SMC-50 Soft Starters

Bulletin 150

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.

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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.

These 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).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

About This Publication

This user manual provides you with the information that is required to program and operate your SMC-50™ soft starter.

The SMC-50 soft starter is a reduced voltage soft starter that uses a state-of-the-art microprocessor- based control module. By using six back-to-back silicon-controlled rectifiers (SCRs) (two per phase), the SMC-50 soft starter provides controlled acceleration, operation/run, and deceleration of standard three-phase squirrel-cage induction or Wye-Delta (6-lead) motors. Power structures are available with an integral bypass contactor or without (solid-state).

The user manual assumes that the installer is a qualified person with previous experience and basic understanding of electrical terminology, configuration procedures, required equipment, and safety precautions.

For safety of maintenance personnel and others who might be exposed to electrical hazards associated with maintenance activities, follow all local safety-related work practices (such as 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.

Terminology

Throughout this publication, we also refer to the SMC-50 soft starter as the SMC-50 controller. These terms are interchangeable.

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.

General Precautions

WARNING:

- Only personnel familiar with the controller and associated machinery should plan or implement the installation, startup, and subsequent maintenance of the system. Failure to do so can result in personal injury and/or equipment damage.
- Hazardous voltage is present in the motor circuit even when the SMC-50 controller is off. To avoid shock hazard, disconnect the main power before working on the controller, motor, and control devices such as Start-Stop push buttons. Procedures that require parts of the equipment to be energized during troubleshooting, testing, and so on, must be performed by properly qualified personnel, using appropriate local safety work practices and precautionary measures.
- Failure of solid-state power switching components can cause overheating due to a single-phase condition in the motor. To help prevent injury or equipment damage, the use of an isolation contactor or shunt trip-type circuit breaker on the line side of the SMC controller is recommended. This device should be capable of interrupting the motor's locked-rotor current.
- Hazardous voltages that can cause shock, burn, or death are present on L1, L2, L3, T1, T2, and T3. For Internal bypass units, hazardous voltages are also present on T4, T5, and T6. Power terminal covers for units rated 90...180 A (solid state) and 108...480 A (integrated bypass) can be installed to help prevent inadvertent contact with terminals. Disconnect the main power before servicing the motor controller, motor, or associated wiring.

ATTENTION:

- Static control precautions are required when you install, test, service, or repair the assembly. The controller contains electrostatic discharge (ESD) sensitive parts and assemblies. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, See applicable ESD protection handbooks.
- Stopping modes, such as braking, are not intended to be used as an emergency stop. You are responsible for determining which stopping mode is best suited to the application. See the applicable standards for emergency stop requirements.
- Pump and linear deceleration stopping modes may cause motor heating. Depending upon the mechanical dynamics of the system, select the lowest stopping time setting that satisfactorily stops the motor.
- Slow speed running is not intended for continuous operation. This is due to reduced motor cooling.
- Two peripheral devices can be connected to the direct programming interface (DPI™) port in the control module. The maximum output current through the DPI port is 560 mA.
- NOTE: A Human Interface Module (HIM) that is installed in the control module HIM port/bezel (Figure 1 on page 11) also draws power from the DPI port.
- Disconnect the controller from the power source when installing or inspecting protective or capacitor modules. These modules should be inspected periodically for damage or discoloration. Replace module if it is damaged or the clear sealant or components are discolored.
- Additional considerations may be required for EMC compliance. See page 35.

ATTENTION:

- The controller must be correctly applied and installed. If applied or installed incorrectly, damage to the components or the reduction in product life may occur. The system may malfunction if the following wiring or application errors occur: undersizing the motor, using an improperly sized controller, using an incorrect or inadequate AC supply, excessive ambient temperatures, or power quality.
- You must program the Motor Overload parameter to provide proper protection. Overload configuration must be properly coordinated with the motor.
- This product has been designed and tested as Class A equipment for electromagnetic compatibility (EMC). Use of this product in domestic environments may cause radio interference, in which case, the installer may need to employ additional mitigation methods.
- Disconnect the controller from the motor before you measure insulation resistance (IR) of the motor windings. Voltages used for insulation resistance testing can cause silicon-controlled rectifier (SCR) failure. Do not make any measurements on the controller with an insulation resistance (IR) or Megger™ tester.
- To protect the Smart Motor Controller (SMC) and/or motor from line voltage surges, protective modules may be placed on the line, load, or both sides of the SMC controller. Do not place protective modules on the load side of the SMC controller when using an inside-the-delta motor connection or with pump, linear deceleration, or braking control.
- The controller can be installed on a system with power factor correction capacitors (PFCC). The PFCCs must only be on the line side of the SMC controller. Installing PFCCs on the load side results in SCR damage and failure.
- The ground fault sensing feature of the SMC-50 controller is intended for monitoring only and not as a ground fault circuit interrupter for personnel protection as defined in NEC Article 100. The ground fault sensing feature has not been evaluated to UL 1053.
- After a short circuit occurs, you must verify device functionality.

This product contains a sealed lithium battery that may need to be replaced during the life of the product.

At the end of its life, the battery that is contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps to protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

Perchlorate material – special handling may apply. See www.dtsc.ca.gov/hazardouswaste/perchlorate.

This perchlorate warning only applies to primary Lithium Manganese Dioxide ($LiMnO_2$) cells or batteries, and products containing these cells or batteries, sold or distributed in California, USA.

ATTENTION: There is a danger of explosion if the lithium battery or real-time clock module in this product is incorrectly replaced. Do not replace the battery or real-time clock module unless power has been removed and the area is known to be nonhazardous.

- Replace the battery only with an equivalent CR2032 coin-cell battery.
- Do not dispose of the lithium battery or real-time clock module in a fire or incinerator. Dispose of used batteries in accordance with local regulations.
- For safety information on the handling of lithium batteries, including handling and disposal of leaking batteries, see Guidelines for Handling Lithium Batteries, publication AG 5-4.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Clarified bit definitions for parameters in Appendix A	219
Updated Function Block programming example	268

Additional Resources

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

Resource	Description
SMC-50 Controller Quick Start Guide, publication 150-QS003	Provides basic setup information for the SMC-50 controller.
SMC-50 Controller Technical Data, publication 150-TD009	Provides comprehensive selection and technical information for SMC-50 controller and accessories.
Enclosed SMC Controllers Selection Guide, publication 150-SG012	Provides selection information about enclosed SMC controller products.
SMC-50 Control Module Replacement Instructions, publication 150-IN078	Provides instructions for replacing the SMC-50 control module.
PowerFlex® 20-HIM-A6 and 20-HIM-C6S HIM (Human Interface Module) user manual, publication 20HIM-UM001.	Provides comprehensive user information for 20-HIM human interface modules.
20-COMM-D DeviceNet™ Adapter user manual, publication 20COMM-UM002.	Provides comprehensive user information for 20-COMM-D DeviceNet adapter.
20-COMM-C Series B / 20-COMM-Q Series A ControlNet™ Adapter user manual, publication 20COMM-UM003.	Provides comprehensive user information for 20-COMM-C ControlNet and 20-COMM-Q ControlNet (Fiber) adapters.
20-COMM-P Profibus Adapter user manual, publication 20COMM-UM006.	Provides comprehensive user information for 20-COMM-P Profibus adapter.
20-COMM-S RS-485 DF1 Adapter user manual, publication 20COMM-UM005.	Provides comprehensive user information for 20-COMM-S RS-485 DF1 adapter.
20-COMM-I Interbus Adapter user manual, publication 20COMM-UM007.	Provides comprehensive user information for 20-COMM-I Interbus adapter.
PowerFlex 20-COMM-E EtherNet/IP Adapter user manual, publication 20COMM-UM010.	Provides comprehensive user information for 20-COMM-E EtherNet/IP adapter.
20-COMM-ER Dual-Port EtherNet/IP™ Communication Adapter user manual, publication 20COMM-UM015.	Provides comprehensive user information for 20-COMM-ER Dual-Port EtherNet/IP Communication adapter
20-COMM-H RS485 HVAC Adapter user manual, publication 20COMM-UM009.	Provides comprehensive user information for 20-COMM-H RS485 HVAC adapter.
20-COMM-K CANopen Adapter user manual, publication 20COMM-UM012.	Provides comprehensive user information for 20-COMM-K CANopen adapter.
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.
Guidelines for Handling Lithium Batteries, publication 1757-5.13	Provides general information about the safe use and handling of Lithium batteries.
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.

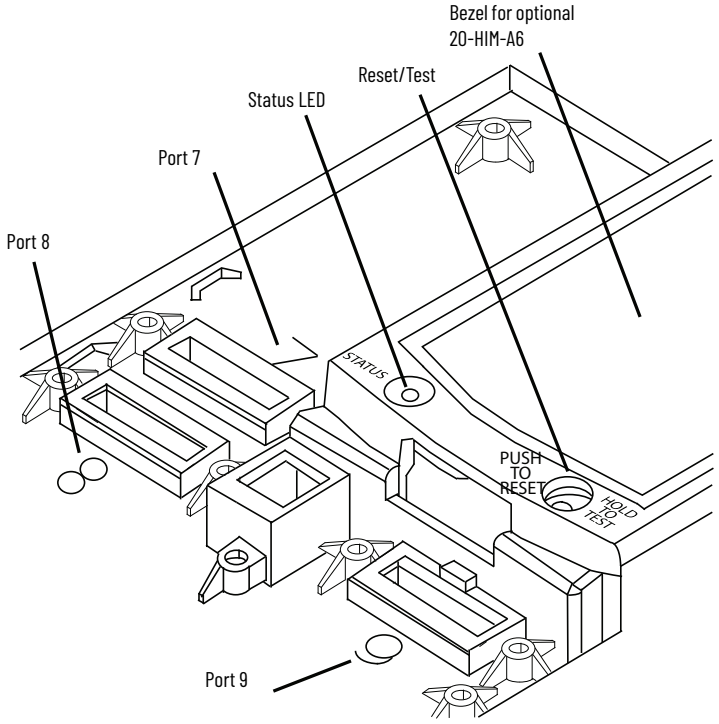
You can view or download publications at rok.auto/literature.

Product Overview

Introduction

The SMC-50™ Smart Motor Controller is a micro-processor based soft starter that is designed to maximize the efficiency of motor starts and stops. The SMC-50 controller uses six silicon-controlled rectifiers (SCRs) (two per phase) to vary the conduction period and control the voltage (torque) to the motor during starting, running, and stopping. The starter has many advanced power monitoring and motor/starter protection features to help increase overall reliability. Product scalability is enabled by its three connection ports (Port 7, 8, and 9) to house additional I/O, network communication, or parameter configuration modules (a maximum of three modules). Scalability continues into the configuration of the controller via different options: a multilingual 20-HIM-A6 controller or a panel-mount keypad with LCD display featuring more advanced configuration features, and software that is PC based and network capable (such as Connected Components Workbench™ Software) with optimal configuration features. The front panel of the SMC-50 controller features a multicolored light-emitting diode (LED) status indicator that provides both diagnostics and controller status information and a Push-to-Reset/Hold-to-Test push button that allows manual reset of an actual fault condition and initiates a tuning cycle or test for fault.

Figure 1 - SMC-50 Controller Indicators and Port Locations



Features

- Internal bypass or solid-state control available
- 108...480 A range for devices with internal bypass; 90...520 A range for solid-state devices
- Rated voltage: 200...690V AC
- Nine standard start modes
- Three expansion ports to install option modules
- Built-in electronic motor overload protection
- Current and voltage sensing on each phase
- Metering
- DPI™ Communication Protocol
- Parameter configuration options
- Energy saver mode
- Logging of the last 100 events with time stamp
- Network communication (option)
- External bypass as an option
- Conformally coated PCBs

Starting Modes

The SMC-50 Smart Motor Controller provides the following starting modes of operation as standard:

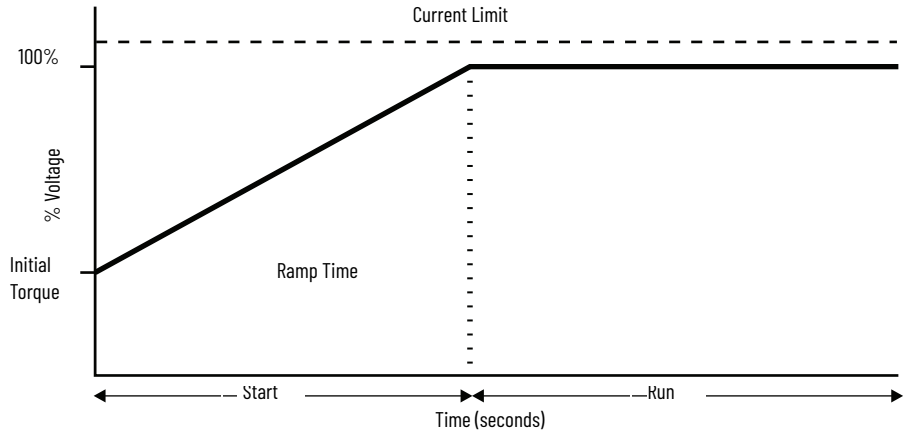
Starting Modes	
Soft Start	Pump Control Mode
Linear Speed Acceleration	Dual Ramp Start
Torque Control Start	Full-voltage Start
Current Limit Start	Preset Slow Speed
Selectable Kickstart	Integral Motor Winding Heater (starting feature)

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 2 - Soft Start Timing Diagram



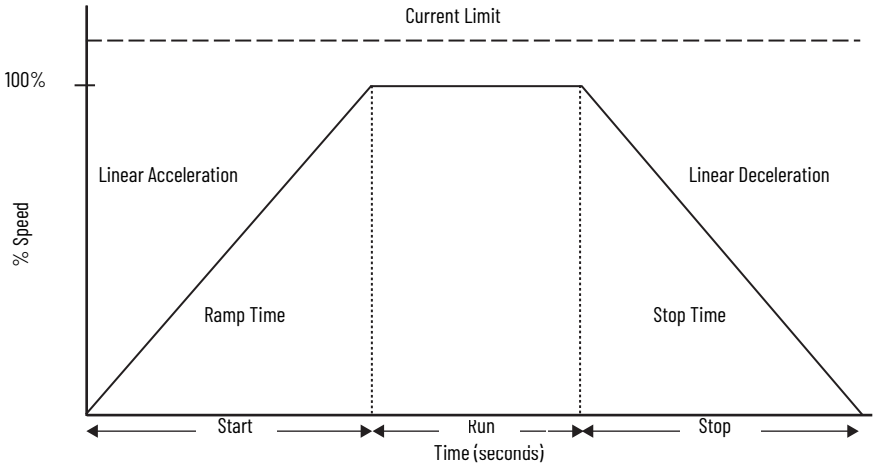
Linear Speed Acceleration

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.

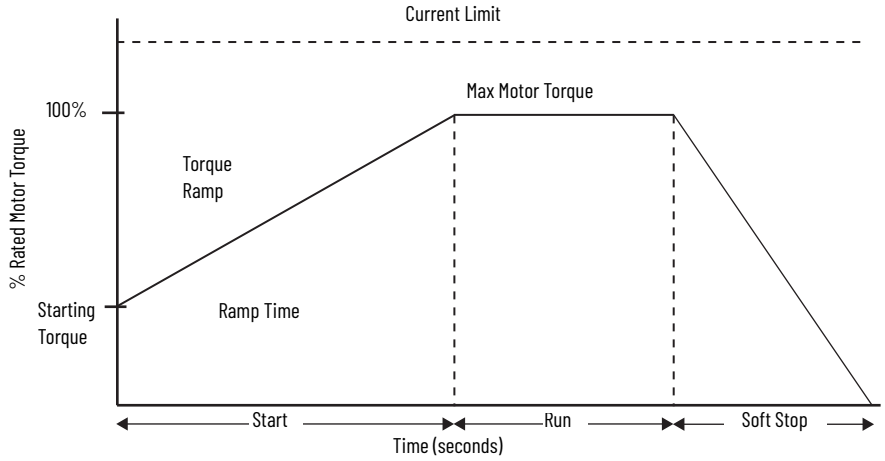
Figure 3 - Linear Speed Acceleration Timing Diagram



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.

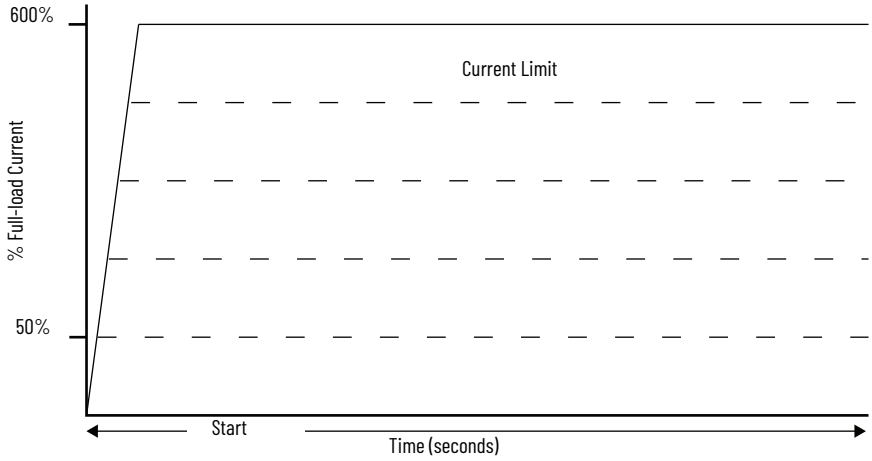
Figure 4 - Torque Control Start Timing Diagram



Current Limit Start

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 with Soft Start, Torque Control, and Linear Speed Acceleration Starts.

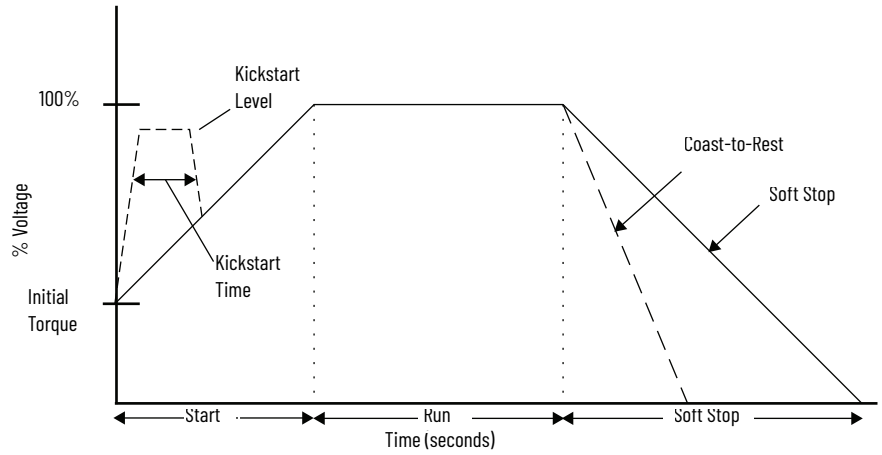
Figure 5 - Current Limit Start Timing Diagram



Selectable Kickstart

The kickstart feature provides a boost at startup to break away loads that may require a pulse of current/torque to get started. It is intended to provide a current/voltage pulse for a short time. Kickstart is available in Soft Start, Current Limit, Pump, and Torque Control modes.

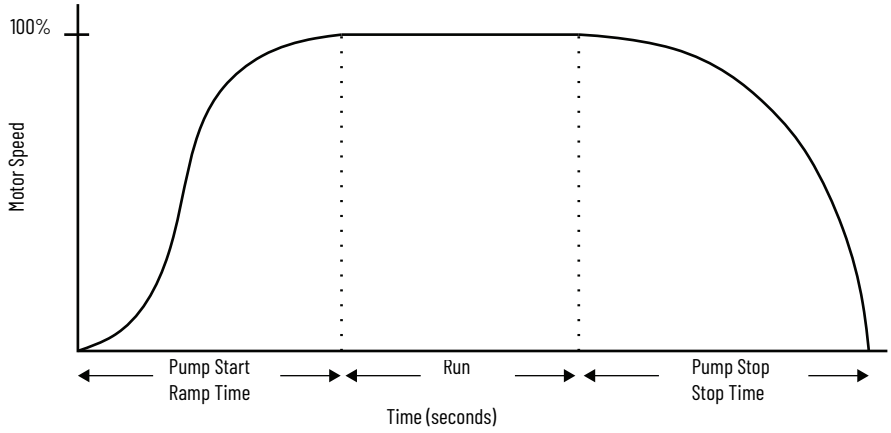
Figure 6 - Selectable Kickstart Timing Diagram



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 increases pump life by reducing pump cavitations. To provide these benefits, the SMC-50 controller's microprocessor generates a motor starting curve that follows the starting characteristics of a centrifugal pump and monitors operation during start to ensure reliable pump starts.

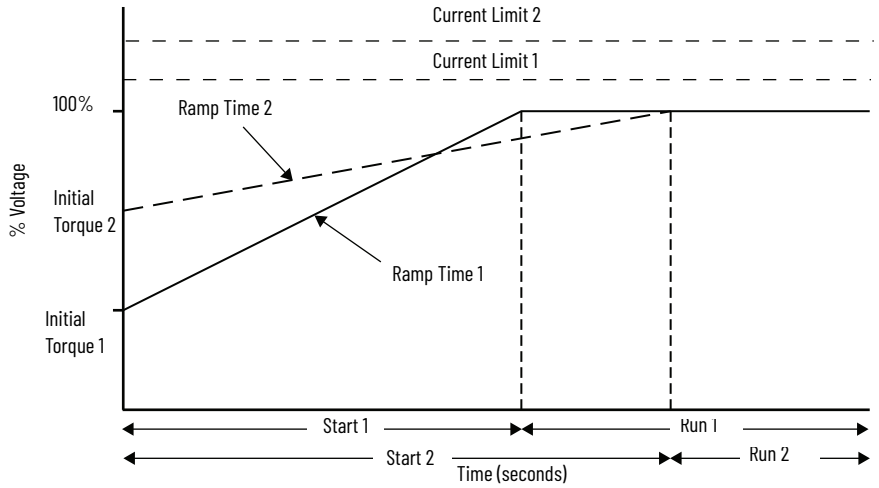
Figure 7 - Pump Control Mode Timing Diagram



Dual Ramp Start

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 8 - Dual Ramp Start Timing Diagram



Full-voltage Start

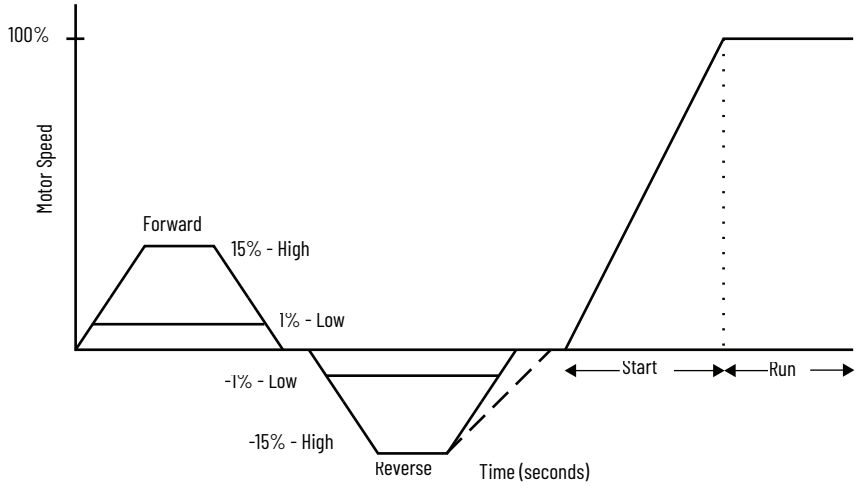
This method is used in applications that require across-the-line (direct-on-line) starting. The SMC-50 controller performs like a solid-state across-the-line contactor. Full inrush current and locked-rotor torque are realized. You can program the SMC-50 controller to provide a full-voltage start in which the output voltage to the motor reaches full voltage in five cycles.

Figure 9 - Full-voltage Start Timing Diagram

Preset Slow Speed

This feature/function can be used on applications that require slow speed moves for positioning material. The Preset Slow Speed can be set from 1% (low), up to 15% (high) in 1% increments of base speed. Forward or reverse movement is enabled through programming the sign (±) of the percent speed. No reversing contacts are required. To achieve accurate stops, braking is also a part of this function. Two independent preset slow speed parameters can be programmed for both speed and direction.

Figure 10 - Preset Slow Speed Timing Diagram



Integral Motor Winding Heater (Starting Feature)

This function eliminates the need for additional hardware to heat the motor from a cold start and enables using a small amount of motor current that is switched to each motor phase in sequence to heat the windings. Heating can be time based or activated by configurable input. The winding heat level is also configurable.

Stopping Modes

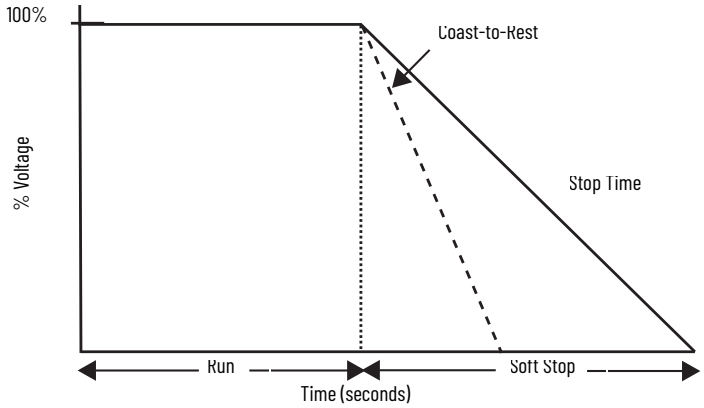
The SMC-50 Smart Motor Controller provides the following Stopping Modes of operation as standard:

Stopping Modes	
Coast	Linear Speed Deceleration
Soft Stop	Pump Stop

Coast

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

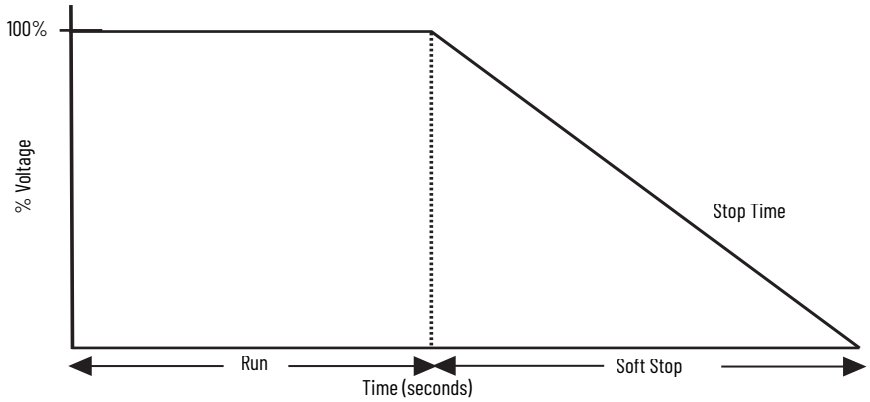
Figure 11 - Coast-to-stop Timing Diagram



Soft Stop

The Soft Stop mode can be used in applications that require 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.

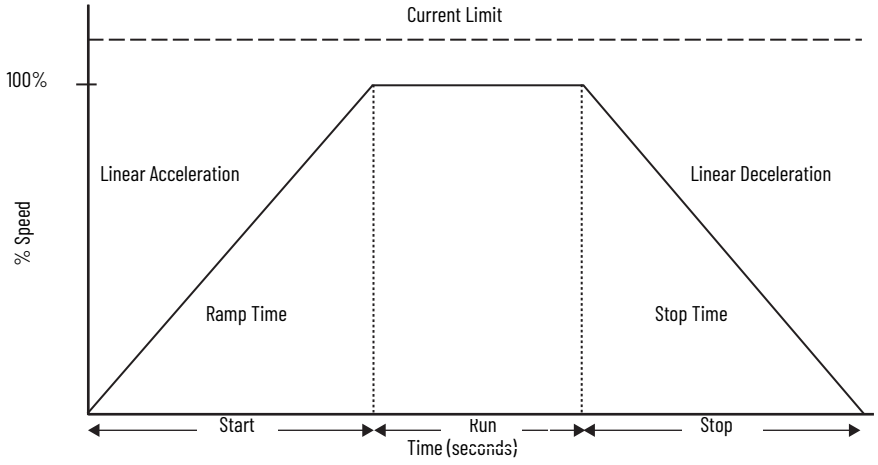
Figure 12 - Soft Stop Timing Diagram



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.

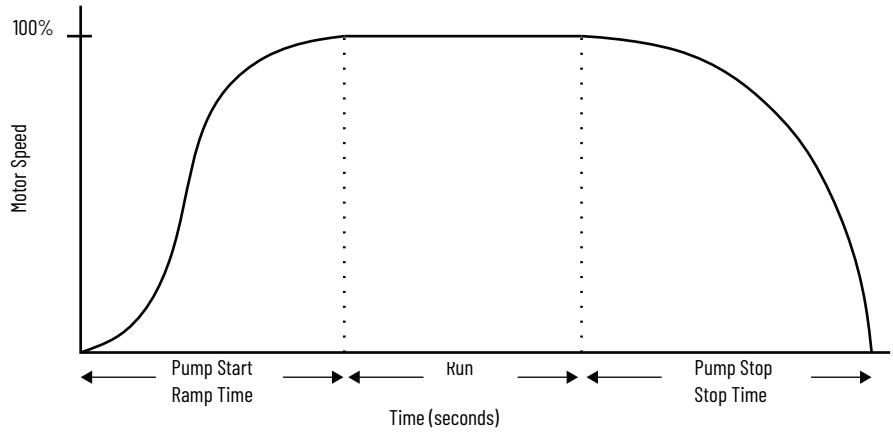
Figure 13 - Linear Speed Deceleration Timing Diagram



Pump Stop

In the same way that 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 controller'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 14 - Pump Stop Timing Diagram



Braking Control Modes[(a)]

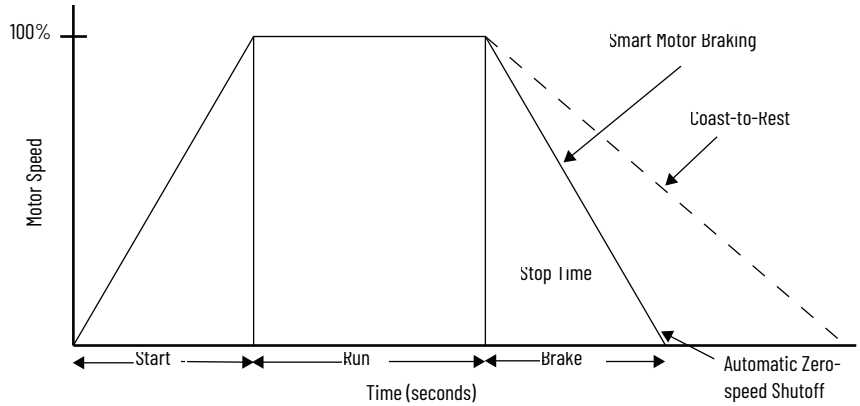
The SMC-50 Smart Motor Controller provides the following braking control modes of operation as standard:

Braking Control Modes	
SMB—Smart Motor Braking	Accu-Stop
Slow Speed with Braking	External Braking Control

SMB—Smart Motor Braking[(a)]

This mode provides motor braking for applications that require the motor to stop faster than a coast-to-rest. Braking control with automatic zero speed shutoff is fully integrated into the design of the SMC-50 controller. This design facilitates a clean, straight-forward installation and eliminates the requirement for additional hardware (for example, braking contactors, resistors, timers, and speed sensors). The microprocessor-based braking system applies braking current to a standard squirrel-cage induction motor. The strength of the braking current is programmable from 0...400% of full-load current.

Figure 15 - SMB Timing Diagram



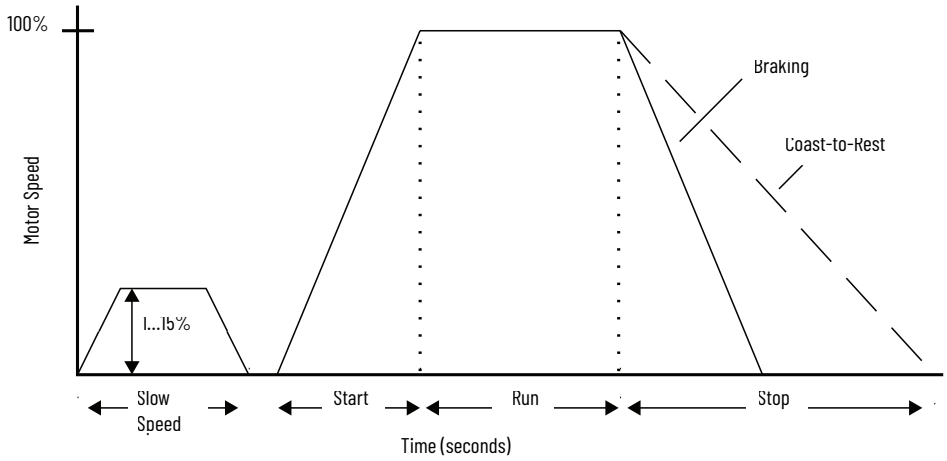
Slow Speed with Braking[(a)]

Slow Speed with Braking is used on applications that require slow speed (in the forward or reverse direction) for positioning or alignment and also require

(a) Not intended to be used as an emergency stop. See the applicable standards for emergency stop requirements.

braking control to stop. Slow Speed adjustments are ±1% ...±15% in 1% increments of base speed. Braking current is adjustable from 0...400%.

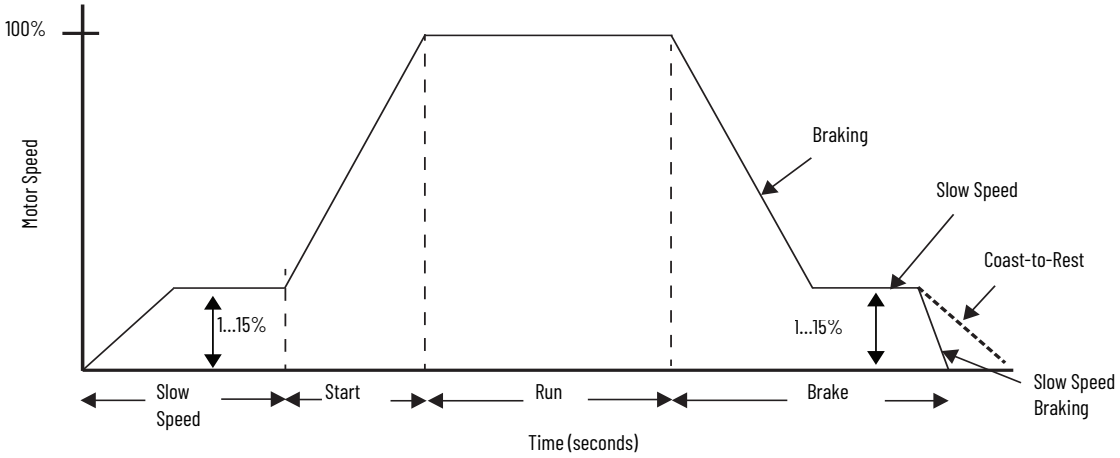
Figure 16 - Slow Speed with Braking Timing Diagram



Accu-Stop[a][b]

This control is used in applications requiring controlled position stopping. During stopping, braking torque is applied to the motor until it reaches the configured preset slow speed value (±1...±15%) and holds the motor at this speed until a stop command is given. Braking torque is then applied until the motor reaches zero speed. Braking current is programmable from 0...400% of full-load current.

