CENTERLINE Medium Voltage SMC-50 Motor Controller

Bulletin Numbers 1503E, 1560F, and 1562F

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual

Original Instructions

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.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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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).

Preface

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Manual Objectives

This manual is intended for use by personnel familiar with Medium Voltage and solid-state power equipment. The manual contains material which will allow the user to operate, maintain and troubleshoot the SMC™-50 family of controllers. The family consists of the following Bulletin numbers: 1503E, 1560F and 1562F. This manual applies only to this series of products.

This user manual pertains to units with firmware release 6.xxx (or later).

Download Firmware, AOP, EDS, and Other Files

Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes from the Product Compatibility and Download Center at rok.auto/pcdc.

Summary of Changes

Topic	Page
Added IEEE/ANSI codes and IEC symbols to protection features	23
Added Recommended Line and Load Cable Sizes table	51
Corrected Function Block Programming graphic	252

Service Procedure

For your convenience, the Rockwell Automation® Global Manufacturing Solutions (CSM), provides an efficient and convenient method of servicing medium voltage products.

Contact your local area support office to make arrangements to have a qualified service representative come to your facility.

A complete listing of Area Support Offices may be obtained by calling your local Rockwell Automation Distributor or Sales Office.

Additional Resources

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

Resource	Description
General Handling Procedures for MV Controllers, publication MVB-5.0	Provides information around receiving, storing, and moving medium voltage controllers.
MV Controllers, 200/400A Two-High Cabinet, Standard and Arc-Resistant Enclosure, publication 1500-UM055	Provides information for installing, maintaining, and operating Two-High cabinets.
Medium Voltage 400A Contactor - Series E and F, publication 1502-UM052	Provides information around receiving and handling, installing, maintaining, and troubleshooting.
Medium Voltage Contactor 800 A, 2400...7200V (Series F), publication 1502-UM054	Provides information around receiving and handling, installing, maintaining, and troubleshooting.
CENTERLINE Medium Voltage SMC Motor Controller Technical Data, publication 1560F-TD001	Provides specification information for medium voltage smart motor controllers
IntelliVAC Contactor Control Module, publication 1503-UM053	Provides information around installing, wiring, commissioning, and troubleshooting.
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
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 rok.auto/literature.

Product Overview

Overview

The SMC™-50 is a solid-state, three-phase, AC line controller. It is designed to provide microprocessor-controlled starting and stopping of standard three-phase, squirrel-cage induction motors, using the same control module as the Allen-Bradley Bulletin 150 SMC-50.

1503E – OEM Controller

A chassis-mount medium voltage solid-state controller designed to mount in an OEM or customer-supplied structure, and designed to work in conjunction with an existing or OEM/customer-supplied starter. It is comprised of several modular components, including:

- Frame-mounted or loose power stacks including gate driver boards
- Loose interface and voltage feedback boards
- Fiber optic cables for SCR firing
- Microprocessor based control module
- Bypass vacuum contactor

1560F – Retrofit Controller

A medium voltage solid-state controller designed to work in conjunction with an existing customer-supplied starter. It includes:

- Tin-plated, copper, horizontal power bus (optional)
- A continuous, bare copper ground bus
- Power electronics
- A bypass vacuum contactor
- Three current transformers
- A low voltage control panel complete with microprocessor-based control module
- Top and bottom plates to accommodate power cables.

Refer to Interlocking on page 57 of Chapter 2.

1562F – Combination Controller

A medium voltage solid-state controller that provides isolation and protection for new installations. It includes:

- Tin-plated, copper, horizontal power bus (optional)
- A continuous, bare copper ground bus
- Power electronics
- A main non-load-break isolating switch and operating handle
- An isolation vacuum contactor
- A bypass vacuum contactor
- Three current limiting power fuses for NEMA Class E2 operation
- Three current transformers
- A control power transformer (optional)
- A low voltage control panel complete with microprocessor-based control module
- Space for necessary auxiliary control and metering devices
- Top and bottom plates to accommodate power cables
- Motor overload protection (included in SMC-50 control module) - available in Arc Resistant enclosures

SMC-50 Control Module

The SMC-50 control module offers a full range of starting and stopping modes as standard:

- Soft Start with Selectable Kickstart
- Soft Stop
- Current Limit Start with Selectable Kickstart
- Sensorless Linear Acceleration
- Sensorless Linear Deceleration
- Pump Conrol (Start and Stop Control modes)
- Torque Control Start
- Dual Ramp Start
- Full Voltage Start (Emergency Run)

Other features that offer further user benefit include:

- Extensive protection and diagnostic features
- Metering
- Communication capability
- I/O

These modes, features and options are further described in this chapter.

Starting Modes

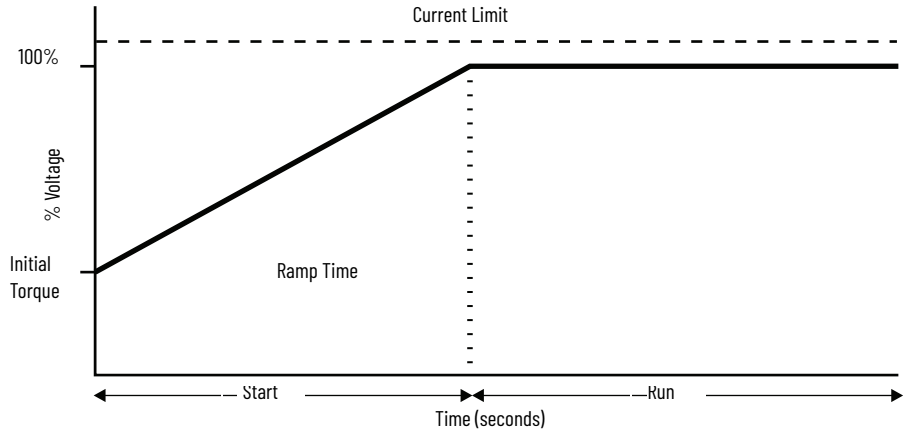
For any of the following starting modes, the motor only accelerates in the programmed time if that time and the current limit setting is appropriate for the connected load. If the set time is too short, or the load is too great, the motor will take longer to reach full speed.

Soft Start

This method covers the most general applications. The motor is given an initial torque setting, which is user adjustable. From the initial torque level, the output voltage to the motor is steplessly increased (ramped) during the acceleration ramp time, which is user-adjustable. A user-adjustable current limit value is also available. This limits the current throughout the soft start.

A motor's torque curve is not a linear function and depends on both applied voltage and current. As such, if the soft starter ramped voltage applied to the motor is sufficient for it to develop torque high enough to overcome the inertia of the load, the motor could quickly accelerate to full speed in less than the configured ramp time when using the Soft Start mode.

Figure 1 - Soft Start Timing Diagram



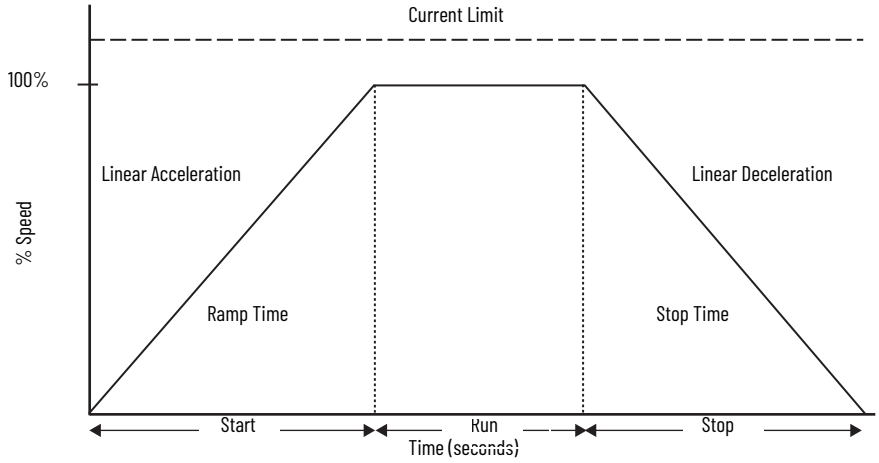
Sensorless Linear Speed Acceleration

With this type of starting mode, the motor acceleration is at a constant rate. The controller accelerates the motor in a linear fashion from the off (0 speed) condition to full speed condition in the time configured in the user-defined ramp time. This is done using a proprietary motor speed feedback algorithm to sense motor speed.

An external speed sensor is NOT required.

This starting mode presents the least amount of stress on mechanical components. An initial torque value is configured to define a motor starting value. A current limit value is also available to limit the starting current throughout the linear acceleration start maneuver. Sensorless linear deceleration is also available, see Linear Speed Deceleration on page 21.

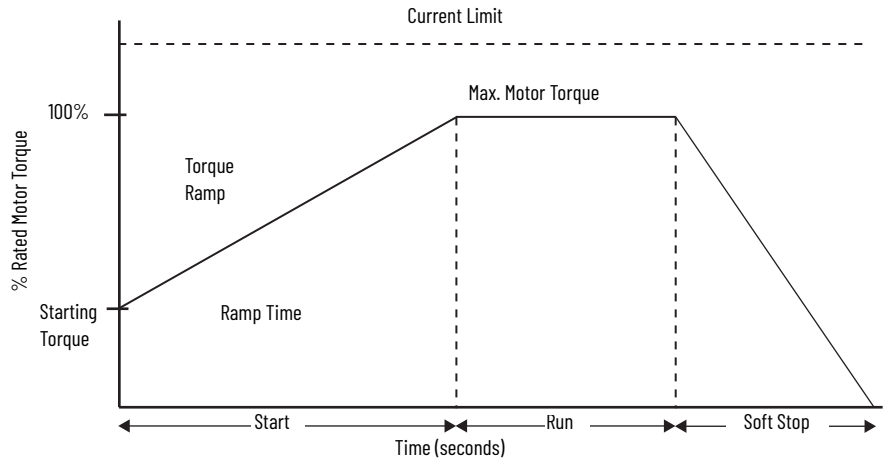
Figure 2 - Linear Speed Acceleration Timing Diagram



Torque Control Start

This method provides a torque ramp from a user-adjustable, initial motor starting torque to a user-adjustable, maximum torque over the defined starting ramp time. The torque control mode provides a more linear starting ramp than a soft start, potentially resulting in less stress on mechanical components and a more time controlled ramp. A current limit value is also available to limit the starting current throughout the torque start.

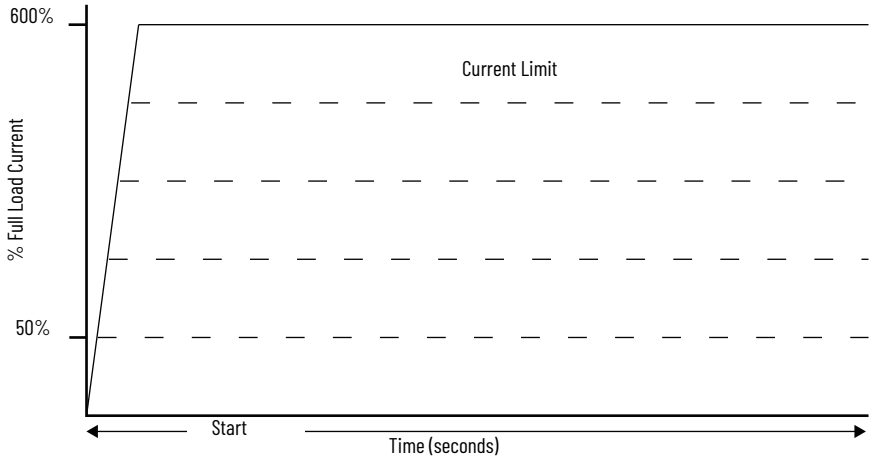
Figure 3 - Torque Control Start Timing Diagram



Current Limit Start(1)

This method provides a current limit controlled start by maintaining a constant current to the motor and is used when it is necessary to limit the maximum starting current. The starting current and current limit starting ramp time is user-adjustable. Current Limit Start can also be used in conjunction with Soft Start, Torque Control, and Linear Speed Acceleration Starts.

Figure 4 - Current Limit Start Timing Diagram

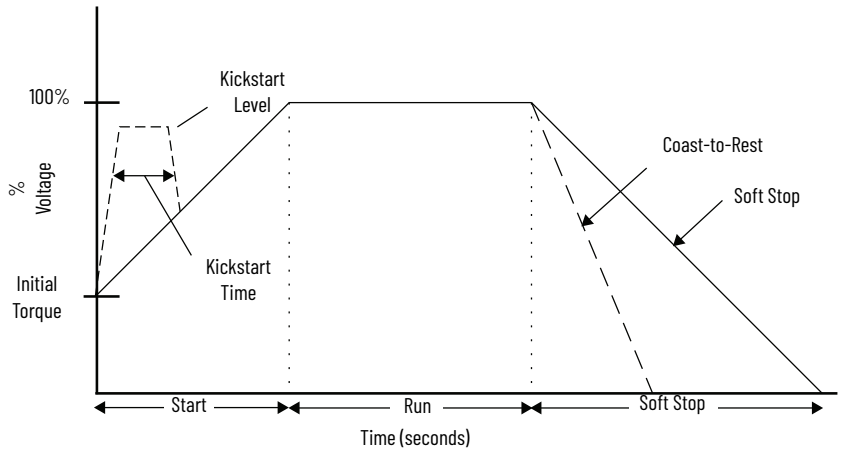


Selectable Kickstart

Selectable kickstart provides a power boost at start-up that is user-adjustable from 0...90% of locked rotor torque. The additional power helps motors generate higher torque to overcome the resistive mechanical forces of some applications when they are started. The selectable kickstart time is user-adjustable from 0.0...2.0 seconds.

(1) Kickstart is also available with Current Limit Start and Dual Ramp Start.

Figure 5 - Selectable Kickstart



Pump Control Mode

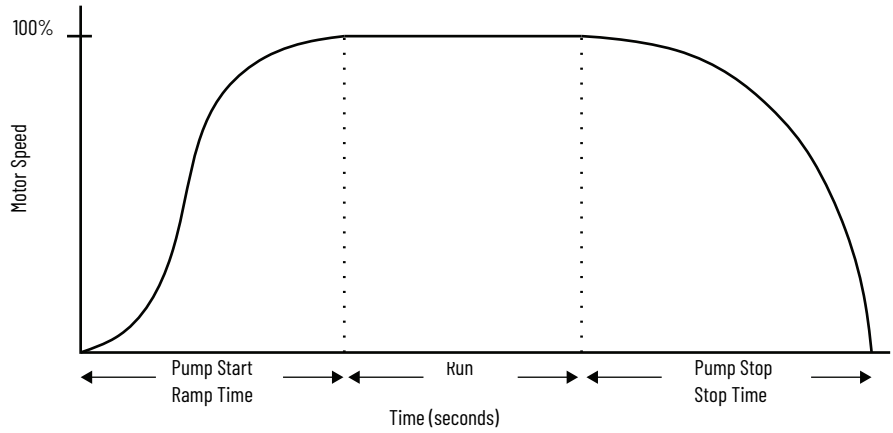
This mode is used to reduce surges in a fluid piping system and the resulting fluid hammer or check valve slam caused by starting a centrifugal pump at full voltage and full speed. This mode also reduces pump cavitations, increasing pump life. To provide these benefits, the SMC-50 module's microprocessor generates a motor starting curve which follows the starting characteristics of a centrifugal pump and monitors operation during start to ensure reliable pump starts.

1. Consult factory if start time settings over 30 seconds are required. See Appendix B for controller duty cycle ratings.
2. The Pump Control option functions only for centrifugal pumps. It is not suited for positive displacement, piston, or other types of pumps.
3. The Pump Stop option functions only for a centrifugal pump running at greater than approximately 2/3 of the motor rated horsepower.
4. Pump applications with input and/or output valves that are closed during starting and/or stopping may not benefit from the Pump Control option. Consult the factory for applications with valves.
5. For starting or stopping times longer than 15 seconds, power fuse selection should be reviewed to ensure no element damage occurs. The fuse minimum melting time-current characteristic curve should be consulted to ensure that, at 1.1 times the full voltage locked rotor current of the motor, the actual starting or stopping time does not exceed 75% of the fuse melting time.
6. Motor overload and/or upstream breaker settings may have to be adjusted to allow the starting or stopping current to flow for extended periods.

ATTENTION: Pump stopping is not intended to be used as an emergency stop. Refer to the applicable standard for emergency stop requirements.

ATTENTION: Pump stopping may cause motor heating depending on the mechanical dynamics of the pumping system. Therefore, select the lowest stopping time setting that will satisfactorily stop the pump.

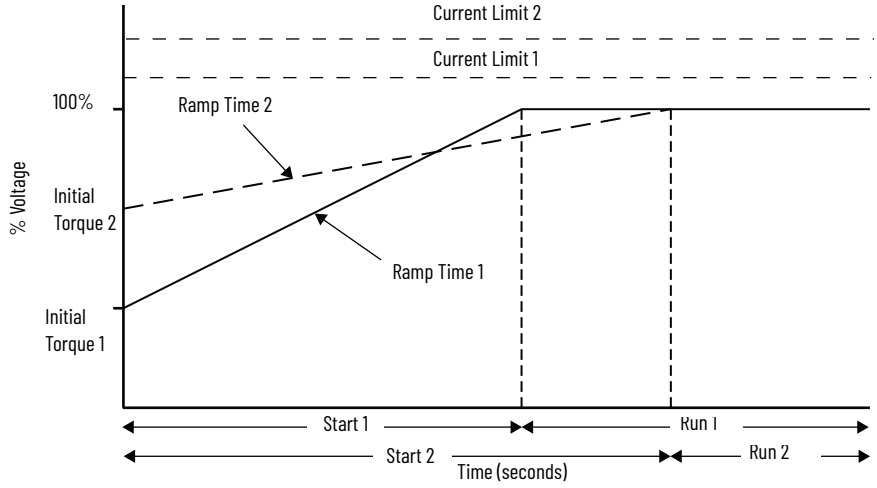
Figure 6 - Pump Control Mode Timing Diagram



Dual Ramp Start(2)

This method is useful on applications with varying loads, starting torque, and start time requirements. Dual Ramp Start gives you the ability to select between two separate start profiles via any programmable auxiliary input. Each start profile can use any of the available starting modes.

Figure 7 - Dual Ramp Start Timing Diagram

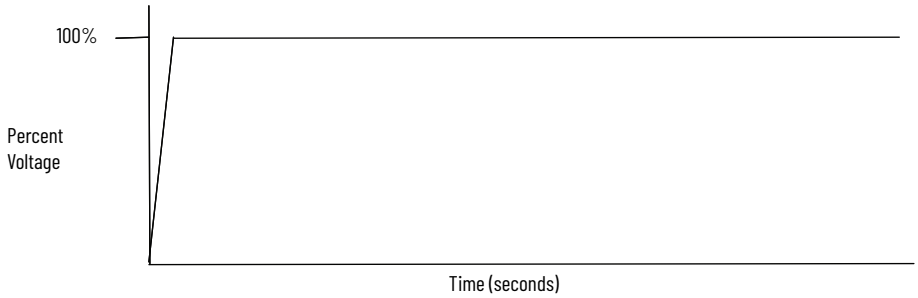


Emergency Bypass Run (Full Voltage Start)

This starting mode is used to provide 'Emergency Bypass Run' when Power switching devices are faulted (for example, shorted SCRs) and any of the soft starting modes cannot be utilized. When programmed for 'Emergency Bypass Run', a 'Start' command will first close the bypass contactor, then the line contactor for an across-the-line (Full voltage) start of the motor. A 'Stop' command will open the line contactor first and allow the motor to coast, regardless of the programmed 'stop mode'. Undervoltage Fault Delay, parameter 99, should be programmed for 2 seconds or more. The start button must be depressed for at least 2 seconds or the unit does not close the main contactor and the motor cannot run.

(2) Kickstart is also available with Current Limit Start and Dual Ramp Start.

Figure 8 - Emergency Bypass Start



Stopping Modes

The SMC-50 Smart Motor Controller provides the following Stopping Modes of operation as standard.

Table 1 -

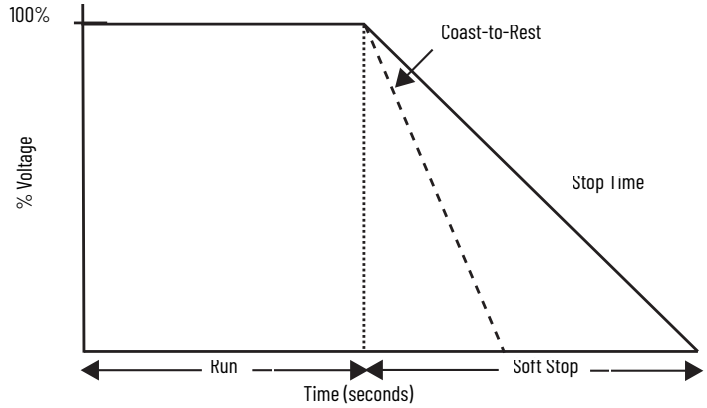
Stopping Mode	Page
Coast	20
Soft Stop	21
Linear Speed Deceleration	21
Pump Stop	22

Except for Coast stop, all other optional stopping modes will increase the stopping time of the motor. Decreased stopping times can only be achieved by using a braking function. Consult the factory for braking options.

Coast

Configuring the stop mode to coast sets the controller to perform a motor coast-to-stop maneuver.

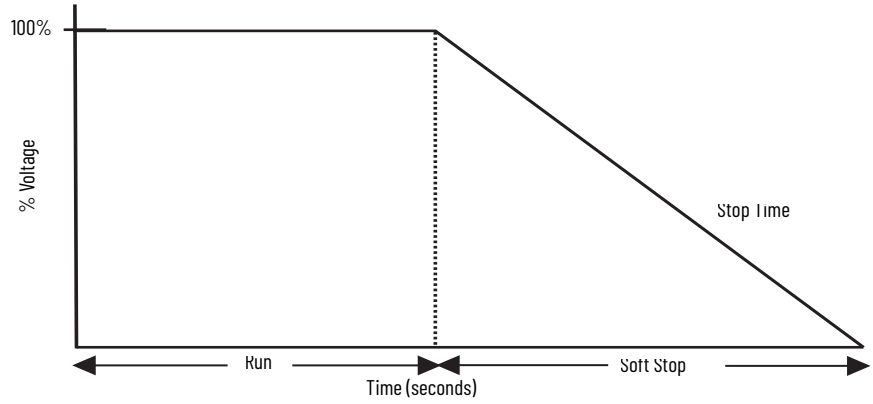
Figure 9 - Coast-to-Stop Timing Diagram



Soft Stop

The Soft Stop mode can be used in applications requiring an extended stop time. The voltage ramp down time is user-adjustable from 0...999 seconds. This load stops when the programmed stop time has elapsed or the voltage ramp drops to a point where the load torque is greater than the motor torque.

Figure 10 - Soft Stop Timing Diagram

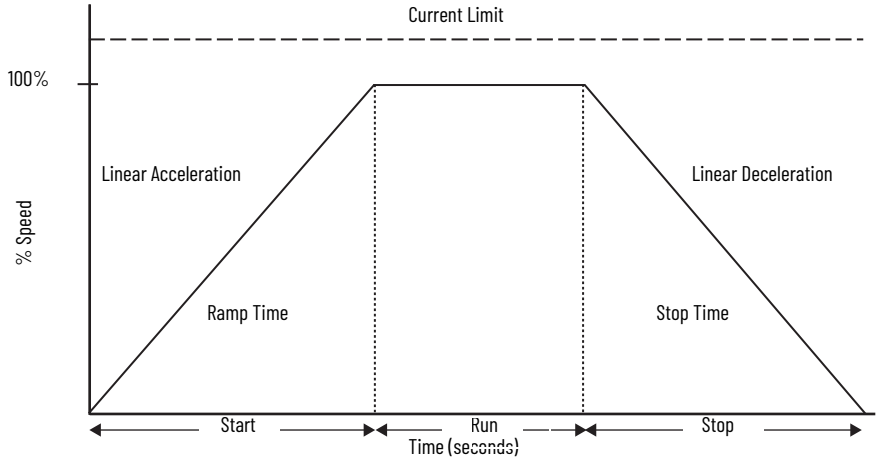


Linear Speed Deceleration

Configuring the motor stop mode to Linear Speed Deceleration mode commands the motor to stop from full speed to zero speed following a linear ramp based on the user-configured stop time. A current limit value is also available to limit the stopping current throughout the Linear Speed Deceleration maneuver.

ATTENTION: Linear deceleration is not intended to be used as an emergency stop. Such usage may result in severe injury or death. Refer to the applicable standards for emergency stop requirements.

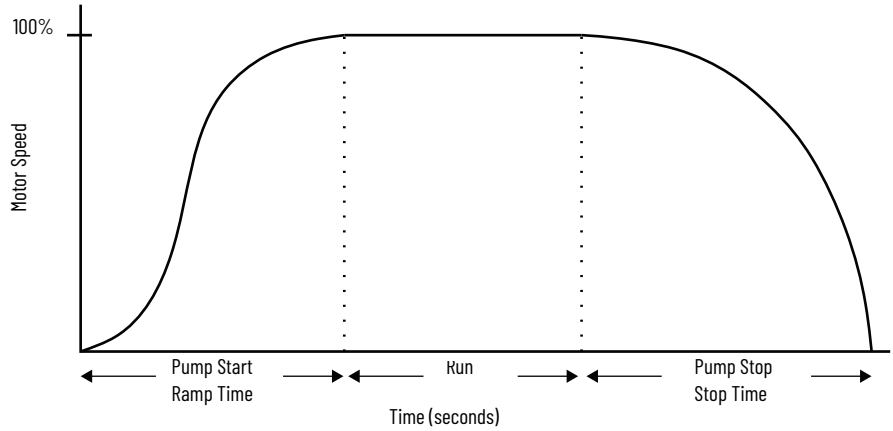
Figure 11 - Linear Speed Deceleration Timing Diagram



Pump Stop

Just as starting a centrifugal pump at full voltage causes fluid hammer and check valve slam, stopping a centrifugal pump that is running at full speed can also produce the same results. The SMC- 50 module's Pump Stop mode generates a motor stop curve, which follows the stop characteristics of a centrifugal pump. This results in the gradual decrease in motor speed.

Figure 12 - Pump Stop Timing Diagram



ATTENTION: Pump stopping is not intended to be used as an emergency stop. See the applicable standard for emergency stop requirements.

ATTENTION: Pump stopping may cause motor heating depending on the mechanical dynamics of the pumping system. Therefore, select the lowest stopping time setting that will satisfactorily stop the pump.

IMPORTANT The Braking Control options (Smart Motor Braking and Slow Speed with Braking) are not offered for standard use in MV applications. Contact factory for more details.

IMPORTANT Energy Saver Run operation and Motor Winding heater operation are not offered for use in MV applications. Consult the factory for further assistance.

Motor and Starter Protection Features

The SMC-50 control module provides both motor and starter alarms and faults. An alarm condition is intended to provide an alert that a potential system issue, or fault is pending to allow time to take corrective action. A fault is intended to protect equipment from damage by shutting that equipment down and/or removing power. The SMC-50 module lets you individually enable or disable motor and starter alarms and faults by bit (On/Off) selection. Alarm and fault trip points are typically user-configurable to allow for application dependence. In addition, many alarms and faults provide a separate user-configurable alarm and fault time delay parameter to limit nuisance trips and shutdowns.

The SMC-50 module has a separate Fault Buffer and Alarm Buffer to maintain a Fault/Alarm history. In addition to the fault/alarm code and description, a time and date stamp is provided by the SMC-50 controller's Real Time Clock (RTC). The Fault Buffer holds the last five faults which provide the time and date; the Alarm Buffer holds the last 100 alarm events which detail the time, date, parameter change, Start, Stop, Coast, Operation, Alarm, Fault, and Fault Reset.

As standard, the SMC-50 module enables manual reset of a fault from the PUSH-TO-RESET/HOLD-TO-TEST button, located adjacent to the LED status indicator. Fault indication and reset can also be performed from a panel-mount HIM or from PC software (such as Connected Components Workbench™ software).

Protection Feature	IEEE/ANSI Code	IEC Symbol	Page
Overload Protection	49	T>	24
Underload Protection	37	I<	26
Undervoltage Protection	27	U< U<< U<<<	26
Overvoltage Protection	59	U> U>> U>>>	26
Voltage Unbalance Protection	47	–	27
Current Imbalance	46	I_2>	27
Stall Protection and Jam Detection	48	I_{st}>	27
Ground Fault[1]	51G	I_0> I_0>> I_0>>> I_0>>>>	28
Thermistor/PTC Protection	26	–	28
Open Gate	–	–	29
Line Faults with Phase Indication	–	–	30
Excessive Starts/Hour	66	N>	30
Overtemperature	26	–	30
Overcurrent Protection	50/51	I> I>> I>>>	31
Total Harmonic Distortion (THD) Fault and Alarm	–	–	31

(1) Requires option card 150-SM2.

Overload Protection

The SMC-50 control module meets applicable requirements as a motor overload protection device. Thermal memory provides added protection and is maintained even when control power is removed. The built-in overload algorithm controls the value stored in Parameter 18, Motor Thermal Usage (see Chapter 4). An Overload Fault will occur when this value reaches 100%. The parameters below provide application flexibility and easy setup.

Table 2 -

Parameter	Range
Overload Class	5...30
Overload Reset	Manual – Auto
Motor FLC	1...2200 A
Service Factor	0.01...1.99

If the SMC-50 is used to control a multi-speed motor, or more than one motor, the Overload Class parameter must be programmed to “OFF” and separate overload relays must be supplied for each speed/motor. The trip rating is 118% of the programmed FLC.

Figure 13 and Figure 14 provide the typical overload trip curves for the available trip classes.

Figure 13 - Overload Trip Curves

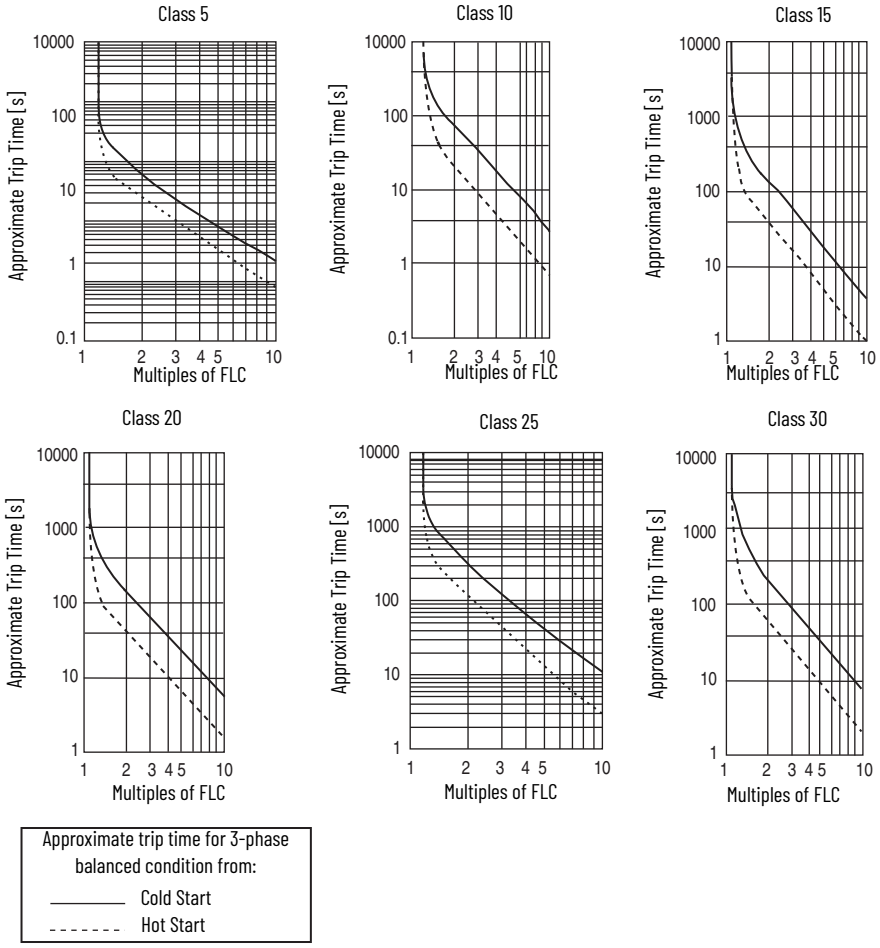
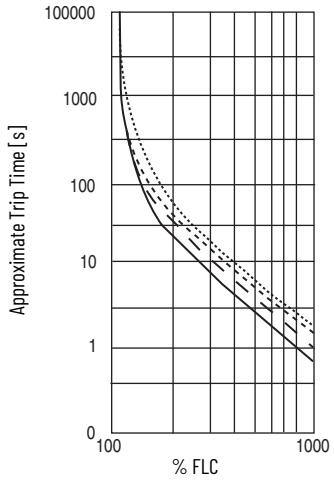


Figure 14 - Restart Trip Curves after Auto Reset



Trip Class	Auto Reset time [s]
10	90
15	135
20	180
30	270

Underload Protection

Utilizing the underload protection of the SMC-50 module, motor operation can be halted if a sudden drop in current is sensed.

The SMC-50 control module provides an adjustable underload trip setting from 0...99% of the programmed motor full load current rating. Trip delay time can be adjusted from 0...99 seconds.

Undervoltage Protection

Utilizing the undervoltage protection of the SMC-50, motor operation can be halted if a sudden drop in voltage is detected.

The SMC-50 module provides an adjustable undervoltage trip setting from 0...99% of the programmed motor voltage. Trip delay time can be adjusted from 0...99 seconds.

For medium voltage applications, undervoltage protection should be set from 80...99%.

An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the HIM, Communication (if applicable), and alarm contact closing.

Overvoltage Protection

Utilizing the overvoltage protection of the SMC-50, motor operation can be halted if a sudden increase in voltage is detected.

The SMC-50 module provides an adjustable overvoltage trip setting from 100...199% of the programmed motor voltage. Trip delay time can be adjusted from 0...99 seconds.

For medium voltage applications, overvoltage protection should be set from 100...115%.

An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the HIM, Communication (if applicable), and alarm contact closing.

Voltage Unbalance Protection

The SMC-50 module is able to detect an unbalance in line voltages. Motor operation can be halted if the unbalance is greater than the desired range.

The SMC-50 module provides an adjustable unbalance setting from 1…25% of the line voltages. Trip delay time can be adjusted from 0…99 seconds.

An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the HIM, Communication (if applicable), and alarm contact closing.

Current Imbalance

A current imbalance condition can be caused by an unbalance in the voltage supply, unequal motor winding impedance, or long and varying wire lengths. When a current imbalance condition exists, the motor can experience an additional temperature rise, which results in degradation of the motor insulation and reduction in life expectancy. Rapid current imbalance fault detection helps to extend the motor's life expectancy and minimize potential damage and loss of production.

The current imbalance calculation is equal to the largest deviation of the three current signals (RMS phase current) from the average phase current, divided by the average phase current. Note that the power pole current is used for the current imbalance calculation.

Current imbalance setting is adjustable from1…25% of the phase current. Trip delay time can be adjusted from 0…99 seconds. This protection is also available when motor is at speed.

Stall Protection and Jam Detection

The SMC-50 control module provides both stall protection and jam detection for enhanced motor and system protection.

- Stall protection is user-adjustable from 0.0…10.0 seconds (This feature is enabled by Default and delay time set at 1 s).
- An alarm (pre-fault) indication level can be programmed to indicate the unit is getting close to faulting. The alarm modification information is displayed through the HIM, Communication (if applicable), and alarm contact closing.
- Jam detection allows the user to determine the jam level (up to 1000% of the motor's full-load current rating) and the delay time (up to 99.0 s) for application flexibility.

Figure 15 - Stall Protection

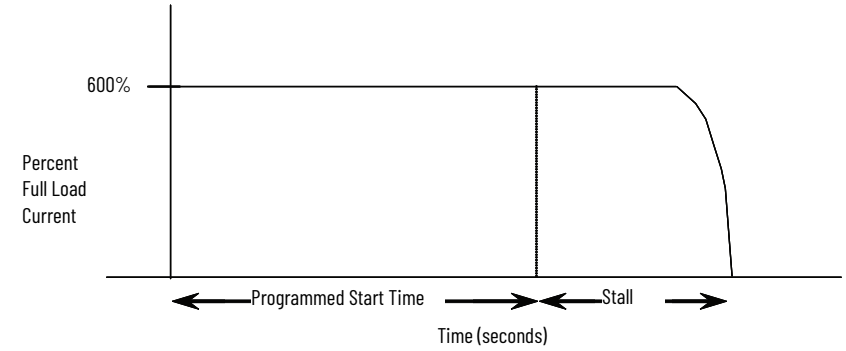
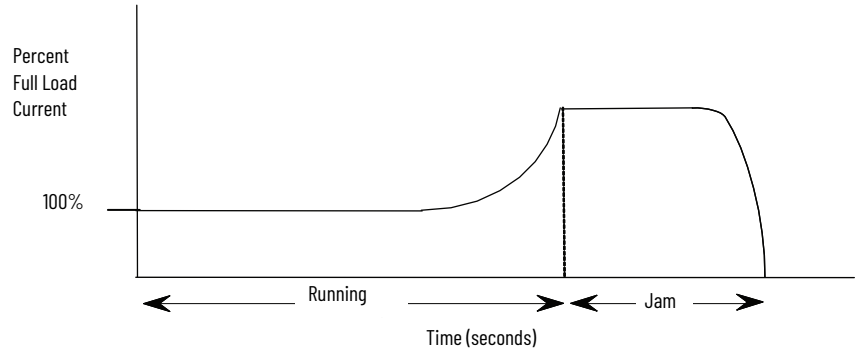


Figure 16 - Jam Detection



Ground Fault

In isolated or high impedance-grounded systems, core-balanced current sensors are typically used to detect low level ground faults caused by insulation breakdowns or entry of foreign objects. Detection of such ground faults can be used to interrupt the system to prevent further damage, or to alert the appropriate personnel to perform timely maintenance.

The SMC-50 module can provide ground fault indication when used with the 150-SM2 Option Module and an external core balance current transformer.

Thermistor/PTC Protection

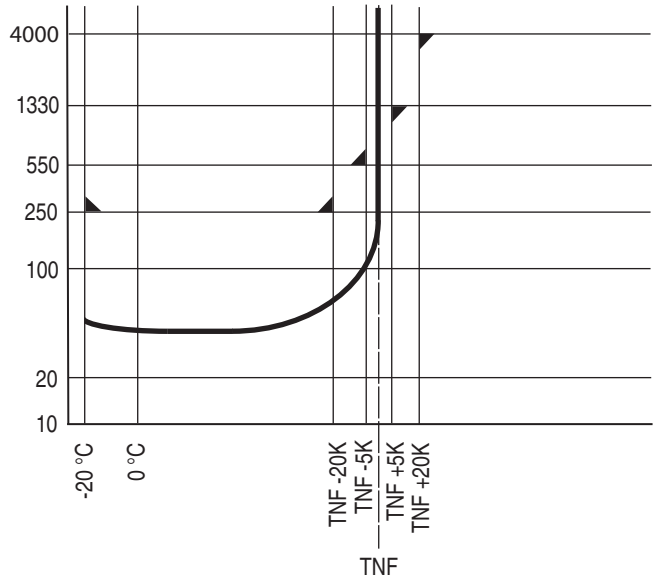
The optional 150-SM2 module lets the SMC-50 control module interface with motor PTC sensors. It is common for motor manufacturers to embed PTC thermistor sensors in motor stator windings to provide temperature monitoring of the motor windings. Because PTC thermistor sensors react to the actual motor winding temperature, enhanced motor protection can be provided to address conditions like obstructed motor cooling and high ambient temperature. Table 3 defines the required PTC thermistor input and response ratings for operation with the 150-SM2 module.

Table 3 - PTC Thermistor Input & Response Ratings

Thermistor Input	Response Ratings
Response Resistance:	3400 Ω ± 150 Ω
Reset Resistance:	1600 Ω ± 100 Ω
Short-circuit Trip Resistance:	25 Ω ± 10 Ω
Maximum Voltage at PTC Terminals: (RPTC = 4 K ohms):	< 7.5V
Maximum Voltage at PTC Terminals: (RPTC = open):	30V
Maximum Number of Sensors Connected in Series:	6
Maximum Cold Resistance of PTC Sensor Chain:	1500 Ω
Response Time:	800 ms

Figure 17 shows the required PTC sensor characteristics for operation with the 150-SM2 Option Module, per IEC-34-11-2.

Figure 17 - PTC Sensor Characteristics per IEC-34-11-2



Open Gate

An open-gate fault indicates that improper SCR firing, typically caused by an open SCR gate or driver system, has been detected on one of the power poles. Before the controller shuts down, it will attempt to start the motor a total of three times (or as programmed in Parameter 133).

An open gate is detected when the module sends a gate signal to the SCRs but does not detect that they turned on. SCR turn-on is detected when the voltage across the leg (L-T) collapses. The Open Gate detection is active during starting or stopping only.

Line Faults with Phase Indication

The SMC-50 control module continually monitors line conditions for abnormal factors. Pre-start protection includes:

- Line Fault (with phase indication)
  - Line voltage loss
  - Missing load connection
  - Shorted SCR

Running protection includes:

- Line Fault (no phase indication)
  - Line voltage loss
  - Missing load connection

Phase reversal protection[3] can be toggled either ON or OFF.

The SMC-50 control module can individually identify and provide a Fault and or Alarm if a power line loss occurs on any phase.

Phase A, B, or C loss = Fault Code 1, 2, or 3 respectively. There are no line loss Fault Parameters to configure.

The Line Loss Fault is enabled or disabled using the Line Loss bit in the Starter Fault Enable, Parameter 136. In addition, a Line Loss Alarm can be enabled or disabled using the Line Loss bit in the Starter Alarm Enable, Parameter 137.

If Line Loss is disabled, consider enabling the Undervoltage Fault to limit potential motor damage caused by phase loss.

Excessive Starts/Hour

The SMC-50 module allows the user to program the desired number of starts per hour (up to 99). This helps eliminate motor stress caused by repeated starting over a short time period.

Refer to Appendix B for duty cycles of the controller highlighting recommended starts per hour.

Overtemperature

The power module temperature is monitored during starting and stopping maneuvers by thermistors. The thermistor is connected to the gate driver board where it is processed, and the status is transmitted by fiber-optic cable through the interface board to the control module. When an overtemperature condition exists (>85 °C), the control module trips and indicates a “PTC Power Pole” fault.

(3) Phase reversal protection is functional only at pre-start.

An overtemperature condition could indicate high ambient temperature, overloading or excessive cycling. After the power module temperature is reduced to allowable levels, the fault can be cleared (see Troubleshooting on page 139 for instructions).

Overcurrent Protection

This feature provides protection to the controller from high level of current during starting and stopping. The trip level is hard-coded to be 9 times of the controller's rated current and this protection cannot be disabled. Also, SMC provides user-adjustable overcurrent trip level through Parameter 351 (800% to 1000% of motor FLC). This user-adjustable overcurrent trip can be enabled or disabled through Par 230 overcurrent bit.

Total Harmonic Distortion (THD) Fault and Alarm

Power Quality THDV (Fault Code 55) and Power Quality THDI (Fault Code 56)—Fault and Alarm

The SMC-50 control module lets you read power line THD which is the average of 32 line frequency harmonics. The calculation for THDI and THDV (THD_x) is:

$$THD_x = \sqrt{\frac{(THD^2_2 + THD^2_3 \ldots THD^2_{31})}{THD_1}}$$

Excessive THD indicates a problem in the power source and/or the application. This can have an adverse effect on the performance of the overall system. THD Fault and Alarm parameters are available for both voltage THDV and current THD I. A Fault and Alarm delay time and a level are also available to configure each of these parameters.

Table 4 - THD Parameter List

Parameter Number	Parameter Name(1)	Minimum/Maximum Value	Default Value	Access	Units
118	THD V F Lvl	0.0...1000.0	1000.0	R/W	%
119	THD V F Dly	0.1...99.0	0.1		SECS
120	THD V A Lvl	0.0...1000.0	1000.0		%
121	THD V A Dly	0.1...99.0	0.1		SECS
122	THD I F Lvl	0.0...1000.0	1000.0		%
123	THD I F Dly	0.1...99.0	0.1		SECS
124	THD I A Lvl	0.0...1000.0	1000.0		%
125	THD I A Dly	0.1...99.0	0.1		SECS

(1) As displayed on the HIM or Connected Components Workbench configuration tools.

Metering

Metering System

Power and operational monitoring parameters include:

- Current—The RMS current value is provided for each phase, plus the average current of all three.
- Voltage—The RMS line-to-line and line-to-neutral voltage values are provided while the motor is running and when stopped. The average of all three is also provided.
- Line Frequency—The SMC-50 control module measures and provides user access to the line frequency (Hz).
- Power—Real, reactive, and apparent power values are calculated for each phase plus the total for all 3 phases. In addition, the current power demand and the maximum power demand is provided.
- Power Factor—The value of the power factor is provided for each phase and as a total of all three.
- Peak Starting Current—The SMC-50 control module stores the peak average RMS motor current consumed for the last 5 start cycles.
- Total Harmonic Distortion (THD)—The SMC-50 control module calculates and provides user access to the THD for the 3 line voltages and 3 motor currents, along with the average value of each.
- Voltage Unbalance—The calculation of the voltage unbalance signal is provided.
- Current Imbalance—The calculation of the current imbalance signal is provided.
- Motor Torque—Electromechanical motor torque is calculated based on current and voltage feedback from the motor.
- Motor Speed—The SMC-50 control module provides a calculated estimate of motor speed in percent of full speed when operating in the linear speed acceleration starting or deceleration stopping mode.
- Elapsed Time and Elapsed Time 2—An elapsed time meter is provided to account for the total accumulated hours the motor has been running. You can reset the meter. Elapsed Time 2 cannot be user reset and holds after 50,000 hours have elapsed.
- Running Time—The running time meter accumulates time (in hours) from the point the motor start command is given up to the point the motor stop command is issued. When a new start command is given, the meter resets to zero and begins accumulating time again.
- Actual Start Time—The unit stores the actual time it takes to complete a start cycle (motor start command issued until motor is up-to speed). The last five start times are stored as parameters for user access and in the Alarm Buffer as events.
- Total Starts—The total starts counter increments on every successful start (no prestart fault occurred) and cannot be reset. The maximum value is 65,635.

For the torque parameter to display correctly, the motor value for Rated Torque, Parameter 47, and Rated Speed, Parameter 48, must be correctly configured.

The Motor Speed meter parameter is only valid when using the Linear Speed Starting or Linear Speed Stopping modes. It provides the estimated motor speed during either the starting or stopping maneuver. When the SMC-50 control module is not in these modes, the Motor Speed meter parameter reads zero except when the unit is at speed. In this case, the parameter displays 100%.

The Elapsed Time meter value is updated every 10 minutes and stored at power down (accurate to 1/6 of an hour). The Elapsed Time meter accumulates to 50,000 hours of operation and can be reset to zero via the Meter Reset parameter.

Motor thermal capacity usage is determined by the built-in electronic thermal overload. An overload fault occurs when this value reaches 100%.

Inputs and Outputs

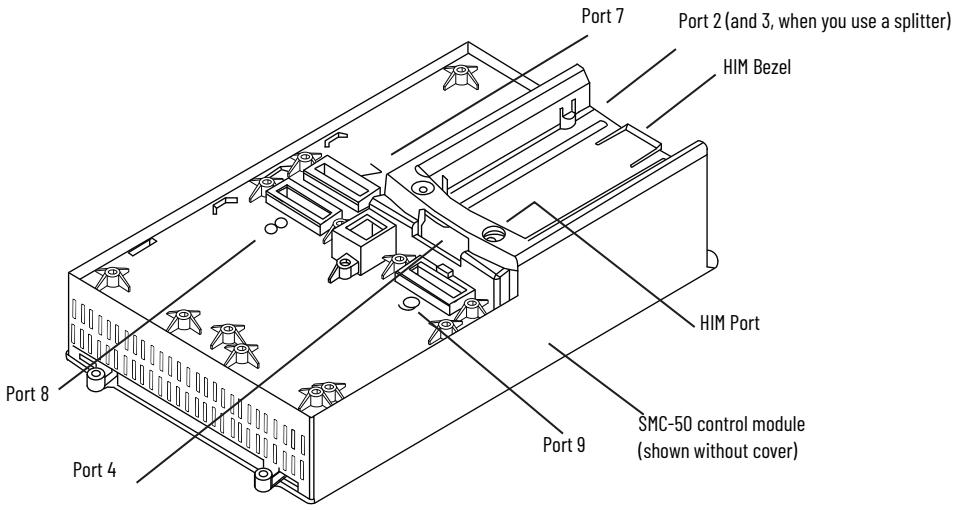
The SMC-50 control module has the ability to accept up to two (2) inputs and two (2) outputs controlled over a network. The two inputs are +24V DC rated (Input #1, terminal 11 and Input #2, terminal 10). Input #1 is used for the Emergency Run function. Input #2 is available and a contact could be inserted between terminal 12 and terminal 10 to realize certain function as expected. For these two inputs, see Chapter 4 for the parameter settings and Chapter 7 for bit identification.

The two outputs are Aux #1 and Aux #2. Aux #1 is programed to be 'Ext. Bypass' Aux #2 is programmed to be 'Normal' all the time.

For MV applications, refer to Status Indication on page 36 for additional details. I/O used for the start and stop command are from the 150-SM4 option module.

Communication Interface

Figure 18 - SMC-50 Controller Control Module—Shown without Cover



Device Peripheral Interface (DPI) Protocol

The SMC-50 soft starter communicates in the same manner as the drive products using the DPI protocol. This enables almost any DPI-supported Human Interface Module (HIM), PC software (such as Connected Components Workbench™ software), or network communications module (20-COMM-xx) to be used with the SMC-50 control module. The SMC-50 module supports four DPI ports for communication devices. Port #1 is located in the module bezel for the front-mounted HIM. Port #2, located on the top of the module, supports a second and third device via Port #3 when a DPI splitter is used. Port #4, located directly below the module bezel, is dedicated to a 20-COMM-xx network communications module when inserted into the space alloted for module option Port #9. All four communication ports can be used simultaneously.

DeviceLogix

DeviceLogix is an embedded control technology in selected Allen-Bradley® products that can control outputs and manage status information on board a device. The SMC-50 control module with DeviceLogix technology can help improve system performance and productivity by controlling outputs and managing status and information within the SMC-50 module. Processing information within the controller can speed up reaction time, which reduces dependency on network throughput and provides an option for decision making if communication with the main control module is lost.

Programming

Figure 19 shows how to connect a HIM and DPI device to the SMC-50 control module. Table 5 provides a description of each port.

The SMC-50 control module only supports the use of DPI communication modules and DPI 20-HIM-A6 Modules.

See the control wiring diagram that enables start-stop control from a HIM.

Figure 19 - SMC-50 Control Module with a HIM

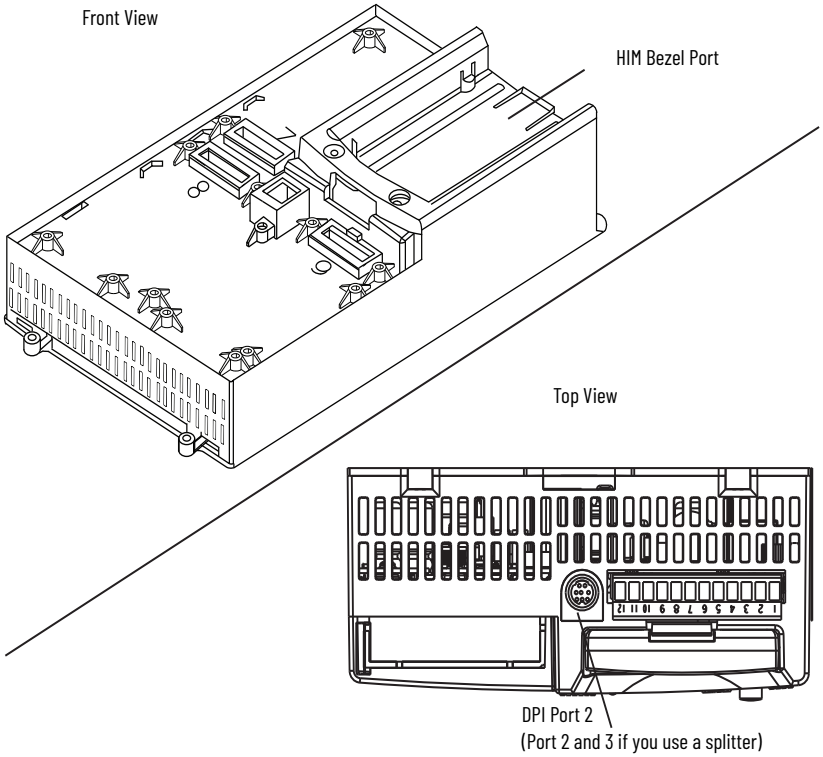


Table 5 - Description of Ports

DPI Port Number	Source
1	Front-Mounted HIM (HIM Bezel)
2	Remote DPI (top of SMC-50 control module)
3	Remote DPI (top of SMC-50 control module with splitter)
4(1)	20-COMM-x Module

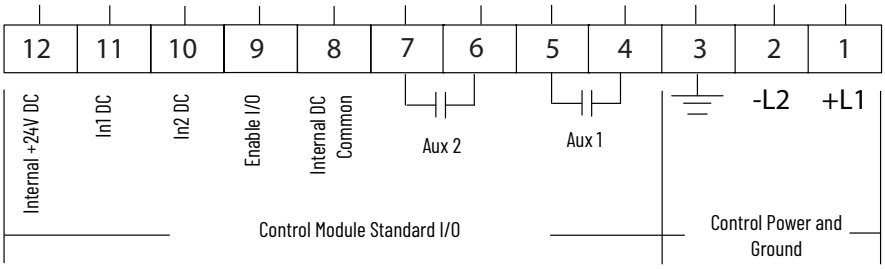
(1) When using a 20-COMM-x network communication module, it must physically be located in control module hardware port 9. However, its DPI Port Number assignment is 4. The cable connection for the DPI Port 4 is located below the HIM bezel (see Figure 19).

Status Indication

All auxiliary contacts can be programmed as NO or NC. The contact without a suffix indicates a NO state (Normal). A contact followed by NC indicates a normally closed state (Normal NC).

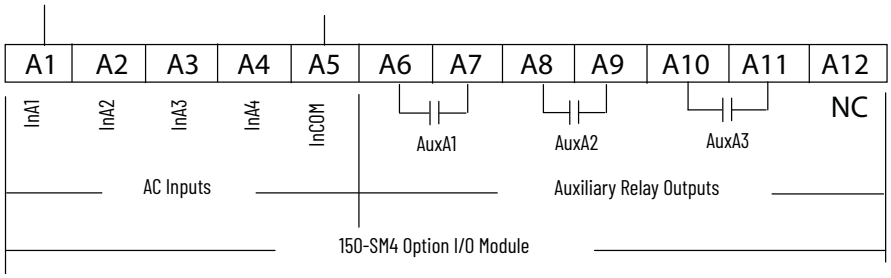
State	Description
Normal/Normal NC	The contact state changes when the unit receives a Start/Stop signal.
Up-to-Speed/Up-to-Speed NC	The contact state changes when the motor approaches rated speed.
Alarm/Alarm NC	The contact state changes when an Alarm condition is detected.
Fault/Fault NC	The contact state changes when a Fault condition is detected.
Network Control/Network Control NC	The contact state is controlled over the network. (Refer to SMC-50 Control Module—Bit Identification on page 124, which describes logic command word to control auxiliary outputs).
External Bypass	This contact controls the Bypass contactor for MV applications.
External Brake	The contact state changes when the external braking command is active and opens when it is not active Aux. Control: The contact state changes when an auxiliary output is configured for Aux. Control.

Figure 20 - Control Terminals - SMC-50 Control Module



- The Aux #1 contact is always programmed for External Bypass (NO) to control the bypass contactor in MV applications.
- The Aux #2 contact is always configured as Normal (NO) to control the line contactor for MV applications.
- In1 DC is typically programmed for Emergency Run in MV Applications

Figure 21 - Control Terminals - 150-SM4 Digital I/O Card (Port 7)



- Input #A1 is typically programmed for 'Start' in MV applications.
- Input #A2 is typically programmed for 'Stop Option' in MV applications.
- Input #A3 is typically programmed for 'Coast' in MV applications.
- Aux #A1 is typically programmed for 'Fault' in MV applications.

Hardware Description

The following sections contain descriptions of system components and system operation. Each section will be described to give the user an understanding of the SMC-50 to facilitate operation and maintenance of the system. Refer to Figure 22 and Figure 23, Typical SMC-50 Power System.

Power Module

The controller consists of three power modules, one for each phase. Each power module consists of incoming and outgoing terminals for cables, SCRs, heatsink and clamp assembly. The SCRs are connected in inverse parallel (and in series for 12- or 18-SCR assemblies) to form a three-phase, AC line controller configuration.

Each power module includes a snubber circuit to limit the rate of rise in voltage across each SCR pair. The module also includes patented current loop gate driver circuits which derive their power primarily from the snubber circuit.

Voltage sharing resistors are connected across each SCR pair to provide static voltage balance for series-connected SCRs. These resistors are tapped to provide a reference for overvoltage protection circuitry on the gate driver board.

A voltage sensing board is used to reduce the line-side and load-side voltages to lower levels that can be measured by the SMC-50 control module.

Current Loop Gate Driver (CLGD) Board

This board provides the turn-on capability for SCR devices. The board also provides optical fiber isolation between itself and the gating source logic. It is primarily powered by recovering energy from the snubber circuit, so it is fully isolated from the control and logic circuits. The board also receives short-term power from the current loop power supply.

The SMC-50 has three heatsinks fitted with a thermistor to monitor temperature rise. The circuitry on the gate driver board accepts the thermistor, and drives a fiber-optic cable if the temperature is below the setpoint (85 °C). If the temperature rises above the setpoint, the driver is turned off, and the SMC-50 is signaled to stop gating and initiate a temperature fault.

Interface Board

This circuit board takes current transformer signals plus line-side and load-side voltage feedback signals from the voltage sensing board and passes them to the SMC-50 for processing. The control module produces gating signals for the SCRs, which are received on the interface board, and used to drive fiber-optic transmitters. The gating signals are sent to the gate-driver circuit board via fiber-optic cables. The interface board also receives temperature feedback from the gate-driver board via fiber-optic cable(s). If the heatsink temperature rises above a set value, a signal is sent to the SMC-50 to stop gating the SCRs and initiate a temperature fault.

For a detailed layout of this circuit board, refer to Figure 37 on page 71.

Figure 22 - Typical SMC-50 Power System • Bulletin 1562F (3300/4160V shown)

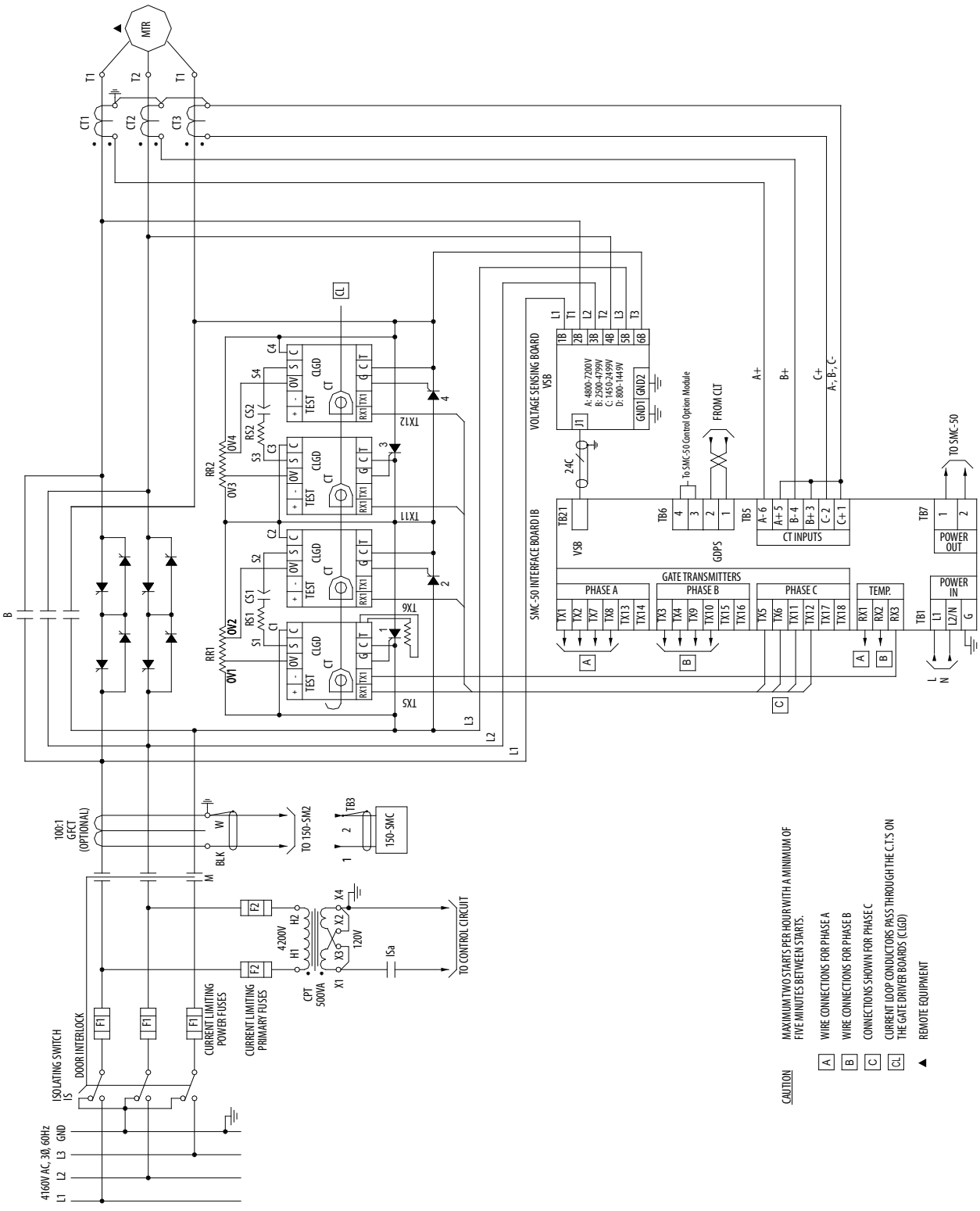
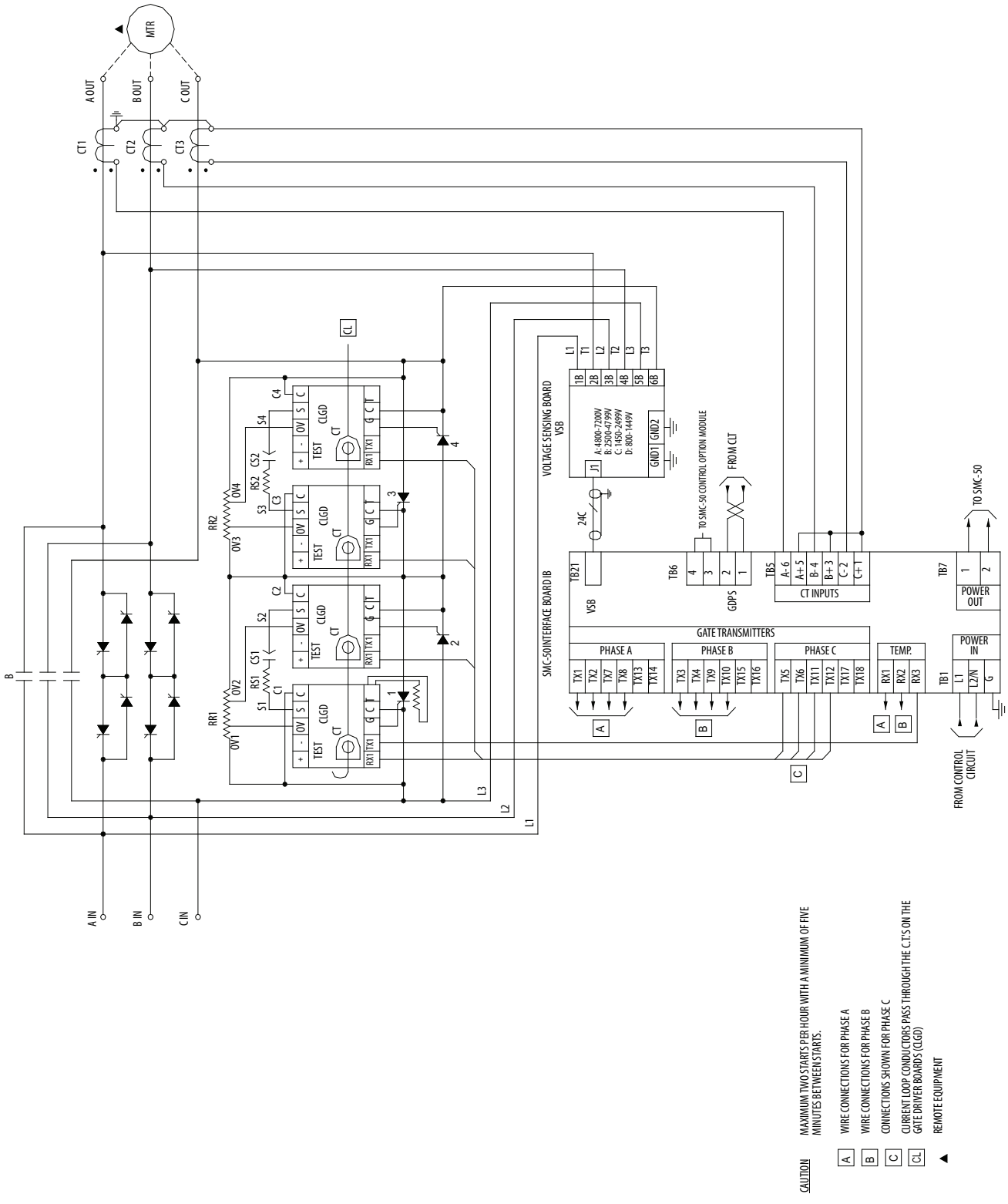


Figure 23 - Typical SMC-50 Power System • Bulletin 1560F (3300/4160V shown)



Functional Description

The following functional descriptions and associated control circuits are for units using IntelliVAC™ contactor control modules. For units with electromechanical (relay) control, refer to Appendix C.

ATTENTION: The control circuit schematics shown below assume that control power is fed from the same source as the primary circuit. If external control power is used, additional control interlocking may be required to avoid unexpected motor start-up. The control interlock should ensure that a motor start request is not inadvertently applied when the primary circuit is disconnected.

Bulletin 1562F • Standard Control

When wired as shown in Figure 24, the controller operates as follows:

Pressing the “Start” button initiates the start sequence. Relay “CR” closes and applies control power to terminal A1 of 150-SM4 Digital I/O card that is inserted in the SMC-50 module. The Aux #2 (“Normal”) closes, energizing “M-IV” and “MCX”, which completes the hold-in circuit on the start button, and closes the main contactor.

The SMC-50 module examines the line voltage, looks for fault conditions, checks phase rotation, calculates zero crossing information, and begins gating the SCRs to start the motor.

When the motor approaches rated speed, the SMC-50 module closes the “Aux #1” (Ext. Bypass) auxiliary contacts, energizing “B-IV”, which closes the bypass contactor. The motor then runs at full line voltage.

When the “Stop” button is pressed, the “CR” relay opens terminal A2 of 150-SM4 Digital I/O card that is inserted in SMC-50 module. If terminal A2 is programmed to be Coast-to-Stop, the Aux2 (Normal) contact opens, dropping out the main contactor, allowing the motor to stop. The Aux1 contact is held closed for a short time by control module. This holds the bypass contactor closed for several seconds as set in Par 192 of SMC-50 module to protect the power electronics from any voltage transients due to opening the motor circuits. If terminal A2 is programmed to be Stop Option, the SMC-50 module will initiate the option stop.

If the loss of current loop transformer assembly is detected by SMC-50 control module, then the terminal A2 will be maintained at high, and terminal A3 will be adopted to initiate the stop. In this situation, when the stop button is pressed, the CR relay opens the terminal A3 of 150-SM4 Digital I/O card inserted in SMC-50 module, Terminal A3 will be always programmed to be Coast-to-stop, so that when current loop transformer assembly doesn't work properly, the SMC-50 will only do Coast-to-Stop.

If the motor has started, the unit is in the bypass mode, and a trip occurs within the SMC-50 module or from an external protection relay; “Aux #2” will open the line contactor immediately, and “Aux #1” will remain closed for the number of programmed seconds to protect the power electronics from any voltage transients due to opening the motor circuits. A trip due to an overload or fault condition will result in a “coast” stop.

Bulletin 1562F • Programming Interface Control

The control scheme shown in Figure 25 allows the SMC-50 to be controlled using Programming Interface Control. See SMC-50 Control Module—Bit Identification on page 124 for Logic Command Word bits assignment. This interface includes provisions for a “Local” mode of control as well.

With the Local-Off-Remote selector switch in the “Remote” position, terminal A2 and A3 of the 150-SM4 DigitaL I/O card will be maintained high, and terminal A1 will open which allows a start command to be executed via the interface control. When a “Start” is executed, the “Aux #2” contact closes, energizing both “M-IV” and “MCX”. The line contactor closes and the unit initiates a start sequence. The E-Stop button still works in remote mode.

When the motor approaches rated speed, the SMC-50 module closes “Aux #1”, energizing “B-IV”, which closes the bypass contactor.

A stop command can be generated via the interface to stop the motor, depending on the stop mode.

Bulletin 1560F • Standard Control

The Bulletin 1560F is intended for addition to an existing motor controller, which provides circuit isolation, motor switching, and overload and overcurrent protection. When wired as shown in Figure 26, the controller operates as follows:

When a start is initiated in the existing motor controller and the contactor (or breaker) closes, a contact must be supplied to tell the 1560F to start also. Start and Stop are the same as Bulletin 1562F • Standard Control on page 40.

The “Fault” contact on the SMC-50 module should be wired into the existing controller to trip the main contactor (or breaker) in the event of a fault condition sensed by the SMC-50 module.

If possible, it is better to have the SMC-50 module control the main contactor directly. In this case, the control circuit would look like, and function like, the descriptions above for the Bulletin 1562F.

Bulletin 1560F • Programming Interface Control

The control scheme shown in Figure 27 allows the SMC-50 to be controlled using Programming Interface Control. See SMC-50 Control Module—Bit Identification on page 124 for Logic Command Word bits assignment. This interface includes provisions for a “Local” mode of control as well.

With the Local-Off-Remote selector switch in the “Remote” position, Start and Stop are the same as Bulletin 1562F • Programming Interface Control on page 41. A stop command can be generated via this interface or by opening “CR”, depending on the control mode.

If possible, it is better to have the SMC-50 module control the main contactor directly. In this case, the control circuit would look like, and function like, the descriptions above for the Bulletin 1562F.

