53	3
			80187-625-52	1
			80190-519-01	18
			80013-183-01	72
			80187-595-52	1
			80018-247-51	1
1503E-PPKA	SMC Power Stack 6900V, 360 A, 3 PH, 50/60 Hz	80258-011-63	80187-515-54	3
			80190-519-01	18
			80013-183-01	72
			80187-595-52	1
			80018-247-51	1
1503E-PPKC	SMC Power Stack 6900V, 600 A, 3 PH, 50/60 Hz	80258-011-64	80187-515-51	3
			80190-519-01	18
			80013-183-01	72
			80187-595-52	1
			80018-247-51	1

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Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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