Figure 17 - Accu-Stop Timing Diagram



External Braking Control[a]

An external braking device can be used to externally brake a motor controlled by the SMC-50 controller. The external braking device is activated using one of the SMC-50 controller's auxiliary relays configured for “Ext Brake” with the stop mode parameter set to “Ext Brake”. The relay is energized when the “Stop” command is given and stays on until the time configured in the “Stop Time” parameter counts down to zero.

(a) Not intended to be used as an emergency stop. See the applicable standards for emergency stop requirements.
(b) Accu-Stop is not included as a parameter/function like that of the SMC Flex soft starter. However, you can accomplish the Accu-Stop function with the Smart Motor Braking Stop Option and Slow Speed with Braking functions.

Internal Bypass Modes

The SMC-50 controllers with internal bypass use its power section SCRs to start and stop a squirrel-cage induction motor. The basic operation of the SCRs is to switch on (conduct) for a certain percentage of the 50/60 Hz AC sine wave to control the amount of voltage that is applied to the motor. By using special control algorithms and motor feedback to manage the voltage applied, the SMC-50 controller can perform various starting, stopping, and braking control modes as outlined in previous sections of this document. During normal run operation, the SMC-50 controller with internal bypass closes the internal bypass contactor(s) when the motor is up to speed. This reduces heat because the motor current is now flowing through the internal bypass contactor and not through the SCRs.

Solid-state Running Modes

The SMC-50 controllers with solid-state power structures provide the following running modes of operation as standard:

Running Modes	
SCR Control—Normal Run Operation	External Bypass—Optional Run Operation
SCR Control—Energy Saver Run Operation	Emergency Run

These modes are only available on solid-state power structures. They are not available on units with internal bypass.

SCR Control - Normal Run Operation

The SMC-50 controller uses its power section SCRs to start, run, and stop (except for coast-to-stop) a squirrel-cage induction motor. The basic operation of the SCRs is to switch on (conduct) for a certain percentage of the 50/60 Hz AC sine wave, as directed by the SMC- 50, to control the amount of voltage that is supplied, the SMC-50 controller provides the previously outlined motor starting, stopping, and braking control modes. During the normal run operation, the SMC-50 controller power section SCRs are conducting for 100% of the 50/60 Hz AC sine wave to provide the motor-specified full-load current (FLA/FLC), voltage, and the resulting torque.

SCR Control – Energy Saver Run Operation

The Energy Saver Run Operation function is typically used in applications where the running motor is lightly loaded or unloaded for an extended time. With the Energy Saver Run Operation function enabled, the SMC-50 controller continuously monitors motor load by using internal feedback to control its SCRs, which reduce the voltage that is applied to the motor. This can reduce power consumption. A parameter is provided to display the possible energy that is saved as a percent.

External Bypass – Optional Run Operation

You can use an external bypass contactor to carry the motor running current. In this running mode, the SCRs are only used for starting and potentially stopping depending on the stop mode selected. The SMC-50 controller uses one of its auxiliary relay outputs to control the external bypass. When you use the SMC-50 controller in external bypass mode with the contacts of the external bypass contactor closed, you have the option of using the SMC-50 controller's internal or external current-sensing capabilities. If you are using external current sensing so that conditions such as metering or alarm/fault are reported to the controller during run operation, an external Bulletin 825-MCM Converter Module is required to interface with the 150-SM2 Option Module. This configuration enables the SMC-50 controller's current-related motor protection features (for example, external overload not required).

If this configuration is not used, a means of external motor protection is required when using an external bypass contactor.

If the bypass kit is used (Frames C and D only), the SMC-50 controller is used for current sensing, metering, alarm/fault conditions, etc., neither a Bulletin 825-MCM converter module nor a Cat. No. 150-SM2 are required.

Emergency Run

When one of the SMC-50 controller's inputs is configured for Emergency Run and that input is activated, all system faults are disabled. This prevents a fault from shutting down the system.

Resistor Loads

The SMC-50 solid-state controller can control directly connected resistive loads by using phase angle control based on a reference value. If this control method is selected, the SMC-50 controller varies the output voltage in response to the changing reference source. This reference source is programmable and extremely flexible. This mode is typically used for resistive heating applications.

Motor and Starter Protection Features

The SMC-50 controller 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 down that equipment and/or removing power. The SMC-50 controller 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 spurious trips and shutdowns.

The SMC-50 controller has a separate fault buffer and alarm buffer to maintain a fault/alarm history. The SMC-50 controller's Real Time real-time clock (RTC) provides a time and date stamp for faults and alarms. The fault buffer holds the last five faults that provide the time and date. The alarm buffer holds the last 100 alarm events that detail the time, date, parameter change, Start, Stop, Coast, Slow Speed Operation, Alarm, Fault, and Fault Reset.

As standard, the SMC-50 controller enables manual reset of a fault from the PUSH-TO-RESET/HOLD-TO-TEST button, which is near the LED status indicator. Fault indication and reset can also be performed from an optional controller bezel and/or panel-mount HIM or from PC software (such as Connected Components Workbench software).

Starter Protection Features

Undervoltage Protection

The SMC-50 controller's Undervoltage Protection can sound an alarm or halt (fault) motor operation if a drop in the incoming line voltage is detected. The undervoltage trip level is adjustable as a percentage of the programmed line voltage from 0…100%. To help eliminate spurious trips, you can program an undervoltage trip delay time of 0.1…99.0 seconds. The line voltage must remain below the undervoltage trip level during the programmed delay time.

Overvoltage Protection

If a rise in the incoming line voltage is detected, the SMC-50 controller's Overvoltage Protection can sound an alarm or halt (fault) motor operation. The overvoltage trip level is adjustable as a percentage of the programmed line voltage, from 100…199%. To help eliminate spurious trips, you can program an overvoltage trip delay time of 0.1…99.0 seconds. The line voltage must remain above the overvoltage trip level during the programmed delay time.

Voltage Unbalance Protection

Voltage unbalance is detected by monitoring the three-phase supply voltage magnitudes along with the rotational relationship of the three phases. The SMC-50 controller halts motor operation when the calculated voltage unbalance reaches the user-programmed trip level. The voltage unbalance trip level is programmable from 0…25% unbalance.

The following additional faults and alarms are also available:

- Phase Reversal (CBA Connection)
- Parameter Configuration Change
- Frequency High and Low
- Open SCR Gate
- Line Loss with Phase Identification
- Poor Voltage Power Quality—THD V

Metering System

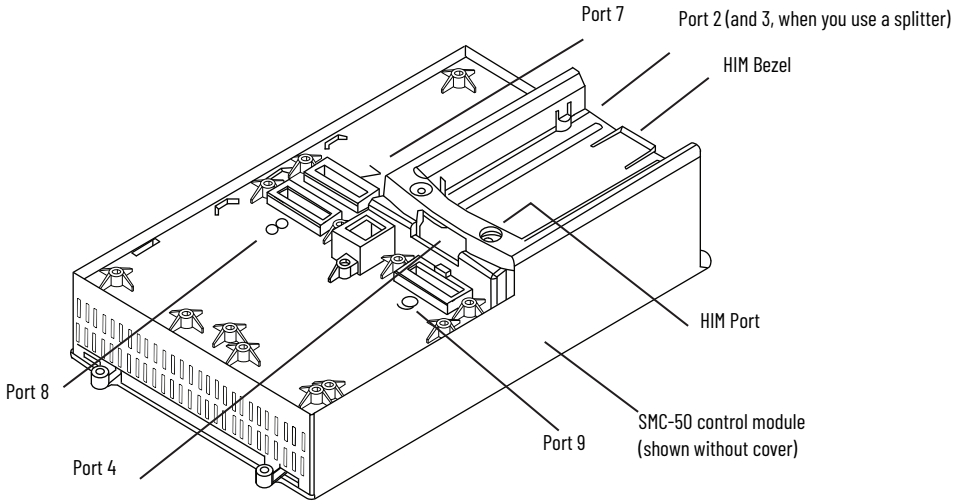
Power and operational monitoring parameters include:

- 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 controller 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 three phases. The current power demand and the maximum power demand are also 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 controller stores the peak average RMS motor current that was consumed for the last five start cycles.

- Total Harmonic Distortion (THD)—The SMC-50 controller calculates and provides user access to the THD for the three line voltages and three 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.
- Energy Savings—The SMC-50 controller provides the percentage of energy that is saved when it is running the motor in the Energy Savings mode.
- Motor Torque—Electromechanical motor torque is calculated based on current and voltage feedback from the motor.
- Motor Speed—The SMC-50 controller 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 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 to accumulate time again.
- Actual Start Time—The unit stores the actual time that is required 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.

Communications

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



Drive Peripheral Interface (DPI™) Protocol

The SMC-50 Soft Starter communicates in the same manner as the Allen-Bradley® SMC Flex™ and drive products that use 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 controller. The SMC-50 controller supports four DPI ports for communication devices. Port #1 is in the controller bezel for the front-mounted HIM. Port #2, on the top of the controller, supports a second and third device via Port #3 when a DPI splitter is used. Port #4, located directly below the controller bezel, is dedicated to a 20-COMM-xx network communications module when inserted into the space allotted for controller 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 controller with DeviceLogix technology can help improve system performance and productivity by controlling outputs and managing status and information within the SMC-50 controller. 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 controller is lost.

Motor Protection Features

Electronic Motor Overload Protection

As standard, the SMC-50 controller incorporates electronic motor overload protection electronically with an I^2t algorithm. Overload Protection is intended to protect the motor, motor controller, and power wiring against overheating caused by excessive overcurrent. The SMC-50 controller meets applicable requirements as a motor overload protective device. It is not intended to protect against a short-circuit condition.

The SMC-50 controller's overload protection is programmable, providing you maximum flexibility. The Overload Trip class is either OFF or is configurable from 5...30. The overload is programmed by entering the motor full-load current rating, service factor, and selecting the trip class. Thermal memory accurately models motor operating temperature. Ambient temperature insensitivity is inherent in the electronic design of the overload. You can also set a timer to disable the overload function during motor starts; another timer lets you monitor the amount of time that remains before the overload trip occurs. Manual or automatic reset of an overload is configurable.

Stall Protection and Jam Detection

Motors can experience locked-rotor currents and develop high torque levels if there is a stall or a jam. These conditions can result in winding insulation breakdown or mechanical damage to the connected load. The SMC-50 controller provides both stall protection and jam detection for enhanced motor and system protection. A jam level (as a percent of motor FLC) is configurable for both an alarm and motor shutdown (fault). In addition, both stall and jam conditions let you set a delay time before initiating an alarm (jam only) or motor shutdown (fault).

Underload Protection

Using the Underload Protection of the SMC-50 controller, an alarm can be sounded or motor operation can be halted (fault) if a drop in current is sensed.

The SMC-50 controller provides an adjustable underload trip setting from 0...99% of the programmed motor full-load current rating with an adjustable trip delay time of 0.1...99.0 seconds.

Excessive Starts Per Hour

The SMC-50 controller lets you program the allowed number of starts within a one-hour sliding window (up to 99). This helps eliminate motor stress that is caused by repetitive starting during a short time. An alarm or fault can be enabled using the single configured value.

User-configurable Alarms and Faults

The following motor alarms and faults can also be configured:

- Apparent Power
- Current Imbalance
- Power Quality[(a)]
- Open Load[(a)]
- Power Quality Total Harmonic Distortion (THD) Current
- Over Power
  - Real
  - Reactive Consumed
  - Reactive Produced
- Under Power
  - Real
  - Reactive Consumed
  - Reactive Produced
- Power Factor Over
  - Leading
  - Lagging
- Power Factor Under
  - Leading
  - Lagging

The SMC-50 controller also has user-configurable motor alarms and faults that you can use to indicate required or planned maintenance.

- Planned Maintenance Hours
- Planned Maintenance Starts

Controller Parameter Configuration

The SMC-50 controller's starting, stopping, and running operations are configured/programmed by changing the settings of a functionally predefined set of parameters. Several different configuration tools are available to perform this.

A configuration tool is not shipped with the SMC-50 controller. You must order the configuration tool separately.

(a) Contains no parameters to configure.

Configuration by Keypad and LCD Display (Human Interface Module Cat. No. 20-HIM-A6)

The upper right portion of the SMC-50 controller has a dedicated bezel and DPI port for the Cat. No. 20-HIM-A6. The 20-HIM-A6 features:

- LCD display to show parameter data values
- detailed diagnostic alarm/fault information
- numeric keypad with function keys to enter parameter data values and navigate to the different SMC-50 controller parameter menus
- null parameter configuration and diagnostic display
- the ability to set up SMC-50 Controller Option Modules.

SMC-50 Smart Motor Controller with 20-HIM-A6

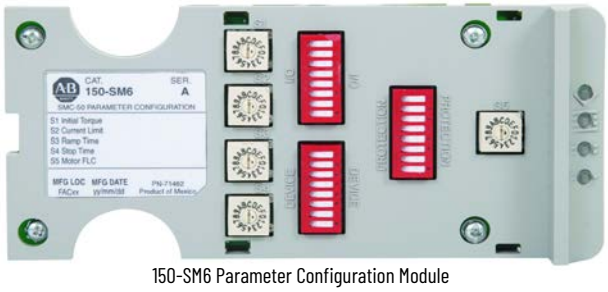
Optional extension cables and control cabinet door mounting kits are available to mount the HIM off the SMC-50 controller.

Configuration by PC Programmable Software

Connected Components Workbench PC software provides connectivity between the PC and the SMC-50 controller and the ability to configure the full set of parameters of the SMC-50 controller. To achieve connectivity, you can directly connect a PC to the SMC- 50 DPI Port #2 (or #3 using a splitter) with (1) a 1203-SSS AnaCANda™ RS-232 to DPI device or (2) a 1203-USB DPI to USB device. Connectivity can also be achieved over Ethernet by using a 20-COMM-E or 20-COMM-ER EtherNet/IP option module installed inside the SMC-50.

Other 20-COMM option modules, such as the 20-COMM-D DeviceNet Module, cannot be used by Connected Components Workbench to configure the SMC-50.

Parameter Configuration Option Module (Cat. No.150-SM6)



150-SM6 Parameter Configuration Module

The Parameter Configuration Option Module inserts into any one of the SMC-50 controller's three option ports (Port 7, 8 or 9). The 150-SM6 features three sets of 8-position ON/OFF DIP switches and five sets of 16-position rotary switches. These switches allow for configuration of several key motor parameters (for example, start and stop modes, ramp time, motor FLA) for limited setup of simple applications. In addition, the 150-SM6 features three diagnostic LED status indicators to display key alarms and faults. Only one 150- SM6 is allowed per SMC-50 controller.

After parameter configuration is complete, the 150-SM6 can be removed from the SMC-50 controller. This enables one module to configure multiple SMC-50 controllers.

When you are using a Cat. No. 150-SM6 PCM to configure the SMC-50 controller, note that the following features, functions, and modes are not configurable:

- Full-voltage start
- Torque ramp start
- External brake stop
- Option card I/O configuration (Cat. No. 150-SM... option modules)
- External bypass
- Specialized output relay configuration (for example, network control, DeviceLogix, auxiliary control)
- Specialized operation modes/features
  - Dual ramp, motor winding heater, emergency run
  - Overload select (Class)
  - Adjustment of slow speed setpoint

Parameters that are not defined and therefore are not configurable by the Cat. No. 150-SM6 PCM can be configured via other means (Human Interface Module (HIM), Connected Components Workbench Software, DriveExplorer™ or DriveExecutive™ software), if necessary.

Control Inputs and Outputs

Standard Inputs[(a)]

The SMC-50 controller comes standard with two 24V DC inputs. The control functionality of each input is user-configurable as follows: Start, Coast, Stop Option (for example, Soft Stop, Pump Stop), Start/Coast, Start/Stop, Slow Speed, Overload Select, Fault Input (N.O.), Fault Input (N.C.), Clear Fault, Emergency Run, Dual Ramp Profile Select, and Start Motor Heater function. The status of any input is readable via communications.

Optional Inputs[(a)]

SMC-50 Smart Motor Controller with 150-SM4

A Cat. No. 150-SM4 Digital I/O option module contains four 120/240V AC inputs and can be inserted into any of the three control module option ports (three modules maximum per control module). The control functionality of each input is user configurable and identical to the standard inputs. The status of any input is readable via communications.

A Cat. No. 150-SM3 Analog I/O option module provides two analog inputs (voltage or current) and can be inserted into any of the three control module option ports (three modules maximum per control module). The control functionality of each input is user configurable. The status of any input is readable via communications.

(a) All standard and optional I/O terminal blocks are removable.

Standard and Optional Outputs[a]

The SMC-50 controller comes standard with two relay outputs. By adding a Cat. No. 150-SM4 Digital I/O Option Module, three additional relay outputs are provided (three option modules maximum per control module). The control functionality of each relay output is user-configurable as follows: Normal (Start Enabled), Up-To-Speed, Fault, Alarm, External Bypass, External brake, Auxiliary Control, Network 1...4, and Fan Control. Each output also includes a user-configurable on and off delay timer (10.0 seconds maximum) and the ability to invert the state of the contact. Network control of each output is also provided. By adding a Cat. No. 150-SM3 Analog I/O module, two analog outputs (voltage of current) are provided.

Optional PTC, Ground Fault[a], and Current Transformer Interface Capability[a]

150-SM2 Option Module

The Cat. No. 150-SM2 Option Module features PTC, ground fault, and external current transformer interface capability. The PTC feature enables connection to external PTC temperature sensors to monitor motor winding temperature and feedback data to the SMC-50. An SMC-50 controller alarm and/or fault can be configured to trip if the PTC setpoint is exceeded. The ground fault feature enables controller detection and enunciation of a possible system ground fault, which could indicate a pending motor winding failure (for example, insulation breakdown). A Bulletin 825-CBCT External Ground Fault (Core Balance) Sensor is also required to interface with the 150- SM2 to fully enable this feature.

When the SMC-50 controller is used in the external bypass mode with the contacts of the external bypass contactor closed, you have the option of using the SMC-50 controller's internal or external current sensing capabilities. If using external current sensing so that conditions such as metering or alarm/fault are reported to the controller during run operation, an external Bulletin 825-MCM Converter Module is required to interface with the 150-SM2 Option Module.

(a) The ground fault sensing feature of the SMC-50 controller is intended for monitoring only. It is not to be used as a ground fault circuit interrupter for personnel protection as defined by Article 100 of the NEC. The sensing feature has not been evaluated to UL 1053.

Notes:

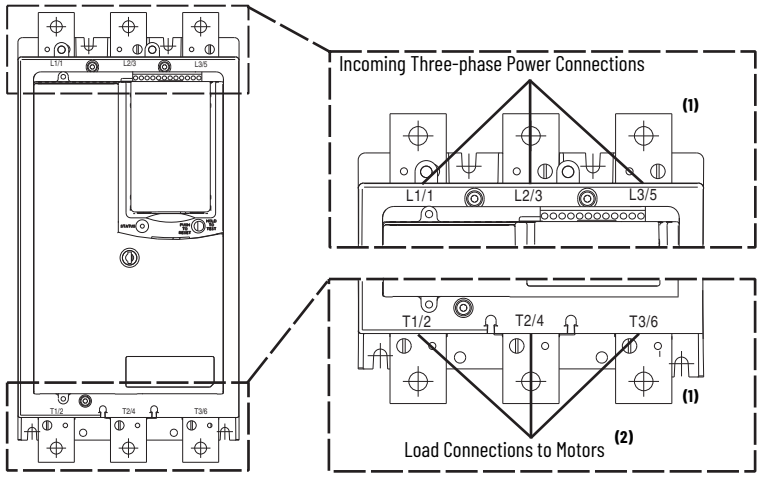
Wiring

This chapter illustrates basic wiring configurations for the SMC-50 controller.

Wiring Terminal Locations

The SMC-50 controller wiring terminal locations are shown in Figure 19. Incoming three-phase power connections are made to terminals L1/1, L2/3, and L3/5. Load connections to motors are made to T1/2, T2/4, and T3/6.

Figure 19 - Wiring Terminal Locations



Note	Information
1	See publication 150-TD009 for lug information
2	Inside-the-delta connected motors require an additional delta distribution block

For controllers rated 210…520 A, a grounding nut (size 1/4-20) is provided for grounding per applicable local codes.

Power Wiring

See the product nameplate for device-specific information.

SMC-50 controller power structures use solid-state SCR designs that can interface with 200…480V AC or 200…690V AC (690V line and 600V inside-the-delta) motors. Both the internally bypassed and solid-state power structures are available. Verify ratings of unit before application.

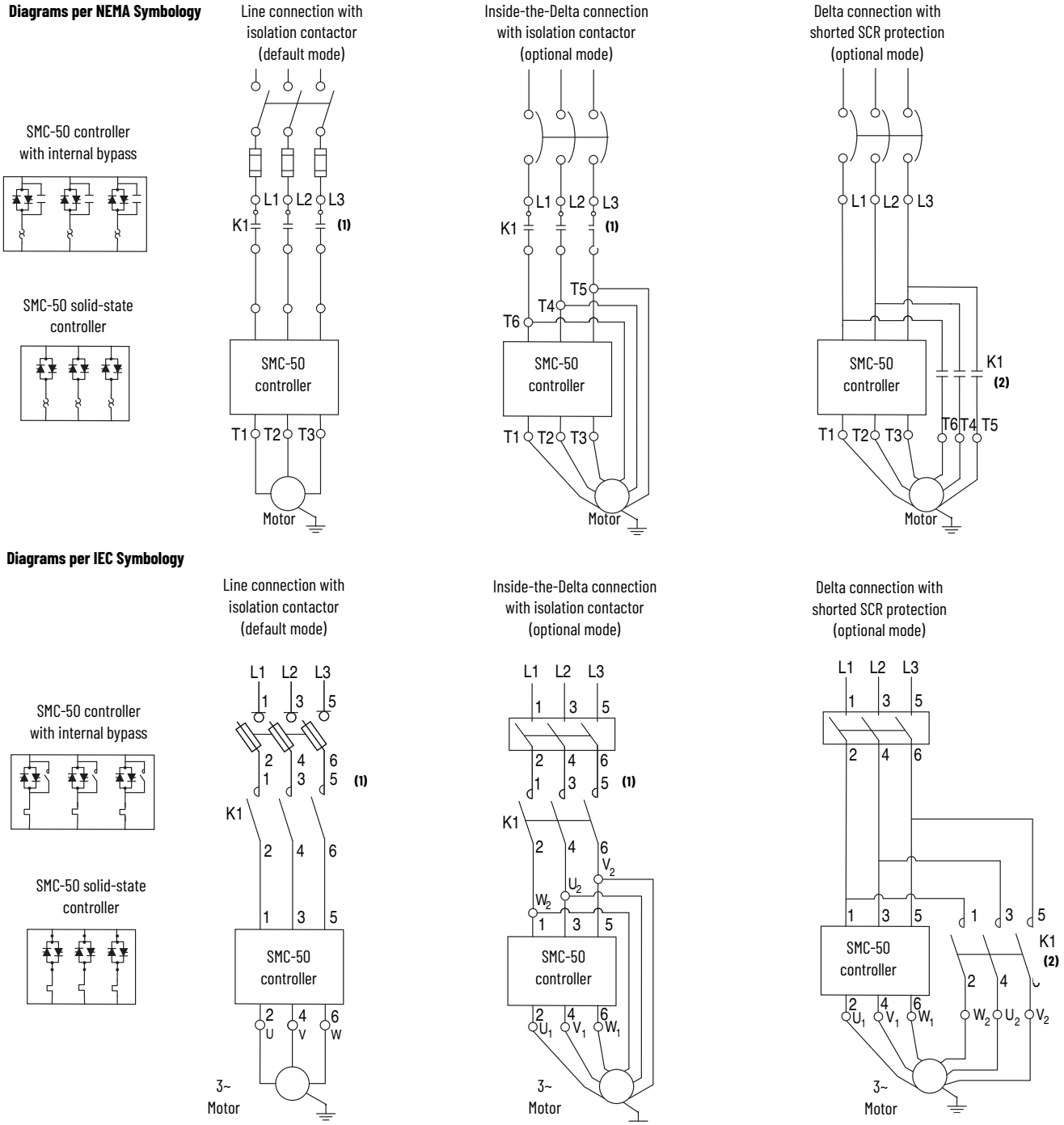
The power structure incorporates three-phase true current-sensing and overtemperature protection. You can use an external bypass contactor if it is required for your application.

ATTENTION:

- Failure of solid-state power switching components can cause overheating due to a single-phase condition in the motor. To help prevent injury or equipment damage, the following is recommended:
- Use an isolation contactor or shunt trip type circuit breaker on the line side of the SMC-50 controller. This device should be capable of interrupting the motor's locked rotor current.
- To achieve coordinated operation with the SMC-50 controller, wire the isolation contactor's control relay to an auxiliary relay output contact on the SMC-50 controller. Program the auxiliary relay contact for the "normal" condition. See Chapter 6 for additional information.

Figure 20 shows typical power wiring diagrams for both line and inside-the-delta connections.

Figure 20 - Power Wiring Diagrams



Note	Information
1	Contactor must be fully rated for motor Hp/kW and FLA
2	For North American applications, size the contactor per the motor Hp and FLA. For IEC applications, size the contactor per the motor AC-1 or AC-3 rating. The short-circuit rating of the contactor must not be less than that of the SMC-50 controller

Power lugs are required for devices rated 108...480 A (internal bypass) and 90...520 A (solid-state). These lugs are sold in kits. Each kit contains three lugs. Table 1 through Table 4 list the number and type of lugs required.

Table 1 - SMC-50 Integrated Bypass Devices Connection Lug Information for Line/Wye Connected Motors

Cat. No.	Rating [A]	Lug Kit Cat. No.	Wire Strip Length [mm]	Conductor Range	Max No. Lugs/Pole		Tightening Torque	
					Line Side	Load Side	Wire - Lug	Lug - Busbar
150-S108..., 150-S135...	108...135	199-LF1	18...20	16...120 mm^2 (#6...250 MCM)	1	1	31 N•m (275 lb•in)	17 N•m (150 lb•in)
150-S201..., 150-S251...	201...251	199-LF1	18...20	16...120 mm^2 (#6...250 MCM)	2	2	31 N•m (275 lb•in)	23 N•m (200 lb•in)
150-S317..., 150-S361..., 150-S480...	317...480	199-LG1	18...25	25...240 mm^2 (#4...500 MCM)	2	2	42 N•m (375 lb•in)	28 N•m (250 lb•in)

Table 2 - SMC-50 Integrated Bypass Devices Connection Lug Information for Inside-the-Delta Connected Motors

Cat. No.	Rating [A]	Lug Kit Cat. No.	Conductor Range	Max No. Lugs/Pole		Tightening Torque	
				Line Side	Load Side	Wire - Lug	Lug - Busbar
150-S108..., 150-S135...	187...234	1494R-N15 (Line side)	25...240 mm^2 (#4...500 MCM)	1	2 (use 199-LF1)	42 N•m (375 lb•in)	17 N•m (150 lb•in)
150-S201..., 150-S251...	348...435	1494R-N14 (Line side)	50...120 mm^2 (1/0...250 MCM)	2	4 (use 199-LF1)	31 N•m (275 lb•in)	23 N•m (200 lb•in)
150-S317..., 150-S361..., 150-S480...	549...831	150-LG5MC (Line side)	95...240 mm^2 (3/0...500 MCM)	1	4 (use 199-LG1)	34 N•m (300 lb•in)	28 N•m (250 lb•in

Table 3 - Solid-state SMC-50 Controller Power Wiring Information, Line/Wye and Inside-the-Delta Configurations

Cat. No.	Rating [A]	Lug Kit Cat. No.	Wire Strip Length [mm]	Conductor Range	Max No. Lugs/Pole		Tightening Torque	
					Line Side	Load Side	Wire - Lug	Lug - Busbar
150-SB...	90...180 (Line/Wye) 155...311 (Delta)	199-LF1	18...20	16...120 mm^2 (#6...250 MCM)	1	1	31 N•m (275 lb•in)	23 N•m (200 lb•in)
150-SC...	210...320 (Line/Wye) 363...554 (Delta)	199-LF1	18...20	16...120 mm^2 (#6...250 MCM)	2	2	31 N•m (275 lb•in)	23 N•m (200 lb•in)
150-SD...	361...520 (Line/Wye) 625...900 (Delta)	199-LG1	18...25	25...240 mm^2 (#4...500 MCM)	2	2	42 N•m (375 lb•in)	28 N•m (250 lb•in)

Table 4 - Solid-state SMC-50 Controller Delta Distribution Block Wiring Information

Cat. No.	Tightening Torque		Quantity	Conductor Range		Wire Strip Length [mm]		Lug Kit Cat. No.
	Line	Load		Line	Load	Line	Load	
150-SB...	42 N•m (375 lb•in.)		3	25...240 mm^2 (#4...500 MCM)		35	35	Allen-Bradley 1492-BG
150-SC...	67.8 N•m (600 lb•in)	31 N•m (275 lb•in)	1	54...400 mm^2 (1/0...750 MCM)	16...120 mm^2 (#6...250 MCM)	45	Top Row = 23 Bottom Row = 48	Marathon Special Products 1353703
150-SD...	67.8 N•m (600 lb•in	67.8 N•m (600 lb•in)	3	54...400 mm^2 (1/0...750 MCM)	54...400 mm^2 (1/0...750 MCM)	45	45	Marathon Special Products 1352702

Grounding Provision

Provision for connecting a field-installed grounding conductor is provided on solid-state units that are rated 210...520 A. The green grounding nut (size 1/4-20) that is near the bottom mounting plate of the controller identifies the grounding location.

Protective Modules

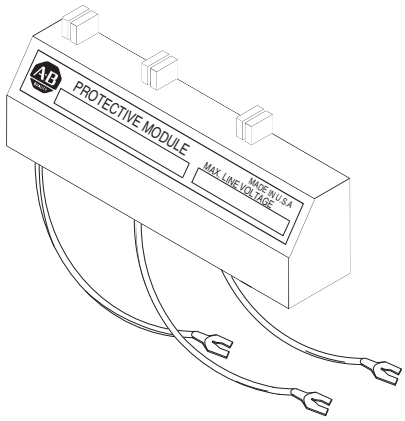
Install a protective module (see Figure 21) that contains MOVs (Metal Oxide Varistors) to protect the SMC-50 power components from electrical transients and/or electrical noise.

You can install protective modules controllers that are rated from 200...600V to protect the power components from electrical transients. The protective modules clip voltage transients that are generated on the lines to prevent such

surges from damaging the SCRs. The use of MOVs is highly recommended, because 480V and 600V MOVs offer maximum protection of 1400V and 1600V respectively.

Protective modules are not available for 690V applications.

Figure 21 - Protective Module



ATTENTION: You can place protective modules on the line, load, or both sides of the SMC-50 controller. However, protective modules must not be placed on the load side of the SMC-50 controller when using inside-the-delta motor connections or with pump, linear speed, or braking control.

There are two general situations that may occur that could indicate the need for using the protective modules.

1. Transient Spikes—Transient spikes typically occur on the lines that feed either the SMC-50 controller or the load from the SMC-50 controller. Transient spikes are created on the line when devices are attached with current- carrying inductances that are open-circuited. The energy stored in the magnetic field is released when the contacts open the circuit. Examples of these include lightly loaded motors, transformers, solenoids, full voltage starters, and electromechanical brakes.
2. Fast-rising Wavefronts—If the SMC-50 controller is installed on a system that has fast-rising wavefronts present, although not necessarily high peak voltages, protective modules may be needed. Additionally, if the controller is on the same bus as other SCR devices (such as AC/DC drives, induction heating equipment, or welding equipment), the firing of the SCRs in those devices can cause noise.

ATTENTION: When you install or inspect the protective module, make sure that the controller has been disconnected from the power source. The protective module should be inspected periodically for damage or discoloration. Replace if necessary.

Electromagnetic Compatibility (EMC)

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 of 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 see the installation instructions, Wiring and Ground Guidelines, publication DRIVES-IN001.

Additional Requirements

- Wire earth ground to control terminal #3 control ground.
- Use shielded wire for PTC and ground fault input.
- Terminate shielded wires to the control module terminal #3 control ground.
- Ground fault CT must be inside or within 3 m (9.84 ft.) of metal enclosure.
- When you use an external HIM, you must place a ferrite core around the HIM cable. Use Fair-Rite Products Corp. part no. 0431167281 or equivalent.
- When you use 240V AC control voltage, you must place a ferrite core around the line/neutral supply wires at the control module. Use Fair-Rite Products Corp. part no. 0431164281 or equivalent.
- When you use 120V AC control on a solid-state D-frame unit, (361, 420, or 520 A), you must place a ferrite core around the line/neutral supply wires at the control module. Use Fair-Rite Products Corp. part no. 0431164281 or equivalent.
- When you use a solid-state B-frame unit, (90, 110, 140, or 180 A), you must install the 150-SMCAP module on the 3-phase line terminals (L1, L2, L3).
- When you use a 150-SM2 option module, you must place a ferrite core around any or all sensor wires, such as PTC or ground fault. Use Fair-Rite Products Corp. part no. 0431167281 or equivalent.