Figure 24 - Typical Bulletin 1562F IntelliVAC Control Circuit

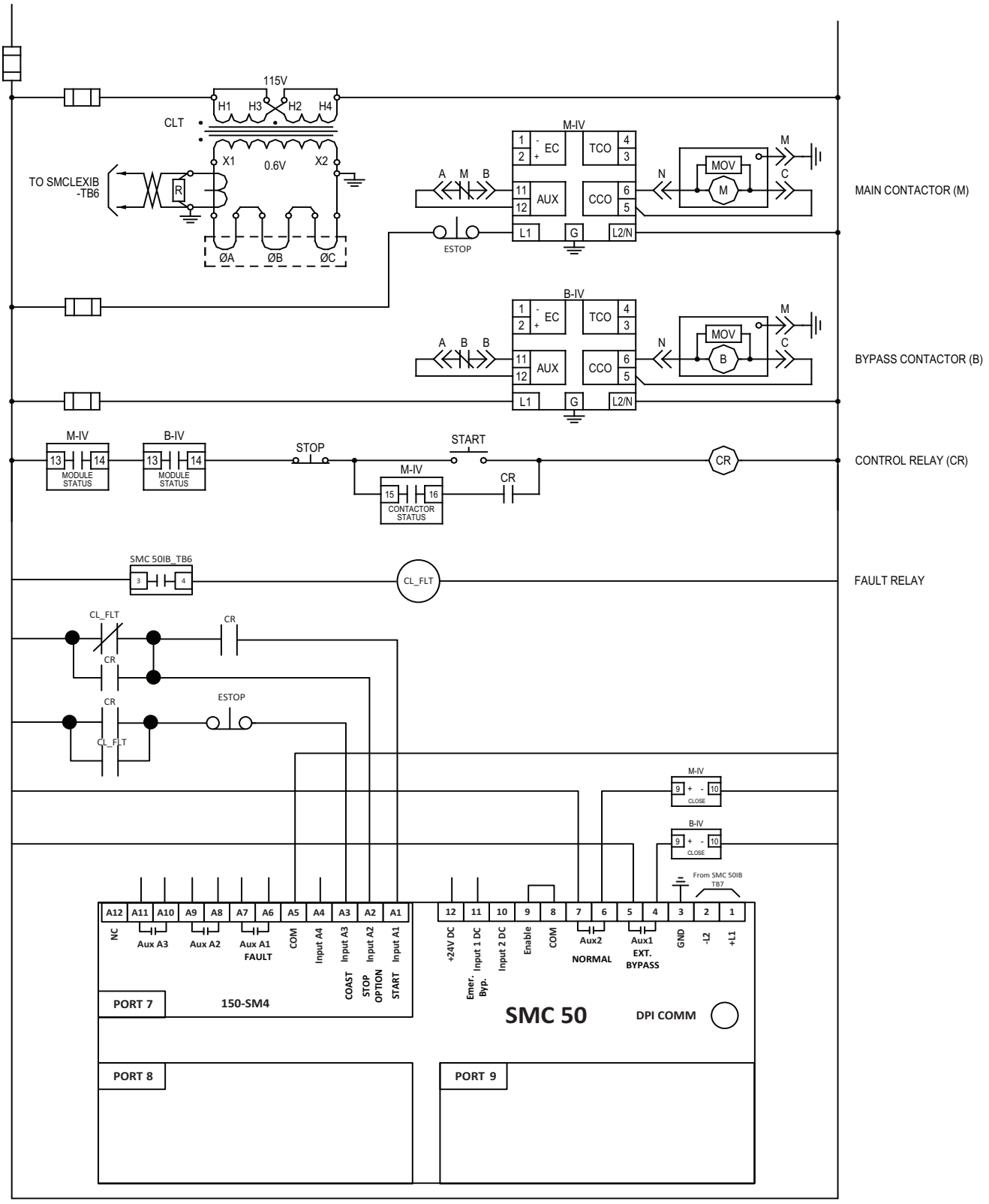


Figure 25 - Typical Bulletin 1562F IntelliVAC Control Circuit • With Communication and Optional Local/Off/Remote

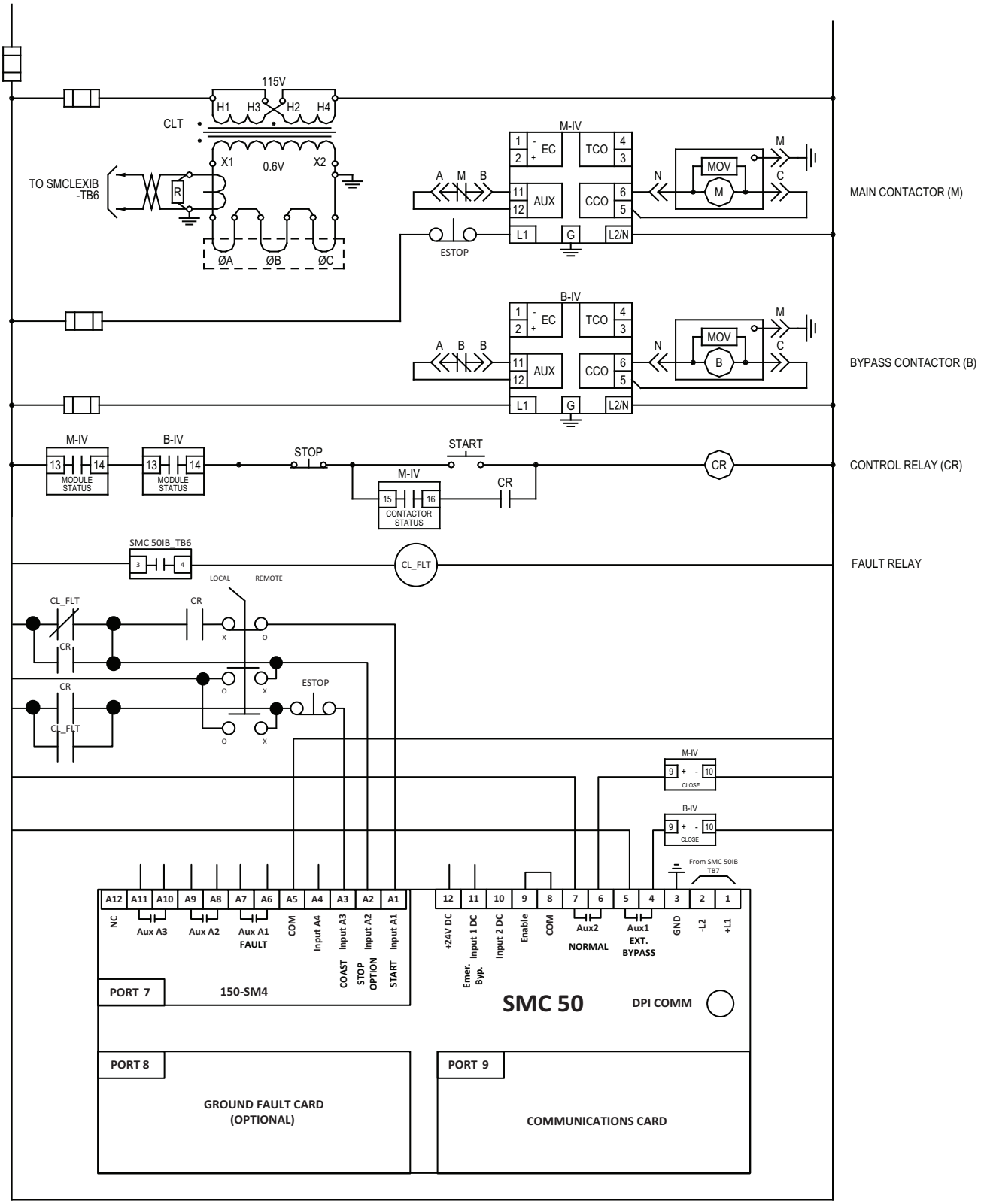
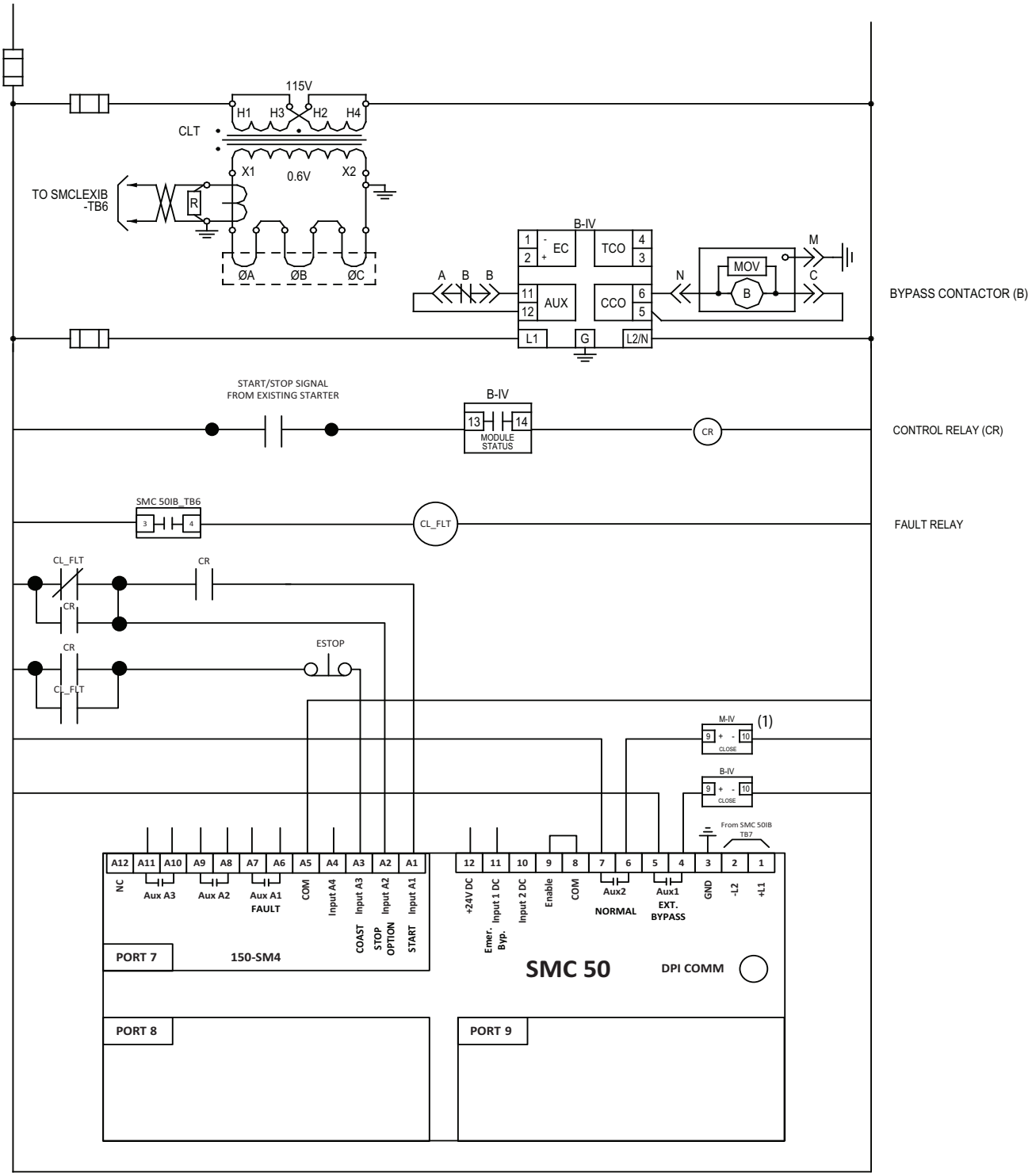
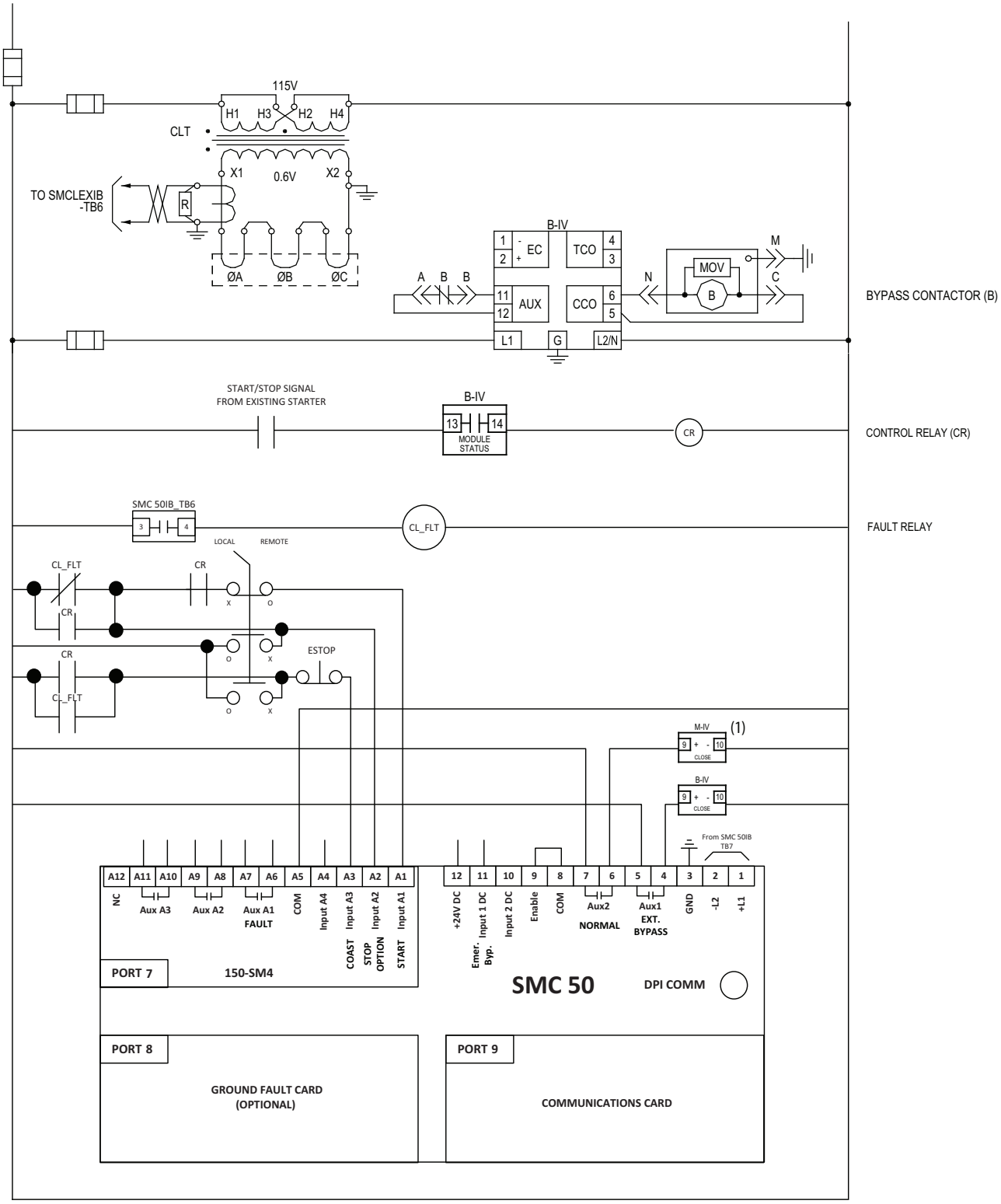


Figure 26 - Typical Bulletin 1560F IntelliVAC Control Circuit



(1) The IntelliVAC control for the main contactor.

Figure 27 - Typical Bulletin 1560F IntelliVAC Control Circuit • With Communication and Optional Local/Off/Remote



(1)The IntelliVAC control for the main contactor.

Notes:

Installation

ATTENTION: Perform the installation duties correctly. Errors may cause commissioning delays, equipment damage, or personal injury.

IMPORTANT For the 1503E, refer to applicable documentation from OEM installation, grounding, interlocking and wiring. This manual should be utilized in conjunction with the OEM supplied documentation, and is suitable for commissioning, programming, calibration, metering, serial communications, diagnostics, troubleshooting, and maintenance of a standard solid-state controller.

Receiving

It is the responsibility of the user to thoroughly inspect the equipment before accepting the shipment from the freight company. Check the item(s) received against the purchase order. If any items are damaged, it is the responsibility of the user not to accept delivery until the freight agent has noted the damage on the freight bill. Should any concealed damage be found during unpacking, it is again the responsibility of the user to notify the freight agent. The shipping container must be left intact and the freight agent should be requested to make a visual inspection of the equipment.

Safety and Codes

ATTENTION: The Canadian Electrical Code (CEC), National Electrical Code (NEC), or other local codes outline provisions for safely installing electrical equipment. Installation MUST comply with specifications regarding wire type, conductor sizes, branch circuit protection, interlocking and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Unpacking and Inspection

After unpacking the material, check the item(s) received against the bill of lading to ensure that the nameplate description of each item agrees with the material ordered. Inspect the equipment for physical damage, as stated in the Rockwell Automation Conditions of Sale.

Remove all packing material, wedges, or braces from within the controller. Operate the contactors and relays manually to ensure that they operate freely. Store the equipment in a clean, dry place if it will not be installed immediately after unpacking. The storage temperature must be between -20...75 °C (-4...167 °F) with a maximum humidity of 95%, non-condensing, to guard against damage to temperature sensitive components in the controller.

General Precautions

In addition to the precautions listed throughout this manual, the following statements, which are general to the system, must be read and understood.

ATTENTION: The controller contains ESD (electrostatic discharge) sensitive parts and assemblies. Static control precautions are required when installing testing, servicing, or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to applicable ESD protection handbooks.

ATTENTION: An incorrectly applied or installed controller can damage components or reduce product life. Wiring or application errors, such as undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures, may result in malfunction of the system.

ATTENTION: Only personnel familiar with the controller and associated machinery should plan or implement the installation, start-up, and subsequent maintenance of the system. Failure to do this may result in personal injury and/or equipment damage.

Transportation and Handling

The controller must be transported on a pallet or via use of the lifting angles supplied as part of all 2.3 m (90 in.) high cabinets or frame units.

ATTENTION: Ensure that the load rating of the lifting device is sufficient to safely raise the controller sections. Failure to do so may result in severe injury and/or equipment damage. Refer to the packing slip enclosed with shipment for shipping weights.

Round rollers can be used to assist in moving the controller to the installation site. Once at the final site, the pipe rolling technique can be used to place the cabinet in the desired position.

ATTENTION: Care must be exercised when using either a forklift, or the pipe rolling technique, for positioning purposes to ensure that the equipment is not scratched, dented or damaged in any manner. Always exercise care to stabilize the controller during handling to guard against tipping and injury to personnel.

Installation Site

Consider the following when selecting the installation site:

A. The operating ambient temperature should be between 0...40 °C (32...104 °F) for NEMA Type 1 or 12 and arc resistant enclosures. For higher ambient conditions, please consult Rockwell Automation factory.

B. The relative humidity must not exceed 95%, non-condensing. Excessive humidity can cause electrical problems from corrosion or excessive dirt buildup.

C. The equipment must be kept clean. Dust buildup inside the enclosure inhibits proper cooling and decreases the system reliability. The equipment should not be located where liquid or solid contaminants can drop onto it. Controllers with ventilated enclosures must be in a room free of airborne contaminants.

D. Only persons familiar with the function of the controller should have access to it.

E. The losses in the controller produce a definite heat dissipation, depending on the unit size, that tends to warm the air in the room. Attention must be given to the room ventilation and cooling requirements to ensure that the proper environmental conditions are met.

F. Operational altitude is 1 km (3300 ft) maximum without derating. Higher altitudes may require optional components. Please consult Rockwell Automation factory.

G. The area of the controller should be free of radio frequency interference such as encountered with some welding units. This may cause erroneous fault conditions and shut down the system.

ATTENTION: An incorrectly applied or installed controller can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or ambient temperatures above or below the specified temperature range may result in malfunction of the controller.

Mounting

The 1503E, 1560F and 1562F are designed to be mounted in the vertical position. Standard cabinet drawings with certified dimension drawings can be obtained by contacting your local Rockwell Automation Sales office for the 1560F/1562F. Please refer to OEM documentation for the 1503E. Refer to the drawings supplied with your order for mounting locations.

Joining hardware can be found in a package mounted on the front of the shipping skid.

See publication MV-QS050 for level floor surface requirements.

Grounding Practices

The purpose of grounding is to:

A. Provide safety for personnel.

B. Limit dangerous voltages to ground on exposed parts.

C. Facilitate proper overcurrent device operation under ground fault conditions.

D. Provide for electrical interference suppression.

IMPORTANT Generally, grounding should be in accordance with the Canadian Electrical Code (CEC) or National Electrical Code (NEC) and other local codes.

Each power feeder from the substation transformer to the controller must be equipped with properly sized ground cables. Simply utilizing the conduit or cable armor as a ground is not adequate. The conduit or cable armor and ground wires should be bonded to ground at both ends. Each enclosure and/or frame must be bonded to ground at a minimum of two locations.

Each AC motor frame must be bonded to grounded building steel within 6.1 m (20 ft) of its location and tied to the controller's ground bus by ground wires within the power cables and/or conduit. The conduit or cable armor should be bonded to ground at both ends.

ATTENTION: Any instruments used for test or troubleshooting should have their case connected to ground for safety. Failure to do so may result in damage to equipment or personal injury.

Recommended Torque Values

When reinstalling components or when reassembling the cabinet, tighten the following bolt sizes to the specified torque values:

Table 6 -

Hardware	Recommended Torque
1/4 in. (M6)	8 N•m (6 lb•ft)
5/16 in. (M8)	15 N•m (11 lb•ft)
3/8 in. (M10)	27 N•m (20 lb•ft)
1/2 in. (M12)	65 N•m (48 lb•ft)
Control Wire Terminals	2.5...4.0 N•m (2.0...3.3 lb•in)
CLGD Power Assembly Terminals	5.6 N•m (50 lb•in)
SMC-50 Control Module Terminals	0.6 N•m (5 lb•in)

For 3/8 in. hardware in the "T"-slots of aluminum heatsinks, the recommended torque is 22 N•m (16 lb•ft). Do not overtorque these connections as the slots will be damaged and the connection will be compromised.

Recommended Line and Load Cable Sizes

Table 7 - Recommended Maximum Line and Load Cable Sizes

	Standard Cabinet	Arc Resistant Cabinet[1]
Line cables	(2) 500 MCM or (1) 750 MCM per phase	(1) 500 MCM or (2) 4/0 per phase
Load cables	(1) 500 MCM or (2) 250 MCM per phase	(2) 500 MCM or (2) 250 MCM per phase

(1) Only available for 180 A and 360 A ratings.

Power Connections

The controller requires a three-phase supply and an equipment grounding conductor to earth ground. A neutral conductor of the three-phase supply is not necessary and is usually not routed to the controller. Three-phase wiring will connect the controller to the motor.

Bulletin 1562F

The Bulletin 1562F unit is available in two main configurations:

1. A modified two-high cabinet (180/360 A, 2400...4160V)
2. A combination of a one-high full voltage non-reversing (FVNR) cabinet and a 1560F unit (600 A, 2400...4160V, and 180/360/600 A, 5500...6900V)

To make power connections for a two-high cabinet, refer to Figure 28 to Figure 30, and publication 1500-UM055 (Chapter 2).

ATTENTION: Bulletin 1562F units provided with an arc resistant enclosure must be installed in accordance with instructions in publication 1500-UM055. See publication MV-QS050 for level floor surface requirements. Failure to do so may result in damage to equipment or personal injury.

To make power connections for a one-high FVNR cabinet and a 1560F unit, proceed as follows:

- Make line connections within the one-high cabinet
- Make load connections at the primary load current transformer terminals

Bulletin 1560F

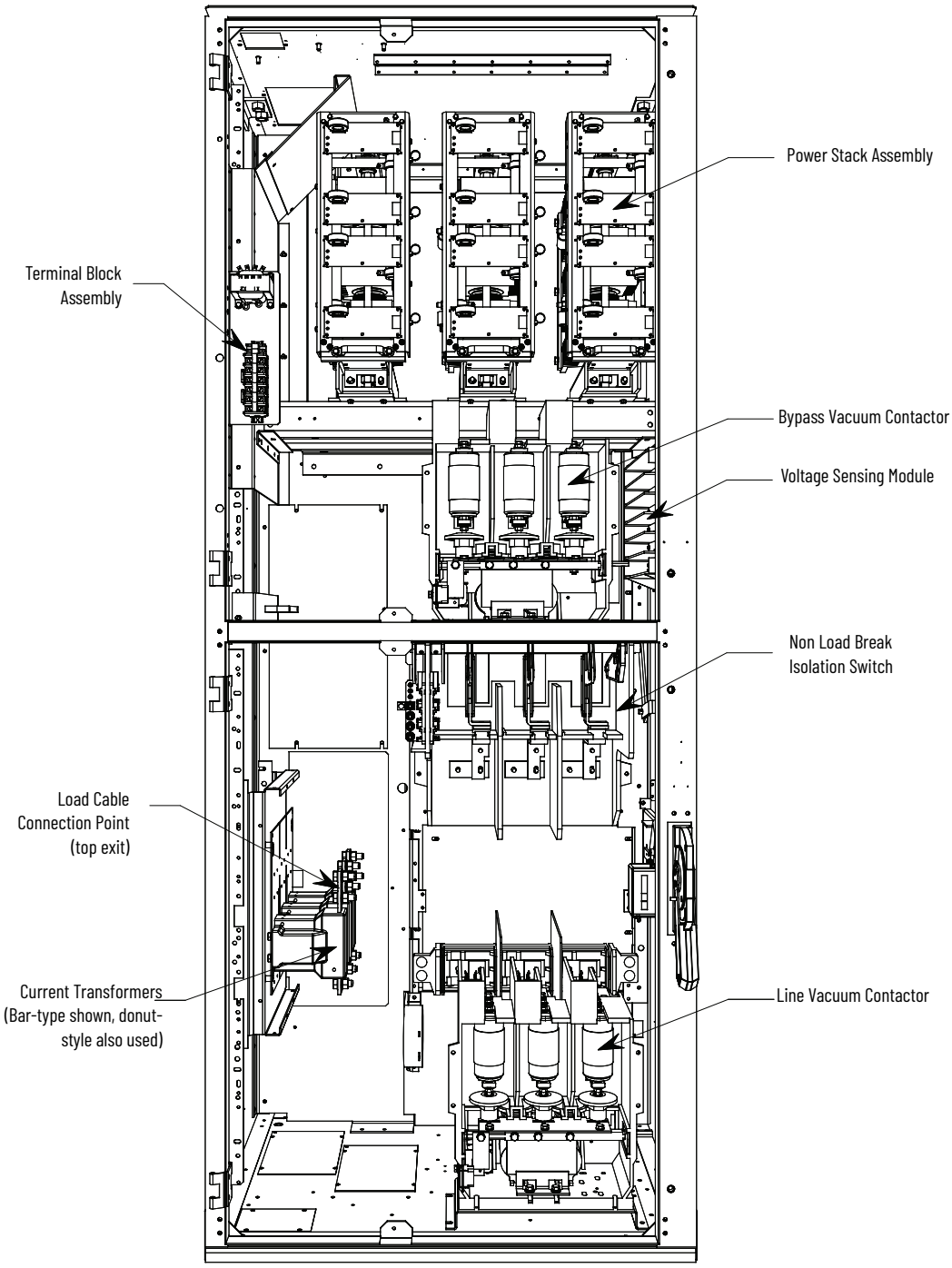
Refer to Figure 31 to Figure 33 to make power connection for a 1560F unit (depending on the rating of the unit).

- Make line connections to the line connection terminals
- Make load connections to the current transformer terminals

The CT assembly can be oriented to allow either top or bottom load cable exit.

Bulletin 1562F

Figure 28 - Cabinet Layout • 1562F – 180/360A, 2400V to 4160V (with LV panels not shown) (Non arc-resistant cabinet shown)(1)



(1) 6900V, arc resistant, and 600 A models available.

Figure 29 - Incoming Line Cable Connections (Rear View with Cover Removed) (Non Arc-resistant Cabinet)

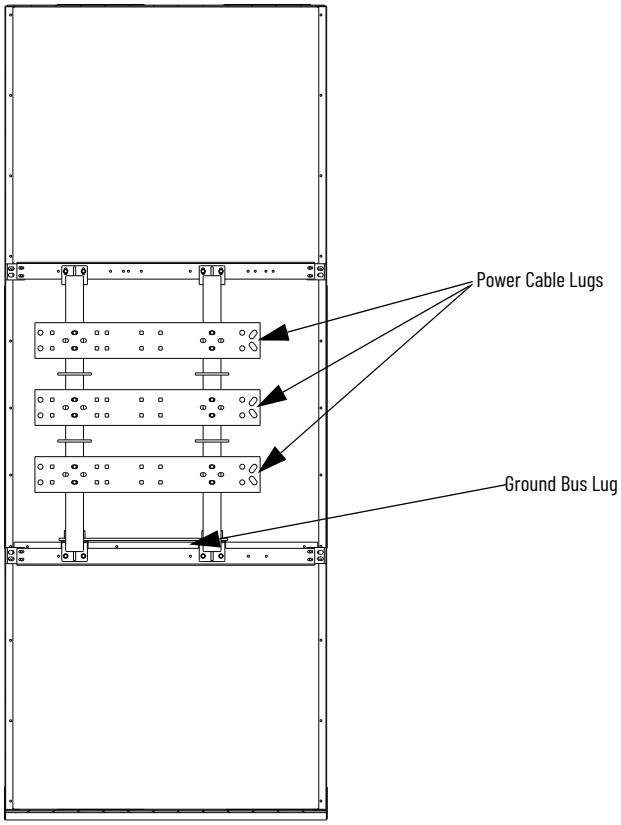
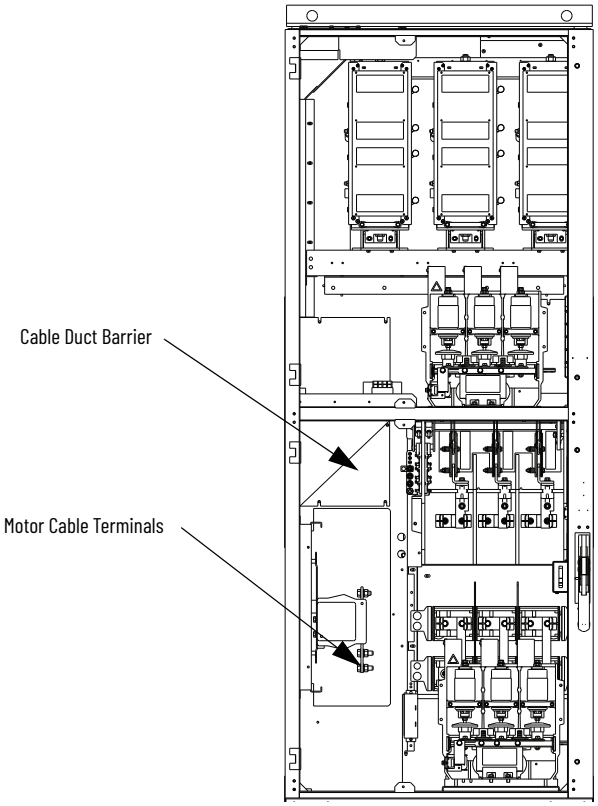


Figure 30 - Bottom Cable Exit Configuration (LV Panel Open to the left) (Non Arc-resistant Cabinet)



Bulletin 1560F

Figure 31 - Power Connections • 1560F – 180/360A, 2400...4160V (Not available in an Arc-resistant design)

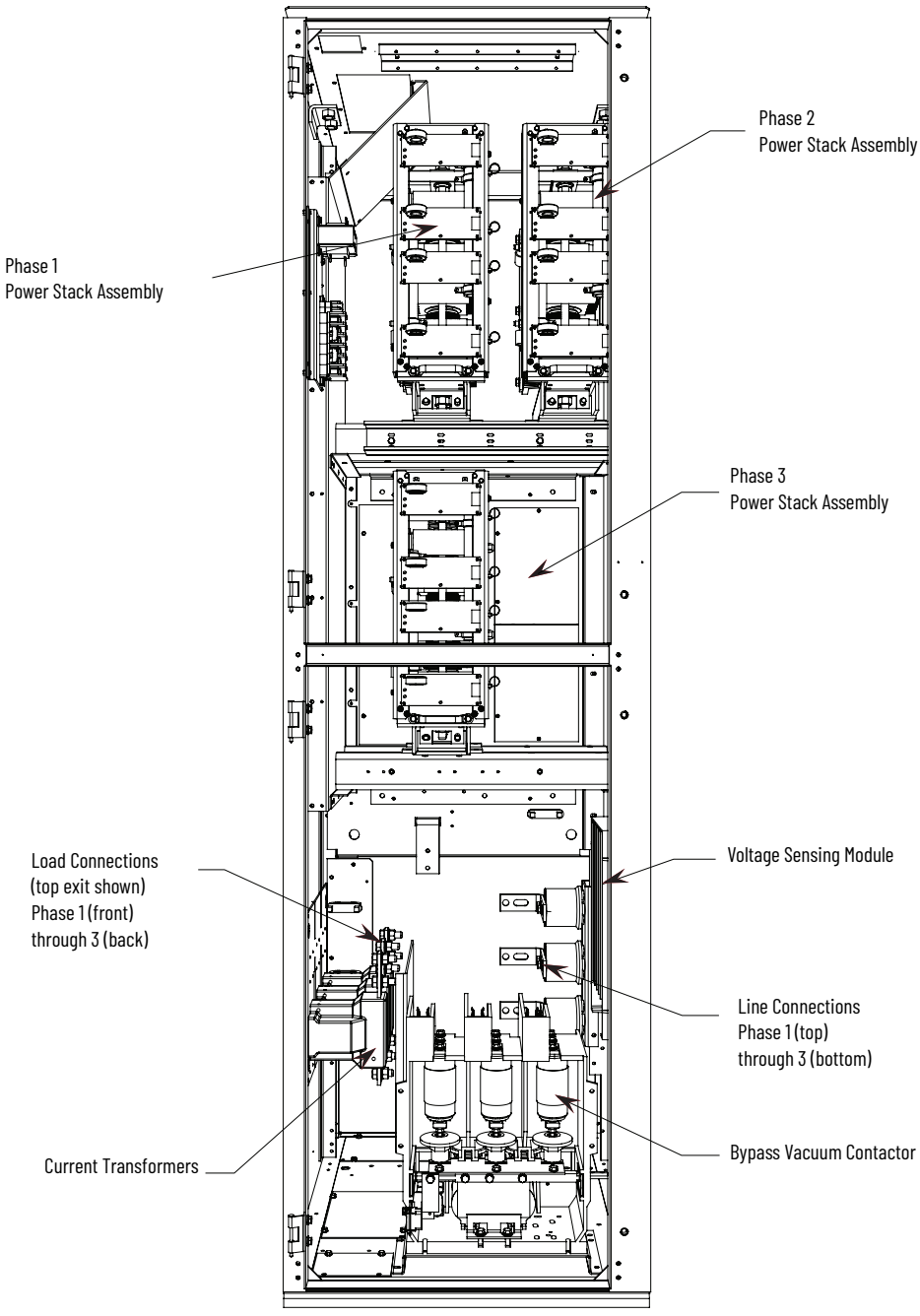


Figure 32 - Power Connections • 1560F – 180/360A, 5500...6900V (Not available in an Arc-resistant design)

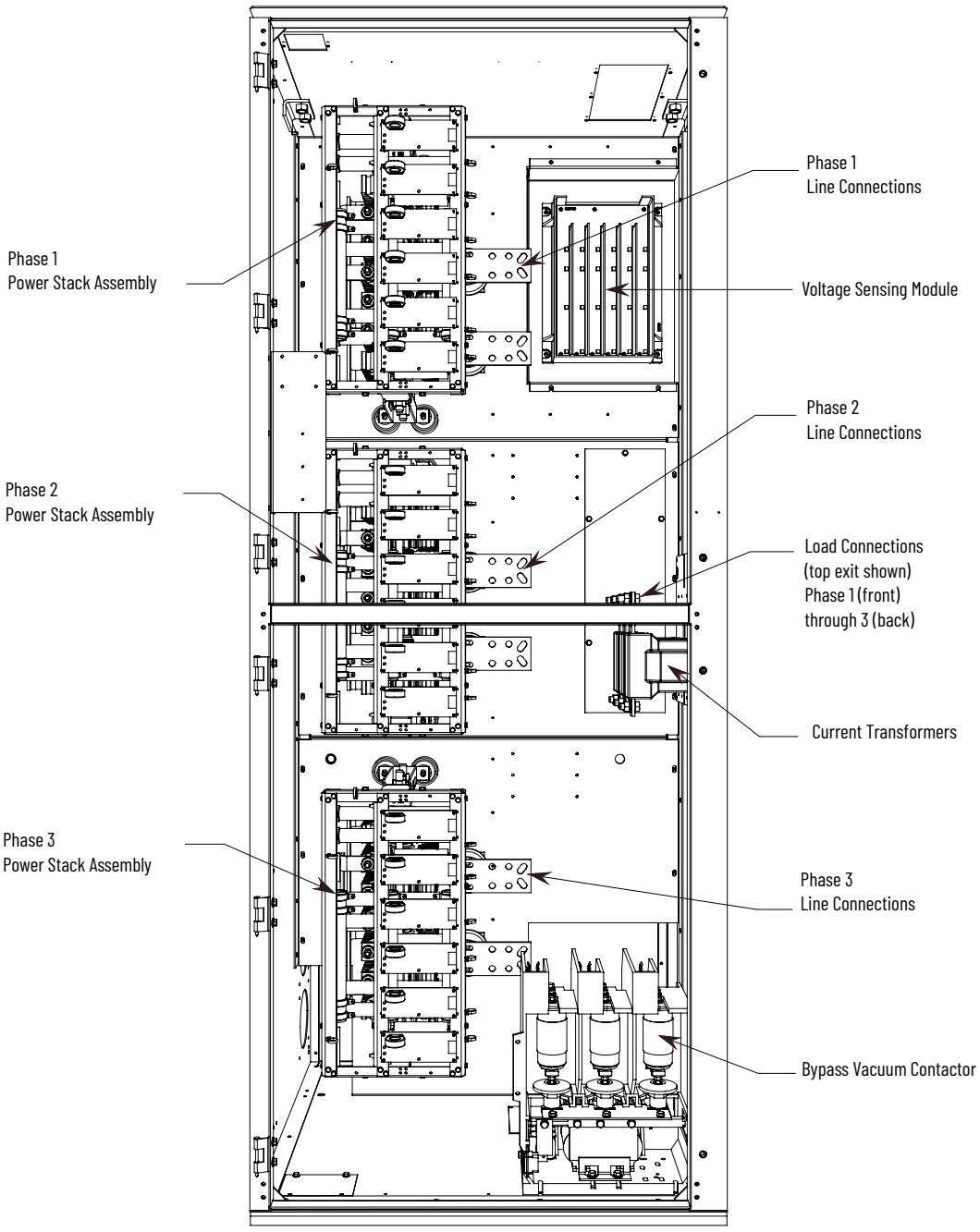
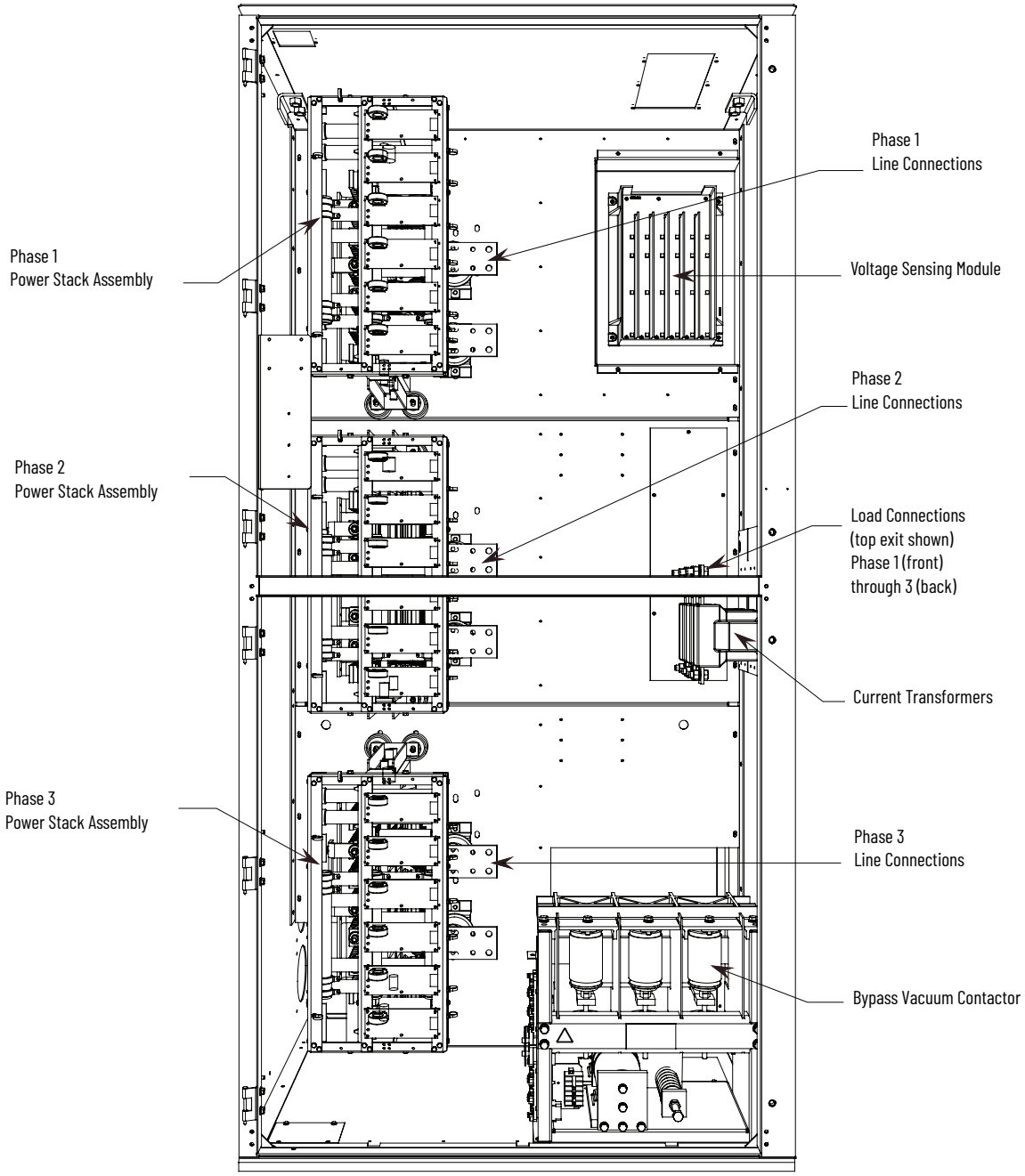


Figure 33 - Power Connections • 1560F – 600A, 2400...6900V (Not available in an Arc-resistant design)



IMPORTANT For retrofit units (Bulletin 1560F), the CEC and NEC require that branch-circuit protection of the AC line input to the controller be provided by a circuit breaker or motor starter. This function is included with a Bulletin 1562F controller.

IMPORTANT The control and signal wires should be positioned at least six (6) inches (150 mm) from medium voltage power cables. Additional noise suppression practices (including separate steel conduits for signal leads, etc.) are recommended.

Bulletin 1503E

For 1503E, refer to applicable documentation from the OEM for installation, grounding, interlocking and wiring. This manual should be utilized in conjunction with the OEM supplied documentation, and is suitable for commissioning, programming, calibration, metering, serial communications, diagnostics, troubleshooting and maintenance of a standard solid-state controller.

Line and Load Power Wiring

The wire sizes must be selected individually, observing all applicable safety and CEC or NEC regulations. The minimum permissible wire size does not necessarily result in the best operating economy. The minimum recommended size for the wires between the controller and the motor is the same as that used if a main voltage source connection to the motor was used. The distance between the controller and motor may affect the size of the conductors used.

Consult the wiring diagrams and appropriate CEC or NEC regulations to determine correct power wiring. If assistance is needed, contact your area Rockwell Automation Sales Office.

Interlocking

Hinged doors and panels, which provide access to medium voltage components, must be mechanically interlocked to ensure circuit isolation. If a combination SMC™-50 (1562F) is purchased from Rockwell Automation, all medium voltage compartments will be mechanically interlocked such that they cannot be opened unless the isolating switch for the unit is open. Each medium voltage door is interlocked to the isolating switch handle. To open the doors, move the isolating switch to the OFF position and loosen the two retaining bolts on the main power cell door. Once this door is open, the other doors may be opened in sequence, depending on the specific interlock scheme provided. The retrofit-type SMC-50 (1560F) is intended to be added to an existing motor controller, and has no isolating means included.

ATTENTION: For 1503E and 1560F, it is the responsibility of the installer/user to ensure the equipment interlocking scheme is in place and functional before energizing the equipment. Inadequate interlocking could expose personnel to energized parts which could result in severe burns, injury or death.

Rockwell Automation can assist with the selection of an appropriate interlocking method, which may include mechanical modifications to the cabinet(s) or key-type lock systems.

An auxiliary cabinet may be attached to the main structure. It will be ram-interlocked with the main power cell door, which will not allow it to be opened until the main power cell door is opened.

Installation

Physical Location

The controller is designed for limited front access (components may have to be removed) and should be installed with adequate and safe clearance to allow for total door opening. The back of the unit may be placed against a wall and several units may be set end to end. In special cases where floor space is limited and the unit is not against a wall, certain cabinet sections may be placed back to back. This requirement must be stated in the specifications in order to mechanically alter the controller.

Ground Bus Bar

Controllers which are delivered in two (or more) sections, or retrofit controllers, will require that the ground bus bar (10 x 51 mm) [0.375 x 2 in.], which runs the entire length of the equipment in the center back side, be reconnected. A mechanical lug for #8-#10 AWG or #6-250 MCM cable is supplied at the incoming end of the line-up. When the sections are brought together, bus links are used to connect the bus bars.

IMPORTANT Refer to 2-high, Series B drawings in Publication 1500-UM055 for power/ground bus connection.

Power and Control Wiring

Controllers consisting of two or more sections will require that the power and control wiring be connected per the schematic drawings provided.

Control Cables

Control cable entry/exit should be located near the terminal blocks; customer's connections are to be routed along the empty side of the terminals. Nylon cable tie loops are provided at the left, front corner of the cabinet to route control cables safely behind the low voltage panel hinges. Cables should be routed so they do not interfere with the swing of the low-voltage panels.

Fiber-Optic Cables

The small, gray (or black) fiber-optic cables are fragile and must be protected during installation from sharp bends and impact.

Power Factor Correction Capacitors

The controller can be installed on a system with power factor correction capacitors. The capacitors must be located on the line side of the controller. This is required to prevent damage to the SCRs in the SMC-50 controller. A separate switching contactor is recommended to apply the capacitors only after the bypass contactor has closed, and to remove them when the bypass contactor opens. See Figure 34 for two different acceptable connection methods.

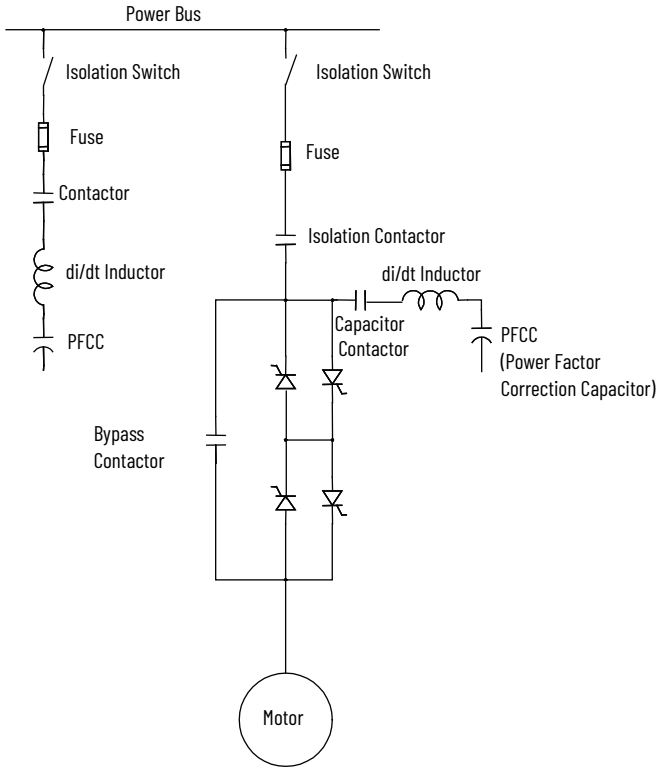
Consult the factory if there are any capacitors on the same branch circuit as the SMC-50.

When discharged, a capacitor has essentially zero impedance. For switching, sufficient impedance should be connected in series with the capacitor bank to limit the inrush current. A method of limiting the surge current is to add inductance in the capacitor circuit. This can be accomplished by putting turns or coils of wire in the power connections to the capacitors. For more information, refer to NEMA standard ICS 2, Part 2, Capacitor Applications.

Care should be used in mounting the coils so that they are not stacked directly on top of each other or they will have a cancelling effect. Also, the coils should be mounted on insulated supports away from metal parts so they will not act like induction heaters.

ATTENTION: Any covers or barriers removed during installation must be replaced and securely fastened before energizing equipment. Failure to do so may result in severe burns, injury or death.

Figure 34 - Typical One-Line Diagram
(Showing 2 Different Styles of Power Factor Capacitor Connections)



Surge Arrestor Protection Devices

Do not install motor surge capacitors and/or motor surge arresters on the load side of the SMC. The issues that warrant this are:

- Motor and system inductance limits the rate at which the current can change through the SMC. If capacitance is added at the motor, the inductance is negated. The surge capacitors downstream of the SMC represent a near zero impedance when presented with a step voltage from the turn on of the SCRs near the line voltage peak. This causes a high level of di/dt to occur, due to the fact that the motor cables are generally short in length. There is very little impedance between the capacitor and SCR to limit the di/dt of this capacitor charging current. This can result in damage to the power semiconductors (SCRs) in the SMC.

- It is essential to understand the clamping voltage of the arresters and type of grounding used in the distribution system. The switching of the SCRs generates slightly higher than nominal peak line to ground voltages. The typical peaks are 1.5 times the nominal line to ground peak voltages. These may cause the arresters to conduct, which could affect the operation of the SMC and result in faults. Depending upon the instance at which the arresters conduct, this could also result in SCR damage.

- The capacitance in combination with the line and motor impedance could also be excited by the voltage steps from SCR switching to create resonant voltage swings which could exceed the device voltage withstanding ratings or surge arrester rating, or cause distorted voltage signals which may be misinterpreted by the SMC-50 control system.

Motor Overload Protection

Thermal motor overload protection is provided as standard (though it must be programmed) with the SMC-50 control module. If the overload trip class is less than the acceleration time of the motor, nuisance tripping may occur.

ATTENTION: Overload protection should be properly coordinated with the motor to avoid damage to equipment.

Two special applications require consideration: Two-speed Motors, and Multi-motor Protection.

Two-speed Motors

The SMC-50 control module has overload protection available for single speed motors. When the SMC-50 control module is applied to a two-speed motor, the Overload Class parameter must be programmed to OFF, and separate overload relays must be provided for each speed.

Multi-motor Protection

The SMC-50 control module provides overload protection for only one motor. When the SMC-50 is controlling more than one motor, the Overload Class Parameter must be programmed to OFF, and individual overload protection is required for each motor.

EMC Compliance

ATTENTION: This product has been designed for Class A equipment. Use of the product in domestic environments may cause radio interference, in which case, the installer may need to employ additional mitigation methods.

The following guidelines are provided for EMC installation compliance.

Enclosure

Install the product in a grounded metal enclosure.

Wiring

- Wire in an industrial control application can be divided into three groups: power, control, and signal. The following recommendations for physical separation between these groups is provided to reduce the coupling effect.
- Different wire groups should cross at 90° inside an enclosure.
- Minimum spacing between different wire groups in the same tray should be 16 cm (6 in.).

- Wire runs outside an enclosure should be run in conduit or have shielding/armor with equivalent attenuation.
- Different wire groups should be run in separate conduits.
- Minimum spacing between conduits containing different wire groups should be 8 cm (3 in.).
- For additional guidelines, please refer to Wiring and Ground guidelines, publication DRIVES-IN001.
- Wire earth ground to control terminal 14.
- Use shielded wire for:
  - PTC Input
  - Ground Fault Input
- Terminate shielded wires to terminal 14.
- Ground fault CT must be inside or within 3 m of metal enclosure.
- To meet produce susceptibility requirements, ferrite cores need to be added to the communication lines. All cores specified below are the split core type, so they can be added to existing connections.
  - When using an external HIM (or DPI interface), a core should be added to the HIM cable near the SMC-50 control module. The recommended core is Fair-Rite no. 0431167281 or equivalent.
  - When using DeviceNet, two cores need to be added to the DeviceNet cable near the SMC-50 control module. The recommended cores are TDK ZCAT2033 0930H and TDK ZCAT2035 0930 or equivalent.

Control Power

Control Voltage

The SMC-50 control module accepts a control power input of 100…240V AC, (-15 / +10%), 1-PH, 50/60 Hz. Refer to the product nameplate to verify the control power input voltage.

Connect control power to the module at terminals 1 (L1+)and 2 (L2-) (see Figure 35). The control power requirement for the control module is 75 VA.

Control Wiring

Table 8 provides the control terminal wire capacity and the tightening torque requirements. Each control terminal will accept a maximum of two wires.

Table 8 - Control Wiring and Tightening Torque

Wire Size	Torque
0.70…2.5 mm^2 (#18 to #14 AWG)	0.6 N•m (5 lb•in.)

Control Terminal Designations

Control Terminal Blocks on the Control Module

SMC-50 control modules come standard with two 24V DC digital on/off inputs and two relay outputs for auxiliary control functions. The standard digital I/O wiring terminal block is on the upper right portion of the SMC-50 module. The terminal block is removable.

Control Wiring Specifications

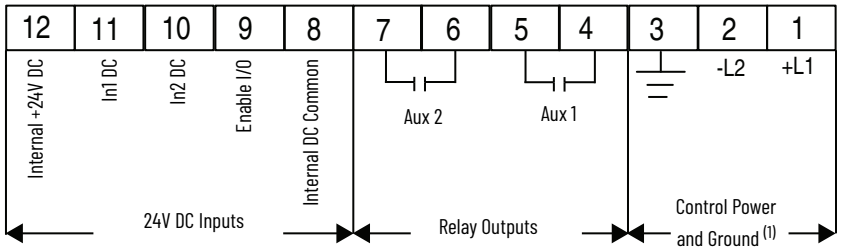
The following table provides the specifications for all SMC-50 module control wiring and option module terminal blocks. Each wiring terminal accepts a maximum of two wires.

Table 9 - Control Wiring Specifications

Wire Size	0.2...2.5 mm^2 (#24...14 AWG)
Maximum Torque	0.8 N•m (7 lb•in.)
Maximum Wire Strip Length	7 mm (0.27 in.)
Screw Type	M3 Slotted

SHOCK HAZARD: To prevent the risk of electrical shock, disconnect all power sources from the controller and option module before you install or service it. Install the controller and option module in a suitable enclosure and keep it free of contaminants.

Figure 35 - Standard Control Terminal Block Identification



(1) See the controller nameplate to verify the control power ratings (120/240V AC or 24V DC).

ATTENTION: IN1 DC (terminal 11) and IN2 DC (terminal 10) are 24V DC inputs on controllers rated 120/240V AC and on controllers rated 24V DC. Voltages that exceed the specified input range may cause damage to the controller.

Terminal Number(1)	Description
1 (2) (3)	Control Power +L1
2 (2)(3)	Control Power Common -L2
3	Ground — To connect to the system/control ground point.
4 (2)(4)	Auxiliary Relay Contact #1—rated 3 A @ 120V AC, 1.5 A @ 240V AC
5 (2)(4)	Auxiliary Relay Contact #1—rated 3 A @ 120V AC, 1.5 A @ 240V AC
6 (2)(4)	Auxiliary Relay Contact #2—rated 3 A @ 120V AC, 1.5 A @ 240V AC
7 (2)(4)	Auxiliary Relay Contact #2—rated 3 A @ 120V AC, 1.5 A @ 240V AC
8	DC Internal I/O Power, DC Common
9	Enable I/O
10 (2)(5)	Input #2 (24V DC) (range 15...30V DC)
11 (2)(5)	Input #1 (24V DC) (range 15...30V DC)
12	+24V DC Internal I/O Power

(1) See publication 150-TD009 for more specifications for option cards 150-SM2, 150-SM4, and 150-SM6.
(2) RC snubbers are required when inductive loads are connected to terminal.
(3) See the controller nameplate to verify the control power ratings (120/240V AC or 24V DC)
(4) When set to external bypass mode, the auxiliary contact is used to control a properly sized external contactor and overload once the motor is at full speed.
(5) Do not connect any additional loads to this terminal. Parasitic loads may cause problems with operation.

Notes:

Commissioning Procedure

Preliminary Setup

1. Ensure the work area is clean and tidy. Pathways to main disconnect and emergency stop push button must be clear and unobstructed.
2. The following test equipment is to be prepared for use:
   - Test power supply, supplied with each controller
   - Multimeters
   - Hi-Pot tester (recommended) or insulation resistance tester
   - Oscilloscope with memory (optional)
3. Complete drawing package and parts list.
4. Specification of project.

System Characteristics

Job Name:_____ Job Number:_____
_____

Rated Voltage:_____Rated Current:_____
S.F.:_____

Actual Motor Load

Load Type:Fan ____ Pump____ Conveyor____ Compressor____ Mixer_____

Other_____

Constant Torque_____*or*Variable Torque _____

Actual Motor Data: _____

Motor HP: _____

Motor Rated Speed: _____

Motor F.L.A.: _____

Motor S.F.: _____

Motor L.R.A.: _____

Frequency: _____

Phases: _____

Important Commissioning Checks

ATTENTION: When commissioning a SMC™-50, it is critical that following important checks are completed. For more details, follow the commissioning guidelines that follow this page.

- Inspect the equipment for any signs of physical damage.
- Verify SMC-50 physical installation is complete.
- Verify the integrity and operation of all safety interlocks.
- Verify that motor mechanical installation is complete.
- Verify that Incoming Power wiring to SMC-50 is complete and all connections are tight.
- Verify that Motor cabling to SMC-50 is complete and that all connections are tight.
- Verify that Control wiring to SMC-50 is complete.
- Check for any damaged components and verify that electrical clearances have not been reduced while installing power cables.
- Check if there are any Power Factor Correction Capacitors (refer to Power Factor Correction Capacitors on page 59 of Chapter 2 for correct installation requirements of these capacitors).
- Check if Surge Capacitors and/or Surge Arrestors are installed at the motor. Open motor junction box and verify it by yourself. These must be disconnected from the circuit. (refer to Surge Arrestor Protection Devices on page 60 of Chapter 2).
- Verify fiber-optic cables are connected at the right location (FO cables on Phase-A power pole go to Phase-A on the Interface board, Phase-B of power pole to Phase-B on the Interface board and Phase-C of power pole to Phase-C on the interface board) and the connectors are fully seated in their sockets.

ATTENTION: The polarity of the gate drive signals is important for proper operation. For example, the A+ and A- transmitters from the interface board must connect to the proper SCRs in the power electronics assembly. See Figure 37.

- Verify that circuit board plug connectors are installed and fully inserted in their sockets.
- Verify that the cooling fan (if supplied) is secured and the rotor is not obstructed.
- Complete device resistance checks per user manual (refer to Resistance Checks on page 75 of Chapter 3).
- Complete Power Supply Tests (refer to Power Supply Tests on page 72 of Chapter 3).
- Program the module with correct parameter settings.
- Start the unit and record scope waveforms (line voltage, motor voltage and motor current).

Preliminary Check

ATTENTION: Ensure that all sources of power are isolated and locked out before working on installed equipment. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Failure to do so may result in severe burns, injury or death.

1. Verify correct power cable phase sequencing, and that connections are tight.
2. Verify power fuse ratings and condition.
3. Verify control fuse ratings and condition.
4. Check that power cable installation has not damaged components, and that electrical spacings have not been reduced.
5. Check that fiber-optic cables are fully seated in their connectors.
6. Check that circuit board plug connectors are installed and fully inserted in their sockets.
7. Check that the cooling fan (if supplied) is secured and the rotor is not obstructed.
8. Verify integrity and operation of all interlocks.
9. In the case of the 1503E, verify wiring and perform all tests in conjunction with OEM documentation.

Programming

SMC-50 Module

Refer to Chapter 4 for programming procedures.

The default (factory) parameter settings are as shown in Appendix A.

Settings may be different on engineered orders, or when option modules or customer requirements dictate different settings.

IMPORTANT	The module should be programmed with an understanding of how the SMC functions, and the characteristics of the motor and driven load. Inappropriate settings may elicit unexpected results such as lack of acceleration torque or full-voltage starting.

IMPORTANT	When SMC-50 module is energized for the very first time, HIM may take couple of minutes to recognize Medium voltage controller. Once the ID file is recognized, HIM will display 'MV Soft Start'

If the factory settings are not suitable for the application, program the module to meet the application requirements. Contact your local Rockwell Automation representative or the factory if assistance is required.

Hi-Pot and Insulation Resistance Test

It is recommended that insulation levels be checked before energizing power equipment. This may be done with a High Voltage AC insulation tester (HI-POT) or an insulation resistance test. See publication 1502-UM052 or publication 1502-UM054 for suggested HI-POT testers, and for test procedures for vacuum contactors. If using an insulation resistance tester, a 5000V type is recommended.

ATTENTION: Solid-state devices can be destroyed by high voltage. Use jumper wires between heatsinks to short out the SCRs before applying high test voltages to the power circuit. Disconnect the white wires (L1, T1, L2, T2, L3, T3) from the voltage sensing board and remove the plug connector. If voltage transformers are present, remove one primary fuse from each device. On the 1503E, consult OEM documentation for location of voltage sensing board.

ATTENTION: Use caution when performing the HI-POT or insulation resistance test. High voltage testing is potentially hazardous and may cause severe burns, injury or death. Where appropriate, the case of the test equipment should be connected to ground.

Insulation may be tested from phase to phase and phase to ground. The recommended level for AC HI-POT testing is (2 X VLL) Volts, where VLL is the rated line-to-line voltage of the power system. The leakage current may be recorded for future comparison testing, and must be less than 20 mA.

If an insulation resistance tester is used, it should indicate 50 k megohms or greater if it is isolated as explained in the next paragraph. If the motor is connected, the insulation resistance tester should indicate 5 k megohms or greater.

If a 1560F is being tested, it is recommended that the input and output cables be disconnected for each phase. If a 1562F is being tested, it is recommended that the main contactor be in the open position, and that the output cables be disconnected for each phase. (See points marked with an asterisk * in Figure 36) This will ensure the unit is isolated from the line and the motor. The line and the motor may be tested separately to locate problem areas. If a 1503E is being tested, consult OEM documentation.

After completing the test, remove all semiconductor jumpers and test the devices with a multimeter to ensure no damage has occurred from the insulation test. Reconnect the system as it existed prior to this section. Perform the power supply and resistance checks in the following sections.

ATTENTION: Failure to reconnect all wires and cables correctly may result in equipment damage, personal injury or death.

Motor Tuning

The SMC-50 control module performs the motor tuning process on the initial start sequence of the motor. Motor tuning includes the identification of the motor parameters and the detection of the motor connection type (Line or Delta). The SMC-50 control module uses the motor tuning data in its control algorithm. During the tuning process, the motor does not turn and makes some audible noise, including pulsing and buzzing. The time to complete the tuning process is approximately 10 to 20 seconds, but varies based on the size and characteristics of the individual motor being used. After successful completion of the tuning process, the motor starts based on the user-programmed start profile. If you interrupt the tuning process by giving a stop command or removing power from the unit, the tuning process repeats on the next start command. Subsequent starts of the motor after a successful tuning do not perform the tuning process.

Note: With some generators, you may have difficulty with the motor tuning. If so, try tuning the motor while it is connected to line power. Contact Rockwell Automation technical support if you need assistance.

After the initial successful tuning of the motor, You can re-start the process via one of the following methods:

1. Change the status of Force Tuning, Parameter 194, to TRUE by using a configuration tool (such as a HIM) with the motor stopped. During the next start cycle, the tuning process occurs and Parameter 194 will change back to FALSE. **OR**
2. Press the "HOLD TO TEST/PUSH TO RESET" push button, located on the front of the control module, for ten seconds with the motor stopped. During the next start cycle, the tuning process occurs. The control module's status LED will flash amber, indicating that Tuning occurs on the next start cycle. **OR**
3. When the control module processes a "Load Factory Defaults" command via Parameter Management, Parameter 229.

If a motor that is smaller or larger than normal is used for initial system testing, you must perform a motor tuning cycle on the motor used in the final installation.

Table 10 lists Parameter 194 Force Tuning along with the key motor parameters checked by the SMC-50 control module during a motor tuning cycle.

Table 10 - Key Motor Parameters Checked During a Motor Tuning Cycle

Parameter Number	Parameter Name	Minimum/Maximum Values	Default Value	Access	Units
194	Force Tuning	FALSE/TRUE	TRUE	R/W	–
195	Stator R	0.00...50.00	0.00...50.00	R	Ohms
196	Total R	0.00...50.00	0.00...50.00		Ohms
197	Coupling Factor	0.00...10.00	0.00...10.00		
198	Inductance	0.00...1000.00	0.00...1000.00		mH
45	Motor Connection	Line/Delta	Line		–

Figure 36 - Typical SMC-50 Power System Wiring Diagram (5500/6900V shown)

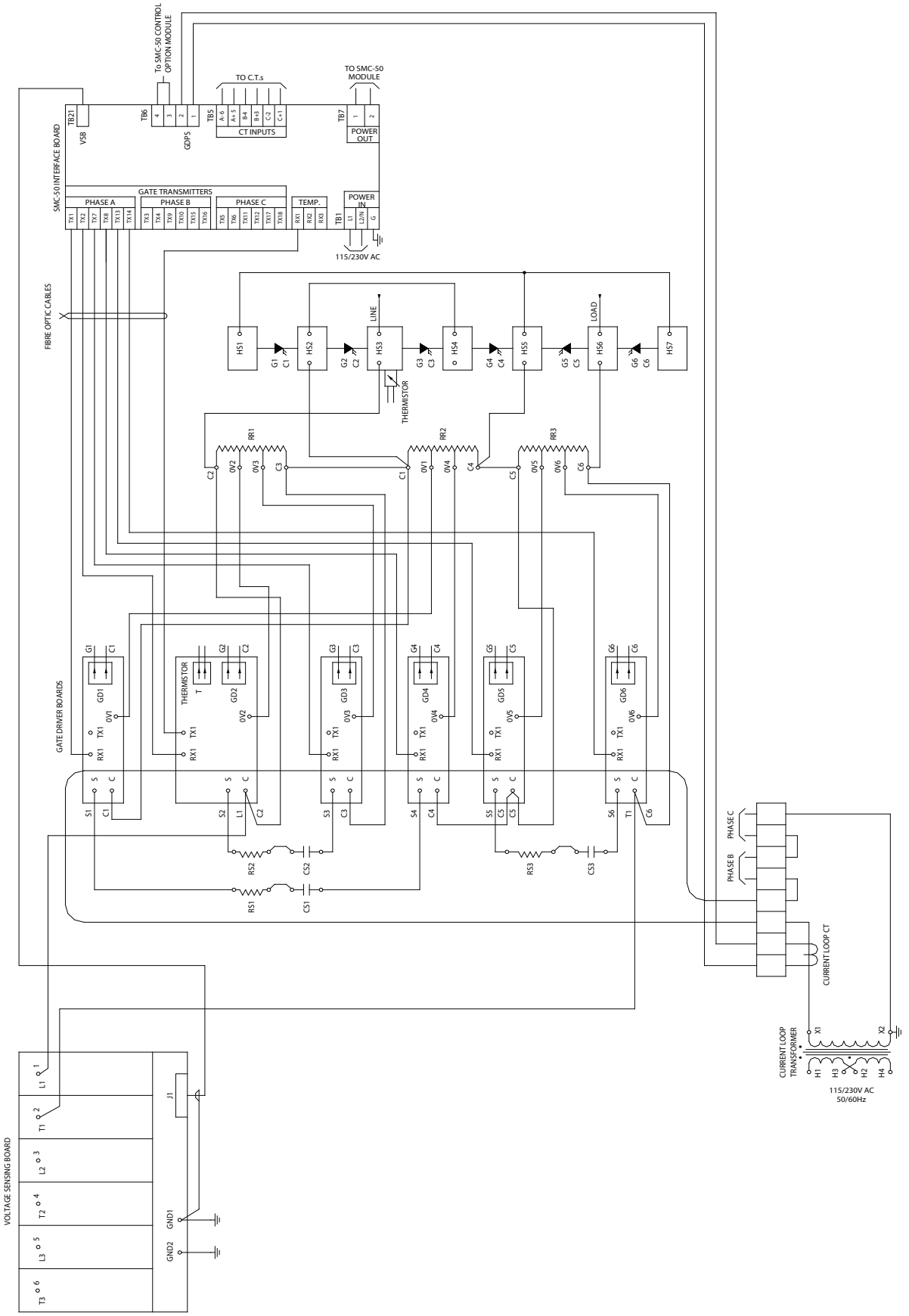
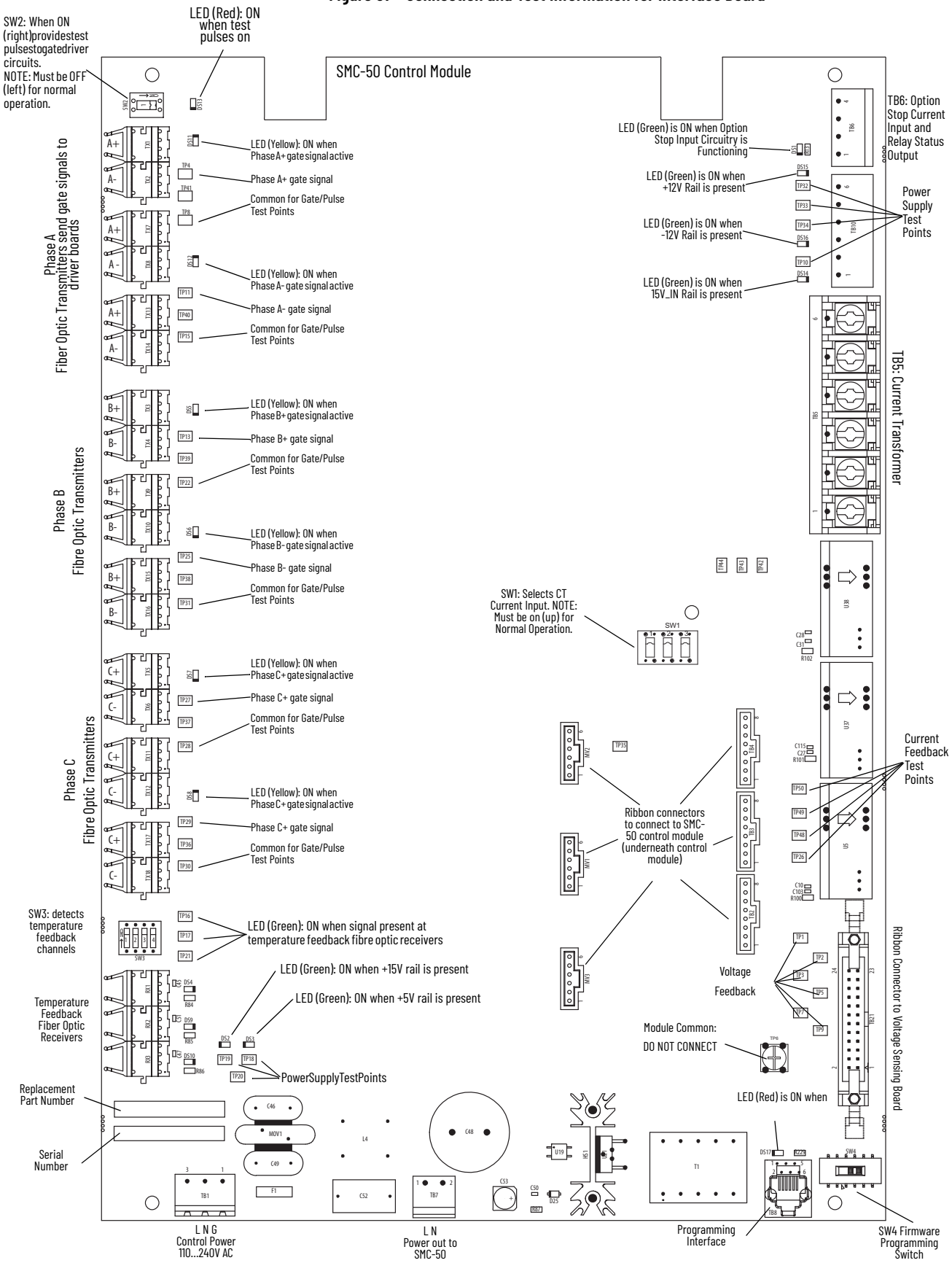


Figure 37 - Connection and Test Information for Interface Board

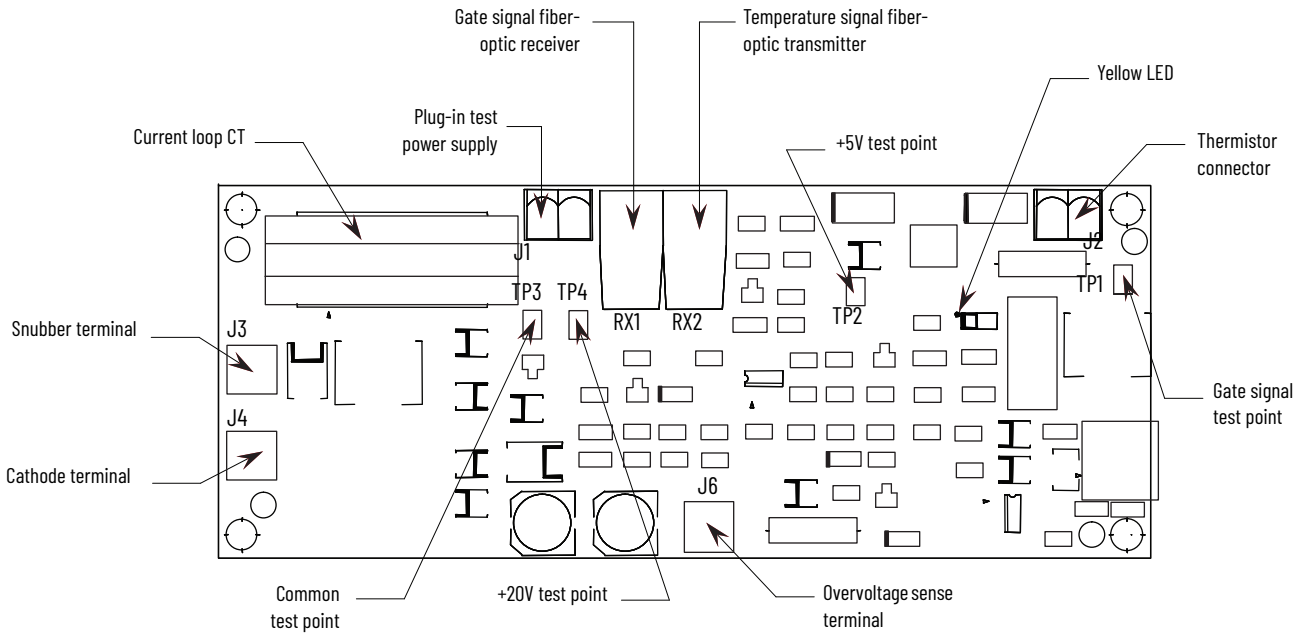


Power Supply Tests

ATTENTION: Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Before proceeding, ensure that all sources of power are isolated and locked out. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Any covers or barriers removed during this procedure must be replaced and securely fastened before energizing equipment. Where appropriate, the case of test equipment should be connected to ground.

1. Isolate incoming power.
2. Open the door(s) providing access to the SCR/heatsink assemblies. You will be touching components which are connected to the high voltage power circuit, so be sure to isolate power as stated above.
3. Apply rated control voltage to the control circuits from a separate control source, or by plugging into the test source connector, and selecting the TEST position of the control switch.
4. Check voltage on each gate driver board by connecting a DC voltmeter at TP4(+) and TP3(-). (See Figure 38.) The voltage should be 18...22V DC.
5. Locate the SMC-50 Interface board in the control section (see Figure 37). This circuit board has the control module mounted on it. Locate the switch labeled SW2 at the upper left corner of the board. Close the switch by sliding the toggle up. This starts a pulse generator to supply simulated gate-pulse signals via fiber optic cables to the gate driver boards. A red LED beside the switch, and the six yellow LEDs on the left side of the Interface board should be lit in the following sequence: DS11 (A+) -> DS12 (A-) ->DS5 (B+) -> DS6(B-) -> DS7 (C+) -> DS8(C-), and repeat after 2 seconds. With the correct fiber optic connection to interface board, the LEDs on Gate Driver Board should be lit in the same sequence. (**Note:** They may appear dim, depending on ambient light conditions).
6. With the gate pulses on, check the voltage again on each gate driver board as described in Step 4 above. The voltage should be 4...5V DC.
7. Locate the Portable Test Power Supply that was included with the equipment, and verify that the rating corresponds to the available power system (i.e. 110/120V AC or 220/240V AC). Plug the unit into the power source, and plug the green connector into J1 on each of the gate driver boards (see Figure 38).

Figure 38 - Test Power Application on Gate Driver Board



8. The yellow LED on the upper right-hand side of the energized gate driver circuit should be lit (it may appear dim, depending on ambient light conditions). While the gate pulses are still on, check the voltage on each gate driver board as described in step 4 above. The voltage should be 10...12V DC. If the voltage is less than 5V, then you have a bad gate drive board. Do not leave the Portable Test Power Supply connected to a bad gate driver board. The power supply adapter will burn up if the gate driver board is shorted.
9. A more detailed check is performed by verifying the actual gate pulses by connecting an oscilloscope between TP1 and TP3 (-) (see Figure 38). To check gate pulses, the pulse generator must be enabled (i.e. SW2 toggled up) and the Portable Test Power Supply should be connected to J1. The pulse should appear as shown in Figure 39 and Figure 40.

Figure 39 - Gate Pulse Detail – Typical SCR (ABB)

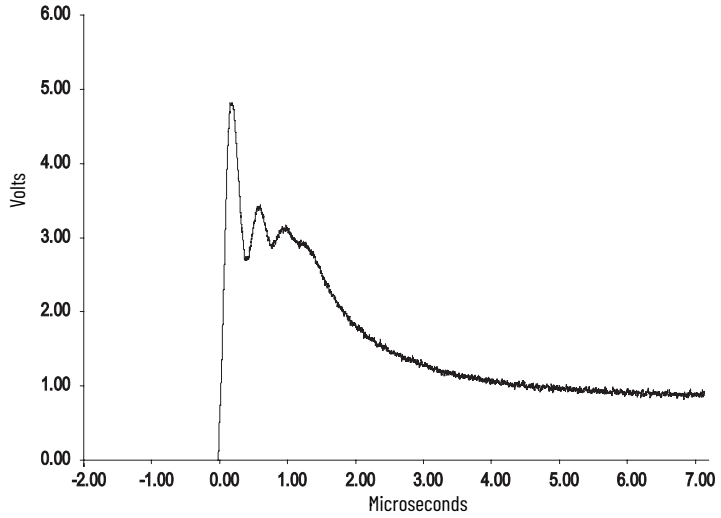
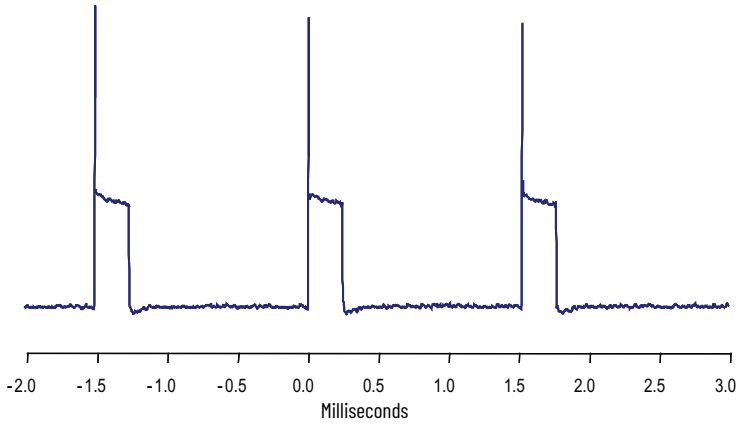


Figure 40 - Gate Pulse Test Waveform



10. If no pulse is observed, and the yellow LED is lit, check for a shorted gate on the SCR by removing the green plug and connecting an ohmmeter to the gate leads. If the LED is not lit, and the circuit voltage is as specified in step 8 (above), pinch the tab on the blue fiber-optic connector and carefully pull it straight out of the receiver. The end of the connector should glow red to indicate the presence of a gate signal.

    If it does not, remove the other end of the cable from the interface board and check that the gray transmitter is emitting red light. If it is, the fiber-optic cable must be replaced. If it isn't, the interface board should be replaced.

11. When each gate driver circuit has been checked, disconnect the power supply and remove it from the cabinet.

ATTENTION: The gate-drive circuits operate at high voltage when the SMC is energized. Failure to remove the portable test power supply will result in equipment damage and may cause severe injury or death.

12. Open the switch SW2 on the interface board (see Figure 37) before returning the unit to service. Ensure the red LED is off.

ATTENTION: If the SW2 switch is not in the open position when the SMC is energized, the motor will start in an uncontrolled manner and may cause severe damage.

13. Check that all plugs and connectors are secure. Retrieve all hardware and tools from the equipment. Replace and secure any barriers removed during servicing and close all doors before applying power.

Control Function Tests

ATTENTION: Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Recommended practice is to disconnect and lock out control equipment from power sources, and allow any stored energy in capacitors to dissipate. The safety related work practices of NFPA 70E, Electrical Safety Requirements for Employee Workplaces, must be followed if it is necessary to work in the vicinity of energized equipment.

1. Apply rated control voltage to the control circuit.
2. Using the control schematic, apply control signals to cause relays and contactors to energize, to verify operation.
3. Remove any jumpers used in the test and restore all circuits to normal when finished.

Resistance Checks

To ensure that resistors and connections have not been damaged during shipment and installation, the following resistance tests should be performed before energizing the starter.

1. Remove all power from the equipment.

ATTENTION: Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment.

2. Measure DC resistance per the following chart:

Table 11 - Power Circuit Resistance Measurements

Location of Probes	1000V	1300V	1500V	2300V	3300V	4160V	5500V	6900V
Cathode to Cathode (KOhms)(1)	–	–	–	–	22...30	23...31	21...29	24...32
Cathode to Cathode (KOhms)(2)	17...23	19...25	20...27	21...29	40...53	43...57	60...90(3)	64...84(3)
Cathode to Gate (Ohms)	10...40	10...40	10...40	10...40	10...40	10...40	10...40	10...40

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

3. If abnormal readings are obtained, see Troubleshooting on page 139.

Voltage Sensing Module

The voltage-sensing module consists of a voltage sensing board and mounting plate. The voltage sensing board has six independent channels, with different sized resistors base on voltage range, which convert voltages up to 10,800V (7.2 kV @ 1.5 pu) down to low voltage levels which can be used by the SMC-50 control logic.

Table 12 shows the input voltage ranges for each of the input terminals on the voltage-sensing module. This module has been designed to operate at a nominal input voltage of up to 7200V with a continuous 40% overvoltage. The output voltages are scaled to provide close to 10V peak for a 140% input voltage at the high end of each of the voltage ranges.

Software will be used to scale the output to show the correct value on the SMC-50 front panel display. (See Parameter #169 – *MV Ratio*)

Table 12 - Input Voltage Ranges

Module Rated Voltage	Voltage Range	MV Ratio
1500	800...1500	1163
2500	1501...2500	582
4800	2501...4800	326
7200	4801...7200	193

The MV ratios shown above are nominal values and may be fine tuned to achieve better accuracy on the display of the SMC-50 control module. While running the motor in bypass mode, compare the voltage displayed on the control module to a known accurate meter connected to the same source voltage as the motor the SMC-50 is controlling. Parameter 169, *MV Ratio*, may be changed up or down to match the control module display to the external meter. A small change in ratio can make a large change in the display, so five units at a time is recommended. Increasing the ratio will decrease the displayed voltage, and visa versa.

Start-Up

1. Remove any temporary jumpers or grounding devices used during commissioning.
2. Check that all tools are removed from the equipment. Any tools or hardware used or dropped during installation and commissioning must be retrieved and accounted for.
3. Check that all barriers or covers removed during installation or commissioning have been securely mounted.
4. Close and secure all doors, and verify function of all interlocks that prevent access to medium voltage compartments when the unit is energized.
5. The controller is ready to power the motor.

Programming

Overview

This chapter provides a basic understanding of the programming/configuration tools available to modify the SMC™-50 control module's parameters. Unlike previous SMC products (for example, SMC-3 and SMC Flex), the SMC -50 control module does not contain a built-in programming tool. This lets you select from several programming tools to best suit your application.

Human Interface Module (HIM) (Cat. No. 20-HIM-A6 or 20-HIM-C6S)

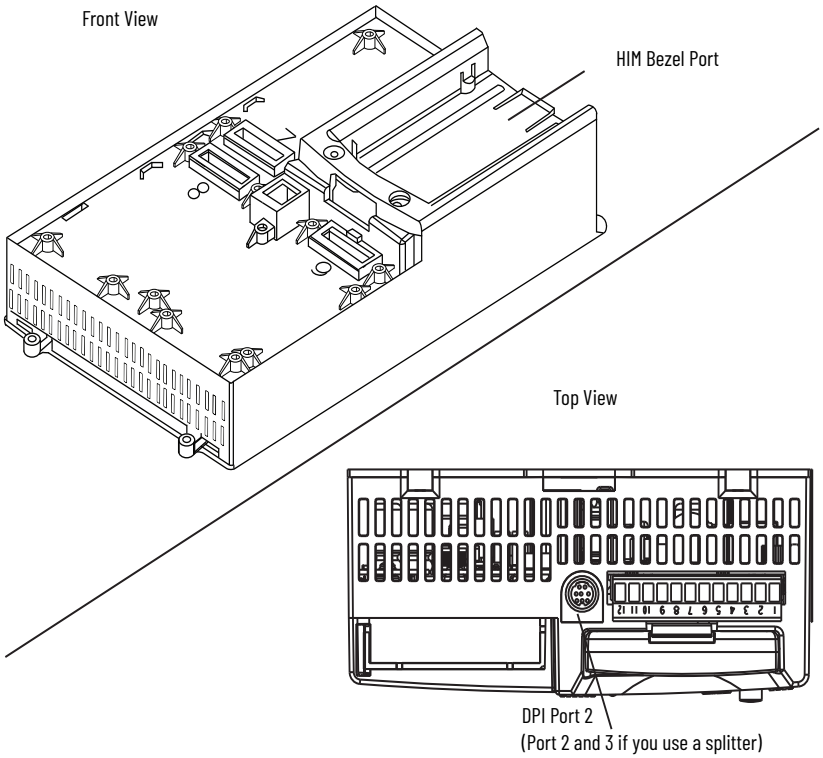
The 20-HIM-A6 lets you:

- configure/monitor all controller parameters,
- configure/monitor all option modules (for example, 150-SM4, digital I/O, etc.), and
- use the SMC-50 module's general startup configuration wizard.

The 20-HIM-A3 cannot configure the option modules or use the general startup configuration wizard. Therefore, the 20-HIM-A3 is not recommended for use with the SMC-50 controller and is not mentioned in this document.

The 20-HIM-A6 is typically inserted into the HIM bezel port located on the upper right of the control module. Inserting the HIM into the bezel provides operation in a NEMA Type 1 environment. The 20-HIM-C6S, a remote (door-mount) version of the 20-HIM-A6, provides operation in a NEMA 4X/12 environment and includes a 1202-C30 interface cable to the SMC-50 control module DPI Port 2 on the top of the module. For additional information on mounting the 20-HIM-A6 or the 20-HIM-C6S, see the HIM user manual, publication 20HIM-UM001.

Figure 41 - HIM Mounting Locations



The following information describes some of the basic screens and keypad functions of the 20-HIM-A6 or 20-HIM-C6S. Additional details about all HIM functions can be found in the user manual, publication 20HIM-UM001.

HIM Single-Function Keys

The four single-function keys only perform their dedicated functions no matter which screen or data entry mode you are using.

Table 13 - HIM Single-Function Keys

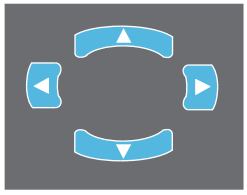
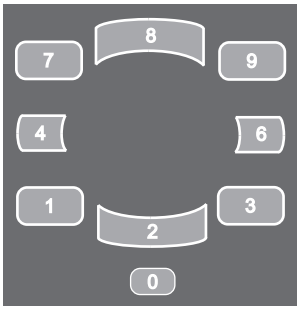
Key	Function
Start	Starts the controller if the control module's Logic Mask is enabled for the port the HIM is connected to. (1)
Folders	Accesses folders for parameters, diagnostics, memory functions, preferences, and other tests.
Controls	Accesses jog, direction, auto/manual, and other control functions.
Stop	Stops the controller or clears a fault. The Stop key is always active. Coast Stop only.

(1) If the device (port) is enabled and removed under power or an expansion device is removed, a fault is generated. The bit location (for example, 0, 1, 2, etc.) corresponds to the DPI port numbers.

HIM Soft Keys

Up to five dynamic soft keys can be shown at the bottom of the HIM screen. Based on the specific screen or the data entry mode being used, a soft key name and its function may change. When a soft key is active, its presentation function and corresponding soft key label are shown at the bottom of the HIM screen.

Table 14 - HIM Soft Key Functions

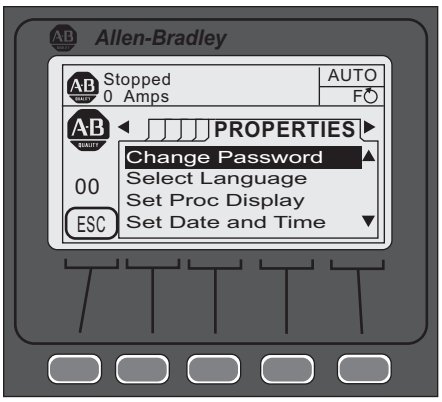
Soft Key	Description	Function
	Multi-Function—Blue	• Scrolls through menus and screens as directed by each arrow • Performs corresponding functions displayed in the data area
	Numeric Keys—Grey	• Enters their respective numeric values
	5/Enter	• Enters the numeric value, 5 • Displays the next level of a selected menu item • Enters new values • Performs intended actions

Password Modification Using the HIM

The SMC-50 control module provides password protection by numeric code (0...65,535) to prevent unwanted modification of parameters. You can view or monitor data and parameter values without entering the password, but modification requires password entry.

The password can be modified from the PROPERTIES folder screen of the 20-HIM-A6 or 20-HIM-C6S, as shown in Figure 42.

Figure 42 - PROPERTIES Folder Screen



If the default password (0=default) is modified, ensure the modified password is written down in a secure place. There is no way to reset the password if it is forgotten. For additional information on password modification, see the 20-HIM-A6 user manual, publication 20HIM-UM001.

To modify the default password, perform the following steps using the 20-HIM-A6 or 20-HIM-C6S:

1. From the initial power-up screen, press the FOLDERS single function key.
2. Use the forward or back arrow key until the PROPERTIES folder screen is displayed, as shown in Figure 42.
3. Select the CHANGE PASSWORD option, then press the Enter (#5) key.
4. Enter a numeric password, then press the Enter (#5) key. This will load the password into the SMC-50 control module's memory.

Parameter Access Level Modification Using the HIM

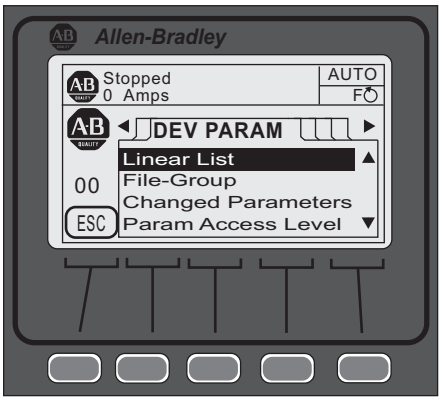
The SMC-50 control module provides three different parameter access levels: Monitor, Basic, and Advanced. These access levels let you limit user access and/or speed viewing or changing of certain parameters.

- The access level is **not** maintained if power to the module is cycled.
- The default access level is Basic.
- The advanced level provides access to all parameters.
- Individual parameter access levels are shown in Table 23 through Table 27 beginning on page 99 and is also contained in the Parameter Linear List, Table 31 through Table 35 beginning on page 109.

To view/modify the current access level, perform the following steps using the 20-HIM-A6:

1. From the initial power-up screen, press the FOLDERS single function key.
2. Press the forward or back arrow key until the DEV PARAM folder screen appears.

3. Select the PARAM ACCESS LEVEL option, then press the Enter (#5) key. The Dev Parameter screen appears.

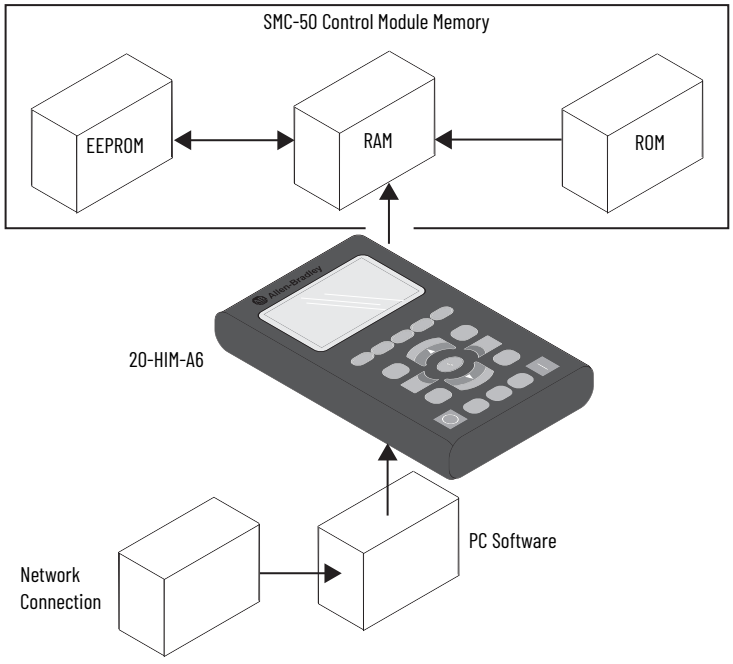


4. Use the up or down arrow to scroll up or down until you reach the desired access level
5. Press Enter (#5) to view that access level.

Parameter Management

Before you begin programming, it is important to understand how the memory is structured within the SMC-50 **and** used on power-up and during normal operation.

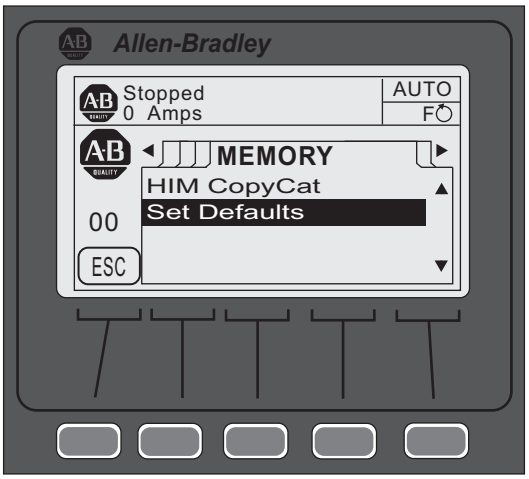
Figure 43 - Memory Block Diagram



RAM (Random Access Memory)

RAM is the work area of the module after it is powered up. The SMC-50 control module uses an Auto Store feature when programming parameters. When parameters are modified in the program mode, the new values are stored immediately in RAM and then in EEPROM (Electrically Erasable Programmable Read-only Memory), once the enter key has been pressed. If control power is lost before the enter key is pressed, these values are lost. When the device powers up, it copies the values from the EEPROM area of memory into RAM.

ROM (Read-only Memory)—Set Defaults



The SMC-50 control module comes with factory default parameter values. These settings are stored in non-volatile ROM and are displayed the first time you enter the Program mode via the Linear List or File-Group mode using the HIM. To restore factory parameter defaults:

1. Navigate to the Memory folders screen with Port <00> displayed.

Option modules can also be restored to defaults using this method. Ensure its respective port number is displayed.

2. Select/highlight the Set Defaults line, then press ENTER (#5). The following text is displayed: WARNING: Sets all Parameters to factory defaults. Continue?
3. Press the ENTER soft key to change defaults or the ESC soft key to return to the previous screen.

You can also restore factory defaults by using the Parameter Management, Parameter 229, available in the Utility File-Group.

EEPROM

The SMC-50 control module provides a non-volatile area for storing user-modified parameter values in the EEPROM.

Parameter Configuration

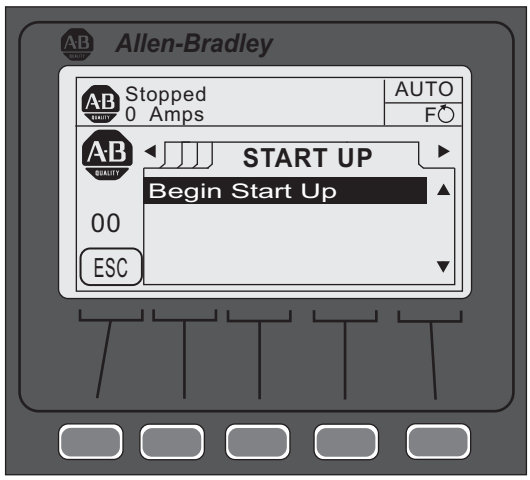
Using the START UP Configuration Tool (20-HIM-A6 or 20-HIM-C6S)

The general START UP configuration tool lets you rapidly configure an controller. Enabled by the SMC-50 control module and the 20-HIM-A6 or 20-HIM-C6S, a series of questions required to configure starting (for example, Soft, Linear, Pump, etc.) and stopping (for example, Coast, Pump, etc.) modes are displayed on the HIM via this tool.

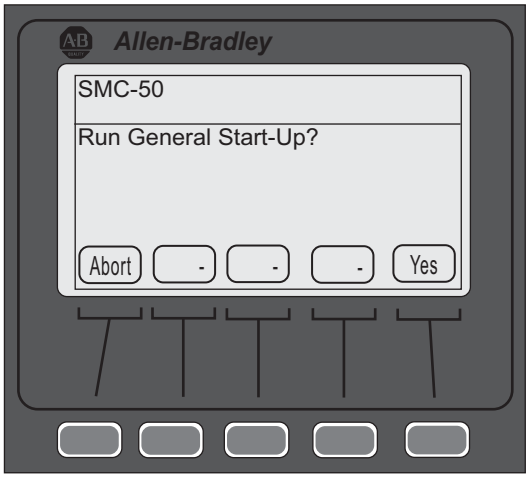
Not all parameters are configured with this tool. You can configure any non-configured startup parameters by using the parameter number or File—Group search method. See Basic Configuration using the HIM on page 101.

Accessing the General START UP Tool

1. Select the FOLDERS single-function key located on the lower left portion of the keypad.
2. Use the left or right arrow key until the START UP folders screen is displayed



3. Press the ENTER (#5) key to begin the configuration process. The HIM displays "Run General Start-up?".
4. Press the Yes soft key to begin the process or Abort soft key to return to the START UP folders screen.



The HIM displays a series of questions about the Motor, Start, and Stop processes.

Depending on the answers to the Start and Stop processes, some screens may not be displayed.

EXAMPLE

If: Soft Start, Linear Speed, or Pump Start is selected:

Then: Starting Torque, Max Torque, Rated Torque, and Rated Speed will not be displayed.

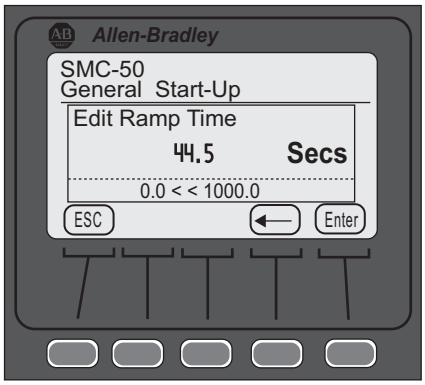
Reason: These parameters are specific to the Torque Start parameter group.

Entering Data into General Startup

1. Display the parameter.

   If the HIM provides the allowable range (for example, 1.0 << 2200.0) at the bottom of the screen, enter the data value. If an up or down arrow soft key is displayed, use the soft key to display the desired selection.

Enter the data value if you see this screen



Use the up and down arrows or soft keys to display your selection if you see this screen

2. Enter the desired value, then press the ENTER soft key.

If you enter an incorrect value: Press the ESC soft key to return to the previous screen, then enter the desired value. Use the left arrow soft key to delete a single digit at a time from the data field to enter the correct digit. If a group of selections is displayed, the left arrow soft key moves to the lowest numbered selection.

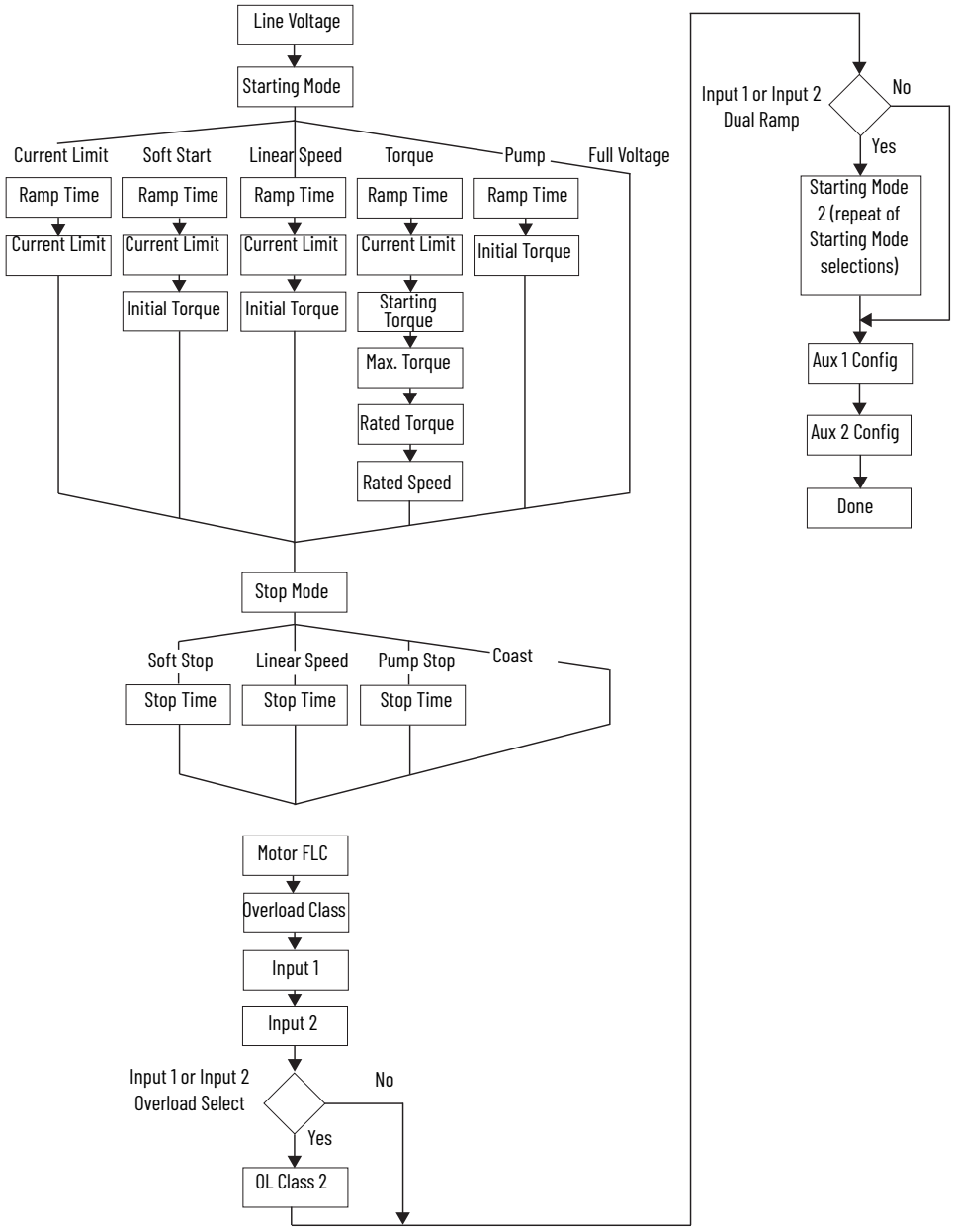
Once all parameters are entered, the START-UP folders screen appears.

Review/Modify Parameter Data

1. Display the START UP folder screen.
2. Press the ENTER (#5) key.
3. Select the "Yes" soft key when "Run General Start-Up?" is displayed.
4. Individually review each parameter (required), pressing the ENTER soft key to move onto the next parameter. If necessary, press the ESC soft key to review the previous parameter.

To modify parameter data, use the procedure outlined in Entering Data into General Startup on page 84.

Figure 44 - Flow Chart—General Startup Parameters



Parameter Search and Configuration

The 20-HIM-A6 or 20-HIM-C6S modules can access all of the controller parameters. These modules provide two basic ways to search for and modify a specific parameter or group of parameters: by parameter number or File-Group. The following example explains how to search by parameter number using the 20-HIM-A6 module.

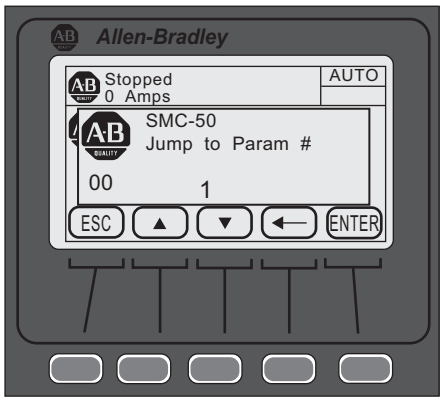
Parameter Search and Configuration by Parameter Number

To perform a parameter number search and modification, perform the following steps.

Parameter Search and Configuration by Parameter Number

1. Ensure that the initial controller Power Up screen appears on the HIM.

2. Using the PAR# soft key, type the desired parameter number to display, press the ENTER soft key, then press the EDIT soft key. The following screen appears.



To access the next/previous PAR# from the one currently displayed, use the UP/DOWN arrow soft keys to display the desired parameter for modification.

3. Press ENTER to load the changed value into memory.

For additional details on these procedures, see the 20-HIM-A6 or 20-HIM-C6S user manual, publication 20HIM-UM001.

Parameter Search and Configuration by File-Group Structure

Parameter Structure

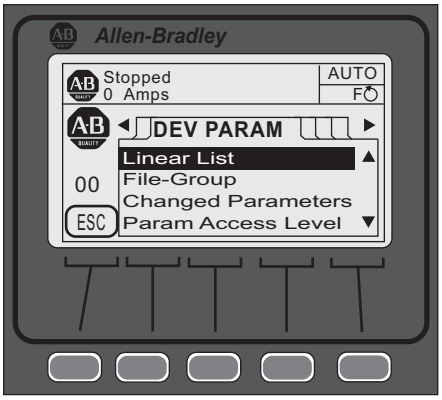
The parameters of the controller are structured into five parameter File-Groups:

1. Monitoring
2. Setup
3. Motor Protection
4. Communications
5. Utility

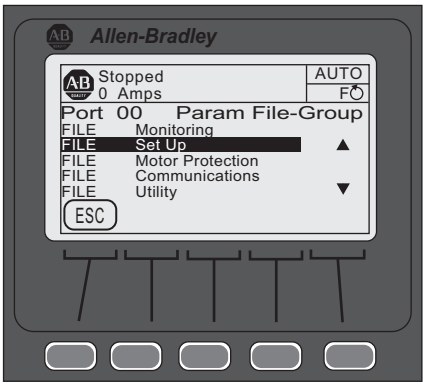
The parameters associated with each of these five File-Groups are shown in Table 23 through Table 27 beginning on page 99 of this chapter.

Parameter Search and Configuration by File-Group (SMC-50 Control Module Category Search)

1. From the HIM Power-Up screen, press the FOLDERS single-function key.
2. Press the LEFT or RIGHT arrow key until the screen displays DEV PARAM. Ensure Port 00 SMC-50 control module is selected from the PORTS screen.



3. Using the DOWN arrow key, scroll to the File-Group selection, then press ENTER (#5 keypad). The screen displays Port 00 Param File-Group at the top of the screen.
4. Using the DOWN arrow key, scroll to the Set Up selection, then press ENTER. The screen displays the setup categories (for example, Basic, Starting).



5. With Basic highlighted, press ENTER (number 5 on the keypad).

6. Scroll to the desired parameter (for example, Line Voltage) to modify it, then press ENTER (number 5 on the keypad).
7. With the parameter displayed, press the EDIT soft key.
8. Enter the desired value, then press the ENTER soft key to save the value.
9. Press the ESC key to return to the Basic category.
10. To modify another parameter in the Basic category, follow steps 5 though 7. To return to a higher level category, press the BACK arrow key.

Using the DEV PARAM folder screen and the File-Group selection, the controller parameters can be selected and configured by functional category. See the Parameter File-Group Structure on page 99.

Parameter Configuration - Using the Setup File Group

Overview

Table 15 shows the parameter sets available within the Basic Setup group.

Table 15 - Setup File Group

Setup File Group Parameters								
Basic (BA)		**Starting (BA)**	**Stopping (BA)**	**Dual Ramp (BA)**	**Advanced**	**I/O (BA)**	**Advanced Tuning**	
Motor Config	Input 2	Starting Mode	Stop Mode	Starting Mode 2	Pump Pedestal (A)	Input 1	Force Tuning (A)	Phase Shift 0% (A)
Line Voltage	Aux 1 Config	Ramp Time	Stop Time	Ramp Time 2	Load Type (A)	Input 2	Starter R	Phase Shift 10% (A)
Starting Mode	Aux 2 Config	Cur Limit Level	Backspin Timer	Cur Limit Level 2	UTS Level (A)	Aux 1 Config	Total R	Phase Shift 20% (A)
	Overload Class	Initial Torque		Initial Torque 2	Stall Position (A)	Aux 1 Invert	Coupling Factor	Phase Shift 30% (A)
Ramp Time		Starting Torque		Starting Torque 2	Stall Level (A)	Aux 1 On Delay	Inductance	Phase Shift 40% (A)
Initial Torque	Service Factor	Max Torque		Max Torque 2	V Shut Off Level (A)	Aux 1 Off Delay	Speed PGain (A)	Phase Shift 50% (A)
Max Torque		Kickstart Time		Kickstart Time 2	I Shut Off Level (A)	Aux 2 Config	Transient Gain (A)	Phase Shift 60% (A)
Cur Limit Level	Motor FLC	Kickstart Level		Kickstart Level 2	Notch Maximum (A)	Aux 2 Invert		Phase Shift 70% (A)
	Starting Torque	Start Delay			Timed Start (A)	Aux 2 On Delay	Transient Zero (A)	Phase Shift 80% (A)
Stop Mode					Bypass Delay (A)	Aux 2 Off Delay		Phase Shift 90% (A)
Stop Time	Max Torque				Demand Period (BA)	Aux Control	Transient Mag (A)	Phase Shift 100% (A)
Input 1	Rated Torque				Num of Periods (BA)			
	Rated Speed						Ping Degree (A)	
							Pings (A)	

For a complete parameter set listing within each parameter File–Group, see Parameter File-Group Structure on page 99.

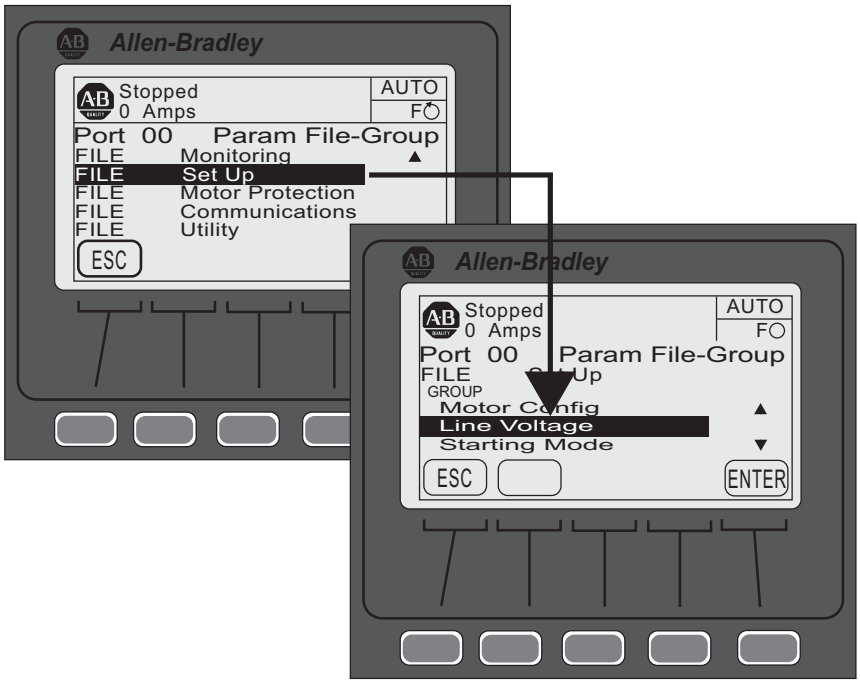
The Basic parameter set in the setup group is limited, yet powerful. It lets you quickly start the system with minimal adjustments and provides quick access to parameters that are required for standard motor connection and overload protection. If you are using advanced controller features (for example, Dual Ramp), however, you must also use the parameter set that is associated with those features. The Setup group is used throughout this section as a baseline for system configuration.

IMPORTANT Parameter values that are modified while the motor is operating are not valid until the next time the operation for that parameter occurs.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Figure 45 shows the initial FILE Setup screens using the HIM.

Figure 45 - Initial FILE Setup Screens



Soft Start and Stop

To program a soft start with simple stop mode operation, you can use the parameters listed in Table 16. You can access the Basic parameter set with the HIM from the Port <00> DEV PARAM folder under the File-Group, File: Setup, Group: Basic Selection sequence.

Table 16 - Soft Start Parameter Group

Parameter Name	Description	Options	Default Value
Motor Configuration	Setting for the motor configuration Line Connected Wye or Inside-the-Delta.(1)	Line, Delta, Auto Detect	Auto Detect
Line Voltage	Select the value of line voltage being used in the system. You must enter the correct line voltage value for the voltage protection functions to work properly.	0…15,000V	4160V
Starting Mode	This mode must be programmed for Soft Start.	Soft Start(2)(3)	Soft Start(2)(3)
Ramp Time	Programs the time period that the controller will ramp the output voltage up to full voltage and to full speed from the Initial Torque level.	0…1000 s	10 s
Initial Torque	The initial reduced output voltage (torque) level for the voltage ramp to the motor is established and adjusted with this parameter—the torque level at which the ramp begins.	0…90% LRT	70% LRT
Current Limit Level	Limits the current supplied to the motor throughout the Soft Start cycle.(4)	50…600% FLC	350% FLC
Stop Mode	Programs the desired Stop Mode.(5)	Coast, Soft Stop, Linear Speed, Pump Stop	Coast
Stop Time	Programs the amount of time desired to ramp from full to zero voltage for Soft, Linear, and Pump Stop mode. The actual ramp stop time will depend on the stopping mode selected and load inertia.	0…999 s	0 s
Input 1	Programs the desired operation of the Control Module to a change in status of Input #1 wired to control terminal #11 (24V DC).	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run	Start/Coast
Input 2	Programs the desired operation of the Control Module to a change in status of Input #2 wired to control terminal #10 (24V DC).		Disable
Aux 1 Config	Aux 1 Config Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(6)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(7), Network 1, Network 2, Network 3, Network 4, Fan Control	Normal
Aux 2 Config	Programs the control function of the Auxiliary Output Contact #2, wired across control terminal #6 and #7. (6)		
Overload Class	Required for motor protection. Lets you select the time-to-trip for the built-in Motor Overload. This selection is based on the type of motor being used and the application it is being applied to.	5…30	10
Service Factor	Required for motor protection. This value is taken directly from the nameplate and used by the controller to determine the ultimate Overload Trip Current.	0.01…1.99	1.15
Motor FLC	Required for motor protection. This programmed value is taken directly from the motor nameplate.	1.0…2200.0 A	1.0 A
Starting Torque	NOT used for a Soft Start.	0…300% RMT	100% RMT
Max Torque	NOT used for a Soft Start.	0…300% RMT	250% RMT
Rated Torque	NOT used for a Soft Start.	0…100,000 N•m	10 N•m
Rated Speed	NOT used for a Soft Start.	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) In the AUTO Detect [default] selection, the controller automatically checks the motor configuration.
(2) Kickstart is available when using Soft Start. A Kickstart Level and Time must be configured if this mode is used. Access these parameters via the Starting Setup Group. The Starting Setup Group can be accessed with the HIM from the Port <00> DEV PARAM folder under the File-Group, File: Setup, Group: Starting selection sequence (see Table 15). Setting either parameter to zero disables Kickstart.
(3) You can also program a start delay time to delay starting for a period of time after the initiation of the START command. The Start Delay parameter can be accessed from the Group Starting selection as noted.
(4) Enter a value to limit the current but not low enough to inhibit the start cycle.
(5) The stopping mode does not need to match the starting mode (for example, a Soft Start can have a stop mode programmed for [Coast], or Linear Stop—there is no Current Limit Stop or Torque Stop mode).
(6) Relay Operational Options (for example, ON and OFF delay, etc.) are provided in the File: Setup, Group: I/O selection sequence. See Table 15.
(7) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from the Aux Control, Parameter 180. See Parameter 180 information for bit assignments.
NOTE: This function enables forcing an output, ON or OFF.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Current Limit Start with Simple Stop Mode

Use the parameters in Table 17 to program a Current Limit Start with simple Stop Mode operation. You can access the Basic parameter set with the HIM.

Table 17 - Current Limit Start with Simple Stop Mode Parameters

Parameter Name	Description	Options	Default Value
Motor Config	Setting for the motor configuration Line Connected Wye or Inside-the-Delta. (1)	Line, Delta, Auto Detect	Auto Detect
Line Voltage	Select the value of line voltage being used in the system. The correct line voltage value must be entered for the voltage protection functions to work properly.	0…15,000V	4160V
Starting Mode	This mode must be programmed for Current Limit.	Current Limit(2)(3)	Current Limit(2)(3)
Ramp Time	Programs the time period that the controller will HOLD the fixed reduced voltage/current before switching to full voltage.	0…1000 [10] seconds	10 s
Initial Torque	NOT used for a Current Limit Start.	0…90% LRT	70% LRT
Current Limit Level	Current Limit Level Limits the current supplied to the motor throughout the Start cycle. (4)	50…600% FLC	350% FLC
Stop Mode	Programs the desired Stop Mode. (5)	Coast, Soft Stop, Linear Speed, Pump Stop	Coast
Stop Time	Programs the amount of time desired to ramp from full to zero voltage for Soft, Linear, and Pump Stop mode. The actual ramp stop time will depend on the stopping mode selected and load inertia.	0…999 seconds	0 s
Input 1	Programs the desired operation of the Control Module to a change in status of Input #1 wired to control terminal #11 (24V DC).	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run	Start/Coast
Input 2	Programs the desired operation of the Control Module to a change in status of Input #2 wired to control terminal #10 (24V DC).		Disable
Aux 1 Config	Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(6)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control (7), Network 1, Network 2, Network 3, Network 4, Fan Control	Normal
Aux 2 Config	Programs the control function of the Auxiliary Output Contact #2, wired across control terminal #6 and #7.		
Overload Class	Required for motor protection. Lets you select the time-to-trip for the built-in Motor Overload. This selection is based on the type of motor being used and the application it is being applied to.	5…30	10
Service Factor	Required for motor protection. This programmed value is taken directly from the nameplate and used by the controller to determine the ultimate Overload Trip Current.	0.01…1.99	1.15
Motor FLC	Required for motor protection. This programmed value is taken directly from the motor nameplate.	1.0…2200.0 A	1.0 A
Starting Torque	NOT used for a Current Limit Start.	0…300% RMT	100% RMT
Max Torque	NOT used for a Current Limit Start.	0…300% RMT	250% RMT
Rated Torque	NOT used for a Current Limit Start.	0…100,000 N•m	10 N•m
Rated Speed	NOT used for a Current Limit Start.	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) In the AUTO Detect [default] selection, the controller automatically checks the motor configuration.
(2) Kickstart is available when using Soft Start. A Kickstart Level and Time must be configured if this mode is used. Access these parameters via the Starting Setup Group. The Starting Setup Group can be accessed with the HIM from the Port <00> DEV PARAM folder under the File-Group, File: Setup, Group: Starting selection sequence (see Table 15). Setting either parameter to zero disables Kickstart.
(3) You can also program a start delay time to delay starting for a period of time after the initiation of the START command. The Start Delay parameter can be accessed from the Group Starting selection as noted.
(4) Enter a value to limit the current but not low enough to inhibit the start cycle.
(5) The stopping mode does not need to match the starting mode (for example, a Soft Start can have a stop mode programmed for [Coast], or Linear Stop—there is no Current Limit Stop or Torque Stop mode).
(6) Relay Operational Options (for example, ON and OFF delay, etc.) are provided in the File: Setup, Group: I/O selection sequence. See Table 15.
(7) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from the Aux Control, Parameter 180. See Parameter 180 information for bit assignments.
NOTE: This function enables forcing an output, ON or OFF.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Linear Acceleration (Linear Speed) Start with Stop

Use the parameters in Table 18 to program a Linear Acceleration Start and Simple Stop Mode operation. You can access the Basic parameter set with the HIM (see Table 15).

Table 18 - Linear Acceleration (Speed Sense) Start with Stop Parameters

Parameter Name	Description	Options	Default Value
Motor Config	Setting for the motor configuration Line Connected Wye or Inside-the-Delta.(1)	Line, Delta, Auto Detect	Auto Detect
Line Voltage	Select the value of line voltage being used in the system. The correct line voltage value must be entered for the voltage protection functions to work properly.	0…15,000V	4160V
Starting Mode	This mode must be programmed for Linear Speed.	Linear Speed(2)(3)	Linear Speed(2)(3)
Ramp Time	Programs the time period that the controller will ramp the output voltage up to full voltage and to full speed from Stop. With the Linear Speed Starting mode, the time to ramp to full speed closes to this value depending on load characteristics.	0…1000 s	10 seconds
Initial Torque	The initial reduced output (torque) level for the voltage ramp to the motor is established and adjusted to this parameter. Torque level at which the ramp begins.	0…90% LRT	70% LRT
Current Limit Level	Limits the current supplied to the motor throughout the Linear Start and Stop cycle.(4)	50…600% FLC	350% FLC
Stop Mode	Programs the desired Stop Mode.(5)	Coast, Soft Stop, Linear Speed, Pump Stop	Coast
Stop Time	Programs the amount of time desired to ramp from full to zero voltage for Soft, Linear, and Pump Stop mode. Actual ramp stop time depends on the stopping mode selected and load inertia.	0…999 s	0 s
Input 1	Programs the desired operation of the Control Module to a change in status of Input #1 wired to control terminal #11 (24V DC).	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run	Start/Coast
Input 2	Programs the desired operation of the Control Module to a change in status of Input #2 wired to control terminal #10 (24V DC).		Disable
Aux 1 Config	Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(6)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(7), Network 1, Network 2, Network 3, Network 4, Fan Control	Normal
Aux 2 Config	Programs the control function of the Auxiliary Output Contact #2, wired across control terminal #6 and #7. (6)		
Overload Class	Required for motor protection. Lets you select the time-to-trip for the built-in Motor Overload. This selection is based on the type of motor being used and the application.	5…30	10
Service Factor	Required for motor protection. This programmed value is taken directly from the nameplate and used by the controller to determine the ultimate Overload Trip Current.	0.01…1.99	1.15
Motor FLC	Required for motor protection. This programmed value is taken directly from the motor nameplate.	1.0…2200.0 A	1.0 Amps
Starting Torque	NOT used for a Linear Speed Start.	0…300% RMT	100 RMT
Max Torque	NOT used for a Linear Speed Start.	0…300% RMT	250% RMT
Rated Torque	NOT used for a Linear Speed Start.	0…100,000 N·m	10 N·m
Rated Speed	NOT used for a Linear Speed Start.	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) In the AUTO Detect [default] selection, the controller automatically checks the motor configuration.
(2) Kickstart is available when using Soft Start. A Kickstart Level and Time must be configured if this mode is used. Access these parameters via the Starting Setup Group. The Starting Setup Group can be accessed with the HIM from the Port <00> DEV PARAM folder under the File-Group, File: Setup, Group: Starting selection sequence (see Table 15). Setting either parameter to zero disables Kickstart.
(3) You can also program a start delay time to delay starting for a period of time after the initiation of the START command. The Start Delay parameter can be accessed from the Group Starting selection as noted.
(4) Enter a value to limit the current but not low enough to inhibit the start cycle.
(5) The stopping mode does not need to match the starting mode (for example, a Soft Start can have a stop mode programmed for [Coast], or Linear Stop—there is no Current Limit Stop or Torque Stop mode).
(6) Relay Operational Options (for example, ON and OFF delay, etc.) are provided in the File: Setup, Group: I/O selection sequence. See Table 15.
(7) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from the Aux Control, Parameter 180. See Parameter 180 information for bit assignments.
NOTE: This function enables forcing an output, ON or OFF.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Torque Start with Stop

Use the parameters in Table 19 to program a Torque Start with simple Stop operation. You can access the basic parameter set with the HIM (see Table 15 on page 88).

Table 19 - torque Start with Stop Parameters

Parameter Name	Description	Options	Default Value
Motor Config	Setting for the motor configuration Line Connected Wye or Inside-the-Delta.(1)	Line, Delta, Auto Detect	Auto Detect
Line Voltage	Select the value of line voltage being used in the system. The correct line voltage value must be entered for the voltage protection functions to work properly.	0…15,000V	4160V
Starting Mode	This mode must be programmed for Torque Ramp.	Torque Ramp(2)(3)(4)	Torque Ramp(2)(3)(4)
Ramp Time	Programs the time period that the controller will ramp the output voltage from the Starting Torque Value to the Programmed Max Torque Value.	0…1000 s	10 s
Initial Torque	NOT used for a Torque Ramp Start.	0…90% LRT	70% LRT
Current Limit Level	Limits the current supplied to the motor throughout the Torque Ramp Start cycle.(5)	50…600% FLC	350% FLC
Stop Mode	Programs the desired Stop Mode. (6)	Coast, Soft Stop, Linear Speed, Pump Stop	Coast
Stop Time	Stop Time Programs the amount of time desired to ramp from full to zero voltage for Soft, Linear, and Pump Stop mode. The actual ramp stop time will depend on the stopping mode selected and load inertia.	0…999 seconds	0…999 s
Input 1	Input 1 Programs the desired operation of the Control Module to a change in status of Input #1 wired to control terminal #11 (24V DC). [Default: Start/Coast]	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run	Start/Coast
Input 2	Input 2 Programs the desired operation of the Control Module to a change in status of Input #2 wired to control terminal #10 (24V DC). [Default: Disable]		Disable
Aux 1 Config	Programs control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5. (7)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(8), Network 1, Network 2, Network 3, Network 4, Fan Control	Normal
Aux 2 Config	Programs control function of the Auxiliary Output Contact #2, wired across control terminal #6 and #7. (7)		
Overload Class	Required for motor protection. Lets you select the time-to-trip for the built-in Motor Overload. This selection is based on the type of motor being used and the application.	5…30 10	10
Service Factor	Required for motor protection. This programmed value is taken directly from the nameplate and used by the controller to determine the ultimate Overload Trip Current.	0.01…1.99	1.15
Motor FLC	Required for motor protection. This programmed value is taken directly from the motor nameplate.	1…2200 Amps	1.0 A
Starting Torque	Programmed initial or starting point for a Torque Ramp Start.	0…300% RMT	100% RMT
Max Torque	Programmed end point for a Torque Ramp Start.	0…300% RMT	250% RMT
Rated Torque	The actual rated torque of the motor being used in a Torque Ramp Start.	0…100,000 N·m	10 N·m
Rated Speed	The actual rated speed of the motor used in the Torque Ramp Start.	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) In the AUTO Detect [default] selection, the controller automatically checks the motor configuration.
(2) Torque Ramp Starting mode requires you to perform a Motor Tuning Cycle. The SMC-50 control module does this automatically the first time the motor is run. You can also force this manually by setting the Force Tuning, Parameter 194, to TRUE (=1), which is accessed from the File Setup, Group Adv. Tuning or by pressing and holding the SMC-50 control module's Reset button for 10 seconds with the motor stopped.
(3) You can also program a start delay time to delay starting for a period of time after the initiation of the START command. You can access the Start Delay parameter from the Group Starting selection. See Table 15.
(4) Kickstart is available when using Torque Start. You must configure a Kickstart Level and Time if you use this mode is. Access these parameters via the Starting Setup Group. You can access the Starting Setup Group with the HIM from the Port <00> DEV PARAM folder under the File-Group, File: Setup, Group: Starting selection sequence. See Table 15. Setting either parameter to zero disables Kickstart
(5) Enter a value to limit the current but not low enough to inhibit the start cycle.
(6) The stopping mode does not need to match the starting mode (for example, a Soft Start can have a stop mode programmed for Coast, or Linear Stop—there is no Current Limit Stop or Torque Stop mode).
(7) Relay Operational Options (for example, ON and OFF delay, etc.) are provided in the File: Setup, Group: I/O selection sequence. See Table 15.
(8) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from the Aux Control, Parameter 180. See Parameter 180 information for bit assignments. NOTE: This function enables forcing an output, ON or OFF.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Pump Start with Stop

Use the parameters in Table 20 to program a Pump Start with simple Stop operation. You can access the basic parameter set with the HIM (see Table 15 on page 88)

Table 20 - Pump Start with Stop Parameters

Parameter Name	Description	Options	Default Value
Motor Config	Setting for the motor configuration Line Connected Wye or Inside-the-Delta.(1)	Line, Delta, Auto Detect	Auto Detect
Line Voltage	Select the value of line voltage being used in the system. The correct line voltage value must be entered for the voltage protection functions to work properly.	0…15,000V	4160V
Starting Mode	This mode must be programmed for Pump Start.	Pump Start(2)(3)	Pump Start(2)(3)
Ramp Time	Programs the time period that the controller will ramp the output voltage to full voltage and motor speed from the programmed Initial Torque value.	0…1000 s	10 s
Initial Torque	The initial reduced output voltage (torque) level for the voltage ramp to the motor is established and adjusted with this parameter. The torque level at which the ramp begins.	0…90% LRT	70% LRT
Current Limit Level	Limits the current supplied to the motor throughout the Torque Ramp Start cycle. (4)	50...600% FLC	350% FLC
Stop Mode	Programs the desired Stop Mode.(5)	Coast, Soft Stop, Linear Speed, Pump Stop	Coast
Stop Time	Programs the amount of time desired to ramp from full to zero voltage for Soft, Linear, and Pump Stop mode. Actual ramp stop time depends on the stop mode selected and load inertia.	0…999 s	0 s
Input 1	Programs the desired operation of the Control Module to a change in status of Input #1 wired to control terminal #11 (24V DC).	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run	Start/Coast
Input 2	Programs the desired operation of the Control Module to a change in status of Input #2 wired to control terminal #10 (24V DC).		Disable
Aux 1 Config	Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(6)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(7), Network 1, Network 2 Network 3, Network 4, Fan Control	Normal
Aux 2 Config	Programs the control function of the Auxiliary Output Contact #2, wired across control terminal #6 and #7.(6)		
Overload Class	Required for motor protection. Lets you select the time-to-trip for the built-in Motor Overload. This selection is based on the type of motor being used and the application.	5…30	10
Service Factor	Required for motor protection. This programmed value is taken directly from the nameplate and used by the controller to determine the ultimate Overload Trip Current.	0.01…1.99	1.15
Motor FLC	Required for motor protection. This programmed value is taken directly from the motor nameplate.	1…2200 A	1 A
Starting Torque	NOT used for Pump Start.	0…300% RMT	100% RMT
Max Torque	NOT used for Pump Start.	0…300% RMT	250% RMT
Rated Torque	NOT used for Pump Start.	0…100,000 N•m	10 N•m
Rated Speed	NOT used for Pump Start.	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) In the AUTO Detect [default] selection, the controller automatically checks the motor configuration.
(2) For best results with a Pump Start, it is recommended that the tuning cycle be run. The SMC-50 control module automatically performs the tuning cycle the first time the motor is run. You can also force this manually by setting the Force Tuning parameter to TRUE (=1), which is accessed from the File Setup, Group Adv. Tuning or by pressing and holding the SMC-50 control module's Reset button for 10 seconds with the motor stopped.
(3) You can program a start delay time to delay starting for a period after the initiation of the START command. You can access the Start Delay parameter from the Group Starting selection. See Table 15.
(4) Enter a value to limit the current but not low enough to inhibit the start cycle.
(5) The stop mode does not need to match the start mode (example: a Soft Start can have a stop mode programmed for Coast, or Linear Stop—there is no Current Limit Stop or Torque Stop mode).
(6) Relay Operational Options (for example, ON and OFF delay, etc.) are provided in the File: Setup, Group: I/O selection sequence. See Table 15.
(7) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from the Aux Control, Parameter 180. See Parameter 180 information for bit assignments. NOTE: This function enables forcing an output, ON or OFF.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Full Voltage Start with Stop

The SMC-50 control module may be programmed to provide a full voltage start (output voltage to the motor reaches full voltage within five line power cycles).

To provide a Full Voltage Start to the motor, the only start parameter that requires adjustment is the Starting Mode. The Basic parameter set should be used to program Full Voltage Start to ensure configuration of other motor configuration and basic protection parameters. Use the parameters in Table 21 to program a Full Voltage Start and Simple or Stop Mode operation. You can access the basic parameter set with the HIM (see Table 15 on page 88).

Table 21 - Full Voltage Start with Stop Parameters

Parameter Name	Description	Options	Default Value
Motor Config	Setting for the motor configuration Line Connected Wye or Inside-the-Delta.(1)	Line, Delta, Auto Detect	Auto Detect
Line Voltage	Select the value of line voltage being used in the system. The correct line voltage value must be entered for the voltage protection functions to work properly.	0…15,000V	4160V
Starting Mode	This mode must be programmed for Full Voltage Start.	Full Voltage(2)	Full Voltage(2)
Ramp Time	Programs the time period that the controller will ramp the output voltage to full voltage and motor speed from the programmed Initial Torque value.	0…1000 s	10 s
Initial Torque	NOT used for Full Voltage Start.	0…90% LRT	70% LRT
Current Limit	NOT used for Full Voltage Start.	50...600% FLC	350% FLC
Stop Mode	Programs the desired Stop Mode.(3)	Coast, Soft Stop, Linear Speed, Pump Stop	Coast
Stop Time	Programs the amount of time desired to ramp from full to zero voltage for Soft, Linear, and Pump Stop mode. Actual ramp stop time depends on the stop mode selected and load inertia.	0…999 s	0 s
Input 1	Programs the desired operation of the Control Module to a change in status of Input #1 wired to control terminal #11 (24V DC).	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run	Start/Coast
Input 2	Programs the desired operation of the Control Module to a change in status of Input #2 wired to control terminal #10 (24V DC).		Disable
Aux 1 Config	Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(4)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(5), Network 1, Network 2 Network 3, Network 4, Fan Control	Normal
Aux 2 Config	Programs the control function of the Auxiliary Output Contact #2, wired across control terminal #6 and #7.(6)		
Overload Class	Required for motor protection. Lets you select the time-to-trip for the built-in Motor Overload. This selection is based on the type of motor being used and the application.	5…30	10
Service Factor	Required for motor protection. This programmed value is taken directly from the nameplate and used by the controller to determine the ultimate Overload Trip Current.	0.01…1.99	1.15
Motor FLC	Required for motor protection. This programmed value is taken directly from the motor nameplate.	1…2200 A	1 A
Starting Torque	Starting Torque NOT used for Full Voltage Start.	0…300% RMT	100% RMT
Max Torque	NOT used for Full Voltage Start.	0…300% RMT	250% RMT
Rated Torque	NOT used for Full Voltage Start.	0…100,000 N•m	10 N•m
Rated Speed	NOT used for Full Voltage Start.	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) In the AUTO Detect [default] selection, the controller automatically checks the motor configuration.
(2) You can also program a start delay time to delay starting for a period of time after the initiation of the START command. You can access the Start Delay parameter from the Group Starting selection. See Table 15.
(3) The stopping mode does not need to match the starting mode (for example, a Soft Start can have a stop mode programmed for Coast, or Linear Stop—there is no Current Limit Stop or Torque Stop mode).
(4) Relay Operational Options (for example, ON and OFF delay, etc.) are provided in the File: Setup, Group: I/O selection sequence. See Table 15.
(5) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from the Aux Control, Parameter 180. See Parameter 180 information for bit assignments. NOTE: This function enables forcing an output, ON or OFF.

ATTENTION: For Overload Protection, it is critical that you enter the data into the SMC-50 control module as it appears on the motor nameplate.

Dual Ramp Start with Stop

Thecontroller lets you select between two start profiles. Configure Start Profile 1 using the Basic parameter set as explained in the previous sections. You can access the basic parameter set with the HIM (see Table 15 on page 88).

The Stop mode selected in the Basic parameter set will apply to both start profiles.

The Basic parameter set provides the method to select between the operation of Start Profile 1 and Start Profile 2 by configuration of Input 1 or Input 2 to the Dual Ramp. If the input configured for Dual Ramp is open (low), Start Profile 1 is selected. If the input is closed (high), Profile 2 is selected.

Set up Start Profile 2 by using the Dual Ramp parameter set. You can use the HIM to access Dual Ramp from the <Port 00> DEV PARAM folder (see Table 15 on page 88). Use the parameters in Table 22 to program a Dual Ramp adjustment.

Table 22 - Dual Ramp Start with Stop Parameters

Parameter Name	Description	Options	Default Value
Starting Mode 2	Select the desired starting mode for Profile 2	Soft Start, Full Voltage, Linear Speed, Torque Start, Current Limit, Pump Start.(1)(2)	—
Ramp Time 2	Programs the Profile 2 time period that the controller will ramp the output voltage to full voltage and motor speed from the programmed Initial Torque value.	0…1000 s	10 s
Current Limit Level 2	The Profile 2 setting limits the current supplied in the motor throughout the Soft Start, Linear Speed, or Torque Ramp cycle.(3)	50…600% FLC	350% FLC
Initial Torque 2	Initial Torque 2 The initial reduced output voltage (torque) level for the Profile 2 Voltage Ramp to the motor is established and adjusted with this parameter. The torque level at which the ramp begins for Profile 2. NOTE: Not used for Torque Ramp.	0…90% LRT	70% LRT
Starting Torque 2	Starting Torque 2 For a Torque Ramp Start, the programmed initial or start torque point for Profile 2. This parameter is not used for other starting modes.	0…300% RMT	100% RMT
Max Torque 2	For Start Profile 2, the programmed torque end point for a Torque Ramp start. This parameter is not used for other starting modes.	0…300% RMT	250% RMT
Kickstart Time 2	For Start Profile 2, if required, a boost of current (torque) is provided to motor for this programmed time period.(4)	0…2 s	0 s
Kickstart Level 2	For Start Profile 2, if required, this parameter programs the amount of current (torque) applied to the motor during Kickstart time.(4)	750, 900, 1000, 1200, 1500, 1800, 3500, 3600 rpm	1800 rpm

(1) Torque Ramp and Linear Speed Starting modes require you to perform a Motor Tuning Cycle. The SMC-50 control module does this automatically the first time the motor is run. You can also force this manually by setting the Force Tuning, Parameter 194, to TRUE (=1), which is accessed from the File Setup, Group Adv. Tuning or by pressing and holding the SMC-50 controller's Reset button for 10 seconds with the motor stopped.

(2) You can also program a start delay time and will apply to both Start Profile 1 and Start Profile 2. The Start Delay parameter can be accessed from the Group Starting selection (see Table 15).

(3) Enter a value to limit the current but not low enough to inhibit the start cycle.

(4) Available for Soft Start, Current Limit, and Torque Start modes. Set to zero to disable Kickstart.

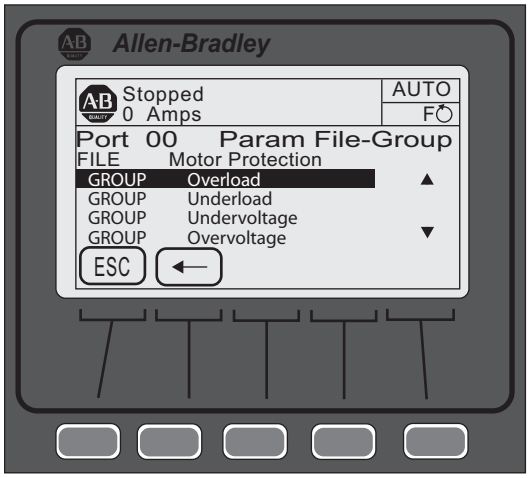
Motor Protection

The Motor Protection Group (see Table 25 on page 100) is used to program motor and starter protection functions. The Motor Protection Group is accessed from the HIM using the Port 00 DEV PARAM folder under the File-Group, File: Motor Protection selection sequence. By using this file group, the SMC-50 control module lets you individually enable, disable, or restart the motor and starter Faults and Alarms. Each of the 21 different Motor/Starter Protection Setup groups (for example, Overload, Underload, Jam, Stall, Voltage Unbal, etc.) has at least one selection for Fault Enable, Alarm Enable, and Restart Enable.

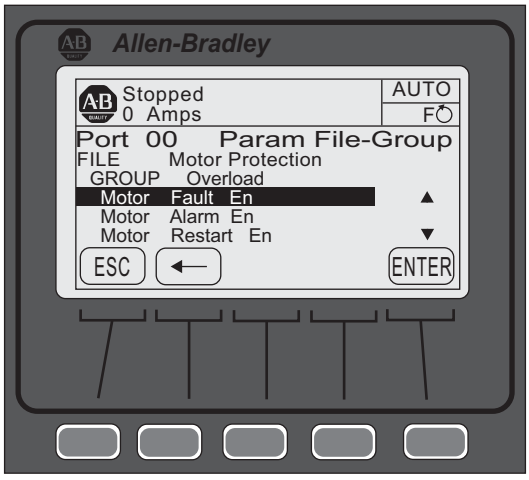
IMPORTANT The majority of parameters have a Fault and an Alarm setting.

To modify any Fault or Alarm bit for enable/disable functionality, perform the following steps.

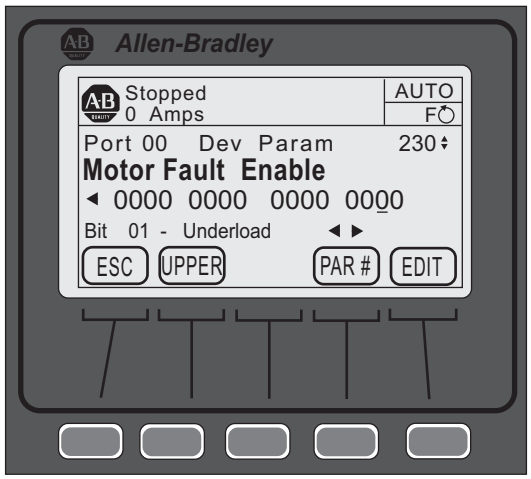
1. From the Motor Protection Group, select the desired group.



2. Press ENTER (number 5 from keypad) to display the associated bit parameters.

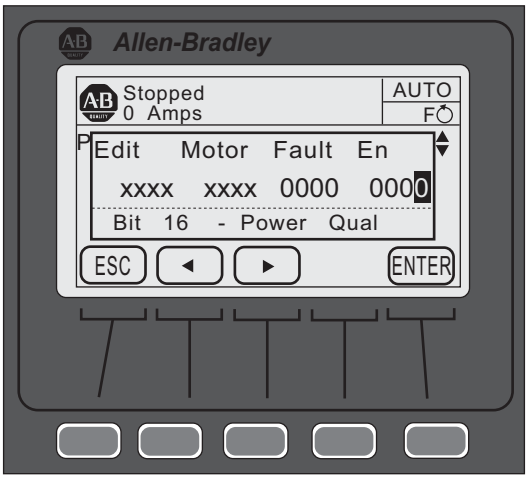


3. Select the desired 16 bit field, then press EDIT.



The UPPER and LOWER soft key allows for switching between the upper (16...31) and lower (0...16) bits.

4. Use the right or left arrow to move the cursor to the desired bit. The bit function is displayed at the bottom of the screen.
5. Enter a 1 to enable or 0 to disable, then press ENTER to load the change into the control module.



Parameter File-Group Structure

The five parameter File-Groups are structured as shown below. The access levels for each parameter are abbreviated as follows:

- M—Monitoring,
- B—Basic,
- A—Advanced, and
- MBA—Monitoring, Basic, and Advanced.

Table 23 - Monitoring Group

Monitoring File Group Parameters							
Metering Basic (MBA)	**Metering Volts (MBA)**	**Metering Current (MBA)**	**Metering Power (MBA)**		**Start Stats (MBA)**	**Monitoring (MBA)**	**Power Quality (MBA)**
Volts P-P Ave	Volts P-P Ave	Current Ave	Real Power	Apparent Power	Start Time 1	Elapsed Time	THD Va
Volts P-N Ave	Volts Phase A-B	Current Phase A	Real Power A	Apparent Power A	Start Time 2	Elapsed Time 2	THD Vb
Current Average	Volts Phase B-C	Current Phase B	Real Power B	Apparent Power B	Start Time 3	Running Time	THD Vc
Torque	Volts Phase C-A	Current Phase C	Real Power C	Apparent Power C	Start Time 4	Energy Savings	THD Vave
Motor Speed	Volts P-N Ave	Current Imbal	Real Demand	Apparent Demand	Start Time 5	Motor Therm Usage	THD Ia
Power Factor	Volts Phase A-N		Max Real Demand	Max Apparent Demand	Peak Current 1	Time to OL Trip	THD Ib
Real Power	Volts Phase B-N		Reactive Power	Power Factor	Peak Current 2	Time to OL Reset	THD Ic
Reactive Power	Volts Phase C-N		Reactive Power A	Power Factor A	Peak Current 3	Time to PM	THD Iave
Apparent Power	Volts Unbal		Reactive Power B	Power Factor B	Peak Current 4	Starts to PM	
Real Energy			Reactive Power C	Power Factor C	Peak Current 5	Total Starts	
Reactive Energy +			Reactive Demand			Product Status	
Reactive Energy -			Max Reactive Demand				
Apparent Energy							
Meter Reset							

Table 24 - Setup File Group

Setup File Group Parameters								
Basic (BA)		**Starting (BA)**	**Stopping (BA)**	**Dual Ramp (BA)**	**Advanced**	**I/O (BA)**	**Advanced Tuning**	
Motor Config	Input 2	Starting Mode	Stop Mode	Starting Mode 2	Pump Pedestal (A)	Input 1	Force Tuning (A)	Phase Shift 0% (A)
Line Voltage	Aux 1 Config	Ramp Time	Stop Time	Ramp Time 2	UTS Level (A)	Input 2	Starter R	Phase Shift 10% (A)
Starting Mode	Aux 2 Config	Cur Limit Level	Backspin Timer	Cur Limit Level 2	Stall Position (A)	Aux 1 Config	Total R	Phase Shift 20% (A)
	Overload Class	Initial Torque		Initial Torque 2	Stall Level (A)	Aux 1 Invert	Coupling Factor	Phase Shift 30% (A)
Ramp Time		Starting Torque		Starting Torque 2	V Shut Off Level (A)	Aux 1 On Delay	Inductance	Phase Shift 40% (A)
Initial Torque	Service Factor	Max Torque		Max Torque 2	I Shut Off Level (A)	Aux 1 Off Delay	Speed PGain (A)	Phase Shift 50% (A)
Max Torque		Kickstart Time		Kickstart Time 2	Notch Maximum (A)	Aux 2 Config	Transient Gain (A)	Phase Shift 60% (A)
Cur Limit Level	Motor FLC	Kickstart Level		Kickstart Level 2	Timed Start (A)	Aux 2 Invert		Phase Shift 70% (A)
	Starting Torque	Start Delay			Bypass Delay (A)	Aux 2 On Delay	Transient Zero (A)	Phase Shift 80% (A)
Stop Mode					Demand Period (BA)	Aux 2 Off Delay		Phase Shift 90% (A)
Stop Time	Max Torque				Num of Periods (BA)	Aux Control	Transient Mag (A)	Phase Shift 100% (A)
Input 1	Rated Torque							
	Rated Speed						Ping Degree (A)	
							Pings (A)	

Table 25 - Motor Protection Group

Motor Protection File Group Parameters							
Overload (BA)	**Underload (BA)**	**Undervoltage (BA)**	**Overvoltage (BA)**	**Jam (BA)**	**Stall (BA)**	**Real Power (BA)**	**Reactive + Power (BA)**
Motor Fault Enable	Motor Fault Enable	Starter Fault Enable	Starter Fault Enable	Motor Fault Enable	Motor Fault Enable	Motor Fault Enable	Motor Fault Enable
Motor Alarm Enable	Motor Alarm Enable	Starter Alarm Enable	Starter Alarm Enable	Motor Alarm Enable	Motor Alarm Enable	Motor Alarm Enable	Motor Alarm Enable
Motor Restart Enable	Motor Restart Enable	Starter Restart Enable	Starter Restart Enable	Motor Restart Enable	Motor Restart Enable	Motor Restart Enable	Motor Restart Enable
Overload Class	Underload F Level			Jam F Level	Stall Delay	MWatts Ov F Level	+MVAR Ov F Level
Overload Class 2	Underload F Delay	Undervolt F Level	Overvolt F Level	Jam F Delay		MWatts Ov F Delay	+MVAR Ov F Delay
Service Factor	Underload A Level	Undervolt F Delay	Overvolt F Delay	Jam A Level		MWatts Ov A Level	+MVAR Ov A Level
Motor FLC	Underload A Delay	Undervolt A Level	Overvolt A Level	Jam A Delay		MWatts Ov A Delay	+MVAR Ov A Delay
OL Reset Level		Undervolt A Delay	Overvolt A Delay			MWatts Un F Level	+MVAR Un F Level
OL Shunt Time						MWatts Un F Delay	+MVAR Un F Delay
OL Inhibit Time						MWatts Un A Level	+MVAR Un A Level
Overload A Lvel						MWatts Un A Delay	+MVAR Un A Delay
Reactive - Power (BA)	**Apparent Power (BA)**	**Leading PF (BA)**	**Lagging PF (BA)**	**Voltage Unbal (BA)**	**Current Imbal (BA)**	**Voltage THD (BA)**	**Current THD (BA)**
Motor Fault Enable	Motor Fault Enable	Motor Fault Enable	Motor Fault Enable	Starter Fault Enable	Motor Fault Enable	Starter Fault Enable	Motor Fault Enable
Motor Alarm Enable	Motor Alarm Enable	Motor Alarm Enable	Motor Alarm Enable	Starter Alarm Enable	Motor Alarm Enable	Starter Alarm Enable	Motor Alarm Enable
Motor Restart Enable	Motor Restart Enable	Motor Restart Enable	Motor Restart Enable	Starter Restart Enable	Motor Restart Enable	Starter Restart Enable	Motor Restart Enable
-MVAR Ov F Level	MVA Ov F Level	Lead PF F Level	Lag PF F Level		Current Imbal F Level		THD I F Level
-MVAR Ov F Delay	MVA Ov F Delay	Lead PF F Delay	Lag PF F Delay	Voltage Unbal F Level	Current Imbal F Delay	THD V F Level	THD I F Delay
-MVAR Ov A Level	MVA Ov A Level	Lead PF A Level	Lag PF A Level			THD V F Delay	THD I A Level
-MVAR Ov A Delay	MVA Ov A Delay	Lead PF A Delay	Lag PF A Delay	Voltage Unbal F Delay	Current Imbal A Level	THD V A Level	THD I A Delay
+MVAR Un F Level	MVA Un F Level	Lead PF F Level	Lag PF F Level			THD V A Delay	
-MVAR Un F Delay	MVA Un F Delay	Lead PF F Delay	Lag PF F Delay	Voltage Unbal A Level	Current Imbal A Delay		
-MVAR Un A Level	MVA Un A Level	Lead PF A Level	Lag PF A Level				
-MVAR Un A Delay	MVA Un A Delay	Lead PF A Delay	Lag PF A Delay	Voltage Unbal A Delay			

Line Frequency (BA)	**Maintenance**	**History (MBA)**	**Restart (BA)**	**Locked Rotor (BA)**
Starter Fault Enable	Motor Fault Enable (BA)	Fault 1	Motor Restart Enable	Motor Fault Enable
Starter Alarm Enable	Motor Alarm Enable (BA)	Fault 2	Starter Restart Enable	Motor Alarm Enable
Starter Restart Enable	Motor Restart Enable (BA)	Fault 3	Restart Attempts	Motor Restart Enable
Frequency High F Level	PM Hours (BA)	Fault 4	Restart Delay	Locked Rotor F Level
Frequency High F Delay	PM Starts (BA)	Fault 5		Locked Rotor F Delay
Frequency High A Level	Time to PM (MBA)	Alarm 1		Locked Rotor A Level
Frequency High A Delay	Starts to PM (MBA)	Alarm 2		Locked Rotor A Delay
Frequency Low F Level	Starts per Hour (MBA)	Alarm 3		OverCurrent LVL
Frequency Low F Delay		Alarm 4		
Frequency Low A Level		Alarm 5		
Frequency Low A Delay				

Table 26 - Communications Group Parameters

Communications File Group Parameters		
Communications Masks (BA)	**Data Links (BA)**	
Logic Mask	Data In A1	Data Out A1
Logic Mask Act	Data In A2	Data Out A2
Write Mask Cfg	Data In B1	Data Out B1
Write Mask Act	Data In B2	Data Out B2
Port Mask Act	Data In C1	Data Out C1
	Data In C2	Data Out C2
	Data In D1	Data Out D1
	Data In D2	Data Out D2

Table 27 - Utility Group Parameters

Utility File Group Parameters		
Preferences	**Motor Data**	**Expansion (MBA)**
Language (BA)	Motor Connection (MBA)	Expansion A Configuration
Fan Configuration (BA)	Line Voltage (BA)	Expansion A Configuration
Motor Configuration (BA)	Motor FLC (BA)	Expansion A Configuration
Parameter Management (A)	Rated Torque (BA)	
	Rated Speed (Ba)	
	User CT Ratio (A)	
	Factory CT Ratio (A)	
	Voltage Ratio (A)	
	Parameter Management (A)	

Option Module Configuration

Basic Configuration using the HIM

When you plug an Option Module into one of the three available ports (07, 08, or 09), you may need to configure the option module parameters. These parameters reside in the option module through one of the ports (07, 08, or 09) and are not included in the SMC-50 (Port <00>) parameter list.