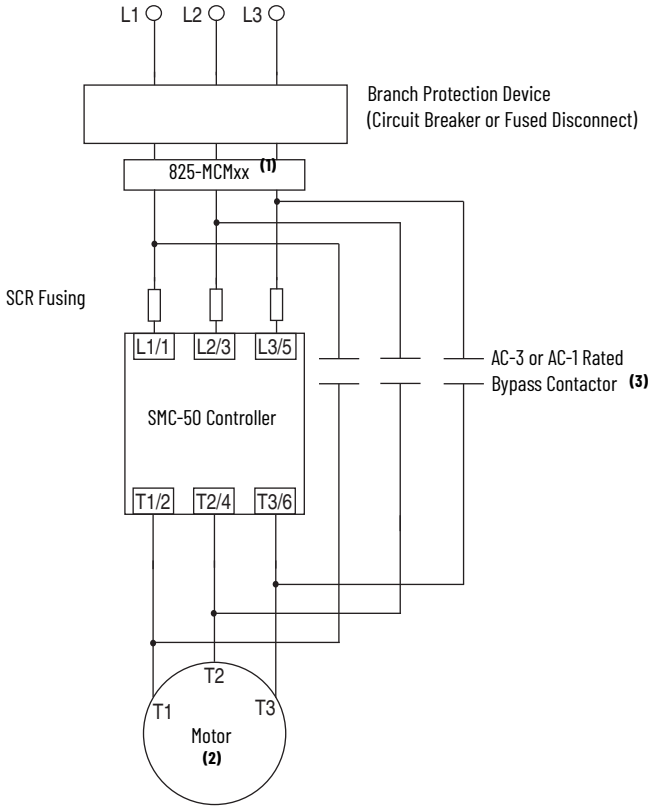
Power Wiring with External Bypass

You can use both the internal bypass and solid-state power structure versions of the SMC-50 controller with an external bypass contactor. Figure 22 through Figure 26 show typical wiring diagrams for line-and inside-the-delta-connected configurations.

All diagrams are valid for both solid-state and internal bypass power structures unless otherwise noted.

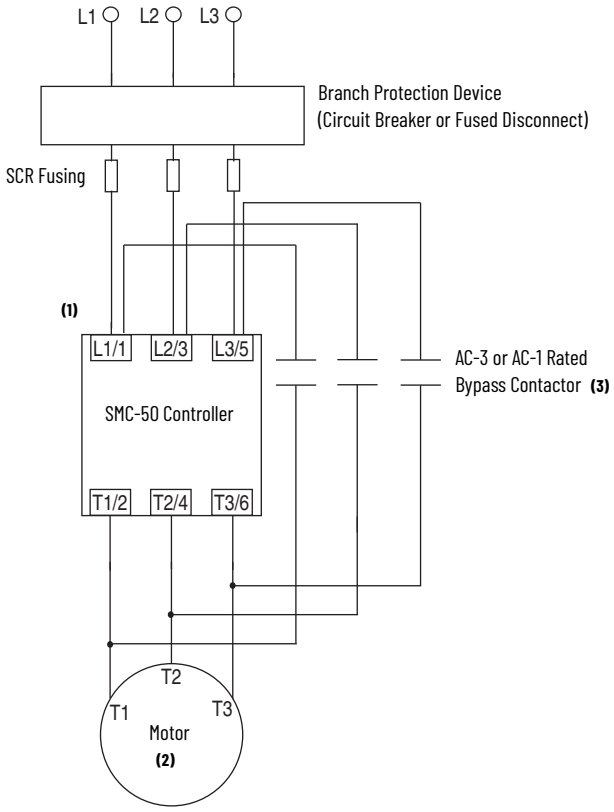
Line-connected Motors

Figure 22 - Line-connected Motor Wiring Diagram using Bul. 825 Converter Module and Cat. No. 150-SM2 Devices with Bypass Contactor



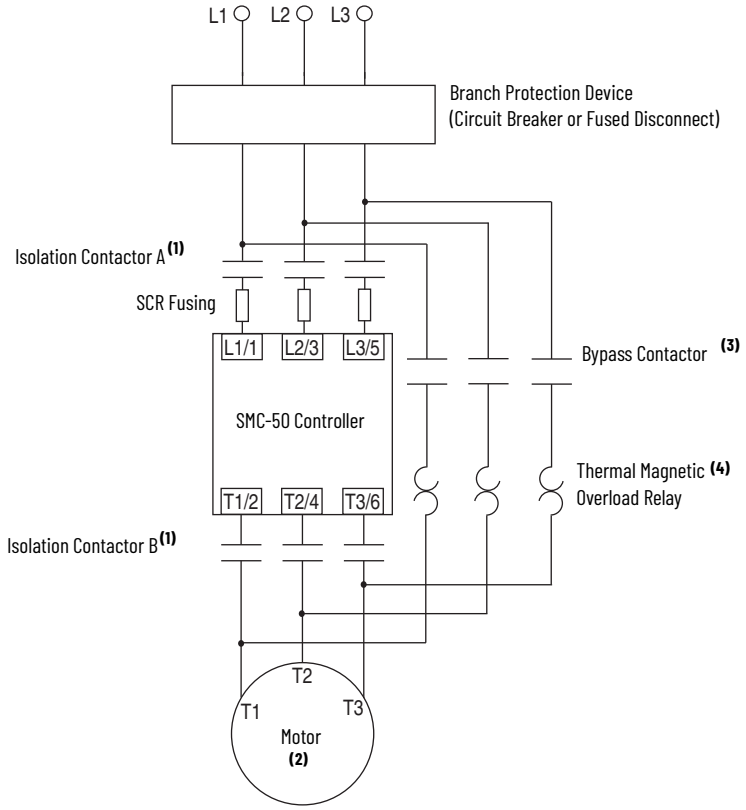
Note	Information
1	The 825-MCMxx provides current feedback to the SMC-50 controller when RUN in Bypass Operation. A Cat. No.150-SM2 is also required. For 30…180 A, use Cat. No. 825-MCM180; For 181…520 A, use Cat. No. 825-MCM20 and user-supplied CTs with 5 A secondary
2	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
3	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured to external bypass

Figure 23 - Line-connected Motor Wiring Diagram for Cat. No. 150-SC... or 150-SD... Devices with Bypass Contactor and Bypass Bus Kit (Solid-state Power Structures Only)



Note	Information
1	SMC-50 controller Bypass Bus Kit Cat. No. 150-SCBK or -SDBK is required
2	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
3	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured to external bypass

Figure 24 - Line-connected Motor Wiring Diagram with Bypass Contactor and External Overload

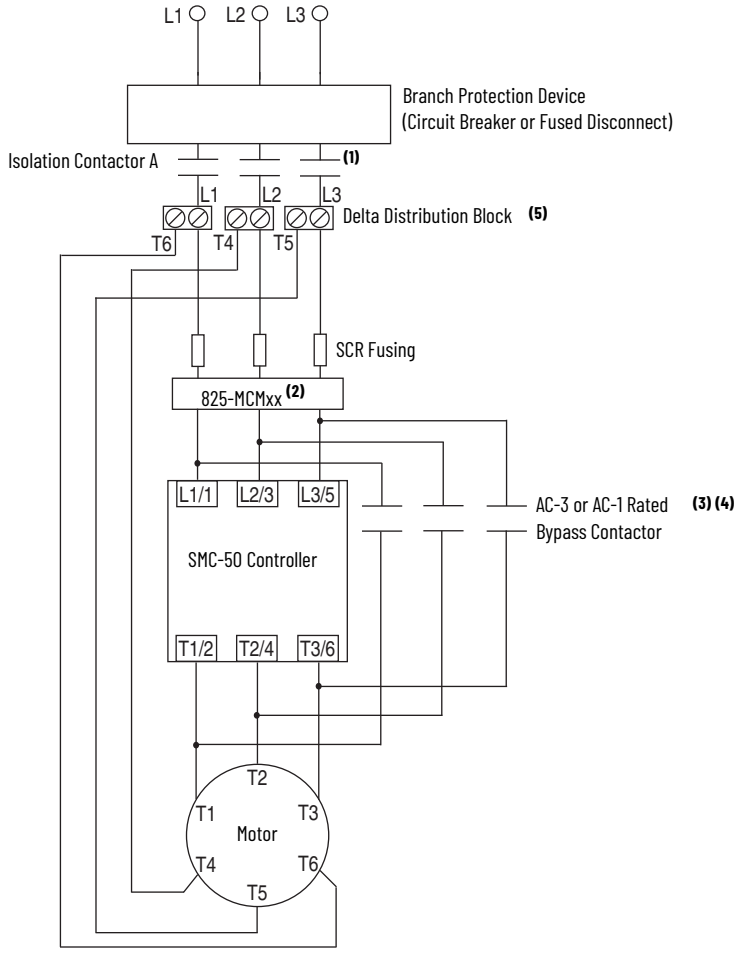


Note	Information
1	Isolation Contactors A and B are required if bypass is used for emergency START, STOP, and RUN operation
2	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
3	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured to external bypass
4	Overload is required

Bypass must be fully rated to motor Hp/kW and FLA.

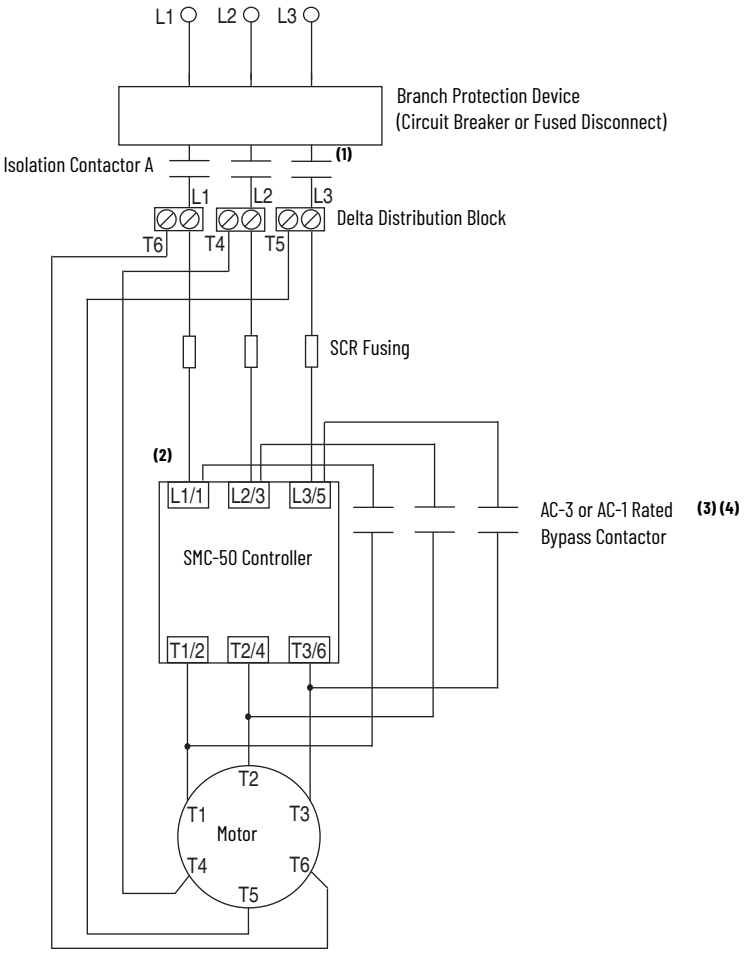
Delta-connected Motors

Figure 25 - Delta-connected Motor Wiring Diagram using Bul. 825 Converter Module and Cat. No. 150-SM2 Devices with Bypass Contactor



Note	Information
1	Isolation contactor required
2	The 825-MCMxx provides current feedback to the SMC-50 controller when RUN in Bypass Operation. A Cat. No.150-SM2 is also required. For 30…180 A, use Cat. No. 825-MCM180; For 181…520 A, use Cat. No. 825-MCM20 and user-supplied CTs with 5 A secondary
3	Configuration not acceptable for emergency RUN off bypass
4	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured to external bypass
5	Delta distribution block needed for solid-state power structures only

Figure 26 - Delta-connected Motor Wiring Diagram for Cat. No. 150-SC... or 150-SD... Devices with Bypass Contactor and Bypass Bus Kit (Solid-state Power Structures Only)



Note	Information
1	Isolation contactor required
2	SMC bypass bus kit (Cat. No. 150-SCBK or -SDBK) is required
3	Configuration not acceptable for emergency RUN off bypass. Controller FRN 3.001 or higher is required
4	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured to external bypass

Control Wiring

Standard Control Terminal Block

SMC-50 controllers 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 controller. The terminal block is removable.

Control Wiring Specifications

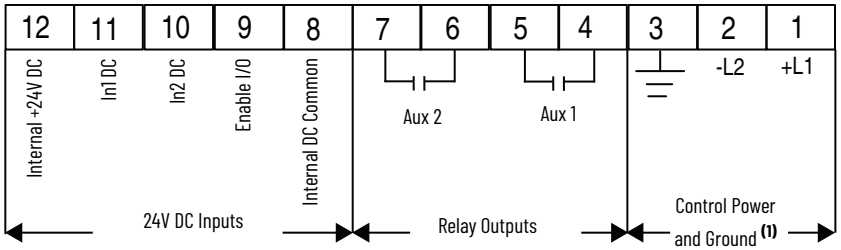
Table 5 provides the specifications for all SMC-50 controller control wiring and option module terminal blocks. Each wiring terminal accepts a maximum of two wires.

Table 5 - Control Wiring Specifications

Attribute	Value
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 help 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 27 - Standard Control Terminal Block Identification



Note	Information
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.

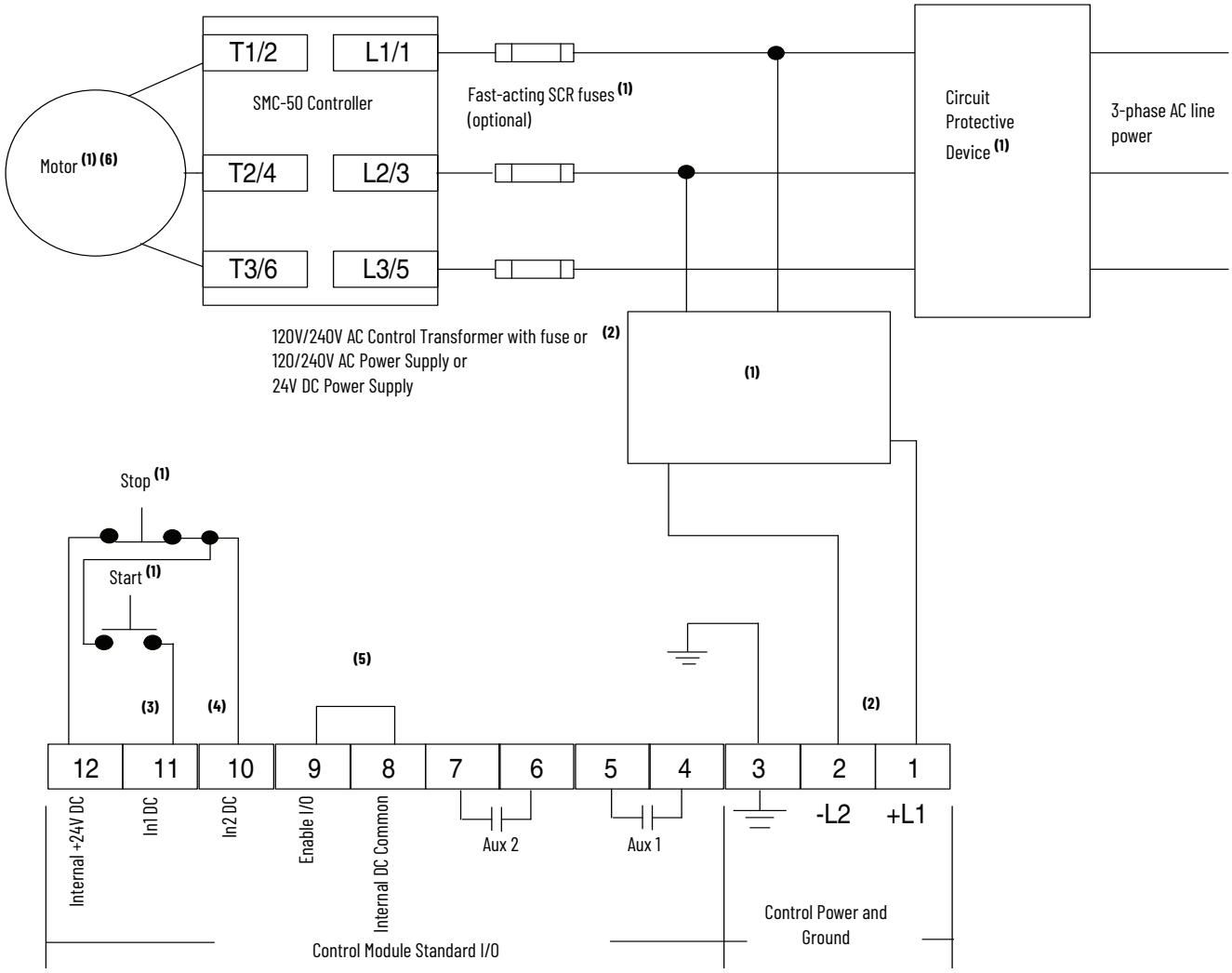
Table 6 - Terminal Descriptions

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

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

Standard Controller Wiring Diagrams

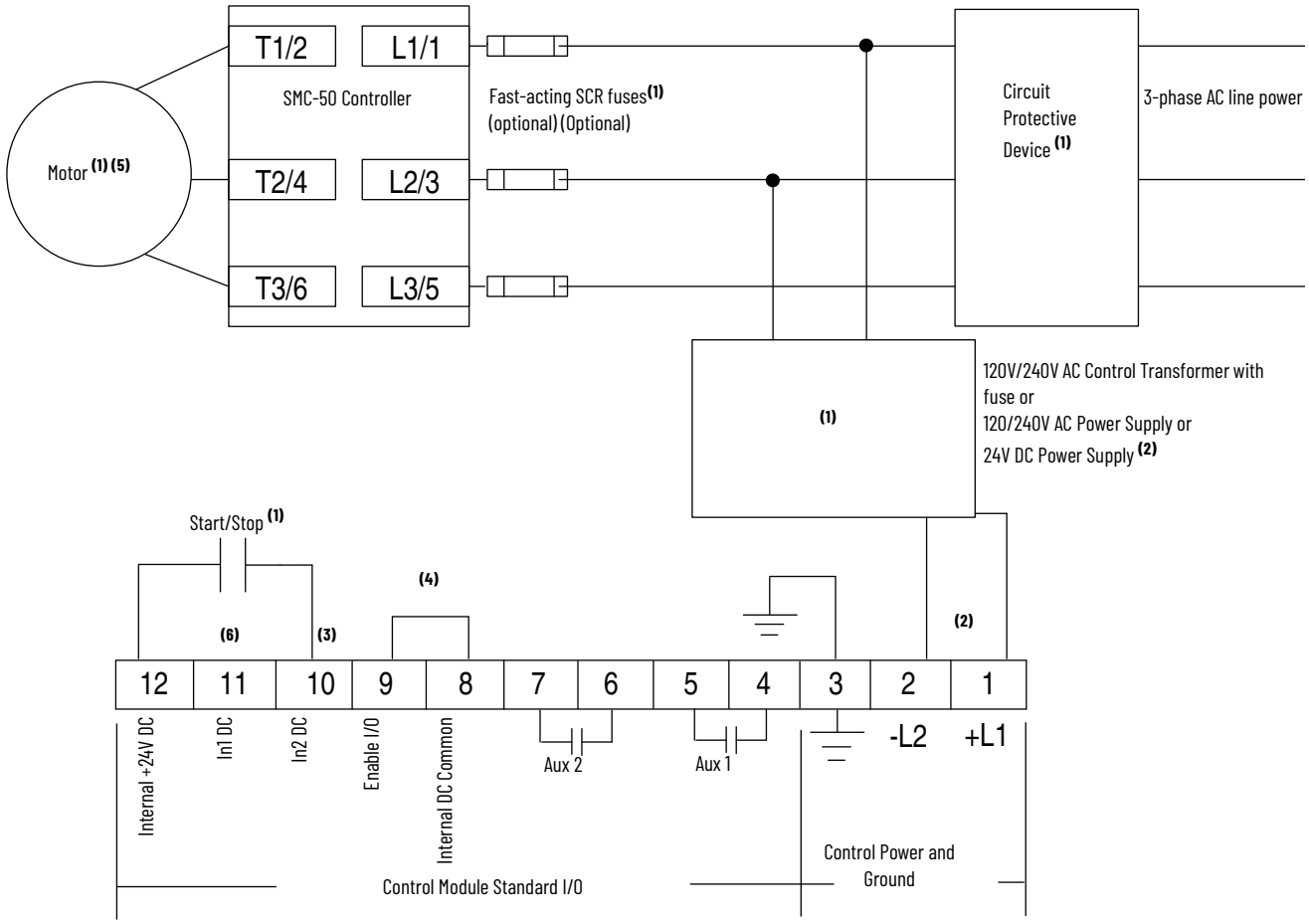
Figure 28 - For Standard 3-Wire Control—DC Inputs, No DPI Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In 1 DC) 24V DC input configured for START input using parameter 56 [Input 1]
4	Terminal 10 (In 2 DC) 24V DC input configured for COAST, STOP option, etc. using parameter 57 [Input2]
5	A customer-supplied jumper is required to enable standard I/O operation
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of off-stream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is selected for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

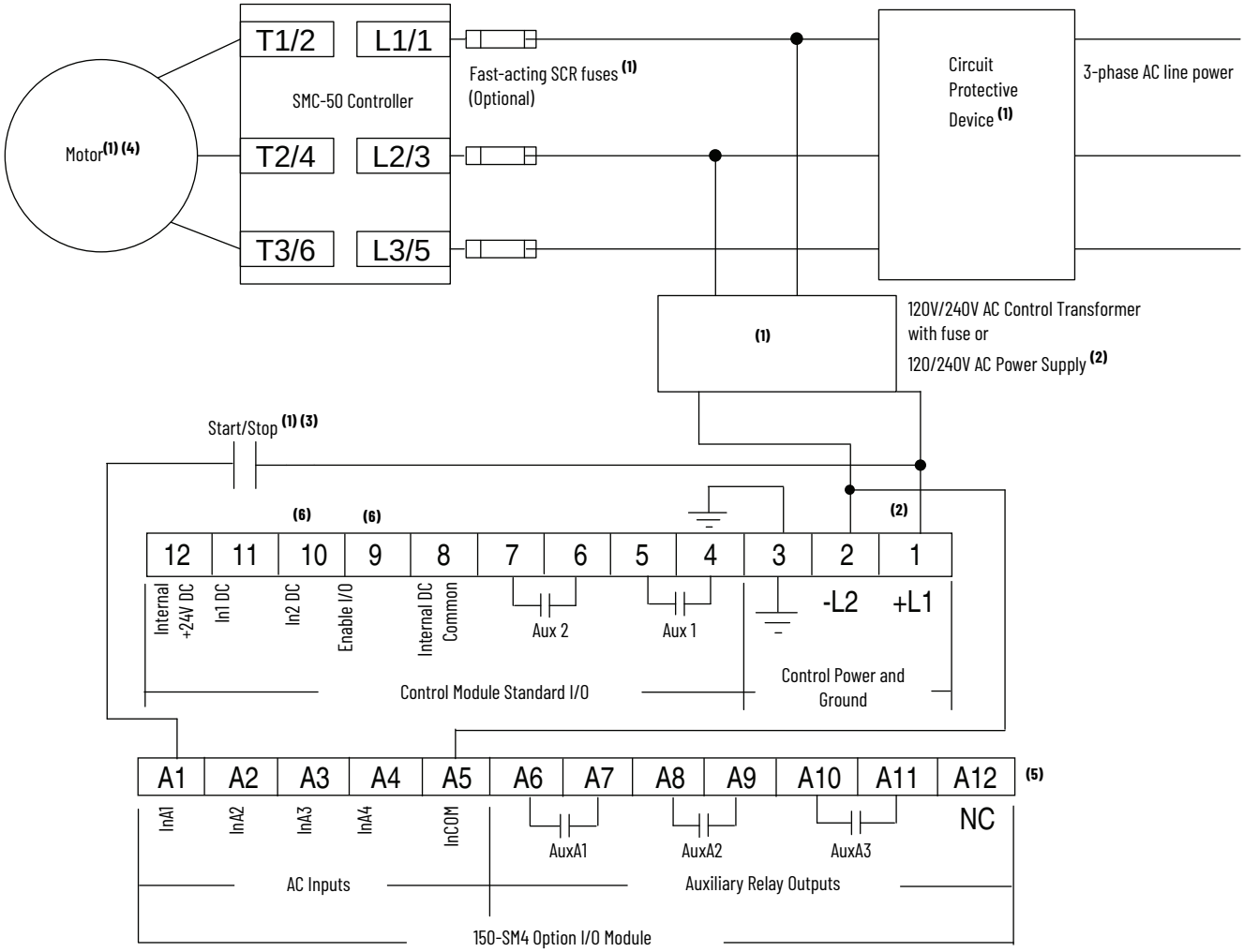
Figure 29 - For 2-Wire Control with Stopping Capability—DC Inputs, No DPI Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 10 (In 2 DC) 24V DC N.O. input is configured for START/STOP or START/COAST using parameter 57 [Input2] (contact closed start initiated, contact open, stop initiated). When using START/STOP or START/COAST, a N.O. input contact **must** be used
4	A customer-supplied jumper is required to enable controller standard I/O operation
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
6	Configure parameter 56 [Input 1] to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is selected for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

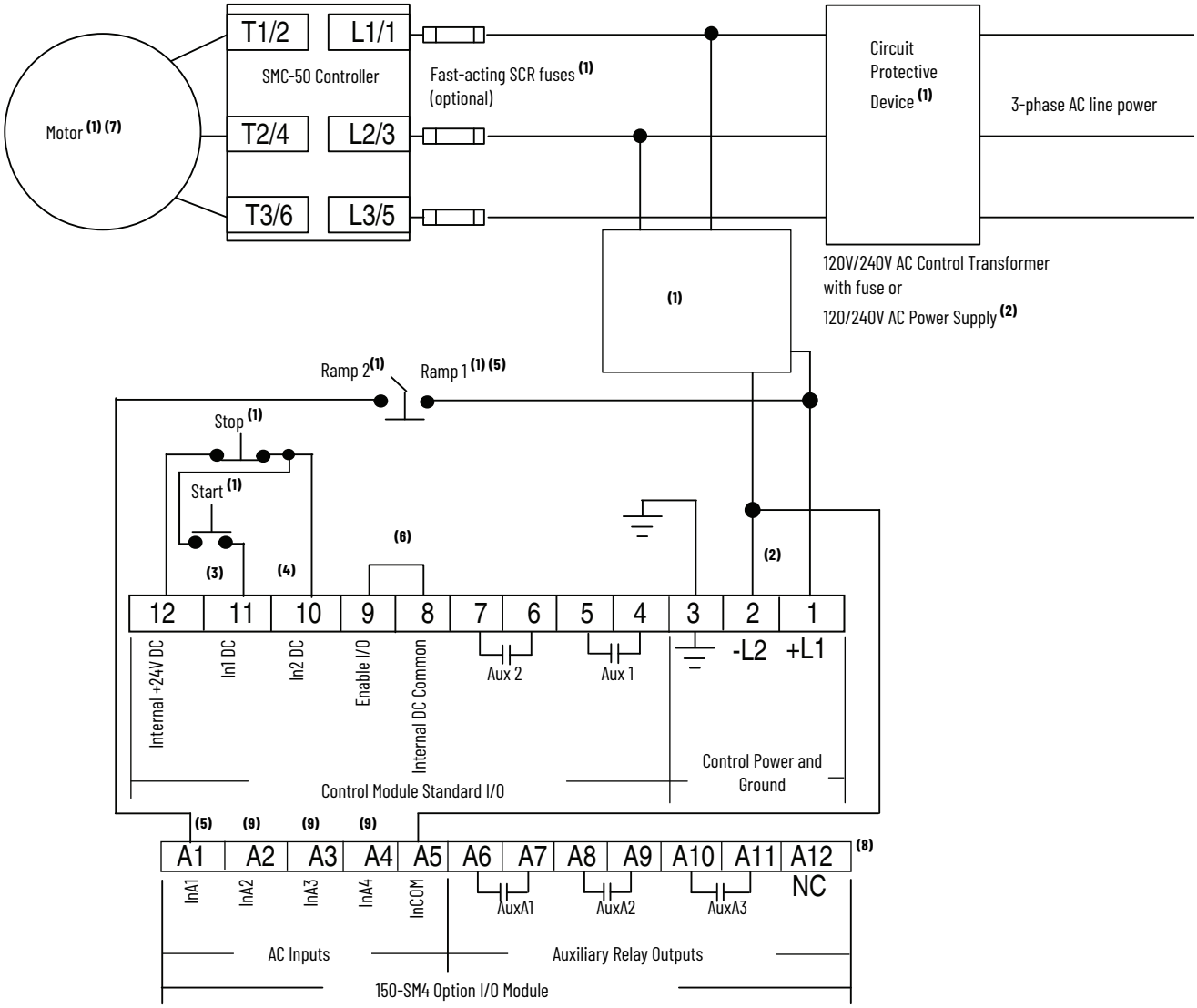
Figure 30 - For 2-Wire Control with Stopping Capability—AC Inputs, No DPI Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal A1 (InA1) 100...240V AC N.O. input is configured for START/STOP or START/COAST using parameter 7-2 [Input 1] (control module port number 7) (contact closed, start initiated, contact open, stop initiated). When using START/STOP or START/COAST, a N.O. input contact **must** be used
4	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
5	The order of the terminal numbers for the option I/O module can be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change
6	Configure both In1, parameter 56 [Input 1], and In2, parameter 57 [Input2], to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is selected for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

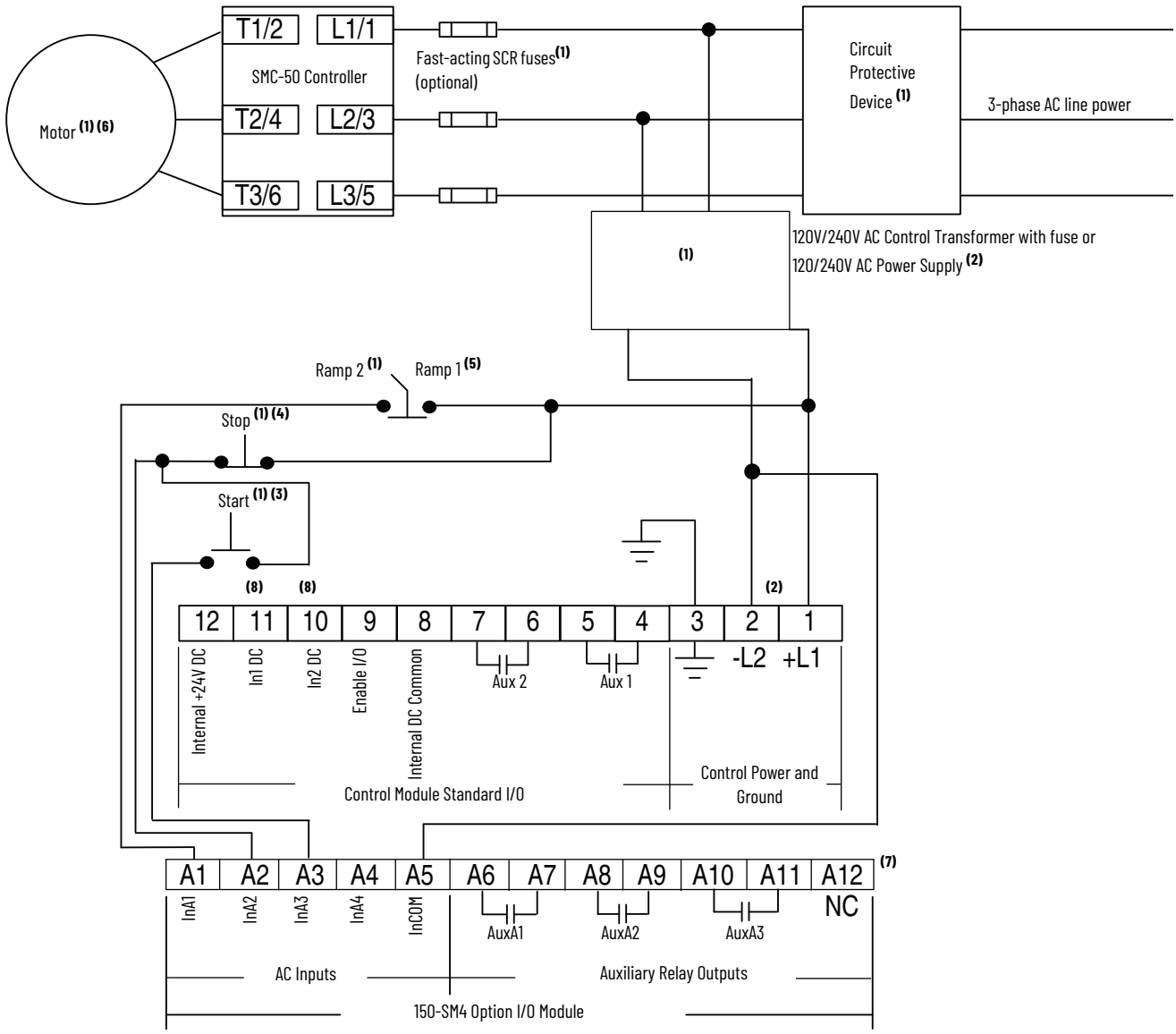
Figure 31 - For Dual Ramp Applications—AC and DC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal 11 (In 1 DC) 24V DC input configured for START input using parameter 56 [Input 1]
4	Terminal 10 (In 2 DC) 24V DC input configured for COAST, STOP option, and so on, using parameter 57 [Input2]
5	Terminal A1 (INA1) 100...240V AC input is configured for Dual Ramp using parameter 7-2 [Input 1] (control module port 7)
6	A customer supplied jumper is required to enable controller I/O operation
7	Due to current leakage through an SCR in the OFF state (controller stopped), some form of off-stream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
8	The order of the terminal numbers for the option I/O module can be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change
9	Ensure that InA2, InA3, and InA4 are configured to "Disable" [Default]

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is selected for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