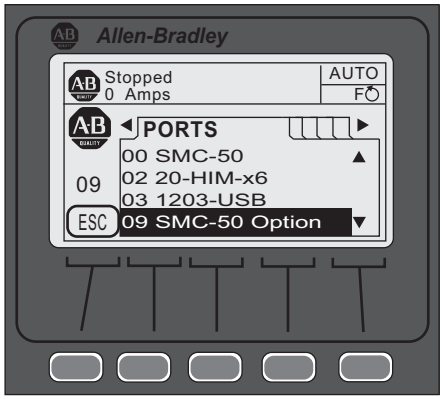
Perform the following steps to access the option module parameters using the HIM.

One Digitial I/O card (150-SM4) is always required for MV applications, and it is always inserted in Port 7.

Before proceeding with these steps: Take note of the SMC-50 control module port number (07, 08, or 09) that the option module is connected to.

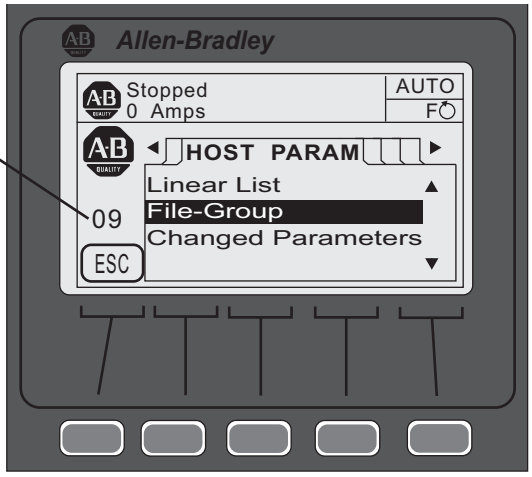
1. Press the FOLDERS single function key.

2. Use the forward or back arrow until the PORTS folder screen is displayed.



3. Use the up or down arrow until the noted port number of the option module is displayed. The HIM displays the HOST PARM file screen and indicates the option module port control module number below the AB logo.

Ensure that the correct port number is displayed before you modify the option module parameter



4. Ensure the correct port number is displayed, then configure the parameters using either the Linear List or File-Group selection.

Parameters can be restored to factory defaults using its respective Parameter Management parameter or the Set Defaults function from the HIM's memory screen. Ensure the correct port number of the device to be restored is displayed before restoring.

For additional information using the FOLDERS function of the HIM, see the 20-HIM-A6 user manual, publication 20HIM-UM001.

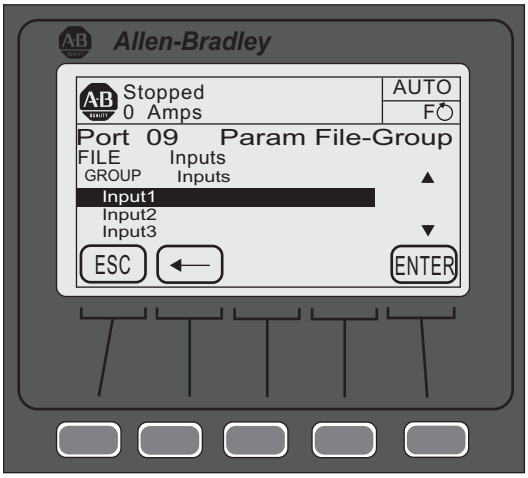
150-SM4 Digital I/O Option Module

In addition to the two on-board 24V DC input and two auxiliary relay outputs of the SMC-50 control module, the 150-SM4 Digital I/O Option Module has four 120...240V AC inputs and three auxiliary relay outputs. You can use these inputs and outputs for control functions.

Configure 120...240V AC Inputs

Before proceeding with the following steps, perform steps 1 through 4 in Basic Configuration using the HIM.

1. From the File-Group screen, press ENTER (number 5 on the keypad). The four inputs are displayed.



2. Use the up or down arrow to select the input, then press ENTER (number 5 on the keypad). The display will show the current setting of the input.
3. Press the EDIT soft key to change the selected input function.
4. Use the up or down arrow to select the desired function (for example, Start, Stop, Coast, etc.), then press the ENTER soft key to load the selection. If necessary, use the back arrow to return to the previous selection.

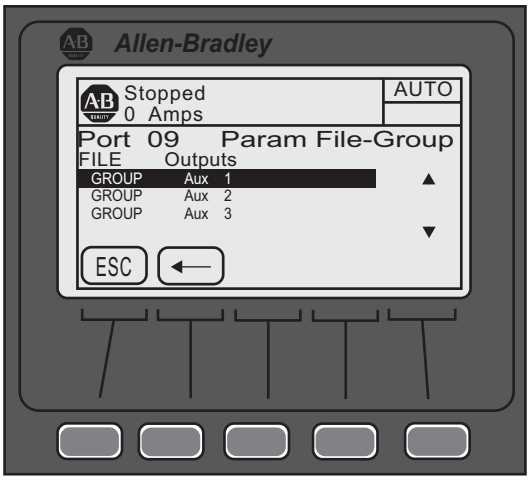
For a complete list of 150-SM4 parameters, see the Digital I/O Option Module Parameter List on page 104.

For additional information using the FILE GROUP function of the HIM, see the 20-HIM-A6 user manual, publication 20HIM-UM001.

Configure Auxiliary Relay Outputs

Before proceeding with the following steps, perform steps 1 through 4 in Basic Configuration using the HIM.

1. Use the up or down arrow to select the one of the Aux Outputs, then press ENTER (number 5 on the keypad).



2. Select one of the four configuration options (Aux X Config, Aux X Invert, Aux X On Delay, or Aux X Off Delay), then press ENTER (keypad or soft key).
3. Modify the auxiliary relay output as desired. If necessary, use the back arrow to return to the previous selection.

Digital I/O Option Module Parameter List

The allowable selections for the 150-SM4 are listed in Table 28.

Table 28 - 150-SM4 Parameters

Parameter		Min/Max Values		Default Value	Access	Units
Number[1]	Name					
X.1	Module Status	Bit 0 = Module Ready/Disabled Bit 1 = Input 1 Status Bit 2 = Input 2 Status Bit 3 = Input 3 Status	Bit 4 = Input 4 Status Bit 5 = Aux 1 Status Bit 6 = Aux 2 Status Bit 7 = Aux 3 Status	–	R	0 = Disabled OFF 1 = Enabled ON
X.2	Input 1	Disable Start Coast Stop Option Start/Coast Start/Stop	Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Motor Heater	Disable	R/W	NA
X.3	Input 2					
X.4	Input 3					
X.5	Input 4					
X.6	Aux 1 Config	[Normal] UTS (Up-to-Speed) Fault Alarm Ext Bypass Ext Brake	DeviceLogix Aux Control[2] Network 1 Network 2 Network 3 Network 4 Fan Control	Normal	R/W	NA
X.7	Aux 1 Invert	Disable Enable		Disable	R/W	
X.8	Aux 1 On Delay	0.0...10.0		0.0	R/W	seconds
X.9	Aux 1 Off Delay	0.0...10.0		0.0	R/W	seconds
X.10	Aux 2 Config	Normal UTS (Up-to-Speed) Fault Alarm Ext Bypass Ext Brake	DeviceLogix Aux Control[2] Network 1 Network 2 Network 3 Network 4 Fan Control	Normal	R/W	NA
X.11	Aux 2 Invert	Disable Enable		Disable	R/W	NA
X.12	Aux 2 On Delay	0.0...10.0		0.0	R/W	seconds
X.13	Aux 2 Off Delay	0.0...10.0		0.0	R/W	seconds
X.14	Aux 3 Config	[Normal] UTS (Up-to-Speed) Fault Alarm Ext Bypass Ext Brake	DeviceLogix Aux Control[2] Network 1 Network 2 Network 3 Network 4 Fan Control	Normal	R/W	NA
X.15	Aux 3 Invert	Disable Enable		Disable	R/W	NA
X.16	Aux 3 On Delay	0.0...10.0		0.0	R/W	seconds
X.17	Aux 3 Off Delay	0.0...10.0		0.0	R/W	seconds
X.18	Parameter Mgmt	Ready Factory Default		Ready	R/W	NA

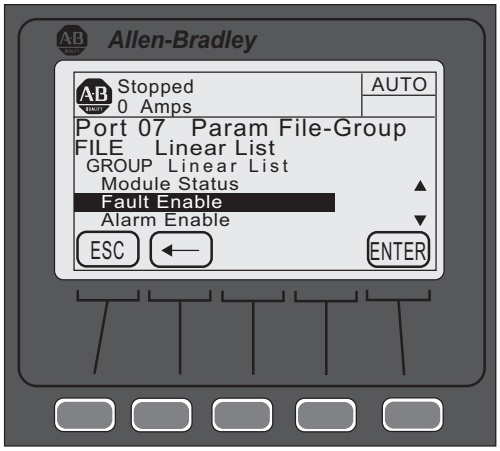
(1) "X" indicates the port number (07, 08, or 09) the 150-SM4 is connected to the SMC-50 control module. This port number is displayed on the HIM screen below the Allen-Bradley brand logo.
(2) An auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit form the AuxControl, Parameter 180.

150-SM2 PTC, Ground Fault, and External Current Transformer Module

The 150-SM2 Option Module provides simultaneous interface capability to three different types of external sensing devices which can be used by the controller for certain application conditions. When installing the 150-SM2 into the SMC-50 control module, the following installation requirements **must** be followed:

- Only one 150-SM2 can be installed in one SMC-50 control module.
- The 150-SM2 **must** reside in port 7 or 8 only. **DO NOT** use port 9 with the 150-SM2.
- When the external CT function is enabled through the 150-SM2 CT Enable Bit, the external CT is calibrated by the SMC-50 control module for scaling, phase shift, and inversion. The calibration cycle will automatically occur:
  - before the first START occurs after the 150-SM2 installation and when the CT Enable, Parameter X.12, = Enable,
  - after a Load Defaults occurs, and
  - when you force tuning of the SMC-50 control module through the Force Tuning, Parameter 194, or the HOLD TO TEST button on the SMC-50 control module is held for > 10 seconds when stopped.

To configure the 150-SM2, follow the steps in Basic Configuration using the HIM on page 101 then proceed with the following steps.



1. Using the File-Group selection, press ENTER (number 5 on the keypad) until the Group Linear List is displayed.
2. Use the up or down arrow to scroll to the desired parameter, then press ENTER.

   If the parameter **is** bit configured (for example, Fault Enable):

   a. Use the left or right arrow to move to the bit location that needs to be modified. The bit function is displayed at the bottom of the screen.

   b. Press EDIT to move to the edit screen.

   c. Change the bit assignment, then press EDIT.

   If the parameter **is not** bit configured (for example, Turns Ratio):

   a. Press the EDIT.

   b. Change the value within the displayed limits, then press ENTER to load the parameter contents into memory.

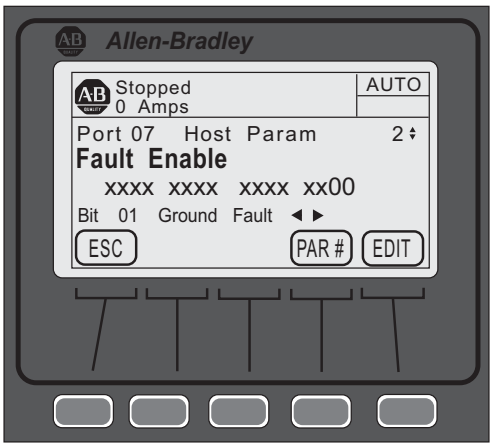


Table 29 provides the parameter detail of the 150-SM2.

Table 29 - 150-SM2 Parameters

Parameter		Min/Max Values	Default Value	Access	Units
Number[1]	Name				
X.1	Module Status	Bit 0 = Module Ready Bit 1 = PTC Bit 2 = CT Loss	–	R	Bit = 0 Disable Bit = 1 Enable
X.2	Fault Enable	Bit 0 = PTC Bit 1 = Ground Fault	–	R/W	Bit = 0 Disable Bit = 1 Enable
X.3	Alarm Enable				
X.4	Restart Enable				
X.5	Turns Ratio[2]	100...2000	1000	R/W	NA
X.6	Ground Fault Level[3]	0.00...5.00	2.5	R/W	Amps
X.7	Ground Fault Delay	0.1...250.0	0.5	R/W	Seconds
X.8	Ground Fault A Level	0.00...5.00	2.5	R/W	Amps
X.9	Ground Fault A Delay	0.1...250.0	0.5	R/W	Seconds
X.10	Ground Fault Inh Time[4]	0.0...250.0	10.0	R/W	Seconds
X.11	Ground Current	0.00...5.00	0.00	R	Amps
X.12	CT Enable	Disable Enable	Disable	R/W	NA
X.13	CT Scaling A	0.10...5.00	1.00	R	NA
X.14	CT Scaling B				
X.15	CT Scaling C				
X.16	Phase Shift A	-12.50...12.50	0.00	R	Degree
X.17	Phase Shift B				
X.18	Phase Shift C				
X.19	Parameter Mgmt	Ready Factory Default	Ready	R/W	NA

(1) 'X' indicates the port number (07, 08, or 09) the 150-SM2 is connected to the SMC-50 control module. This port number is displayed on the HIM screen below the AB brand logo.
(2) Configure Turns Ratio to the value of the Ground Fault sensor CT Turns Ratio (for example, 825-CBCT=100:1 Set X.5 to 100.
(3) The sensing range of the module.
(4) Inhibit Time lets you inhibit (disable) ground fault protection for the time selected during starting.

Metering

Overview

While the SMC™-50 operates a motor, it is also monitoring several different parameters to provide a full-function metering package.

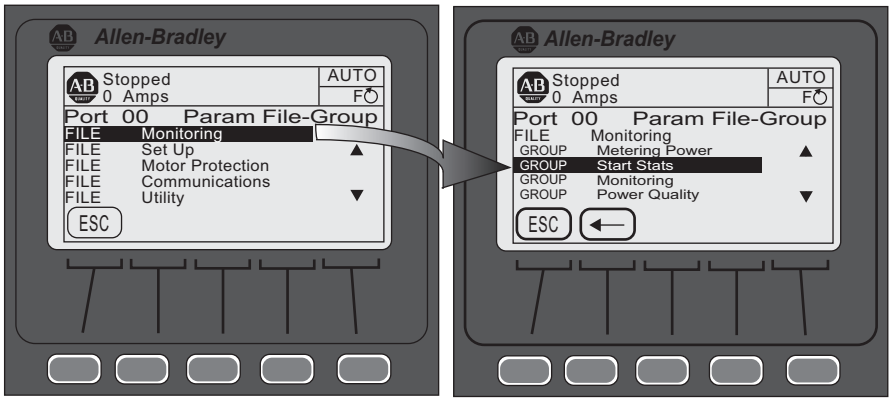
Viewing Metering Data

To access the metering information using the 20-HIM-A6, use the keypad to follow the procedure below.

1. From the SMC-50 control module standard power-up screen, select **FOLDERS**.
2. Use the right or left arrow until the **Port 00 DEV PARAM** screen is displayed.

Ensure the Advanced Access Level is selected, located at the bottom of the DEV PARAM screen. For additional configuration details, see Parameter Access Level Modification Using the HIM on page 80.

3. From the **Port 00 DEV PARAM** screen, select File-Group, then press the ENTER key (number 5 on the keypad). The **Port 00 Param File-Group** screen appears.
4. Use the up or down Arrow key to select File Monitoring. The Port 00 Param File-Group File Monitoring screen appears with seven GROUP metering selections (Metering Basics, Metering Volts, Metering Current, Metering Power, Start Stats. Monitoring, Power Quality).



5. Use the up or down arrow key to select the desired GROUP, then press the ENTER key (number 5 on the keypad).
6. Select the desired parameter from the previous group selected, then press the ENTER key to monitor the metering parameter.

With the exception of the Meter Reset, Parameter 16, the metering parameters contained in the Monitoring File-Group are Read (R) only. See Metering System on page 32 and Metering Parameters on page 108 for a detailed list of metering parameters.

Resetting Metering Parameters

Meter Reset, Parameter 16, is used to clear (reset to 0) the contents of metering parameters Elapsed Time, Energy, Time to PM (Preventive Maintenance), and Starts to PM. To clear the contents of any one of these parameters, configure Meter Reset to the specific parameter you wish to clear.

EXAMPLE To clear (reset to 0) the Elapsed Time, configure Meter Reset to Elapsed Time. The controller will then clear the Elapsed Time and the value of Meter Reset will return to Ready 0.

To access Meter Reset using the 20-HIM-A6, perform steps 1...4, Viewing Metering Data.

1. From Step 4, select the **Metering Basic Group**, then press ENTER (number 5 on the keypad).
2. Use the down arrow on the keypad to select/highlight **Meter Reset**.
3. With Meter Reset highlighted, press the ENTER key (number 5 on the keypad) or the ENTER soft key.
4. Press the EDIT soft key.
5. Use the up or down arrow to select the desired parameter (Elapsed Time, Energy, Time to PM, or Starts to PM) to be reset, then press the soft ENTER soft key. The selected parameter is reset to zero with the exception of the Starts to PM.

When the ENTER key is pressed and Starts to PM is selected, its contents is set to the value contained in PM Starts, Parameter 127.

Metering Parameters

Current

The SMC-50 control module calculates true RMS current based on Current Transformer (CT) feedback for all three phases. It also calculates an average value of the three phase currents. During Braking operation, the calculated current is estimated based on time and current settings. This parameter reports the three-phase motor current measurements. These measurements are always line current, regardless of the type of connection. The accuracy of the current calculation is ±5% of the true RMS current.

Table 30 - Metering Parameters Associated with Current

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
5	Current Average	0...15,000	0	R	Amps
6	Current Phase A				
7	Current Phase B				
8	Current Phase C				

Voltage

Line-to-Line and Line-to-Neutral RMS voltage is calculated for all three phases with the average of the three voltages also provided. The data is provided whenever 3-phase power is applied.

The accuracy of the voltage calculations is ±2% of the true RMS voltage.

Table 31 - Metering Parameters Associated with Voltage

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
1	Voltage P-P Average	[0]...15,000	[0]	R	Volts
2	Volts Phase A-B				
3	Volts Phase B-C				
4	Volts Phase C-A				
265	Voltage P-N Average	[0]...9000	[0]	R	Volts
266	Volts Phase A-N				
267	Volts Phase B-N				
268	Volts Phase C-N				

Torque

The SMC-50 control module calculates true electromechanical torque based on the existing motor voltage and current feedback data.

- During Braking operations, Torque reads 0.
- For the Torque parameter to display correctly, the motor value for Rated Torque, Parameter 47, and Rated Speed, Parameter 48, must be correctly configured.

The accuracy of the torque calculations is ±10% of the true electromechanical torque.

Table 32 - Metering Parameters Associated with Torque

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
9	Torque	-50...300	0	R	%

Power

Real, Reactive, and Apparent power calculations (along with demand and maximum demand) are made on each line power phase along with a total for all three phases.

The Energy parameters can be cleared using the Meter Reset parameter. See Resetting Metering Parameters on page 108 for further details.

For Reactive Energy, Parameter 278 and 279, the system will keep a:

- positive energy, which only integrates power when it is positive,
- negative energy, which only integrates power when it is negative, and
- net energy, which always integrates.

The demand numbers are calculated as follows:

- Energy is calculated over a period of time defined by "Demand Period", Parameter 290.
- The previous "n" period values are averaged and the result is written to the Demand, Parameter 272, 281 and 288, which is used in calculating the Max Demand values. This averaging uses a rolling window algorithm where the previous "n" periods are averaged.

Table 33 - Metering Parameters Associated with Power

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
269	Real Power A	±1000.000	0.000	R	MW
270	Real Power B				
271	Real Power C				
10	Real Power				
11	Real Energy	±1000.000	0.000	R	MWH
272	Real Demand	±1000.000	0.000	R	MW
273	Max Real Demand				
274	Reactive Power A	±1000.000	0.000	R	MVAR
275	Reactive Power B				
276	Reactive Power C				
277	Reactive Power				
278	Reactive Energy C	±1000.000	0.000	R	MVRH
279	Reactive Energy P				
280	Reactive Energy	±1000.000	0.000	R	MVRH
281	Reactive Demand	±1000.000	0.000	R	MVAR
282	Max. Reactive Dmd				
283	Apparent Power A	±1000.000	0.000	R	MVA
284	Apparent Power B				
285	Apparent Power C				
286	Apparent Power				
287	Apparent Energy				MVAH
288	Apparent Demand				MVA
289	Max. Apparent Demand				
290	Demand Period	1...255	1	R/W	min
291	Number of Periods	1...15	1	R/W	—

Power Factor

Power Factor is calculated for each phase along with a total power factor value. The power factor calculation does not apply during Braking operations.

Table 34 - Metering Parameters Associated with Power Factor

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
292	Power Factor A	-1.00...1.00	0.00	R	NA
293	Power Factor B				
294	Power Factor C				
17	Power Factor				

Elapsed Time

The SMC-50 control module keeps a log of the total accumulated hours the controlled motor has been running via the Elapsed Time metering parameter. The Elapsed Time meter value is updated every 10 minutes and stored at power down (accurate to 1/6 of an hour). The Elapsed Time meter accumulates to 50,000 hours of operation and can be reset to zero via the Meter Reset parameter (see Resetting Metering Parameters on page 108).

Elapsed Time 2 is similar to Elapsed Time. Elapsed Time 2 differs in that you cannot reset it and will count up to 50,000 hours and then hold that value (it will not roll over).

Table 35 - Metering Parameters Associated with Elapsed Time

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
12	Elapsed Time	0.0...50000.0	0.0	R	Hours
13	Elapsed Time 2			R	

Running Time

The Running Time meter parameter logs the amount of time the motor has been operating. The timer resets to zero and begins counting as each start command is received.

When the controller is stopped, the parameter displays the length of time the motor was previously operating.

Table 36 - Metering Parameters Associated with Running Time

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
14	Running Time	0.0...50000.0	0.0	R	Hours

Motor Speed

The Motor Speed meter parameter is only valid when using the Linear Speed Starting or Linear Speed Stopping modes. It provides the estimated motor speed during either the starting or stopping maneuver. When the controller is not in these modes, the Motor Speed meter parameter reads zero except when the unit is at speed. In this case, the parameter displays 100%.

Table 37 - Metering Parameters Associated with Motor Speed

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
34	Motor Speed	0...100	0.0	R	%

Actual Start Time

The SMC-50 control module logs the start time of the last five motor starts and stores that information in Parameters 24 through 28. The start time data is stored in a first-in, first-out method so the record of the last five starts is always maintained.

Table 38 - Metering Parameters Associated with Actual Start Time

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
24	Start Time 1	0...1000	0	R	Seconds
25	Start Time 2				
26	Start Time 3				
27	Start Time 4				
28	Start Time 5				

Peak Start Current

The SMC-50 control module logs the peak average RMS current during each start and stores that information in Parameters 29 through 33. The Peak Start Current data is stored in a first-in, first-out method so the record of the last five starts is always maintained.

Table 39 - Metering Parameters Associated with Peak Start Current

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
29	Peak Current 1	0...15,000	0	R	Amps
30	Peak Current 2				
31	Peak Current 3				
32	Peak Current 4				
33	Peak Current 5				

Total Starts

The SMC-50 control module maintains a Total Start counter which is incremented each time the controller is started. As shipped, the counter value is zero. You cannot reset it.

The Total Starts counter is not incremented if the controller faults on a pre-start fault. It is incremented once SCR gating begins.

Table 40 - Metering Parameters Associated with Total Starts

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
23	Total Starts	0...30,000	0.0	R	NA

Total Harmonic Distortion (THD)

The SMC-50 control module provides the IEEE calculated THD value for the three Line Voltages (Line-to-Neutral) and the three Motor Phase Currents (current through controller Power Pole[1]). In addition, the average THD is calculated for both Line Voltage and Phase Current.

The controller algorithm uses a round-robin approach to gather the six signals by sampling one signal and then calculating the THD value for that signal. In other words, each power cycle current and voltage THD are calculated for a phase, then for the next phase and so on.

When the motor is not running, the Current-Based THD values read 0.

Table 41 - Metering Parameters Associated with THD

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
35	THD V_a	0.0...1000.0	0.0	R	%
36	THD V_b				
37	THD V_c				
38	THD V_{ave}				
39	THD I_a				
40	THD I_b				
41	THD I_c				
42	THD I_{ave}				

Line Frequency

The SMC-50 control module measures and displays the system 3-phase AC Line Frequency. Upon power up, the Line Frequency parameter displays zero until a valid AC Line Frequency is measured. When three-phase power is removed from the controller, the parameter maintains the value of the previous frequency reading.

Table 42 - Metering Parameters Associated with Line Frequency

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
224	Line Frequency	0...100	0	R	Hz

(1) When in external bypass running mode/configuration, you can use an external CT (825-MCM) and a 150-SM2 Option Module to read current-based (THD Ix) values.

Current Imbalance

The SMC-50 control module provides a calculated Current Imbalance value. The Current Imbalance calculation is equal to the largest deviation of the three RMS phase current signals from the average RMS phase current, divided by the average. Note that the controller Power Pole Current is used for the Current Imbalance calculation.

Table 43 - Metering Parameters Associated with Current Imbalance

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
295	Current Imbalance	0...100	0	R	%

Voltage Unbalance

The SMC-50 control module provides a calculated Voltage Unbalance value. The Voltage Unbalance calculation is equal to the largest deviation of the three RMS phase voltage signals from the average RMS phase voltage divided by the average. Note that the phase-to-neutral voltage is used in the calculation for voltage unbalance.

Table 44 - Metering Parameters Associated with Voltage Unbalance

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
296	Voltage Unbalance	0...100	0	R	%

Optional HIM Operation

Overview

The SMC™-50 control module offers a variety of unique control options that provide enhanced motor starting and stopping capabilities.

HIM Control Buttons

The control buttons available with the Bulletin 20-HIM-A6 LCD modules are compatible with the control options on the controller. Table 45 and Table 46 detail the functionality of each control button. For additional details on using the 20-HIM-A6, see the user manual, publication 20HIM-UM001.

IMPORTANT You must enable the logic mask port before you initiate control commands except for Stop, which always initiate a Coast-to-Stop command. See Control Enable on page 121 for instructions.

ATTENTION: The Bulletin 20-HIM-A6 LCD module's stop push button is not intended to be used as an emergency stop. See applicable standards for emergency stop requirements.

Table 45 - 20-HIM-A6 Control Button Functionality, Standard Control

Option	Action	Operation When Pressed
Soft Stop Current Limit Full Voltage Linear Speed		The green start button begins motor acceleration to full speed.
		The red stop button provides a coast stop, and/or reset a fault.
		This button brings up the Control Screen to enable the stop option maneuver. See the HIM Control Screen on page 116 section.

Table 46 - 20-HIM-A6 Control Button Functionality, Pump Control

Option	Action	Operation When Pressed
Pump Control		The green start button begins motor acceleration to full speed.
		The red stop button provides a coast stop, and/or reset a fault.
		Displays the Control Screen with the Jog button. The jog button initiates a pump stop maneuver.

HIM Control Screen

The HIM Control Screen is typically used to directly control a drive. Press the  (controls) key to display the Control Screen.

IMPORTANT To navigate from the Control Screen to another HIM menu screen, you must press the ESC soft key. This deactivates the Control Screen and displays the previous screen.

Figure 46 - HIM Control Screen

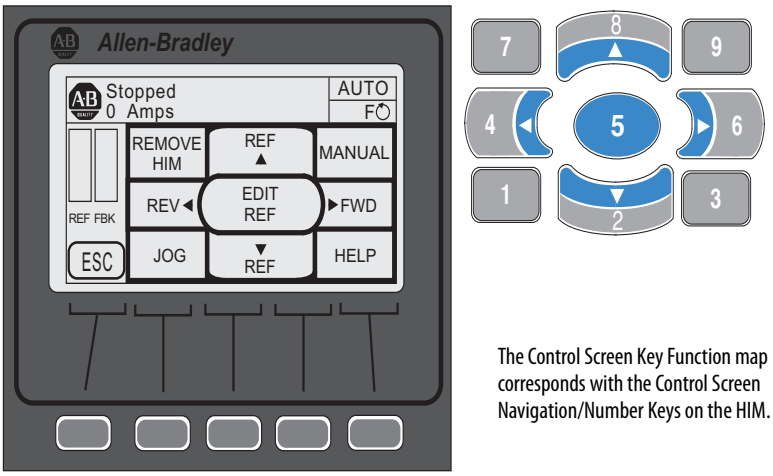


Table 47 - Control Screen Soft Key Functionality

Label	Name	Function
ESC	Escape	Reverts back to the previous screen.

Table 48 - Control Screen Navigation/Number Keys

Label	Name	Function
JOG		Stop Option for controller
REF ?		NA
HELP		Displays Rockwell Automation Drive's Technical Support direct phone number, website address, and email address.
REV ◀		NA
EDIT REF		NA
FWD ▶		NA
REMOVE HIM		Allows HIM removal without causing a fault if the HIM is not the last controlling device. The REMOVE HIM label is not available when the HIM has a manual control of the host SMC-50 controller. In this case, a fault occurs if the HIM is removed.
REF ?		NA
MANUAL		NA

CopyCat Function of the 20-HIM-A6

The SMC-50 control module supports the CopyCat function of the 20-HIM-A6. For details on using the CopyCat function, see the 20-HIM-A6 user manual, 20HIM-UM001.

Notes:

Communications

Overview

The SMC™-50 control module provides advanced communications capabilities that allow you to start and stop it from multiple sources and provide diagnostic information through the use of communication interfaces. The SMC-50 control module uses DPI as an internal method of communication bus; therefore, all standard DPI communication interfaces that are used by other devices (for example, PowerFlex® drives) can be used in the SMC-50 control module. SCANport™ devices are not supported by the SMC-50 control module.

Standard DPI communications cards are available® for various protocols, including DeviceNet, ControlNet, ModBus, and PROFIBUS DP. Other modules may be available in the future. For specific programming examples, configuration, or programming information, see the user manual for the communication module being used. Table 49 shows a list of available modules.

Table 49 - Communication Card Selection by Protocol Type

Protocol Type	Cat. No.	User Manual
DeviceNet	20-COMM-D	20COMM-UM002
ControlNet	20-COMM-C	20COMM-UM003
Profibus®	20-COMM-P	20COMM-UM006
RS-485	20-COMM-S	20COMM-UM005
InterBus	20-COMM-I	20COMM-UM007
EtherNet/IP	20-COMM-E	20COMM-UM010
Dual Port EtherNet/IP	20-COMM-ER	20COMM-UM015
RS485 HVAC	20-COMM-H	20COMM-UM009
ControlNet (Fiber)	20-COMM-Q	20COMM-UM003
CANopen	20-COMM-K	20COMM-UM012

Communication Ports

The SMC-50 control module supports four DPI ports for communication. Port 1 is for the front-mounted (bezel) Human Interface Module (HIM). Ports 2 and 3 are supported through the serial connection on the top of the device and are typically used to interface with a door mounted HIM or a PC. Port 2 is the default connection with port 3 available by installing a splitter on port 2. DPI Port 4 is supported by connecting one of the communication cards listed in Table 49 to the internal DPI communication card connection (SMC-50 control module hardware controller port 9).

HIM Keypad and Displays

The SMC-50 control module can be programmed with the optional Bulletin 20-HIM-A6 LCD display. Parameters are organized in a multi-level menu structure and are divided into programming groups.

Connecting the HIM to the Control Module

Figure 47 shows how to connect a HIM and DPI device to the SMC-50 control module. Table 50 provides a description of each port.

The SMC-50 controller only supports the use of DPI communication modules and DPI 20-HIM-A6 Modules.

See the control wiring diagram that enables start-stop control from a HIM.

Figure 47 - SMC-50 Control Module with a HIM

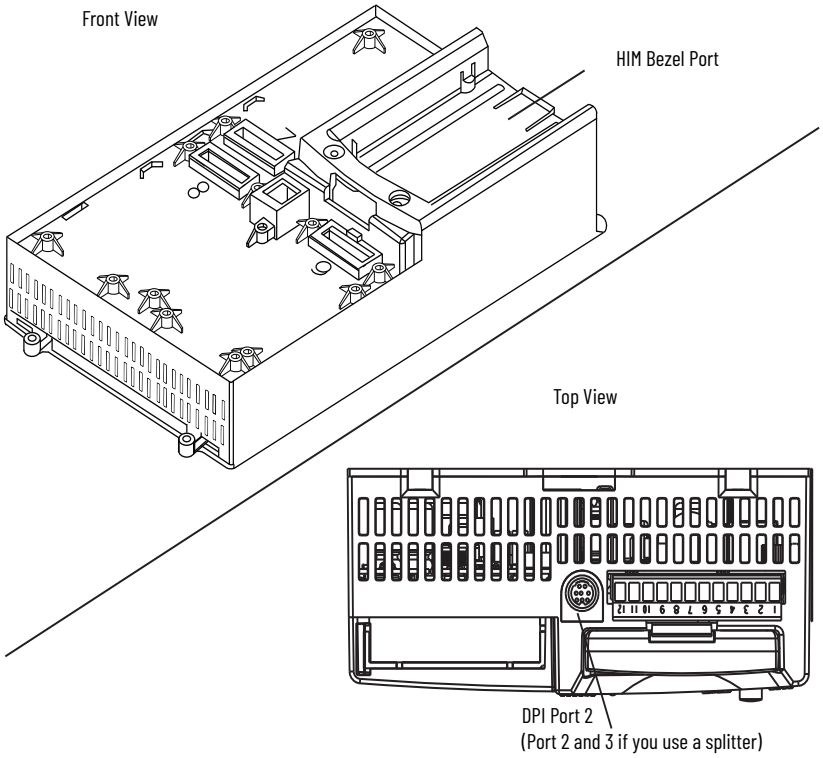


Table 50 - Description of Ports

DPI Port Number	Source
1	Front-Mounted HIM (HIM Bezel)
2	Remote DPI (top of SMC-50 control module)
3	Remote DPI (top of SMC-50 control module with splitter)
4(1)	20-COMM-x Module

(1) When using a 20-COMM-x network communication module, it must physically be located in control module hardware port 9. However, its DPI Port Number assignment is 4. The cable connection for the DPI Port 4 is located below the HIM bezel (see Figure 47).

Control Enable

Logic Mask, Parameter 148, lets you configure whether a communication device (HIM or network connection) can perform motor control commands such as starting. Each communication port (1 through 4) can be enabled (bit= 1) or disabled (bit = 0) as required. When a given device is enabled through the logic mask that device is allowed to execute control commands. In addition, disconnecting any device with the logic mask enabled will result in an Exp Removed (X026)[1] communication fault. You can disconnect adevice that is disabled through the logic mask without causing a fault[2].

IMPORTANT Stop commands override all start commands and can be initiated from the hardwired inputs or any DPI port regardless of the logic mask.

Logic Mask Enable/Disable using a HIM

To enable motor control using a connected HIM, follow the procedure below with the connected HIM's programming keys.

The Bulletin 20-HIM-A6 provides start and stop control of the controller. However, the Logic Mask factory default settings disable control commands other than Stop through the controller's DPI ports 1, 2, 3, or 4.

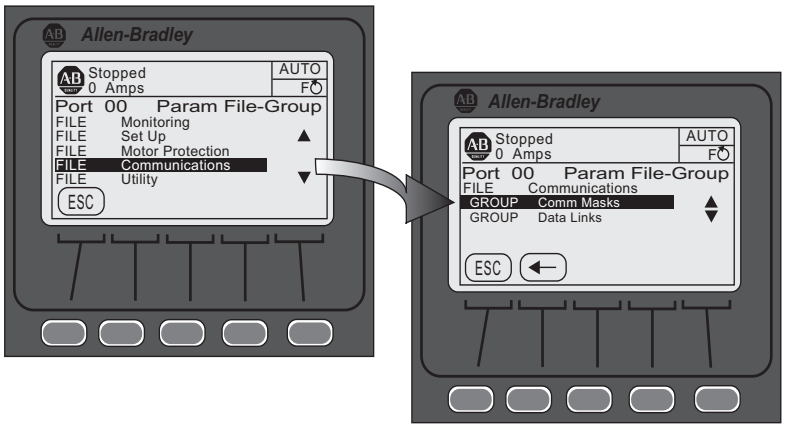
To enable motor control from either of the four ports using a connected 20-HIM-A6, the following steps must be performed from the SMC-50 control module standard power-up screen.

1. Press the  key. Use the right or left arrow key on the keypad to display the <00> DEV PARAM folder screen.
2. Select/highlight the File-Group.
3. Press the  (enter) key. The Port 00 Param File-Group screen appears.

Ensure the Advanced Access Level is selected, located at the bottom of the DEV PARAM screen. For additional configuration details, see Parameter Access Level Modification Using the HIM on page 80.

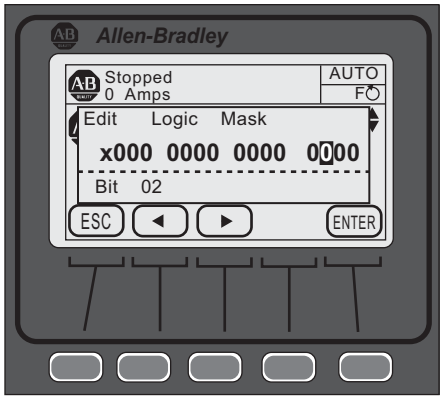
(1) When a given device is disabled through the logic mask that device cannot execute control commands, but can still be used for configuration and monitoring. X = DPI port number of the device causing the Fault.
(2) If a 20-HIM-A6 is enabled for control via the Logic Mask, it can still be removed using the HIM control screen. See Chapter 6.

4. Press the ▼ to select FILE Communications, then press 5. The GROUP Comm Masks and Data Links screen appears.



5. With Comm Mask selected/highlighted, press the 5 key. The GROUP Comm Masks screen appears with the associated Logic Mask Action selected.

6. Select/highlight Logic Mask, then press the 5 key. The Edit Logic Mask screen with bit field appears.



7. Press the EDIT key to modify the settings, then use the left or right arrow to select the desired bit, 1 through 4, then press the 5 key.

   To enable motor control, press 1 or press 0 to disable motor control from the selected DPI port, then press EDIT.

Table 51 - Logic Mask and Logic Mask Active Parameter Specifications

Parameter		Bit Number	DPI Assignment	Access	Units [default]
Number	Name				
148	Logic Mask	0 - NA 1 2 3 4 5 - 15 NA	Port 0 - NA Port 1 Port 2 Port 3 Port 4 Port 5 - 15 NA	R/W	Bit = 0 [disabled] Bit = 1 enabled
149	Logic Mask Act			R	Bit = 0 [disabled] Bit = 1 enabled [Follows Logic Mask]

IMPORTANT
- The Logic Mask must be set to 0 or the "REMOVE HIM" key is depressed via the HIM controller screen (see Chapter 6) before you disconnect the HIM from the SMC-50 control module. If not, the unit will fault on a “Exp. Removed”.
- The Logic Mask Active, Parameter 149, is a read-only parameter that shows the logic mask actually in use at any given time. It typically follows the Logic Mask, Parameter 148, except in some application environments where network communication is in use.

Loss of Communication with DPI Device

An "Exp. Removed" fault indicates that a device was improperly removed. There is a Fault code determined by port number.

DPI provides a separate Exp. fault for each port. This fault can be generated directly by the peripheral and is separate from the Exp. Removed fault (device specific).

Default Input/Output Communication Configuration

The default configuration for I/O communication is 4 bytes in and 4 bytes out (TX = 4 bytes, RX = 4 bytes). The total size may very when used with a communication card. The default configuration is arranged according to the following table.

Table 52 - Default Configuration

Word	Produced Data (Status)	Consumed Data (Control)
0	Logic Status	Logic Command
1	Feedback (1)	Reference(2)

(1) The feedback word is always Ave Current.
(2) The reference word is not used with the SMC-50 control module, however the space must be reserved.

The total data size produced or consumed may vary, depending on the communication card being used. For more information, see the user manual of the specific communication card being used with the SMC-50 control module.

Variable Input/Output Configuration

The SMC-50 control module supports 32-bit Data Links. Therefore, you can configure the device to return additional information. The I/O message size depends on how many DataLinks are enabled. The following table summarizes the I/O data sizes.

Table 53 - I/O Data Sizes

Rx Size	Tx Size	Logic Status/Command (16-bit)	Reference/FeedBack (16-bit)	DataLinks			
				A	B	C	D
4	4	x	x				
12	12	x	x	x			
20	20	x	x	x	x		
28	28	x	x	x	x	x	
36	36	x	x	x	x	x	x

To configure DataLinks, see Configuring DataLink™ on page 126.

SMC-50 Control Module—Bit Identification

Product Functional (Logic) Status, Parameter 43, is used to provide SMC-50 control module functional (logic) status to communication devices. Table 54 details Parameter 43, which is a read-only parameter.

Table 54 - Logic Status

Bit Number	Status/Function	Description	
		1	0
0	Enabled/Ready	Control Power Applied	Control Power NOT applied
1	Running	Power applied to motor (gating SCRs or bypass closed)	Power NOT applied to motor
2	Phasing	ABC phasing	CBA phasing
3	Phasing Active	Three-phase is valid	No valid three-phase detected
4	Starting (Accel)	Performing a start maneuver	Not performing a start maneuver
5	Stopping (Decel)	Performing a stop maneuver (coast to stop not included)	Not performing a stop maneuver
6	Alarm	Alarm present	No alarm present
7	Fault	Fault condition exists and has not been cleared	No fault condition
8	At Speed	Full voltage applied (bypass or full SCR conduction)	No full voltage applied
9	Start/Isolation	Start/Isolation contactor enabled	Start/Isolation contactor disabled
10	Bypass	Bypass contactor enabled	Bypass contactor disabled
11	Ready	Ready to Run	Control Inhibit Active (do not run)
12-13	Reserved	Always 0	
14	Input #1	Control Module Input #1 Status	
15	Input #2	Control Module Input #2 Status	

Table 55 - Logic Command Word (Control)

Bit Number	Control	Description	
		1	0
0	Stop	Coast/Inhibit	No action
1	Start	Start	No action
2	Stop Option	Stop/Maneuver	No action
3	Clear Fault	Clear fault	No action
5	Emergency Run	Enable emergency run mode	Disable emergency run mode
8…10	Reserved	These bits must always be set to 0	
11	Aux Enable	Use the Network #1 - #4 bits	Ignore the Network #1 - #4 bits
12	Network #1	Closes any output configured for Network #1	Opens any output configured for Network #1

Table 55 - Logic Command Word (Control)

Bit Number	Control	Description	
		1	0
13	Network #2	Closes any output configured for Network #2	Opens any output configured for Network #2
14	Network #3	Closes any output configured for Network #3	Opens any output configured for Network #3
15	Network #4	Closes any output configured for Network #4	Opens any output configured for Network #4

Reference/Feedback

The SMC-50 control module does not offer the analog **Reference** feature. The analog **Feedback** feature is supported and provides Current Average, Parameter 5, automatically as the feedback word.

Parameter Information

A complete listing of the SMC-50 parameters is located in Appendix on page 179.

Scale Factors for PLC Communication

The parameter values stored and produced by the SMC-50 through communication are unscaled numbers. When reading or writing values from a PLC image table, it is important to apply the proper scaling factor, which is based on the number of decimal places.

Read Example

Power Factor, Parameter 17—The stored value is 85. Because this value has two decimal places, the value should be divided by 100. The correctly read value is 0.85.

Write Example

Motor FLC, Parameter 78—The example value, which is to be written to the SMC-50 control module, is 75 A. Because this value has one decimal place, the value should be multiplied by 10. The correctly written value is 750.

Display Text Unit Equivalents

Some parameters have text descriptions when viewed from a HIM or through a communication software program such as RSNetworx™. When receiving or sending information from a PLC each text description has a numerical equivalent. The table below shows an example of Meter Reset, Parameter 16, and the appropriate relationship between the text descriptor and the equivalent value. This relationship is identical for other similar parameters located in Appendix B.

Table 56 - Meter Reset Parameter Example

Text Description	Numerical Equivalent
Ready	0
Elapsed Time	1
Energy	2
Time to PM	3
Starts to PM	4

Configuring DataLink™

DataLink is supported in the SMC-50 control module. DataLink is a mechanism that most drives use to transfer data to and from the controller without using an explicit message. The SMC-50 control module supports a 32-bit DataLink, allowing you to configure the device to return up to eight additional pieces of information without the need for an explicit message.

Criteria for Using DataLink

- Each set of DataLink parameters in an SMC-50 can be used by only one adapter. If more than one adapter is connected, multiple adapters must not try to use the same DataLink.
- Parameter settings (contents) in the SMC-50 control module determine the data passed through the DataLink mechanism.
- When DataLink is used to change a value in the SMC-50 control module, the value is not written to the Non-Volatile Storage (NVS). However, if the controller is powered down, the current value is written to NVS.

To configure DataLink, you must use Parameters 153...168 of the SMC-50 control module. See Table 57 for a detailed listing of these parameters. For additional information about DataLink, see the communication interface's user manual.

Table 57 - Parameter 153 - 168 DataLinks Detail

Parameter Number	Description		Min/Max [Default]	Access	Units
153	Data In	A1	[0]-Max Parameter Number(1)	R/W	—
154		A2			—
155		B1			—
156		B2			—
157		C1			—
158		C2			—
159		D1			—
160		D2			—
161	Data Out	A1			—
162		A2			—
163		B1			—
164		B2			—
165		C1			—
166		C2			—
167		D1			—
168		D2			—

(1) The data transferred via the DataLink function is the setting (content(s)) of the parameter number as entered by you here.

Updating Firmware

You can obtain the latest version of firmware and instructions for the SMC-50 control module can be obtained from http://ab.rockwellautomation.com/Motor-Control/LV-Soft-Starters/SMC-50#resources.

Notes:

Diagnostics

Overview

This chapter describes the fault diagnostics of the controller and the conditions that cause various faults to occur.

Protection Programming

Many of the protective features available with the SMC™-50 control module can be enabled and adjusted through the programming parameters provided. For further details on programming, see Motor Protection on page 97.

Diagnostic Status Indicators

The SMC-50 control module multi-color Diagnostic LED Status Indicator and HOLD TO TEST, PUSH TO RESET button are located below the HIM bezel port. The Status LED indicates the status and fault conditions of the controller.

Table 58 - Corresponding LED Color and Fault Conditions

Status LED Color	Device Mode	SMC-50 Control Module Status
Green	Running	Running without an alarm
Green/Amber	Running	Running with an alarm
Green Flashing	Ready	Ready (no inhibit and no fault) without an alarm
Amber/Flashing	Ready	Ready (no inhibit and no fault) with tuning enabled on the next start
Amber	Ready	Ready with alarm (no tuning enabled)
Red/Amber	Inhibit	Inhibited; cannot start due to a Stop command
Red	Faulted	A non-resettable fault has occurred
Red/Flashing	Faulted	A resettable fault has occurred
Red/Green	Download	Firmware is being downloaded

The HOLD TO TEST, PUSH TO RESET button lets you reset an alarm/fault, test for a fault condition, and initiate the tuning mode.

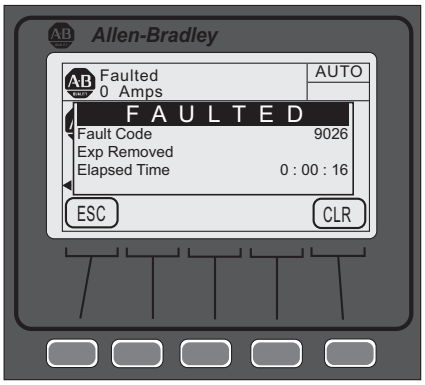
Table 59 - Function Initiation of the HOLD TO TEST, PUSH TO RESET Button

Function	Time Required to Press Button
Fault Reset	Momentary (less than 2 seconds)
Test Fault	Greater than 3 seconds, but less than 10 seconds
Initiate Tuning Mode	Greater than 10 seconds (motor must be stopped)

Fault Display (20-HIM-A6)

When you use the SMC-50 control module with a 20-HIM-A6, the HIM displays the fault information.

Figure 48 - Fault Display



IMPORTANT Resetting a fault does not correct the cause of the fault condition. You must take corrective action before you reset the fault.

The fault display remains active as long as control power is applied. If you cycle control power, the fault is cleared, the control module re-initializes, and the display shows a status of Stopped unless the Fault condition still exists.

You can press Esc to get to another programming/diagnostic list, but the SMC-50 control module is still in a faulted state.

Clear Fault

You can clear a fault using any of the following methods:

- Program the SMC-50 to automatically clear a fault using Restart Enable, Parameter 135 or 264.
- Press the SMC-50 control module HOLD TO TEST, PUSH TO RESET button.
- Connect a N.O. push button to Option Input #1 (terminal 11) or # 2 (terminal 10). Option Input #1 or #2 must be programmed for Clear Fault using Parameter 56 or 57.

This can also be done with an Input from a 150-SM4 Option I/O Module.

- Cycle the control power to the SMC-50.

IMPORTANT You cannot reset an overload fault until the value of the Motor Thermal Usage, Parameter 18, is below the value programmed in OL Reset, Parameter 80.

Fault and Alarm Buffer - Parameter List

The SMC-50 stores the five most recent Fault and Alarm codes (Fault Parameter List 138 to 142, Alarm Parameter List 143 to 147) in parameter memory from newest to oldest.

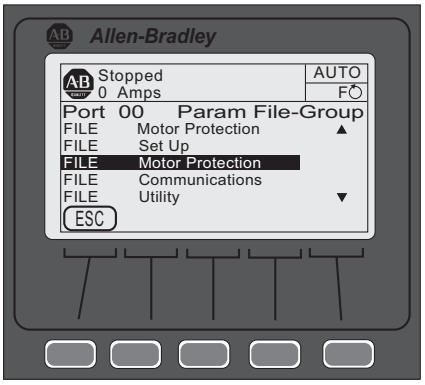
Accessing the Fault and Alarm Parameters

Using the 20-HIM-A6, the fault and alarm parameter lists can be displayed in the Motor Protection File Group or Linear List parameter number search (Fault Parameter List 138 to 142, Alarm Parameter List 143 to 147). To use the File-Group method, perform the following steps:

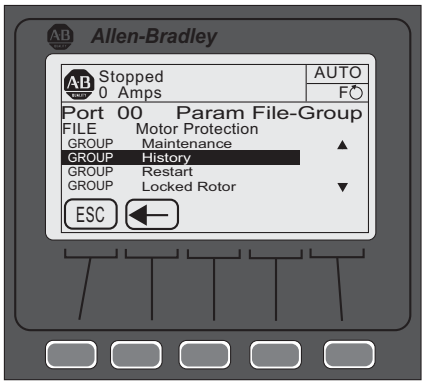
1. From the SMC-50 control module standard power up screen, press the Folders keypad key at the lower left of the display.

Make sure that the Advanced access level (located at the bottom of the <00> DEV PARAM screen) is selected before pressing ENTER. See Parameter Access Level Modification Using the HIM on page 80 for additional details.

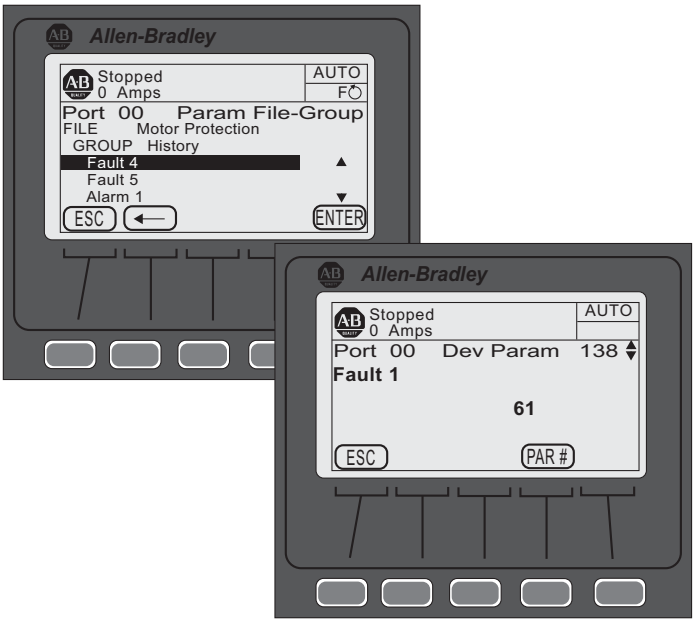
2. From the <00> DEV PARAM folder screen select File-Group, then press ENTER (number 5 from the keypad). The Port 00 Param File Group screen appears.
3. Use the down arrow key to select (highlight) FILE Motor Protection, then press ENTER (number 5 from the keypad).



4. Use the down arrow key to select GROUP History, then press ENTER (number from the keypad).



5. Use the arrow keys on the keypad to navigate to the Fault or Alarm number to review, then press ENTER (number 5 from the keypad).

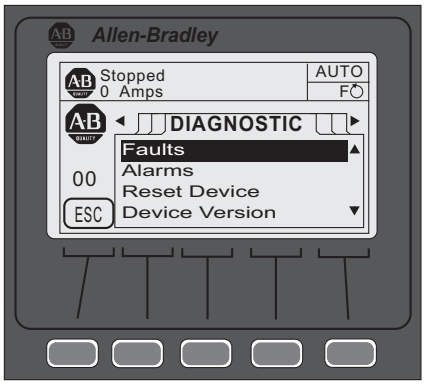


In step 5, Fault 61 is displayed. For Fault/Alarm code data, see Table on page 134.

Accessing the Fault and Alarm Buffers

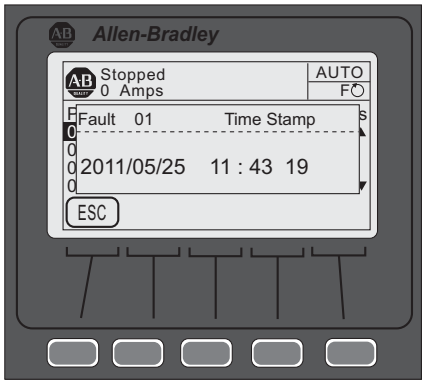
In addition to the SMC-50 control module storing the most recent Alarm and Fault codes as parameters, the date and time the Fault or Alarm occurred is stored in the Fault Buffer (last five faults) and Alarm Buffer (last 100 alarms). To access Fault buffers and Alarm Buffers using the 20-HIM-A6, you must access the Diagnostic folder. To do so, perform the following steps.

1. From the SMC-50 control module standard power up screen, press the Folders key at the lower left of the display.
2. Using the right or left arrow key, display the DIAGNOSTIC folder.
3. Using the up or down arrow key, select either Faults or Alarms, then press ENTER. In this example, Faults is used.



The HIM displays the five most recent Fault codes if Faults was selected. The HIM displays the 100 most recent Alarm codes with an abbreviated description if Alarm codes were selected. The most recent code is listed as 01 with the second most recent code as 02, and so on.

4. Select the Fault or Alarm in question, then press ENTER. The date and time that the Fault or Alarm occurred is displayed.



The Fault/Alarm buffers are available using Connected Components Workbench software via the Explore and Device properties drop-down menu. Ensure 0-SMC-50 controller is selected from the list of Devices.

Fault Codes

Table 60 provides a complete cross-reference of the available fault codes and corresponding fault descriptions.

Table 60 - Fault/Alarm Code Cross-Reference

Fault/Alarm Name		Code	LED Code	Category(1)	Host	DPI/HIM/COMM	Exp 7, 8, 9	Fault/Alarm Name	Code	LED Code	Category(1)	Host	DPI/HIM/COMM	Exp 7, 8, 9
Line Loss	A	1	1	D	X	–	–	Under Power Real	43	–	M	X	–	–
	B	2				–	–	Over Power Real	44	–	M	X	–	–
	C	3				–	–	Un Power Reac +	45	–	M	–	–	–
Shorted SCR	A	4	1	D	X	–	–	Ov Power Reac +	46	–	M	–	–	–
	B	5				–	–	Und Power App	47	–	M	–	–	–
	C	6				–	–	Ov Power App	48	–	M	–	–	–
Open Gate	A	7	2	D	X	–	–	Frequency	49	–	M	X	–	–
	B	8				–	–	PM Hours	50	–	M	X	–	–
	C	9				–	–	PM Starts	51	–	M	X	–	–

Table 60 - Fault/Alarm Code Cross-Reference (Continued)

Fault/Alarm Name		Code	LED Code	Category[1]	Host	DPI/HIM/COMM	Exp 7, 8, 9
SCR Overtemp		10	3	D	X	–	–
Open Bypass	A	11	2	D	X	–	–
	B	12				–	–
	C	13				–	–
No Load		14	2	M	X	–	–
Open Load	A	15	2	M	X	–	–
	B	16				–	–
	C	17				–	–
Voltage Unbal		18	3	M	X	–	–
Overvoltage		19	–	M	X	–	–
Undervoltage		20	–	M	X	–	–
Overload		21	4	M	X	–	–
Underload		22	–	M	X	–	–
Jam		23	–	M	X	–	–
Stall		24	5	M	X	–	–
Phase Reversal		25	6	M	X	–	–
Exp Removed		26	–	D	–	X	X
Exp Incompat		27	–	D	–	–	X
Expansion		28	–	D	–	X	X
Excess Starts		29	–	M	X	–	–
CT Loss	A	30	4	D	X	–	–
	B	31				–	–
	C	32				–	–
HAL ID		33	5	D	X	–	–
NVS Error		34	5	D	–	–	–
V24 Recovery		35	5	D	X	–	–
V24 Loss		36	5	D	X	–	–
VControl Loss		37	5	D	X	–	–
TB Input[3]	1	38	6	D	X	–	X
	2	39			X	–	X
	3	40			–	–	X
	4	41			–	–	X
Current Imbal		42	7	M	X	–	–

Fault/Alarm Name		Code	LED Code	Category[1]	Host	DPI/HIM/COMM	Exp 7, 8, 9
Power Quality	A	52	–	M	X	–	–
	B	53	–	M	X	–	–
	C	54	–	M	X	–	–
Power Quality THD V		55	–	M	X	–	–
Power Quality THD I		56	–	M	X	–	–
Config Change		57	–	D	X	–	–
Ground Fault		58	–	M	–	–	X
Motor PTC		59	–	M	–	–	X
Power Pole PTC		60	3	D	X	–	–
I/O Config		61	–	D	X	–	–
Test Fault		62	6	D	X	–	
Und PF Lag		63	–	M	–	–	–
Und PF Lead		64	–	M	X	–	–
Ovr PF Lag		65	–	M	X	–	–
Ovr PF Lead		66	–	M	X	–	–
-MVAR Over		67	–	M	X	–	–
-MVAR Under		68	–	M	X	–	–
RTC Battery Low		69	5	D	X	–	–
Locked Rotor		70	–	M	X	–	–
Start[2]		71	–	–	–	–	–
Stop Option[2]		73	–	–	–	–	–
Coast [2]		74	–	–	–	–	–
Clear Fault[2]		75	–	–	–	–	–
Fault [2]		76	–	–	–	–	–
Param Change[2]		77	–	–	–	–	–
Reserved	78-99		–	–	–	–	–
System Faults	100-199		5	D	X	–	–

(1) For Category, M= Motor; D=Device
(2) Codes 71...77 are Event codes.
(3) TB = Terminal Block Input

Table provides an overview of the Fault and Alarm codes with Time Delay and Restart options plus a basic description of what causes each Fault or Alarm to occur.

Most Faults and Alarms are individually bit enabled and disabled (F/A Bit Enab) and can have a user configurable delay time to help avoid nuisance trips (Time Delay Aval). In addition, many have the ability to automatically restart once the condition is cleared (Restart En).

Table 61 - Linear Listing—Fault and Alarm Code Overview

Fault/Alarm Code Name		F/A Code	Time Delay Avail.	F/A Bit Enable	Restart Enable	Description F/A= Fault and Alarm, A= Alarm, F= Fault	
Line Loss	A	1	N	Y	Y	**F/A** Loss of line power for Phase A, B, or C	
	B	2					
	C	3					
Shorted SCR	A	4	N	N	NA	**A** During prestart checks (motor stopped not running), the SMC-50 control module monitors for current flow in each individual phase.	**NOTE:** In Wye configurations, a single Phase A, B, or C shorted SCR is not detected until the unit is started. This fault is always enabled.
	B	5					
	C	6					
Open Gate	A	7	N	Y	Y	**F/A** Indicates that an abnormal condition that causes faulty firing (for example, open SCR Gate) has been sensed during the starting sequence.	
	B	8					
	C	9					
SCR Overtemp		10	N	N	NA	**F** The SMC-50 control module protects the SCRs from damage caused by overtemperature operation using an internally configured I^2t. **NOTE:** This fault is always enabled.	
Open Bypass	A	11	N	N	NA	**F** Open Bypass Phase A	Device senses that the bypass contactor did not close on the respective phase.
	B	12	N	N	NA	**F** Open Bypass Phase B	
	C	13	N	N	NA	**F** Open Bypass Phase C	
No Load		14	N	Y	Y	**F/A** The SMC-50 control module can determine if a load connection exists (total load lost or all load leads lost) and a No Load Fault and/or Alarm can be indicated.	
Open Load	A	15	N	Y	Y	**F/A** An Open Load A	Fault/Alarm indicates that the Phase X load lead connection is OFF/Open.
	B	16				**F/A** An Open Load B	
	C	17				**F/A** An Open Load C	
Voltage Unbalance		18	Y	Y	Y	**F/A** Indicates that when the calculated unbalance level is greater than the user-defined Fault and/or Alarm level. See Chapter 4 for calculated value details.	
Overvoltage		19	Y	Y	Y	**F/A** Indicates that if the average line voltage is greater than the user-defined Fault and/or Alarm level.	
Undervoltage		20	Y	Y	Y	**F/A** Indicates that if the average line voltage is less than the user-defined Fault and/or Alarm level.	
Overload		21	Y(1)	Y	Y	**F/A** Enabled in the Motor Protection Group by programming the: Overload Class, Overload Reset, Motor FLC, and Service Factor.	
Underload		22	Y	Y	Y	**F/A** Motor operation will halt (Fault only) if the value of the motor's average RMS current is less than the user-defined value.	
Jam		23	Y	Y	Y	**F/A** Indicates that the motor current increases above the user-defined Fault and or Alarm level while the motor is running at speed. This F/A condition is not active during starting or stopping.	
Stall		24	Y	Y	Y	**F/A** Condition exists and a Fault/Alarm is generated if the SMC-50 control module senses that the motor is NOT Up-to-Speed (UTS) at the end of the programmed starting ramp time plus the time programmed in the Stall Delay time.	
Phase Reversal		25	N	Y	Y	**F/A** Fault/Alarm is indicated when the incoming power to the SMC-50 control module is in any sequence other than ABC.	
Exp Removed		26	N	N	NA	**F** Removing an expansion module (device) (for example, a 150-SM4) from a SMC-50 control module will result in a x026 fault, where "x" is the SMC-50 control module port number (7, 8, or 9) the expansion module was installed. DPI devices (for example, 20-HIM-A6 or 20-COMM-X) will only generate this fault if its associated bit in Logix Mask parameter is set. **NOTE:** If an expansion module (device) (for example, a 150-SM4 is removed from a SMC-50 controller), the message "Device Conflicts Port xy Not Found" is displayed on the HIM or PC software) when power returns.	

Table 61 - Linear Listing—Fault and Alarm Code Overview (Continued)

Fault/Alarm Code Name		F/A Code	Time Delay Avail.	F/A Bit Enable	Restart Enable	Description F/A= Fault and Alarm, A= Alarm, F= Fault
Exp Incompat		27	N	N	NA	**F** Inserting an expansion module or DPI device into an incompatible control module port number or inserting an expansion module into a control module with incompatible version of firmware results in this Fault. The port number of the offending device is included as the first digit of this Fault code.
Expansion		28	N	N	NA	**F** General Fault that can be generated by an expansion or peripheral device. The port number of the offending device is included as the first digit of this Fault code.
Starts per Hour		29	N	Y	Y	**F/A** Starts per Hour is the maximum number of starts (user configured) within a sliding one hour window. Once the number of starts per hour is reached, any additional starts will cause a Fault/ Alarm Code 29.
CT Loss	A	30	N	N	NA	**F** CT Loss A (Phase A) — fault occurs when current feedback is invalid. This Fault is always enabled.
	B	31				**F** CT Loss B (Phase B)
	C	32				**F** CT Loss B (Phase B)
HAL ID		33	N	N	NA	**F** HAL ID Fault is generated if the controller determines that an incorrect (incompatible) power pole is installed. This Fault is always enabled.
NVS Error		34	N	N	NA	**F** Indicates an error in the SMC-50 control module 's nonvolatile memory storage. Clearing the Fault requires a change to the parameter or loading defaults (preferred). It is not cleared by cycling power. This Fault is always enabled.
Future Use		35				Future use.
V24 Loss		36	N	N	NA	**F** Indicates that the voltage level of the SMC-50 control module's internal 24V DC supply which provides power to the control module logic and on-board 24V DC I/O has fallen outside of the allowable range. This Fault is always enabled.
VControl Loss		37	N	N	NA	**F** Indicates that the control voltage level of the user-applied control voltage has fallen outside the allowable upper or lower limit. This Fault is always enabled.
TB Input	1	38	N	N	NA	**F** Occurs when the Control Input is configured to generate a Fault and the input condition (N.O. or N.C.) is satisfied.
	2	39				
	3	40				
	4	41				
Current Imbal		42	Y	Y	Y	**F/A** Exists when the calculated imbalance level is equal to or greater than the user-defined Fault/Alarm level.
Under Power Real		43	Y	Y	Y	**F/A** Occurs when the Real Power: falls below the user-defined fault/ alarm level.
Over Power Real		44	Y	Y	Y	**F/A** Occurs when the Real Power: rises above the user-defined fault/ alarm level.
Un Power Reac +		45	Y	Y	Y	**F/A** Occurs when the Reactive Power +: falls below the user-defined fault/ alarm level.
Ov Power Reac +		46	Y	Y	Y	**F/A** Occurs when the Reactive Power +: rises above the user-defined fault/ alarm level.
Under Power App		47	Y	Y	Y	**F/A** Occurs when the Apparent Power+: falls below the user-defined fault/ alarm level.
Over Power App		48	Y	Y	Y	**F/A** Occurs when the Apparent Power+: rises above the user-defined fault/ alarm level.
Frequency		49	Y	Y	Y	**F/A** Occurs if the line frequency goes above or below the user-defined frequency high or frequency low Fault/Alarm level.
PM Hours		50	N	Y	Y	**F/A** User-defined value which sets the number of elapsed hours (actual operating hours of the motor) before a fault/alarm is signaled indicating that preventive maintenance should be performed.
PM Starts		51	N	Y	Y	**F/A** User-defined value which sets the number of starts before a fault/alarm is signaled indicating that preventive maintenance should be performed.

Table 61 - Linear Listing—Fault and Alarm Code Overview (Continued)

Fault/Alarm Code Name		F/A Code	Time Delay Avail.	F/A Bit Enable	Restart Enable	Description F/A= Fault and Alarm, A= Alarm, F= Fault	
Power Quality	A	52	N	Y	Y	**F/A** Fault condition which indicates that the starter is not properly firing its:	A Phase SCR.
	B	53					B Phase SCR.
	C	54					C Phase SCR.
Power Quality THD V		55	Y	Y	Y	**F/A** Indicates a high, voltage based total harmonic distortion level.	
Power Quality THD I		56	Y	Y	Y	**F/A** Indicates a high, current based total harmonic distortion level.	
Config Change		57	N	Y	Y	**F/A** Indicates any change to the SMC-50 control module parameter configuration.	
Ground Fault		58	Y	Y	Y	**F/A** Indicates the value of Ground Fault Current goes above the user-defined fault/alarm level. **NOTE:** A 150-SM2 Ground Fault PTC Feedback Module and 825-CBCT Core Balanced Ground Fault Sensor are required to configure this Fault/Alarm.	
Motor PTC		59	N	Y	Y	**F/A** Indicates the embedded motor PTC sensing device is tripped/closed due to a motor overtemperature condition. **NOTE:** A 150-SM2 Ground Fault PTC Feedback Module is required to configure this Fault/Alarm.	
Power Pole PTC		60	N	N	NA	**F B**uilt-in Power Pole PTC Temperature Sensor is used to measure power pole temperature. A fault occurs when the temperature rises above a predetermined level. This fault is always enabled.	
I/O Config		61	N	N	NA	**F** Occurs when any input is programmed as a start and no input is configured as a coast or stop. The fault occurs when the start or maneuver is attempted (the motor will not start). This fault is also generated when the input configuration changes from one that cannot start the motor to one that can. It will also be generated when a parameter is changed from an input that can stop the motor to one that cannot. This fault is always enabled.	
Test Fault		62	N	N	NA	**F** Occurs when the Push-to-Reset, Hold-to-Test push button on the SMC-50 control module is pushed for ≥ 3 seconds but < 10 seconds.	
Under PF Lag		63	Y	Y	Y	**F/A** Occurs when the lagging Power Factor goes below the user-defined fault/alarm level.	
Under PF Lead		64	Y	Y	Y	**F/A** Occurs when the leading Power Factor goes below the user-defined fault/alarm level.	
Over PF Lag		65	Y	Y	Y	**F/A** Occurs when the lagging Power Factor goes above the user-defined fault/alarm level.	
Over PF Lead		66	Y	Y	Y	**F/A** Occurs when the leading Power Factor goes above the user-defined fault/alarm level.	
-MVAR Over		67	Y	Y	Y	**F/A** Occurs when the magnitude of the Reactive Power rises above the user-defined level.	
-MVAR Under		68	Y	Y	Y	**F/A** Occurs when the magnitude of the Reactive Power falls below the user-defined level.	
RTC Battery Low		69	N	N	NA	**A** Occurs when the SMC-50 control module battery that maintains the value of the Real Time Clock (RTC) is low and needs to be replaced immediately. Alarm is always enabled.	
Locked Rotor		70	Y	Y	Y	**F/A** Occurs when the motor current increases above the user-defined fault/alarm level while the motor is in any running mode. This F/A condition is not active during starting or stopping.	
Start		71	NA	NA	NA	This is an Event Code and is stored in the Alarm Buffer for:	Start Event tracking.
Stop Option		73	NA	NA	NA		Stop Option Event tracking.
Coast		74	NA	NA	NA		Coast Event tracking.
Clear Fault		75	NA	NA	NA		Clear Fault Event tracking.
Fault		76	NA	NA	NA		Fault Event tracking.
Parm Change		77	NA	NA	NA		Parameter Change Event tracking.
Reserved		78...99	N	N	N	Future Use.	
System Faults		100...199	N	N	NA	A general Fault/Alarm typically associated with the SMC-50 control module hardware (for example, system Watchdog Time failure).	

(1) Overload is inherently a time-based fault.

Auxiliary Relay Output Fault or Alarm Indication

You can program Auxiliary Relay Output contacts for Fault or Alarm, N.O., or N.C. indication. You can also configure an ON or OFF Delay Time. Basic parameter setup (without N.C. or timed functions) is in the Setup / I/O Parameter Group. Full configuration is available from the Setup / I/O Parameter Group.

Troubleshooting

Introduction

For safety of maintenance personnel and others who might be exposed to electrical hazards associated with maintenance activities, follow the local safety related work practices (for example, NFPA 70E, Part II in the United States). Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to their respective job assignments.

SHOCK HAZARD: Hazardous voltage is present in the motor circuit even when the controller is off. To avoid shock hazard, disconnect main power before working on the controller, motor, and control devices (for example, Start-Stop push buttons). Procedures that require parts of the equipment to be energized during troubleshooting, testing, etc., must be performed by properly qualified personnel using appropriate local safety work practices and precautionary measures.

ATTENTION: Disconnect the controller from the motor before measuring insulation resistance (IR) of the motor windings. Voltages used for insulation resistance testing can cause SCR failure. Do not make any measurements on the controller with an IR tester.

The flowchart in Figure 49 aids in quick troubleshooting.

The time it takes for the motor to come up to speed may differ from the time programmed. This depends upon the motor and load characteristics.

Figure 49 - Troubleshooting Flowchart

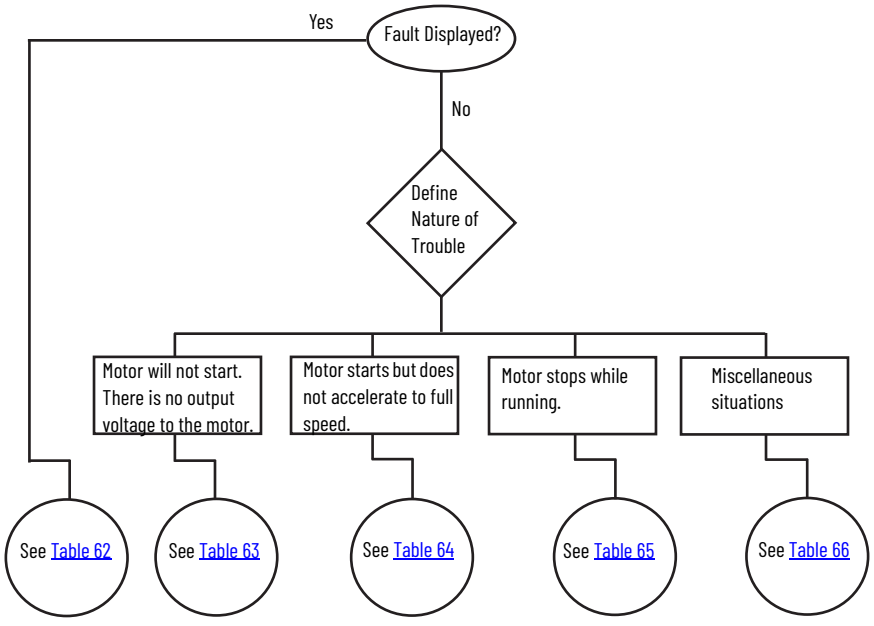


Table 62 - Fault Display Explanation

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
Line Loss (with phase indication)	1, 2, 3	Prestart and Running	• High impedance line connection • Missing supply phase • Motor not connected properly • Incoming 3-phase voltage instability	• Check for line and load loose connections. • Check for open line (for example, blown fuse). • Check for open line lead(s). • Verify power quality. • Disable this fault/alarm feature.
Shorted SCR (with phase Indication)	4, 5, 6	In All Modes	• Shorted power module.	• Check for shorted SCR, perform a resistance check (see Power Module Check section), or replace power module if necessary.
Open Gate (with phase indication)	7, 8, 9	Start or Stop	• Open gate circuitry • Loose gate lead	• Perform a resistance check (see Power Module Check section), replace power module if necessary. • Remove control module from the power section and check gate lead connections (TB5, TB6, and TB 7) are firmly seated to the control module. • Disable this fault/alarm feature.
SCR Overtemp or PTC Power Pole	10 or 60	In All Modes	• Controller ventilation blocked • Controller duty cycle exceeded • Ambient temperature limit exceeded • Failed thermistor	• Check for proper controller ventilation. • Check application-appropriate duty cycle. • Wait for controller to cool or provide external cooling if ambient temperature is high. • Replace power module or control module as needed.
Open Bypass	11, 12, 13	In All Modes	• Control voltage is low • Inoperable power module bypass	• Check control voltage power supply. • Check control module TB2…TB4 and TB5…TB7 for proper order and secureness. • Make sure that no auxiliary contact is set to “external bypass”.
No Load or Open Load (with Phase Indication)	14, 15, 16, 17	Prestart Only	• Loss of load side power wiring with phase indication (15=A, 17=C) • Start command cycled unexpectedly with motor rotating	• Check all load side power connections. • Check motor windings (insulation resistance test).
Voltage Unbalance or Current Imbalance	18 or 42	Running	• Power line unbalance is greater than the programmed value • The delay time programmed is too short for the application	• Check the power system and correct if necessary or change the programmed value. • Extend the delay time to match the application requirements. • Disable this fault/alarm feature.
Overvoltage	19	Running	• Power line grid voltage is greater than the programmed value • Abnormal voltage regulation • The parameter settings and/or delay time programmed are not suited for the application	• Check the power system and correct if necessary. **NOTE:** If the power source is a backup generator, check the stability of the generator voltage regulator. Replace if necessary. • Modify the parameter and/or extend the delay time to match the application requirements. • Disable this fault/alarm feature.
Undervoltage	20	Running	• Power line grid voltage is less than the programmed value • Abnormal voltage regulation • The parameter settings and or delay time programmed are not suited for the application	• Check the power system and correct if necessary. **NOTE:** If the power source is a backup generator, check the stability of the generator voltage regulator. Replace if necessary. • Modify the parameter and/or extend the delay time to match the application requirements. • Disable this fault/alarm feature.
Overload	21	Running	• Motor overloaded • Overload parameters are not matched to the motor	• Check motor overload condition. • Check programmed values for overload class and motor FLC; verify current draw of the motor. • Disable this fault/alarm feature.[1]
Underload	22	Running	• Broken motor shaft, belt, grating, etc. • Pump cavitation • Programmed setting incorrect for application	• Check machine drive components and loading. • Check pump system. • Repair or replace motor. • Check programmed settings. • Disable this fault/alarm feature.
Jam	23	Running	• Motor current has exceeded the user programmed jam level for the programmed time	• Correct source of jam or excessive loading. • Check programmed time value. • Disable this fault/alarm feature.
Stall	24	Running	• The motor did not reach full speed by the end of the programmed ramp time • Incorrect programmed setting	• Check pump system, machine drive components, and loading; repair or replace motor, if necessary. • Check programmed settings. • Disable this fault/alarm feature.
Phase Reversal	25	Prestart Only	• The controller is not detecting incoming supply voltage in the expected ABC sequence	• Check power wiring and correct, if necessary. • Disable this fault/alarm feature.

Table 62 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
Exp Removed	x026[2]	In All Modes	• Expansion module is loose or removed • Expansion module is defective	• Reseat or replace the expansion module connector to the control module and tighten module screws. • Replace defective module.
Exp Incompat	x027[2]	In All Modes	• Expansion module is inserted into an incompatible control module port number • Controller firmware is not compatible with the expansion module • Expansion module is defective	• Insert the expansion module into a compatible control module port. • Update the control module firmware • Replace defective module.
Expansion	x028 [2]	In All Modes	• Expansion module is loose or removed • Expansion module is defective • Expansion module is inserted into an incompatible control module port number • Controller firmware is not compatible with the expansion module	• Reseat and/or replace loose/removed module and tighten module screws. • Replace defective expansion module. • Update control module firmware.
Starts per Hour	29	Starting	• The number of starts within the last hour has exceeded the programmed value • Programmed setting is incorrect for the application	• Wait for the hour to expire, then restart the motor. • Reduce the actual number of starts per hour or increase the programmed start time (if allowed by the application) and controller thermal limits. • Turn off this fault/alarm feature.
CT Loss: A, B, or C	30, 31, or 32	In All Modes	• Loose CT cable connection between the power section and the control module • Phase A (F30), B (F31), or C (F32) current transformer feedback circuit has failed • Option Module 150-SM2 with external CT operation (Fault Code 7030, 8030)	• Remove the control module from the power section; verify connectors TB2 (A), TB3 (B), and TB4 (C) are firmly seated to the control module. • Replace the control module and/or the power section. • Inspect the CT sensor cables for loose connections; check CTs for damage; repair/replace CTs if necessary; replace 150-SM2 option module if necessary.
Hall ID	33	In All Modes	• Loose cables between the controller and power section. • Incompatible power section installed with the controller	• Remove the control module from the power section; verify connectors TB2 (A), TB3 (B), and TB4 (C) are firmly seated to the control module. • Check the power section and replace, if necessary.
NVS Error	34	In All Modes	• Controller memory corrupted • Option module error (Fault Code 7034, 8034, or 9034)	• Modify a parameter or load parameter defaults (preferred) and reload the customer-specific parameters. • Check the option module sensor cables. • Replace the option module.
Future Use	35	NA	NA	NA
V24 Loss	36	In All Modes	• Loose connection at Control Terminals 1 (+L1) and 2 (-L2) • Excessive load on internal 24V supply • Low line voltage condition	• Check the control power and verify it is within the specification; check the line connections and grounding to the SMC™-50 controller control terminals. • Replace the control module.
V Control Loss	37	In All Modes	• Loose connection at Control Terminals 1 (+L1) and 2 (-L2) • Low line voltage condition	• Check the control power and verify it is within the specification; check the connections and grounding to the controller control terminals. • Replace the control module.
TB Input:1, 2, 3 and 4	38, 39, 40, and 41	In All Modes	• The condition to generate the TB Input fault is satisfied • Terminal wiring configuration or fault N.O./N.C. configuration of input is incorrect	• Clear the fault condition. • Rewire and/or reconfigure the input.
Voltage Unbalance or Current Imbalance	42 or 18	Running	• Power line unbalance is greater than the programmed value • The delay time programmed is too short for the application	• Check the power system and correct if necessary or change the programmed value. • Extend the delay time to match the application requirements. • Disable this fault/alarm feature.
Und Pwr Real[3]	43	Running	• Abnormally reduced real (MW) power draw by the motor possibly due to broken mechanical connection (belt, gears, etc.) between motor and load • Pump cavitation • Programmed setting is incorrect for the application	• Repair/replace the condition causing the reduced real power load. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Ovr Pwr Real[3]	44	Running	• Abnormally high real (KW) power draw by the motor • Programmed setting is incorrect for the application	• Repair/replace the condition causing the high KW power draw. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.

Table 62 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
Un Pwr Reac+ [3]	45	Running	• Abnormally reduced reactive (+MVAR) power produced by the motor • Programmed setting is incorrect for the application	• Repair/replace the condition causing the reduced +MVAR power draw. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Ov Pwr Reac+[3]	46	Running	• Abnormally high reactive (+MVAR) power produced by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition causing the high +MVAR power draw. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Und Pwr App [3]	47	Running	• Abnormally reduced apparent (MVA) power draw by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition causing the reduced +MVA power draw. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Ovr Pwr App [3]	48	Running	• Abnormally high apparent (MVA) power draw by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition causing the high +MVA power draw. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Frequency	49	Running	• Speed control regulation system of the generator prime mover (for example, diesel engine) is unable to adjust to current load conditions or is defective • Abnormal power grid connections; power generation source is operating outside its normal frequency limits or range	• Reduce the generator load, increase generator output, replace the speed control system, or generator. **NOTE:** For a diesel generator system, Rockwell Automation recommends it be oversized by a factor of three for Soft Start applications. • Contact the power company for additional information. • Modify the programmed fault/alarm parameters to better suit the application.
PM Hours	50	In All Modes	• The number of hours programmed in the PM Hours Parameter has been reached	• Perform required maintenance and reset the PM Hours parameter. • Disable this fault/alarm feature.
PM Starts	51	Pre-Start	• The number of Starts programmed in the PM Start Parameter has been reached	• Perform required maintenance and reset the PM Hours parameter. • Disable this fault/alarm feature.
Power Quality: A, B, or C	52, 53, or 54	Start or Stop	• Incoming 3-phase voltage instability or distortion • High impedance line or load connection	• Check supply voltage for capability to start/stop the motor; check for loose connections on the line side or motor side of the power wires. • Verify and correct the input power quality issue • Disable this fault/alarm feature.
Power Quality: THD V	55	Running	• The current mix of loads on the power line contributing to the THD V has exceeded the programmed THD V level and/or time	• Check the mix of loads (what was added, what was changed); modify the load mix if necessary. • Change the programmed THD V level and/or delay time. • Disable this fault/alarm feature.
Power Quality: THD I	56	Running	• The current mix of loads on the power line contributing to the THD I has exceeded the programmed THD I level and/or time	• Check the mix of loads (what was added, what was changed); modify the load mix if necessary. • Change the programmed THD I level and/or delay time. • Disable this fault/alarm feature.
Config Change	57	In All Modes	• A controller parameter has been modified	• Disable this fault/alarm feature.
Ground Fault	X058[2]	Running	• The ground fault current level has exceeded the programmed value • The delay time is too short for the application **NOTE:** An optional 150-SM2 Ground Fault PTC Module is required for this fault.	• Check the power system and motor; correct if necessary. • Check the programmed ground fault levels to match application requirements; modify if necessary. • Extend the delay time to match the application requirements. • Disable this fault/alarm feature.
Motor PTC	X059[2]	In All Modes	• Motor ventilation is blocked. • Motor duty cycle is exceeded • PTC open or shorted **NOTE:** An optional 150-SM2 Ground Fault PTC Module is required for this fault.	• Check for proper ventilation. • Check application duty cycle. • Wait for motor to cool or provide external cooling, then check resistance of PTC. • Disable this fault/alarm feature.
SCR Overtemp or PTC Power Pole	60 or 10	In All Modes	• Controller ventilation blocked • Controller duty cycle exceeded • Ambient temperature limit exceeded • Failed thermistor	• Check for proper controller ventilation. • Check application-appropriate duty cycle. • Wait for controller to cool or provide external cooling if ambient temperature is high. • Replace power module or control module as needed.

Table 62 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
I/O Config	61	Pre-Start	• The configuration of the control I/O does not meet the system rules	• Modify the control I/O configuration to meet the established rules.
Test Fault	62	In All Modes	• The SMC-50 control module's Push to Reset/Hold to Test push button was pressed for more than three seconds, but less than ten • The SMC-50 control module's Push to Reset/Hold to Test push button is stuck or damaged	• To reset the Test fault, press the Push to Reset/Hold to Test push button for less than two seconds. **NOTE:** Only use the Push to Reset push button when absolutely necessary. • Attempt to dislodge the push button or replace the control module if necessary.
Und PF Lag	63	In All Modes	• A lagging PF is abnormally under the typical value; less inductance or more capacitance has been introduced to the power line • A programmed setting or time value is incorrect for the application	• Determine the cause of the reduced Lagging PF. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Und PF Lead	64	Running	• A leading PF is abnormally under the typical value; less inductance or more capacitance has been introduced to the power line • A programmed setting or time value is incorrect for the application	• Determine the cause of the reduced Leading PF • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Ovr PF Lag	65	Running	• A lagging PF is abnormally over the typical value; more inductance or less capacitance has been introduced to the power line • A programmed setting or time value is incorrect for the application	• Determine the cause of the Over PF Lagging • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
Ovr PF Lead	66	Running	• A leading PF is abnormally under the typical value; less inductance or more capacitance has been introduced to the power line • A programmed setting or time value is incorrect for the application	• Determine the cause of the Over PF Leading. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
-MVAR Over [3]	67	Running	• Abnormally high reactive (-MVAR) power consumed by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition causing the high -MVAR. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
-MVAR Under[3]	68	Running	• Abnormally reduced reactive (-MVAR) power consumed by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition causing the reduced -MVAR. • Modify the programmed fault/alarm parameters to better suit the application. • Disable the fault/alarm feature.
RTC Battery Low	69	Pre-Start	• Battery reading is below the acceptable level to potentially maintain the real time clock and calendar	• Replace battery (CR2032) as soon as possible.
Locked Rotor	70	In All Modes	• Motor has stalled; rotor is not turning	• Check motor and load for binding or jammed conditions • Parameters are not adequately configured for the application. Review and adjust. • Disable the fault/alarm feature.
Start	71	Starting	• A start event (command) has occurred. This is not a fault.	• NA
Stop Option	73	Stop Option	• A stop option event (command) has occurred. This is not a fault.	• NA
Coast	74	Coast	• A coast-to-stop event (command) has occurred. This is not a fault.	• NA
Clear Fault	75	Faulted	• A clear fault event (command) has occurred. This does not generate a fault.	• NA
Fault	76	Faulted	• A fault event (command) has occurred. This is not a fault.	• NA

Table 62 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
Param Change	77	Stopped	• A change to one of the controller parameters has occurred. This is not a fault.	• NA
Reserved	78…99	NA	• NA	• NA
System Faults	100…199	In All Modes	• There is an issue with the control module wiring • The control module is defective	• Review the control module wiring. Ensure the ground terminal is secure and connected to the system's earth ground. Ensure an RC snubber/suppressor is connected to all inductive loads in the control circuit. See input wiring. • Replace the control module.

(1) If controller based motor overload is disabled, external motor overload protection should be used.
(2) "X" indicates a port number in which the expansion module resides in the SMC-50 control module .
(3) The Real, Reactive, and Apparent Power faults/alarms are best suited to provide indication of an abnormal running operation of the motor or system which another parameter (for example, Underload, Overload, Jam, Stall, etc.) does not provide. To understand what is an abnormal running operation, you need to determine a "normal" or "typical" value, usually established during system startup.

Table 63 - Motor Will Not Start—No Output Voltage to the Motor

Display	Possible Cause	Possible Solutions
Fault displayed	• See fault description	• See Table 62 addressing fault conditions
HIM display is blank	• Failed HIM • Control voltage is absent • Failed control module • HIM connection is loose	• Check control wiring and correct if necessary • Check HIM connection • Cycle control power • Replace HIM only • Replace control module only
Stopped 0.0 Amps	• Pilot devices • SMC Enable input is open at terminal 9 • Configured or wired input terminals are not wired correctly • Start-Stop control has not been enabled for the human interface module • Control voltage • Failed control module	• Check wiring; follow the instructions on page 121 to enable control capability. • Check control voltage • Replace control module
Starting	• One or more power phases are missing • Isolation contactor (if used) is not picking up	• Check power system • Check that the controller Aux. relay output controlling the Isolation Contactor is configured to "Normal". • Check the Isolation Contactor for proper operation

Table 64 - Motor Rotates but Does Not Accelerate to Full Speed

Display	Possible Cause	Possible Solutions
Fault displayed	• See fault description	• See Table 62 addressing fault conditions
Starting	• Mechanical problems Inadequate Current Limit setting • Failed control module	• Check for binding or external loading and correct • Check motor • Adjust the Current Limit Level to a higher setting • Replace control module

Table 65 - Motor Stops While Running

Display	Possible Cause	Possible Solutions
Fault displayed	• See fault description	• See addressing fault conditions
HIM display is blank	• Failed HIM • Control voltage is absent • Failed control module • HIM connection is loose	• Replace HIM • Check control wiring and correct if necessary • Replace control module • Check HIM connection
Stopped 0.0 Amps	• Pilot devices • Failed control module	• Check control wiring and correct if necessary • Replace control module
Starting	• One or more power phases are missing • Failed control module	• Check power system • Replace control module

Table 66 - Miscellaneous Situations

Display	Possible Causes	Possible Solutions
Motor current and voltage fluctuates with steady load	• Motor • Erratic Load	• Verity type of motor as a standard squirrel cage induction motor • Check load conditions
Erratic operation	• Loose connections	• Shut off **all** power to controller and check for loose connections
Accelerates too fast	• Starting time • Initial torque • Current limit setting • Kickstart	• Increase starting time • Lower initial torque setting • Decrease current limit setting • Lower kickstart time or turn off
Accelerates too slow	• Starting time • Initial torque • Current limit setting • Kickstart	• Decrease starting time • Increase initial torque setting • Increase current limit setting • Increase kickstart time or turn off
Motor stops too quickly with Soft Stop option	• Time setting	• Verify the programmed stopping time and correct if necessary
Motor stops too slowly with Soft Stop option	• Stopping time setting • Misapplication	• Verify the programmed stopping time and correct if necessary • The Soft Stop option is intended to **extend** the stopping time for loads that stop suddenly when power is removed from the motor.
Fluid surges with pumps still occur with the Soft Stop option	• Misapplication	• Soft Stop ramps voltage down over a set period of time. In the case of pumps, the voltage may drop too rapidly to prevent surges. A closed loop system such as Pump Control would be more appropriately suited.
Motor overheats	• Overload • Blocked ventilation	• Allow motor to cool and reduce load. • Remove blockage and ensure motor is being adequately cooled.
Motor short circuit	• Winding fault	• Identify fault and correct • Check for shorted SCR; replace if necessary • Ensure power terminals are secure
Motor coasts when option stop is programmed	• Option not programmed • Current loop power supply not active • Incorrect control logic • Bypass contactor set for delayed drop-out	• Verify the option parameter settings and correct if necessary • Verify current loop power supply • Verify connections to module terminals 16 and 17 • Verify that the Bypass Contactor is configured for <100ms drop-out time. For relay control, the FDO version contactor is required; for IntelliVAC control, set Drop-out time to 50 ms (no PFCC) or 75 ms (if PFCC contactor in same controller). For IntelliVAC settings, refer to Chapter 4 of 1503-UM053.

Control Module Removal

The control module is not intended for field repair. The entire module must be replaced in the event of failure. The following procedure must be followed before unplugging the control module.

1. Remove all power from the equipment.

SHOCK HAZARD: To avoid shock hazard, ensure the main power has been disconnected before working on the controller, motor or control devices. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Failure to do so may result in burns, injury or death.

2. Make sure that the wires are properly marked and that the program parameters are recorded.
3. Disconnect all control wires to control module.
4. Loosen the four control module screws.
5. Carefully rotate the module to the left, and unplug the five ribbon cables from the interface board.

ATTENTION: When removing the control module, make sure to hold the module in place as the screws are removed, to avoid strain on the ribbon cables.

To install control module, follow the reverse order for removal.

The MV SMC-50 must use firmware release 4.006 or later. This User Manual pertains to units with firmware released 6.xxx (or later).

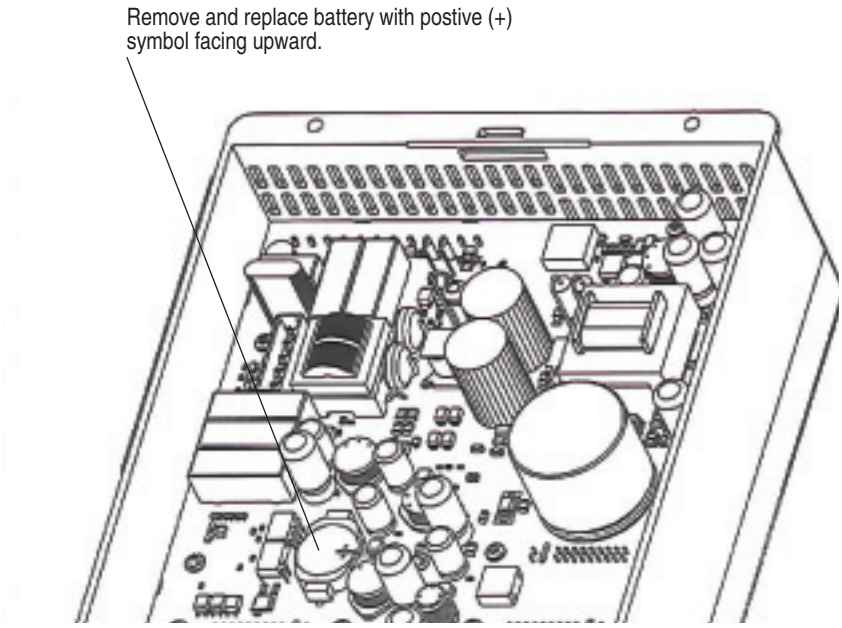
Real Time Clock (RTC) Battery Replacement

The SMC-50 Control Module comes standard with a RTC used to time and date stamp Faults and Alarms. When the control power is not applied to the SMC-50, the operation of the RTC is maintained by an off-the-shelf Lithium™ CR2032 coin cell battery. The battery must be replaced if the SMC-50's low battery alarm is activated.

To replace the battery:

1. Perform the steps that are required to remove the control module. See the control module installation instructions, publication 150-IN078.
2. Locate the battery on the circuit board. Note the positive symbol is facing upward.

Bottom Side of SMC-50



3. Remove the existing battery, disposing of it according to local environmental codes.
4. With the positive symbol of the new battery facing upward, properly seat the battery into place.
5. Perform the steps that are required to replace the control module. See the control module installation instructions, publication 150-IN078.
6. Reprogram/reset the clock.

Voltage Feedback Circuit Tests

The most straightforward means of checking the feedback circuits is to perform the "snubber and resistor testing" procedure, found on page 163. Another possible test involves measuring the feedback voltages at the interface board (see Figure 37 on page 71). This can only be done with line voltage applied. If the motor does not start, it may be necessary to temporarily modify the control circuit to close the line contactor without applying a start signal to the SMC-50 module. In this case, the three line voltages (Line A, Line B, Line C) measured with respect to ground should be approximately 1 volt rms. It is important that the level in each phase is the same as the other phases, within ± 1%.

If any voltage is well outside this range, there may be a problem either with the system voltage, or with the voltage sensing board. Note that the load side voltages (Load A, Load B, Load C) will be very low, since the SCRs are not turned on, and only a low leakage current flows to the motor.

If the motor will start and run, the line and load voltages should be the same when the bypass contactor is closed.

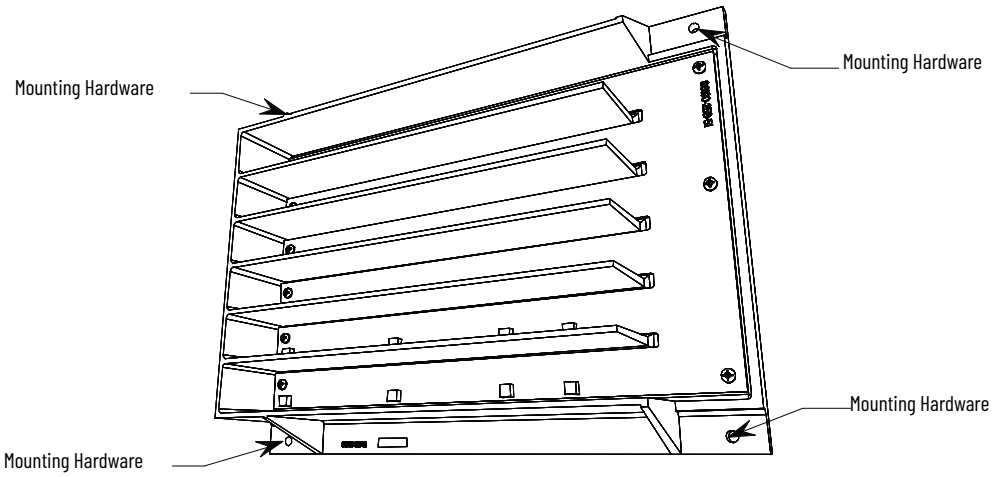
Voltage Sensing Board Replacement

1. Ensure there is no power to the equipment.

SHOCK HAZARD: To prevent electrical shock, ensure the main power has been disconnected before working on the sensing board. Verify that all circuits are voltage free using a hot stick or appropriate high voltage-measuring device. Failure to do so may result in injury or death.

2. Mark the position of the ribbon cable and wires.
3. Remove the screws and lift the ring lugs from the terminals to remove the wires.
4. Release the locking mechanism located on each side of the ribbon cable connector and pull the ribbon cable straight out to prevent bending the pins.
5. Remove the 4 nuts that secure the assembly to the side panel.
6. Replace with the new assembly securing with all 4 nuts and washers. (See Figure 50.)
7. Replace ring lugs on terminals. Plug in ribbon cable making sure that it is positioned properly and fitting is secure (locking mechanism is engaged).
8. For personnel and equipment safety, ensure both grounding connections are reconnected to the sensing board.

Figure 50 - Sensing Board with mounting hardware placement

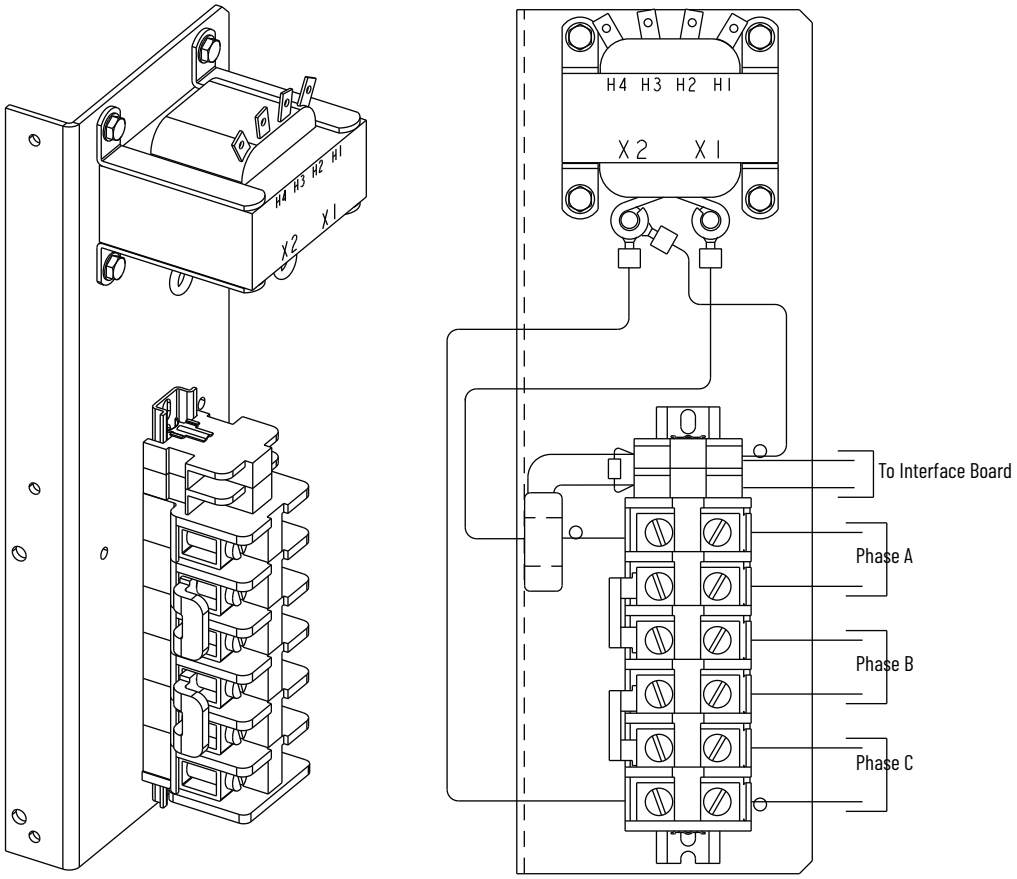


Current Loop Power Supply

The current loop gate driver (CLGD) boards receive power from two sources:

1. The snubber circuit (while the SCR power modules are active).
2. The current loop power supply, which maintains a pre-charge level of power during periods when the SCR power modules are inactive (this allows SCR gating while the snubber circuit is being charged).

Figure 51 - Current Loop Power Supply



The current loop power supply provides a current of 50 AC to each SCR power module phase assembly. If this current is not detected and fed back to the interface boards, stop maneuvers will not function (and an Alarm will be generated).

Circuit Board Replacement

The replacement of printed circuit boards is straightforward, however, there are a number of precautions which must be considered when handling the boards.

ATTENTION: Some circuit boards may contain CMOS components which can be destroyed by static charges generated by friction of materials made with synthetic fibres. Use of damaged circuit boards may also damage related components. A grounding wrist strap is recommended for handling sensitive circuit boards.

1. Remove all power from the equipment.

ATTENTION: To avoid shock hazard, ensure the main power has been disconnected before working on the controller, motor or control devices. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Failure to do so may result in burns, injury or death.

2. Carefully detach all wires, cables and connectors, noting their location and orientation. For the interface board, remove the control module (see page 146).

ATTENTION: The fiber-optic cables can be damaged if struck or bent sharply. They have a locking feature which requires pinching the tab on the connector and gently pulling straight out. The component on the printed circuit board should be held to prevent damage.

3. For boards mounted with hardware, remove the hardware, taking care not to drop anything onto other circuits. For boards with nylon stand-off posts, squeeze the section above the board and carefully pull the board up and off the post.
4. Lift out the circuit board, and check that the replacement board is the correct part number and revision before installation (refer to Appendix H). Install the new board by replacing the hardware, or pressing down onto nylon stand offs. Connect all wires, cables and connectors. Ensure that all switch and/or jumper settings on the new board are identical to those on the old board, and correct for the application.

Power Circuit Troubleshooting

Thyristor (SCR) Testing

If a power semiconductor is suspected of malfunctioning, it may be checked as follows:

1. Remove all power from the equipment.

SHOCK HAZARD: To avoid shock hazard, ensure the main power has been disconnected before working on the controller, motor or control devices. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Failure to do so may result in burns, injury or death.

2. Measure DC resistance per the following chart:

Table 67 - SCR Resistance Measurements

Location of Probes	1000V	1300V	1500V	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	19...25	20...27	21...29	40...53	43...57	60...90(3)	64...84(3)
Cathode to Gate (Ω)	10...40	10...40	10...40	10...40	10...40	10...40	10...40	10...40

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

The actual resistance value depends on the ohmmeter used, the particular brand/rating of SCR and external circuit influences. It is impossible to accurately measure the condition of the SCR when it is unclamped!

3. If a short circuit is suspected, the SCR must be isolated from all surrounding circuitry (i.e. unplug gate and cathode leads, and remove snubber and resistor circuit leads from the driver boards). Measure resistance to confirm state of the SCRs. If the SCRs are not shorted, proceed to snubber and resistor circuit testing, following this procedure.
4. If a faulty device is found, the entire heatsink assembly must be removed.

ATTENTION: For heatsink assemblies containing four or more SCRs, the entire matched set shall be replaced. Devices connected in series must have performance specifications matched for proper operation. Failure to use matched sets may result in damage to the devices.

5. Complete heatsink assemblies with matched SCRs are available as a renewal part (see Appendix H). In most cases, the assembly can be dismantled to replace the SCRs.

SCR Replacement Procedure

This procedure applies to 180 A and 360 A units < 5000V only.

IMPORTANT Refer to OEM documentation for SCR stack location in 1503E.

A. Remove SCR Stack from Unit

For all types of SMCs, the stack requiring new SCRs must first be removed from the unit as follows:

1. Remove all power from the equipment.

SHOCK HAZARD: To avoid shock hazard, ensure main power has been disconnected before working on the controller, motor or control devices. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Failure to do so may result in burns, injury or death.

2. Service to phase a module may require removing the medium voltage door and swinging out the low voltage panel (for 36-inch wide, two-high cabinet only); see Figure 52.
3. Remove current loop cable (see Figure 51).

4. Unplug all fiber-optic cables from the gate-driver board. Unplug gate lead connectors.

ATTENTION: The gray fiber-optic cables can be damaged if struck or bent sharply. They have a locking feature which requires pinching the tab on the connector and gently pulling straight out. The component on the printed circuit board should be held to prevent damage.

5. Disconnect the power cables from the terminals on the left side of the heatsink assembly. Use care not to damage components. The sharing resistors are fragile.
6. Remove two nuts at bottom front of heatsink assembly so the module can be removed using the pull handle. (Phase C requires angling the module to clear the front cabinet flange.) Position fiber-optic cables and wiring so they will not be damaged as the module is removed from the cabinet.
7. Pull module out slowly, and slide onto a platform lift, or lift the module out of the cabinet.

ATTENTION: The heatsink assembly is heavy (approx. 25 kg [55 lb] or greater). To avoid injury, always use two people to remove and handle the assembly. Place the heatsink on a cart to aid in its transport.

8. Place the module on a flat surface (see Figure 55, Figure 58 and Figure 64). When tilting the module, ensure that wires are not damaged.

B. Replace SCRs

For 600A units, it is mandatory that the entire stack be replaced. The high clamping force requires the factory to tighten the clamp hardware. See Appendix H for part numbers. Proceed to step C.

Refer to Figure 52 to Figure 64.

- SCR positions are numbered in succession from the top down. The SCR cathode is at the end with the wide flange.

ATTENTION: The SCRs must be oriented correctly with the cathode end either up or down, depending on the specific assembly. Note the orientation before removing the SCRs, and refer to the detail in the appropriate figure in this chapter.

1. Remove the shorting bar. Measure the resistance between adjacent heatsinks to determine which SCR(s) is (are) shorted. Assemblies with four or six SCRs must use matched sets. See Figure 56 and Figure 62 for the position of the matched sets. If an SCR from each set is shorted, all of the SCRs in the module must be replaced. A properly functioning SCR will measure in excess of 100 kohms from anode to cathode, and 10...40 Ω from gate to cathode.

IMPORTANT **DO NOT** loosen any of the nuts on the fiber rods on either side of the clamp bars. They must remain as they are to maintain squareness. See Figure 54, Figure 57 and Figure 63.

2. Loosen the clamp by rotating the center nut below the indicator washer at the top end of the clamp. Refer to Figure 54, Figure 57 and Figure 63.

   As the center nut is rotated, the entire spring assembly is retracted from the top heatsink. Continue to retract until there is a gap of approximately 6 mm (0.25 in.).
3. The heatsinks may now be spread apart to allow removal of the SCRs.

4. Apply a thin film of Electrical Joint Compound (supplied) to both faces of the new SCRs.
5. Place the new SCRs in position starting from the top and pushing the heat sinks together as you proceed down the stack. Make sure the SCRs are positioned and oriented properly. Refer to Figure 55, Figure 58, and Figure 64.
6. Ensure that the SCRs are properly seated on the locating pins in the heatsinks and rotate each SCR so that the leads are oriented toward the front right side of the assembly.
7. Advance the center nut until the spring assembly engages the top heatsink. Make sure the clamp is properly seated on the locating pins in the top and bottom heatsinks before beginning to tighten.
8. Tighten the center nut until the indicator washer becomes loose with some friction. The clamp is now at the proper force and must not be clamped any tighter. If the indicator washer becomes too loose (no friction), back the center nut off slowly until the washer is loose with some friction.
9. Replace the shorting bar. Torque hardware to 30 N•m (20 lb•ft). For 3/8 in. hardware in the "T" slots of aluminum heatsinks, the recommended torque is 22 N•m (16 lb•ft). Do not overtorque these connections as the slots will be damaged and the connection will be compromised.

C. Install Refurbished Stack

1. Inspect all connections on the module. Inspect wire insulation and components for damage.
2. Install the module in the cabinet. Watch for power cables and fiber-optic cables as module is slid into place. Tighten locking nuts at the bottom of the module.
3. Connect power cables and tighten hardware to 30 N•m (20 lb•ft).
4. Install gate-driver board, ensuring that the locking tabs on the nylon circuit board supports are all engaged. Plug in thermistor and gate connectors and reconnect wires to the left side of the board. Plug in the fiber-optic cables.
5. Replace current loop cable (see Figure 51). Tighten the terminals at the current loop power supply to 5.6 N•m (50 lb•in).
6. Make sure all connections are secure. Perform resistance checks according to instructions on "Thyristor (SCR) Testing" (page 150), and test gate-drive circuits by performing power supply tests in Chapter 3 (page 72).

Figure 52 - Upper Low Voltage Panel and Power Cell Detail (1562F) • 2400...4160V, 180/360A

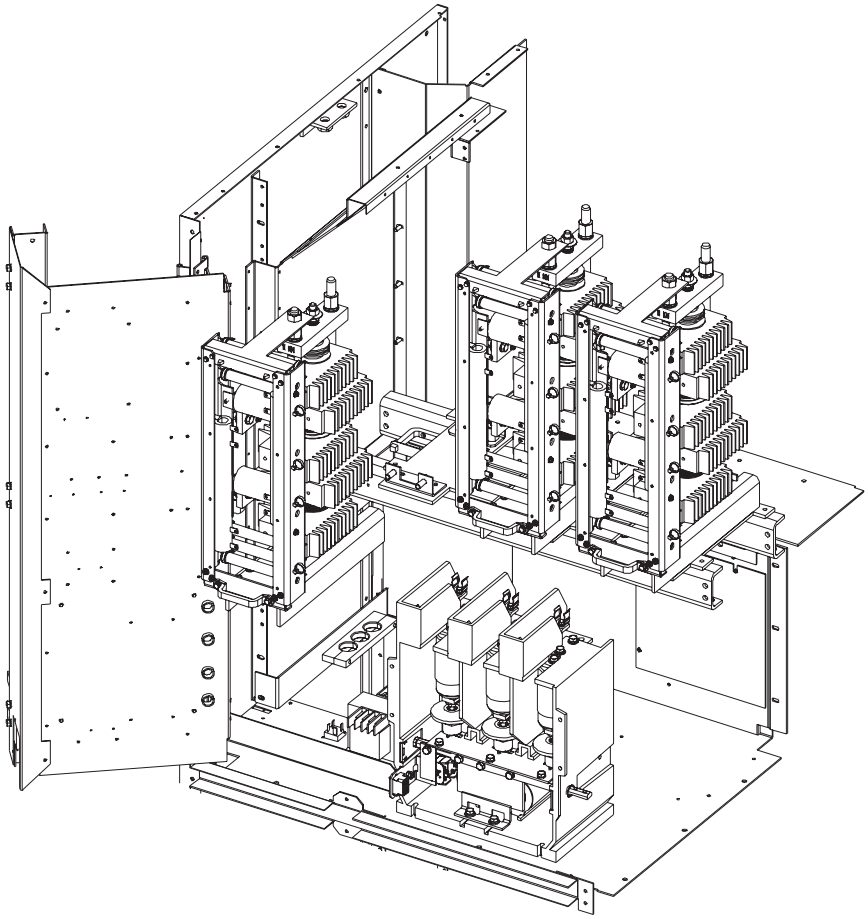


Figure 53 - Power Module Assembly (one phase) • 1000/1300/1500/2400V, 180/360A

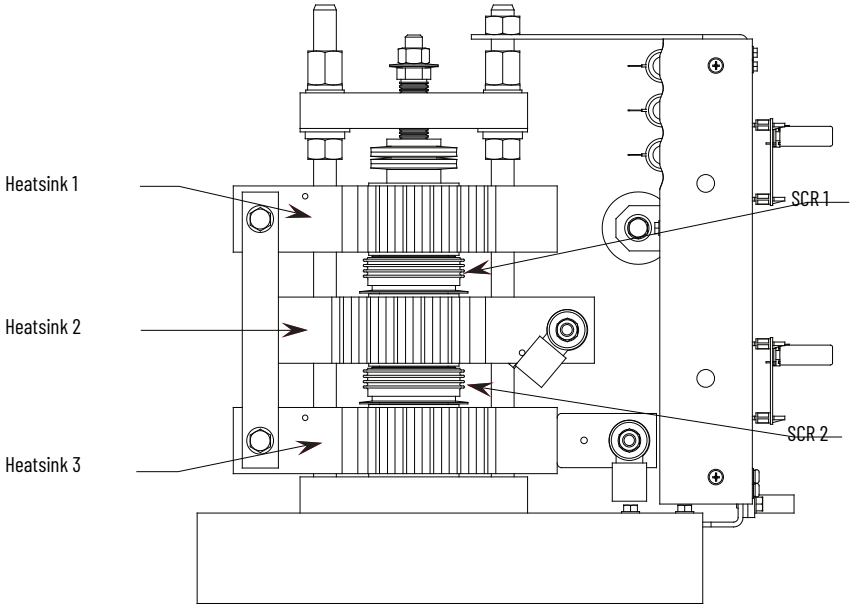


Figure 54 - Heatsink Clamp

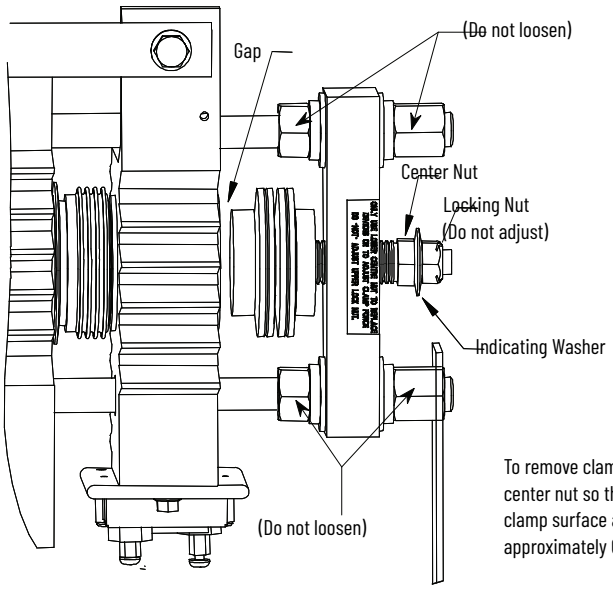


Figure 55 - Removal of SCR (1000...240V, 180/360A)

To Remove SCR:
- Remove shorting bar hardware
- Pry opposing heatsinks apart
- Extract SCR

To Insert New SCR:
- Apply thin film of electrical joint compound to surfaces of SCR
- Install SCR so that it is seated in locating pin of heatsink (note orientation of SCR).
- Pry heatsinks to close gap, ensuring that SCR is seated properly in both its locating pins.
- Rotate SCR so that all leads have same direction.

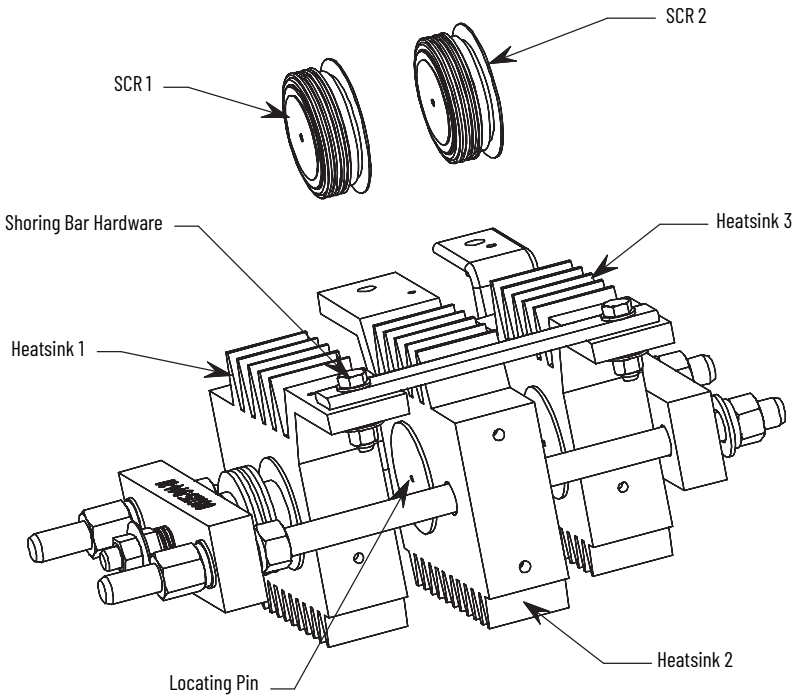
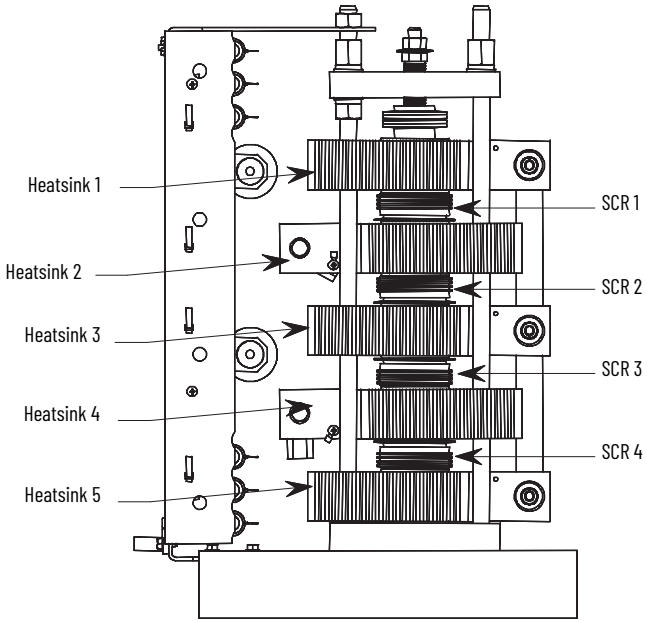
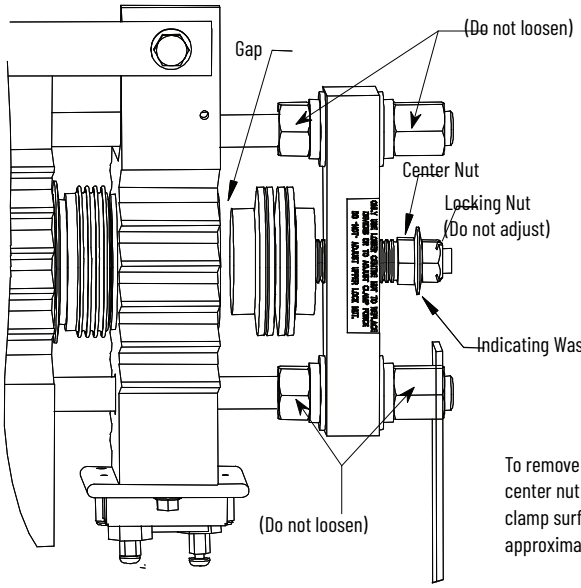


Figure 56 - Power Module Assembly (one phase) • 3300/4160V, 180/360A



Note: SCR 1 and SCR 3 are a matched set. SCR 2 and SCR 4 are a matched set.

Figure 57 - Heatsink Clamp



To remove clamp pressure, loosen lower center nut so that the gap between the clamp surface and the heatsink is approximately 6 mm (0.25 in.).

Figure 58 - Removal of SCR 2 and SCR 4 (3300...4160V, 180/360A)

To Remove SCR 4:
- Remove shorting bar hardware
- Pry Heatsinks 4 and 5 apart
- Extract SCR

To Insert New SCR:
- Apply thin film of electrical joint compound to surfaces of SCR
- Install SCR so that it is seated in locating pin of heatsink (note orientation of SCR).
- Pry heatsinks to close gap, ensuring that SCR is seated properly in both its locating pins.
- Rotate SCR so that all leads have same direction.

Proceed to replace SCRs matched pair (SCR 2).

Note: You must replace both SCRs of a matched set.

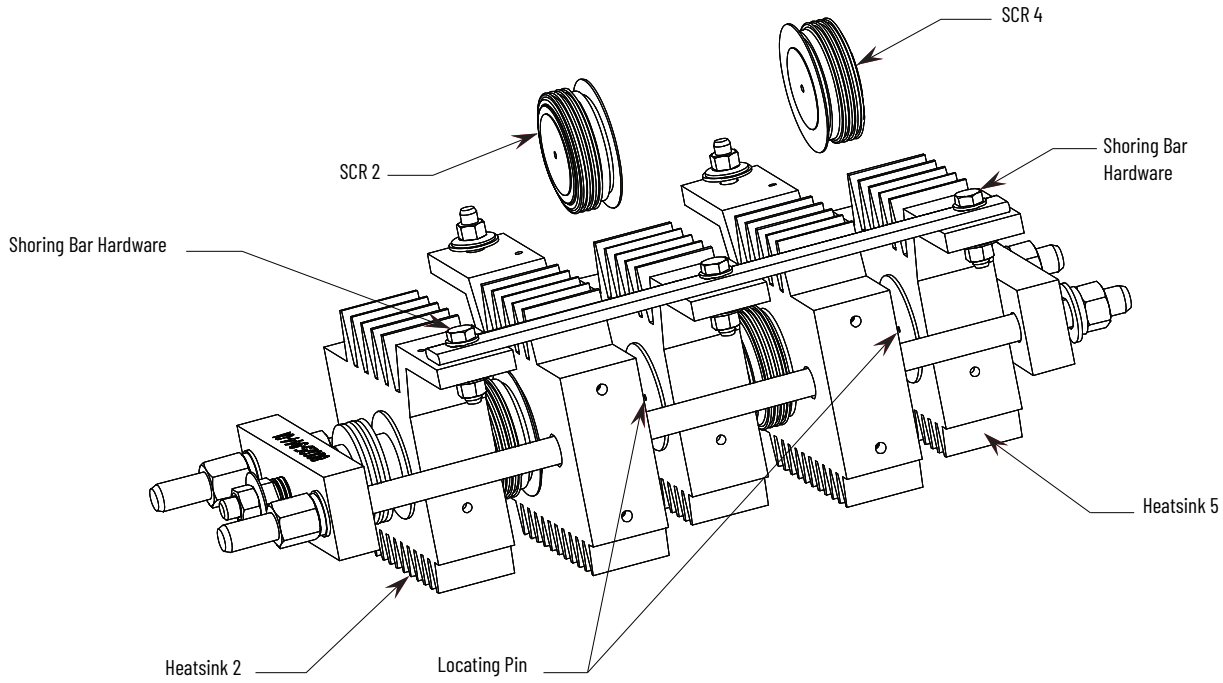


Figure 59 - Power Module Assembly (one phase) • 5500/6900V, 180/360A

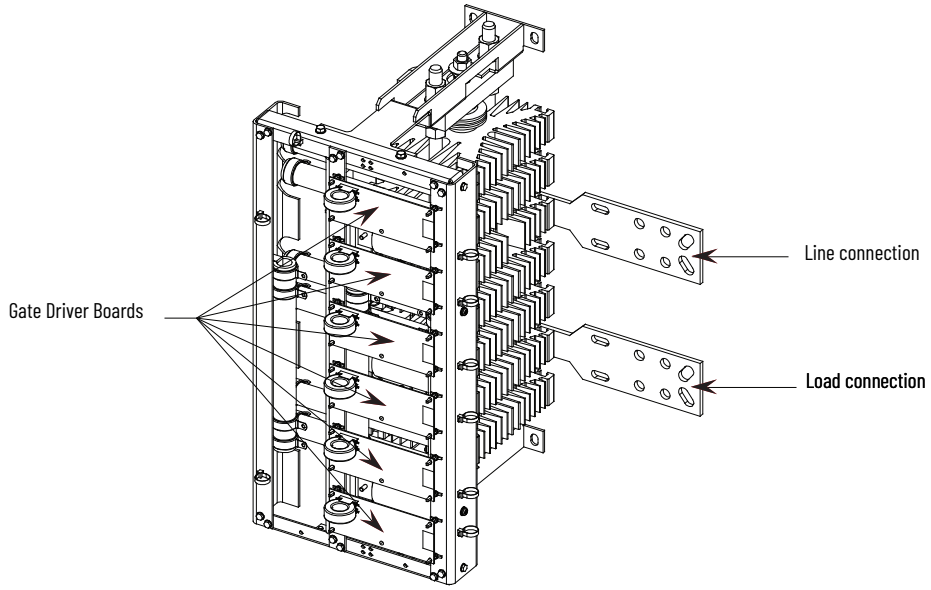


Figure 60 - Power Module Assembly (one phase) with Gate Driver Boards Removed • 5500/6900V, 180/360A

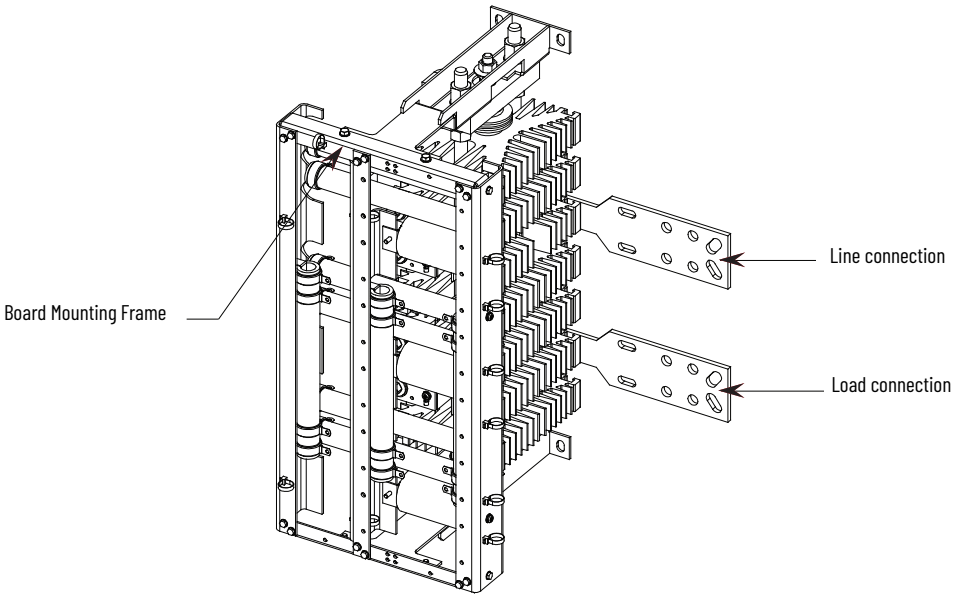


Figure 61 - Power Module Assembly (one phase) with Boards and Frame Removed • 5500/6900V, 180/360A

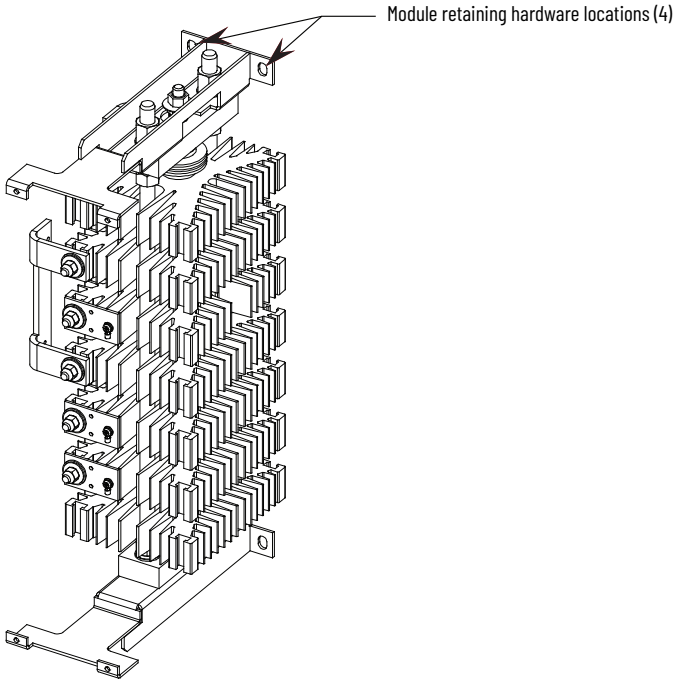
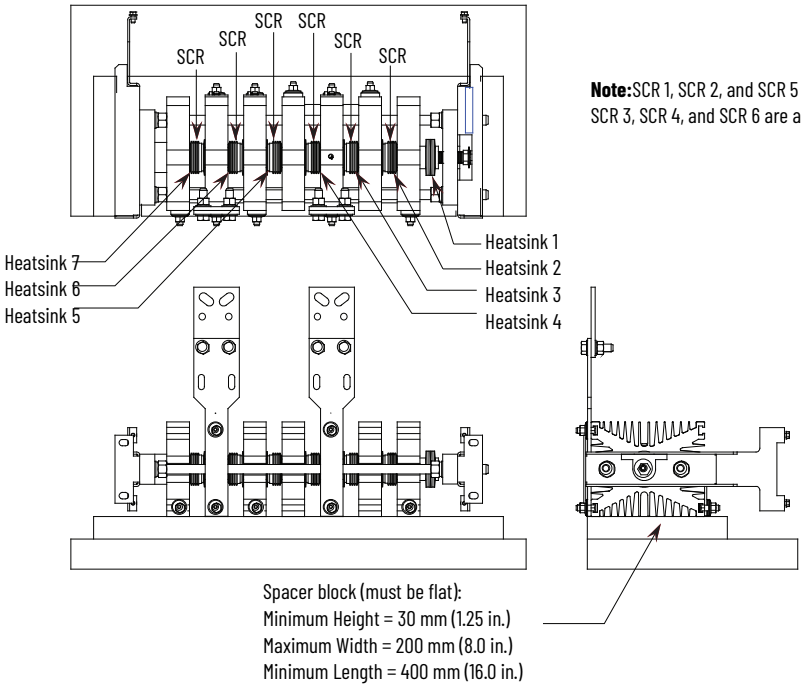


Figure 62 - 6900V Heatsink Assembly, 180/360A Positioned on bench for SCR replacement



Note: SCR 1, SCR 2, and SCR 5 are a matched set.
SCR 3, SCR 4, and SCR 6 are a matched set.

Figure 63 - 6900V SCR Replacement, 180/360A

To remove clamp pressure:
Loosen lower center nut so that the gap between the clamp surface and the heatsink is approximately 6 mm (0.25 in.). A 21-mm open end wrench is required.

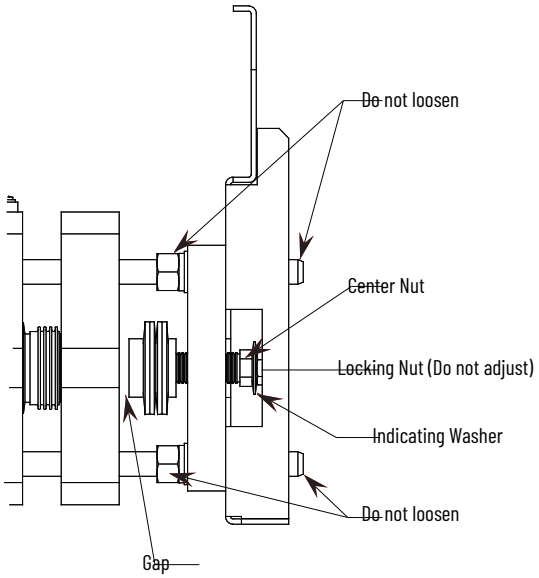


Figure 64 - Removing and Replacing SCR 1, SCR 2 and SCR 5

To Remove SCR 1:
- Remove shorting bar hardware
- Pry heatsinks 1 and 2 apart
- Extract SCR

To Insert New SCR:
- Apply thin film of electrical joint compound to surfaces of SCR.
- Install SCR so that it is seated in locating pin of heatsink (note orientation of SCR).
- Pry heatsinks to close gap, ensuring that SCR is seated properly in both its locating pins.
- Rotate SCR so that all leads have same direction.

Proceed to replacement of other SCRs in the matched set (SCR 2 and SCR 5).

Note: You must replace all three SCRs of a matched set.

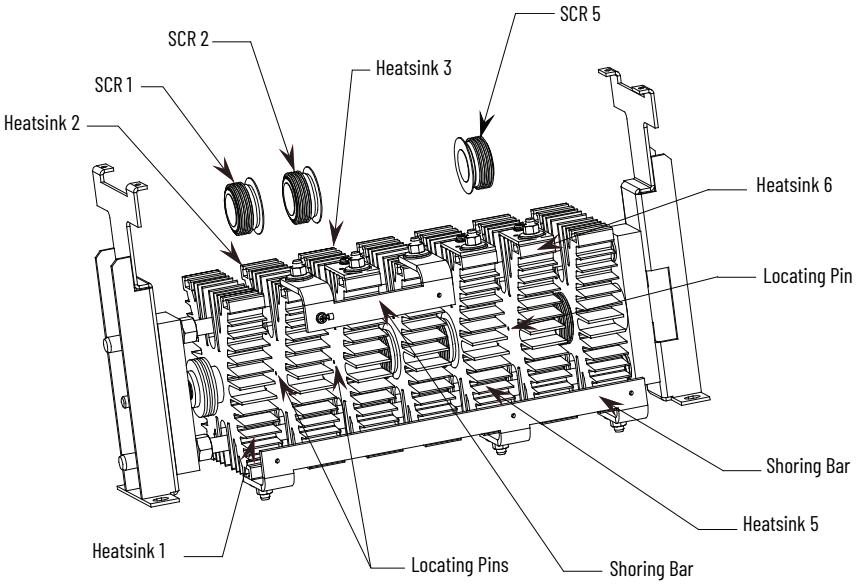


Figure 65 - Power Module Assembly (1-Phase) • 2300V, 600A

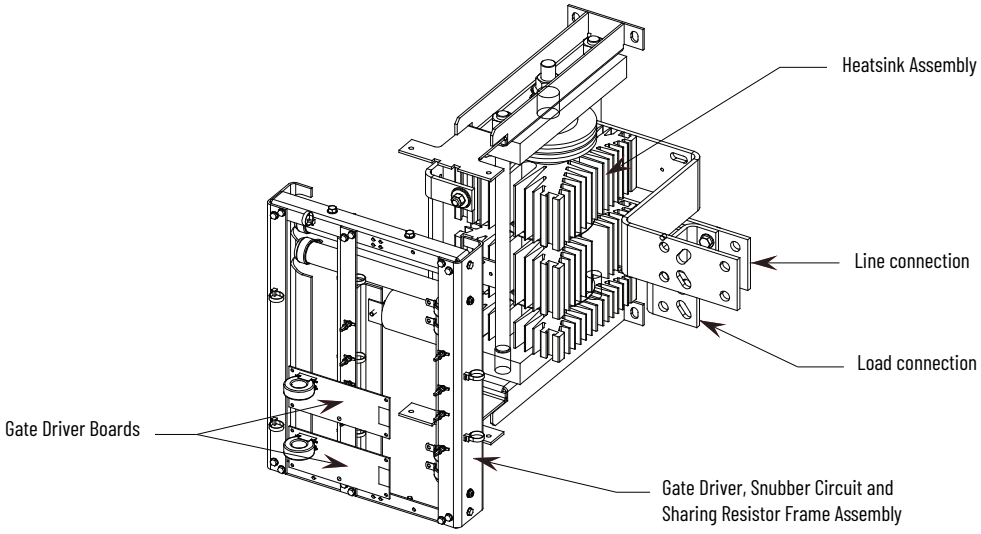


Figure 66 - Power Module Assembly (one phase) • 3300/4160V, 600A

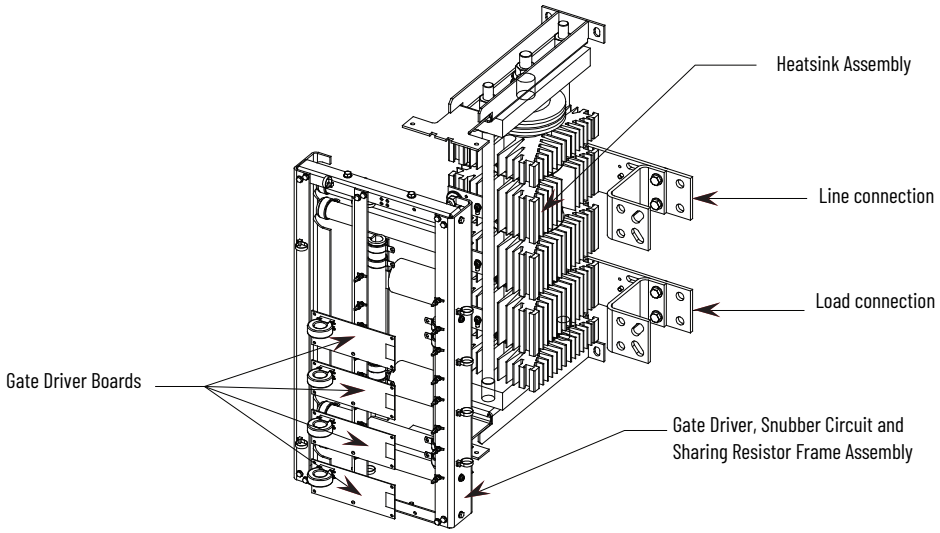
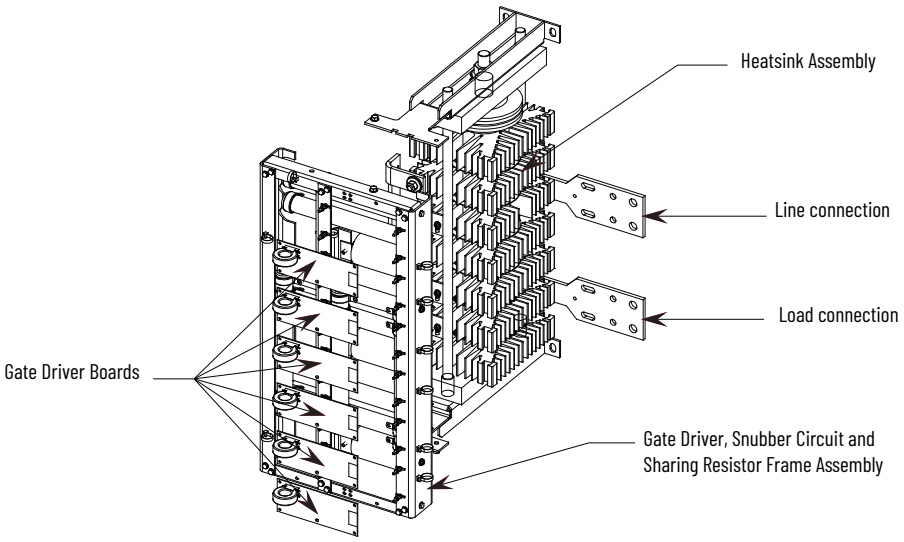


Figure 67 - Power Module Assembly (1-Phase) • 5500/6900V, 600A



Snubber and Resistor Circuit Testing

If the resistance checks from the thyristor testing section were abnormal and the thyristors checked out OK, there may be a problem in the snubber or resistor circuits.

1. Remove all power from the equipment.

> **SHOCK HAZARD:** To avoid shock hazard, ensure main power has been disconnected before working on the controller, motor or control devices. Verify that all circuits are voltage free using a hot stick or appropriate voltage measuring device. Failure to do so may result in burns, injury or death.

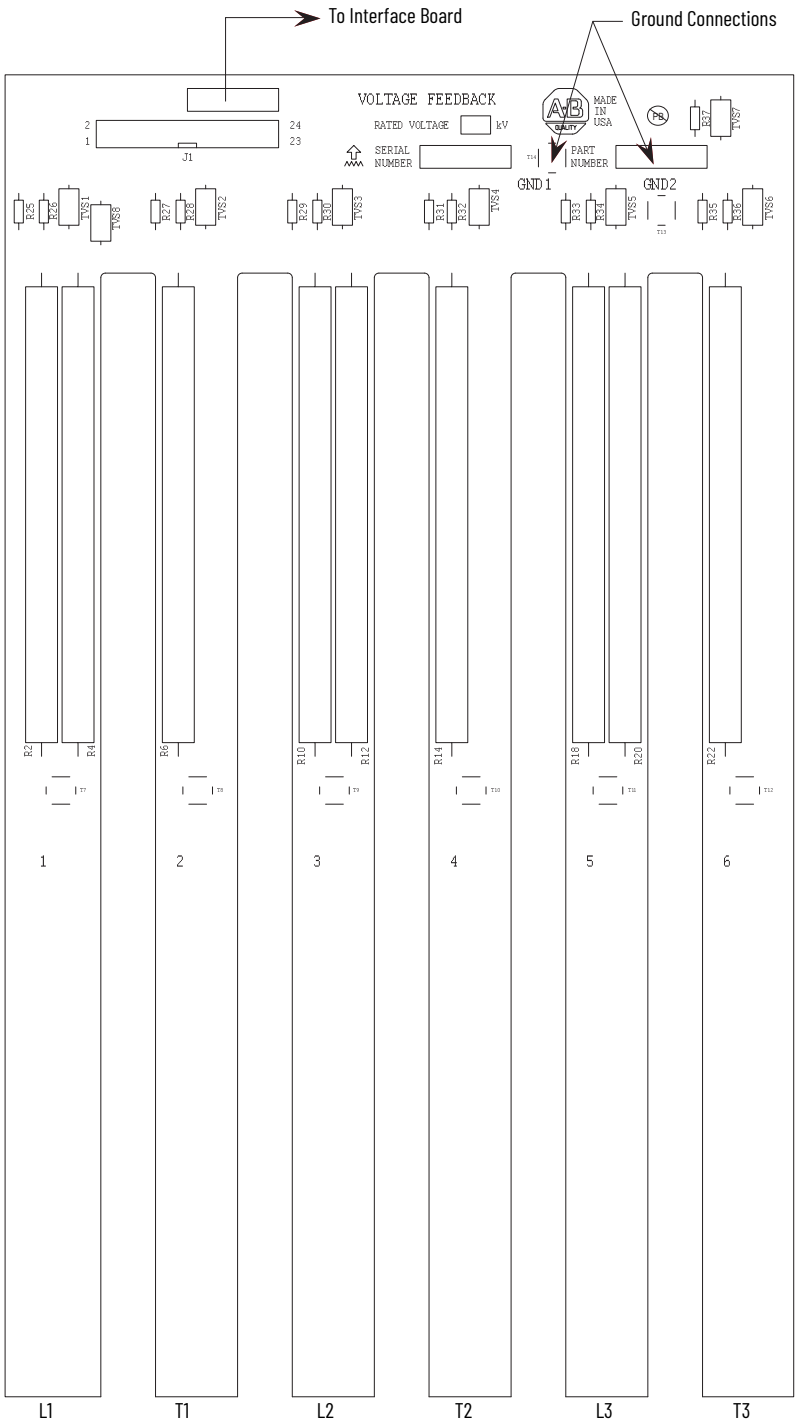
2. Check the snubber components and sharing resistors by isolating them and measuring values as follows (See Figure 69 to Figure 72):

RS	60 Ω (180 A and 360 A) 30 Ω (600 A)
CS	0.5 or 0.68 µF (180 A and 360 A) 1.0 µF (600 A)
RRx	32.5 kΩ total, taps at 2.5 kΩ from each end (x = 1, 2, or 3)

   Replace any out-of-spec components. See Appendix H.

3. If the snubbers and sharing resistors are within tolerances, check the resistance of the voltage sensing module (refer to Figure 68). Remove the ribbon connector from J1 by pressing down on the locking tabs then gently pulling the connector out. Take note of which tap the white high voltage wires are connected to, then remove them (L1, T1, L2, T2, L3, T3). Measure the resistance between each tap and the ground connection, and compare to the values in Figure 68.

Figure 68 - Voltage Sensing Board



V rated	Tap 1, 3, 5	Tap 2, 4, 6
1.5 kV	1.9 M	2.8 M
2.5 kV	3.7 M	5.6 M
4.8 kV	6.6 M	10.0 M
7.2 kV	11.2 M	16.9 M

Values: +/- 2%

Measure across R25, R27, R29, R31, R33, and R35 located at the bottom of each leg of the module. The resistance should be 11.3 kΩ. (The two ground connections must be connected to ground, or to each other if the module has been removed.)

If the values for each leg vary by more than 1%, the voltage sensing module may need to be replaced. See Appendix H and refer to procedure on page 148.

ATTENTION: Grounds must be reconnected on the voltage sensing boards. Failure to do so may result in injury, death or damage to equipment.

The white high voltage wires must be connected to the correct tap on each leg of the voltage sensing module. Failure to do so may result in equipment damage.