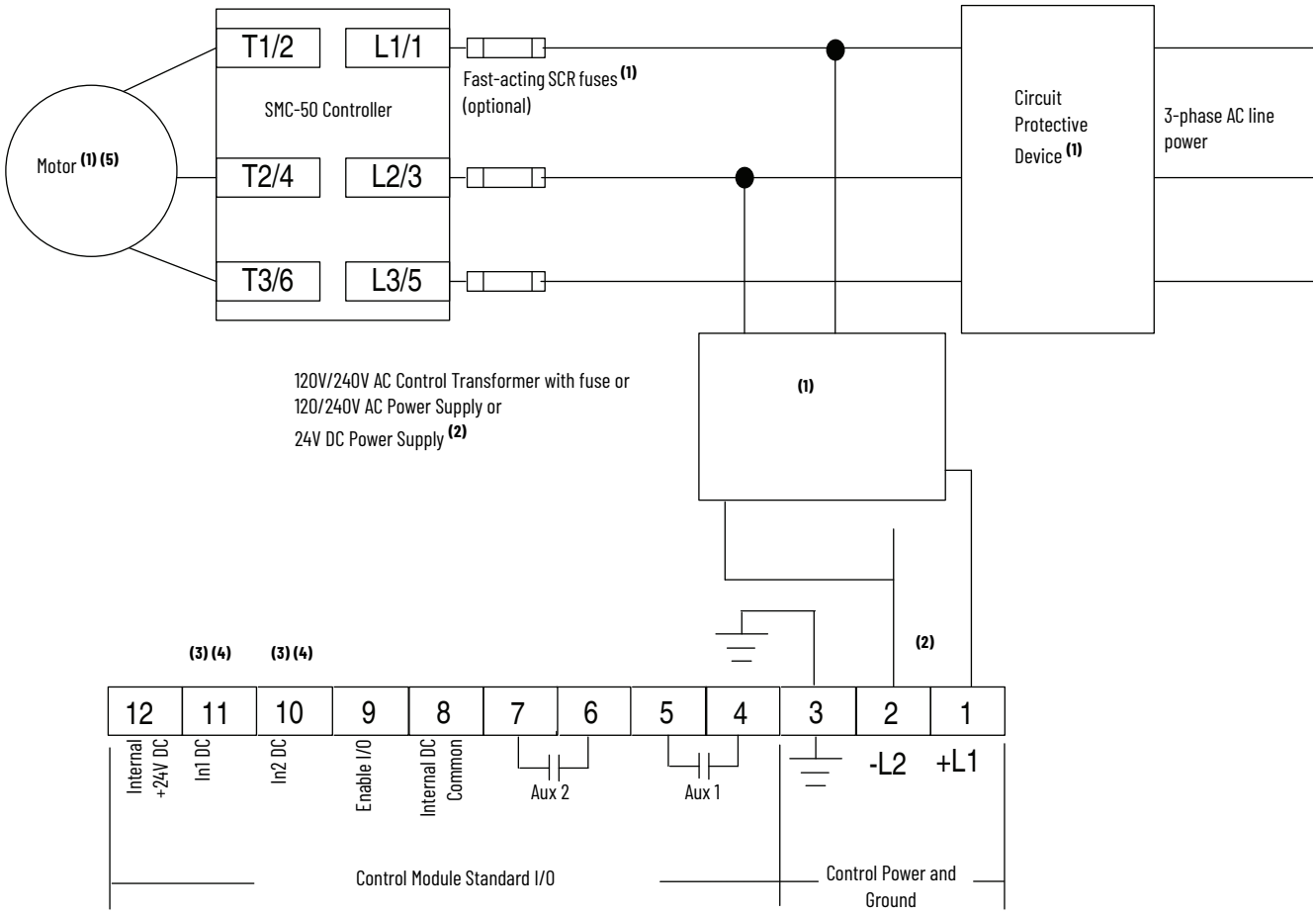
Figure 32 - For Dual Ramp—AC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal A3 (InA3) 100...240V AC input configured for START input using Parameter 7-4 (control module port 7)
4	Terminal A2 (InA2) 100...240V AC input configured for COAST, STOP option, etc. using Parameter 7-3 (control module port 7)
5	Terminal A1 (InA1) 100...240V AC input is configured for Dual Ramp using parameter 7-2 [Input 1] (control module port 7)
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of off-stream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
7	The order of the terminal numbers for the option I/O module can be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change
8	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is selected for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

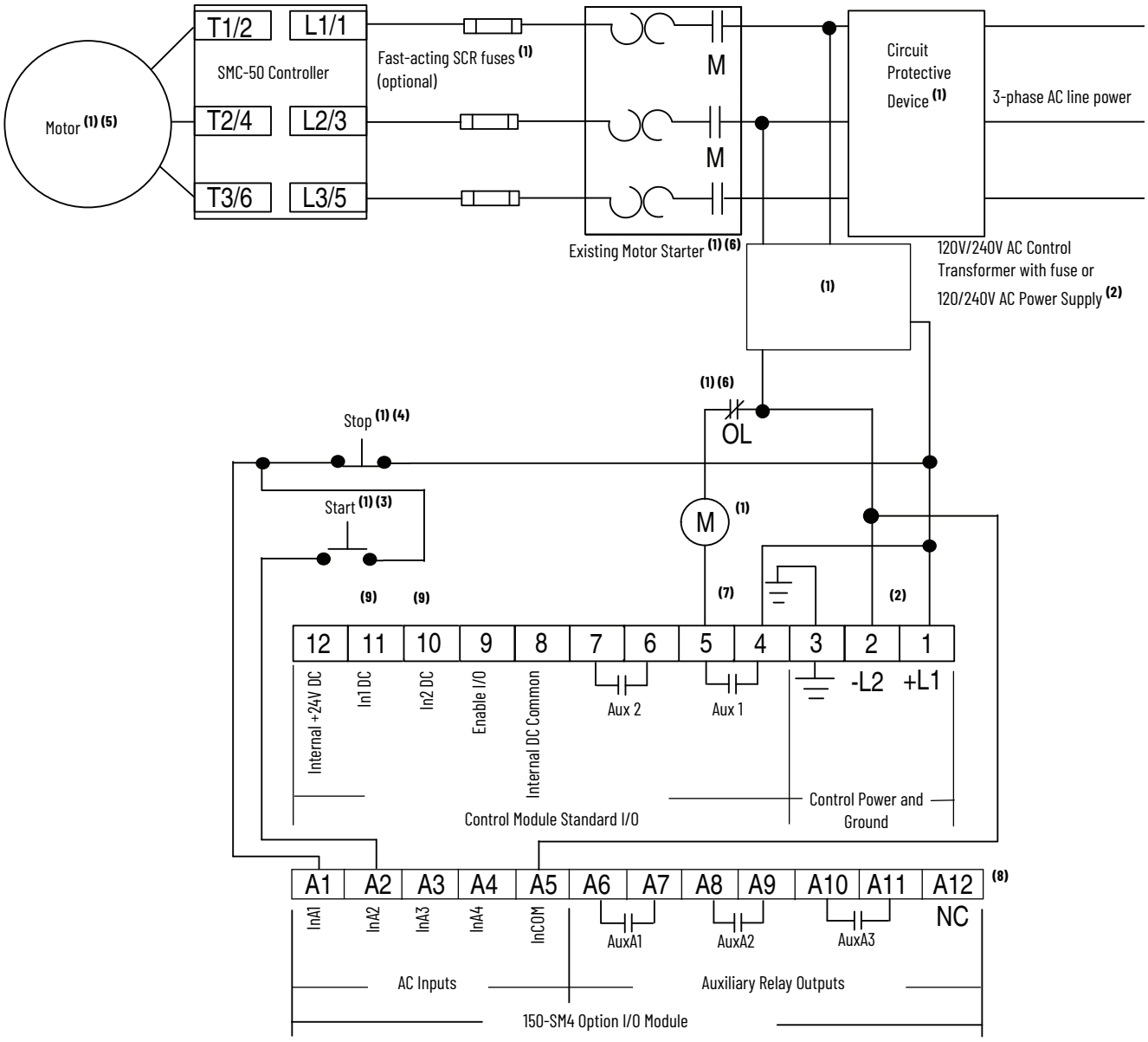
Figure 33 - For Start/Stop Control via HIM or Communications



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"
4	For DPI operation, if the start/stop operation is done via communications (DPI port, 20-COMM module, or HIM) the appropriate bit (2p0...4) in the Logic Mask, Parameter 148, must be set. See Chapter 9 for additional details
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of off-stream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details

- If terminal 10 and 11 are required for a non Stop/Start function (e.g. slow speed), see Parameter 56 and Parameter 57 Communication Control word bits 0-5 for options.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

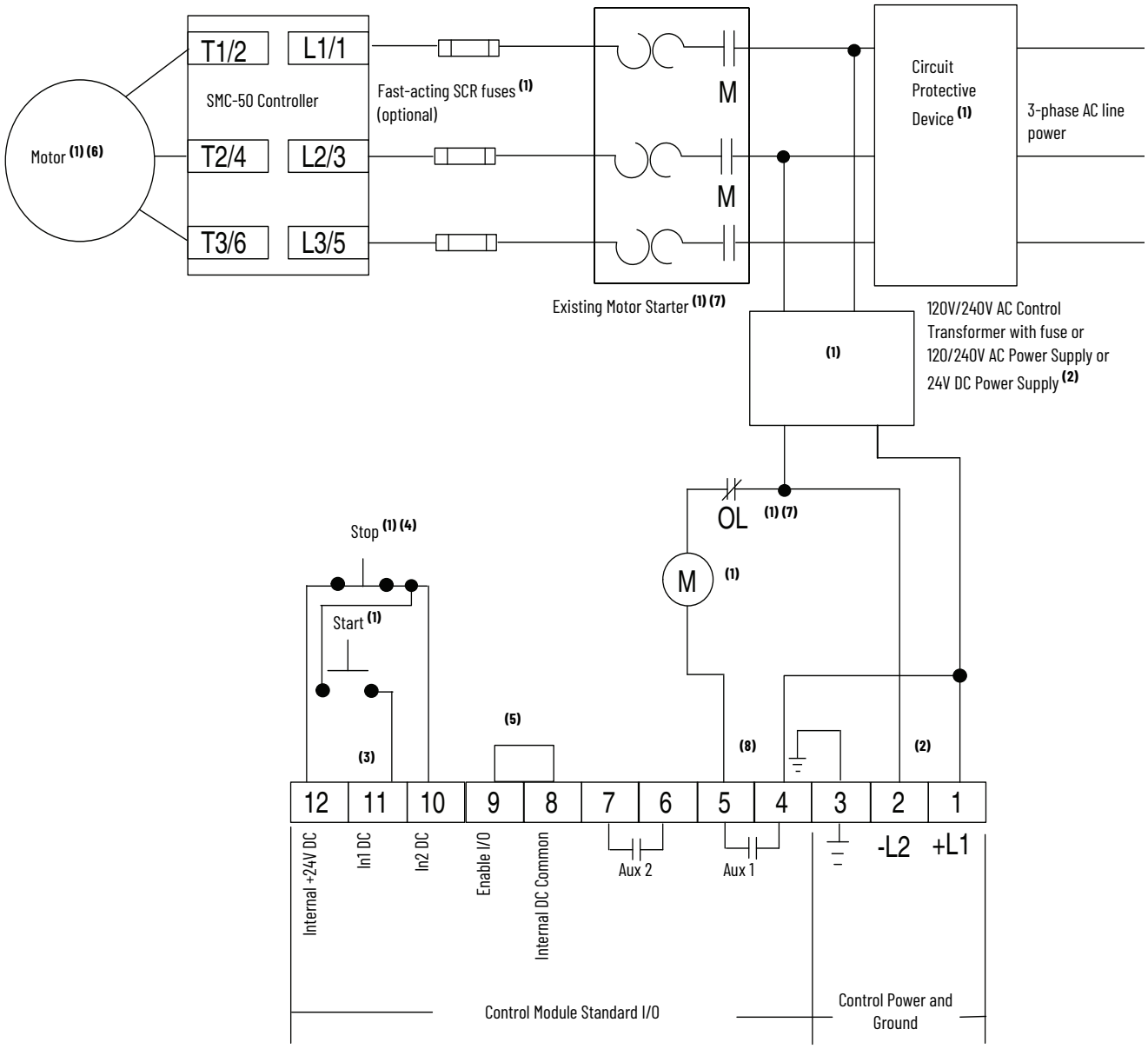
Figure 34 - For Retrofit Applications— AC Inputs, No DPI Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal A2 (InA2) 100...240V AC input configured for START input using Parameter 7-3 (control module port 7)
4	Terminal A1 (InA1) 100...240V AC input configured for Coast, Stop Option, etc, using Parameter 7-2 (control module port 7)
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. In this example, the Existing Motor Starter fulfills that requirement
6	Due to existing motor starter overload protection, the overload protection should be disabled in the SMC-50 controller
7	Set Aux 1 to NORMAL using Parameter 172. NORMAL = Aux 1 contact closes to energize the M coil with the START push button and opens to de-energize it when the stop maneuver, initiated by the stop push button, is complete
8	The order of the terminal numbers for the option I/O module cam be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change
9	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.

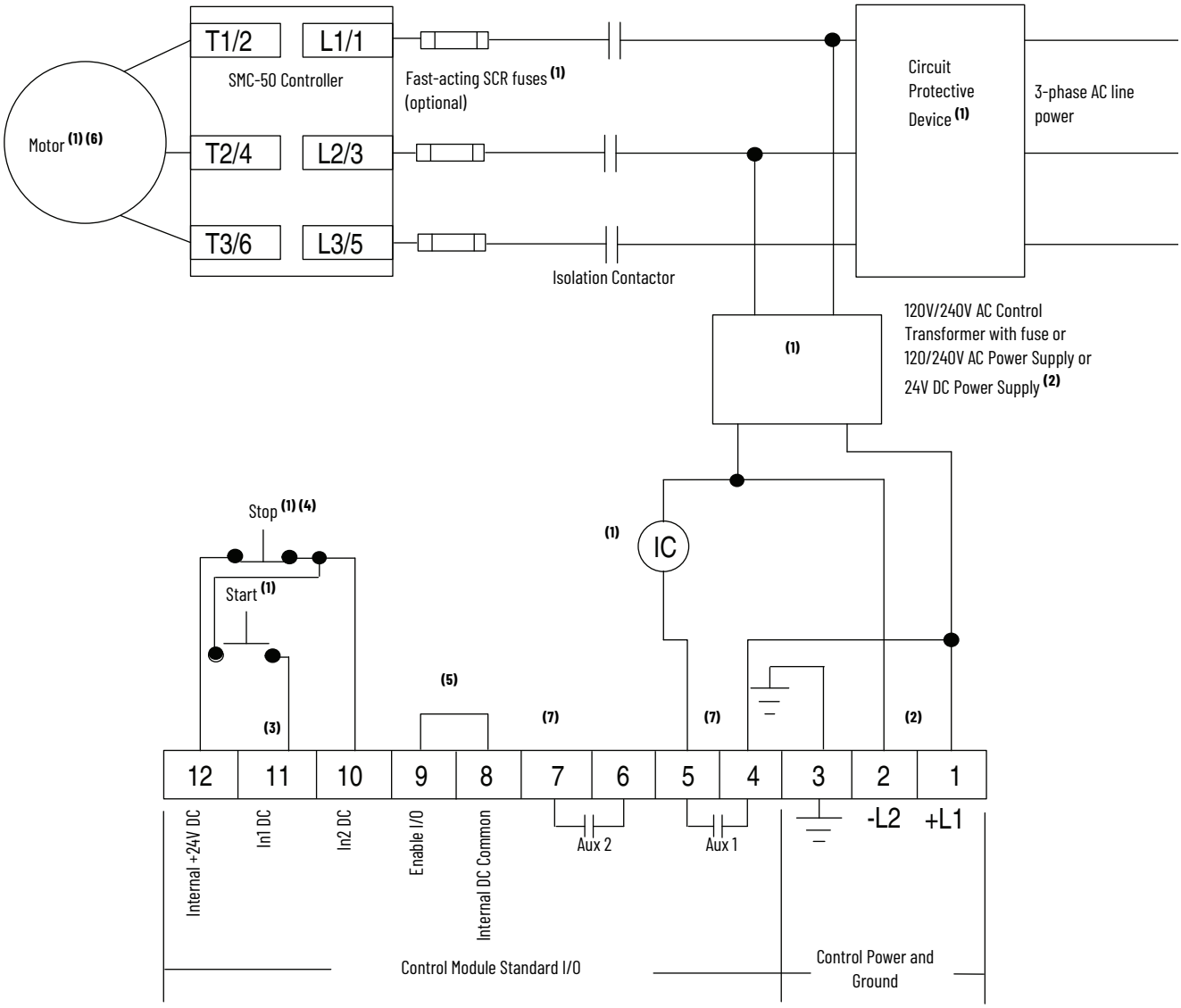
Figure 35 - For Retrofit Applications – DC Inputs, No DPI Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In1 DC) 24V DC input is configured for START input using Parameter 56
4	Terminal 10 (In2 DC) 24V DC input configured for COAST, STOP OPTION, etc. using Parameter 57
5	A customer-supplied jumper is required to enable the controller I/O operation
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. In this example, the existing Motor Starter fulfills that requirement
7	Due to existing motor starter overload protection, the overload protection should be disabled in the SMC-50 controller
8	Set Aux 1 to NORMAL using Parameter 172. NORMAL = Aux 1 contact closes to energize the M coil with the START push button and opens to de-energize it when the stop maneuver, initiated by the stop push button, is complete

The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.

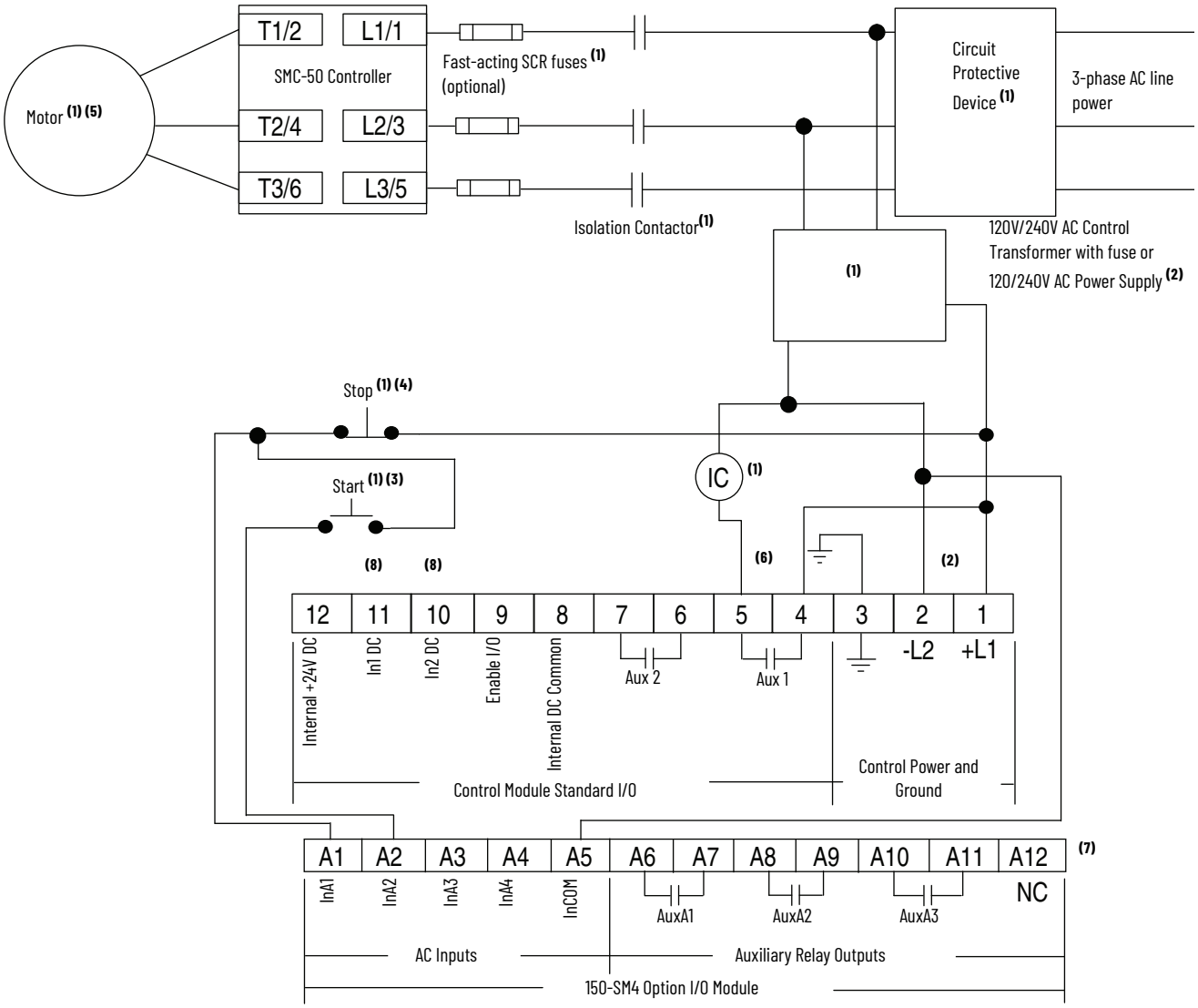
Figure 36 - For Isolation Contactor Applications—DC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In1 DC) 24V DC input is configured for START input using Parameter 56
4	Terminal 10 (In2 DC) 24V DC input configured for COAST, STOP OPTION, etc. using Parameter 57
5	A customer-supplied jumper is required to enable the controller I/O operation
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation (for example, the Isolation Contactor used in this diagram) is recommended if the motor requires maintenance
7	Configure Aux 1 to NORMAL using Parameter 172. NORMAL = Aux 1 contact closes to energize the IC coil with the START push button and opens to de-energize it when the stop maneuver, initiated by the stop push button, is complete

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor (as shown in this diagram) or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

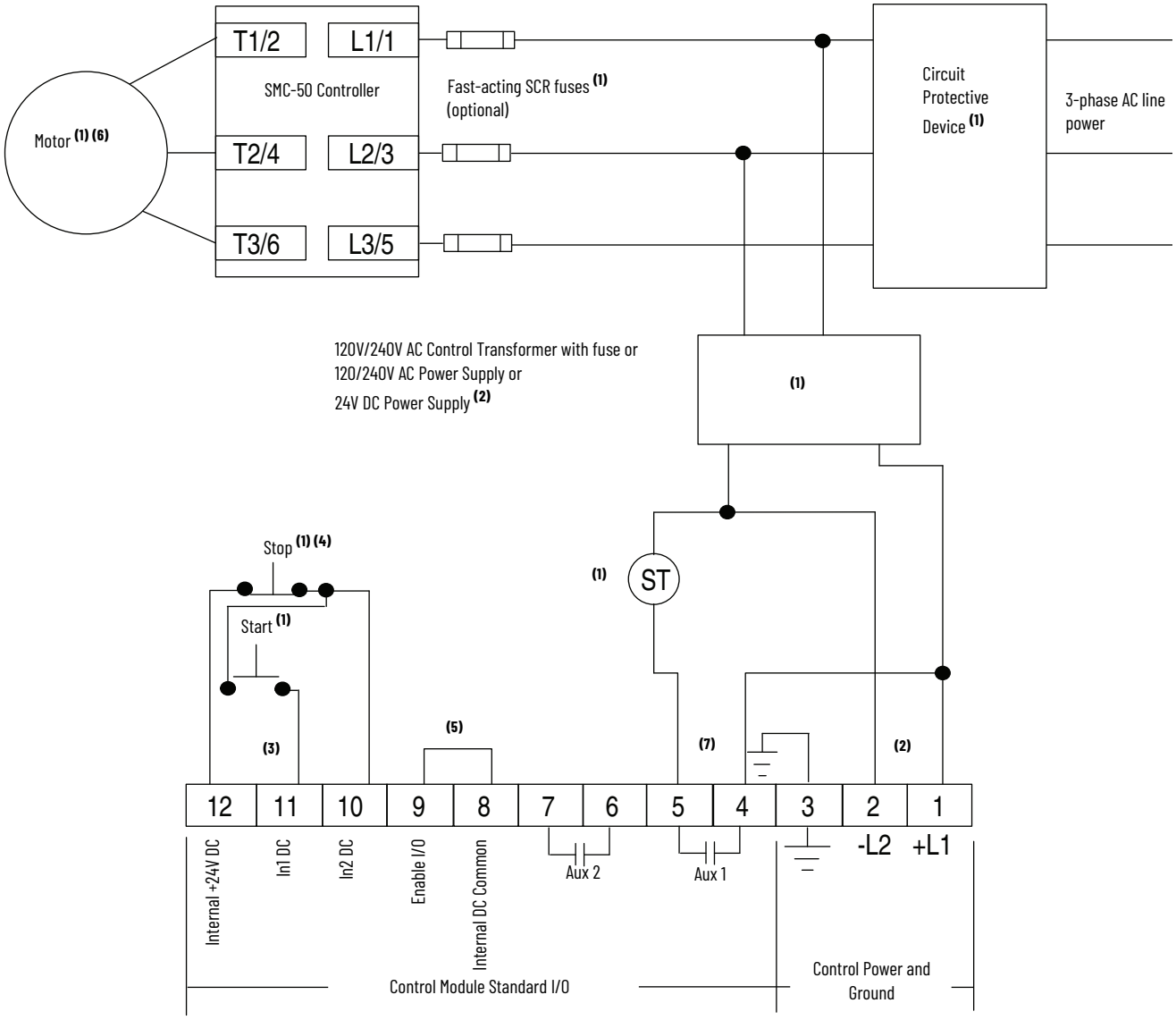
Figure 37 - For Isolation Contactor Applications—AC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal A2 (InA2) 100...240V AC input is configured for START input using Parameter 7-3 (control module port 7)
4	Terminal A1 (InA1) 100...240V AC input configured for COAST, STOP OPTION, etc. using Parameter 7-2 (control module port 7)
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation (for example, the isolation contactor used in this diagram) is recommended if the motor requires maintenance
6	Configure Aux 1 to NORMAL using Parameter 172. NORMAL = Aux 1 contact closes to energize the IC coil with the START push button and opens to de-energize it when the stop maneuver, initiated by the stop push button, is complete
7	The order of the terminal numbers for the option I/O module can be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change
8	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor (as shown in this diagram) or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

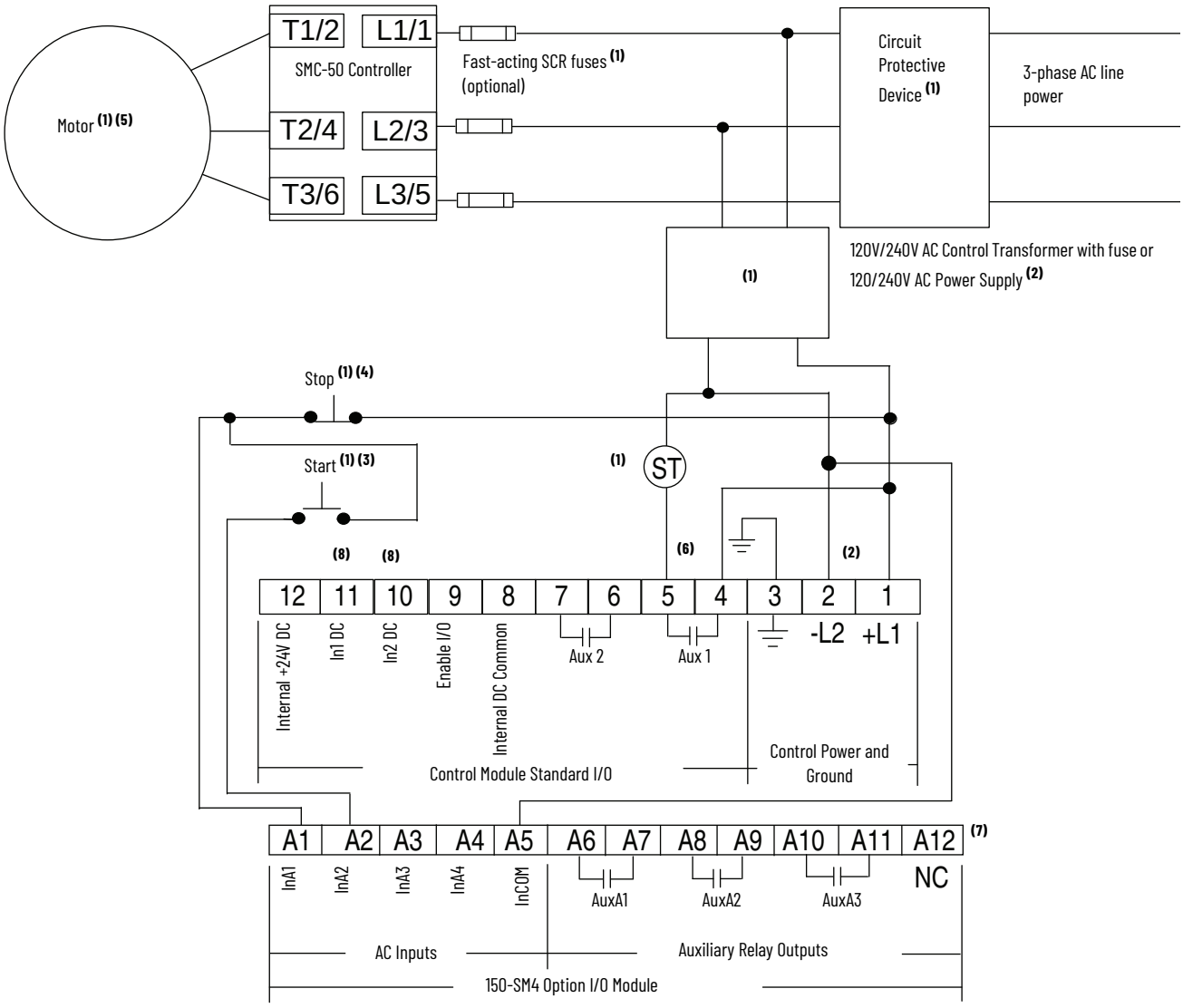
Figure 38 - For Shunt Trip Applications—DC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In1 DC) 24V DC input is configured for START input using Parameter 56
4	Terminal 10 (In2 DC) 24V DC input configured for COAST, STOP OPTION, etc. using Parameter 57
5	A customer-supplied jumper is required to enable the controller I/O operation
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83.
7	Configure Aux 1 to FAULT using Parameter 172. During a controller fault condition, the Aux 1 contact closes to energize the Shunt Trip (ST) coil

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

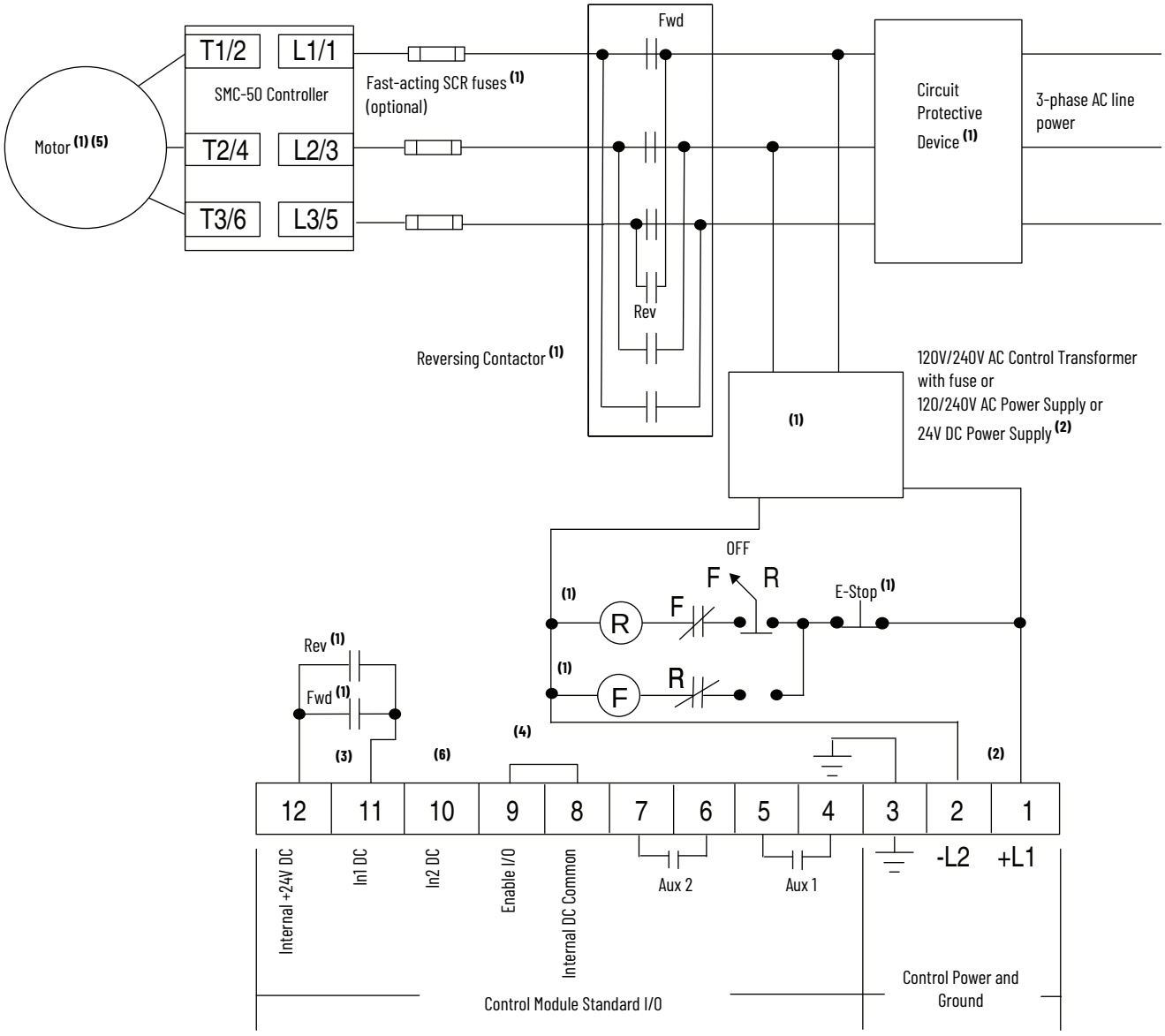
Figure 39 - For Shunt Trip Applications—AC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal A2 (InA2) 100...240V AC input is configured for START input using Parameter 7-3 (control module port 7)
4	Terminal A1 (InA1) 100...240V AC input configured for COAST, STOP OPTION, etc. using Parameter 7-2 (control module port 7)
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83.
6	Configure Aux 1 to FAULT using Parameter 172. During a controlled fault condition the Aux 1 contact closes to energize the Shunt Trip (ST) coil
7	The order of the terminal numbers for the option I/O module can be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change
8	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

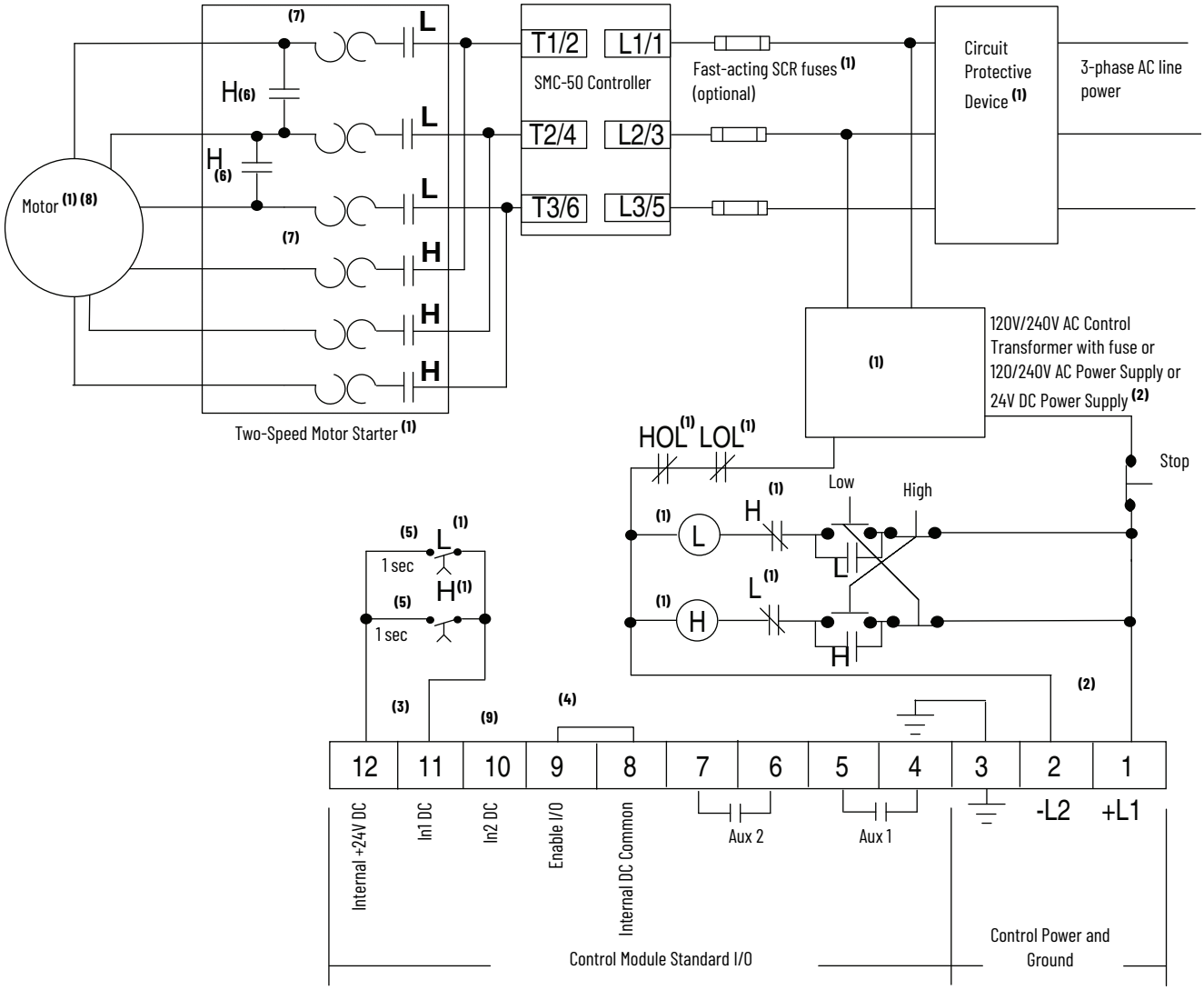
Figure 40 - For Single-speed Reversing Applications—DC Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In1 DC) 24V DC input is configured for START/COAST using Parameter 56
4	A customer-supplied jumper is required to enable the controller I/O operation
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. In this example, the reversing contactor provides isolation
6	Configure In2DC (Input 2 - Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- The SMC-50 controller minimum transition time for reversing is 0.5 s. The SMC-50 controller phase reversal must be disabled in reversing applications.