The ribbon cable must be connected to J1 only on the voltage sensing board or the equipment will not function.

4. When repairs are complete, re-assemble all parts, check all fasteners, and verify all connections are correct and tight. Make sure all barriers and mechanical parts are in place and secured.

ATTENTION: Make sure ground wires from the Voltage Sensing Module are securely connected to the ground bar in the low voltage panel or ground bus. Failure to do so may result in severe injury or equipment damage.

5. Repeat Thyristor (SCR) resistance checks (page 150) and Power Supply Tests (page 72).

Snubber Resistor Replacement

When replacing the ceramic wire-wound type snubber resistors, use caution when handling the parts. The resistor element is under a thin coating on the ceramic tube, and it may be damaged if dropped, struck or scraped.

Figure 69 - Typical 1500/2400V Module Wiring (180/360 A)

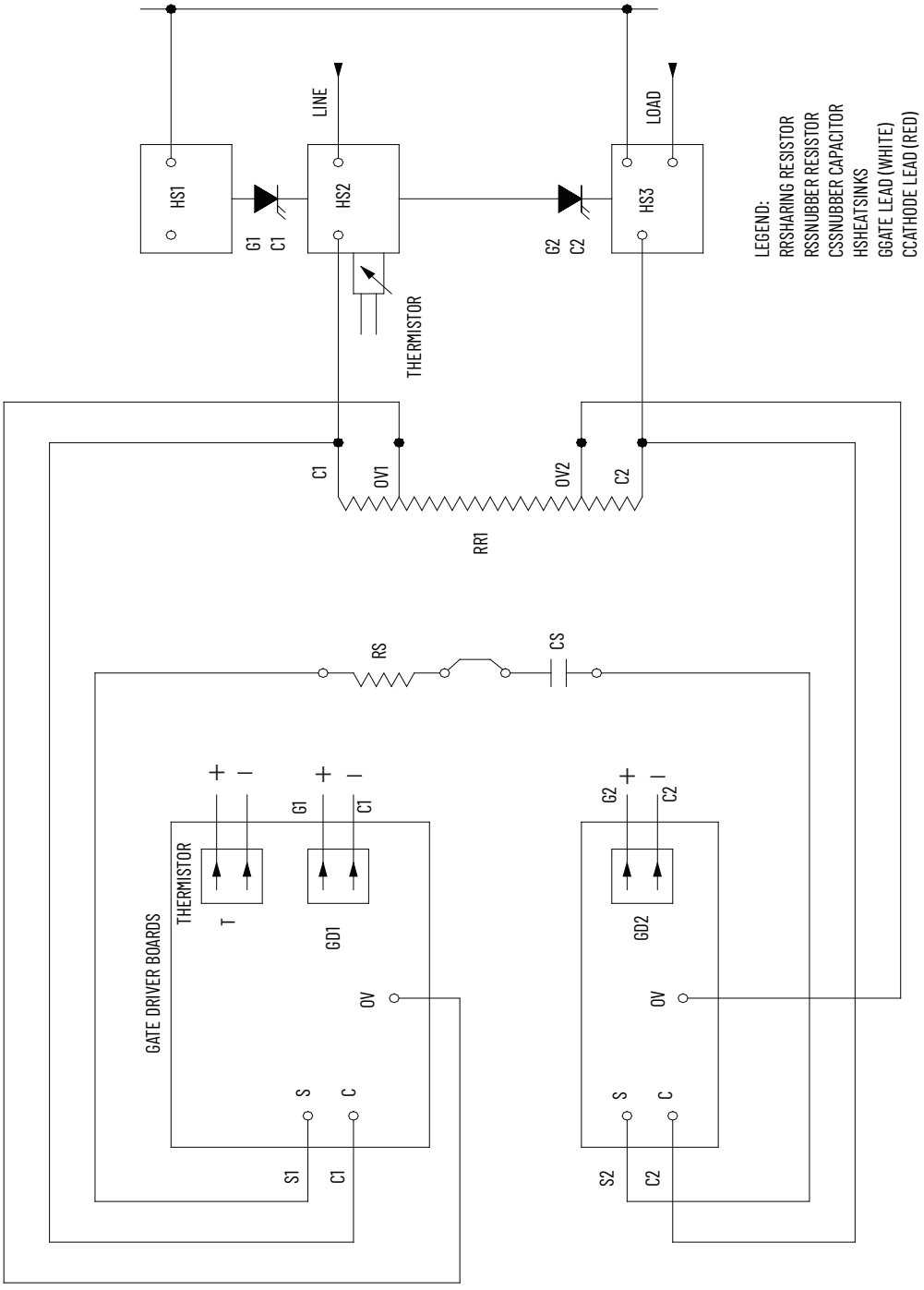


Figure 70 - Typical 1500/2400V Module Wiring (600 A)

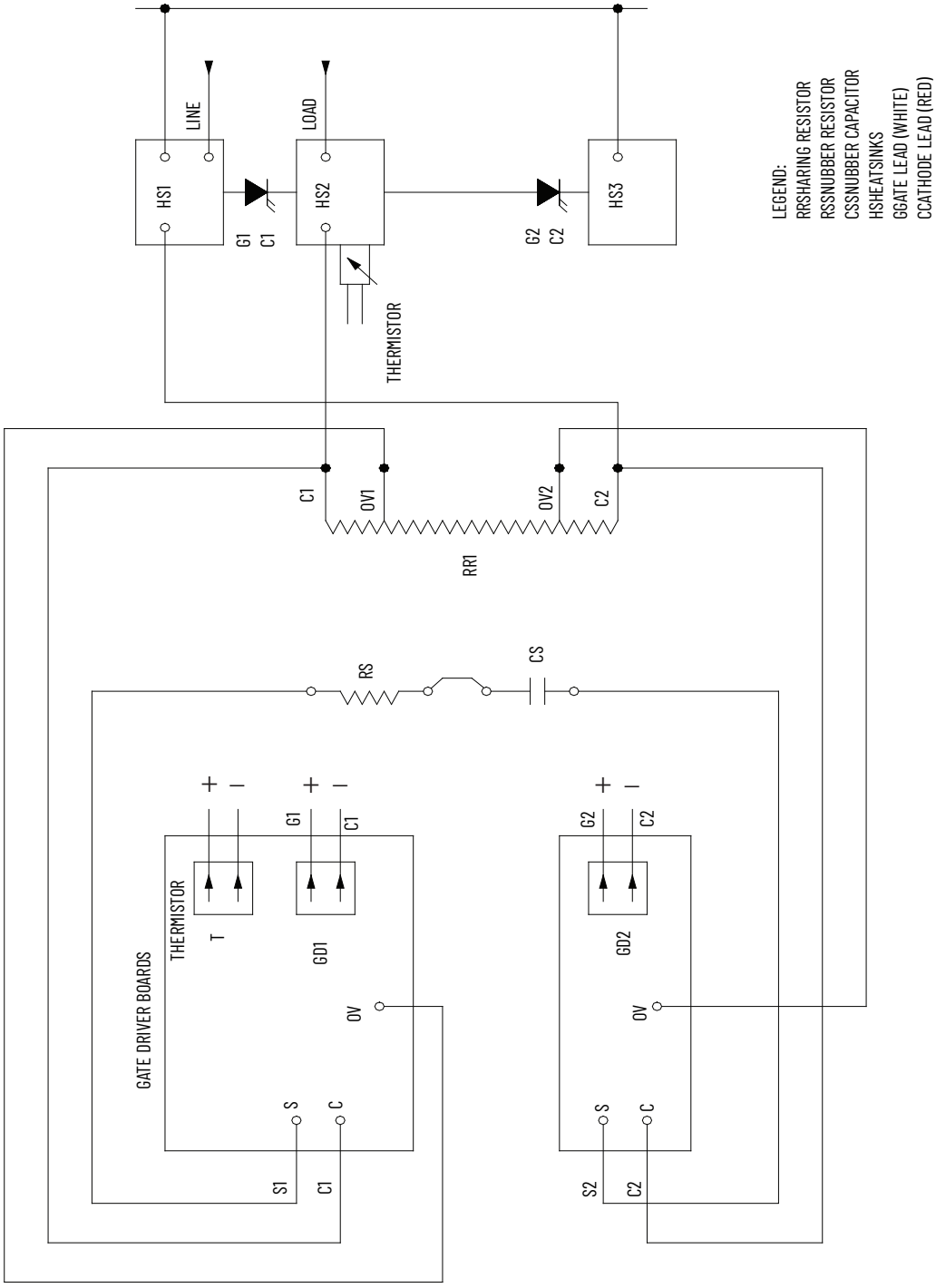


Figure 71 - Typical 3300/4160V Module Wiring (180/360/600 A)

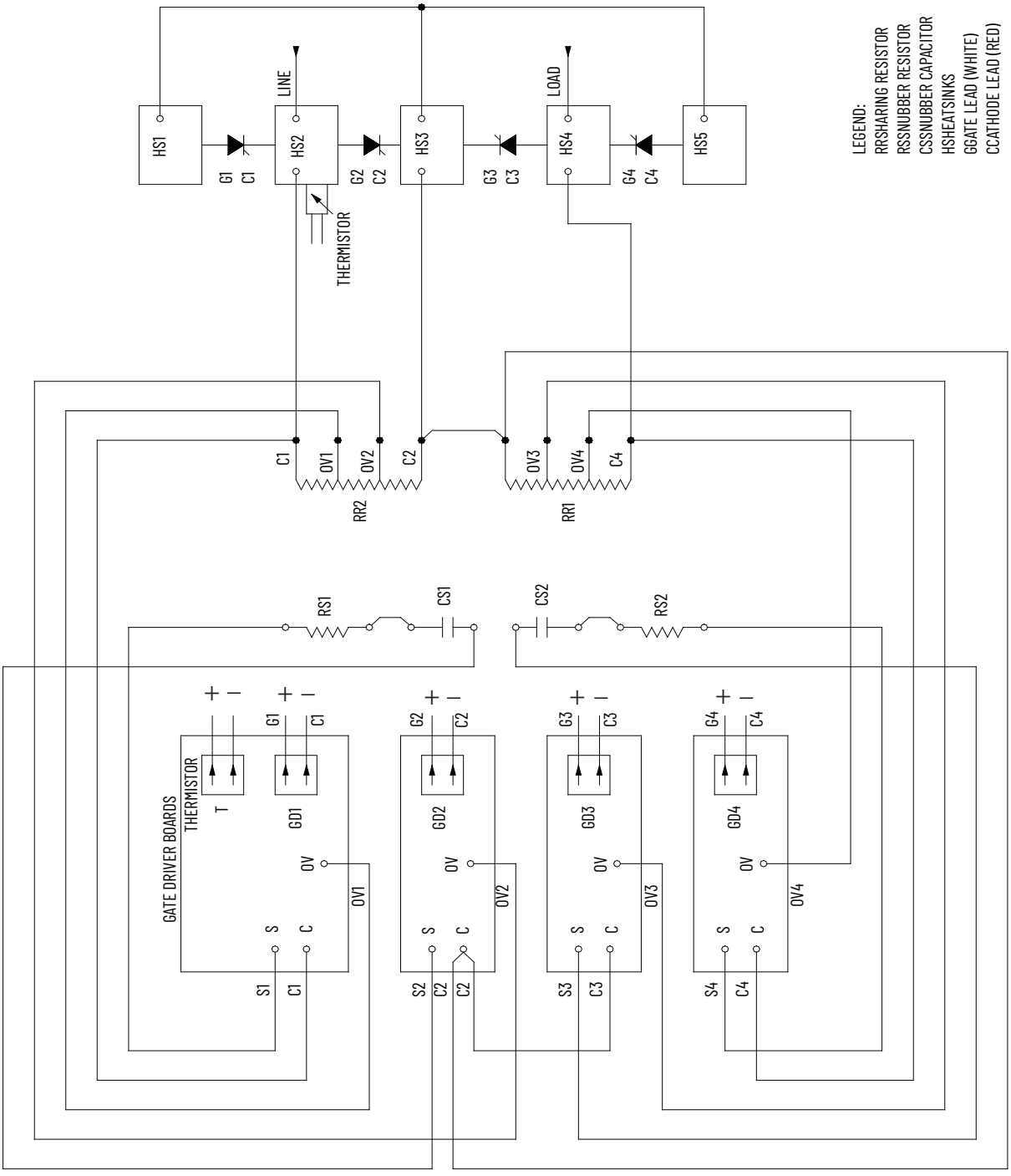
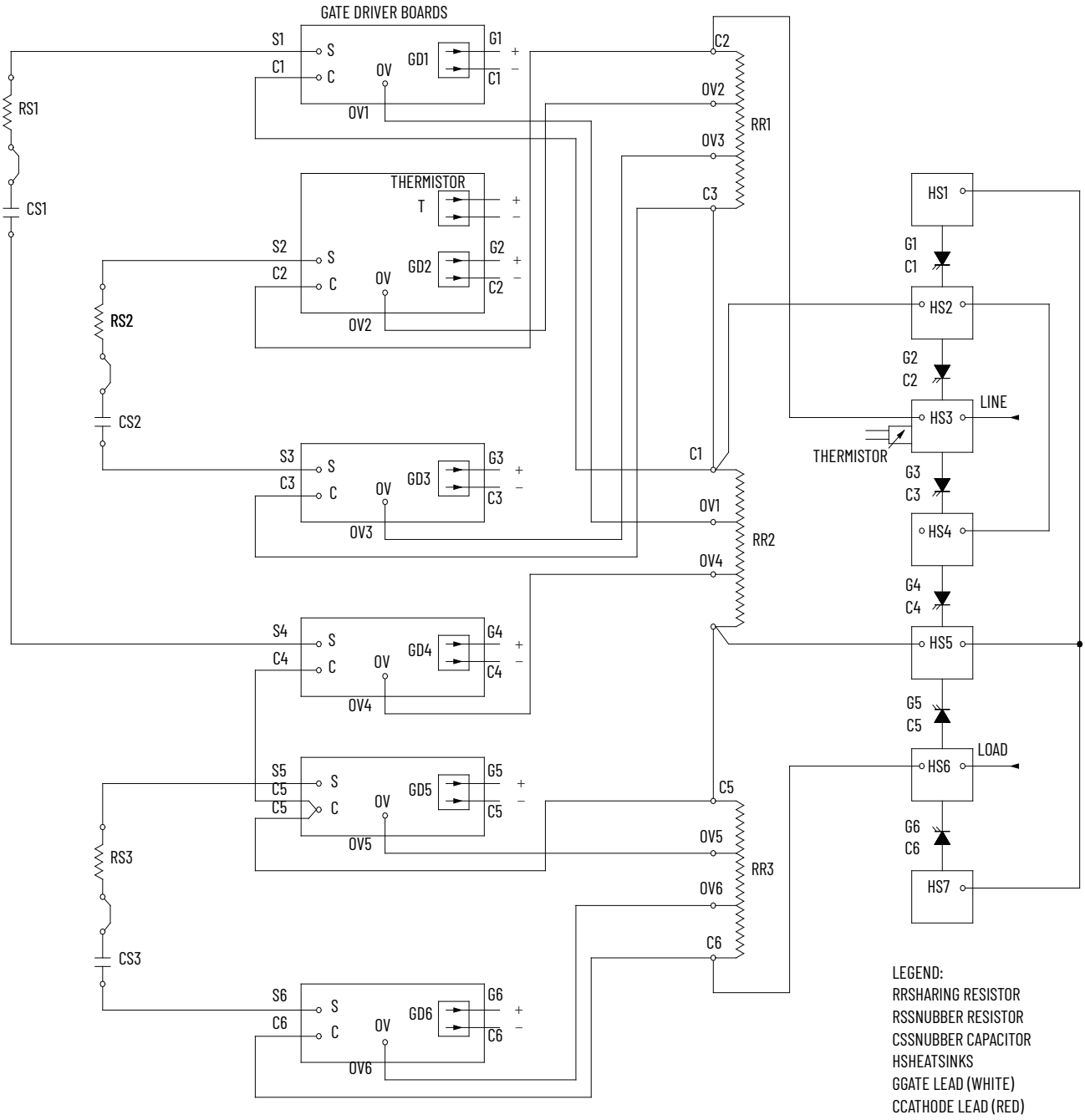


Figure 72 - Typical 6900V Module Wiring (180/360/600 A)


GATE DRIVER BOARDS
S1
C1
S
C
OV
GD1
G1
C1
OV1
THERMISTOR
T
S2
C2
GD2
G2
C2
OV2
S3
C3
GD3
G3
C3
OV3
S4
C4
GD4
G4
C4
OV4
S5
C5
GD5
G5
C5
OV5
S6
C6
GD6
G6
C6
OV6
RS1
CS1
RS2
CS2
RS3
CS3
C2
OV2
OV3
C3
RR1
C1
OV1
OV4
RR2
C5
OV5
OV6
C6
RR3
HS1
HS2
HS3
HS4
HS5
HS6
HS7
G1
C1
G2
C2
G3
C3
G4
C4
G5
C5
G6
C6
LINE
LOAD
THERMISTOR
LEGEND:
RRSHARING RESISTOR
RSSNUBBER RESISTOR
CSSNUBBER CAPACITOR
HSHEATSINKS
GGATE LEAD (WHITE)
CCATHODE LEAD (RED)

Notes:

Maintenance

Preventive Maintenance Protection

Preventive Maintenance (PM) Hours Protection—Fault and Alarm

PM Hours Fault (Code 50) and Alarm

You can configure the SMC™-50 control module to provide a Fault and/or Alarm to indicate that PM should be performed after a programmed number of hours have elapsed, Fault Code 50. Do this by setting a value in the Time to PM, Parameter 21, to indicate the amount of running time before PM needs to be done.

The programmed Time to PM value counts down while the motor is starting, stopping, and running. When the Time to PM parameter value reaches zero, the configured Fault and/or Alarm condition is activated and the parameter counter stops decrementing.

After the preventive maintenance is complete, you can reset the Fault and/or Alarm. You must reload the Time to PM to the value configured and stored in the PM Hours, Parameter 126, through the Meter Reset, Parameter 16, via the HIM or network connection.

Enable the PM Hours Fault by using the PM Hours bit in the Motor Fault Enable, Parameter 230. The PM Hours Alarm is enabled using the PM Hours bit in the Motor Alarm Enable, Parameter 231.

Table 68 - PM Hours Protection Parameter List

Parameter Number	Parameter Name(1)	Minimum/Maximum Value	Default Value	Access	Units
126	PM Hours	1...10000	10000	R/W	HRS
21	Time to PM	0.0...10000.00	0.0	R	HRS
16	Meter Reset	Ready, Elapsed Time, Energy, Time to PM, Starts to PM	Ready	R/W	–

(1) As displayed on the HIM or Connected Components Workbench configuration tools.

PM Starts Protection—Fault and Alarm

PM Starts Fault (Code 51) and Alarm

You can configure the SMC-50 control module to provide a Fault and/or Alarm to indicate that PM should be performed after a pre-defined number of starts have occurred, Fault Code 51. Do this by using the PM Starts, Parameter 127, Starts to PM, Parameter 22, and Meter Reset, Parameter 16.

The Starts to PM parameter indicates the number of starts before preventive maintenance needs to be performed. This value counts down by one for each start initiated, even if the start is not completed. When the Starts to PM value reaches zero, the configured Fault and/or Alarm condition activates and the counter stops counting.

After the preventive maintenance is complete, you can reset the Fault and/or Alarm. You must reload the Starts to PM to the value configured and stored in the PM Starts parameter through the Meter Reset, Parameter 16 via a HIM or network communications.

The PM Starts Alarm function is enabled using the PM Starts bit in the Motor Fault Enable, Parameter 230. The Alarm is enabled using the PM Starts bit in the Motor Alarm Enable, Parameter 231.

Table 69 - Starts Protection Parameter List

Parameter Number	Parameter Name(1)	Minimum/Maximum Value	Default Value	Access	Units
127	PM Starts	1...50000	100	R/W	
22	Starts to PM	0...50000	0	R	
16	Meter Reset	Ready, Elapsed Time, Energy, Time to PM, Starts to PM	Ready	R/W	

(1) As displayed on the HIM or Connected Components Workbench configuration tools.

Safety and Preventative Maintenance

The Maintenance Technician should become familiar with the layout and be aware of the basic system parameters. Only qualified technicians should be allowed to work with this equipment under competent supervision.

General housekeeping is the key to maintaining power electronic and electrical equipment. They are to be kept as dust free as possible. A scheduled program of inspection will reduce the possibility of problems.

ATTENTION: Servicing energized industrial control equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Recommended practice is to disconnnect and lock out control equipment from power sources, and allow any stored energy in capacitors to dissipate. If it is necessary to work in the vicinity of energized equipment, the safety related work practices of NFPA 70E, Electrical Safety Requirements for Employee Workplaces, must be followed.

Periodic Inspection

For OEM-supplied components, refer to documentation provided by the OEM for recommended periodic maintenance procedures.

Industrial control equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions, and adjusted as indicated by experience. An initial inspection, within 3 or 4 months after installation, is suggested. Applicable parts of the following guidelines should be used:

Contamination

If inspection reveals that dust, moisture or other contamination has reached the control equipment, the source must be eliminated. This could indicate an incorrect or ineffective enclosure, unsealed enclosure openings (conduit or other) or incorrect operating procedures. Dirty, wet or contaminated parts must be replaced unless they can be cleaned effectively by vacuuming or wiping.

ATTENTION: Allen-Bradley magnetic starters, contactors and relays are designed to operate without lubrication – do not lubricate these devices since oil or grease on the pole face (mating surfaces) of the operating magnet may cause the device to stick in the "ON" mode. Erratic operation can result with injury or death.

Some parts of other devices are factory lubricated – if lubrication during use or maintenance of these devices is needed, it will be specified in their individual instructions. If in doubt, consult the nearest Rockwell Automation sales office for information.

Vacuum Bottles

The contacts in a vacuum bottle cannot be seen or examined directly. They rely on the high vacuum to operate properly and to interrupt current. Visually inspect the wear of the main contacts with the contacts closed. When any part of the wear indicator, located on the front side of the hex shaft, moves up into the bearing, replace all three vacuum bottles (see Vacuum Contactor User Manual).

The vacuum level should be tested periodically by applying high voltage alternating current across the open bottle using a vacuum tester or Hi-Pot equipment (see Vacuum Contactor User Manual).

Terminals

Loose connections can cause overheating that can lead to equipment malfunction or failure. Check the tightness of all terminals and bus bar connections and securely tighten any loose connections. Replace any parts or wiring damaged by overheating.

Coils

If a coil exhibits evidence of overheating (cracked, melted or burned insulation), it must be replaced. In that event, check for and correct overvoltage or undervoltage conditions, which can cause coil failure. Be sure to clean any residues of melted coil insulation from other parts of the device or replace such parts.

Solid-State Devices

Solid-state devices require little more than a periodic visual inspection. Printed circuit boards should be inspected to determine whether all cables are properly seated in their connectors. Board locking tabs should also be in place. Necessary replacements should be made only at the PC board or plug-in component level. Solvents should not be used on printed circuit boards. Where blowers are used, air filters, if supplied, should be cleaned or changed periodically depending on the specific environmental conditions encountered. For additional information see NEMA Standards Publication No. ICS 1.1 - 1987 entitled “Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control”.

ATTENTION: Use of other than factory recommended test equipment for solid-state controls may result in damage to the control or test equipment, or unintended actuation of the controlled equipment.

Static-Sensitive Items

While performing maintenance on the MV SMC, special precautions must be observed in handling or touching certain static-sensitive components in the cabinet. Most circuit cards and SCRs can be damaged by Electro-Static Discharge (ESD). If personnel will make contact with an ESD-sensitive component during maintenance, they must be grounded. Grounding should be accomplished with a wrist strap which is connected to an approved ground.

Overload Maintenance After a Fault Condition

See NEMA Standards Publication No. ICS 2 Appendix A entitled “Maintenance of Motor controllers after a fault condition”.

Final Check Out

After maintenance or repair of industrial controls, always test the control system for proper functioning under controlled conditions that avoid hazards in the event of a control malfunction.

Keep Good Maintenance Records

This rule will be most helpful in locating possible intermittent problems by pointing to a particular area of recurring trouble within the overall system. Furthermore, good maintenance records will help reduce major, costly shutdowns by demanding the use of proper test equipment and an appropriate inventory of spare parts. For additional information see NFPA 70B, "RECOMMENDED PRACTICE FOR ELECTRICAL EQUIPMENT MAINTENANCE", published by the National Fire Protection Association.

Power Components

Power components should be kept clean and free of dirt and obstructions. This will avoid tracking and heat buildup, thereby increasing the life of the device.

Control Components – Electronic

The printed circuit boards are to be kept clean and free of any accumulations of dirt and foreign materials.

Materials which create static electricity should never be allowed near circuit boards while in the unit, or in storage. Caution should be used when one is near or handling circuit boards. There are no other requirements, other than housekeeping standards, that the maintenance program requires on the logic control components.

Interlocks

Verify that interlocks function as intended, and have not been forced, damaged or removed.

Barriers

Verify that all barriers are in place and securely fastened.

Environmental Considerations

Hazardous Materials

Environmental protection is a top priority for Rockwell Automation. The facility that manufactured this medium voltage product operates an environmental management system that is certified to the requirements of ISO 14001. As part of this system, this product was reviewed in detail throughout the development process to ensure that environmentally inert materials were used wherever feasible. A final review has found this product to be substantially free of hazardous material.

Please be assured that Rockwell Automation is actively seeking alternatives to potentially hazardous materials for which no feasible alternatives exist today in the industry. In the interim, the following precautionary information is provided for your protection and for the protection of the environment. Please contact the factory for any environmental information on any material in the product or with any general questions regarding environmental impact.

Capacitor Dielectric Fluid

The fluids used in the snubber capacitors are generally considered very safe and are fully sealed within the capacitor housings. Shipping and handling of this fluid are typically not restricted by environmental regulations. In the unlikely event that capacitor fluid leaks out, avoid ingestion or contact with skin or eyes as slight irritation could result. Rubber gloves are recommended for handling.

To clean up, soak into an absorbent material and discard into an emergency container. Do not dispose into any drain or into the environment in general or into general landfill refuse. Dispose of according to local regulations. If disposing of an entire capacitor, the same disposal precautions should be taken.

Printed Circuit Boards

Printed circuit boards may contain lead in components and materials. Shipping and handling of these boards are typically not restricted by environmental regulations, however, lead is considered a hazardous substance. Circuit boards must be disposed of according to local regulations and must not be disposed of with general landfill refuse.

Chromate Plating

Sheet steel and fasteners may be plated with zinc and sealed with a chromate-based dip (gold- or silver-colored finish). Shipping and handling of chromate plated parts are typically not restricted by environmental regulations, however, chromate is considered a hazardous substance. Chromate plated parts must be disposed of according to local regulations and must not be disposed of with general landfill refuse.

In Case Of Fire

This product is highly protected against arcing faults and therefore it is very unlikely it would be the cause of a fire. In addition, the materials used are self-extinguishing (i.e. they will not burn without a sustained external flame). If, however, the product is subjected to a sustained fire from some other source, some of the polymer materials will produce toxic gases. As with any fire, individuals involved in extinguishing the fire or anyone in close proximity should wear a self-contained breathing apparatus to protect against any inhalation of toxic gases.

Disposal

When disposing of the product, it should be disassembled and separated into groups of recyclable material as much as possible (for example, steel, copper, plastic, wire, etc.). These materials should then be sent to local recycling facilities. In addition, all disposal precautions mentioned above must also be taken for those particular materials.

Notes:

Parameter Information

Parameter List

Table 70 - SMC -50 Parameter List

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
1	Volts Phase PP Ave	Volt	0/15000	0		Displays the calculated average voltage of the applied three phase to phase line voltages being measured by the SMC-50.	R
2	Volts A-B	Volts	0/15000	0		Displays the Phase A to Phase B voltage applied to the SMC at the supply terminals.	R
3	Volts B-C	Volts	0/15000	0		Displays the Phase B to Phase C voltage applied to the SMC at the supply terminals.	R
4	Volts C-A	Volts	0/15000	0		Displays the Phase C to Phase A voltage applied to the SMC at the supply terminals.	R
5	Current Phase Ave	Amps	0/15000	0		Displays the average of the three phase currents flowing through the SMC Power section to the load.	R
6	Current Phase A	Amps	0/15000	0		Displays the Current flowing through the Phase A power pole of the SMC Power section to the load.	R
7	Current Phase B	Amps	0/15000	0		Displays the Current flowing through the Phase B power pole of the SMC Power section to the load.	R
8	Current Phase C	Amps	0/15000	0		Displays the Current flowing through the Phase C power pole of the SMC Power section to the load.	R
9	Torque	%	-50/300	0.0		Displays the true electromechanical torque calculated based on current and voltage feedback. In order for this reading to display correctly the value for Rated Torque parameter must be set.	R
10	Real Power	MW	-1000/1000	0.000		Displays the total Real Power.	R
11	Real Energy	MWH	-1000/1000	0.000		Displays the Real Energy, where Real Energy equal to Real Power X Time. This parameter is updated every 1/10 of an hour (6 minutes).	R
12	Elapsed Time	Hours	0/50000	0.0		Displays the elapsed motor running time since the last reset of the Elapsed timer by the user.	R
13	Elapsed Time 2	Hours	0/50000	0.0		Displays the elapsed motor running time since the control module was manufactured.	R
14	Running Time	Hours	0/50000	0.0		Displays the time the motor has been running since the last start command. This value will go to zero when a motor is restarted after a stop command or fault.	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
16	Meter Reset		0/4	0	-Ready -Elapsed Timer -Time to PM -Starts to PM	Provides the user the ability to reset various timers and counters by selecting the appropriate reset option. **Ready**: Ready state of parameter, waiting for selection **Elapsed Timer**: Zero the elapsed timer **Time to PM**: Reset the Time to PM timer to the value set in parameter PM Hours (126) **Starts to PM**: Reset the Starts to PM counter to the value set in parameter PM Starts (127)	R/W
17	Power Factor		-1/1	0.00		Displays the Cosine of the phase angle between the voltage and current. A positive values is leading and negative value is lagging.	R
18	Motor Therm Usage	%MTU	0/200	0		Displays the thermal capacity utilized in the motor overload algorithm. A value of 100% will result in a motor overload fault. This value can go over 100% depending on the rate at which the motor is heating before an overload trip.	R
19	Time to OL Trip	Secs	0/1000	0		Displays the estimated time before an overload trip will occur if the present operating conditions persist. If operating below ultimate trip current the value will display the max value.	R
20	Time to OL Reset	Secs	0/1000	0		Displays the estimated time until the motor overload fault can be reset. The MTU reset level is set by the OL reset parameter (80).	R
21	Time to PM	Hrs	0/10000	0		Displays the estimated time to a preventive maintenance event if enabled. The scheduled time for a PM event is set by the user via the PM Hours parameter (126).This value can be reset by the user after an event via the meter reset parameter (16).	R
22	Starts to PM		0/50000	0		Displays the estimated number of starts to a PM event if enabled. The scheduled number of starts for a PM event is set by the user via the PM Starts parameter (127).This value can be reset by the user after an event via the meter reset parameter (16).	R
23	Total Starts		0/30000	0		Displays the total number of SMC starts. The SMC keeps a Start Counter which will be incremented each time the SMC is started. This parameter cannot be reset by the customer and leaves the factory with a value of 0.	R
24	Start Time 1	Secs	0/1000	0		Displays the measured start time of the previous start.	R
25	Start Time 2	Secs	0/1000	0		Displays the measured start time of the 2nd previous start.	R
26	Start Time 3	Secs	0/1000	0		Displays the measured start time of the 3rd previous start.	R
27	Start Time 4	Secs	0/1000	0		Displays the measured start time of the 4th previous start.	R
28	Start Time 5	Secs	0/1000	0		Displays the measured start time of the 5th previous start.	R
29	Peak Current 1	Amps	0/15000	0		Displays the measured peak current of the previous start.	R
30	Peak Current 2	Amps	0/15000	0		Displays the measured peak current of the 2nd previous start.	R
31	Peak Current 3	Amps	0/15000	0		Displays the measured peak current of the 3rd previous start.	R
32	Peak Current 4	Amps	0/15000	0		Displays the measured peak current of the 4th previous start.	R
33	Peak Current 5	Amps	0/15000	0		Displays the measured peak current of the 5th previous start.	R
34	Motor Speed	%	0/100	0		Displays the estimated motor speed during starting and stopping. This parameter is only valid when using the linear speed starting or linear speed stopping modes.	R
35	THD Va	%	0/1000	0		Measures the THD of the applied Phase A line voltage.	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
36	THD Vb	%	0/1000	0		Measures the THD of the applied Phase B line voltage.	R
37	THD Vc	%	0/1000	0		Measures the THD of the applied Phase C line voltage.	R
38	THD Vave	%	0/1000	0		Displays the calculated average of the three voltage THD measurements.	R
39	THD Ia	%	0/1000	0		Measures the THD of the applied Phase A current.	R
40	THD Ib	%	0/1000	0		Measures the THD of the applied Phase B current.	R
41	THD Ic	%	0/1000	0		Measures the THD of the applied Phase C current.	R
42	THD Iave	%	0/1000	0		Displays the calculated average of the three current THD measurements.	R
43	Product Status		0/65535	0	bit 0 = Enabled/ Ready bit 1 = Running bit 2 = Phasing bit 3 = Phasing Active bit 4 = Starting (Accel) bit 5 = Stopping (Decel) bit 6 = Alarm bit 7 = Fault bit 8 = At Speed bit 9 = Start/ Isolate bit 10 = Bypass bit 11 = Ready bit 12 - 13 = Reserved bit 14 = Input #1 bit 15 = Input #2	The product Logic Status is made available to all DPI devices and is also available as a bit enumerated parameter "Product Status". The bits in this parameter correspond with the bits in the Product Logic Status defined for DPI. **bit 0**: 1 -Ready; 0 -Not Ready; **bit 1**: 1 -Power Applied to Motor (Gating SCRs or Bypass closed); 0 -Power NOT Applied to Motor **bit 2**: 1 -ABC Phasing; 0 -CBA Phasing **bit 3**: 1 -3 Phase is valid; 0 -No valid 3-phase detected **bit 4**: 1 -Performing a Start Maneuver ; 0 -Not Performing a Start Maneuver **bit 5**: 1 -Performing a Stop Maneuver (coast to stop not included); 0 -Not Performing a Stop Maneuver **bit 6**: 1 -Alarm Present; 0 -No Alarm Preset **bit 7**: 1 -Fault Condition Exists and hasn't been cleared; 0 -No Fault Condition **bit 8**: 1 -Full Voltage Applied (Bypass or full SCR conduction); 0 -Not Full Voltage Applied **bit 9**: 1 -Start/Isolate Contactor Enabled; 0 -Start/Isolate Contactor Disabled **bit 10**: 1 -Bypass Contactor Enabled; 0 -Bypass Contactor Disabled **bit 11**: 1 indicates that the SMC is eady to accept a Start command. The device is not faulted or in the process of stopping, starting or jogging **bit 12-13**: 0 always **bit 14**: Control Module Input #1 Status. 1 =Input Closed; **bit 15**: Control Module Input #2 Status. 1 =Input Closed;	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
44	Motor Config		0/2	2	Line Delta [Auto]	Provides the user the ability to select the type of motor connection the SMC is being applied to, 'Line' or 'Delta'. It can also be set to 'Auto Config' and the SMC will determine the motor connection.	R/W
45	Motor Connection		0/1	0	[Line] Delta	Displays the type of motor connection the SMC is configured to operate with.	R
46	Line Voltage	Volt	0/15000	4160		The Line voltage applied to the SMC L1, L2, L3 terminals.	R/W
47	Rated Torque	Nm	0/100000	10		Enables the user the ability to enter the rated torque of the motor as read from the motors pecifications (typically nameplate). This is required for proper torque mode starts and stops.	R/W
48	Rated Speed	RPM	0/7	5	750 900 1000 1200 1500 [1800] 3500 3600	Enables the user the ability to enter the rated motor speed as read from the motor specifications (typically nameplate). This is required for proper torque mode starts and stops.	R/W
49	Starting Mode		0/5	2	-Full Voltage -Current Limit -[Soft Start] -**Linear Speed-(Sensorless)** -**Torque Ramp** -Pump Start	Used to program the SMC controller for the type of starting mode that best fits the application. **Full Voltage**: Apply full voltage to the motor at start. **Current Limit**: Apply limited current for a programmed period of time. **Soft start**: Slowly increase current to load over a programmed period of time. **Linear Speed**: Increase current to cause a linear acceleration of the motor. **Torque Ramp**: Slowly increase torque generated by motor over fixed period of time. **Pump Start**: Special starting algorithm for pump applications.	R/W
50	Ramp Time	Sec	0/1000	10.0		Enables the user the ability to configure the time period during which the controller will ramp the output voltage.	R/W
51	Initial Torque	%LRT	0/90	70		The initial reduced voltage output level for the voltage ramp is established and adjusted with this parameter.	R/W
52	Max. Torque	%	0/300	250		Gives the user ability to configure the maximum torque limit of a torque ramp during a torque start operation.	R/W
53	Cur Limit Level	%FLC	50/600	350		The current limit level that is applied for the ramp time selected.	R/W
54	Kickstart Time	SEC	0/2	0.0		A boost of current is applied to the motor for this programmed time.	R/W
55	Kickstart Level	%LRT	0/90	0		Gives the user the ability to adjust the amount of current boost applied to the motor during the kickstart period.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
56	Input 1		0/14	4	Disable Start Coast Stop Option [Start/Coast] Start/Stop Reserved Reserved Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Reserved	Allows the user to select the operation of Terminal 11, Input 1 on the control module. **Disable**: Disable the input - ignores any assertion to Input 1, Terminal 11. **Start**: Initiates a start as set up by the start parameters at Input 1, Terminal 11 (High). **Coast**: Initiates a coast stop.- no current to motor at Input 1, Terminal 11 (Low). **Stop Option**: Initiates a stop maneuver as set up by the stopping parameters at Input 1 (Low). **[Start/Coast]**: if Input 1 = 0 - Stops motor; 1- Initiates a start as set up by the start parameters **Start/Stop**: if Input 1 = 0- Initiates a stop maneuver as set up by stopping parameters; 1- Initiates a start as set up by the start parameters **Dual Ramp**: if Input 1 = 0 - Use starting mode 1; 1 - Use starting mode 2 **OL Select**: if Input 1 = 0 - Use Motor Overload Class 1; 1 - Use Motor Overload Class 2 **Fault**: A fault condition forced if Input 1= 1. **Fault NC**: A fault condition forced if Input 1 = 0. **Clear Fault**: Clear a fault from input 1 Terminal 11 (High). **Emerg Run**: Allow motor to run in emergency run mode if asserted from Input 1, Terminal 11 - does not start motor (High).	R/W
57	Input 2		0/14	0	[Disable] Start Coast Stop Option Start/Coast Start/Stop Reserved Reserved Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Reserved	Allows the user to select the operation of Terminal 10, Input 2 on the control module. **[Disable]**: Disable the input - ignores any assertion to Input 2, Terminal 10. **Start**: Initiates a start as set up by the start parameters at Input 2, Terminal 10 (High). **Coast**: Initiates a coast stop.- no current to motor at Input 2, Terminal 10 (Low). **Stop Option**: Initiates a stop maneuver as set up by the stopping parameters at Input 2 (Low). **Start/Coast**: if Input 2 = 0 - Stops motor; 1- Initiates a start as set up by the start parameters **Start/Stop**: if Input 2 = 0- Initiates a stop maneuver as set up by stopping parameters; 1- Initiates a start as set up by the start parameters **Dual Ramp**: if Input 2 = 0 - Use starting mode 1; 1 - Use starting mode 2 **OL Select**: if Input 2 = 0 - Use Motor Overload Class 1; 1 - Use Motor Overload Class 2 **Fault**: A fault condition forced if Input 2= 1. **Fault NC**: A fault condition forced if Input 2 = 0. **Clear Fault**: Clear a fault from Input 2 Terminal 10 (High). **Emerg Run**: Allow motor to run in emergency run mode if asserted from Input 2, Terminal 10 - does not start motor (High).	R/W
58	Starting Mode 2		0/5	2	Full Voltage Current Limit [Soft Start] Linear Speed Torque Ramp Pump Start	Allows the user to program an alternate starting mode for the SMC-50 that suits the application. **Full Voltage**: Apply full voltage to the motor at start. **Current Limit**: Apply limited current for a programmed period of time. **Soft start**: Slowly increase current to load over a programmed period of time. **Linear Speed**: Increase current to cause a linear acceleration of the motor. **Torque Ramp**: Slowly increase torque generated by motor over fixed period of time. **Pump Start**: Special starting algorithm for pump applications.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
59	Ramp Time 2	Sec	0/1000	10.0		Allows the user to set an alternate time period during which the controller will ramp the output voltage.	R/W
60	Initial Torque 2	%LRT	0/90	70		Allows the user to set an alternate initial reduced voltage output level for the voltage ramp.	R/W
61	Max. Torque 2	%	0/300	250		Allows the user to set a alternate maximum torque limit of a torque ramp during a torque start operation.	R/W
62	Cur Limit Level 2	%FLC	50/600	350		Allows the user to set an alternate current limit level that is applied for the ramp time selected.	R/W
63	Kickstart Time 2	SEC	0/2	0		Allows the user to set an alternate boost current to be applied to the motor for the programmed time.	R/W
64	Kickstart Level 2	%LRT	0/90	0		Allows the user to set an alternate adjustment of the amount of current applied to the motor during the kickstart period.	R/W
65	Stop Mode		0/5	0	[Coast] Soft Stop Linear Speed Pump Stop Reserved External Brake	Allows the user to program the SMC-50 for the type of stopping that best suits the application. **[Coast]**: Coast-to-Rest. **Soft stop**: Slowly reduces current by reducing voltage applied to the motor over a programmed period of time. **Linear Speed**: Stops the motor following a linear speed ramp over a programmed period of time. **Pump Stop**: Slowly reduces current by reducing voltage applied to the motor using the pump stop algorithm over a programmed period of time. **External Brake**: Closes an external contactor to apply braking current to the motor.	R/W
66	Stop Time	Sec	0/999	0		Sets the time period which the controller will ramp the voltage during a stopping maneuver.	R/W
67	Backspin Timer	Sec	0/999	0		Avoids starting into a backspin condition. The timer begins counting after a stop is completed (coast, stop maneuver, fault etc). All start inputs will be ignored until the backspin timer has timed out.	R/W
68	Pump Pedestal	%	0/50	0		Provides the ability to adjust the pump algorithm slightly for different applications. Typically, this is used to shorten the ramp time before the SMC-50 starts to get aggressive in its pump stopping maneuver.	R/W
75	Overload Class		5/30	10		Sets the desired trip class of internal solid state overload. Overload fault and alarms are enabled and disabled in the Starter Fault En and Starter Alarm parameters.	R/W
76	Overload Class 2		5/30	10		Allows user to set the internal solid state overload to an alternate trip class. This Trip Class is used when an input (configured as overload select) is asserted.	R/W
77	Service Factor		0.01/1.99	1.15		Parameter to enter the value of the motor's service factor from the nameplate.	R/W
78	Motor FLC	Amps	1/2200	1.0		Parameter to enter the Full Load Current (FLC) value from the motor's nameplate.	R/W
79	Motor FLC 2	Amps	1/2200	1.0		Second motor FLC setting to be used when Overload #2 is selected using the "Overload 2" input.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
80	OL Reset Level	%MTU	1/99	75		When the level of Motor Thermal Usage (MTU) drops below this limit after an OL fault, an overload reset can occur. If restart is enabled, the motor overload will automatically reset when the MTU drops below this level.	R/W
81	OL Shunt Time	Secs	0/999	0		Disables the overload from incrementing MTU for the selected time period after a start or stop command is initiated.	R/W
82	OL Inhibit Time	Secs	0/999	0		Disables the overload from tripping during stopping maneuvers. The MTU. Therm Usage continues to increment during these maneuvers.	R/W
83	Overload A Level	%MTU	0/100	90		The MTU level that will set off an alarm when exceeded. The Overload bit the Motor Alarm En parameter must be set to signal an alarm.	R/W
84	Locked Rtr F Lvl	%FLC	400/1000	600		The peak phase current to the load that, if exceeded for the time period defined in Locked Rtr Delay, will signal a fault. The Locked Rotor bit in the Motor Fault En parameter must be set to signal a fault.	R/W
85	Locked Rtr F Dly	Secs	0.1/100	0.1		The time period that the peak phase current exceeds the Locked Rtr F Level to signal a fault. The Locked Rotor bit in the Motor Fault En parameter must be set to signal a fault.	R/W
86	Underload F Lvl	%FLC	0/99	0		If phase current drops below this level for the period of time set in Underload F Dly parameter, an Underload Fault will be signaled. The Underload bit in the Motor Fault En parameter must be set to signal a fault.	R/W
87	Underload F Dly	Secs	0.1/99	0.1		The time period that the phase current must be below the level set in the Underload F Level parameter before a underload fault is signaled. The Underload bit in the Motor Fault En parameter must be set to signal a fault.	R/W
88	Underload A Lvl	%FLC	0/99	0		If phase current drops below this level for the period of time set in Underload A Dly parameter, an Underload Alarm will be signaled. The Underload bit in the Motor Alarm En parameter must be set to signal a alarm.	R/W
89	Underload A Dly	Secs	0.1/99	0.1		The time period that the phase current must be below the level set in the Underload A Level parameter before an Underload Alarm is signaled. The Underload bit in the Motor Alarm En parameter must be set to signal a alarm.	R/W
90	MWatts Ov F Lvl	MW	0/1000	0.000		If the Real Power exceeds this level for the time period set in MWatts Ov F Dly parameter, an MWatts Ov fault will be signaled. The MWatts Ov bit in the Motor Fault En parameter must be set to signal a fault.	R/W
91	MWatts Ov F Dly	Secs	0.1/99	0.1		The time period that Real Power must exceed MWatts Ov F Lvl to signal a fault. The MWatts Ov bit in the Motor Fault En parameter must be set to signal fault.	R/W
92	MWatts Ov A Lvl	MW	0/1000	0.000		If the Real Power exceeds this level for the time period set in MWatts Ov A Dly parameter, a MWatts Ov Alarm will be signaled. The MWatts Ov bit in the Motor Alarm En parameter must be set to signal an alarm.	R/W
93	MWatts Ov A Dly	Secs	0.1/99	0.1		The time period that Real Power must exceed MWatts Ov A Lvl to signal an alarm. The MWatts Ov bit in the Motor alarm En parameter must be set to signal an alarm.	R/W
94	MWatts Un F Lvl	MW	0/1000	0.000		If the Real Power drops below this level for the time period set in MWatts Un F Dly parameter, an MWatts Un Fault will be signalled. The MWatts Un bit in the Motor Fault En parameter must be set to signal a fault.	R/W
95	MWatts Un F Dly	Secs	0.1/99	0.1		The time period that Real Power must drop below MWatts Un F Lvl to signal a fault. The MWatts Un bit in the Motor Fault En parameter must be set to signal a fault.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
96	MWatts Un A Lvl	MW	0/1000	0.000		If the Real Power drops below this level for the time period set in MWatts Un A Dly parameter, an MWatts Un Alarm will be signaled. The MWatts Un bit in the Motor Alarm En parameter must be set to signal an alarm.	R/W
97	Mwatts Un A Dly	Secs	0.1/99	0.1		The time period that Real Power must drop below MWatts Un A Level to signal an alarm. The MWatts Un bit in the Motor Alarm En parameter must be set to signal an alarm.	R/W
98	Undervolt F Lvl	%V	0/100	90		If the average three phase line voltage drops below this level for the time period set in the Undervolt F Dly parameter, an Undervolt fault will be signaled. The Undervolt bit in the Starter Fault En parameter must be set to signal a fault.	R/W
99	Undervolt F Dly	Secs	0.1/99	3.0		The time period that the average three phase voltage must remain below Undervolt F Level to signal a fault. The Undervolt bit in the Starter Fault En parameter must be set to signal a fault.	R/W
100	Undervolt A Lvl	%V	0/100	90		If the average three phase line voltage drops below this level for the time period set in the Undervolt A Dly parameter, an Undervolt Alarm will be signaled. The Undervolt bit in the Starter Alarm En parameter must be set to signal an Alarm.	R/W
101	Undervolt A Dly	Secs	0.1/99	3.0		The time period that the average three phase voltage must remain below Undervolt A Lvl to signal an Alarm. The Undervolt bit in the Starter Alarm parameter must be set to signal an Alarm.	R/W
102	Overvolt F Lvl	%V	100/199	110		If the average three phase line voltage exceed this level for the time period set in the Overvolt F Dly parameter, an Overvolt fault will be signaled. The Overvolt bit in the Starter Fault En parameter must be set to signal a fault.	R/W
103	Overvolt F Dly	Secs	0.1/99	3.0		The time period that the average three phase voltage must exceed the Overvolt F Level to signal a fault. The Overvolt bit in the Starter Fault En parameter must be set to signal a fault.	R/W
104	Overvolt A Lvl	%V	100/199	110		If the average three phase line voltage exceed this level for the time period set in the Overvolt A Dly parameter, an Overvolt alarm will be signaled. The Overvolt bit in the Starter Alarm parameter must be set to signal an alarm.	R/W
105	Overvolt A Dly	Secs	0.1/99	3.0		The time period that the average three phase voltage must exceed the Overvolt A Level to signal an alarm The Overvolt bit in the Starter alarm En parameter must be set to signal a alarm.	R/W
106	Volt Unbal F Lvl	%	1/25	15		If the line-to-line voltage imbalance condition exceeds the Volt Unbal F Lvl for the period set in Volt Unbal F Dly, a fault will be signalled. The Volt Unbal bit must be set in the Starter Fault En parameter to signal a fault. See manual for details on imbalance calculations.	R/W
107	Volt Unbal F Dly	Secs	0.1/99	3.0		The time period that the voltage imbalance exceeds the Volt Unbal F Lvl to signal a fault. The Volt Unbal bit in the Starter Fault En parameter must be set to signal a fault.	R/W
108	Volt Unbal A Lvl	%	1/25	15		If the line-to-line voltage imbalance condition exceeds the Volt Unbal A Lvl for the time period set in Volt Unbal A Dly, an alarm will be signalled. The Volt Unbal bit must be set in the Starter Alarm parameter to signal a alarm. See manual for details on imbalance calculations.	R/W
109	Volt Unbal A Dly	Secs	0.1/99	3.0		The time period that the voltage imbalance exceeds the Volt Unbal A Level to signal a alarm. The Volt Unbal bit in the Starter Alarm parameter must be set to signal a alarm.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
110	Cur Imbal F Lvl	%	1/25	15		If the line-to-line current imbalance condition exceeds the Cur Imbal F Lvl for the time period set in Cur Imbal F Dly, a fault will be signalled. The Cur Imbal bit must be set in the Motor Fault En parameter to signal a fault.	R/W
111	Cur Imbal F Dly	Secs	0.1/99	3.0		The time period that the current imbalance exceeds the Cur Imbal F Lvl to signal a fault. The Cur Imbal bit in the Motor Fault En parameter must be set to signal a fault.	R/W
112	Cur Imbal A Lvl	%	1/25	15		If the line-to-line current imbalance condition exceeds the Cur Imbal A Lvl for the time period set in Cur Imbal A Dly, an alarm will be signalled. The Cur Imbal bit must be set in the Motor Alarm En parameter to signal a Alarm.	R/W
113	Cur Imbal A Dly	Secs	0.1/99	3.0		The time period that the current imbalance exceeds the Cur Imbal A Lvl to signal an alarm. The Cur Imbal bit in the Motor Alarm En parameter must be set to signal an alarm.	R/W
114	Jam F Lvl	%FLC	0/1000	1000		If the peak phase current exceeds the Jam F Lvl for the time period set in Jam F Dly, a fault will be signaled. The Jam bit must be set in the Motor Fault En parameter to signal a fault.	R/W
115	Jam F Dly	Secs	0.1/99	0.1		The time period that the peak phase current exceeds the Jam F Lvl to signal a fault. The Jam bit in the Motor fault En parameter must be set to signal a fault.	R/W
116	Jam A Lvl	%FLC	0/1000	1000		If the peak phase current exceeds the Jam A Lvl for the time period set in Jam A Dly, an alarm will be signaled. The Jam bit must be set in the Motor Alarm En parameter to signal a alarm.	R/W
117	Jam A Dly	Secs	0.1/99	0.1		The time period that the peak phase current exceeds the Jam A level to signal an alarm. The Jam bit in the Motor Alarm En parameter must be set to signal a alarm.	R/W
118	THD V F Lvl	%	0/1000	1000		If the average total harmonic distortion (THD) on the line voltage exceeds the THD V F Lvl for the time period set in THD V F Dly, a fault will be signaled. The THD V bit must be set in the Starter Fault En parameter to signal a fault.	R/W
119	THD V F Dly	Secs	0.1/99	0.1		The time period that the average THD on the line voltage exceeds the THD V F Lvl to signal a fault. The THD V bit in the Starter Fault En parameter must be set to signal a fault.	R/W
120	THD V A Lvl	%	0/1000	1000		If the average THD on the line voltage exceeds the THD V A Lvl for the time period set in THD V Dly, an alarm will be signaled. The THD V bit must be set in the Starter Alarm parameter to signal a alarm.	R/W
121	THD V A Dly	Secs	0.1/99	0.1		The time period that the average THD on the line voltage exceeds the THD V A Lvl to signal a alarm. The THD V bit in the Starter Alarm parameter must be set to signal an alarm.	R/W
122	THD I F Lvl	%	0/1000	1000		If the average THD on the phase current exceeds the THD I F Lvl for the period set in THD I F Dly, a fault will be signalled. The THD I bit must be set in the Motor Fault En parameter to signal a fault.	R/W
123	THD I F Dly	Secs	0.1/99	0.1		The time period that the average THD on the phase current exceeds the THD I F Lvl to signal a fault. The THD I bit in the Motor Fault En parameter must be set to signal a fault.	R/W
124	THD I A Lvl	%	0/1000	1000		If the average THD on the phase current exceeds the THD I A Lvl for the time period set in THD I A Dly, an alarm will be signaled. The THD I bit must be set in the Motor Alarm En parameter to signal an alarm.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
125	THD I A Dly	Secs	0.1/99	0.1		The time period that the average THD on the phase current exceeds the THD I A Lvl to signal an alarm. The THD I bit in the Motor Alarm En parameter must be set to signal an alarm.	R/W
126	PM Hours	Hrs	1/10000	10000		This is a counter the user can set to generate an alarm or fault to signal a need for preventive maintenance. The Hours to PM parameter is initialized to this value and counts down when the motor is running.	R/W
127	PM Starts		1/50000	100		This is a counter the user can set to generate an alarm or fault to signal a need for preventive maintenance. The Starts to PM parameter is initialized to this value and counts down each time the motor is started.	R/W
128	Starts per Hour		1/10	10		The user can program the maximum number of starts within a sliding one-hour window. Once the number of starts per hour is reached any additional starts will cause a fault.	R/W
129	Freq High F Lvl	Hz	45/66	63		The highest line voltage frequency that can be applied to the SMC-50 before causing a Freq High F Lvl fault. The Freq High bit in the Starter Fault En parameter must be set to signal a fault.	R/W
130	Freq Low F Lvl	Hz	45/66	47		The lowest line voltage frequency that can be applied to the SMC-50 before causing a Freq Low F Lvl fault.The Freq Low bit in the Starter Fault En parameter must be set to signal a fault.	R/W
131	Freq High A Lvl	Hz	45/66	63		The highest line voltage frequency that can be applied to the SMC-50 before causing a Freq High F Lvl alarm. The Freq High bit in the Starter Alarm parameter must be set to signal an alarm.	R/W
132	Freq Low A Lvl	Hz	45/66	47		The lowest line voltage frequency that can be applied to the SMC-50 before causing a Freq Low F Lvl alarm. The Freq Low bit in the Starter Alarm parameter must be set to signal an alarm.	R/W
133	Restart Attempts		0/5	0		Allows the user to enable the SMC-50 to auto-restart for up-to five attempts after a thyristor has failed to fire and results in an open gate fault trip.	R/W
134	Restart Dly	Secs	0/60	0		Provides a delay time prior to the SMC-50's attempt to restart the motor after a fault.	R/W
135	Starts Restart En		Bit Value 0/1	0 Future	Volt Unbal Overvoltage Undervoltage Phase Rev Line Loss Open Gate Config Change Freq THD V Future	Allows the user to select which type of fault that the SMC-50 can try to restart from once the restart delay period has expired. To enable a restart from a fault, the function must be selected (1). Restart Attempts, Parameter 133, and Restart Delay, Parameter 134, must be configured.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
136	Starter Fault En		Bit Value 0/1	0 0 0 0 1 1 0 0 0	Volt Unbal Overvoltage Undervoltage Phase Rev Line Loss Open Gate Config Change Freq THD V	Allows the user to enable faults associated with the control module. The bit for a fault must be set (1) for the fault to be asserted.	R/W
137	Starter Alarm En		Bit Value 0/1	0	Volt Unbal Overvoltage Undervoltage Phase Rev Line Loss Open Gate Config Change Freq THD V	Allows the user to enable alarms associated with the control module. The bit for an alarm must be set (1) for the alarm to be asserted.	R/W
138	Fault 1		0/10000	0		First entry in the fault buffer and is the most recent fault to have occurred.	R/W
139	Fault 2		0/10000	0		Second entry in the fault buffer.	R/W
140	Fault 3		0/10000	0		Third entry in the fault buffer.	R/W
141	Fault 4		0/10000	0		Fourth entry in the fault buffer.	R/W
142	Fault 5		0/10000	0		Fifth entry in the fault buffer. The oldest fault displayed in the fault buffer.	R/W
143	Alarm 1		0/10000	0		First entry in the alarm buffer and is the most recent alarm to have occurred.	R/W
144	Alarm 2		0/10000	0		Second entry in the alarm buffer.	R/W
145	Alarm 3		0/10000	0		Third entry in the alarm buffer.	R/W
146	Alarm 4		0/10000	0		Fourth entry in the alarm buffer.	R/W
147	Alarm 5		0/10000	0		Fifth entry in the alarm buffer. There can be up to 100 events stored in the alarm buffer. To see the whole buffer, go the diagnostics tab on the HIM or DriveExplorer.	R/W
148	Logic Mask		0/65535	0		The bits in this parameter allow the user to enable (bit=1) or disable (bit=0) which DPI ports the SMC-50 will accept Start and Maneuver commands from. Coast Stop commands are always accepted from any port. **bit 1** = port 1 (On board HIM) [Default=0] **bit 2** = port 2(DPI port on control module) [Default=0] **bit 3** = port 3(DPI port on control module with splitter) [Default=0] **bit 4** = port 4(Internal Comm module) [Default=0] **bit 5-13** = unused **bit 14** = port 14 [DeviceLogix engine] **bit 15** = unused	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
149	Logic Mask Act		0/65535	0		Displays which DPI port the SMC-50 will accept a start command from. It may be different from the Logic Mask set by the local user if someone changes it over the network. **bit 1** = port 1 (on board HIM) **bit 2** = port 2 (DPI port on control module) **bit 3** = port 3 (DPI port on control module with splitter) **bit 4** = port 4 (Internal Comm module) **bit 5-15** = reserved	R
150	Write Mask Cfg		0/65535	7FFF		This bits in this parameter allow the user to enable (bit=1) or disable (Bit=0) which DPI ports the SMC-50 will accept write commands from. Only selected ports can modify parameters. **bit 1** = port 1 (on board HIM) [Default=1] **bit 2** = port 2 (DPI port on control module) [Default=1] **bit 3** = port 3 (DPI port on control module with splitter) [Default=1] **bit 4** = port 4 (Internal Comm module) [Default=1] **bit 5-15** = reserved [Default=0]	R/W
151	Write Mask Act		0/65535	0		Displays which DPI ports the SMC will accept write commands from that can change parameters. It may be different from the Write Mask Cfg parameter setup by the local user if someone changes it over the network. **bit 1** = port 1 (on board HIM) **bit 2** = port 2 (DPI port on control module) **bit 3** = port 3 (DPI port on control module with splitter) **bit 4** = port 4 (Internal Comm module) **bit 5-15** = reserved	R
152	Port Mask Act		0/65535	0		Displays which DPI ports are active on the control module and will accept operational commands from. **bit 1** = port 1 (on board HIM) **bit 2** = port 2 (DPI port on control module) **bit 3** = port 3 (DPI port on control module with splitter) **bit 4** = port 4 (Internal Comm module) **bit 5-15** = reserved	R
153	Data In A1		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
154	Data In A2		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
155	Data In B1		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
156	Data In B2		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
157	Data In C1		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
158	Data In C2		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
159	Data In D1		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
160	Data In D2		0/159999	0		This is the a channel IN Datalink index, holding the parameter number of the parameter that will be written to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
161	Data Out A1		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
162	Data Out A2		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
163	Data Out B1		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
164	Data Out B2		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
165	Data Out C1		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
166	Data Out C2		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
167	Data Out D1		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
168	Data Out D2		0/159999	0		This is the a channel OUT Datalink index, holding the parameter number of the parameter that will be read to during Datalink communications. A value of 0 indicates that it is disabled.	R/W
169	Voltage Ratio		1/32767	3079		Allow OEM's to fine-tune their voltage dividers.This is a Medium Voltage specific parameter and has no function at 690 volts and below.	R/W
170	User CT Ratio		1/1500	50		Allows the user to achieve proper current ratio for FLC ratings when using external CTs. This is a MV specific parameter and has no function at 690 volts and below. The CT ratio has a default 5 A secondary value on the secondary side of the CT (for example, 100:5).	R/W
171	I FDBK scale		0.01/10	1		Set at the factory to achieve proper current ratio for FLC ratings when using external CTs. This is a MV specific parameter and has no function at 690 volts and below.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
172	Aux 1 Config		0/12	0	[Normal] UTS Fault Alarm Ext Bypass Ext Brake DeviceLogix Aux Conrol Network 1 Network 2 Network 3 Network 4	Allows the user to configure the functionality of the Aux1 relay output on the control module based on the following selections. **[Normal]**: Aux 1 closes when start command asserted and opens when motor stops [Default]. **UTS**: Aux 1 closes when motor reaches up to speed and opens when motor is not at speed. **Fault**: Aux1 closes when the SMC-50 enters a fault state and opens when the fault is cleared. **Alarm**: Aux1 closes when the SMC-50 detects an alarm condition and opens when alarm is cleared. **Ext Bypass**: Aux1 closes when the SMC-50 enters the external bypass mode and opens when it leaves that mode. **Ext Brake**: Aux1 closes when Ext Braking command is active and opens when it is not active. DeviceLogix: Aux1 is controlled by DeviceLogix program. **Aux Control**: When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary. **Network 1**: With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1. **Network 2**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 2. **Network 3**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 3. **Network 4**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 4.	R/W
173	Aux 1 Invert		0/1	0	[Disable] Enable	Enables the user to invert the logic of the Aux 1 output. When disabled, it is a normally open relay output contact when de-energized. By enabling the invert function, the relay contact becomes a normally closed contact when de-energized. **Disable**: Aux 1 relay output not inverted [Default] (N.O.). **Enable**: Aux 1 relay output inverted (N.C.)	R/W
174	Aux 1 On Delay	Secs	0/10	0.0		A time delay in activating the Aux1 relay contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
175	Aux 1 Off Delay	Secs	0/10	0.0		A time delay in de-activating the Aux1 relay contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
176	Aux2 Config		0/12	0	[Normal] UTS Fault Alarm Ext Bypass Ext Brake DeviceLogix Aux Conrol Network 1 Network 2 Network 3 Network 4	Allows the user to configure the functionality of the Aux2 relay output on the control module based on the following selections. **[Normal]**: Aux2 closes when start command asserted and opens when motor stops [Default]. **UTS**: Aux2 closes when motor reaches up to speed and opens when motor is not at speed. **Fault**: Aux2 closes when the SMC-50 enters a fault state and opens when the fault is cleared. **Alarm**: Aux2 closes when the SMC-50 detects an alarm condition and opens when alarm is cleared. **Ext Bypass**: Aux2 closes when the SMC-50 enters the external bypass mode and opens when it leaves that mode. **Ext Brake**: Aux2 closes when Ext Braking command is active and opens when it is not active. DeviceLogix: Aux2 is controlled by DeviceLogix program. **Aux Control**: When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary. **Network 1**: With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1. **Network 2**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 2. **Network 3**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 3. **Network 4**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 4.	R/W
177	Aux 2 Invert		0/1	0	[Disable] Enable	Enables the user to invert the logic of the Aux 1 output. When disabled, it is a normally open relay output contact when de-energized. By enabling the invert function, the relay contact becomes a normally closed contact when de-energized. **Disable**: Aux 1 relay output not inverted [Default] (N.O.). **Enable**: Aux 1 relay output inverted (N.C.)	R/W
178	Aux 2 On Delay	Secs	0/10	0.0		A time delay in activating the Aux1 relay contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
179	Aux 2 Off Delay	Secs	0/10	0.0		A time delay in de-activating the Aux1 relay contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
180	Aux Control			0	Aux 1/Aux 2/Aux 7-1/Aux 7-2/Aux 7-3/Aux 7-4/Aux 8-1/Aux 8-2/Aux 8-3/Aux 8-4/Aux 9-1/Aux 9-2/Aux 9-3/Aux 9-4/ Reserved/ Reserved	When an Auxiliary Relay output is configured for "Aux Control" a bit within this parameter will control the state of the auxiliary. **Bit 0** - Control Module Aux Relay 1; **Bit 1** - Control Module Aux Relay 2; **Bit 2** - Expansion Port 7 Aux Relay 1; **Bit 3**- Expansion Port 7 Aux Relay 2; **Bit 4**- Expansion Port 7 Aux Relay 3; **Bit 5**- Expansion Port 7 Aux Relay 4; **Bit 6** - Expansion Port 8 Aux Relay 1; **Bit 7**- Expansion Port 8 Aux Relay 2; **Bit 8**- Expansion Port 8 Aux Relay 3; **Bit 9**- Expansion Port 8 Aux Relay 4; **Bit 10** - Expansion Port 9 Aux Relay 1; **Bit 11** - Expansion Port 9 Aux Relay 2; **Bit 12** - Expansion Port 9 Aux Relay 3; **Bit 13** - Expansion Port 9 Aux Relay 4; **Bits 14, 15** - Reserved.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
181	Language		0/6	0	[English] French Spanish Italian German Portuguese Mandarin	Provides the ability to configure the language that is displayed for any interface device. The selected language will be the same for all devices connected to the SMC-50.	R/W
182	Start Delay	Secs	0/30	0		The time between asserting a start command with valid 3-phase applied and the SMC-50 starting the motor can be delayed by setting the "Start Delay". If a stop is asserted during the delay period, the start is cancelled.	R/W
183	Timed Start		0/1	0	[Disable] Enable	This parameter is used to force the starting profile to complete its entire time ramp period. This ability can help to avoid conditions where an up-to-speed is sensed before the motor is actually up to speed. **Disable**: Complete starting mode when up-to-speed detected. **Enable**: Complete starting mode when ramp time expires.	R/W
184	V Shutoff Level	%	0/100	25		Provides the ability to manually adjust the threshold for the controller's voltage (notch) shutoff detection level. Since this parameter has the potential to modify the SCR operational control scheme, it is important that any change made be in small (several percent) increments. **Do NOT disable (0) this parameter and Parameter 185 (I Shutoff Level) at the same time or SCR firing (motor control) instability can occur**. Contact RA Technical Support for assistance. When running high-efficiency motors with Energy Saver, this value may need to be adjusted downward.	R/W
185	I Shutoff Level	%	0/37	0		Provides the ability to adjust the level at which the SMC-50 expects to see current or the level of current which the SMC-50 determines the SCR has turned off. A common reason for increasing this value would be to compensate for the inability of the control to sense a voltage notch due to significant LINE voltage noise or LINE distortion. Since this parameter has the potential to modify the SCR operational control scheme, it is important that any change made be in small (several percent) increments.**Do NOT disable (0) this parameter and Parameter 184 (V Shutoff Level) at the same time or SCR firing (motor control) instability can occur**. Contact Rockwell Automation Technical Support for assistance.	R/W
186	UTS Level	%	0/100	75		The SMC-50 has the ability to determine if the motor is up-to-speed (UTS). If the SMC-50 encounters a problem detecting motor UTS, this parameter can be modified by the user to compensate. If the SMC-50 is detecting the UTS condition to soon (e.g., abrupt speed change), this number should be increased (this typically occurs on high efficiency motors). If the SMC-50 is detecting the UTS condition to late or not at all (display does not indicate At Speed), this number should be lowered. Contact RA Technical Support for assistance.	R/W
187	Stall Level	%	0/100	75		Allows the user to set the motor winding voltage level (as a percentage of line voltage) at which the SMC-50 will consider the motor stalled.	R/W
188	Stall Delay	Secs	0/30	1.0		Allows the user to configure the time period after the start maneuver start time that the motor has to reach UTS, or else a stall fault will occur.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
189	Stall Position	%	0/100	75		Allows the user to set the change in the notch position at which the SMC-50 will consider the motor stalled.	R/W
190	Notch Maximum (Pump Control)		50/70	60.0		Allows the user to change the maximum notch value during pump stop. This parameter is not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
191	Notch Position	%	40/100	87.5		Enables the user to make a manual adjustment to an internal value used for notch control gain, which impacts the SMC-50 starting control algorithm. This parameter is not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
192	Bypass Delay	Secs	2/10	2		During the coast to stop, the bypass contactor will be hold by this number after the Main Contactor open.	R/W
194	Forced Tuning		0/1	1	FALSE [TRUE]	Enables the controller's tuning algorithms to analyze the load and supply and adjust parameters for easy set up and optimum performance. **FALSE**: Do not run tuning algorithm (was already run or disabled by user). **[TRUE]**: Run tuning algorithm at next start command [Default].	R/W
195	Stator R	Ohms	0/50	0.00		Enables the user to read/view the motor stator resistance value that was measured during the tuning process.	R
196	Total R	Ohms	0/50	0.00		Enables the user to read/view the motor total load resistance that was measured during the tuning process.	R
197	Coupling Factor		0/10	0.00		This is a coefficient inserted by the controller during the tuning process and viewable by the user.	R
198	Inductance	mH	0/1000	0.00		Enables the user to read/view the motor inductance that was measured during the tuning process.	R
199	Speed Pgain		1/10000	1000		Provides the ability to adjust the gain factor used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
200	Transient Mag		0/2	0.90		Provides the ability to adjust the gain factor used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
201	Transient Zero		0/10	5.00		Provides the ability to adjust the gain factor used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
202	Transient Gain		0/4	1.00		Provides the ability to adjust the gain factor used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
203	Ping Degree		0/180	50.0		Timing parameter used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
204	Pings		0/20	2		Timing parameter used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
205	Phase Shift 0		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
206	Phase Shift 10		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
207	Phase Shift 20		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
208	Phase Shift 30		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
209	Phase Shift 40		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
210	Phase Shift 50		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
211	Phase Shift 60		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
212	Phase Shift 70		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
213	Phase Shift 80		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
214	Phase Shift 90		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
215	Phase Shift 100		-360/360	0		Timing parameters used in speed measurement algorithms. These parameters are not typically modified and it is recommended that RA Technical Support be contacted for assistance before attempting to do so.	R/W
216	Board Temp	°C	-25/100	20		Displays the internal temperature of the SMC control module.	R
217	Exp 7 Config		0/5	0	[None] Input/Output Analog I/O (future) GFCT/PTC/CT DIP Switch Seq Start (future)	Displays the type of expansion board plugged into Expansion Port 7.	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
218	Exp 8 Config		0/5	0	[None] Input/Output Analog I/O (future) GFCT/PTC/CT DIP Switch Seq Start (future)	Displays the type of expansion board plugged into Expansion Port 8.	R
219	Exp 9 Config		0/5	0	[None] Input/Output Analog I/O (future) GFCT/PTC/CT DIP Switch Seq Start (future)	Displays the type of expansion board plugged into Expansion Port 9.	R
224	Line Frequency	Hz	0/100	0		Displays the line frequency of the three phase voltage applied to the SMC-50 at terminals L1, L2, and L3.	R
225	Freq High F Dly	Secs	0.1/99	0.1		Allows the user to configure the time period that the supplied line voltage frequency must exceed Freq High F Lvl parameter value before causing a Freq High fault. The Freq High bit must be set in the Starter Fault En parameter for the fault to activate.	R
226	Freq High A Dly	Secs	0.1/99	0.1		Allows the user to configure the time period that the supplied line voltage frequency must exceed Freq High A Lvl parameter value before causing a Freq High alarm. The Freq High bit must be set in the Starter Alarm parameter for the fault to activate.	R
227	Freq Low F Dly	Secs	0.1/99	0.1		Allows the user to configure the time period that the supplied line voltage frequency must drop below Freq Low F Lvl parameter value before causing a Freq Low fault. The Freq Low bit must be set in the Starter Fault En parameter for the fault to activate.	R
228	Freq Low A Dly	Secs	0.1/99	0.1		Allows the user to configure the time period that the supplied line voltage frequency must drop below Freq Low A Lvl parameter value before causing a Freq Low alarm. The Freq Low bit must be set in the Starter Alarm parameter for the fault to activate.	R
229	Parameter Mgmt		0/1	0	[Ready] Factory Default	Allows the user to force all the Control Module parameters to default values. This has no impact on any option module(s) installed. Each Option module has its own associated Parameter Mgmt parameter: **[Ready]**: Waiting for command to set factory defaults **Factory Default**: Command for SMC to set all Control Module Writable Parameters to factory default values. This command does not impact Option Module parameters.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
230	Motor Fault En		Bit Value 0/1		[Overload] Underload MWatts Over Mwatts Under +MVAR Over +MVAR Under -MVAR Over -MVAR Under MVA Under MVA Over Curr Imbal Jam [Stall] Starts/Hr PM Hours PM Starts [Power Qual] [Open Load] THD I Lead PF Un Lead PF Ov Lag PF Un Lag PF Ov Locked Rotor Overcurrent EN	Allows the user to enable Motor related faults that can be detected by the SMC-50. 0 = Fault Disabled 1 = Fault Enabled [Default]	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
231	Motor Alarm En		Bit Value 0/1		Overload Underload MWatts Over Mwatts Under +MVAR Over +MVAR Under -MVAR Over -MVAR Under MVA Under MVA Over Curr Imbal Jam Stall Starts/Hr PM Hours PM Starts Power Qual Open Load THD I Lead PF Un Lead PF Ov Lag PF Un Lag PF Ov Locked Rotor	Allows the user to enable Motor related alarms that can be detected by the SMC-50. 0 = Fault Disabled 1 = Fault Enabled [All Disabled as Default]	R/W
232	+MVAR Ov F Lvl	MVAR	0/1000	0.000		Allows the user to enter a value for the Consumed Reactive Power Over Fault Level (+MVAR Ov F Lvl). If the current actual +MVAR value is greater than the +MVAR OV F Lvl for a time period greater than that defined by +MVAR Ov F Dly, a +MVAR Ov Fault will be signaled.	R/W
233	+MVAR Ov F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the +MVAR Over Fault delay. If the current actual value of Consumed Reactive Power (+MVAR) is greater than the +MVAR OV F Lvl for a time period greater than that defined by +MVAR Ov F Dly, a +MVAR Ov Fault will be signaled	R/W
234	+MVAR Ov A Lvl	MVAR	0/1000	0.000		Allows the user to enter a value for the Consumed Reactive Power Over Alarm Level (+MVAR OV A Lvl). If the current actual +MVAR value is greater than the +MVAR OV A Lvl for a time period greater than that defined by +MVAR Ov A Dly, a +MVAR Ov Alarm will be signaled.	R/W
235	+MVAR Ov A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the +MVAR Over Alarm Delay (+MVAR Ov A Dly). If the current actual value of Consumed Reactive Power (+MVAR) is greater than the +MVAR Ov A Level for a time period greater than that defined by +MVAR Ov A Dly, a +MVAR Ov Alarm will be signaled.	R/W
236	+MVAR Un F Lvl	MVAR	0/1000	0.000		Allows the user to enter a value for the Consumed Reactive Power Under Fault Level (+MVAR Un F Lvl). If the current actual +MVAR value is less than the +MVAR Un F Level for a time period greater than that defined by +MVAR Un F Dly, a +MVAR Un Fault will be signaled.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
237	+MVAR Un F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the +MVAR Under Fault delay. If the Consumed Reactive Power (+MVAR) is less than the +MVAR Un F Level for a time period greater than that defined by +MVAR Un F Dly, a +MVAR Un Fault will be signaled.	R/W
238	+MVAR Un A Lvl	MVAR	0/1000	0.000		Allows the user to enter a value for the Consumed Reactive Power Under Alarm Level (+MVAR Un A Lvl). If the current actual value of Consumed Reactive Power (+MVAR) is less than the +MVAR Un A Level for a time period greater than that defined by +MVAR Un A Dly a +MVAR Un Alarm will be signaled.	R/W
239	+MVAR Un A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the +MVAR Under Alarm Delay (+MVAR Un A Dly). If the current actual value of Consumed Reactive Power (+MVAR) is less than the +MVAR Un A Level for a time period greater than that defined by +MVAR Un A Dly, a +MVAR Un Alarm will be signaled.	R/W
240	MVA Ov F Lvl	MVA	0/1000	0.000		Allows the user to enter a value for the MVA Over Fault Level (MVA Ov F Lvl). If the current actual value of Apparent Power (MVA) is greater than the MVA Ov F Lvl for a time period greater than that defined by MVA Ov F Dly, a MVA Ov Fault will be signaled.	R/W
241	MVA Ov F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Apparent Power Over Fault Delay (MVA Ov F Dly). If the current actual value of Apparent Power (MVA) is greater than the MVA Ov F Lvl for a time period greater than that defined by MVA Ov F Dly, a MVA Ov Fault will be signaled.	R/W
242	MVA Ov A Lvl	MVA	0/1000	0.00		Allows the user to enter a value for the MVA Over Alarm Level (MVA Ov A Lvl). If the current actual value of the Apparent Power (MVA) is greater than the MVA Ov A Lvl for a time period greater than that defined by MVA Ov A Dly, a MVA Ov Alarm will be signaled.	R/W
243	MVA Ov A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Apparent Power Over Alarm Delay (MVA Ov A Dly). If the current actual value of the Apparent Power (MVA) is greater than the MVA Ov A Lvl for a time period greater than that defined by MVA Ov A Dly, a MVA Ov Alarm will be signaled.	R/W
244	MVA Un F Lvl	MVA	0/1000	0.00		Allows the user to enter a value for the MVA Under Fault Level (MVA Un F Lvl). If the current actual value of the Apparent Power (MVA) is less than the MVA Un F Lvl for a time period greater than that defined by MVA Un F Dly, a MVA Un Fault will be signaled.	R/W
245	MVA Un F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Apparent Power Under Fault Delay (MVA Un F Dly). If the current actual value of the Apparent Power (MVA) is less than the MVA Un F Lvl for a time period greater than that defined by MVA Un F Dly, a MVA Un Fault will be signaled.	R/W
246	MVA Un A Lvl	MVA	0/1000	0.00		Allows the user to enter a value for the MVA Under Alarm Level (MVA Un A Lvl). If the current actual value of the Apparent Power (MVA) is less than the MVA Un A Lvl for a time period greater than that defined by MVA Un A Dly, a MVA Un Alarm will be signaled.	R/W
247	MVA Un A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Apparent Power Under Alarm Delay (MVA Un A Dly). If the current actual value of the Apparent Power (MVA) is less than the MVA Un A Lvl for a time period greater than that defined by MVA Un A Dly, a MVA Un Alarm will be signaled.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
248	Lead PF Ov F Lvl		0/1	0.00		Allows the user to enter a value for the Leading Power Factor Over Fault Level (Lead PF Ov F Lvl). If the current actual Power Factor value is leading more than the Lead PF Ov F Lvl for a time period greater than that defined by Lead PF Ov F Dly, a Lead PD Ov Fault will be signaled.	R/W
249	Lead PF Ov F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Leading Power Factor Over Fault Delay (Lead PF Ov F Dly). If the current actual Power Factor value is leading more than the Lead PF Ov F Lvl for a period greater than that defined by Lead PF Ov F Dly, a Lead PD Ov fault will be signaled.	R/W
250	Lead PF Ov A Lvl		0/1	0.00		Allows the user to enter a value for the Leading Power Factor Over Alarm Level (Lead PF Ov A Lvl). If the current actual Power Factor value is leading more than the Lead PF Ov A Lvl for a period greater than that defined by Lead PF Ov A Dly, a Lead PD Ov alarm will be signaled.	R/W
251	Lead PF Ov A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Leading Power Factor Over Alarm Delay (Lead PF Ov A Dly). If the current actual Power Factor value is leading more than the Lead PF Ov A Lvl for a period greater than that defined by Lead PF Ov A Dly, a Lead PD Ov alarm will be signaled.	R/W
252	Lead PF Un F Lvl		0/1	0.00		Allows the user to enter a value for the Leading Power Factor Under Fault Level (Lead PF Un F Lvl). If the current actual Power Factor value is leading less than the Lead PF Un A Lvl for a time period greater than that defined by Lead PF Un A Dly, a Lead PD Un Fault will be signaled.	R/W
253	Lead PF Un F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Leading Power Factor Under Fault Delay (Lead PF Un F Dly). If the current actual Power Factor value is leading less than the Lead PF Un A Lvl for a time period greater than that defined by Lead PF Un A Dly, a Lead PD Un Fault will be signaled.	R/W
254	Lead PF Un A Lvl		0/1	0.00		Allows the user to enter a value for the Leading Power Factor Under Alarm Level (Lead PF Un A Lvl). If the current actual Power Factor value is leading less than the Lead PF Un A Lvl for a time period greater than that defined by Lead PF Un A Dly, a Lead PD Un Alarm will be signaled.	R/W
255	Lead PF Un A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Leading Power Factor Under Alarm Delay (Lead PF Un A Dly). If the current actual Power Factor value is leading less than the Lead PF Un A Lvl for a time period greater than that defined by Lead PF Un A Dly, a Lead PD Un Alarm will be signaled.	R/W
256	Lag PF Ov F Lvl		-1/0	0.00		Allows the user to enter a value for the Lagging Power Factor Over Fault Level (Lag PF Ov F Lvl). If the current actual Power Factor value lags more than the Lag PF Ov F Lvl for a time period greater than that defined by Lag PF Ov F Dly, a Lag PF Ov Fault will be signaled.	R/W
257	Lag PF Ov F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Lagging Power Factor Over Fault Delay (Lag PF Ov F Dly). If the current actual Power Factor value lags more than the Lag PF Ov F Lvl for a time period greater than that defined by Lag PF Ov F Dly, a Lag PF Ov Fault will be signaled.	R/W
258	Lag PF Ov A Lvl		-1/0	0.00		Allows the user to enter a value for the Lagging Power Factor Over Alarm Level (Lag PF Ov A Lvl). If the current actual Power Factor value lags more than the Lag PF Ov A Lvl for a time period greater than that defined by Lag PF Ov A Dly, a Lag PF Ov Alarm will be signaled.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
259	Lag PF Ov A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Lagging Power Factor Over Alarm Delay (Lag PF Ov A Dly). If the current actual Power Factor value lags more than the Lag PF Ov A Lvl for a time period greater than that defined by Lag PF Ov A Dly, a Lag PF Ov Alarm will be signaled.	R/W
260	Lag PF Un F Lvl		-1/0	0.00		Allows the user to enter a value for the Lagging Power Factor Under Fault Level (Lag PF Un F Lvl). If the current actual Power Factor value lags less than the Lag PF Un F Lvl for a time period greater than that defined by Lag PF Un F Dly, a Lag PF Un Fault will be signaled.	R/W
261	Lag PF Un F Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Lagging Power Factor Under Fault Delay (Lag PF Un F Dly). If the current actual Power Factor value lags less than the Lag PF Un F Lvl for a time period greater than that defined by Lag PF Un F Dly, a Lag PF Un Fault will be signaled.	R/W
262	Lag PF Un A Lvl		-1/0	0.00		Allows the user to enter a value for the Lagging Power Factor Under Alarm Level (Lag PF Un A Lvl). If the current actual Power Factor value lags less than the Lag PF Un A Lvl for a time period greater than that defined by Lag PF Un A Dly, a Lag PF Un Alarm will be signaled.	R/W
263	Lag PF Un A Dly	Secs	0.1/99	0.1		Allows the user to enter a time value for the Lagging Power Factor Under Alarm Delay (Lag PF Un A Dly). If the current actual Power Factor value lags less than the Lag PF Un A Lvl for a period greater than that defined by Lag PF Un A Dly, a Lag PF Un alarm will be signalled.	R/W
264	Motor Restart En (Refer to 264)					Manual P111: The SMC-50 can be configured to automatically reset the overload fault when it has cooled to the set Overload Reset Level, Parameter 80. The Motor Restart Enabled (Motor Restart En), Parameter 264, must be enabled (Overload = Set) to allow the Overload Reset Level parameter to function.	

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
264	Motor Restart En		Bit Value 0/1		Overload Underload MWatts Over Mwatts Under +MVAR Over +MVAR Under -MVAR Over -MVAR Under MVA Under MVA Over Curr Imbal Jam Stall Starts/Hr PM Hours PM Starts Power Qual Open Load THD I Lead PF Un Lead PF Ov Lag PF Un Lag PF Ov Locked Rotor	Enables the user to adjust the Motor Restart Enable conditions. Setting (=1) a bit causes the motor to attempt a restart after the selected event is detected. A limit to the number of starts attempted before a fault is signalled can be set in the Restart Attempts parameter. 0 = Do not attempt a restart after fault is cleared 1 = Attempt a restart after this fault is cleared NOTE: Restart attempts, Parameter 133, and Restart Delay, Parameter 134, must also be configured. [All Disabled as Default]	R/W
265	Voltage Pn Ave	Volts	0/9000	0		Displays the average of the sum of the three phase voltages to neutral.	R
266	Voltage Phase A-N	Volts	0/9000	0		Displays Phase A (L1) to neutral voltage.	R
267	Voltage Phase B-N	Volts	0/9000	0		Displays Phase B (L2) to neutral voltage.	R
268	Voltage Phase C-N	Volts	0/9000	0		Displays Phase C (L3) to neutral voltage.	R
269	Real Power A	MW	-1000/1000	0.000		Displays the Real Power of the Phase A branch which is equal to Phase A Voltage x Phase A Current x PF.	R
270	Real Power B	MW	-1000/1000	0.000		Displays the Real Power of the Phase B branch which is equal to Phase B Voltage x Phase B Current x PF.	R
271	Real Power C	MW	-1000/1000	0.000		Displays the Real Power of the Phase C branch which is equal to Phase C Voltage x Phase C Current x PF.	R
272	Real Demand	MW	-1000/1000	0.000		Displays Real Energy (MWH) averaged over a period of time defined by Demand Period.	R
273	Max. Real Demand	MW	-1000/1000	0.000		Displays the Maximum energy demand recorded since the last energy meter reset.	R
274	Reactive Power A	MVAR	-1000/1000	0.000		Displays the reactive power of the Phase A branch.	R
275	Reactive Power B	MVAR	-1000/1000	0.000		Displays the reactive power of the Phase B branch.	R
276	Reactive Power C	MVAR	-1000/1000	0.000		Displays the reactive power of the Phase C branch.	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
277	Reactive Power	MVAR	-1000/1000	0.000		Displays the total reactive power.	R
278	Reactive Energy C	MVARH	-1000/1000	0.000		Displays the reactive energy being consumed by the load.	R
279	Reactive Energy P	MVARH	-1000/1000	0.000		Displays the reactive energy being produced by the load.	R
280	Reactive Energy	MVARH	-1000/1000	0.000		Displays the total reactive energy which is equal to Reactive Power X time.	R
281	Reactive Demand	MVAR	-1000/1000	0.000		Displays the Reactive Energy consumed or generated by the system over the Demand Time Period.	R
282	Max. Reactive Dmd	MVAR	-1000/1000	0.000		Displays the maximum reactive energy demand recorded since the energy meters were reset	R
283	Apparent Power A	MVA	-1000/1000	0.000		Displays the Apparent Power (VA) measured in the phase A branch.	R
284	Apparent Power B	MVA	-1000/1000	0.000		Displays the VA measured in the phase B branch.	R
285	Apparent Power C	MVA	-1000/1000	0.000		Displays the VA measured in the phase C branch.	R
286	Apparent Power	MVA	-1000/1000	0.000		Displays the total apparent power consumed (-) or produced (+) by the load.	R
287	Apparent Energy	MVAH	-1000/1000	0.000		Displays the Apparent Energy which is equal to Apparent Power x Time.	R
288	Apparent Demand	MVA	-1000/1000	0.000		Displays the total amount of Apparent Energy which is equal to MVAH x demand period produced or consumed by the load.	R
289	Max. Apparent Dmd	MVA	-1000/1000	0.000		Displays the maximum apparent demand recorded since energy meters were reset.	R
290	Demand Period	Mins	1/255	1		Enables the user to enter the time period that energy samples are taken to calculate demand.	R/W
291	Num of Periods		1/15	1		Enables the user to enter the number of periods that energy measurements are taken in calculating demand.	R/W
292	Power Factor A		-1/1	0.00		Displays the power factor in the Phase A branch of the load circuit.	R
293	Power Factor B		-1/1	0.00		Displays the power factor in the Phase B branch of the load circuit.	R
294	Power Factor C		-1/1	0.00		Displays the power factor in the Phase C branch of the load circuit.	R
295	Current Imbal	%	0/100	0.00		Displays the percent current imbalance measured in the load circuit (max deviation of current from the average of three currents / average current of three currents).	R
296	Voltage Imbal	%	0/100	0.00		Displays the percent voltage imbalance measured in the load circuit (max deviation of voltage from the average of three voltages / average current of three voltages).	R
297	-MVAR Ov F Lvl	MVAR	-1000/0	0.000		Enables the user to enter a value for the Generated Reactive Power Over Fault Level (-MVAR Ov F Lvl). If the current actual value for Generated Reactive Power is more than the -MVAR Ov F Lvl for a period greater than that defined by -MVAR Ov F Dly, a -MVAR Ov fault will be signaled.	R/W
298	-MVAR Ov F Dly	Secs	0.1/99	0.1		Enables the user to enter a time value for the Generated Reactive Power Over Fault Delay (-MVAR Ov F Dly). If the current actual value for the Generated Reactive Power is more than the -MVAR Ov F Lvl for a time period greater than that defined by -MVAR Ov F Dly, a -MVAR Ov fault will be signaled.	R/W
299	-MVAR Ov A Lvl	MVAR	-1000/0	0.000		Enables the user to enter a value for the Generated Reactive Power Over Alarm Level (-MVAR Ov A Lvl). If the current actual value for Generated Reactive Power is more than the -MVAR Ov A Lvl for a period greater than that defined by -MVAR Ov A Dly, a -MVAR Ov Alarm will be signaled.	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
300	-MVAR Ov A Dly	Secs	0.1/99	0.1		Enables the user to enter a time value for the Generated Reactive Power Over Alarm Delay (-MVAR Ov A Dly). If the current actual value for the Generated Reactive Power is more than the -MVAR Ov A Lvl for a period greater than that defined by -MVAR Ov A Dly, a -MVAR Ov alarm will be signaled.	R/W
301	-MVAR Un F Lvl	MVAR	-1000/0	0.000		Enables the user to enter a value for the Generated Reactive Power Under Fault Level (-MVAR Un F Lvl). If the current actual value for Generated Reactive Power is less than the -MVAR Un F Lvl for a period greater than that defined by -MVAR Un F Dly, a -MVAR Un Fault will be signaled.	R/W
302	-MVAR Un F Dly	Secs	0.1/99	0.1		Enables the user to enter a time value for the Generated Reactive Power Under Fault Delay (-MVAR Un F Dly). If the current actual value for Generated Reactive Power is less than the -MVAR Un F Lvl for a period greater than that defined by -MVAR Un F Dly, a -MVAR Un Fault will be signaled.	R/W
303	-MVAR Un A Lvl	MVAR	-1000/0	0.000		Enables the user to enter a value for the Generated Reactive Power Under Alarm Level (-MVAR Un A Lvl). If the current actual value for Generated Reactive Power is less than the -MVAR Un A Lvl for a period greater than that defined by -MVAR Un A Dly, a MVAR Un Alarm will be signaled.	R/W
304	-MVAR Un A Dly	Secs	0.1/99	0.1		Enables the user to enter a time value for the Generated Reactive Power Under Alarm Delay (-MVAR Un A Dly). If the current actual value for Generated Reactive Power is less than the -MVAR Un A Lvl for a period greater than that defined by -MVAR Un A Dly, a -MVAR Un Alarm will be signaled.	R/W
305	Starting Torque	%	0/300	100		Enables the user to enter Starting Torque value required for a torque start operation.	R/W
306	Starting Torque 2	%	0/300	100		Enables the user to enter an alternate Starting Torque required for a torque start operation.	R/W
309	Input Status		0/65535	0	Input 1 Input 2 Input 7-1 Input 7-2 Input 7-3 Input 7-4 Input 8-1 Input 8-2 Input 8-3 Input 8-4 Input 9-1 Input 9-2 Input 9-3 Input 9-4	Displays the status of all the digital inputs for the SMC-50 **Bit 0** - Displays status of control module input #1; **Bit 1** - Displays status of Control Module Input #2. **Bit 2** - Displays status of Control Module Port 7, 150-SM4 Option Module Input #1. **Bit 3** - Displays status of Control Module Port 7, 150-SM4 Option Module Input #2. **Bit 4**- Displays status of Control Module Port 7, 150-SM4 Option Module Input #3. **Bit 5**- Displays status of Control Module Port 7, 150-SM4 Option Module Input #4. **Bit 6** - Displays status of Control Module Port 8, 150-SM4 Option Module Input #1. **Bit 7**- Displays status of Control Module Port 8, 150-SM4 Option Module Input #2. **Bit 8**- Displays status of Control Module Port 8, 150-SM4 Option Module Input #3. **Bit 9**- Displays status of Control Module Port 8, 150-SM4 Option Module Input #4. **Bit 10** - Displays status of Control Module Port 9, 150-SM4 Option Module Input #1. **Bit 11** - Displays status of Control Module Port 9, 150-SM4 Option Module Input #2. **Bit 12** - Displays status of Control Module Port 9, 150-SM4 Option Module Input #3. **Bit 13** - Displays status of Control Module Port 9, 150-SM4 Option Module Input #4. **Bit 14 & 15** - Reserved.	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
310	Locked Rotor A Lvl	%FLC	400/1000	600		Enables the user to enter a value for the Locked Rotor Alarm Level (Locked Rtr A Lvl). The locked rotor value represents the motor peak phase current to the load that if exceeded for the period defined in Locked Rtr A Delay will signal a fault. The Locked Rotor bit in the Motor Alarm En parameter must be set to signal a alarm.	R/W
311	Locked Rotor A Dly	Secs	0.1/100	0.1		The time period that the peak phase current exceeds the Locked Rtr F Level to signal a fault. The Locked Rotor bit in the Motor Fault En parameter must be set to enable a fault.	R/W
312	Product Command		0/65535	0	Stop Start Jog Clear Fault Reserved Emer Run Reserved Reserved Reserved Reserved Rserved Aux Enable Network_1 Network_2 Network_3 Network_4	Displays an image of the DPI product command required for DPI communications. **Stop**: 1 - Coast/Inhibit; 0 - No Action; **Start**: 1 - Start; 0 - No Action; **Jog**: 1 -Stop Maneuver/Inhibit; 0 -No Action; **Clear Fault**: 1 -Clear Faults; 0 - No Action; **Emer Run**: 1 - Enable Emergency Run Mode; 0 - Disable Emergency Run Mode; **Aux Enable**: 1 -Use the Network #1 - #4 bits; 0 -Ignore the Network #1 - #4 bits; **Network_1**: 1 -Closes any Output Configured for "Network 1"; 0 - Opens any Output Configured for "Network 1"; **Network_2**: 1 -Closes any Output Configured for "Network 2"; 0 - Opens any Output Configured for "Network 2"; **Network_3**: 1 -Closes any Output Configured for "Network 3"; 0 - Opens any Output Configured for "Network 3"; **Network_4**: 1 -Closes any Output Configured for "Network 4"; 0 - Opens any Output Configured for "Network 4";	R
313	Rebalance Level	%	0/100	0		The percentage of motor current imbalance above which the SMC-50 will rebalance the motor current	R/W
314	Va Peak	Volts	0/15000	0		The peak value of the Phase A line to neutral voltage during the motor start, run, and stop cycle. The value resets to 0 when the motor starts.	R
315	Vb Peak	Volts	0/15000	0		The peak value of the Phase B line to neutral voltage during the motor start, run, and stop cycle.The value resets to 0 when the motor starts.	R
316	Vc Peak	Volts	0/15000	0		The peak value of the Phase C line to neutral voltage during the motor start, run, and stop cycle. The value resets to 0 when the motor starts.	R
317	Ia Peak	Amps	0/15000	0		The peak value of the Phase A current during the motor start, run, and stop cycle. The value resets to 0 when the motor starts.	R
318	Ib Peak	Amps	0/15000	0		The peak value of the Phase B current during the motor start, run, and stop cycle. The value resets to 0 when the motor starts.	R
319	Ic Peak	Amps	0/15000	0		The peak value of the Phase C current during the motor start, run, and stop cycle. The value resets to 0 when the motor starts.	R
320	SSVolts Phas A-B	Volts	0/15000	0		Snapshot of the Phase A-B voltage when a fault occurs. The value is overwritten if a subsequent fault occurs	R
321	SSVolts Phas B-C	Volts	0/15000	0		Snapshot of the Phase B-C voltage when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
322	SSVolts Phas C-A	Volts	0/15000	0		Snapshot of the Phase C-A voltage when a fault occurs. The value is overwritten if a subsequent fault occurs.	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
323	SSCurrent Phas A	Amps	0/15000	0		Snapshot of the Phase A current when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
324	SSCurrent Phas B	Amps	0/15000	0		Snapshot of the Phase B current when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
325	SSCurrent Phas C	Amps	0/15000	0		Snapshot of the Phase C current when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
326	SSPower Factor		-1/1	0		Snapshot of the Motor Power Factor when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
327	SSMtr Thrm Usage	%MTU	0/200	0		Snapshot of the Motor Thermal Usage when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
328	SSMotor Speed	%	0/100	0		Snapshot of the Motor Speed when a fault occurs. The value is overwritten if a subsequent fault occurs	R
329	SSTHD Vave	%	0/1000	0		Snapshot of the average voltage Total Harmonic Distortion (THD) when a fault occurs. The value is overwritten if a subsequent fault occurs,	R
330	SSTHD Iave	%	0/1000	0		Snapshot of the average current Total Harmonic Distortion (THD) when a fault occurs. The value is overwritten if a subsequent fault occurs.	R
331	SSProduct Status		0/65535	0	Enable/Ready Running Phasing Phasing Active Starting (Accel) Stopping (Decel) Alarm Fault At Speed Start/Isolate Bypass Ready Reserved Reserved Input #1 Input #2	Snapshot of the product status when a fault occurs. The value is overwritten if a subsequent fault occurs. **Bit 0** - 1 -Ready; 0 -Not Ready **Bit 1** - 1 -Power Applied to Motor(Gating SCRs or Bypass closed); 0 -Power not applied; **Bit 2** - 1 -ABC Phasing; 0 -CBA Phasing; **Bit 3** - 1 -3 phase is valid; 0 -No valid 3 phase; **Bit 4** - 1 - Performing a Start Maneuver ; 0 -Not Performing **Bit 5** - 1 - Performing a Stop Maneuver (coast to stop not included); 0 -Not Performing **Bit 6** - 1 - Alarm Present; 0 -No Alarm Present; **Bit 7** - 1 – Fault Condition Exists and hasn't been cleared; 0 - No Fault Condition; **Bit 8** - 1 – Full Voltage Applied (Bypass or full SCR conduction); 0 -Not Full Voltage Applied; **Bit 9** - 1 – Start/Isolate Contactor Enabled; 0 -Start/Isolate Contactor Disabled; **Bit 10** - 1 – Bypass Contactor Enabled; 0 - Bypass Contactor Disabled **Bit 11** - 1 indicates that the SMC is ready to accept a Start command. The device is not faulted or in the process of stopping, starting or jogging. **Bit 12** - 0 **Bit 13** - 0 **Bit 14** - Control Module Input #1 Status. 1 = Input Closed. **Bit 15** - Control Module Input #2 Status. 1 = Input Closed.	R
332	SSBoard Temp	°C	-25/100	20		Snapshot of the internal temperature of the SMC control module when a fault occurs. The value is overwritten if a subsequent fault occurs	R
333	SSLine Frequency	Hz	0/100	0		Snapshot of the line frequency of the three phase voltage when a fault occurs. The value is overwritten if a subsequent fault occurs	R

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
334	Restart Auto		Bit Value 0/1	All disabled	Volt Unbal Overvoltage Undervoltage Line Loss	Modifies the Auto Restarting of the selected faults so that the restart is attempted when the fault condition is removed rather than after a fixed time delay.	R/W
335	DLX Input 1		-2^31/2^31	0		General purpose parameter used as an input to the DeviceLogix Engine.	R/W
336	DLX Input 2		-2^31/2^31	0		General purpose parameter used as an input to the DeviceLogix Engine.	R/W
337	DLX DL Input 1		0/159999	1		General purpose datalink used to select another parameter within the SMC-50 as an input to the DeviceLogix Engine.	R/W
338	DLX DL Input 2		0/159999	1		General purpose datalink used to select another parameter within the SMC-50 as an input to the DeviceLogix Engine.	R/W
339	DLX DL Input 3		0/159999	1		General purpose datalink used to select another parameter within the SMC-50 as an input to the DeviceLogix Engine.	R/W
340	DLX DL Input 4		0/159999	1		General purpose datalink used to select another parameter within the SMC-50 as an input to the DeviceLogix Engine.	R/W
341	DLX DL Input 5		0/159999	1		General purpose datalink used to select another parameter within the SMC-50 as an input to the DeviceLogix Engine.	R/W
342	DLX DL Input 6		0/159999	1		General purpose datalink used to select another parameter within the SMC-50 as an input to the DeviceLogix Engine.	R/W
343	DLX Output 1		-2^31/2^31	0		General purpose parameter that can be written by the DeviceLogix engine and monitored from a HIM or network device.	R
344	DLX Output 2		-2^31/2^31	0		General purpose parameter that can be written by the DeviceLogix engine and monitored from a HIM or network device.	R
345	DLX Command				Ready Enable Disable	Allows the user to enable or disable the DeviceLogix engine. Once the "Enable" or "Disable" command has been executed the parameter will automatically revert back to "Ready".	R/W
346	DLX Status				Enable Disable	Indicates the current state of the DeviceLogix engine.	R
347	Load Type		0/1		[Motor] Resistive	Allow choice of Motor Load or Resistive Heater Load -Motor Load -Resistive Heater Load	R/W

Table 70 - SMC -50 Parameter List (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	R/W
348	Ref Source		0/8		[Output V Ref] P7 In1 P7 In2 P8 In1 P8 In2 P9 In1 P9 In2 DLX Output 1 DLX Output 2	Allows selection of Source for Resistive Heater Output Voltage -Output Voltage Reference Parameter (Set in Par349) -Analog Input #1 from 150-SM3 option module in Expansion Port 7 -Analog Input #2 from 150-SM3 option module in Expansion Port 7 -Analog Input #1 from 150-SM3 option module in Expansion Port 8 -Analog Input #2 from 150-SM3 option module in Expansion Port 8 -Analog Input #1 from 150-SM3 option module in Expansion Port 9 -Analog Input #2 from 150-SM3 option module in Expansion Port 9 -DeviceLogix Output #1 -DeviceLogix Output #2	R/W
349	Output V Ref	%	1/100	1	N/A	Parameter that can be set from 1% to 100% output voltage for Resistive Heating Mode.	R/W
351	OverCurrent LVL	%	800/1000	800		Threshold for overcurrent protection (the manually enabled one)	R/W

Table 71 - 150-SM2 Option Card Parameters

Number	Name	Unit	Min/Max	Default	Enum Text	Description	Read/ Write
SM2.01 (GF)	Module Status		0/7	7	[Ready] [PTC] [CT Loss]	Displays information about the operational status of the 150-SM2 PTC, Ground Fault, and External Current Transformer (CT) Option Module. **Ready**: Bit 0 = Ready; Bit Set =1 indicates the module is ready for operation. **PTC**: Bit 1 = PTC; 1 = PTC Indicating Fault 0; = No fault **CT Loss**: Bit 2 = CT Loss; 1 = CT disconnected; 0 = CT Connected	R
SM2.02 (GF)	Fault Enable		0/3	0	PTC Ground Fault	**PTC**: 0 = PTC Fault Disabled; 1 = PTC Fault Enabled **GF**: 0 = Ground Fault Disabled; 1 = Ground Fault Enabled	R/W
SM2.02 (GF)	Fault Enable (Refer to SM2.2)						
SM2.03 (GF)	Alarm Enable		0/3	0	PTC Ground Fault	**PTC**: 0 = PTC Alarm Disabled; 1 = PTC Alarm Enabled **GF**: 0 = Ground Fault Alarm Disabled; 1 = Ground Fault Alarm Enabled	R/W
SM2.04 (GF)	Restart Enable		0/3	0	PTC Ground Fault	**PTC**: 0 = does not restart after PTC Fault is cleared; 1 = restart after PTC Fault is cleared **GF**: 0 = does not restart after the Ground Fault is cleared; 1 = restart after the Ground Fault is cleared	R/W
SM2.05 (GF)	Turns Ratio	:1	100/2000	1000		Enables user to configure the turns ratio for the GFCT being used.	R/W
SM2.06 (GF)	Gnd Flt Level	Amps	0/5	2.50		Enables the user to configure the level (value) of ground current (primary current of GFCT) that determines a ground fault condition.	R/W
SM2.07 (GF)	Gnd Flt Delay	Secs	0.1/250	0.5		Sets the time limit that the ground fault level must be exceeded before signalling a fault.	R/W
SM2.08 (GF)	Gnd Flt A Level	Amps	0/5	2.50		Sets the level of ground current that determines a ground fault alarm condition.	R/W
SM2.09 (GF)	Gnd Flt A Delay	Secs	0.1/250	0.5		Sets the time limit that the ground fault level must be exceeded before signalling an alarm.	R/W
SM2.10 (GF)	Gnd Flt Inh Time	Secs	0/250	10.00		User configurable time delay to inhibit ground fault after a start.	R/W
SM2.11 (GF)	Ground Current	Amps	0/5	0.00		Measured ground current.	R/W
SM2.12 (GF)	CT Enable		0/1	0	[Disable] Enable	Disable/Enable CT Function.	R/W
SM2.13 (GF)	CT Scaling A		0/5	0.01		Displayed result of the SMC-50 tuning feature determination of the scaling between external CT and the internal current measuring circuitry.	R
SM2.14 (GF)	CT Scaling B		0/5	0.01		Displayed result of the SMC-50 tuning feature determination of the scaling between external CT and the internal current measuring circuitry.	R
SM2.15 (GF)	CT Scaling C		0/5	0.01		Displayed result of the SMC-50 tuning feature determination of the scaling between external CT and the internal current measuring circuitry.	R
SM2.16 (GF)	Phase Shift A	Deg	-12.5/12.5	0		Displayed result of the SMC-50 tuning feature determination of the phase shift between external CT and the internal current measuring circuitry.	R

Table 71 - 150-SM2 Option Card Parameters (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	Read/ Write
SM2.17 (GF)	Phase Shift B	Deg	-12.5/12.5	0		Displayed result of the SMC-50 tuning feature determination of the phase shift between external CT and the internal current measuring circuitry.	R
SM2.18 (GF)	Phase Shift C	Deg	-12.5/12.5	0		Displayed result of the SMC-50 tuning feature determination of the phase shift between external CT and the internal current measuring circuitry.	R
SM2.19 (GF)	Parameter Mgmt		0/1	0	[Ready] Factory Default	**Ready**: Waiting for command to set defaults. **Factory Default:** Set all writable parameters to factory default values.	R/W

Table 72 - 150-SM4 Parameters

Number	Name	Unit	Min/Max	Default	Enum Text	Description	Read/ Write
SM4.01 (DIO)	Module Status		0/256	0	Ready Input 1 Input 2 Input 3 Input 4 Aux 1 Aux 2 Aux 3 Bit 8-15 Spare	Displays information about the operational status of the 150-SM4 Digital I/O Option Module. **Ready**: Bit 0 = Ready; Bit Set = indicates the module is ready for operation. **Input1**: Bit 1 = Input 1; Bit Set (1) indicates the input is ON. **Input2**: Bit 2 = Input 2; Bit Set (1) indicates the input is ON. **Input3**: Bit 3 = Input 3; Bit Set (1) indicates the input is ON. **Input4**: Bit 4 = Input 4; Bit Set (1) indicates the input is ON. **Aux1**: Bit 5 = Aux 1; Bit Set (1) indicates the auxiliary relay output is ON. **Aux2**: Bit 6 = Aux 2; Bit Set (1) indicates the auxiliary relay output is ON. **Aux3**: Bit 7 = Aux 3; Bit Set (1) indicates the auxiliary relay output is ON.	R
SM4.02 (DIO)	Input 1		0/13	0	[Disable] Start Coast Stop Option Start/Coast Start/Stop Reserved Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Reserved	Allows the user to select the operation of Input Terminal A1, Option Input 1 on the 150-SM4 Digital I/O Option Module. **Disable**: Disable the input - ignores any assertion to Input 1, Terminal A1. **Start**: Initiates a start as set up by the start parameters at Input 1, Terminal A1 (High). **Coast**: Initiates a coast stop.- no current to motor at Input 1, Terminal A1 (Low). **Stop Option**: Initiates a stop maneuver as set up by the stopping parameters at Input 1 (Low). **[Start/Coast]**: if Input 1 = 0 - Stops motor; 1- Initiates a start as set up by the start parameters **Start/Stop**: if Input 1 = 0- Initiates a stop maneuver as set up by stopping parameters; 1- Initiates a start as set up by the start parameters **Dual Ramp**: if Input 1 = 0 - Use starting mode 1; 1 - Use starting mode 2 **OL Select**: if Input 1 = 0 - Use Motor Overload Class 1; 1 - Use Motor Overload Class 2 **Fault**: A fault condition forced if Input 1= 1. **Fault NC**: A fault condition forced if Input 1 = 0. **Clear Fault**: Clear a fault from input 1 Terminal A1 (High). **Emerg Run**: Allow motor to run in emergency run mode if asserted from Input 1, Terminal A1 - does not start motor (High).	R/W
SM4.03 (DIO)	Input 2		0/13	0	[Disable] Start Coast Stop Option Start/Coast Start/Stop Reserved Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Reserved	Allows the user to select the operation of Input Terminal A2, Option Input 2 on the 150-SM4 Digital I/O Option Module. **Disable**: Disable the input - ignores any assertion to Input 1, Terminal A2. **Start**: Initiates a start as set up by the start parameters at Input 1, Terminal A2 (High). **Coast**: Initiates a coast stop.- no current to motor at Input 1, Terminal A2 (Low). **Stop Option**: Initiates a stop maneuver as set up by the stopping parameters at Input 1 (Low). **[Start/Coast]**: if Input 1 = 0 - Stops motor; 1- Initiates a start as set up by the start parameters **Start/Stop**: if Input 1 = 0- Initiates a stop maneuver as set up by stopping parameters; 1- Initiates a start as set up by the start parameters **Dual Ramp**: if Input 1 = 0 - Use starting mode 1; 1 - Use starting mode 2 **OL Select**: if Input 1 = 0 - Use Motor Overload Class 1; 1 - Use Motor Overload Class 2 **Fault**: A fault condition forced if Input 1= 1. **Fault NC**: A fault condition forced if Input 1 = 0. **Clear Fault**: Clear a fault from input 1 Terminal A2 (High). **Emerg Run**: Allow motor to run in emergency run mode if asserted from Input 1, Terminal A2 - does not start motor (High).	R/W

Table 72 - 150-SM4 Parameters (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	Read/ Write
SM4.04 (DIO)	Input 3		0/13	0	[Disable] Start Coast Stop Option Start/Coast Start/Stop Reserved Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Reserved	Allows the user to select the operation of Input Terminal A3, Option Input 3 on the 150-SM4 Digital I/O Option Module. **Disable**: Disable the input - ignores any assertion to Input 1, Terminal A3. **Start**: Initiates a start as set up by the start parameters at Input 1, Terminal A3 (High). **Coast**: Initiates a coast stop.- no current to motor at Input 1, Terminal A3 (Low). **Stop Option**: Initiates a stop maneuver as set up by the stopping parameters at Input 1 (Low). **[Start/Coast]**: if Input 1 = 0 - Stops motor; 1- Initiates a start as set up by the start parameters **Start/Stop**: if Input 1 = 0- Initiates a stop maneuver as set up by stopping parameters; 1- Initiates a start as set up by the start parameters **Dual Ramp**: if Input 1 = 0 - Use starting mode 1; 1 - Use starting mode 2 **OL Select**: if Input 1 = 0 - Use Motor Overload Class 1; 1 - Use Motor Overload Class 2 **Fault**: A fault condition forced if Input 1= 1. **Fault NC**: A fault condition forced if Input 1 = 0. **Clear Fault**: Clear a fault from input 1 Terminal A3 (High). **Emerg Run**: Allow motor to run in emergency run mode if asserted from Input 1, Terminal A3 - does not start motor (High).	R/W
SM4.05 (DIO)	Input 4		0/13	0	[Disable] Start Coast Stop Option Start/Coast Start/Stop Reserved Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Reserved	Allows the user to select the operation of Input Terminal A4, Option Input 4 on the 150-SM4 Digital I/O Option Module. **Disable**: Disable the input - ignores any assertion to Input 1, Terminal A4. **Start**: Initiates a start as set up by the start parameters at Input 1, Terminal A4 (High). **Coast**: Initiates a coast stop.- no current to motor at Input 1, Terminal A4 (Low). **Stop Option**: Initiates a stop maneuver as set up by the stopping parameters at Input 1 (Low). **[Start/Coast]**: if Input 1 = 0 - Stops motor; 1- Initiates a start as set up by the start parameters **Start/Stop**: if Input 1 = 0- Initiates a stop maneuver as set up by stopping parameters; 1- Initiates a start as set up by the start parameters **Dual Ramp**: if Input 1 = 0 - Use starting mode 1; 1 - Use starting mode 2 **OL Select**: if Input 1 = 0 - Use Motor Overload Class 1; 1 - Use Motor Overload Class 2 **Fault**: A fault condition forced if Input 1= 1. **Fault NC**: A fault condition forced if Input 1 = 0. **Clear Fault**: Clear a fault from input 1 Terminal A4 (High). **Emerg Run**: Allow motor to run in emergency run mode if asserted from Input 1, Terminal A4 - does not start motor (High).	R/W

Table 72 - 150-SM4 Parameters (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	Read/ Write
SM4.06 (DIO)	Aux1 Config		0/12	0	[Normal] UTS Fault Alarm Ext Bypass Ext Brake DeviceLogix Aux Conrol Network 1 Network 2 Network 3 Network 4	Allows the user to configure the functionality of the Aux1 Relay Output on the 150-SM4 Digital I/O Option Module. **[Normal]**: Aux 1 closes when start command asserted and opens when motor stops [Default]. **UTS**: Aux 1 closes when motor reaches up to speed and opens when motor is not at speed. **Fault**: Aux1 closes when the SMC-50 enters a fault state and opens when the fault is cleared. **Alarm**: Aux1 closes when the SMC-50 detects an alarm condition and opens when alarm is cleared. **Ext Bypass**: Aux1 closes when the SMC-50 enters the external bypass mode and opens when it leaves that mode. **Ext Brake**: Aux1 closes when Ext Braking command is active and opens when it is not active. DeviceLogix: Aux1 is controlled by DeviceLogix program. **Aux Control**: When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary. **Network 1**: With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1. **Network 2**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 2. **Network 3**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 3. **Network 4**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 4.	R/W
SM4.07 (DIO)	Aux1 Invert		0/1	0	[Disable] Enable	Enables the user to invert the logic of the Aux1 output. When disabled, it is a normally open relay output contact when de-energized. By enabling the invert function, the relay contact becomes a normally closed contact when de-energized. **Disable**: Aux1 Relay Output is not inverted (N.O.). **Enable**: Aux1 Relay Output is inverted (N.C.)	R/W
SM4.08 (DIO)	Aux1 On Delay	Secs	0/10	0.0		A user-selected time delay in activating the Aux1 Relay Contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
SM4.09 (DIO)	Aux1 Off Delay	Secs	0/10	0.0		A user-selected time delay in de-activating the Aux1 Relay Contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
SM4.10 (DIO)	Aux2 Config		0/11	0	[Normal] UTS Fault Alarm Ext Bypass Ext Brake DeviceLogix Aux Conrol Network 1 Network 2 Network 3 Network 4	Allows the user to configure the functionality of the Aux2 Relay Output on the 150-SM4 Digital I/O Option Module. **[Normal]**: Aux 2 closes when start command asserted and opens when motor stops [Default]. **UTS**: Aux 2 closes when motor reaches up to speed and opens when motor is not at speed. **Fault**: Aux2 closes when the SMC-50 enters a fault state and opens when the fault is cleared. **Alarm**: Aux2 closes when the SMC-50 detects an alarm condition and opens when alarm is cleared. **Ext Bypass**: Aux2 closes when the SMC-50 enters the external bypass mode and opens when it leaves that mode. **Ext Brake**: Aux2 closes when Ext Braking command is active and opens when it is not active. DeviceLogix: Aux2 is controlled by DeviceLogix program. **Aux Control**: When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary. **Network 1**: With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1. **Network 2**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 2. **Network 3**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 3. **Network 4**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 4.	R/W

Table 72 - 150-SM4 Parameters (Continued)

Number	Name	Unit	Min/Max	Default	Enum Text	Description	Read/ Write
SM4.11 (DIO)	Aux2 Invert		0/1	0	[Disable] Enable	Enables the user to invert the logic of the Aux2 output. When disabled, it is a normally open relay output contact when de-energized. By enabling the invert function, the relay contact becomes a normally closed contact when de-energized. **Disable**: Aux2 Relay Output is not inverted (N.O.). **Enable**: Aux2 Relay Output is inverted (N.C.)	R/W
SM4.12 (DIO)	Aux2 On Delay	Secs	0/10	0.0		A user-selected time delay in activating the Aux2 Relay Contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
SM4.13 (DIO)	Aux2 Off Delay	Secs	0/10	0.0		A user-selected time delay in de-activating the Aux2 Relay Contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
SM4.14 (DIO)	Aux3 Config		0/12	0	[Normal] UTS Fault Alarm Ext Bypass Ext Brake DeviceLogix Aux Conrol Network 1 Network 2 Network 3 Network 4	Allows the user to configure the functionality of the Aux3 Relay Output on the 150-SM4 Digital I/O Option Module. **[Normal]**: Aux3 closes when start command asserted and opens when motor stops [Default]. **UTS**: Aux3 closes when motor reaches up to speed and opens when motor is not at speed. **Fault**: Aux3 closes when the SMC-50 enters a fault state and opens when the fault is cleared. **Alarm**: Aux3 closes when the SMC-50 detects an alarm condition and opens when alarm is cleared. **Ext Bypass**: Aux3 closes when the SMC-50 enters the external bypass mode and opens when it leaves that mode. **Ext Brake**: Aux3 closes when Ext Braking command is active and opens when it is not active. DeviceLogix: Aux3 is controlled by DeviceLogix program. **Aux Control**: When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary. **Network 1**: With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1. **Network 2**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 2. **Network 3**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 3. **Network 4**: With an auxiliary configured as Network 2 it is controlled over the LAN as Relay 4.	R/W
SM4.15 (DIO)	Aux3 Invert		0/1	0	[Disable] Enable	Enables the user to invert the logic of the Aux3 output. When disabled, it is a normally open relay output contact when de-energized. By enabling the invert function, the relay contact becomes a normally closed contact when de-energized. **Disable**: Aux3 Relay Output is not inverted (N.O.). **Enable**: Aux3 Relay Output is inverted (N.C.)	R/W
SM4.16 (DIO)	Aux3 On Delay	Secs	0/10	0.0		A user-selected time delay in activating the Aux3 Relay Contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
SM4.17 (DIO)	Aux3 Off Delay	Secs	0/10	0.0		A user-selected time delay in de-activating the Aux3 Relay Contact can be programmed. Note: when an aux relay is configured for External Bypass, that delay is not applied to the relay output.	R/W
SM4.18 (DIO)	Parameter Mgmt		0/1	0	[Ready] Factory Default	Allows the user to set all 150-SM4 Digital I/O Option Module parameters to default values. **Ready**: Waiting for command to set defaults. **Factory Default**: Set all writable parameters to factory default values.	R/W

Notes:

Controller Duty Cycle Ratings

1560F/1562F Medium Voltage SMC Motor Controller Starting Duty

The following tables outline the starting duty cycles for the Bulletin 1560F and Bulletin 1562F controllers.

Table 73 - Controller Starting Duty Ratings

Rated Voltage (V)	Rated Current (A)		
	180	360	600
1500...2400	Duty Cycle 1	Duty Cycle 1	Duty Cycle 1
3300...4160	Duty Cycle 1	Duty Cycle 1	Duty Cycle 1
6900	Duty Cycle 1	Duty Cycle 2	Duty Cycle 1 (@ 500A rated current) Duty Cycle 3 (@ 600A rated current)

Table 74 - Duty Cycles 1...3

Duty Cycle 1			
Multiple of Rated Current	3	4	5
ON time (in seconds)	50	30	15
OFF time (in seconds)	300	300	300
Number of Consecutive ON/OFF operations	2	2	2
Rest Time (in hours)	1	1	1
Repeat above steps for number of sequences	1	1	1
Duty Cycle 2			
Multiple of Rated Current	3	4	5
ON time (in seconds)	40	24	12
OFF time (in seconds)	300	300	300
Number of Consecutive ON/OFF operations	2	2	2
Rest Time (in hours)	1	1	1
Repeat above steps for number of sequences	1	1	1
Duty Cycle 3			
Multiple of Rated Current	3	4	5
ON time (in seconds)	35	20	10
OFF time (in seconds)	300	300	300
Number of Consecutive ON/OFF operations	2	2	2
Rest Time (in hours)	1	1	1
Repeat above steps for number of sequences	1	1	1

Notes:

1560F and 1562F Relay Control

Functional Description

The following functional descriptions and associated control circuits are for units using electromechanical (relay) control.

IMPORTANT	The Rockwell Automation® relay control panel (1503E-CXXX) ensures reliable operation of the contactor within its published specifications. The relays break the DC current drawn by the closing, holding, and trip coils. The relays coordinate their pick-up and drop out voltages with the pick-up and drop out voltages of the contactor to operate in under-voltage conditions.

Bulletin 1562F • Standard Control

When wired as shown in Figure 73, the controller operates as follows:

Pressing the “Start” button initiates the start sequence. Relay “CR” closes and applies control power to terminal A1 of 150-SM4 Digital I/O card that is inserted in the SMC™-50 module. The auxiliary contact #2 (set for “normal”) closes, picking up “MC”, which completes the hold-in circuit on the start button, and closes the main contactor.

The SMC-50 module examines the line voltage, looks for fault conditions, checks phase rotation, calculates zero crossing information, and begins gating the SCRs to start the motor.

When the motor approaches rated speed, the SMC-50 module closes the “AUX1” (Ext. Bypass) auxiliary contacts, closing relay “BC”, which closes the bypass contactor. The motor then runs at full line voltage.

When the “Stop” button is pressed, the “CR” relay opens terminal A2 of 150-SM4 Digital I/O card that is inserted in SMC-50 module. If terminal A2 is programmed to be Coast-to-Stop, the Aux2 (Normal) contact opens, dropping out the main contactor, allowing the motor to stop. The Aux1 contact is held closed for a short time by control module. This holds the bypass contactor closed for several seconds as set in Par 192 of SMC-50 module to protect the power electronics from any voltage transients due to opening the motor circuits. If terminal A2 is programmed to be Stop Option, the SMC-50 module will initiate the option stop.

If the loss of current loop transformer assembly is detected by SMC-50 control module, then the terminal A2 will be maintained at high, and terminal A3 will be adopted to initiate the stop. In this situation, when the stop button is pressed, the CR relay opens the terminal A3 of 150-SM4 Digital I/O card inserted in SMC-50 module, Terminal A3 will be always programmed to be Coast-to-stop, so that when current loop transformer assembly doesn't work properly, the SMC-50 will only do Coast-to-Stop.

If the motor has started, the unit is in the bypass mode, and a trip occurs within the SMC-50 module or from an external protection relay, AUX2 will open the line contactor immediately. “AUX1” will remain closed for the number of programmed seconds to protect the power electronics from any voltage transients due to opening the motor circuits. A trip due to an overload or fault condition will result in a “coast” stop.

Bulletin 1562F • Programming Interface Control

The control scheme shown in Figure 75 allows the SMC-50 to be controlled using Programming Interface Control. (Refer to SMC-50 Control Module—Bit Identification on page 124 for Logic Command Word bits assignment for DPI control). This interface includes provisions for a “Local” mode of control as well.

With the Local-Off-Remote selector switch in the “Remote” position, terminal A2 and A3 of the 150-SM4 DigitaL I/O card will be maintained high, and terminal A1 will open which allows a start command to be executed via this interface. The EStop button still works in remote mode. The “Aux #2” contact closes, energizing “MC”, which closes the main contactor.

When the motor approaches rated speed, the SMC-50 module closes “Aux #1” contact, energizing “BC”, which closes the bypass contactor.

A stop command can be generated via the programming interface to stop the motor, depending on the stop mode.

If the motor has started, the unit is in the bypass mode, and a trip occurs within the SMC-50 module or from an external protection relay, AUX2 will open the line contactor immediately. “AUX1” will remain closed for the programmed number of seconds to protect the power electronics from any voltage transients due to opening the motor circuits. A trip due to an overload or fault condition will result in a “coast” stop.

Bulletin 1560F • Standard Control

The Bulletin 1560F is intended for addition to an existing motor controller, which provides circuit isolation, motor switching, and overload and overcurrent protection. When wired as shown in Figure 75, the controller operates as follows:

When a start is initiated in the existing motor controller and the contactor (or breaker) closes, a contact must be supplied to tell the 1560F to start also. Start and Stop are the same as Bulletin 1562F • Standard Control on page 219.

The “Fault” contact on the SMC-50 module should be wired into the existing controller to trip the main contactor (or breaker) in the event of a fault condition sensed by the SMC-50 module.

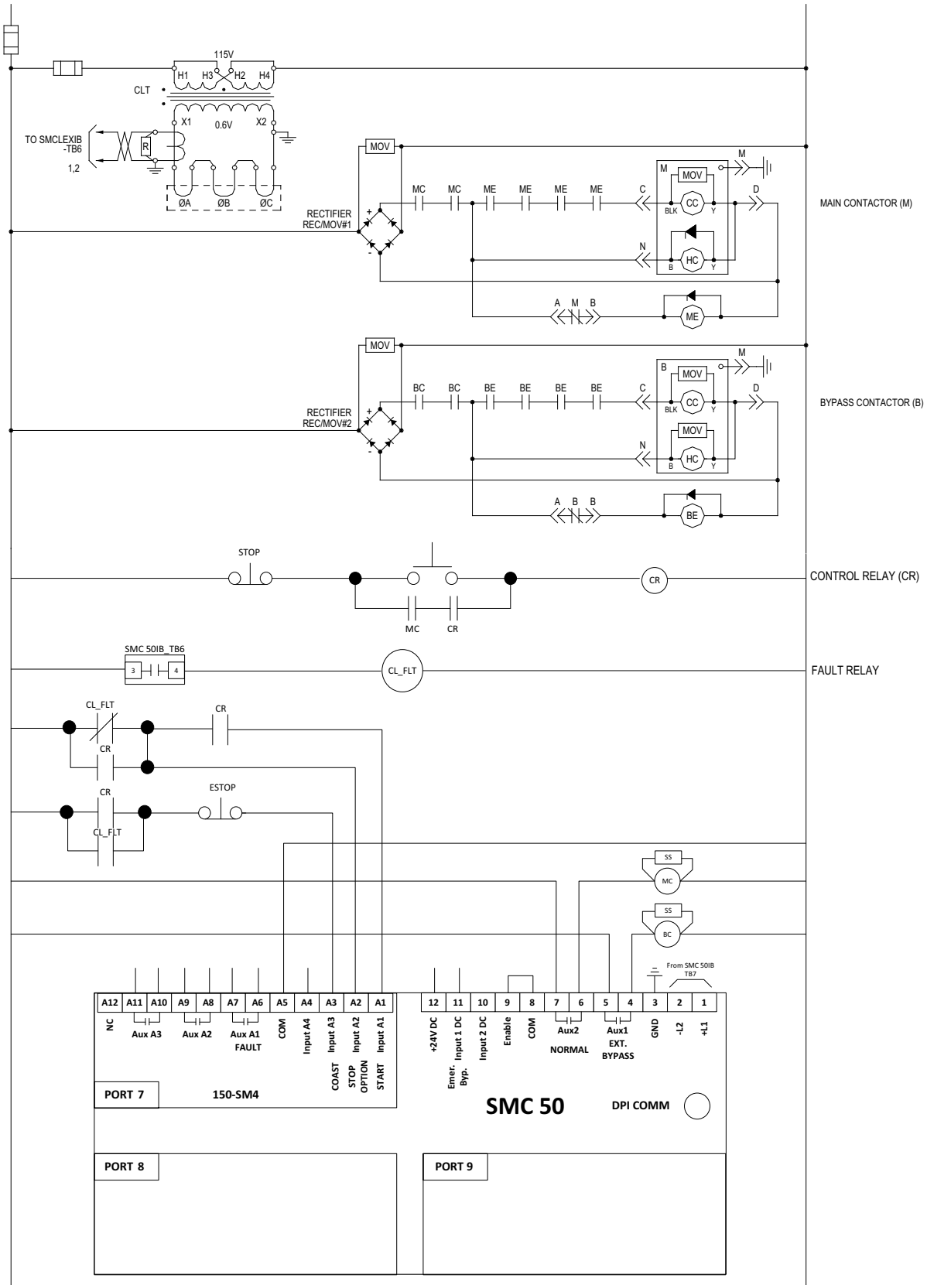
If possible, it is better to have the SMC-50 module control the main contactor directly. In this case, the control circuit would look like, and function like, the descriptions above for the Bulletin 1562F.

Bulletin 1560F • Programming Interface Control

The control scheme shown in Figure 76 allows the SMC-50 to be controlled using Programming Interface Control. (Refer to SMC-50 Control Module—Bit Identification on page 124 for Logic Command Word bits assignment for the interface control). This interface includes provisions for a “Local” mode of control as well.

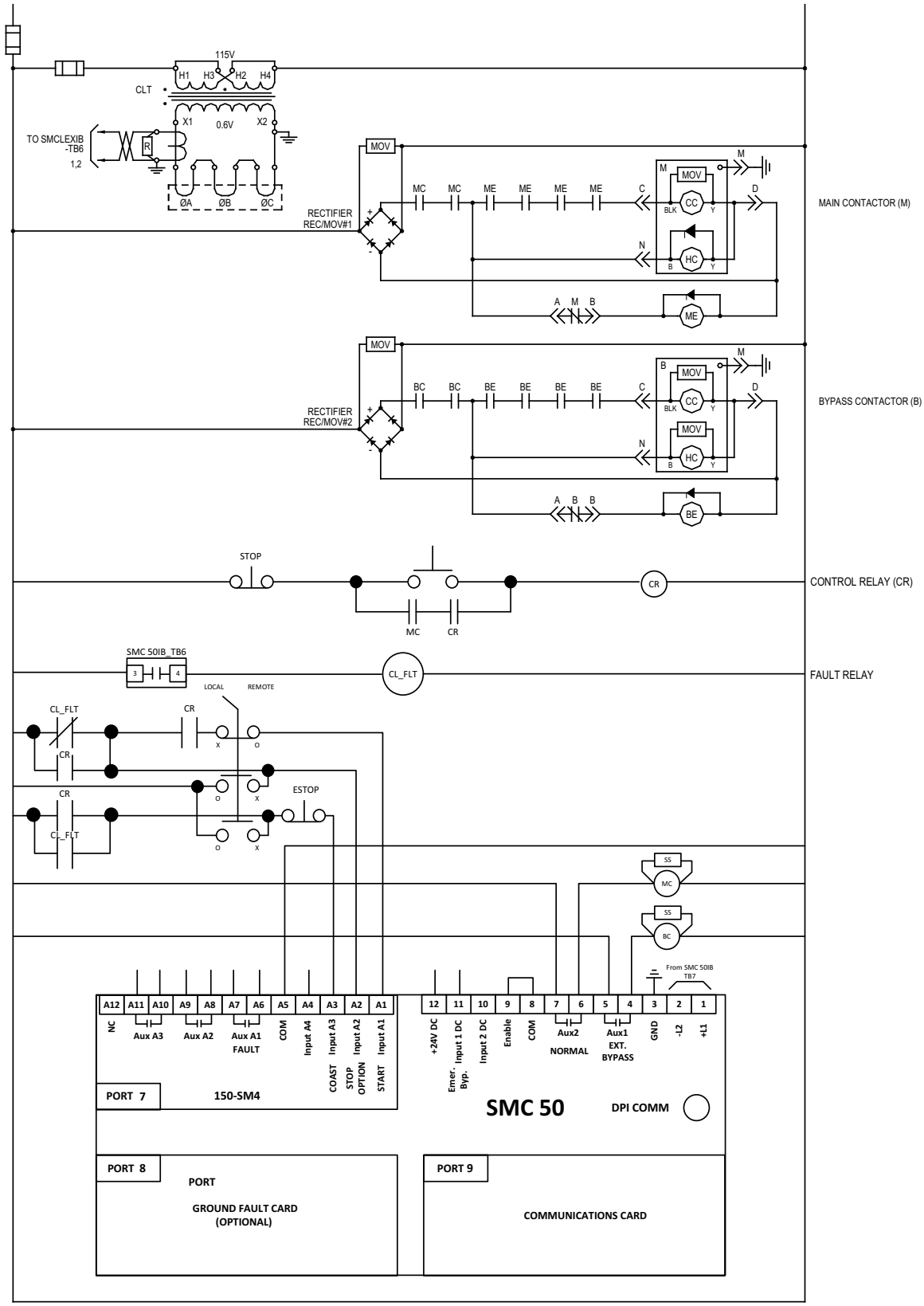
With the Local-Off-Remote selector switch in the “Remote” position, start and stop are the same as Bulletin 1562F • Programming Interface Control on page 220. If possible, it is better to have the SMC-50 module control the main contactor directly. In this case, the control circuit would look like, and function like, the descriptions above for the Bulletin 1562F.

Figure 73 - Typical 400 Amp Bulletin 1562F Relay Control Circuit[(a)]



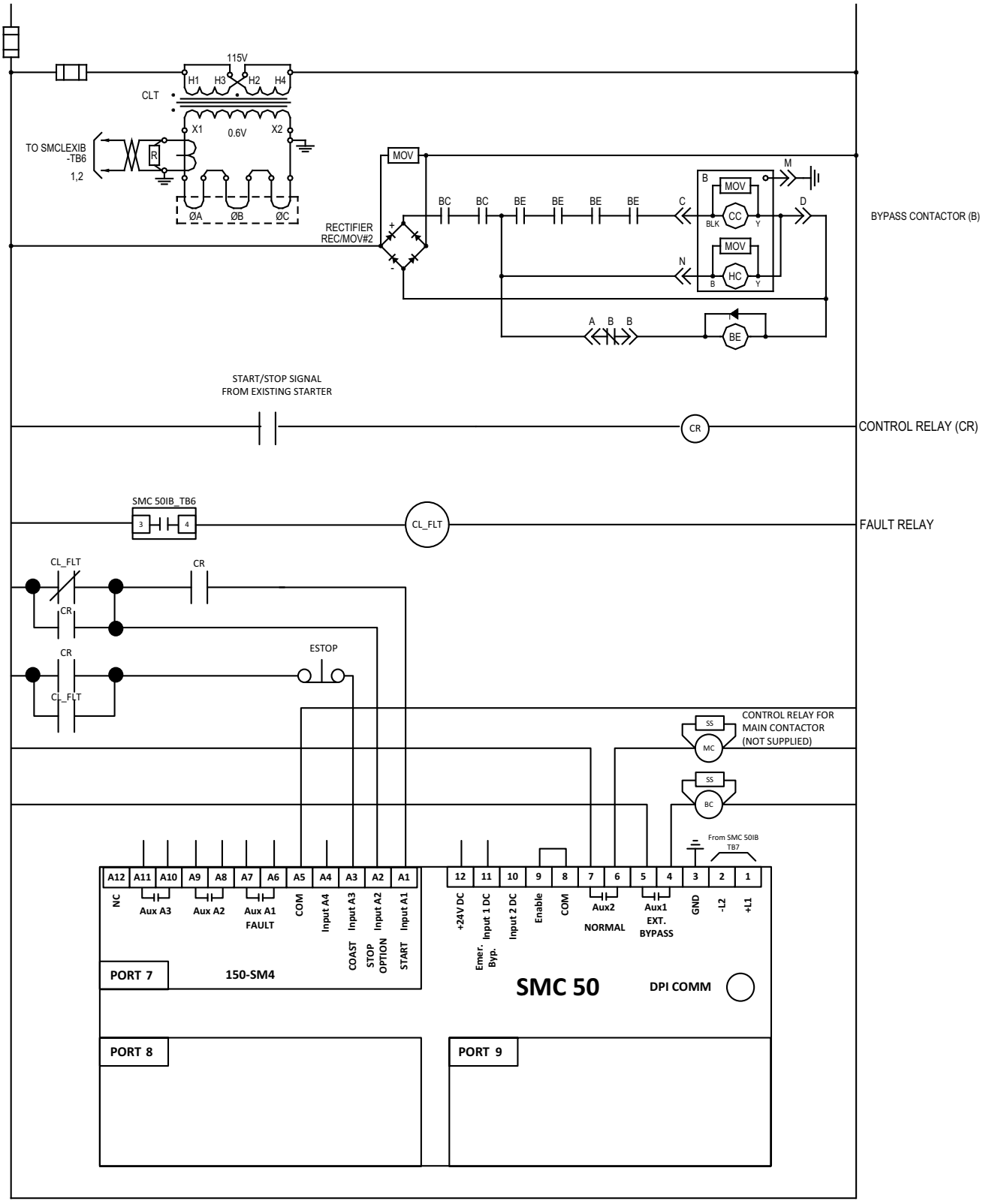
(a) CC and HC and their wiring into the control circuit are part of the Rockwell Automation relay control panel (1503E-CXXX). This control panel ensures reliable operation of the contactor within its published specification.

Figure 74 - 400 Amp Bulletin 1562F Relay Control Circuit • With DeviceNet (or DPI) Communication and Optional Local/Off/Remote[a]



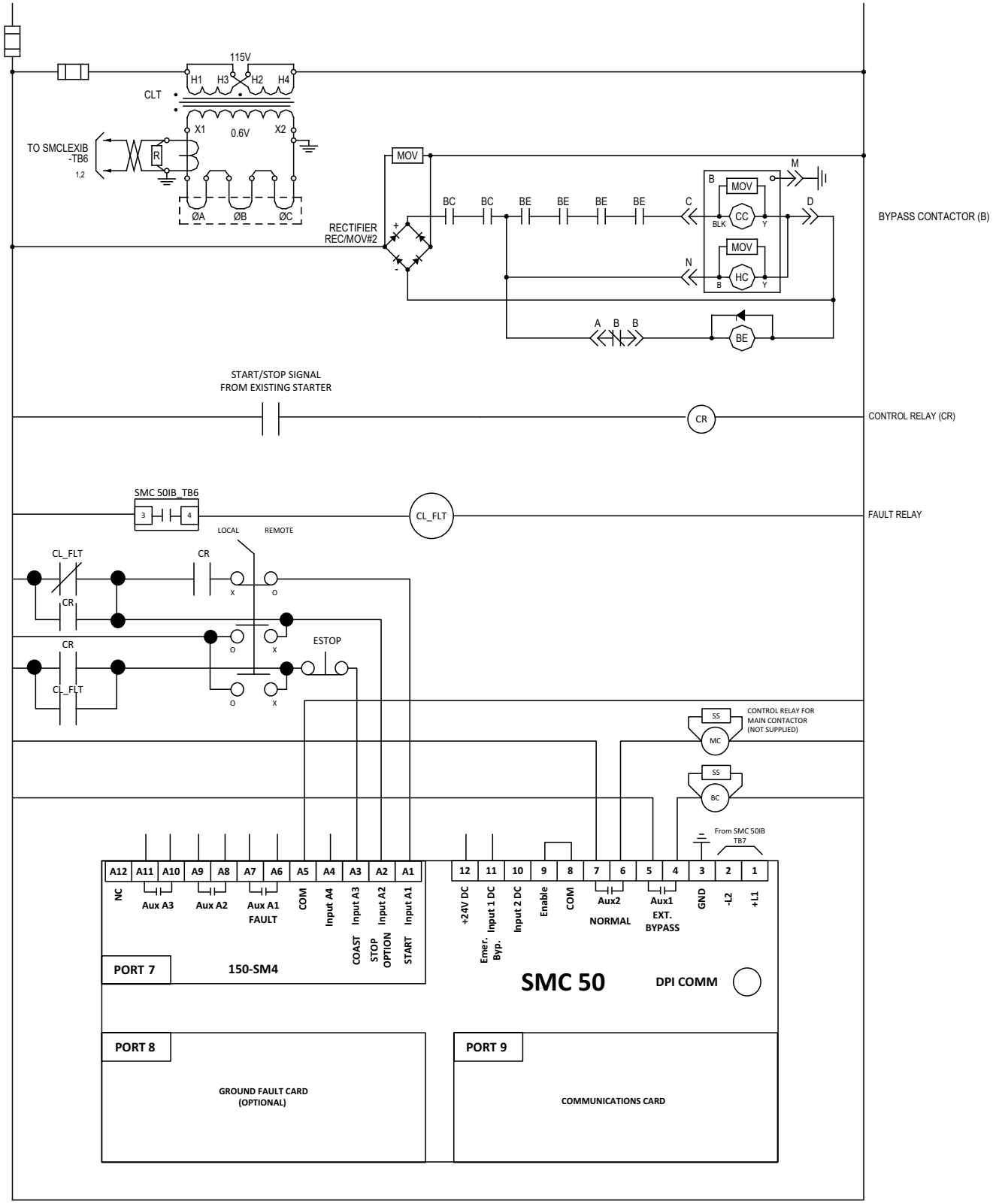
(a) CC and HC and their wiring into the control circuit are part of the Rockwell Automation relay control panel (1503E-CXXX). This control panel ensures reliable operation of the contactor within its published specification.

Figure 75 - 400 Amp Bulletin 1560F Relay Control Circuit • Without Stop Control[(a)]



(a) CC and HC and their wiring into the control circuit are part of the Rockwell Automation relay control panel (1503E-CXXX). This control panel ensures reliable operation of the contactor within its published specification.

Figure 76 - 400 Amp Bulletin 1560F Relay Control Circuit • With DeviceNet (or DPI) Communication and Optional Local/Off/Remote [a]



(a) CC and HC and their wiring into the control circuit are part of the Rockwell Automation relay control panel (1503E-CXXX). This control panel ensures reliable operation of the contactor within its published specification.

Notes:

ArcShield Unit Information

Overview

ArcShield™ units have a robust arc resistant enclosure design that has been tested per IEEE C37.20.7 (2001). Each ArcShield structure was tested to withstand the effects of an arc flash at 40 kA or 50 kA[a] for 0.5 s. ArcShield units provide an enhanced Type 2B Accessibility level.

ArcShield Design

ArcShield units typically include a pressure relief vent on the roof of the structure (some incoming units may not have a pressure relief vent if top cable entry is required). Under arc flash conditions the pressure relief vent will open allowing hazardous flames and gases to exit the enclosure via plenum or chimney system. The low voltage panel area is sealed to prevent flames and gases from entering; however, suitable personal protective equipment (PPE) must be used whenever working on live circuits.

ATTENTION: To ensure Arc resistant integrity, it is important to ensure that the following rules are followed:

- The pressure relief vent may not be tampered with, and it is not to be used as a step.
- No alterations can be made to the ArcShield structure.
- All covers, plates and hardware removed for installation or maintenance purposes must be re-installed and properly secured. Failure to do so voids the arc resistant integrity.
- Power cable entry points are to be treated as the boundary between a hazardous location and sealed accordingly. Failure to do so voids the arc resistant integrity.
- A plenum or chimney must be used to direct the arc flash energy to a suitable location. Failure to do so voids the arc resistant integrity. Refer to Appendix E for plenum installation instructions. Refer to Appendix F for chimney installation instructions.
- All wiring between the low voltage panel and the power cell must be routed through a suitable gland to ensure flames and gases are not transmitted into this area (as fitted from factory).
- The medium voltage power cell doors must be properly secured, using both the handle mechanism and the door bolts. Failure to do so voids the arc resistance integrity.

(a) 50 kA is only for specific configurations.

Exhaust Systems: Chimney or Plenum Option

Plenum Information

A plenum can be provided for each unit, and is to be field-mounted on the top of the unit structure (some incoming units may not have a plenum if top cable entry is required). The purpose of the plenum is to direct the hazardous flames and gases away from the top of the arc resistant enclosure. Unit plenums are secured to the top of the unit structure and to adjacent plenums, creating a continuous conduit for release of the arc flash energy. Refer to Appendix E for plenum installation instructions.

Each plenum based, ArcShield line-up includes a plenum exhaust piece that extends beyond either the left or right ends of the line-up. The other end of the plenums is capped with an end cover. Extensions can be added to the plenum to allow the arc flash energy to be directed further away from the ArcShield line-up to an area where safe venting of the plasma gases can occur.

Figure 77 - Elements of ArcShield Plenum

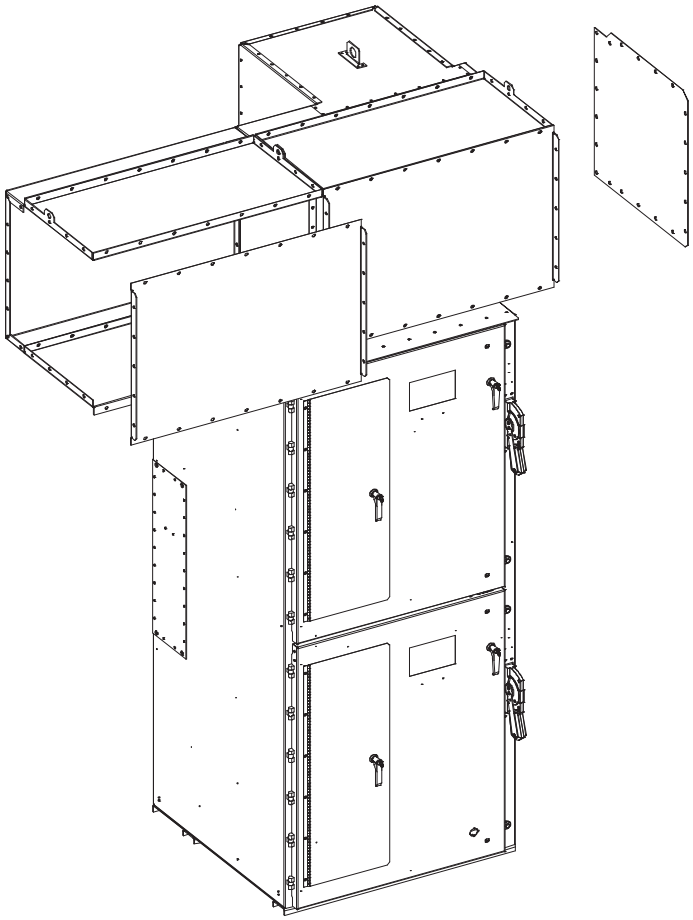
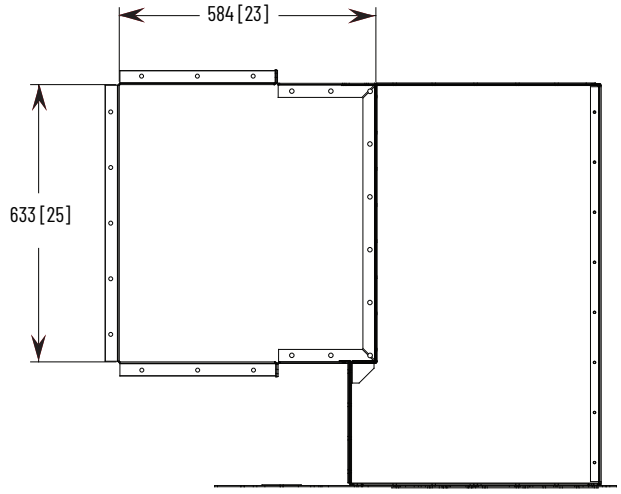


Figure 78 - Cross-section of plenum extension, dimensions in mm [inches]



Plenum Exhaust Considerations

The following options for locating the plenum exhaust are presented:

1. Plenum ducted to an area of the control room where arc gases are permitted to escape, with plenum extensions (see Figure 79, Figure 80 and Figure 81).
2. Plenum duct to outside of control room (see Figure 79 and Figure 80).