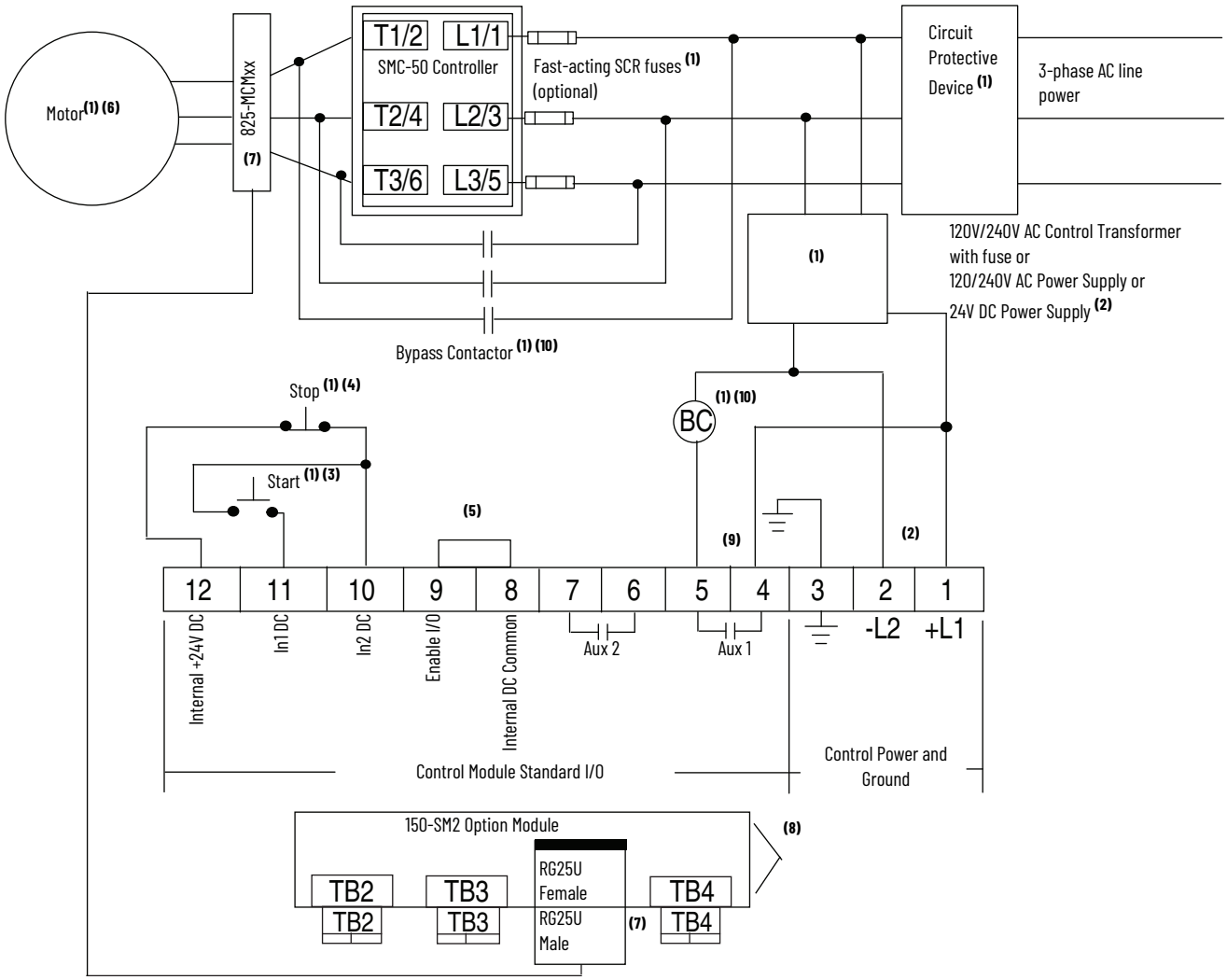
Figure 41 - For Two-speed Applications—DC Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In1 DC) 24V DC input is configured for START/COAST using Parameter 56
4	A customer-supplied jumper is required to enable the controller I/O operation
5	Customer-supplied timers with hard contact are required to accept DC power
6	Two-speed consequent pole operations
7	The SMC-50 controller overload must be disabled
8	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83.
9	Configure In2DC (Input 2 - Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

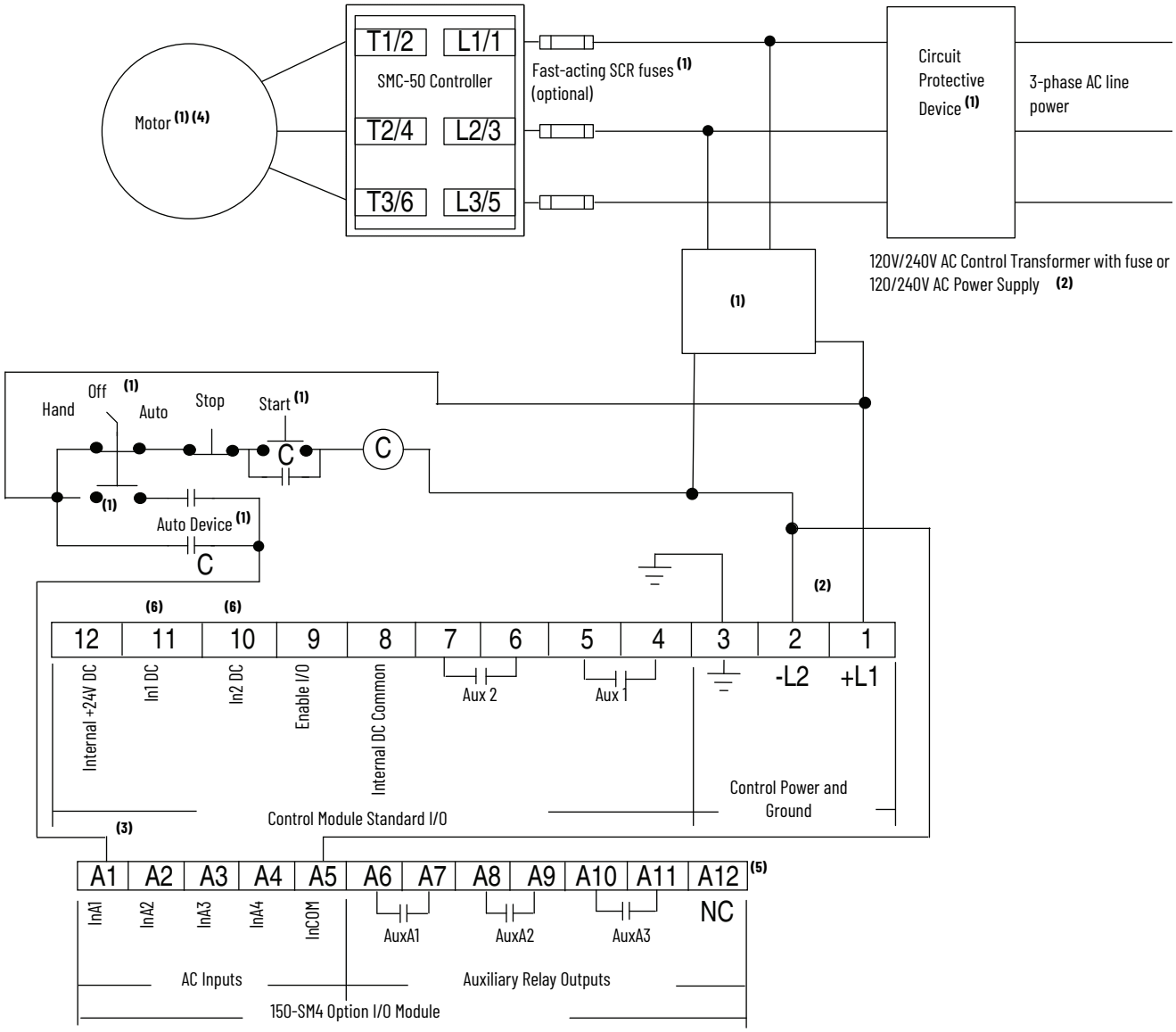
Figure 42 - For SMC Start, Run, On Bypass—DC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC or 24V DC)
3	Terminal 11 (In1 DC) 24V DC input is configured for START input using Parameter 56
4	Terminal 10 (In2 DC) 24V DC input configured for COAST, STOP OPTION, etc. using Parameter 57
5	A customer-supplied jumper is required to enable the controller I/O operation
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. SeeFigure 83.
7	In Bypass Contactor RUN operation, the 825-MCM and the 150-SM2 provide current-based protective feedback features including overload. Only the cable provided with the 825-MCM converter can be used in this configuration. The maximum cable length is 4 m; the 825-MCM must be within 4 m of the SMC-50 controller.
8	The order of the terminal numbers for the 150-SM2 module can be reversed depending on which expansion slot on the control module the option I/O module is in. The function associated with the terminal number does not change.
9	The Aux 1 relay output is configured for external bypass using Parameter 172.
10	In North America, size the bypass contactor per the motor Hp and FLA. In IEC, size the bypass contactor per the motor AC-1 rating. The short-circuit rating of the bypass contactor must not be less than that of the SMC-50 controller.

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

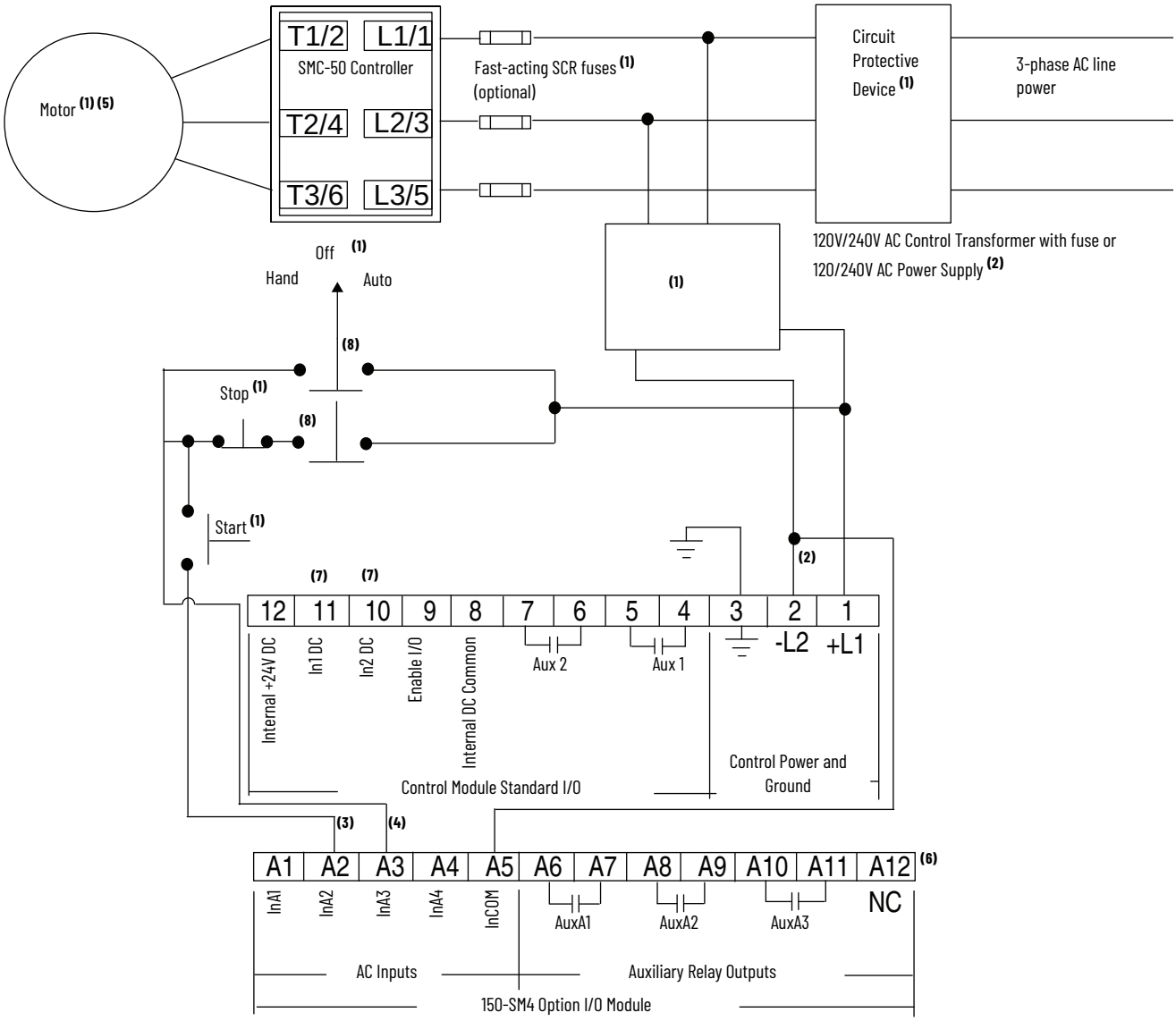
Figure 43 - Hand-OFF-Auto Control with Start/Stop Push Buttons—AC Control



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Terminal A1 (InA1) 100...240V AC input is configured for START/STOP or START/COAST using Parameter 7-2 (control module port 7, Start = Input High, Coast/Stop = Input Low)
4	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83.
5	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change
6	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

Figure 44 - For Hand-OFF-Auto (DPI) with Start/Stop Push Buttons—AC I/O



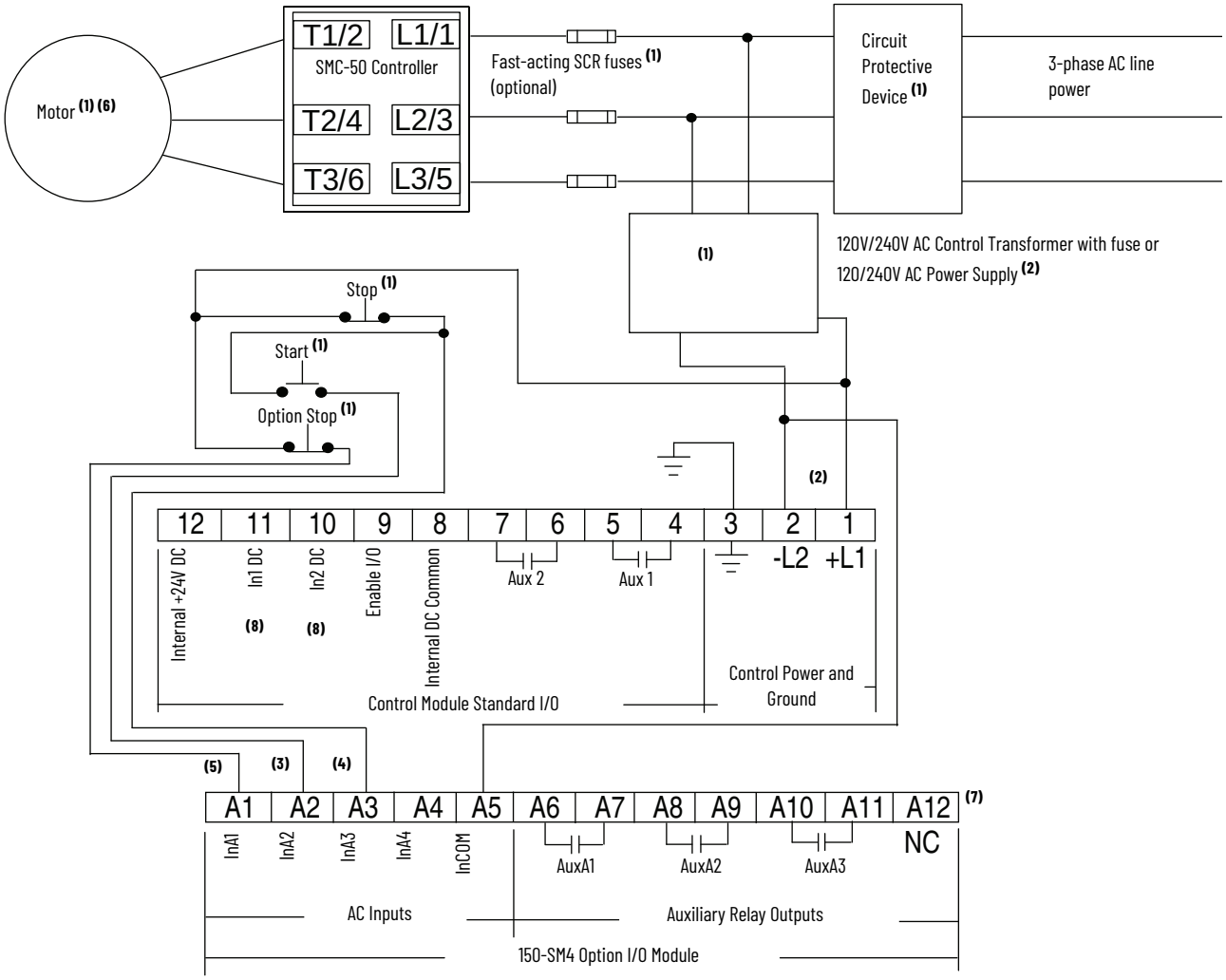
Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Option I/O Terminal A2 (InA2) 100...240V AC input is configured for START input using Parameter 7-4 (control module port 7)
4	Option I/O Terminal A3 (InA3) 100...240V AC input configured for COAST, STOP OPTION, etc. using Parameter 7-3 (control module port 7)
5	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. SeeFigure 83.
6	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change
7	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"
8	The switch is closed in this position

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

Soft Stop, Pump Control, and Smart Motor Braking (SMB)

Figure 45 shows the typical wiring diagrams for the Soft Stop, Pump Control, and SMB options.

Figure 45 - Soft Stop, Pump Stop, or Braking Control Option, AC Control

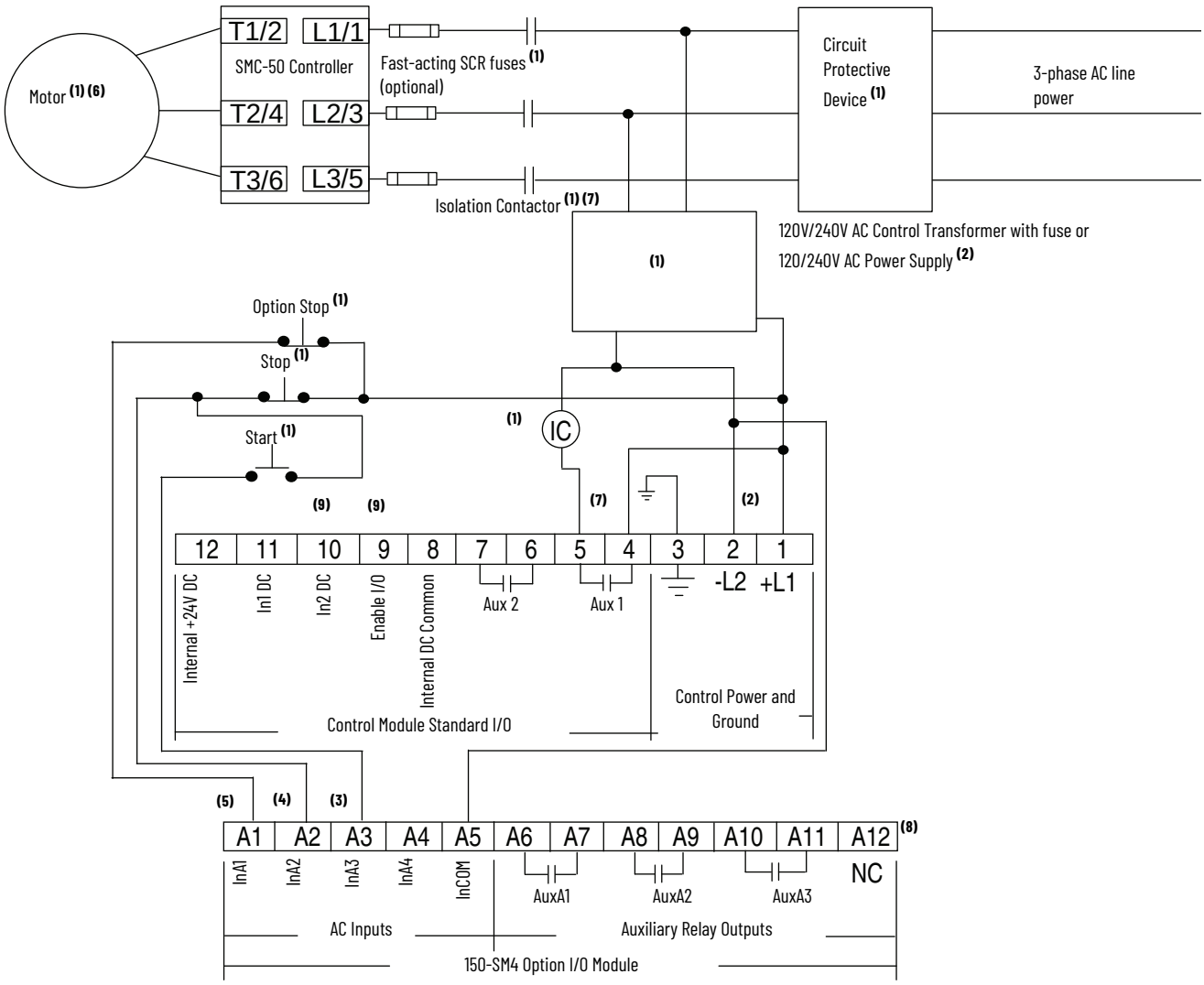


Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Option I/O Terminal A2 (InA2) 100...240V AC input is configured for START input using Parameter 7-3 (contact module port 7)
4	Option I/O Terminal A3 (InA3) 100...240V AC input configured for COAST using Parameter 7-4 (contact module port 7)
5	Option I/O module Terminal A1 (InA1) 120/240V AC input is configured for STOP OPTION using Parameter 7-2 (contact module port 7)
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83.
7	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change.
8	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

Slow Speed with Braking

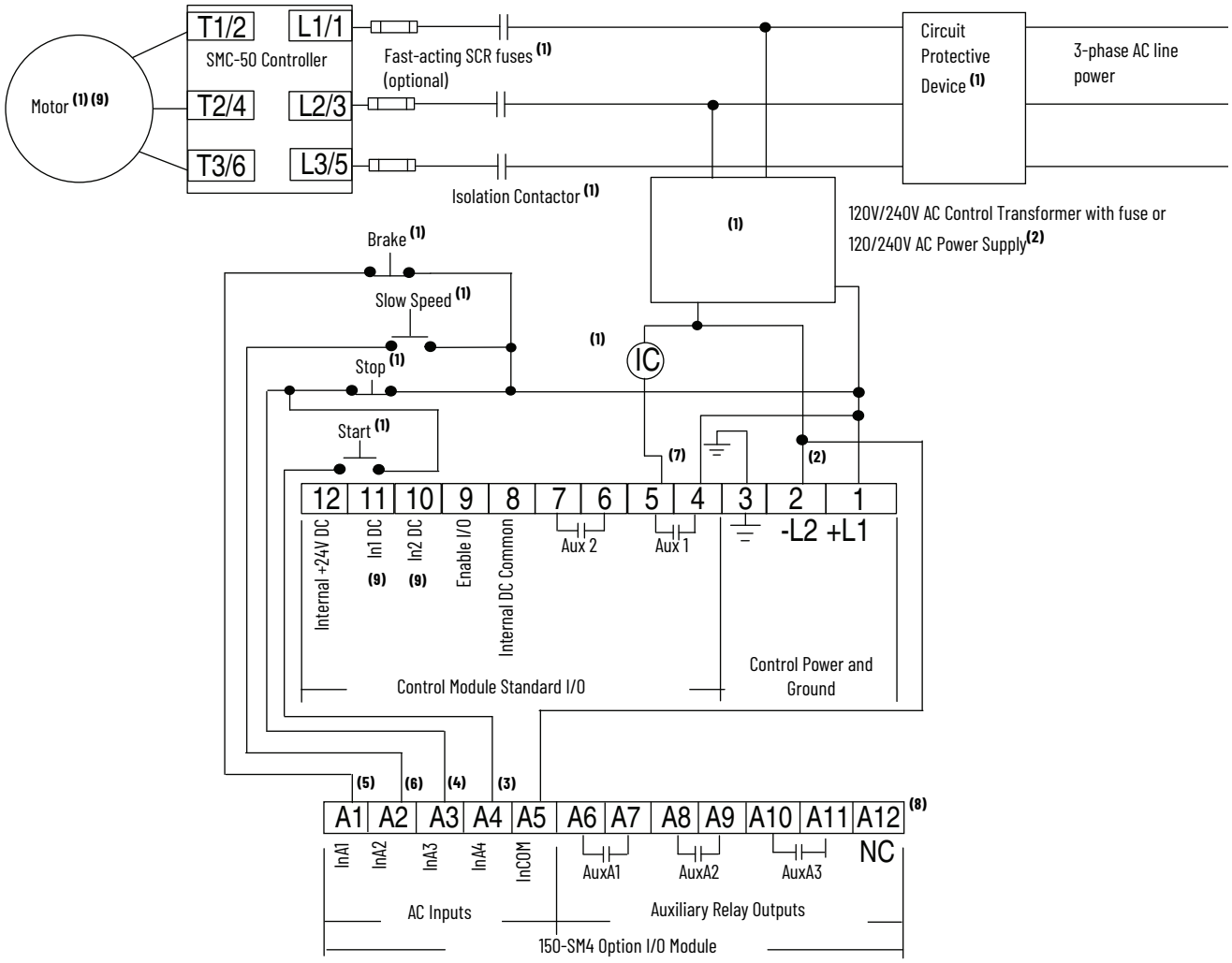
Figure 46 - For Isolation Contactor with STOP Option Applications, AC Inputs



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Option I/O Terminal A3 (InA3) 100...240V AC input is configured for START input using Parameter 7-4 (control module port 7)
4	Option I/O Terminal A2 (InA2) 100...240V AC input configured for COAST using Parameter 7-3 (control module port 7)
5	Option I/O module Terminal A1 (InA1) 100...240V AC input is configured for STOP OPTION using Parameter 7-2 (control module port 7)
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation (for example, the one shown in this diagram) is recommended if the motor requires maintenance
7	Configure Aux1 to NORMAL using Parameter 172. NORMAL = Aux1 contact closes to energize the IC coil with the START push button and open to de-energize when the stop maneuver, initiated by the STOP push button, is complete
8	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change
9	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

Figure 47 - For Isolation Contactor and Slow Speed with Braking Application— AC Control

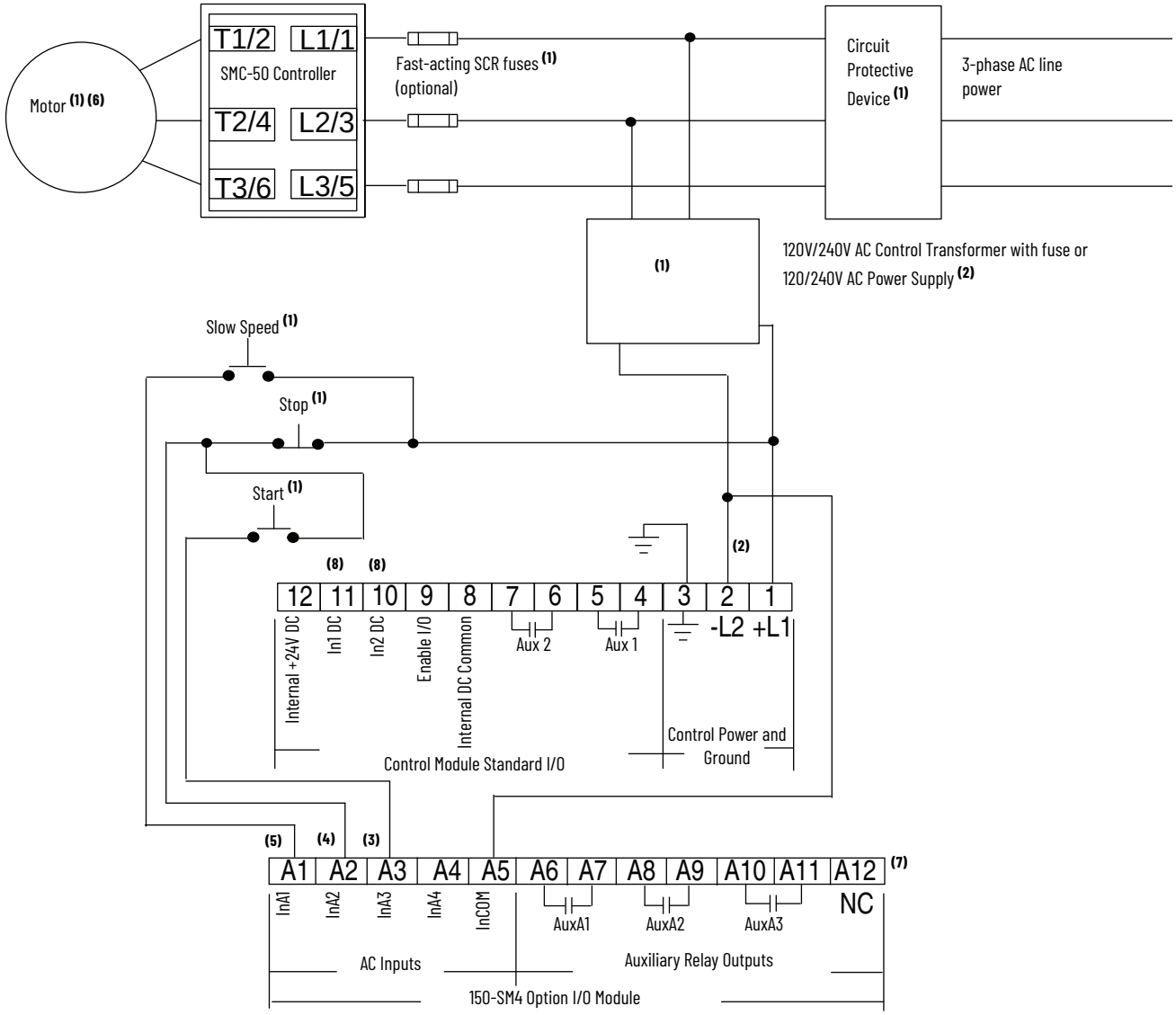


Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Option I/O Terminal A4 (InA4) 100...240V AC input is configured for START input using Parameter 7-5 (control module port 7)
4	Option I/O Terminal A3 (InA3) 100...240V AC input configured for COAST, etc. using Parameter 7-4 (control module port 7)
5	Option I/O module Terminal A1 (InA1) 100...240V AC input is configured for STOP OPTION using Parameter 7-2 (control module port 7). Set parameter 65 [Stop Mode] to SMB.
6	Option I/O module Terminal A2 (InA2) 100...240V AC input is configured for SLOW SPEED using Parameter 7-3 (control module port 7)
7	Configure Aux1 to NORMAL using Parameter 172. NORMAL = Aux1 contact closes to energize the IC coil with the START push button and open to de-energize when the stop maneuver, initiated by the STOP push button, is complete
8	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change
9	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable".

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor (as shown in this diagram) or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

Preset Slow Speed

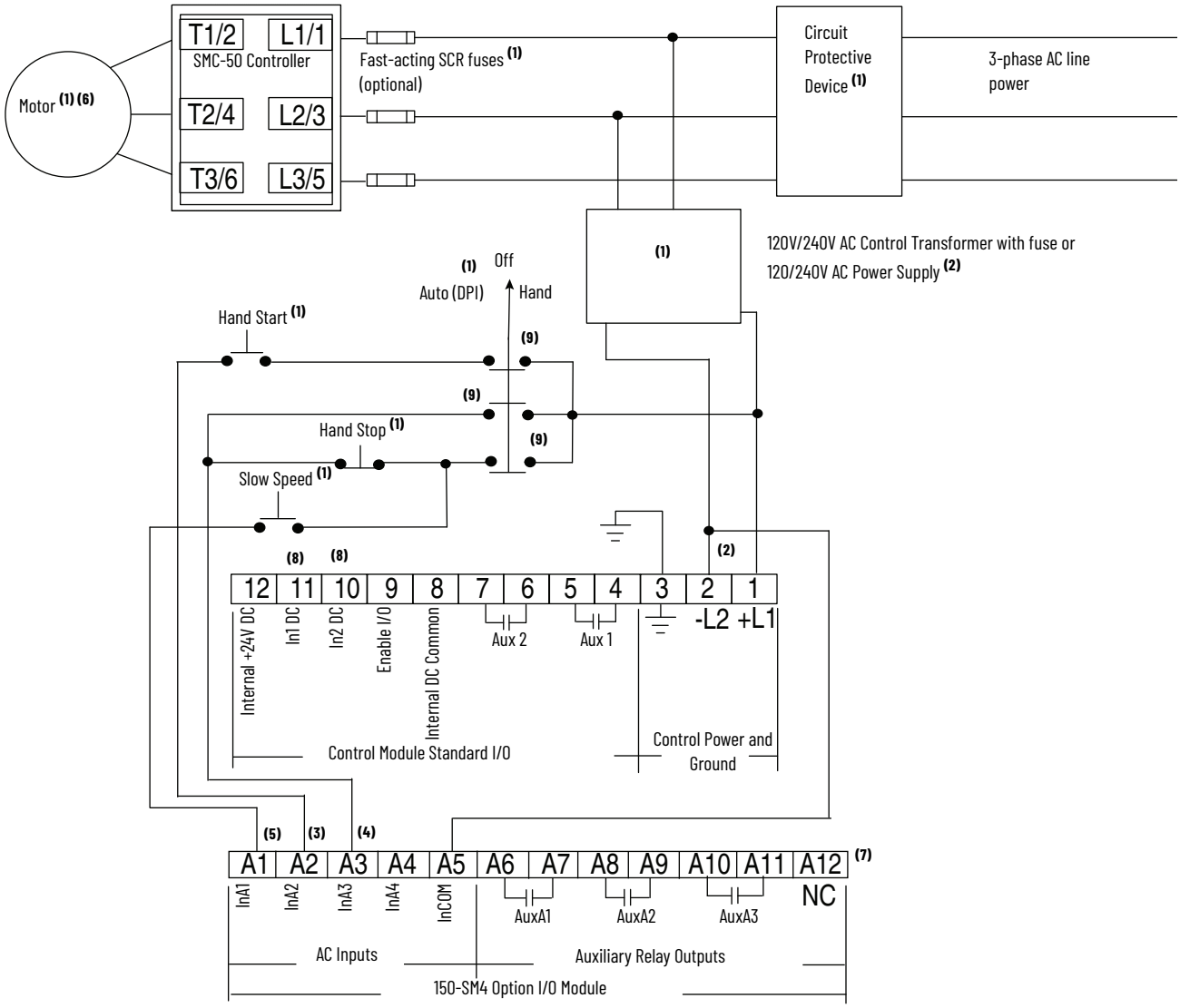
Figure 48 - For Preset Slow Speed Control—AC I/O



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Option I/O Terminal A3 (InA3) 100...240V AC input is configured for START input using Parameter 7-4 (control module port 7)
4	Option I/O Terminal A2 (InA2) 100...240V AC input configured for COAST, Stop Option, etc. using Parameter 7-3 (control module port 7)
5	Option I/O terminal A1 (InA1) 120/240V AC input configured for SLOW SPEED using Parameter 7-2 (control module port 7)
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details.
7	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change
8	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable"

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

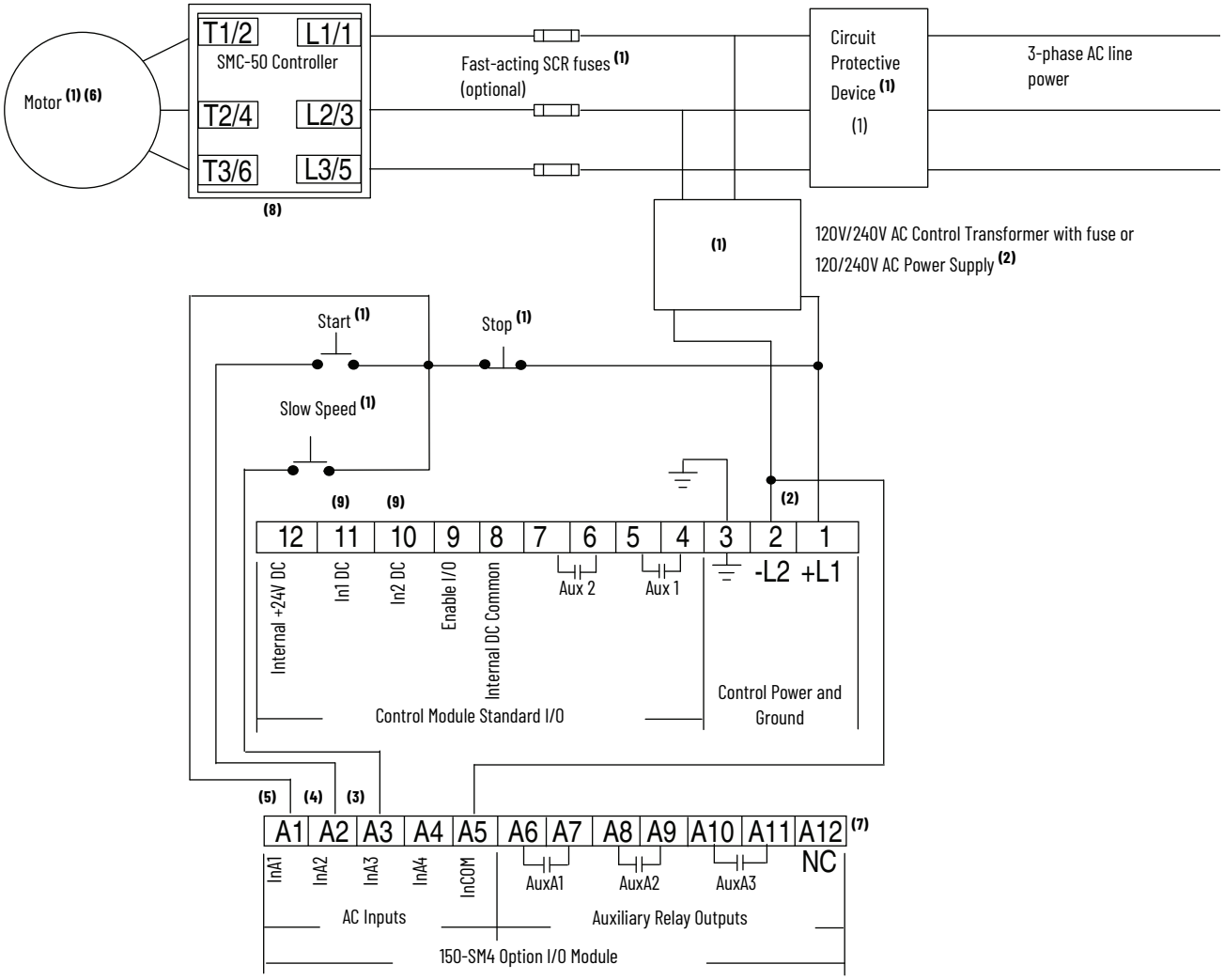
Figure 49 - For Preset Slow Speed Control for Hand-OFF-Auto (DPI) —AC I/O



Note	Information
1	Customer supplied.
2	See the controller nameplate to verify control power input ratings (100...240V AC).
3	Option I/O Terminal A2 (InA2) 100...240V AC input is configured for START input using Parameter 7-3 (control module port 7).
4	Option I/O Terminal A3 (InA3) 100...240V AC input configured for COAST, Stop Option, etc. using Parameter 7-4 (control module port 7).
5	Option I/O Terminal A1 (InA1) 120/240V input configured for SLOW SPEED using Parameter 7-2 (control module port 7).
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details.
7	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change.
8	Configure both In1 (Input 1—Parameter 56) and In2 (Input 2—Parameter 57) to "Disable".
9	The switch is closed in this position.

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

Figure 50 - Accu-Stop—AC I/O



Note	Information
1	Customer supplied
2	See the controller nameplate to verify control power input ratings (100...240V AC)
3	Option I/O Terminal A3 (InA3) 100...240V AC input configured for SLOW SPEED, Stop Option, etc. using Parameter 7-4 (control module port 7)
4	Option I/O Terminal A2 (InA2) 100...240V AC input is configured for SART input using Parameter 7-3 (control module port 7)
5	Option I/O Terminal A1 (InA1) 120/240V Input configured for COAST using Parameter 7-2 (control module port 7)
6	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if the motor requires maintenance. See Figure 83 for details
7	The order of the terminal numbers for the option I/O module are reversible, depending on the control module expansion port it is in. The function associated with the terminal number does not change.
8	Configure Stop Mode to SMB using Parameter 65; Braking Current using Parameter 69; Slow Speed using Parameter 72; and Slow Brake using Parameter 73 (Parameter 73 = 0 results in Coast).
9	Configure both In1(Input 1 - Parameter 56) and In2 (Input 2 - Parameter 57) to DISABLE.

- The controller generates an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.
- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the motor winding(s). This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller Aux contacts configured to NORMAL.

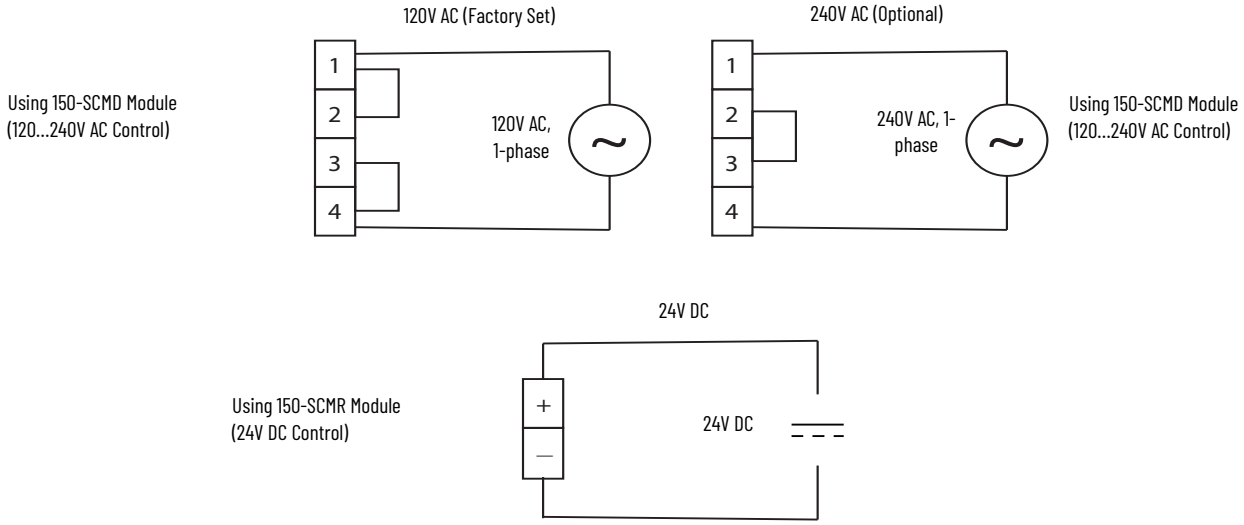
Fan Wiring

Fans for the SMC-50 controllers should be wired according to the instructions in this section.

Integrated Bypass Units

For units with integrated bypass, you should wire the fans as shown in Figure 51.

Figure 51 - Fan Wiring—Integrated Bypass Units



Solid-state Units

Solid-state units do not require any additional wiring. The fans are connected internally.

Upgraded Units

For SMC Flex controller-to-SMC-50 controller control upgrades, the fans remain connected as they were in the SMC Flex controller. You do not need to change any wiring.

IMPORTANT	Fan voltage must match the control voltage of the SMC-50 controller. Examples: 120V AC control voltage = 120V AC fan voltage; 24V DC control voltage = 24V DC fan voltage

Operating Modes

Operation

The SMC-50 controller with an internal bypass power structure can operate standard squirrel-cage induction motors rated 27…480 A or star-delta (wye-delta) type motors rated 47…831 A operated inside-the-delta.

The SMC-50 controller with a solid-state power structure can operate standard squirrel-cage induction motors rated 30…520 A or star-delta (wye-delta) type motors rated 52…900 A operated inside-the-delta.

IMPORTANT Verify line and control voltage values on the product before you apply power.

Motor Configuration

Line-connected wye, line-connected delta, and inside-the-delta motor configurations are possible with the SMC-50 controller. The motor tuning feature of the SMC-50 controller automatically determines the motor connection. Motor tuning is done automatically by the controller on initial motor start or forced to occur by the user. You can also enter the configuration of the Motor Connection via parameter 44, into the SMC-50 controller. You must enter the Motor Line Voltage into the controller via parameter 46 [Line Voltage] to enable the motor protection features to function (default 480V).

Motor Tuning

The SMC-50 controller 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 controller 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…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.

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 restart the process via one of the following methods:

1. Change the status of parameter 194 [Forced Tuning] 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 changes back to FALSE. **OR**
2. Press the "HOLD TO TEST/PUSH TO RESET" push button on the front of the controller for ten seconds with the motor stopped. The tuning

process occurs during the next start cycle. The controller's status LED flashes amber to indicate that tTuning occurs on the next start cycle. **OR**

3. When the controller processes a "Load Factory Defaults" command via parameter 229 [Parameter Mgmt].

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

Table 7 lists parameter 194 [Forced Tuning] and other key motor parameters that the SMC-50 controller checks during a motor tuning cycle.

Table 7 - Key Motor Parameters Checked During a Motor Tuning Cycle

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
194	Force Tuning	FALSE/TRUE	TRUE	R/W	–
195	Stator R	0.00...50.00	0.00...50.00	R	Ω
196	Total R	0.00...50.00	0.00...50.00		Ω
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		–

Resistive Loads

The resistive load feature lets you control voltage from 1...100% of full voltage with simple settings.

- Setting parameter 347 [Load Type] to Resistive.
- Set the reference source, parameter 348 [Ref Source], to either Output V Ref (Output Voltage Reference), analog card 150-SM3 input, or DeviceLogix output.

If the Ref Source is selected in parameter 348 [Ref Source], then you must set parameter 349 [Output V Ref]. You must also set parameter 46 [Line Voltage] and parameter 78 [Motor FLC].

The Motor FLC when resistive load is selected is actually resistance full load current; you need to calculate this if you do not know the value for the load. If needed, You can also set parameter 53 [Cur Limit Level] to limit the amount of current that is supplied to the resistors. You can change the value of the reference source while the SMC-50 controller is in a run state.

ATTENTION: You cannot use the resistive load feature on motor loads

Three-phase Balanced Loads

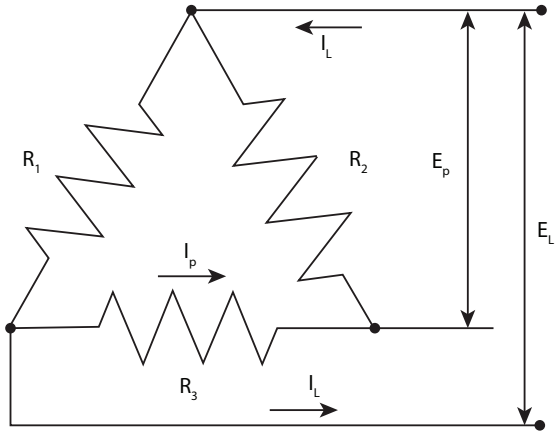
Variable	Definition
R	Resistance
R_1	Branch 1 resistance
R_2	Branch 2 resistance
R_3	Branch 3 resistance
E_L	Line voltage
E_P	Phase voltage
I_L	Line current
I_P	Phase current
W	Wattage
PF	Power factor

Wattage Calculations:

Wye: $W=E_L^2/R = 3(E_P^2)/R$

Delta: $W = 3(E_L^2)/R$

Figure 52 - Delta- and Wye-connected Resistive Loads



Delta

$E_L = E_p$

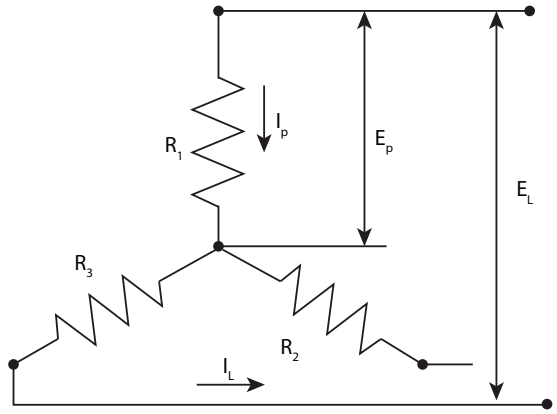
$I_L = 1.73 \times I_p$

$I_p = I_L/1.73$

$P = I_L \times E_L \times 1.73 \times PF$

$W = 1.73 \times I_L \times E_L$

Note: With resistive loads, PF = 1.0 and therefore P = W



Wye

$I_L = I_p$

$E_L = 1.73 \times E_p$

$E_p = E_L/1.73$

$P = I_L \times E_L \times 1.73 \times PF$

$W = 1.73 \times I_L \times E_L$

Figure 53 - Delta Configuration for SMC-50 Controller

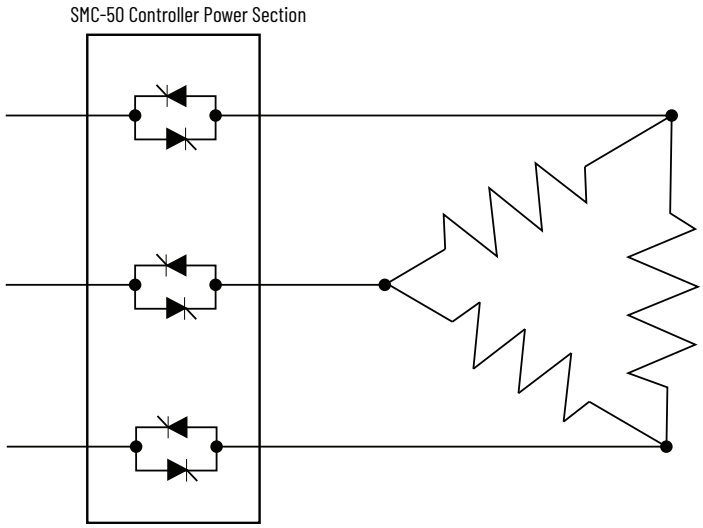


Figure 54 - Grounded Wye Configuration for SMC-50 Controller

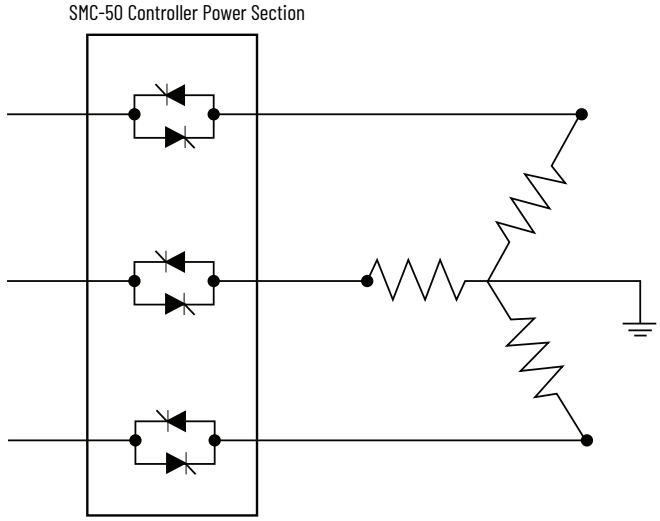


Figure 55 - Inside-the-Delta Configuration for SMC-50 Controller

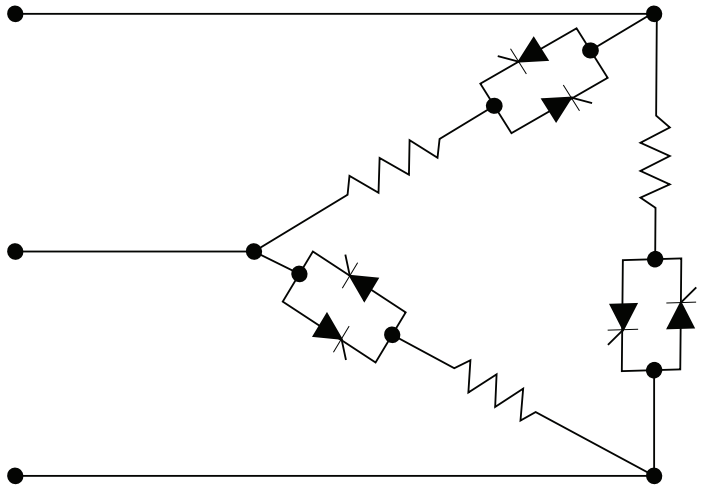


Table 8 - SMC-50 Controller Resistive Load Parameters

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Unit
347	Load Type	Motor/Resistive	Motor	Read/write	–
348	Ref Source	Output V Ref P7 In1 P7 In2 P8 In1 P8 In2 P9 In1 P9 In2 DLX Output 1 DLX Output 2	Output V Ref		–
349	Output V Ref	1...100	1		%
46	Line Voltage	0...700	400		Volts
53	Cur Limit Level	50...600	350		%FLC
78	Motor FLC[1]	1.0...2200.0	1.0		Amps

(1) You must calculate Motor FLC for the resistive load current based on the watts, voltage, and configuration.

Starting Modes

Overview

Configure the SMC-50 controller starting mode using parameter 49 [Starting Mode]. The available starting modes are: Soft Start [default], Current Limit, Torque Ramp, Linear Speed (Linear Acceleration), Pump Start, and Full Voltage.

Linear Speed (Linear Acceleration)

Set parameter 49 [Starting Mode] = Linear Speed.

The SMC-50 can start the motor following a timed linear ramp. The value of parameter 50 [Ramp Time] is selectable from 0.0...1000.0 seconds and determines the time the motor ramps from a zero speed to full speed condition. Parameter 51 [Initial Torque] sets the starting torque that is supplied to the motor from the controller. A current limit setting (50...600% selectable of motor FLC) is also available. If the controller reaches the current limit setpoint, the acceleration ramp stops. When the unit comes out of current limit, the linear ramp resumes.

Kickstart is not available with this starting mode.

Figure 56 provides a graphical example of a linear acceleration; Table 9 provides a list of linear acceleration parameters.

Figure 56 - Linear Speed Acceleration Timing Diagram

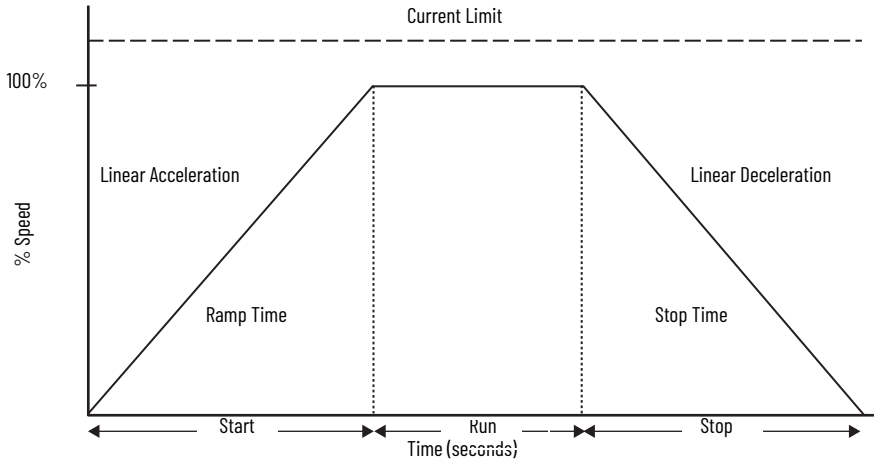


Table 9 - Linear Acceleration Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
50	Ramp Time	0.0...1000.0	10.0	R/W	Secs
51	Initial Torque	0...90	70		%LRT
53	Cur Limit Level	50...600	350		%FLC
78	Motor FLC	1.0...2200.0	1.0		Amps
199	Speed PGain	0...10000	1000		–

Soft Start

Set parameter 49 [Starting Mode] = Soft Start. This is the factory default value.

This mode has the most general applications. The motor is given an initial torque setting using parameter 51 [Initial Torque], which is user-adjustable

from 0...90% of locked rotor torque. From the initial torque level, the output voltage to the motor is linearly increased during the acceleration ramp time. The acceleration ramp time is adjustable from 0...1000 seconds using parameter 50 [Ramp Time].

During soft start, a current limit override (50...600% FLC) is also available to limit current throughout the start cycle using parameter 53 [Cur Limit Level]. The controller has Up-to-Speed (UTS) detection to determine when the motor is at full speed. If the motor reaches UTS before the end of the ramp time, the SMC-50 controller applies full voltage to the motor and the soft start is ended. The UTS level can be configured in percent of the SMC-50 controller's applied motor voltage using parameter 186 [UTS Level]. Table 10 lists the full Soft Start parameter list.

If the controller is detecting UTS too soon, the UTS level should be increased. This typically occurs in very high-efficiency motors. If the controller is detecting UTS too late or not at all, the UTS level should be lowered. This typically occurs in very low-efficiency motors. See Timed Start on page 77 for additional details.

Figure 57 - Soft Start Timing Diagram

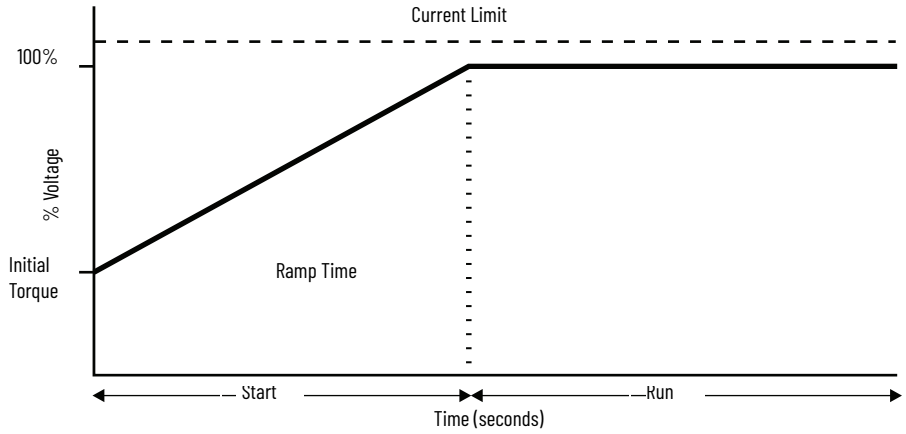


Table 10 - Soft Start Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
50	Ramp Time	0.0...1000.0	10.0	R/W	Secs
51	Initial Torque	0...90	70		%LRT
53	Cur Limit Level	50...600	350		%FLC
54	Kickstart Time	0.0...2.0	0.0		Secs
55	Kickstart Level	0.0...90	0.0		%LRT
182	Start Delay	0.0...30	0.0		Secs
186	UTS Level	0...100	75		%
78	Motor FLC	1.0...2200.0	1.0		Amps

Selectable Kickstart

This feature provides a torque (current) boost at startup to break away loads that require a pulse of high torque to get started. The amount of torque pulse is selectable from 0...90% of locked rotor torque using parameter 55 [Kickstart Level]. The time duration for the selectable kickstart is user-adjustable from 0.0...2.0 seconds using parameter 54 [Kickstart Time].

Kickstart is available in Soft Start, Current Limit, Pump, and Torque Control starting modes.

Figure 58 provides a graphical representation of Kickstart. Table 11 provides the Kickstart Mode Parameter List.

Figure 58 - Selectable Kickstart Timing Diagram

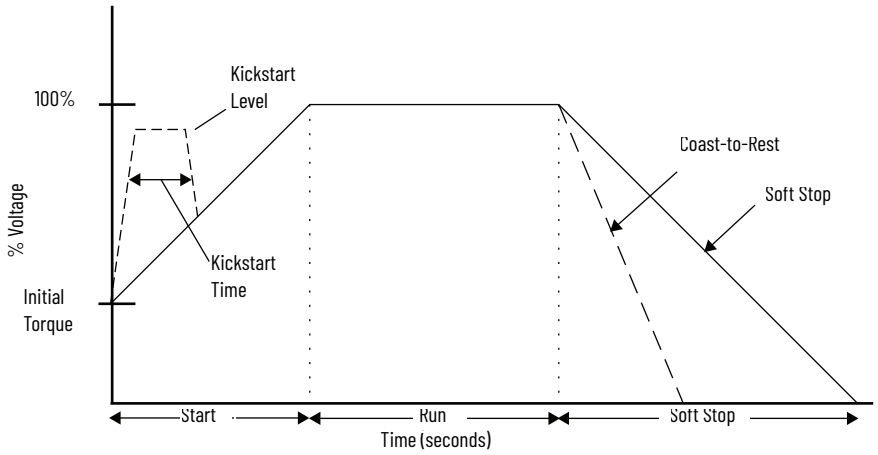


Table 11 - Kickstart Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
54	Kickstart Time	0.0...2.0	0.0	R/W	Secs
55	Kickstart Level	0.0...90	0.0		%LRT

Current Limit Start

Set parameter 49 [Starting Mode] = Current Limit.

This starting mode provides a true current limit start, and is used when it is required to limit the maximum starting current to the load. This is accomplished using parameter 53 [Cur Limit Level], which is user-adjustable from 50...600% of the motor full-load current rating (FLC) and parameter 50 [Ramp Time], which is user-adjustable from 0.0...1000.0 seconds. For current limit, the Ramp Time is the time that the controller holds the current limit level until switching to full voltage. If the controller senses that the motor has reached the UTS condition during the current limit starting mode, the current limit ramp ends. As with Soft Start, the UTS level can be modified to account for load or motor characteristics. If Ramp Time has expired and UTS is not achieved, the SMC-50 controller holds the current limit until UTS is reached, a Motor Overload Trip, or Starter Overtemp Fault occurs. Kickstart is also available with current limit.

Figure 59 provides a graphical depiction of a Current Limit Start. Table 12 provides a list of Current Limit Start parameters.

Figure 59 - Current Limit Start Timing Diagram

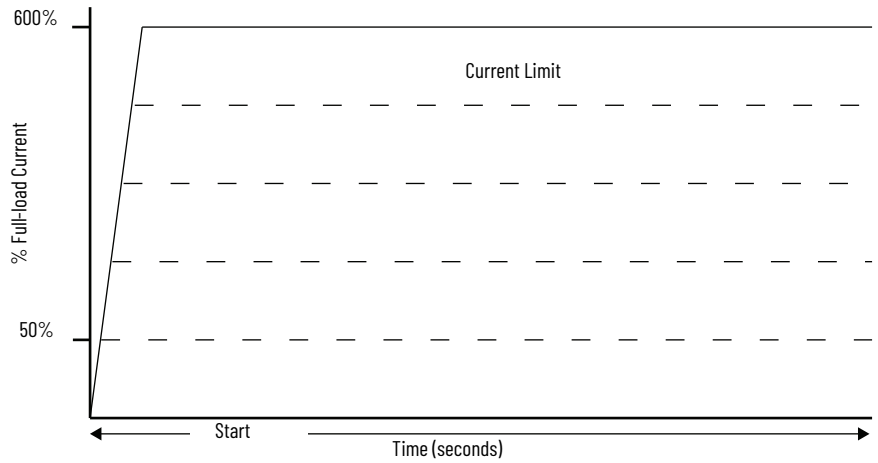


Table 12 - Current Limit Start Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
50	Ramp Time	0.0...1000.0	10.0	R/W	Secs
53	Cur Limit Level	50...600	350		%FLC
54	Kickstart Time	0.0...2.0	0.0		Secs
55	Kickstart Level	0.0...90	0.0		%LRT
182	Start Delay	0.0...30	0.0		Secs
186	UTS Level	0.0...100	75		%
78	Motor FLC	1.0...2200.0	1.0		Amps

Full Voltage Start

Set parameter 49 [Starting Mode] = Full Voltage.

This starting mode is used for applications requiring across-the-line starting. The controller supplied voltage to the motor reaches full voltage within five AC line cycles (0.08 s at 60 Hz and 0.1 s at 50 Hz).

Figure 60 - Full Voltage Start Timing Diagram

Torque Control Start

Set parameter 49 [Starting Mode] = Torque Ramp.

This motor starting method provides a torque ramp from an initial starting torque level to a maximum torque level over the start time. The torque levels are entered in percent of rated motor torque. This requires that you configure parameter 47 [Rated Torque] to the motor's rated torque. The torque start operating mode requires motor tuning to function properly. Tuning can be forced manually; it is otherwise performed automatically the first time the motor is started. See Motor Tuning on page 67.

Figure 61 - Torque Control Start Timing Diagram

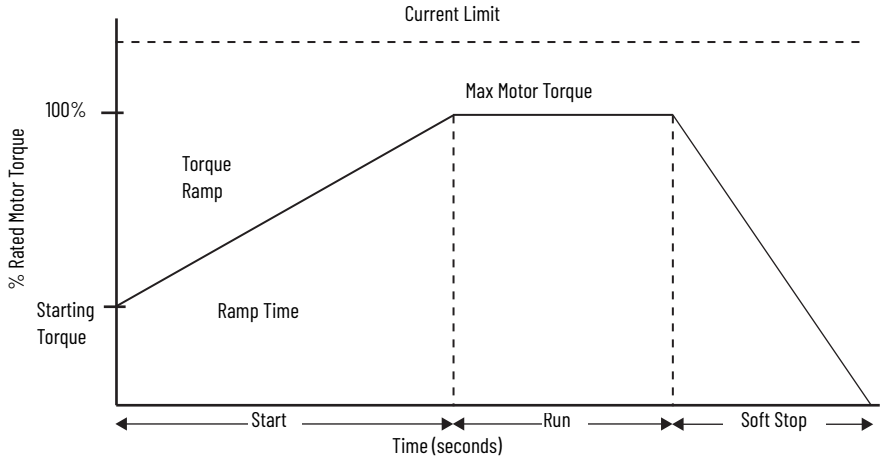


Table 13 provides a list of Torque Control Start parameters.