Plan the location where the plenum will exhaust. Ensure that:

- There is no access to personnel while equipment is energized.
- Area is free of flammable material or vapors

Ensure that adequate space is provided around the plenum exhaust, as outlined in Figure 79 through Figure 81.

IMPORTANT Be aware that equipment in the area of the plenum exhaust point will be damaged or destroyed.

Figure 79 - Plenum Exit Left with Extension(s) to Internal Controlled Access Area (Top View)

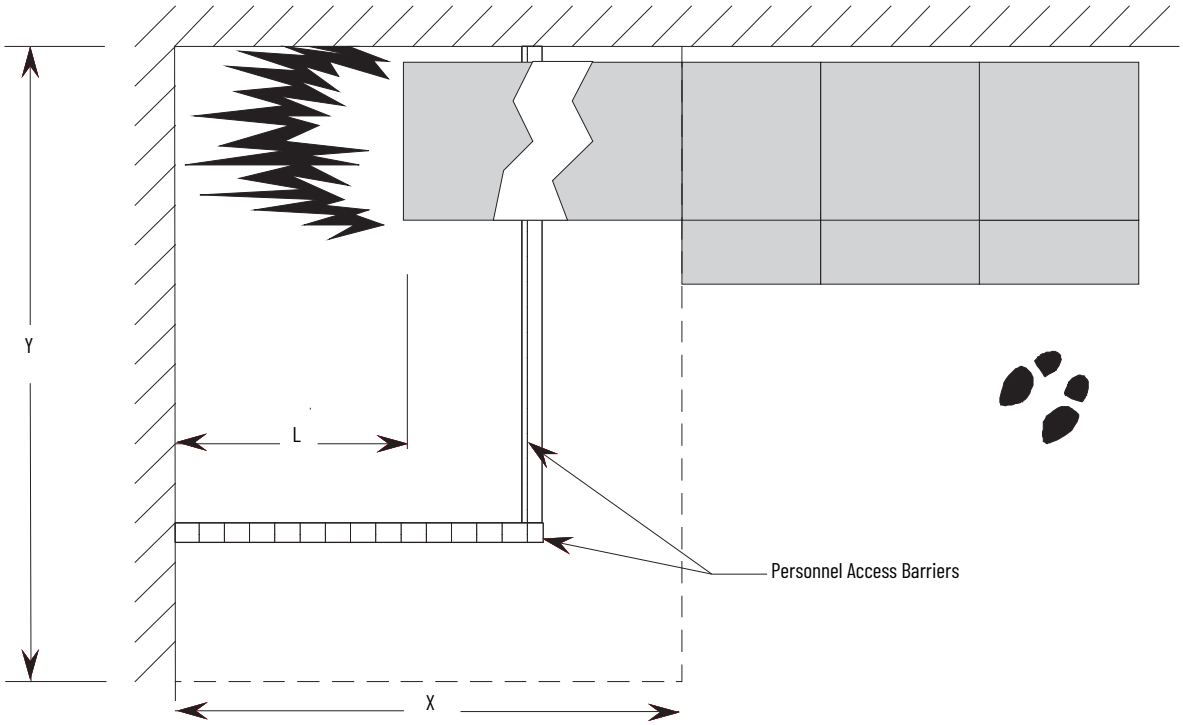
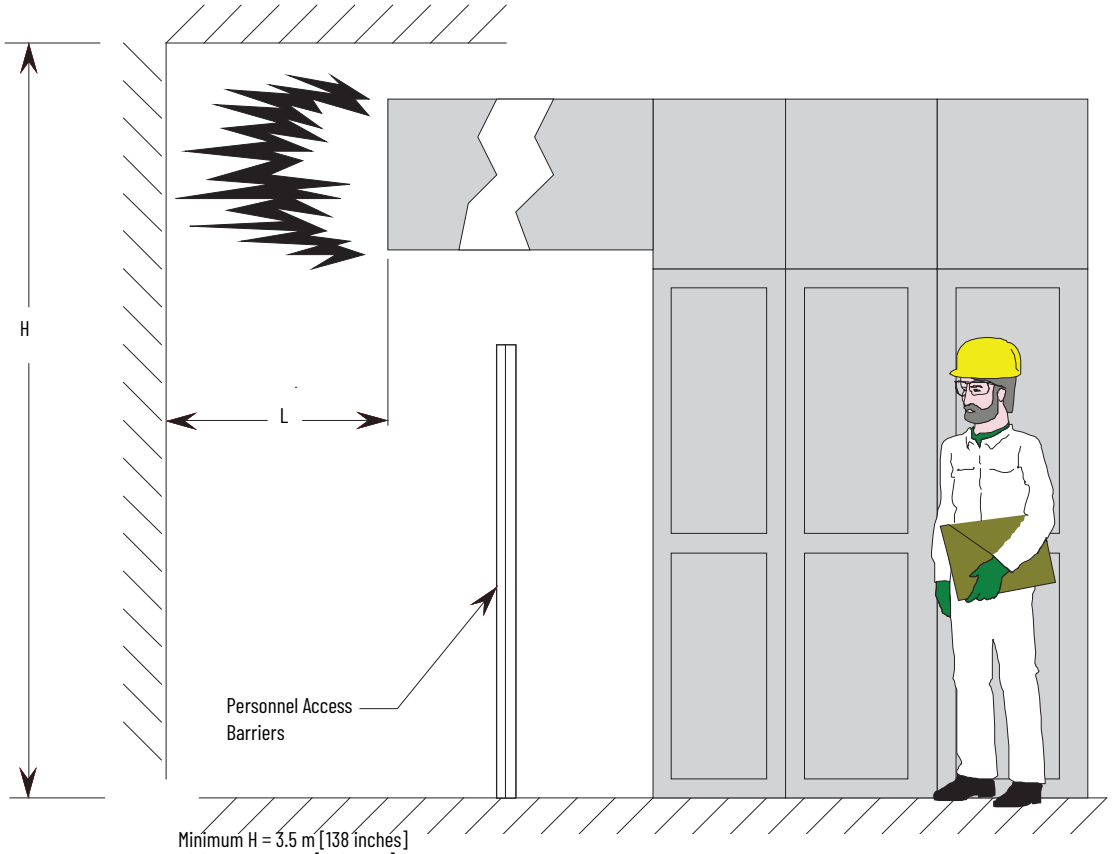
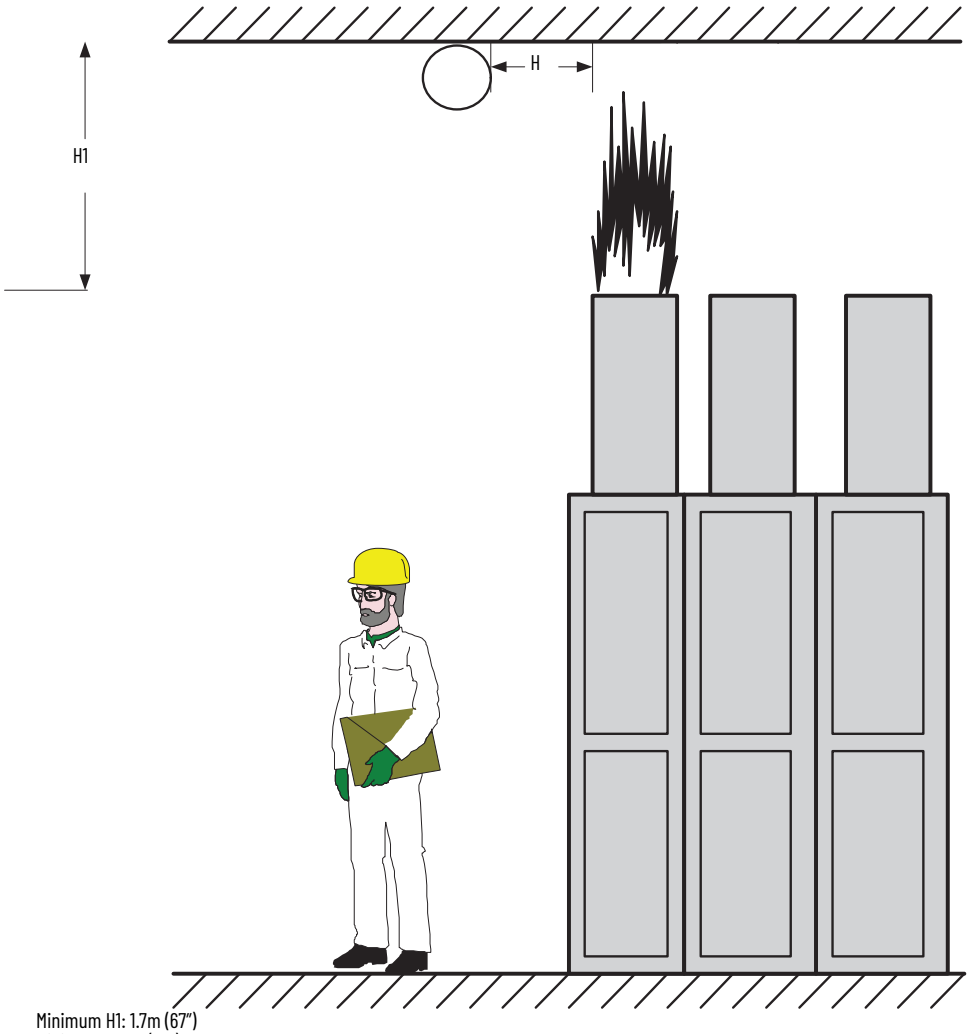


Figure 80 - Plenum Exit Left with Extensions to Internal Controlled Access Area (Front View)



Minimum H = 3.5 m [138 inches]
Minimum L = 1.2 m [47 inches]
Minimum Volume of space required for safe pressure relief:
X *Y* H = 11 m^3 [390 cubic feet]

Figure 81 - Chimney Exhaust Space Requirements



Minimum H1: 1.7m (67″)
Minimum H: 1m (37″)

Additional Notes

The walls of the plenum exit area must be capable of withstanding the pressure generated.

Any painted surfaces which face direct contact with the arc products may ignite. Flame suppression is recommended.

The exit point can also be outside the building. Ensure exit area can not be blocked by ice, snow, vermin nests.

Access barriers are recommended as a means of restricting access by personnel while the equipment is energized. Chain link fencing is a suitable barrier material.

Equipment that consists of more than 4 vertical sections bolted together may require additional plenum exits. Rockwell Automation will provide guidance on requirements for additional plenum exits when required.

Chimney Information

Where adequate clean height (space) is available, chimney can be provided for each unit in place of the plenum system. It is to be field mounted on top of the unit structure. The purpose of the chimney is to direct the hazardous flames and gases away from the top of the resistant enclosure for the chimney is secured to the top of each unit structure. Refer to Appendix F for chimney installation instructions.

Each ArcShield line-up includes a chimney exhaust section that extends vertically directly above the enclosure.

Chimney Exhaust Considerations

1. From the outlet of the chimney, there needs to be a minimum clear distance of 1.7m from the top of the chimney to the ceiling, and 1m (39 in.) on each side.
2. No obstructions (for example, piping) can be in path of the exhaust within this 1.7m (67 in.) height requirement.

Plan the location where the chimney will exhaust. Ensure that:

- There is no access to personnel while equipment is energized.
- Area is free of flammable material or vapors.
- Ensure that adequate space is provided around the chimney exhaust as outlined in Figure 81.

ArcShield Plenum Installation Instructions

The following instructions are provided to ensure the proper installation and function of plenum components supplied with ArcShield™ enclosures. Refer to Appendix D for additional information related to ArcShield plenums before attempting to follow these instructions.

See publication MV-QS050 for level floor surface requirements.

Recommended Torque Values

- 1/4-20 Thread Fasteners – 7.5 N•m (6 lb•ft)
- 5/16-18 Thread Fasteners – 14 N•m (11 lb•ft)

Plenum Bracing

Bracing of the plenum must be able to withstand the dynamic forces of the arc fault as well as any other vibration or seismic effects associated with the installation. Most of this force will be in the direction opposite to where the relief vent exits. The amount of bracing will depend on how the plenum is supported at its exit as well as the distance from the end of the cabinets to the exit vent.

- A flange is available for installing hangers for supporting the weight of the plenum.
- The plenum extension has holes for mechanical support.
- Weight per unit length of Rockwell supplied plenum = 28 kg/m (19 lb/ft).
- Installer is responsible for ensuring that the plenum extension has sufficient support to resist the effect of vibrations and seismic effects.

IMPORTANT Plan the location where the plenum will exhaust (refer to Appendix D). Be aware that equipment in the area of the plenum exhaust may be damaged or destroyed. The plenum exhaust area is to be marked as a Hazardous Zone, and labeled per Figure 82.

Figure 82 - Plenum Exhaust Label

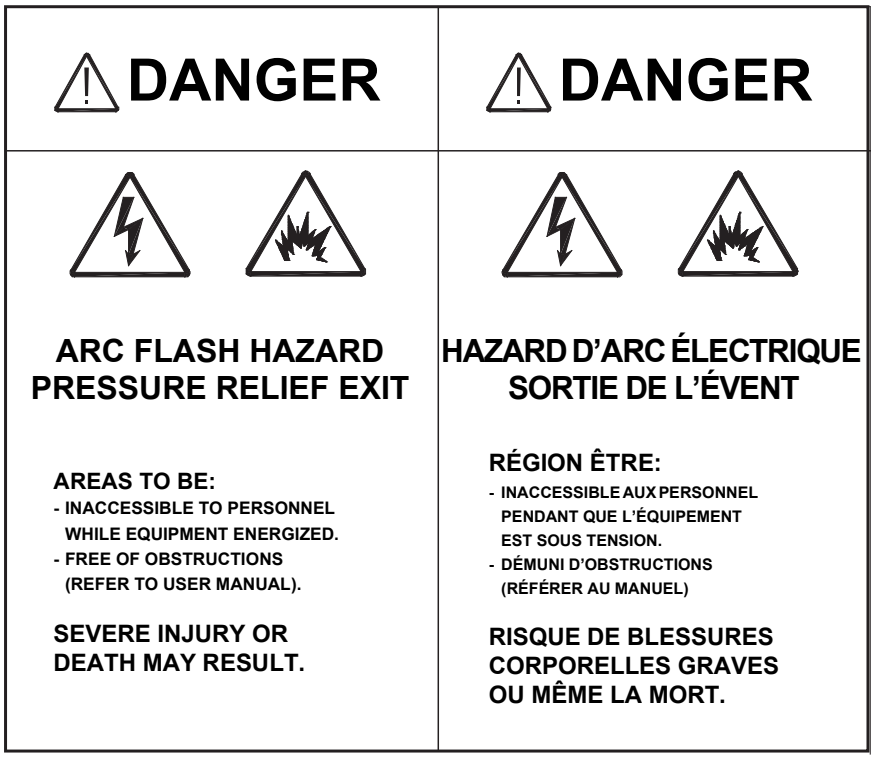
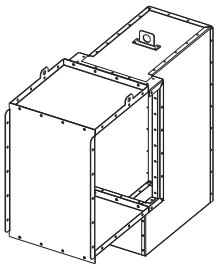
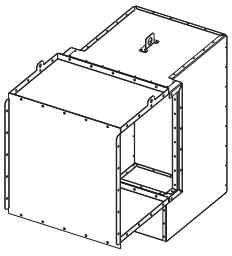


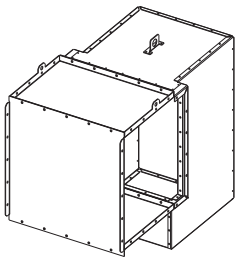
Figure 83 - Various Plenum Components Available



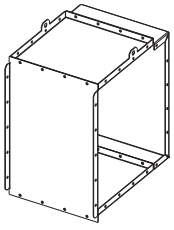
18 in. wide Plenum
Fastened directly over the 0.5 m (18 inch) wide cabinet



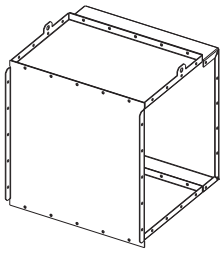
26 in. wide Plenum
Fastened directly over the 0.7 m (26 inch) wide cabinet



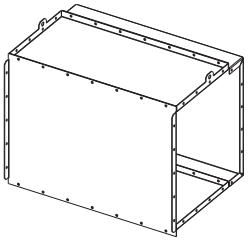
36 in. wide Plenum
Fastened directly over the 0.9 m (36 inch) wide cabinet



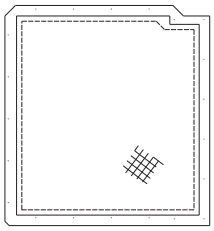
18 in. long Extension
Connected to the last Plenum on the exhaust end of the "line-up"



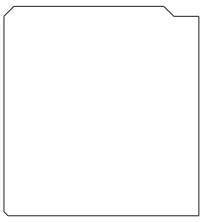
26 in. long Extension
Connected to the last Plenum on the exhaust end of the "line-up"



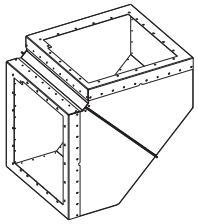
36 in. long Extension
Connected to the last Plenum on the exhaust end of the "line-up"



Screen Cover Plate
Fastened at the opening of the last component on the exhaust end



End Cover Plate
Fastened at the opening of the last Plenum in the "line-up" opposite the exhaust end to seal Plenum end

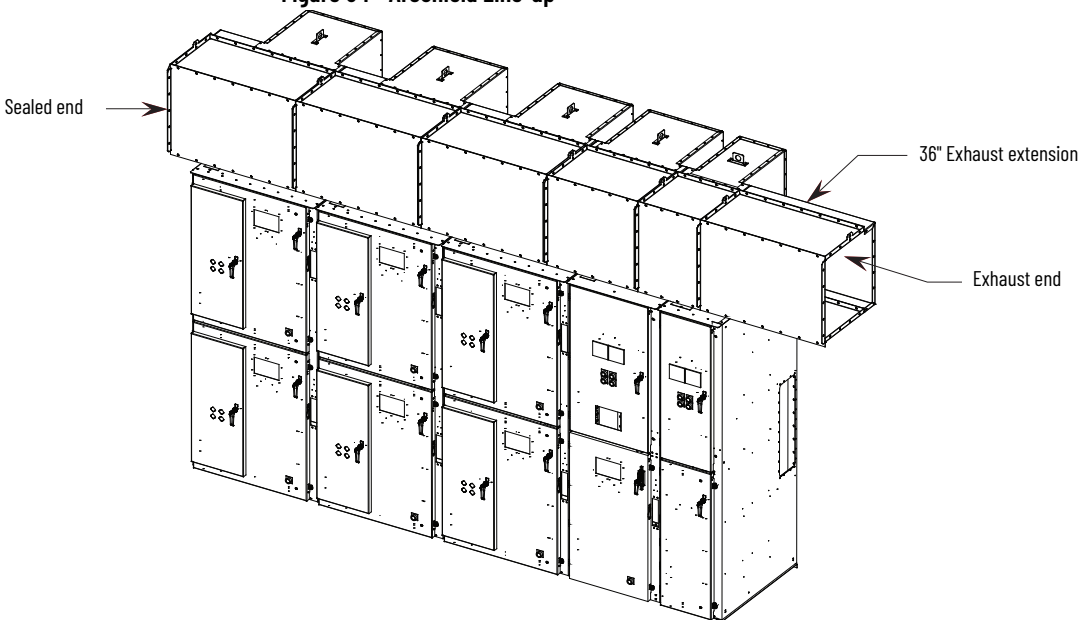


90° Elbow Section
Connected at the exhaust end of the Plenum (or Extension)

General Plenum Layout for ArcShield Line-up

An example of a general Plenum assembly configuration is shown in Figure 84. Plenums of varying widths are mounted directly over the MV enclosures of the corresponding width. A 0.9 m (36 in.) Exhaust extension assembly is shown mounted on the extreme right side Plenum of the equipment "Line-up" (can alternatively exhaust to the left. Engineered systems can be made site specific).

Figure 84 - ArcShield Line-up



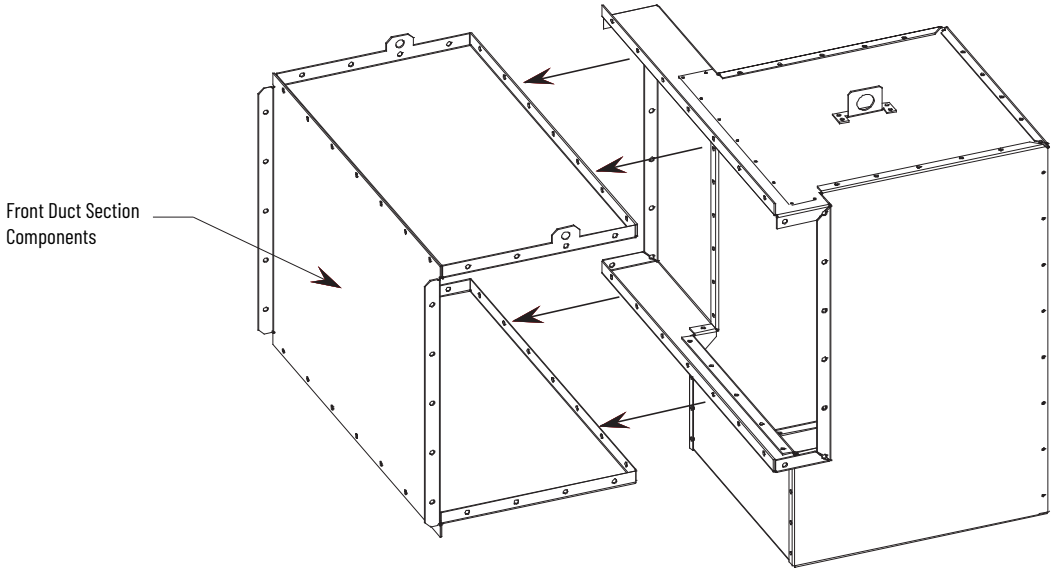
Plenum exhaust can be on the left or right hand end of the line-up. Pictures and figures in this procedure are shown for a right hand exhaust exit direction. Also shown is an optional vertical (top) direction exhaust extension (see Figure 98).

IMPORTANT Plenum components not directly mounted to the tops of the MV enclosures, must have additional mounting support. This includes the Extension components and 90° Elbow Sections (refer to STEP 7 – Additional Mounting Support on page 241).

STEP 1 – Mounting a Single Plenum

Before mounting a single Plenum over an MV enclosure, the front duct section must first be removed. This is shown in Figure 85.

Figure 85 - Removing Front Duct Section



Cabinet Preparation

In preparation for mounting Plenum, remove 1/4-20 fasteners from the Relief vent on the top of the MV enclosure. Leave the (4) corner fasteners in place (see Figure 87).

Figure 86 - Typical Relief Vent Fasteners (top view)

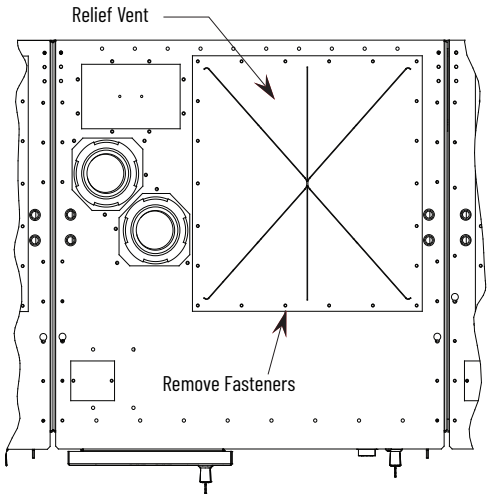
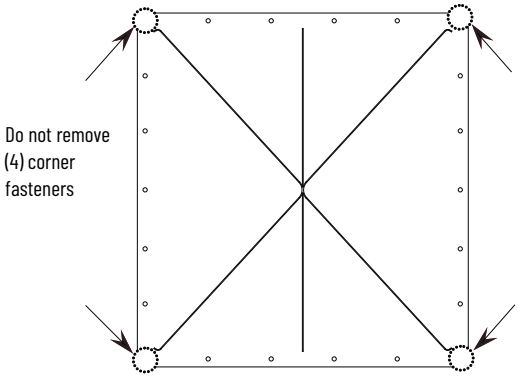


Figure 87 - Relief Vent

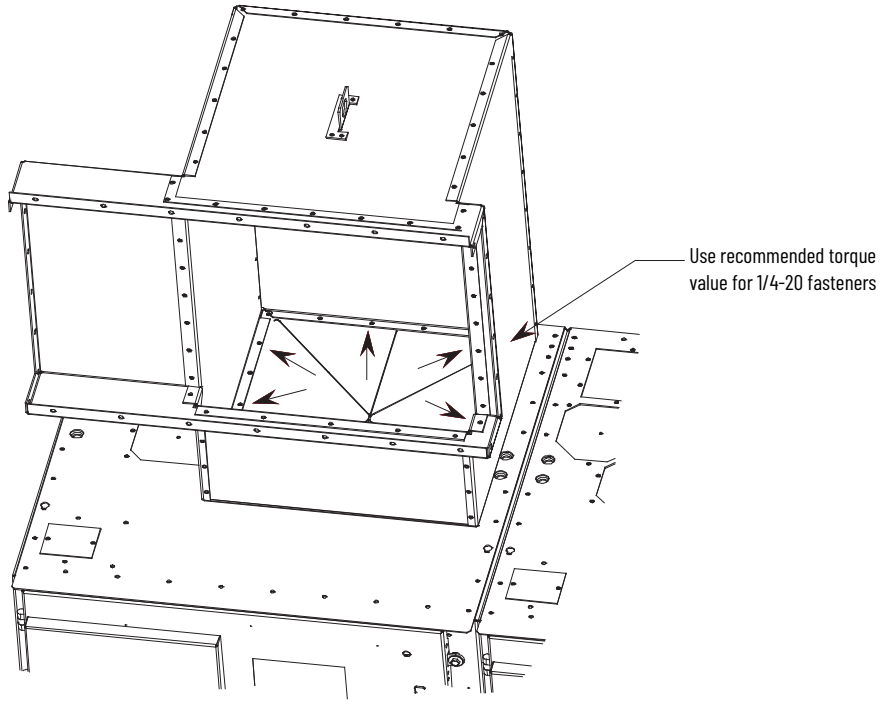


The Plenums are designed to fit over the fastener heads at the corners of the Relief vent. The corner fasteners are required to secure the Relief vent during installation.

Plenum Placement on Structure

Once the Plenum has been lifted in place directly over the relief vent (shown in Figure 88), all 1/4-20 fasteners, removed in Cabinet Preparation above, are replaced to attach the Plenum to the top of the enclosure. Use hand tools only.

Figure 88 - Plenum Placement

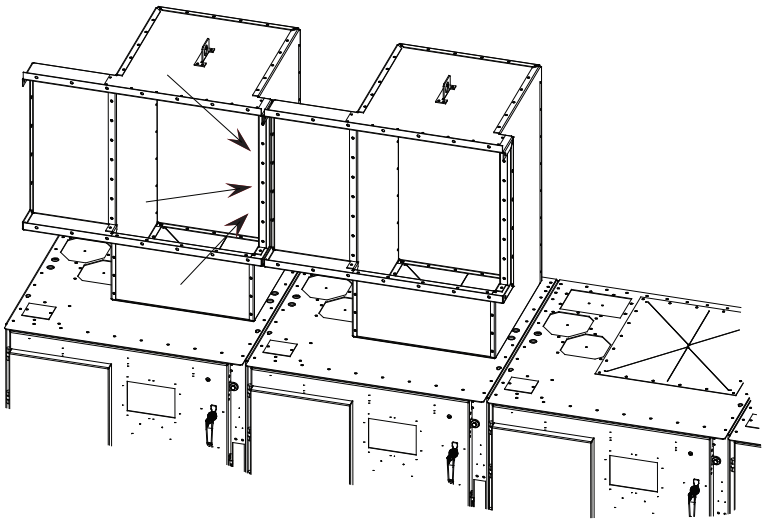


Use silicone caulking generously to fill any air gaps once the Plenum has been securely mounted in place.

STEP 2 – Alignment of 'Side-by-Side' Plenums

Plenums mounted side-by-side must be fastened together through the aligning holes using 5/16-inch supplied hardware (see Figure 89).

Figure 89 - Aligning "Side-by-Side" Plenums



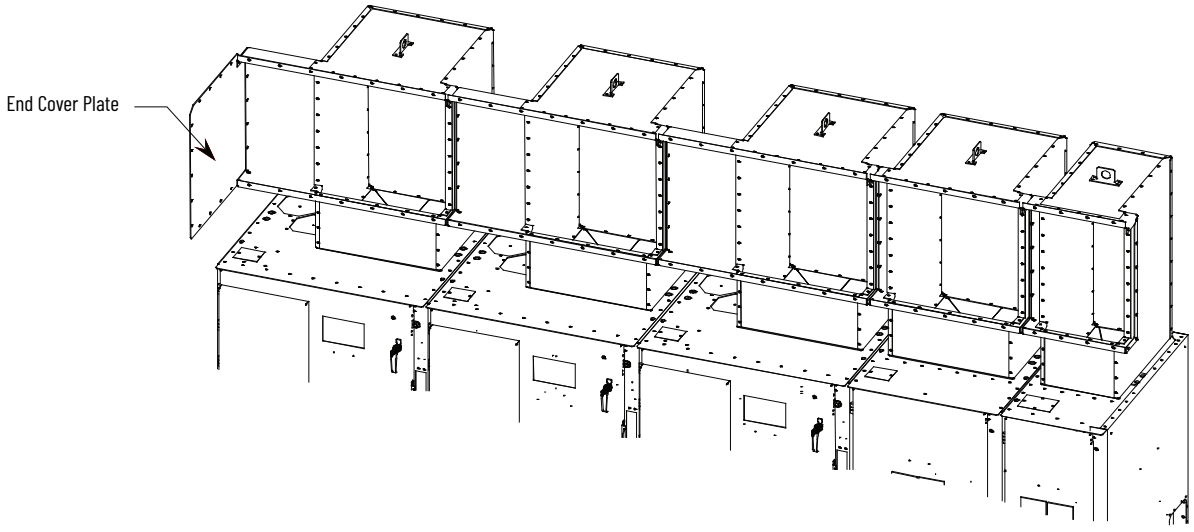
IMPORTANT Any unused holes must be filled with thread forming screws. i.e.: "Lifting Lug holes".

All Gaps must be sealed and filled with silicone.

STEP 3 – Sequence of Final Assembly

All Plenums in a Line-up must be mounted to the top of each enclosure and to the Plenum directly beside it before the front duct sections are re-attached (see Figure 85).

Figure 90 - Sequence of Final Assembly



The 'End Cover Plate' must be mounted on the closed end of the Line-up at this time during the assembly using 5/16-inch hardware (see Figure 90 Left side).

STEP 4 – Closing the Front of the Plenum Sections

After the first stage of the Plenum assemblies have been mounted, the Plenums can then be "closed-up" by replacing the front duct sections as shown in Figure 91 to Figure 93.

Figure 91 - Top Plate

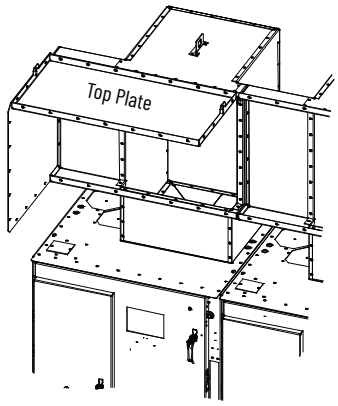


Figure 92 - Bottom Plate

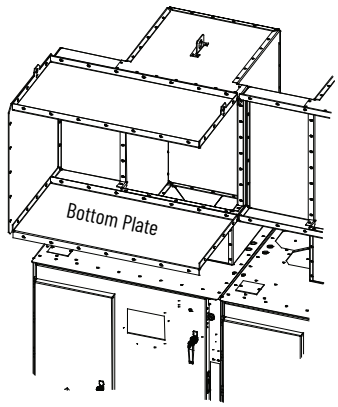
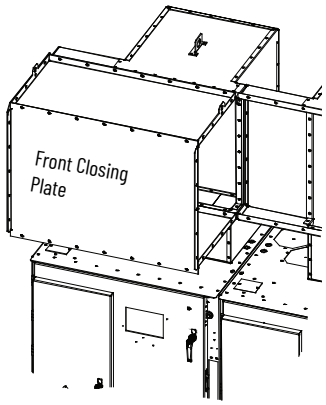


Figure 93 - Front Closing Plate



IMPORTANT	Do not re-install the front duct section of the last Plenum on the exhaust side of the Line-up at this time (refer to STEP 6 – Mounting Extension/Elbow to Plenum 'Line-up' on page 241 for more information).

Use silicone caulking generously to fill any air gaps once the Plenum has been securely mounted in place.

STEP 5 – Extension and Elbow Assembly

The 36 in. extension components and 90° elbow section are to be attached using 5/16-inch hardware in the following sequence:

Step 5A – See Figure 94

Step 5B – See Figure 95

Step 5C – See Figure 96

The Screen Cover Plate is attached in Figure 95.

Figure 94 - 90° Elbow Section Assembly, Step 5A (Front View)

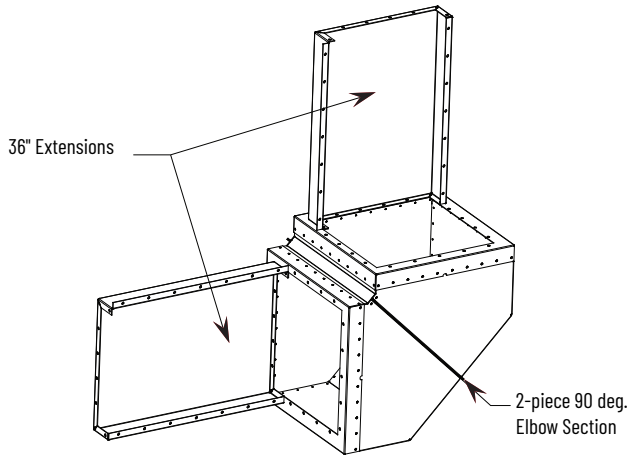


Figure 95 - 90° Elbow Section Assembly, Step 5B (Front View)

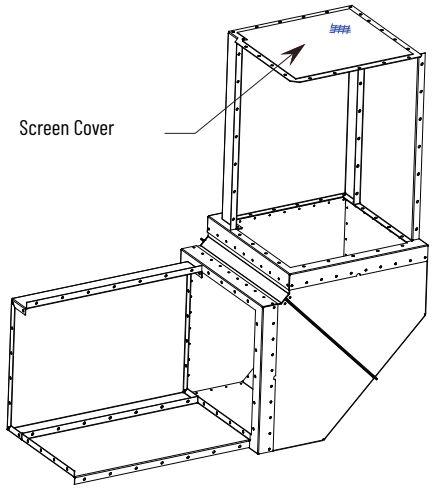
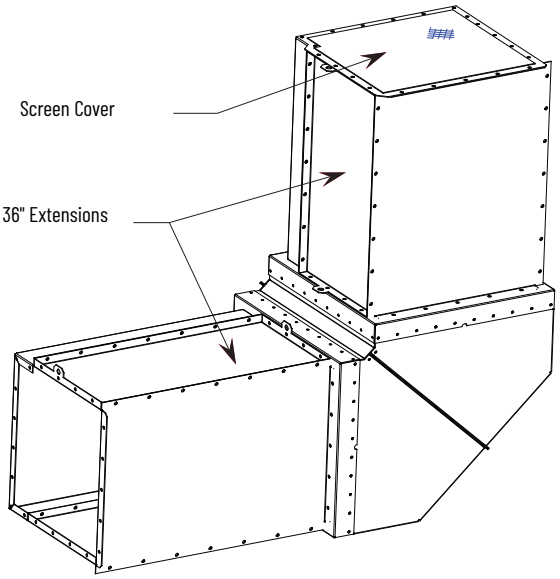


Figure 96 - 90° Elbow Section Assembly, Step 5C (Front View)

The Extension components are attached to the Elbow Section using 5/16-inch Hardware.

Figure 96 illustrates what the Extension/Elbow Assembly should resemble when finished.

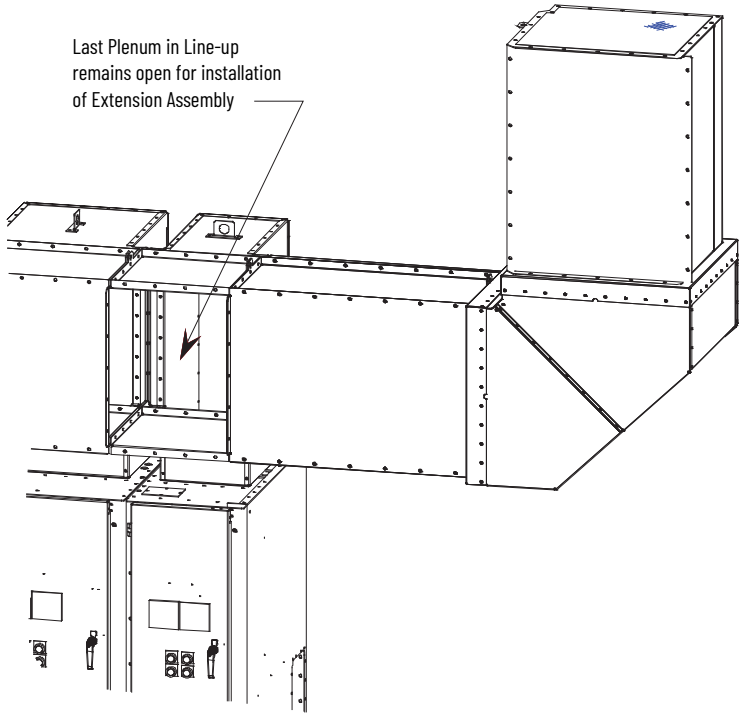


Use silicone caulking generously to fill any air gaps once the Plenum has been securely mounted in place.

STEP 6 – Mounting Extension/Elbow to Plenum 'Line-up'

As referred to in STEP 4 – Closing the Front of the Plenum Sections on page 239, the last Plenum at the exhaust side of the line-up has the front duct section removed. This allows access to fastener holes in order to mount the Extension/Elbow components (see Figure 97).

Figure 97 - Optional Extension/Elbow with Vertical Extension (Right side exit)



After the Extension/Elbow assembly is attached through the fastener holes on the inside flange of the Plenum, the front duct section can be replaced and fastened through the holes on the outside flanges.

STEP 7 – Additional Mounting Support

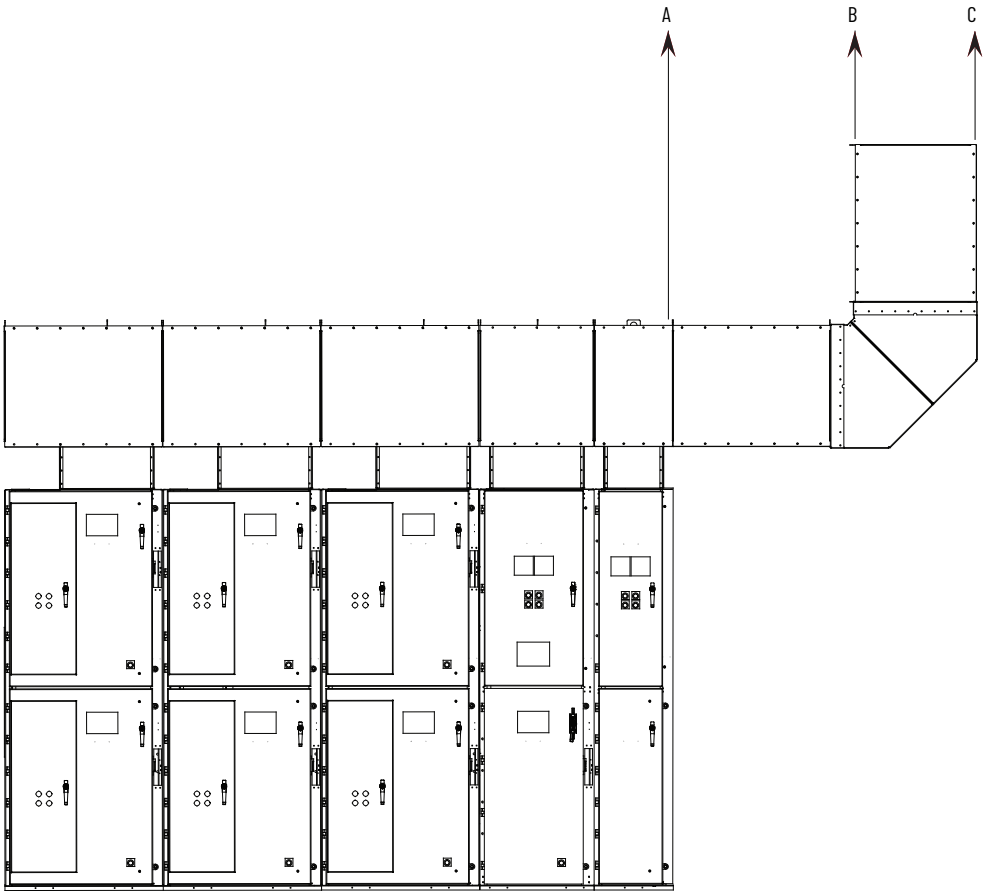
The Extension/Elbow Assembly must have additional mounting support.

90° Elbow Section: Approximate weight 64 kg (142 lb)

36 in. Extension Assembly: Approximate weight 51 kg (112 lb)

Figure 98 shows an example of how the Extension/Elbow Sections can be supported by suspension from a high ceiling. Points **A**, **B**, and **C** show where chains or high tension cables may be connected.

Figure 98 - Completed Assembly for optional vertical exit Plenum (Right hand exit)



During an arc fault, the plenum will be subjected to a brief high pressure shock wave. The Extension/Elbow assembly may experience dynamic loading. It is important to account for dynamic loading when selecting supporting means and materials.

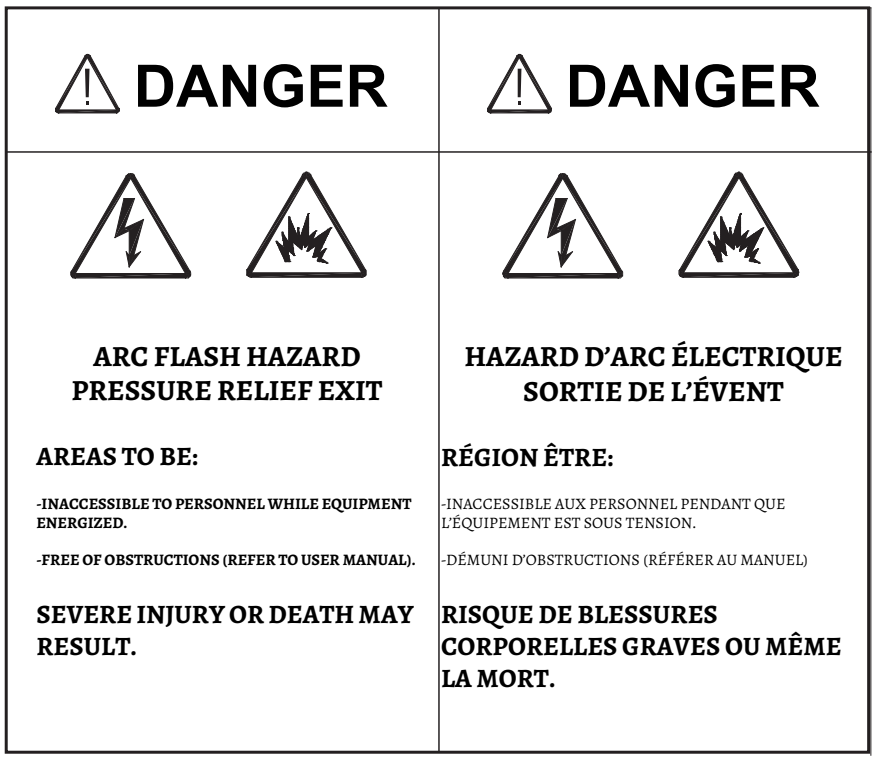
ArcShield Chimney Installation Instructions

The following instructions are provided to ensure the proper installation and function of chimney supplied with ArcShield enclosures. Refer to Appendix D for additional information related to ArcShield chimney before attempting to follow these instructions.

Recommended Torque Values

- 1/4 -20 Thread Fasteners – 7.5 N•m (6 lb•ft)
- 5/16 -18 Thread Fasteners – 14 N•m (11 lb•ft)

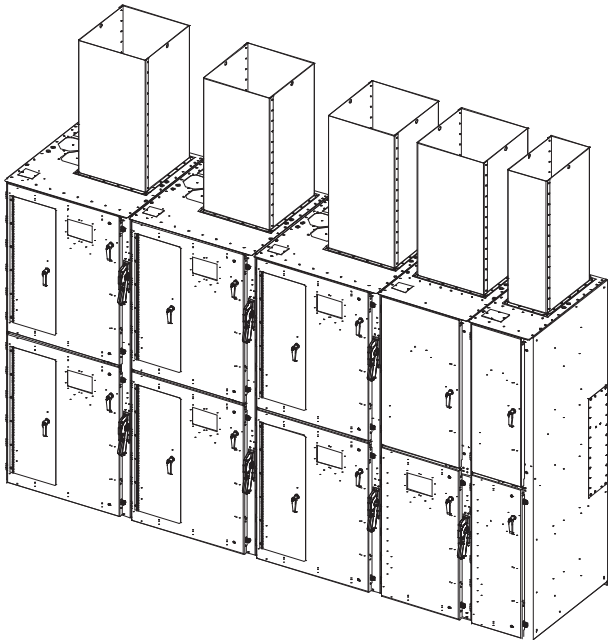
Figure 99 - Chimney Exhaust Label



General Plenum Layout for ArcShield Line-up

An example of a general chimney assembly configuration is shown in Figure 100. Chimneys of varying widths are mounted directly over the MV enclosures of the corresponding width.

Figure 100 - ArcShield Line-ups



Cabinet Preparation

In preparation for mounting a chimney, remove 1/4-20 fasteners from the Relief vent on the top of the MV enclosure. Leave the (4) corner fasteners in place (see Figure 102).

Figure 101 - Relief Vent Fasteners (top view)

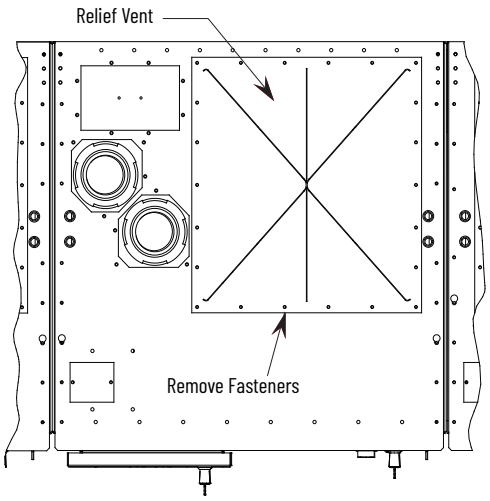
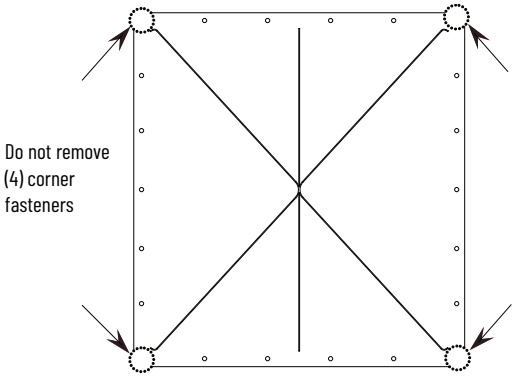


Figure 102 - Relief Vent

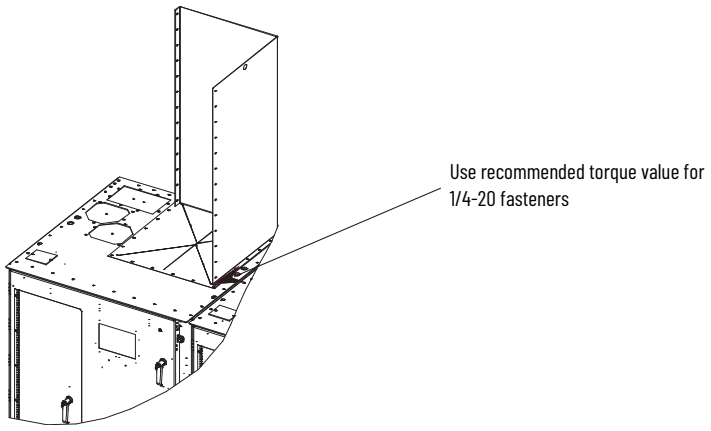


The chimneys are designed to fit over the fastener heads at the (4) corners of the Relief vent. The corner fasteners are required to secure the Relief vent during installation.

Chimney Placement on Structure

Once the Chimney has been lifted in place directly over the relief vent (shown in Figure 102), all 1/4-20 fasteners, removed in Cabinet Preparation on page 244, are replaced to attach the chimney to the top of the enclosure.

Figure 103 - Chimney Placement



Use silicone caulking generously to fill any air gaps once the chimney has been securely mounted in place.

Notes:

Using DeviceLogix

Introduction

DeviceLogix™ is a standard feature in the SMC™-50 control module (firmware 4.002 and higher). DeviceLogix can be used to control and monitor the controller. Program DeviceLogix for the controller through a DeviceLogix Editor component (icon), available in Connected Components Workbench™ software version 6 and later. You cannot use other DeviceLogix Editors, such as RSNetWorx™ for DeviceNet.

Table 75 - Basic Features

	SMC-50 Control Module 4.002 and later
DeviceLogix Library	Version 5
Maximum number of function blocks	32
Program update time per number of blocks used	20 ms (fixed): 1...10 blocks 30 ms (fixed): 11...21 blocks 40 ms (fixed): 22...32 blocks

The DeviceLogix implementation provides basic logic capability for applications. A 20...40 ms scan time is provided depending on program size. You can use DeviceLogix in both networked and stand- alone environments. DeviceLogix continues execution independent of the controller's state (such as starting, running, fault)

There is no data retention in DeviceLogix during a power cycle. Timer and counter accumulators, calculation results, latched bits, etc. are cleared.

Controlling the operating modes (starting, stopping, etc.) through DeviceLogix requires you to set bit #14 of the "Logic Mask" (parameter #148).

Parameters

See parameters 335...346 in Table 70 on page 179 for DeviceLogix parameter descriptions.

Function Block Elements

The following function block elements are available:

- Bit and Analog I/O[(a)] 
- Process 
- Select/Limit 

(a) Bit and Analog I/O do not count against the Function Block total. All other elements count, with each instance counting as one Function Block.

- Timer/Counter 
- Compare 
- Compute/Math 
- Move/Logical 
- Macro Block 

The DeviceLogix Editor provides a graphical interface for configuring Function Blocks to provide local control within the drive. DeviceLogix Editor navigation and programming basics are not covered in this manual. Refer to the DeviceLogix user manual, publication RA-UM003 for additional information.

Macro Blocks 

You can create up to five Macro Blocks and you can use each five times. The selections are empty until you create a Macro Block. You also create the icon text associated with each Macro Block.

Bit and Analog I/O Points 

The DeviceLogix controller in Port 14 uses (32) bit inputs, (18) bit outputs, (24) analog inputs, and (2) analog outputs.

Bit Inputs 

Available bit inputs to the DeviceLogix program include:

Bit Inputs	Name	Description
(17) Hardware Boolean Inputs	Input 1, Input 2	State of the 2 inputs on the control module.
	P7 Ready, P8 Ready, P9 Ready	Status indicating that the expansion card installed into the corresponding expansion port is functioning and Ready
	PX input 1 – PX input 4	Status of the Boolean inputs from the expansion cards – See the Expansion Card Mapping table below
(15) Network Boolean Inputs	Running Phase Rotation Phase Detection Starting Stopping Alarm Fault At Speed Start Bypass Ready	These Boolean inputs correspond to the statuses listed in Table 54 on page 124
	Network Bit 1 Network Bit 2 Network Bit 3 Network Bit 4	These Boolean inputs correspond to the statuses listed in Table 55 on page 124

The function of the expansion port inputs depends on the card installed in the given port. Table 76 shows how the bit inputs are mapped for each card type:

Table 76 - Bit Input Mapping

Bit Input	Digital I/O (150-SM4)	Analog I/O (150-SM3)	PTC / Ground Fault (150-SM2)
PX Input 1	Input #1	DAC #1 Open Status	PTC Status
PX Input 2	Input #2	DAC #1 Shorted Status	CT Loss Status
PX Input 3	Input #3	DAC #2 Open Status	None (always 0)
PX Input 4	Input #4	DAC #1 Shorted Status	None (always 0)

Bit Outputs 

Bit Outputs are used to connect to real-world output devices (pilot lights, relays, etc.) that are wired to an auxiliary relay in the controller. Available bit outputs are shown in Table 77.

Table 77 - Bit Output Mapping

Bit Outputs	Name	Description
(11) Hardware Boolean Outputs	Aux 1, Aux2	Auxiliary Relays available on the control board.(1)
	PX Aux1 – PX Aux3	Auxiliary Relays #1 - #3 available on the Digital I/O (150-SM4) Expansion Card(1)
(7) Network Boolean Outputs	Coast Start Stop CLR Fault Emergency Run Motor Heater	These outputs can be used to control the controller in the same way a PLC can control the controller. See Table 55 on page 124 for a definition of these control bits.

(1) The Auxiliary Relays must be programmed to "Device Logix" to allow the DeviceLogix program to control each specific relay. For example, if you want to control Aux 1 on the control module you must configure "Aux1 Config" (parameter #172) to "Device Logix". Similarly, to control Aux 1 in a Digital I/O (150-SM4) expansion card you must configure "Aux 1 Config" (parameter #6 in the expansion card) to "Device Logix".

Analog Inputs

Available analog inputs to the DeviceLogix program are all 32-bit integers and include the data points shown in Table 78.

Table 78 - Analog Input Data Points

Analog Inputs	Name	Description
(22) Network Analog Inputs	Volt PP Ave	Average Phase to Phase Voltage (Param #1 - Volts)
	I Ave	Average Current (Param #5 – Amps)
	Torque	Average Torque (Param #9 - %)
	Real Power	Total Real Power (Param #10 – kWatts)
	Power Factor	Average Power Factor (Param #17 – in hundredths)
	Volt PN Ave	Average Phase to Neutral Voltage (Param #265 – Volts)
	Reactive Power	Total Reactive Power (Param #277 – kWatts)
	Apparent Power	Total Apparent Power (Param #286 – kWatts)
	DLX In 1, DLX In 2	DLX General-purpose Input parameters (Param #335, #336)
	DLX DL1 – DLX DL6	DLX Datalink Input Parameters (Param #337-342)
	PX In 1 – PX In 2	Analog inputs from the expansion cards – See Table 79

The function of the expansion port inputs depends on the card installed in the given port. Table 79 shows how the analog inputs are mapped for each card type.

Table 79 - Expansion Card Input Mapping

Bit Input	Digital I/O (150-SM4)	Analog I/O (150-SM3)	PTC / Grd Fault (150-SM2)
PX In 1	None (always 0)	Analog In #1 (Param X.6)	Ground Current (Param #11)
PX In 2	None (always 0)	Analog In #2 (Param X.16)	None (always 0)

Analog Outputs

Available analog outputs from the DeviceLogix program are all 32-bit integers and include the data points in Table 80.

Table 80 - Analog Output Data Points

Analog Outputs	Name	Description
(2) Network Analog Outputs	A Out 1 – A Out 2	General-purpose Output parameters (Param #343, #344)

Tips

Data Types

The DeviceLogix implementation supports 32-bit integers only.

DeviceLogix Scratchpad Registers

The SMC-50 control module provides 2 input (parameter #335, #336) and 2 output (parameter #343, #344) scratchpad registers. The input parameters can be written by any configuration or network device and used as an input to DeviceLogix. The output parameters can be written by DeviceLogix and displayed on configuration devices or read using network devices.

SMC-50 Control Module DeviceLogix Input Datalinks (P337...P342)

The SMC-50 control module provides parameters directly to DeviceLogix as analog inputs. Additional parameters from the host and expansion cards can be made available through the DeviceLogix Datalink inputs. The value of the parameter linked to by the datalink is made available to DeviceLogix. For example, configuring a datalink to “Mtr Therm Usage” (parameter #18) would make the motor thermal usage value available to DeviceLogix.

Program Examples

Example 1: Selector Switch Operation

This example demonstrates how a selector switch could be used to select one or four parameters to write to one of the scratchpad output parameters.

Table 81 represents the inputs and outputs for a 4 position selector switch.

Table 81 - Four-position Selector Switch I/O

Inputs		Outputs	
Input 1	**Input 2**	**Output Selection**	**Selector Switch Output**
0	0	0	Volt PP Ave
0	1	1	Volt Phase A-B
1	0	2	Volt Phase B-C
1	1	3	Volt Phase C-A

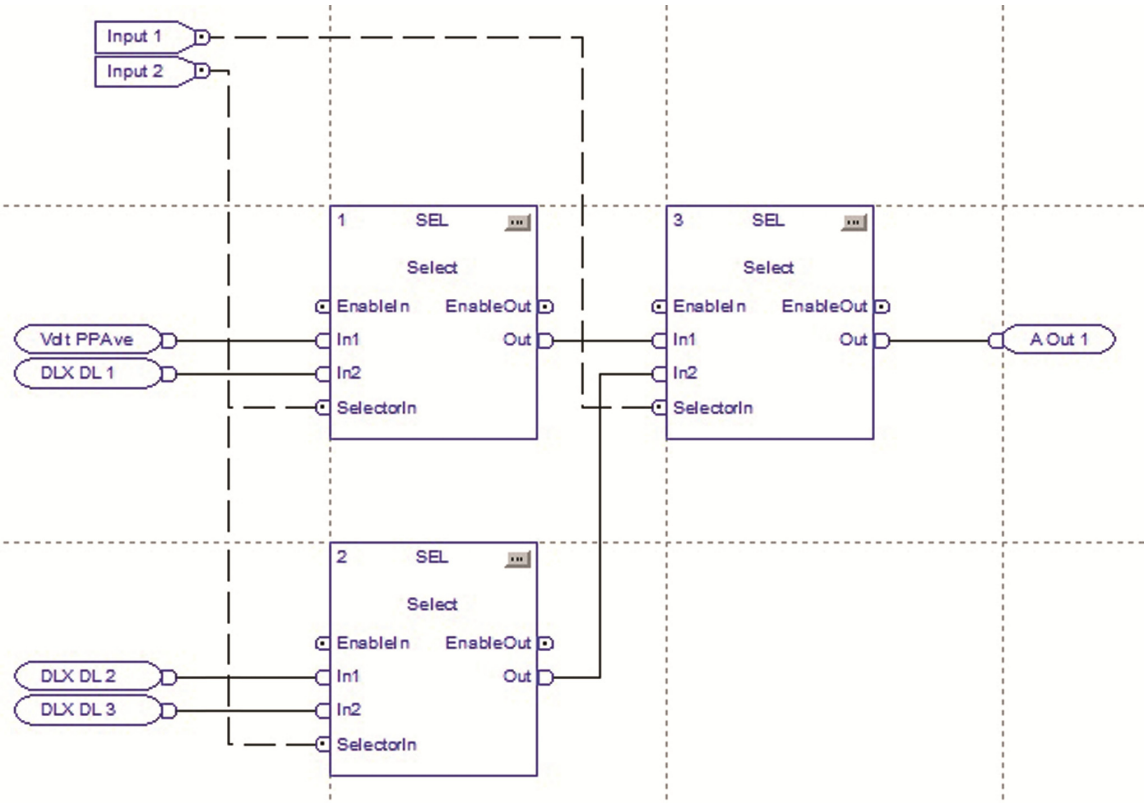
Parameter Configuration

Because the individual phase voltage parameters are not directly available in DeviceLogix (only the average voltage – Volt PP Ave is) we use three of the DeviceLogix Datalink parameters to make those values available to DeviceLogix as shown in Table 82

Table 82 - DeviceLogix Datalink Parameters

Parameter No.	Parameter	Value	Description
337	DLX DL Input 1	Port 0: Volts Phase A-B	Value for Selection 01
338	DLX DL Input 2	Port 0: Volts Phase B-C	Value for selection 10
339	DLX DL Input 3	Port 0: Volts Phase C-A	Value for selection 11

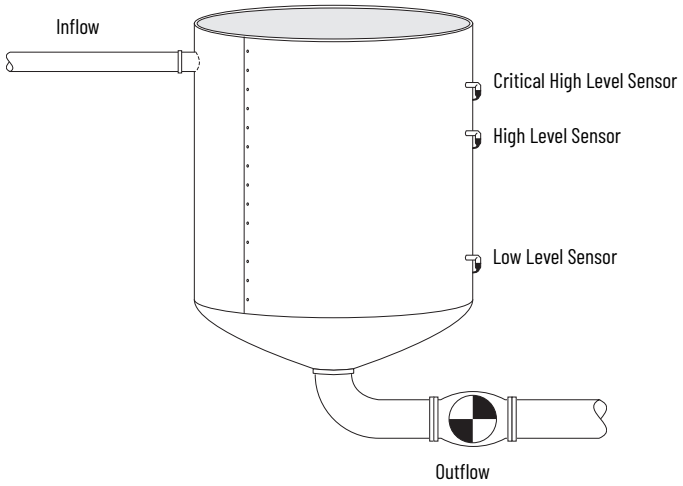
Figure 104 - Function Block Programming



Example 2: Wet Well Operation

This example demonstrates how you can use basic control logic for motor control. It is assumed that a Digital I/O (150-SM4) option module is installed in Port #8.

Figure 105 - Wet Well



The application consists of the discrete I/O that is listed in Table 83

Table 83 - Wet Well Discrete I/O

Type	Location of I/O	Name	Description
Inputs	Port #8 Input #2	Critical High Level sensor	Indicates a critically high level. It is normally a backup to the High Level sensor and is also used to detect whether the High Level sensor is faulty.
	Port #8 Input #3	High Level sensor	Indicates the well is at a high level and it is time to start pumping using the controller.
	Port #8 Input #4	Low Level sensor	When OFF, it is used to indicate that the well is empty (as long as the High and Critical High Level sensors are also OFF). The controller stops operating (end of pumping cycle).
Outputs	Port #8 Aux #1	Sensor Failure pilot light	Indicates that there is a problem with either the High Level or Low Level sensors
	Port #8 Aux #2	Critical Level Pilot light	Indicates that the Critical Level Sensor is active.
	No External Wiring	Start	Start signal to the SMC-50 control module.
	No External Wiring	Stop	Stop signal to the SMC-50 control module.

Example logic requirements:

- Start the motor when the High Level Sensor is ON.
- Stop the motor when all the level sensors are OFF.
- Annunciate a Sensor Fault condition and Stop the controller when any of these conditions exist:
  - The Low Level sensor is OFF when either the High Level or Critical High Level sensors are ON
  - The High Level sensor is OFF when the Critical High Level sensor is ON
- Activate the Critical High Level Pilot when the Critical High Level sensor is active.
- Reset alarms / faults with a Reset push button input

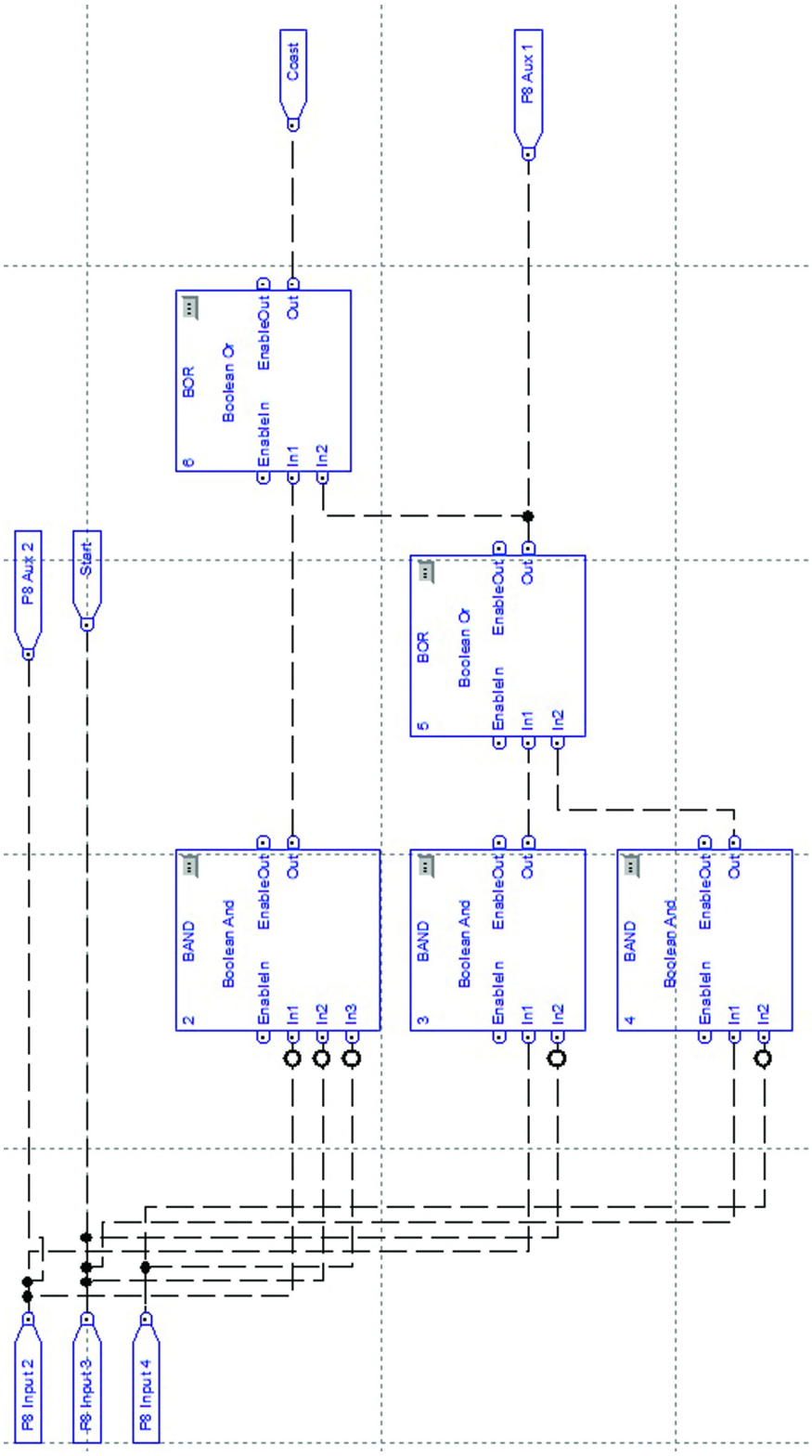
Parameter Configuration

The parameters that are listen in Table 84 are configured for this example.

Table 84 - Wet Well Parameter Configuration

Port Parameter No.	Parameter	Value	Description
0.148.14 Host Parameter #148 Bit #14	"Logic Mask"	Set bit #14	Allow DeviceLogix to control the motor.
8.6 Port #8 Parameter #6	"Aux 1 Config"	"Device Logix"	Auxiliary #1 is used to control the Sensor Failure pilot light. In order for DeviceLogix to control the Auxiliary it must be configured to "Device Logix".
8.10 Port #8 Parameter #10	"Aux 2 Config"	"Device Logix"	Auxiliary #2 is used to control the Critical Level pilot light. In order for DeviceLogix to control the Auxiliary it must be configured to "Device Logix".

Figure 106 - Function Block Programming



Spare Parts

Power Stacks

Table 85 - Replacement SCRs(1)

SMC Rated Voltage (max.)	Description	Part Number	
		180 Amp	360 Amp
1500	Individual – no matching required (6 per controller)	80156-815-61-R	80156-894-71-R
2500	Individual – no matching required (6 per controller)	80156-893-71-R	80156-894-71-R
4800	Matched set of two (6 sets per controller)	80156-893-72-R	80156-894-72-R
7200	Matched set of three (6 sets per controller)	80156-893-73-R	80156-894-73-R

(1) Due to stringent torquing specifications for 600A power stacks, individual SCRs are not replaceable. It is mandatory that the entire power stack be replaced.

Table 86 - Complete Power Stacks (3 per controller)

SMC Rated Voltage (max.)	Part Number		
	180 Amp	360 Amp	600 Amp(1)
1500	80187-513-53-R	80187-513-52-R	80187-522-51-R
2500	80187-513-51-R	80187-513-52-R	80187-522-51-R
4800	80187-514-51-R	PN-187622	80187-523-51-R
7200	PN-184393	80187-521-52-R	PN-187623

(1) Due to stringent torquing specifications for 600A power stacks, individual SCRs are not replaceable. It is mandatory that the entire power stack be replaced.

Table 87 - Snubber Capacitor / Snubber Resistor

Snubber Capacitor	Part Number	
	180/360 Amp	600 Amp
All voltages	80026-508-02-R (0.68 µF)	80025-812-01-R (1.0 µF)

Snubber Resistor(1)	Part Number(2)	
	180/360 Amp	600 Amp
1500/2500/4800V	80025-588-02-R (20 Ω, 100W)	PN-187624 (15 Ω, 225W)
7200V	PN-152354 (30 Ω, 225W)	PN-187624 (15 Ω, 225W)

(1) All parts are ceramic, wirewound, non-inductive winding.
(2) Resistors are series connected for a total of 60 Ω per snubber for 180/360A assemblies and 30 ? per snubber for 600A assemblies. A controller has one snubber per pair of SCRs (i.e. 3 snubbers for 2500V, 6 snubbers for 4800V, 9 snubbers for 7200V).

Table 88 - Common Parts

Quantity	Description		Part Number
1 per SCR pair[1]	Sharing resistor 32.5 kΩ, 225W, two 2.5 kΩ taps		80025-753-01-R
1 per SCR[1]	Current loop self-powered gate driver board (CLGD)		80190-520-01-R
1 per controller	Voltage Sensing Board (VSB)	1500V	80187-708-51-R
		2500V	80187-708-52-R
		4800V	80187-708-54-R
		7200V	80187-708-55-R
(1 per SCR) + 3[1]	Fiber Optic Cable	2.5 m	80025-549-03-R
		5.0 m	80025-549-01-R
1 per controller	Test Power Supply	120V AC for North America	80187-051-51-R
		Universal	80187-245-51-R
1 per controller	Current loop transformer, 50VA 115/230 : 0.6V		80022-133-01-R
3 per controller[2]	Current loop cable assembly	5 ft	81023-213-10-R
		6 ft	PN-307281
		7 ft	80018-246-52-R
		8 ft	80023-213-13-R
		9 ft	PN-262346
1 per controller	Current loop sense CT		PN-152357
1 per controller	Ribbon cable from VSB to Interface Board		PN-489086
3 per controller	Ribbon cable from Control Module to Interface Board (6-pin)		80174-201-01-R
3 per controller	Ribbon cable from Control Module to Interface Board (8-pin)		80174-201-02-R

(1) Refer to Table 89 for an explanation of the number of SCRs per controller, which is voltage dependant.
(2) Different lengths are used for the various configurations. The current loop total length must equal 21 ft. for proper operation.

Table 89 - Interface Board

Quantity	Description	Part Number
1 per controller	180 A, 1500...2400V controller	PN-539324
1 per controller	180 A, 3300...4160V controller	PN-539325
1 per controller	180 A, 6600...6900V controller	PN-539326
1 per controller	360 A, 1500...2400V controller	PN-539327
1 per controller	360 A, 3300...4160V controller	PN-539328
1 per controller	360 A, 6600...6900V controller	PN-539329
1 per controller	600 A, 1500...2400V controller	PN-539330
1 per controller	600 A, 3300...4160V controller	PN-539331
1 per controller	600 A, 6600...6900V controller	PN-539332

Table 90 - Accessories

Qty per controller	Description	Part Number
1	Control Module (Standard)	PN-281287
1	HIM (Bezel Mounted)	350325-A06
1	SMC-50 Digital I/O Module	PN-71481
1	SMC-50 Ground Fault, PTC Module	PN-71480
	Fuse Extractor	80144-491-02-F

Notes:

1. Reference only.
2. 1503 – For OEM products, refer to OEM-supplied documentation for specific spare parts list. 1560/1562F are Allen-Bradley manufactured starters.
3. For spare parts for starter and contactor components, refer to Additional Resources on page 12.

Accessories

Accessories

Table 91 - Accessories

Description	Description/Used With	Catalog Number
HIM	Remote Door Mounted IP66 (Type 4/12) Programmer Only	20-HIM-C6S
Communication Modules	Remote I/O	20-COMM-R
	RS 485 (DF-1)	20-COMM-S
	DeviceNet®	20-COMM-D
	ControlNet	20-COMM-C
	EtherNet/IP™	20-COMM-E
	PROFIBUS	20-COMM-P
	INTERBUS 2	20-COMM-I
	LonWorks	20-COMM-L
	ControlNet® (Fiber)	20-COMM-Q
	RS485 HVAC	20-COMM-H

Notes:

History of Changes

This appendix contains the new or updated information for each revision of this publication. These lists include substantive updates only and are not intended to reflect all changes. Translated versions are not always available for each revision.

1560F-UM001B-EN-P, February 2020

Change
Added additional information around Undervoltage Fault Delay and the start button
Switched input information for terminals 10 and 11
Switched terminal 10 and 11 descriptions
Altered graphic to indicate separate fuses for the main contactor and bypass contactor
Added footnote identifying IntelliVAC
Revised wording around motor surge capacitor and arrester installation location
Corrected reference from 150-SM6 to 150-SM2
Removed 'Replace power module' from fault display 11, 12, 13
Changed Parameter 57 description from Terminal 11 to 10
Added note clarifying 5 A secondary value for CT ratio
Switched terminal 10 and 11 descriptions
Added footnote identifying control relay
Removed 150-SM6 Parameter Config column

Notes:

Numerics

A

B

C

D

E

F

G

H

I

J

L

M

N

O

P

R

S

T

U

V

W

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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