Table 13 - Torque Start Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
305	Starting Torque	0...300	100	R/W	%
52	Max Torque	0...300	250		%
50	Ramp Time	0.0...1000.0	10.0		Secs
47	Rated Torque	0...10000	10		N•m
48	Rated Speed	750, 900, 1500, 1800, 3600	1800		rpm
53	Cur Limit Level	50...600	350		%FLC
54	Kickstart Time	0.0...2.0	0.0		Secs
55	Kickstart Level	0.0...90	0.0		%LRT
78	Motor FLC	1.0...2200.0	1.0		Amps

Pump Control Start and Stop

Set parameter 49 [Starting Mode] = Pump Start.

Set parameter 65 [Stop Mode] = Pump Stop.

This control mode helps to reduce surges (fluid hammer) during the starting and stopping of a centrifugal pump by smoothly accelerating and decelerating the motor. As such, starting and stopping parameters are typically configured together. The microprocessor analyzes the motor variables and generates commands that control the motor and reduce the possibility of surges occurring in the system.

The starting time (parameter 50 [Ramp Time]) is programmable from 0.0...1000.0 seconds and the stopping time (parameter 66 [Stop Time]) is programmable from 0...999 seconds when the Pump Stop mode is selected from parameter 65 [Stop Mode].

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. Select the lowest stopping time setting that satisfactorily stops the pump.

Figure 62 - Pump Control Mode Timing Diagram

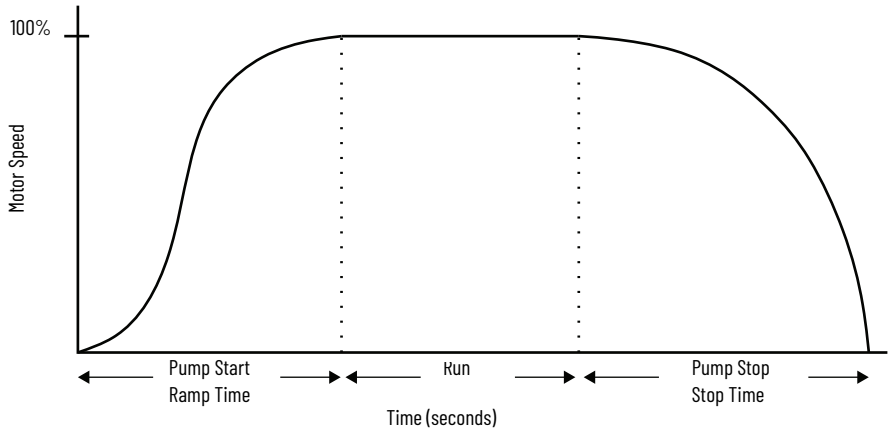


Table 14 - Pump Start Control Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
50	Ramp Time	0.0...1000.0	10.0	R/W	Secs
51	Initial Torque	0...90	70		%LRT
67	Backspin Timer	0...999	0		Secs
54	Kickstart Time	0.0...2.0	0.0		Secs
55	Kickstart Level	0.0...90	0.0		%LRT
78	Motor FLC	1.0...2200.0	1.0		Amps

Table 15 - Pump Stop Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
66	Stop Time	0.0...999.0	0.0	R/W	Secs
68	Pump Pedestal	0.0...50.0	0.0		%

Parameter 68 [Pump Pedestal] lets you modify the internal pump control algorithm for special application conditions.

For example, if overload trips persist during stopping, either reduce parameter 66 [Stop Time] or increase the Pump Pedestal in 5% increments. Try not to exceed 40%.

Additional Start Features—Functions

Dual Ramp Start

This feature is useful for applications that have varying loads (and therefore varying starting feature requirements). Dual Ramp lets you select between two separate start profiles with separately adjustable ramp times, initial torque settings, and do on, to best meet the application needs.

The second start profile is enabled by configuring one of the controller auxiliary inputs to Dual Ramp and activating that input. When the Start command is then activated, the second start profile begins.

Figure 63 - Dual Ramp Start Timing Diagram

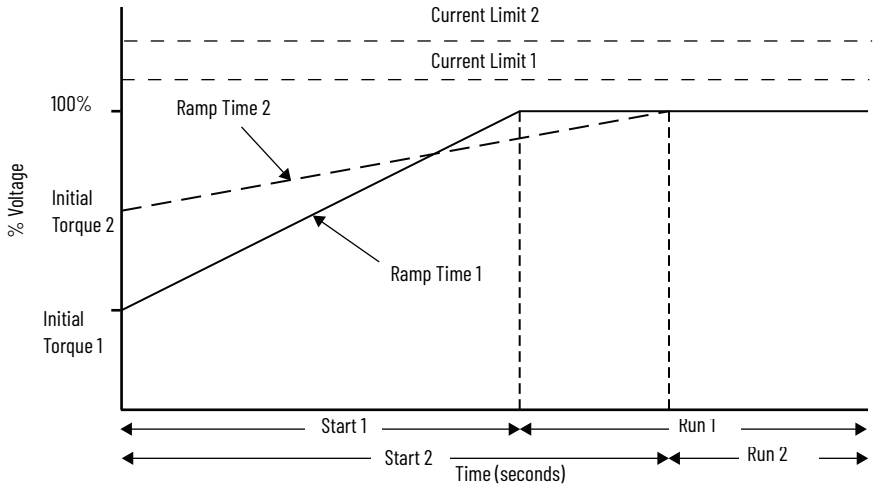


Table 16 - Dual Ramp Start Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
49	Starting Mode	Full Voltage, Current Limit, Soft Start, Linear Speed, Torque Ramp, Pump Start	Soft Start	R/W	–
50	Ramp Time	0.0...1000.0	10.0		Secs
51	Initial Torque	0...90	70		%LRT
52	Max Torque	0...300	250		%
53	Cur Limit Level	50...600	350		%FLC
54	Kickstart Time	0.0...2.0	0.0		Secs
55	Kickstart Level	0.0...90	0.0		%LRT
305	Starting Torque	0...300	100		%
58	Starting Mode 2	Full Voltage, Current Limit, Soft Start, Linear Speed, Torque Ramp, Pump Start	Soft Start		–
59	Ramp Time 2	0.0...1000.0	10.0		Secs
60	Initial Torque 2	0...90	70		%LRT
61	Max Torque 2	0...300	250		%
62	Cur Limit Level 2	50...600	350		%FLC
63	Kickstart Time 2	0.0...2.0	0.0		Secs
64	Kickstart Level 2	0...90	0.0		%LRT
306	Starting Torque 2	0...300	100		%
182	Start Delay	0...30	0		Secs

Start Timer (Start Delay)

This feature lets you set a user-configurable start (0...30 s) delay from the point when the start command is enabled until the start sequence actually occurs. This feature applies to any start mode.

Timed Start

Parameter 183 [Timed Start] forces the starting profile to complete the entire user-configured ramp time before applying full voltage. In some starting modes (for example, soft start) and with certain loads (for example, lightly loaded motor), an early UTS condition can be generated placing the SMC-50 controller in full-voltage start, which might cause excessive current. Setting

Timed Start to "Enable" forces all starts to complete the configured Ramp Time that is set in parameter 50 [Ramp Time].

Backspin Timer

Parameter 67 [Backspin Timer] is provided to avoid starting a motor into a backspin condition, which can result in motor shaft damage. The user-configured time begins to count down after a stop maneuver is complete. All start inputs are ignored until the backspin timer has timed out.

Motor Winding Heater Function

The Motor Winding Heater function provides low levels of current to each of the motor windings to preheat a cold motor before starting. To avoid thermally stressing an individual motor winding, the SMC-50 controller cycles the heating current to each of the phases. This feature provides a programmable heating level, heating time, and a control (terminal block) input that can be used to start the process.

Configuration of control module inputs is done via parameter 56 [Input 1] or parameter 57 [Input 2]. If a 150-SM4 Optional Digital I/O Module is configured, its inputs can also be used for the motor winding heater function.

Table 17 - Motor Winding Heater Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
220	Heating Time	0...1000	0	R/W	Secs
221	Heating Level	0...100	0		%

The motor winding heater function is activated after it receives a valid start command. After a valid start, you can activate the heating function by:

- programming parameter 220 [Heating Time] to a nonzero value or
- configuring an input to "Motor Heater" and activating that input before the start command.

The heater function continues for the specified time or until the input is deactivated, at which time the motor starts. The heater function is disabled if the:

- parameter 221 [Heating Level] is set to zero, or
- parameter 220 [Heating Time] is set to zero, or
- input is inactive (or not configured) at the time of the start command.

Stopping Modes

Overview

Parameter 65 [Stop Mode] defines the type of stop maneuver that the SMC-50 controller performs when a stop command is issued. The STOP command can be initiated through any input[(a)], a network command, or the JOG key on the A6 HIM.

The STOP Key on a Cat. no. 20-HIM-A6 or 20-HIM-C6S device initiates a Coast-to-Stop.

The available stopping modes are:

- Coast-to-stop
- Soft Stop

(a) To use terminal block inputs to initiate a Stop Mode, configure the respective input for Start/Stop or Stop Option.

- Linear Speed Deceleration
- SMB Smart Motor Braking
- Pump Stop
- External Brake

Coast-to-Stop

Set parameter 49 [Starting Mode] = Coast. This is the factory default value.

When parameter 65 [Stop Mode] is set to coast-to-stop and the STOP command is initiated, the starter does not perform any other function and the motor coasts to a stop. No other Stop parameters need to be configured if Coast-to-Stop is enabled.

The Coast-to-Stop command overrides all other commands that could result in motor operation. When this command is initiated, it is latched into the controller's logic so that no other motor command can occur until it is cleared. It is cleared when all terminal block Start inputs are opened and any other Soft Stop (Inhibits a Start) input is removed. In a 2-wire control scheme, this involves placing the Start/Stop input in the Stop position; in a 3-wire control scheme, this involves opening the Start input.

Soft Stop

Set parameter 65 [Stop Mode] = Soft Stop.

The Soft Stop feature can be used in applications that require an extended stop time. The voltage ramp down time is user-adjustable from 0...999 seconds using parameter 66 [Stop Time]. The load stops when the SMC-50 controller output voltage drops to a point where the load torque is greater than the developed motor torque.

ATTENTION: Soft Stop is not intended to be used as an emergency stop. See the applicable standards for emergency stop requirements.

Figure 64 - Soft Stop Timing Diagram

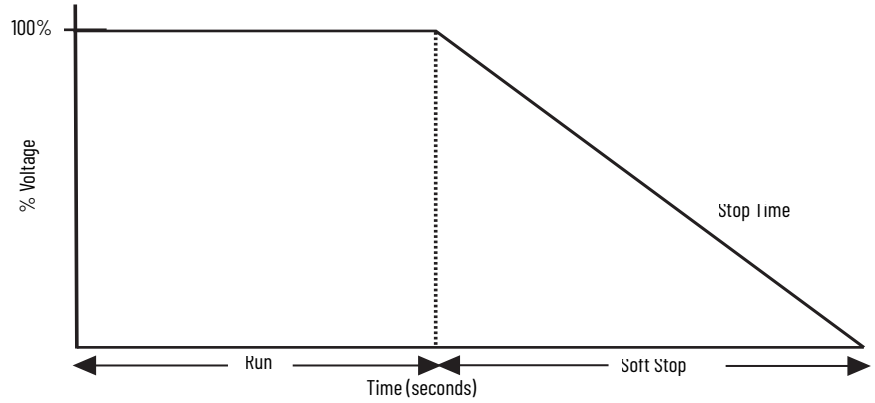


Table 18 - Soft Stop Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
66	Stop Time	0...999	0	R/W	Secs

For additional details, see Figure 71 on page 88

Linear Speed (Linear Deceleration)

Set parameter 65 [Stop Mode] = Linear Speed.

When parameter 65 [Stop Mode] is configured for Linear Speed, the SMC-50 controller stops the motor following a timed linear speed ramp that is configured in parameter 66 [Stop Time]. A current limit setting is also available to limit the current while stopping. If the current limit level is reached, the motor decelerates faster than the defined ramp. If motor current falls below the current limit, the ramp is resumed.

ATTENTION: Linear Stop is not intended to be used as an emergency stop. See the applicable standards for emergency stop requirements.

Figure 65 - Linear Speed Deceleration Timing Diagram

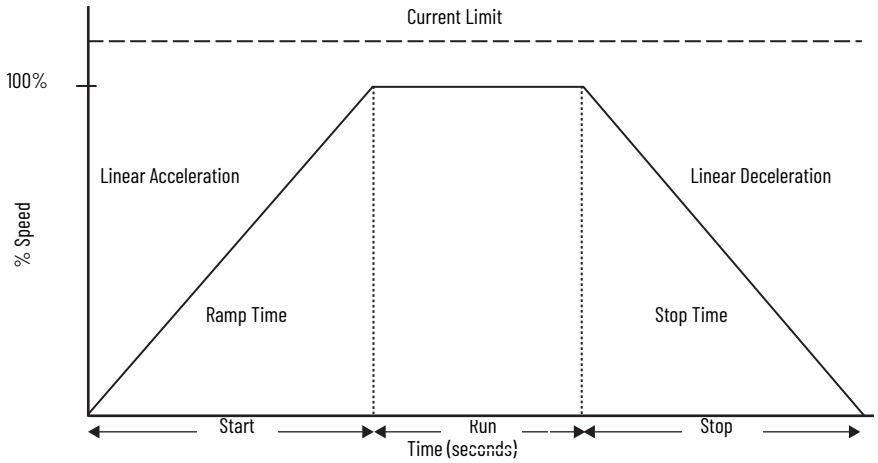


Table 19 - Linear Deceleration Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
66	Stop Time	0.0...999	0.0	R/W	Secs
53	Cur Limit Level	50...600	350		%FLC

For additional details, see Figure 71 on page 88.

Smart Motor Braking (SMB)

Set parameter 65 [Stop Mode] = SMB.

When parameter 65 [Stop Mode] is configured for SMB and the Stop Maneuver is commanded, the SMC-50 controller applies the configured braking current and brakes the motor to a stop. This function can be used in applications that require reduced stopping times. The SMC-50 incorporates a microprocessor-based system that applies braking current to the motor without any additional equipment. This option offers a user-adjustable braking current setting from 0...400% of the motor's full-load current rating using parameter 69 [Braking Current]. It also provides automatic brake current shut-off at zero speed detection.

ATTENTION: Smart Motor Braking is not intended to be used as an emergency stop. See applicable standards for emergency stop requirements.

Figure 66 - SMB Timing Diagram

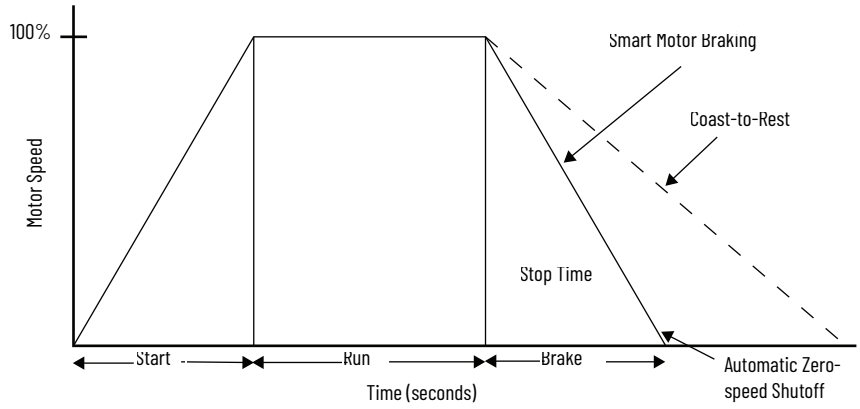


Table 20 - SMB Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
66	Stop Time(1) (2)	0...999	0	R/W	Secs
69	Braking Current	0...400	0		%FLC

(1) You do not need to program a Stop Time when you are using SMB. SMB automatically controls the duration (Stop Time) of the braking current to the motor from the Running at Speed condition until a zero speed condition (Zero Speed Braking Shut Off feature/function). Programming a Stop Time overrides the SMB Zero Speed Braking Shutoff feature/function. This could result in current being applied to a stopped motor, which causes the motor to overheat.

(2) With parameter 66 [Stop Time], set to a nonzero time value, the user-selected parameter 69 [Braking Current] is applied for the user-configured "Stop Time" regardless of the motor speed (for example, Automatic Zero Speed Detection disabled). You can use this braking method in applications where detecting zero speed is ineffective or when braking the motor to a complete stop results in random overload trips. An ideal Stop Time setting can be accomplished by trial and error, but should always allow for some coast time. Setting the Stop Time for too long of a time can result in braking current to be applied to a stopped motor and likely results in overload trips.

Preset Slow Speed and Slow Speed with Braking

The Slow Speed Mode can be used in applications that require a jog for general-purpose positioning. Parameter 72 [Slow Speed 1] and parameter 350 [Slow Speed 2] provide operation from +1...15% forward or -1...15% reverse of the motor base speed.

You must configure an SMC-50 controller control input for Slow Speed to initiate a slow speed operation. You must configure a second input for Coast or Stop Option, parameter 56 [Input 1] and parameter 57 [Input 2].

The Slow Speed operating mode requires motor tuning to function properly. Tuning can be forced manually; it is otherwise performed automatically the first time the motor is started. See Motor Tuning on page 67.

To provide more precise stopping from a slow speed operation, braking from slow speed can also be configured using parameter 73 [Slow Brake Cur]. The maximum allowable brake current is 350% FLC. A value of 0 (default) applies no braking and a motor coast-to-stop results and slow speed is terminated.

ATTENTION: Slow speed running is not intended for continuous operation; motor cooling and thermal capacity of the controller are reduced in this operating mode.

Figure 67 - Preset Slow Speed Timing Diagram

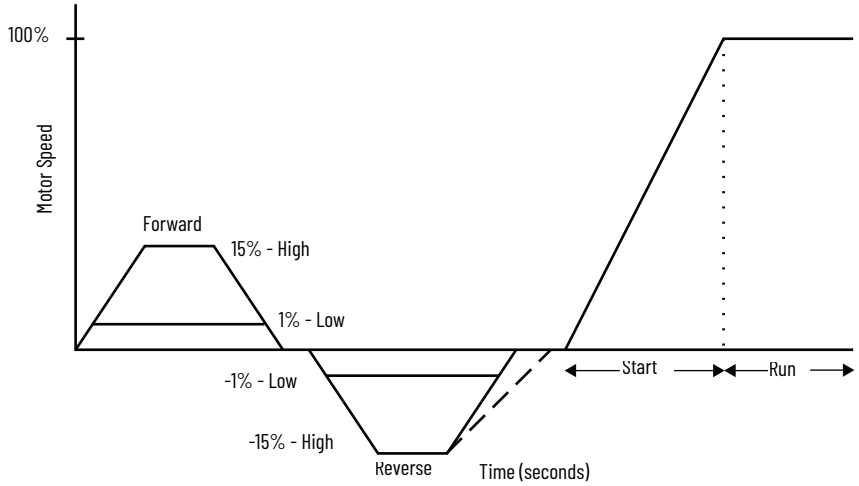


Table 21 - Preset Slow Speed and Slow Speed with Braking Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
56	Input 1	0...14	4 (Stop option)	R/W	–
57	Input 2	0...14	0 (Disable)		–
72	Slow Speed 1	-15...+15(1)	+10(1)		%
73	Slow Brake Cur	0...350(2)	0(2)		%FLC
350	Slow Speed 2	-15...+15(1)	+10(1)		%

(1) Direction of the motor rotation is dependent on the sign (±) of Slow Speed%.
(2) With parameter 73 [Slow Brake Cur] set to 0 (default), the motor coasts-to-stop from Slow Speed. When the value is between 1...350, braking current is applied from Slow Speed.

Accu-Stop™

This function combines the benefits of the SMB and Preset Slow Speed features. For general-purpose positioning, the Accu-Stop function provides a brake from full speed to the preset slow speed setting, then a brake or coast-to-stop.

The Accu-Stop function is enabled whenever parameter 65 [Stop Mode] is configured for SMB and:

- a control input is configured for Stop
- a control input is configured for Start
- a control input is configured for Slow Speed.

With the above SMC-50 controller control configuration and with the motor running, enabling the Slow Speed input initiates an SMB to the value that is configured in parameter 72 [Slow Speed 1]. The SMC-50 controller continues to run the motor in slow speed until the Slow Speed input is disabled, At that point, the motor either brakes to stop or coasts to stop, depending on the value of parameter 73 [Slow Brake Cur]. If the value of Slow Brake Cur is zero, the motor coasts to stop from Slow Speed. If the value of Slow Brake Cur is a value other than zero, the SMC-50 controller uses braking to stop the motor using that value as a percent of the Motor FLC. See Figure 68, Figure 75, and Table 22.

The Accu-Stop operating mode requires motor tuning to function properly. Tuning can be forced manually; it is otherwise performed automatically the first time the motor is started. See Motor Tuning on page 67.

ATTENTION: Accu-Stop is not intended to be used as an Emergency Stop. See applicable standards for emergency stop requirements

Figure 68 - Accu-Stop Timing Diagram

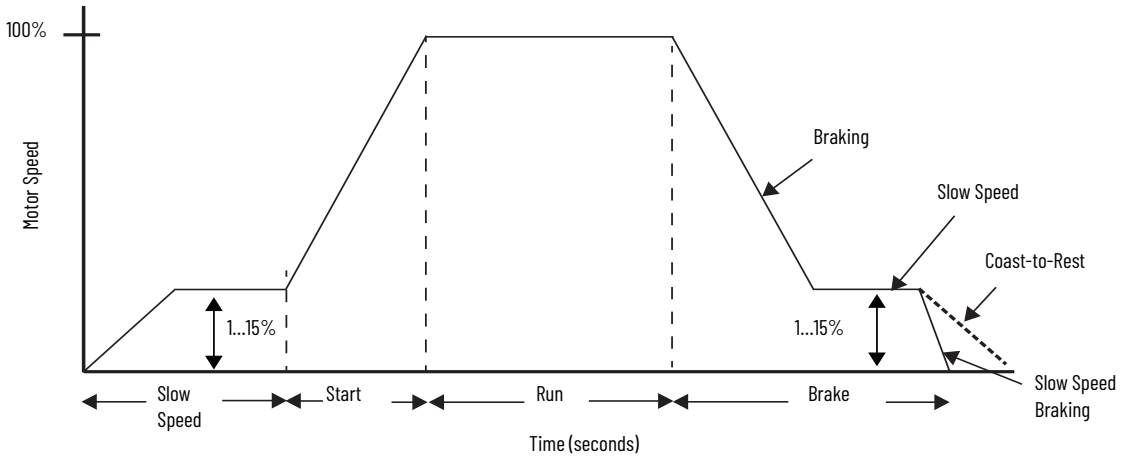


Table 22 - Accu-Stop Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
65	Stop Mode	SMB	Coast	R/W	–
66	Stop Time(1)(2)	0...999	0		Secs
69	Braking Current	0...400	0		%FLC
72	Slow Speed (3)	-15...+15	+10		%
73	Slow Brake Cur(4)	0...350	0		%FLC

(1) You do not need to program a Stop Time when you are using SMB. SMB automatically controls the duration (Stop Time) of the braking current to the motor from the Running at Speed condition until a zero speed condition (Zero Speed Braking Shut Off feature/function). Programming a Stop Time overrides the SMB Zero Speed Braking Shutoff feature/function. This could result in current being applied to a stopped motor, which causes the motor to overheat.
(2) With parameter 66 [Stop Time], set to a nonzero time value, the user-selected parameter 69 [Braking Current] is applied for the user-configured "Stop Time" regardless of the motor speed (for example, Automatic Zero Speed Detection disabled). You can use this braking method in applications where detecting zero speed is ineffective or when braking the motor to a complete stop results in random overload trips. An ideal Stop Time setting can be accomplished by trial and error, but should always allow for some coast time. Setting the Stop Time for too long of a time can result in braking current to be applied to a stopped motor and likely results in overload trips.
(3) Direction of the motor rotation is dependent on the sign (±) of Slow Speed.
(4) With parameter 73 [Slow Brake Cur] set to 0 (default), the motor coasts-to-stop from Slow Speed. When the value is between 1...350, braking current is applied from Slow Speed.

External Braking Control

Set parameter 65 [Stop Mode] = External Brake.

The external braking control feature enables an external mechanical motor brake to function in concert with the SMC-50 controller stop parameter. When parameter 65 [Stop Mode] is set to Ext Brake and the stop maneuver is commanded, the starter removes power to the motor and closes any auxiliary output that is configured for External Brake. The auxiliary output relay that is configured for External Brake(a) remains active for the user-configured parameter 66 [Stop Time]. After the Stop Time is complete, the unit opens the auxiliary output and switches to the stopped state. While in the External Brake stopped mode, all relays and status functions operate as they would in any other mode.

(a) The appropriate auxiliary relay must be configured for the Ext. Brake stopping function by using the Aux X relay configuration parameter (for example parameter 172 [Aux1 Config], parameter 176 [Aux2 Config].

Table 23 - External Braking Control Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
66	Stop Time	0...999	0	R/W	s

Running Modes

Internal Bypass Modes

The unit runs under SCR control mode when it starts and stops a motor. When the motor is up to speed, the internal bypass contactor(s) close. Motor current then flows through the contactor(s) and not through the SCRs.

Solid-state (SCR) Control Mode

The unit runs at full voltage under SCR control mode when the unit is at full speed and when no external bypass contactor is provided. All SMC-50 controller diagnostic and power monitoring features are available in this running mode.

External Bypass Control Mode

An external bypass contactor may be configured to operate the motor while running at full voltage and speed. The SMC-50 controller controls the external bypass contactor by using one of the auxiliary relay outputs configured to Ext. Bypass using that output's configuration parameter.

Devices rated 90...180 A

In external bypass control mode on devices rated 90...180 A, the controller's integral current sensors are out of the control circuit. If all current sensing features (including motor overload) are desired while running in external bypass control mode, then the optional PTC/Ground Fault/External Current Transformer Expansion Module (150-SM2) and an 825-MCM180 current sensor are required. See Figure 110 and Figure 42.

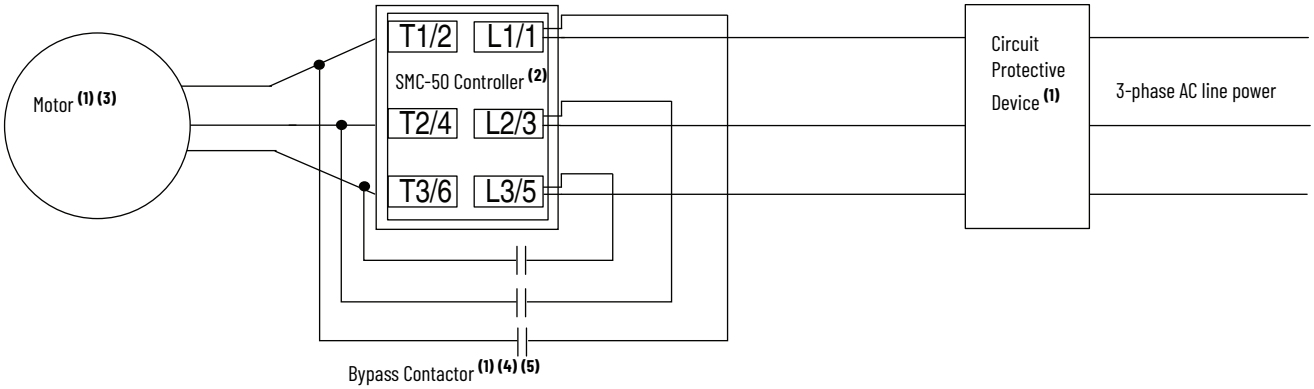
Devices rated 210...520 A

In external bypass control mode on devices rated 210...520 A, the controller's integral current sensors remain in the control circuit by using Cat. No. 150-SCBK (devices rated 210...320 A) or Cat. No. 150-SDBK (devices rated 361...520 A) Bypass Kits. See Figure 69. You can use the optional PTC/Ground Fault/External Current Transformer Expansion Module (150-SM2) and an 825-MCM20 with user-supplied CTs with 5 A secondary in place of the bypass kits. See Figure 108 and Figure 42.

When using the Cat. No. 150-SCBK or 150-SDBK bypass kit, the controller firmware must be FRN 3.001 or higher.

The Cat. No. 150-SM2 Expansion Module can only be inserted into control module expansion port 7 or 8. In addition, only one 150-SM2 Expansion Module can be used per control module. After the 150-SM2 Expansion Module is installed in the control module and power is applied, it must be configured using the 20-HIM-A6, the 20-HIM-C6S, or PC software (for example, Connected Components Workbench software). For additional configuration details, see Chapter 2 and Chapter 6.

Figure 69 - Wiring Diagram for Frame C (Cat. No. 150-SC...) or Frame D (Cat. No. 150-SD...) Devices with Bypass Contactor and Bypass Bus Kit



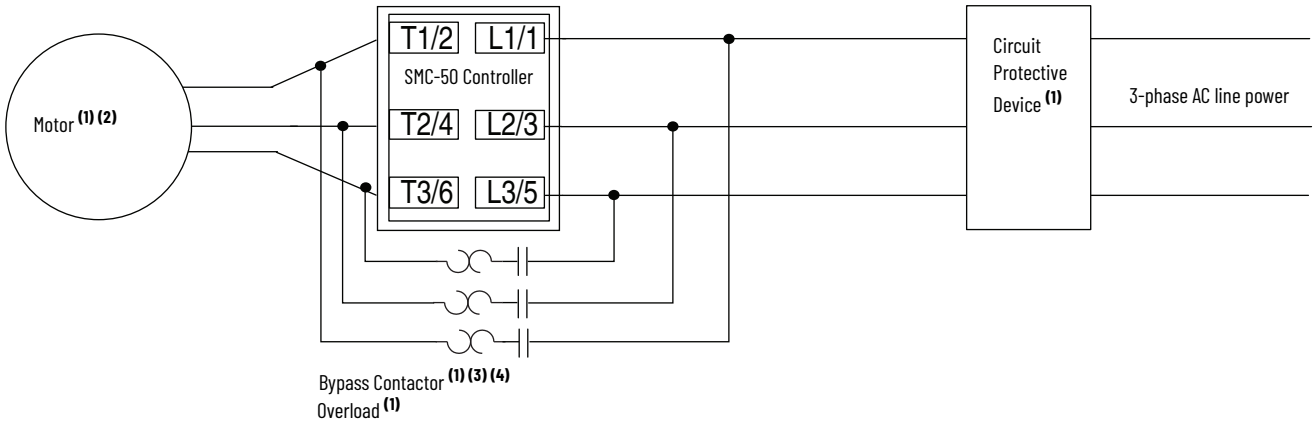
Note	Information
1	Customer supplied
2	SMC-50 controller Bypass bus kit Cat. No. 150-SCBK (Frame C; Cat. No. 150-SC...) or 150-SDBK (Frame D; Cat. No. 150-SD...). Controller FRN 3.001 or higher is required.
3	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See Figure 83 for details.
4	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured for external bypass.
5	In North America, size the bypass contactor per the motor Hp and FLA. In IEC applications, size the bypass contactor per the motor AC-1 rating. The short-circuit rating of the bypass contactor must not be less than that of the SMC-50 controller.

In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the winding(s) of the motor. This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller auxiliary contacts that is configured to NORMAL.

External Overload (all devices)

The SMC-50 controller can also be used with an external overload in conjunction with the external bypass. In this configuration, the external bypass contactor must be fully rated to the motor Hp/kW and FLA. See Figure 70 on page 86.

Figure 70 - Wiring Diagram with Bypass Contactor and External Overload



Note	Information
1	Customer supplied
2	Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See Figure 83 for details
3	Bypass must be controlled by an auxiliary contact of the SMC-50 controller that is configured for external bypass
4	Bypass contactor must be fully rated to motor Hp/kW and FLA

- In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the winding(s) of the motor. This could potentially result in overheating or damage to the motor. To help prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker that can interrupt the motor's locked rotor current on the line side of the SMC-50 controller is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 controller auxiliary contacts that is configured to NORMAL.

Energy Saver Mode

The energy saver function only applies during light motor load situations, at which time the SMC-50 controller reduces current to the motor, which in turn saves energy.

When in energy saver operation, the Energy Savings status bit is set. In addition, parameter 15 [Energy Savings] indicates the percentage energy savings.

Parameter 17 [Power Factor] should be monitored and recorded when the motor is running at no/light load and at full/heavy load. The power factor value where the controller enters Energy Saver mode is determined by setting parameter 193 [Energy Saver] to a value between the no/light load and full/heavy load recorded values.

Table 24 - Energy Saver Mode Parameter List

Parameter No.	Parameter Name	Min/Max Value	Default Value	Access	Units
15	Energy Savings	0...100	0	R	%
17	Power Factor	-1.00...1.00	0	R	–
193	Energy Saver	0.00...1.00	0.00	R/W	–

Set parameter 193 [Energy Saver] = 0 to disable Energy Saver mode.

Emergency RUN

With the SMC-50 controller, a control terminal or network (via Comm Control Word) input can be configured as the Emergency Run command input. All faults are disabled when this input is active.

The Emergency Run command input does not actually start the unit, but causes the unit to run in the Emergency Run mode. The Emergency Run command can be initiated at any time. This command is not latched, which lets you cancel Emergency Run mode while the unit is still running.

Sequence of Operation

Figure 71 through Figure 76 show the different operation sequences for the Soft Stop, Preset Slow Speed, Pump Control, SMB Smart Motor Braking, Accu-Stop, and Slow Speed with Braking options.

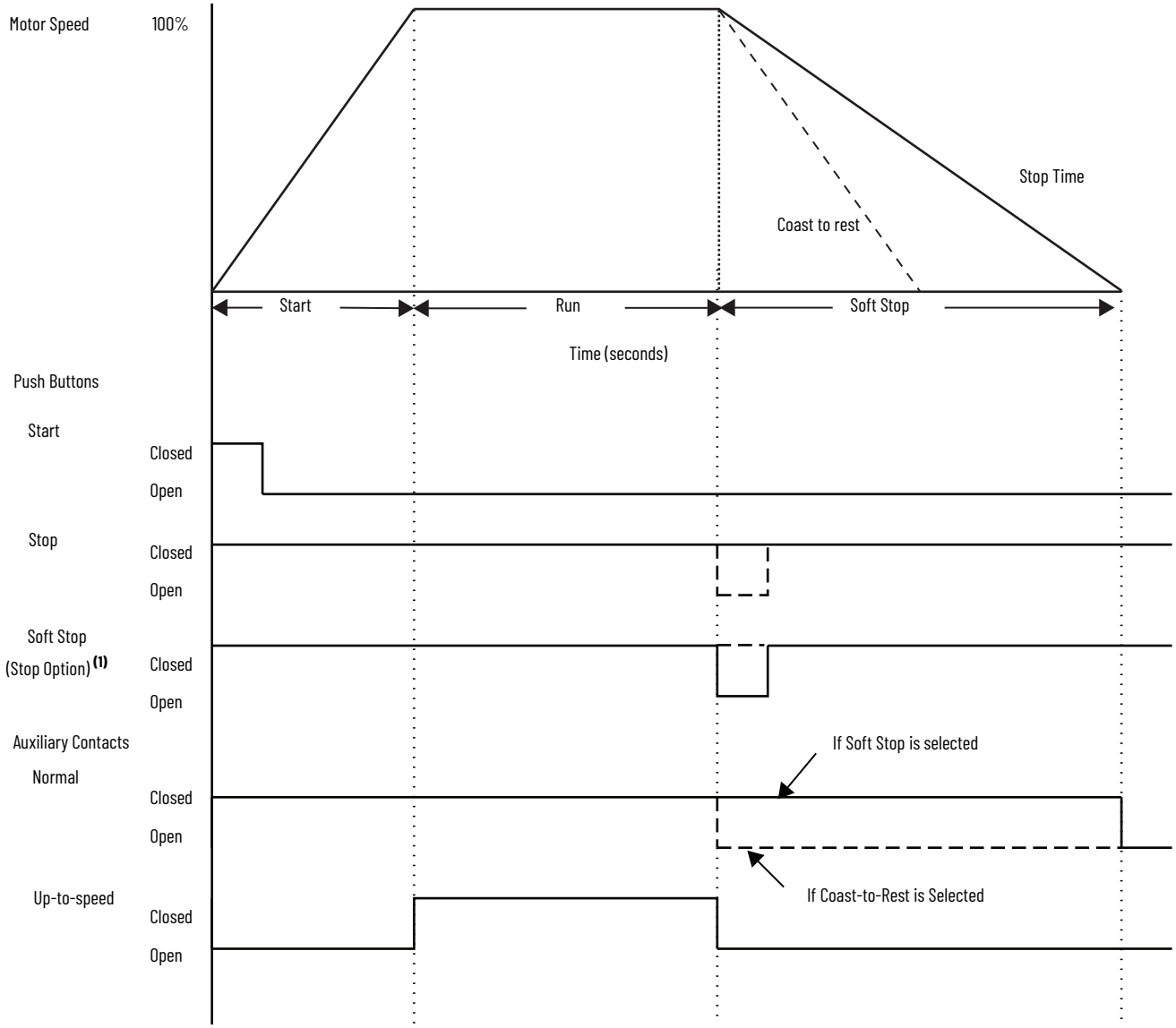
When control power is present but 3-phase line power is not applied, a valid START command causes AUX contacts configured for "Normal" to close. While waiting for 3-phase line power, the SMC-50 controller indicates "Starting". The start sequence is initiated when 3-phase line power is applied.

ATTENTION: You are responsible for determining which stopping mode is best suited to the application and meets applicable standards for operator safety on a particular machine.

ATTENTION: Stopping modes are NOT intended to be used as an emergency stop. See applicable standards for emergency stop requirements.

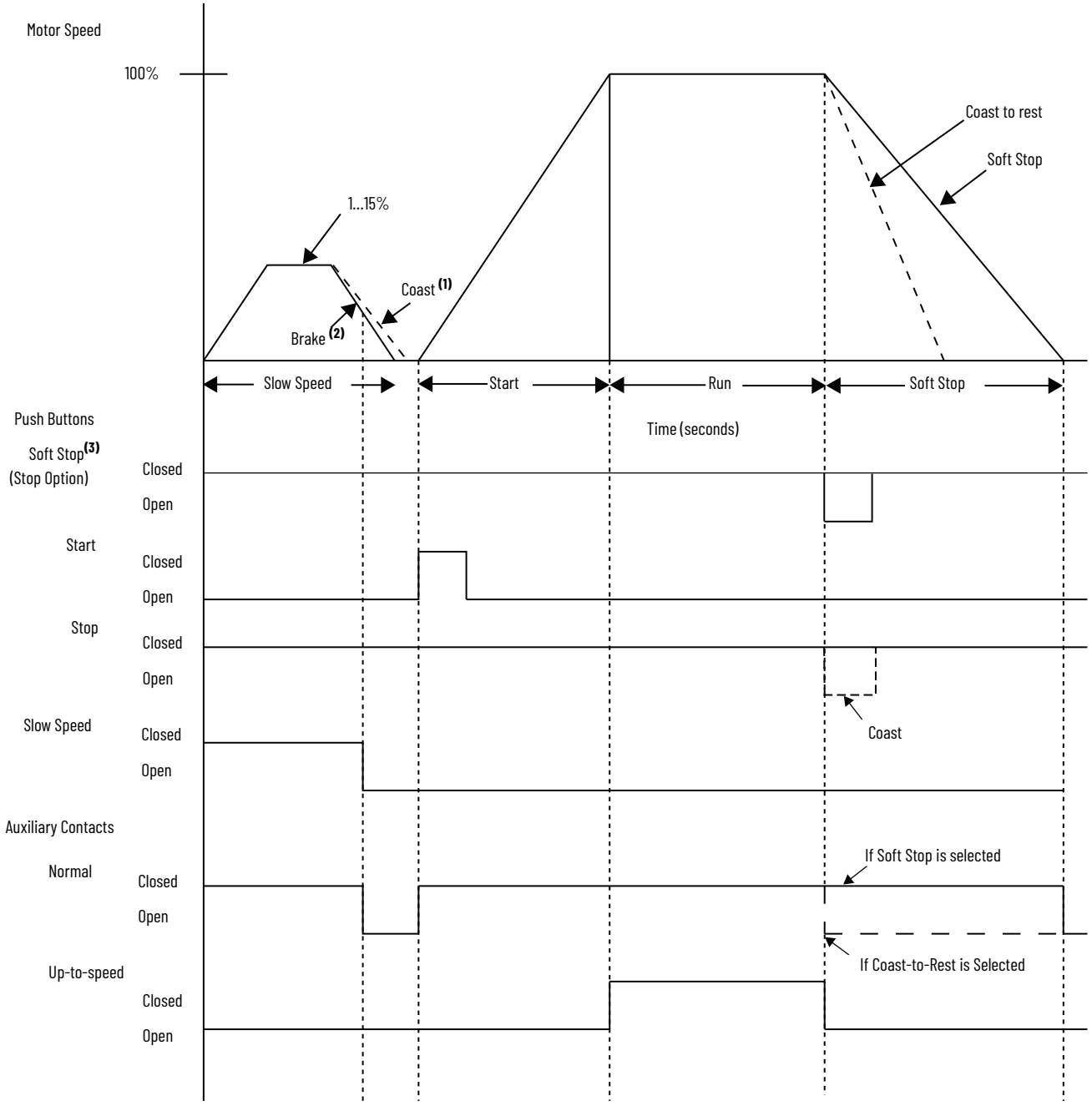
ATTENTION: The Energy Savings setting is motor and load dependent. Setting this to high may cause the unit to enter energy savings too soon and increase current.

Figure 71 - Soft Stop



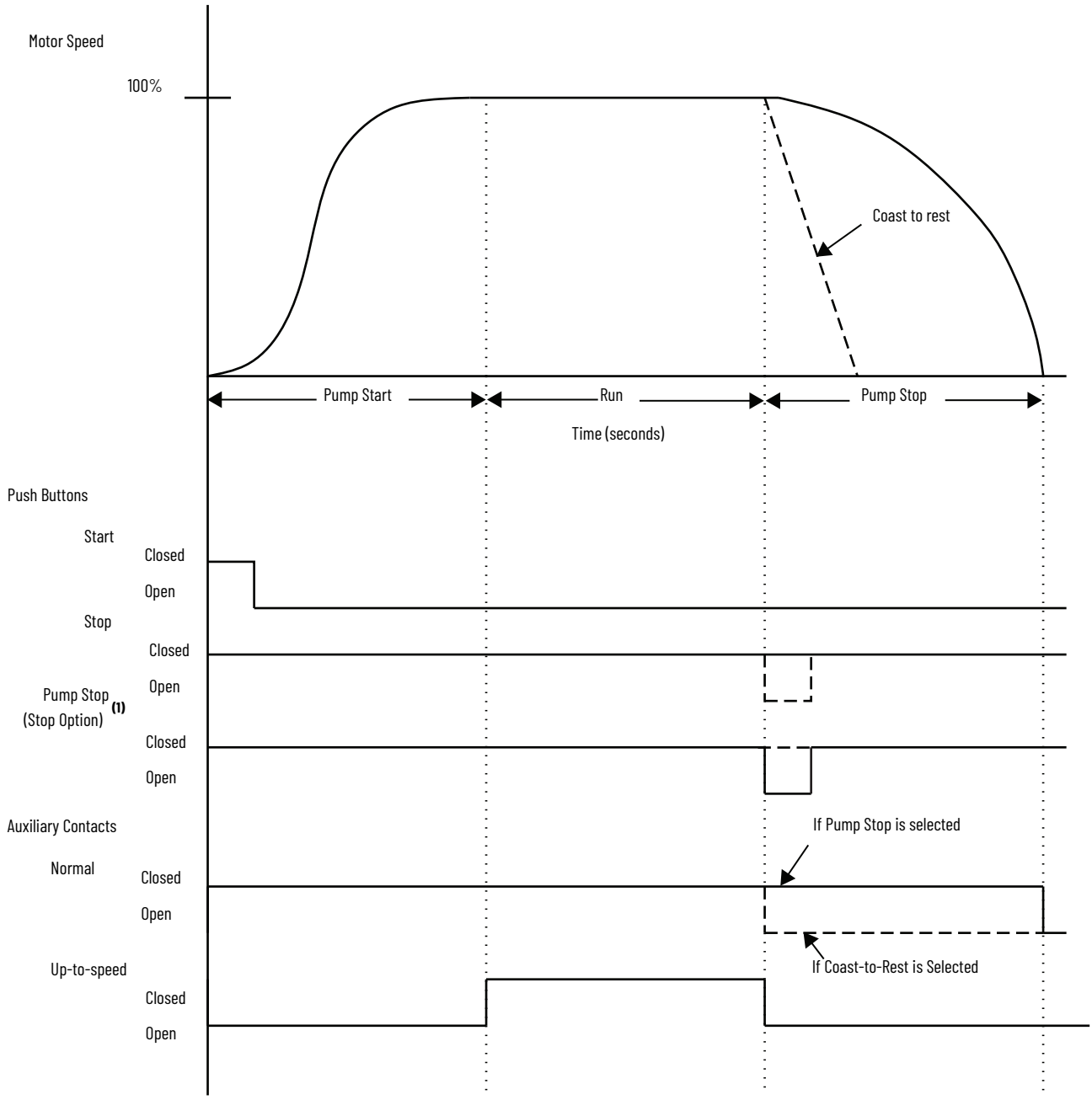
Note	Information
1	When parameter 65 [Stop Mode] is configured for Soft Stop and the Input push button is configured for the Stop Option

Figure 72 - Preset Slow Speed



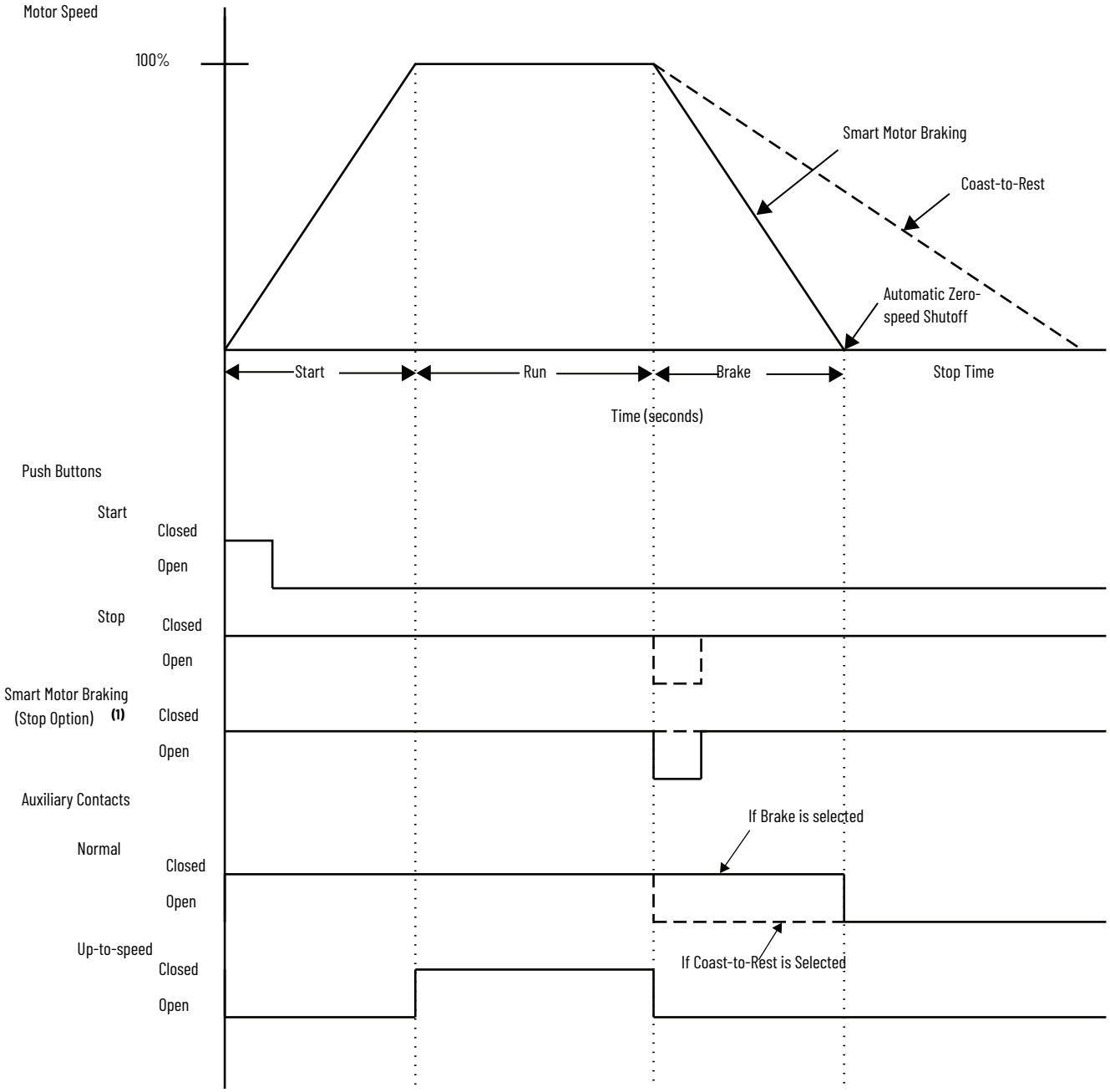
Note	Information
1	Coast if parameter 73 [Slow Brake Cur] = 0
2	Brake if parameter 73 [Slow Brake Cur] >0 and <350
3	When parameter 65 [Stop Mode] is configured for Soft Stop and the Input push button is configured for the Stop Option

Figure 73 - Pump Control



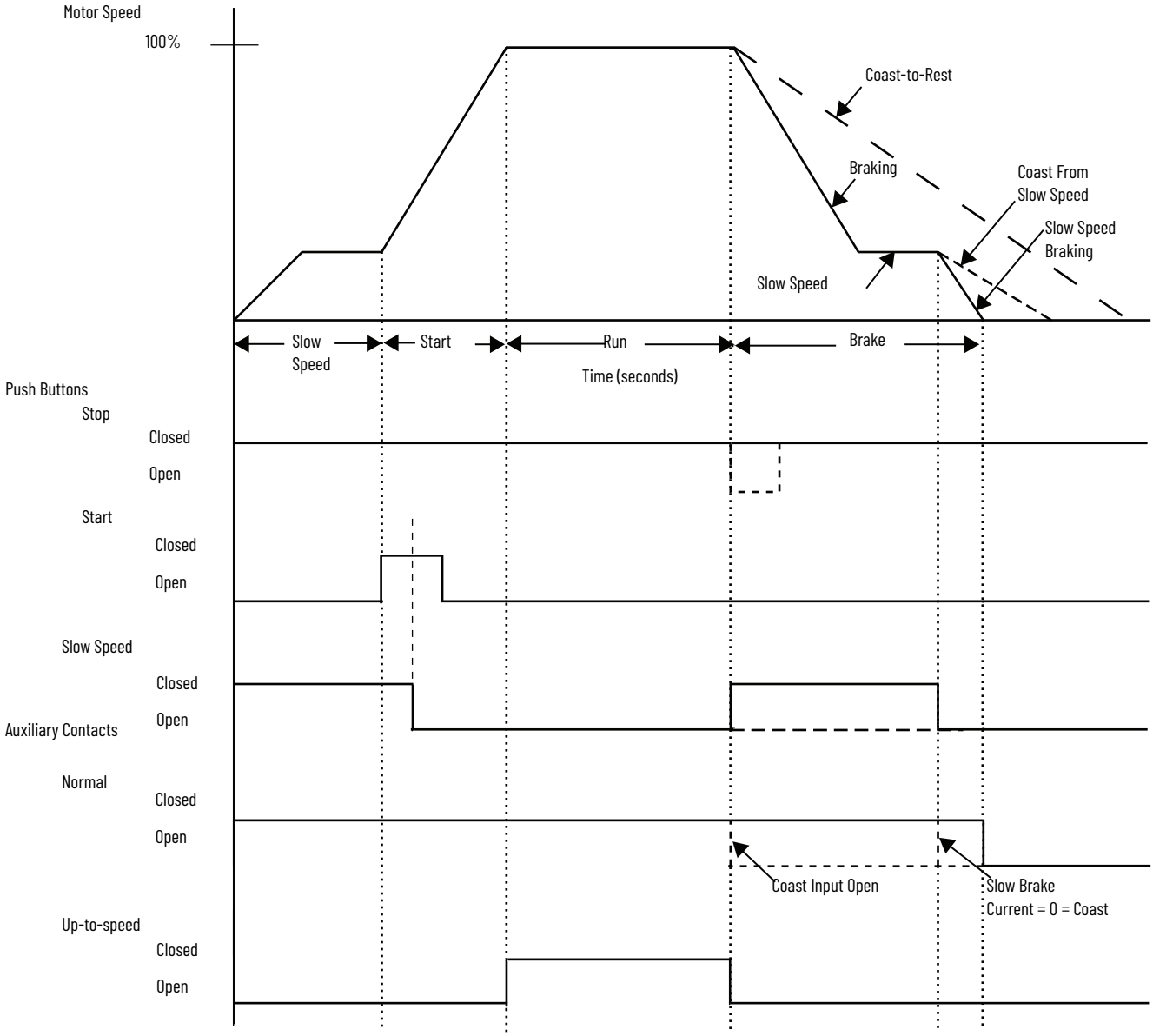
Note	Information
1	When parameter 65 [Stop Mode] is configured for Pump Stop and the Input push button is configured for Stop Option.

Figure 74 - Smart Motor Braking (SMB)



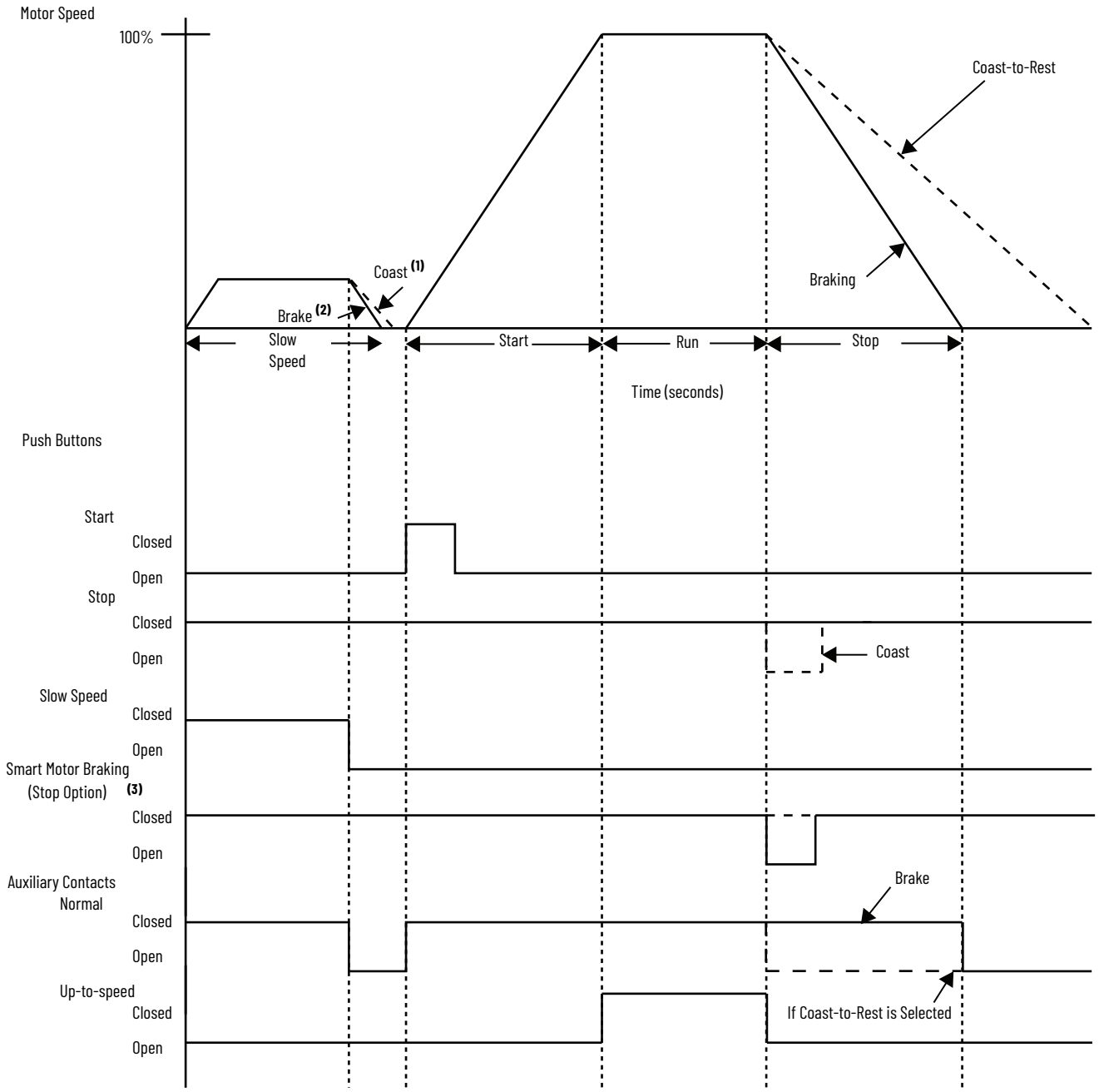
Note	Information
1	When parameter 65 [Stop Mode] is configured for SMB and with the Input push button that is configured for the Stop Option

Figure 75 - Accu-Stop



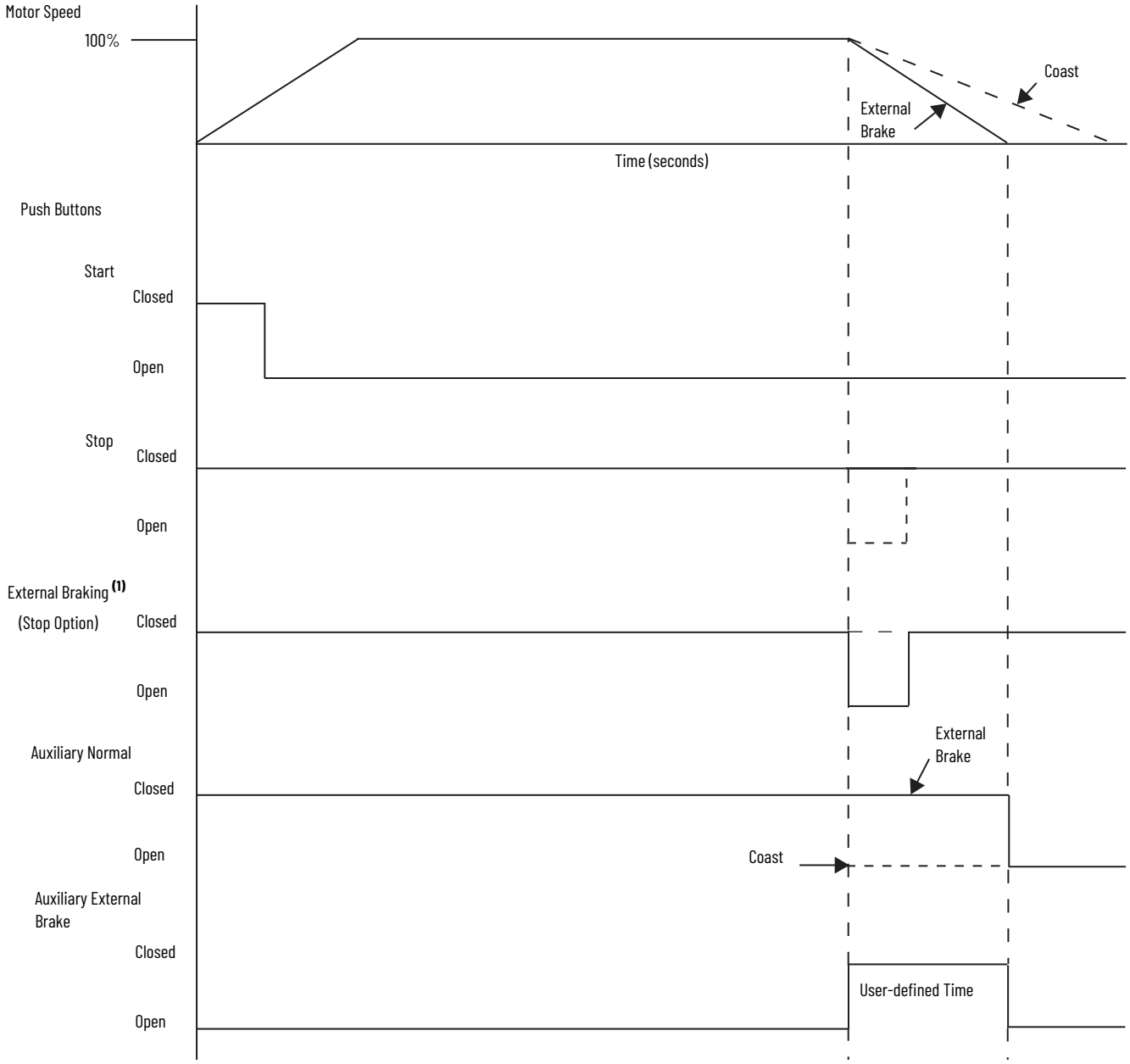
Parameter Selections:
1. Parameter 65 [Stop Mode] = SMB
2. Parameter 69 [Braking Current] = User-defined Value
3. Parameter 72 [Slow Speed 1]= User-defined Value/Selection
4. Parameter 73 [Slow Brake Cur] = User-defined Value (0 enables Coast-to-Rest)

Figure 76 - Slow Speed with Braking



Note	Information
1	Coast if parameter 73 [Slow Brake Cur] = 0
2	Brake if parameter 73 [Slow Brake Cur] >0 and <350
3	When parameter 65 [Stop Mode] is configured for SMB and with the Input push button that is configured for the Stop Option

Figure 77 - External Braking



Note	Information
1	When parameter 65 [Stop Mode] is configured for Ext. Brake, (Eternal Brake) and the input push button is configured for STOP option

Special Application Considerations

Introduction

This chapter describes some extra application considerations for the SMC-50 controller.

Design Philosophy

SMC-50 controllers are designed to operate in today's industrial environments. Our controllers are manufactured to provide consistent and reliable operation.

Line Voltage Conditions

Voltage transients, disturbances, harmonics, and noise exist in any industrial supply. A solid-state controller must be able to withstand these noises and not be an unnecessary source of generating noise back into the line.

Ease of selection for the required line voltage is achieved with a design that provides operation over a wide voltage range, at 50/60 Hz, within a given controller rating.

Current and Thermal Ratings

Solid-state controller ratings must achieve reliability under the wide range of current levels and starting times that are needed in various applications.

Mechanical Shock and Vibration

Solid-state controllers must withstand the shock and vibration that the machinery that they control generates. SMC-50 controllers meet the same shock and vibration specifications as electromechanical starters.

Noise and Radio Frequency (RF) Immunity

This product meets Class A requirements for EMC emission levels.

Altitude

Altitudes up to 2000 meters (6560 ft) are permitted without derating. The allowable ambient temperature for the controller must be de-rated for altitudes above 2000 meters (6560 ft). Using the SMC Thermal Wizard helps you to determine the proper size SMC-50 controller.

Pollution

This product is intended for a Pollution Degree 2 environment.

Atmospheric Protection

ANSI/ISA-71.04-2013; Class G3 Environment.

Setup

Simple, easily understood settings provide identifiable, consistent results.

For ease of installation, the controllers include compact design and feed-through wiring. SMC-50 controllers are global products that are rated at 50/60 Hz. You can use multiple methods to program the controller, including an optional keypad with LCD display. Expandable inputs/outputs, analog, and communication cards are available to provide moire control flexibility.

Motor Overload Protection

When it is coordinated with the proper short-circuit protection, overload protection is intended to protect the motor, motor controller, and power wiring against overheating caused by excessive overcurrent. The SMC-50 controller meets applicable requirements as a motor overload protective device.

The SMC-50 controller incorporates, as standard, electronic motor overload protection. This overload protection is accomplished electronically with circuits and an I^2t algorithm.

The built-in overload protection is programmable, providing you with flexibility. The overload trip class can be selected for class OFF, or 5…30 protection. You can program the trip current to the motor full-load current rating.

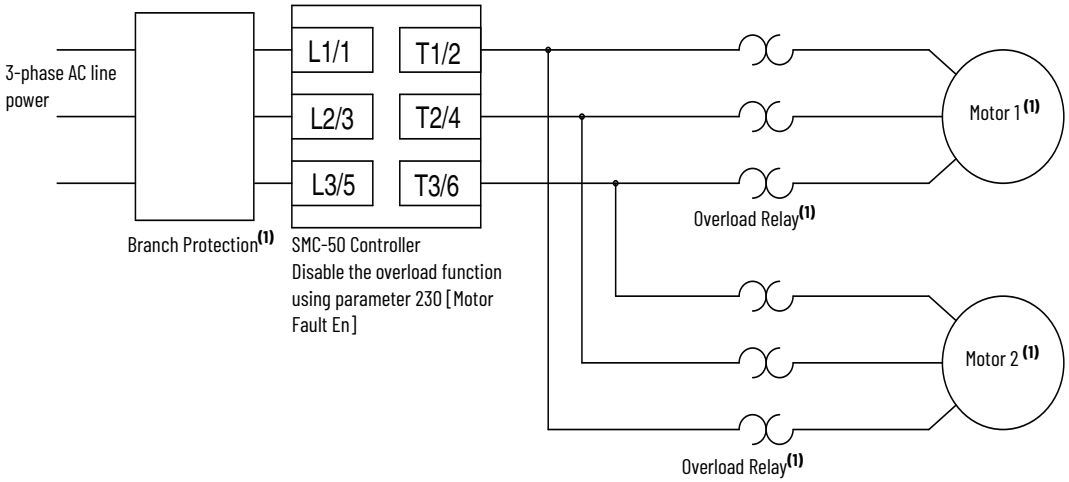
Thermal memory is included in the device functionality to model motor operating and cooling temperatures. Ambient temperature insensitivity is inherent in the electronic design of the overload protection.

The SMC-50 controller has overload protection available for single-speed motors. When the SMC-50 controller is applied to a two-speed motor, you must disable the Overload function via parameter 230 [Motor Fault En] and you must provide separate overload relays for each speed. Figure 41 shows an example of a motor protection wiring schematic.

Multiple Motors

The SMC-50 controller operates with multiple motors connected to it. Motors should be mechanically coupled. To size the controller, add the total nameplate amperes of all connected loads. Turn off the stall and jam features. Separate overloads are still required to meet the National Electric Code (NEC) requirements.

Figure 78 - Multi-Motor Application



Note	Information
1	Customer supplied

You cannot use the built-in overload protection in multi-motor applications. Disable the SMC-50 Overload function using parameter 230 [Motor Fault En].

Special Motors

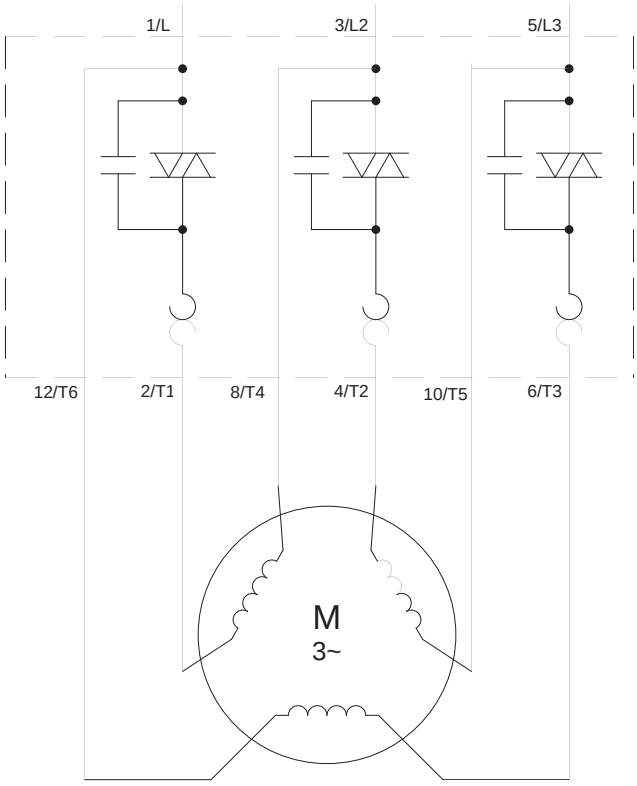
You can apply or retrofit the SMC-50 controller to special motors (wye-delta, part winding, synchronous, and wound rotor) as described in the following paragraphs.

Wye-Delta Motors

Wye-Delta is a traditional electromechanical method of reduced voltage starting. It requires a delta-wound motor with all leads brought out to facilitate a wye connection. At the start command, approximately 58% of full line voltage is applied, generating about 33% of the motor's full-voltage starting torque capability. After an adjustable time interval, the motor is automatically connected in delta.

To apply an SMC-50 controller to a wye-delta motor, the power wiring from the SMC-50 controller is wired in an inside-the-delta configuration to the motor. This connects all six motor connections back to the SMC-50 controller. Because the controller applies a reduced-voltage start electronically, the transition connection is no longer necessary. You can adjust the starting torque with parameter programming.

Figure 79 - Inside-the-Delta Wiring



Part Winding

Part winding motors incorporate two separate, parallel windings in their design. In a traditional part winding starter, one set of windings is given full line voltage, and the motor draws about 400% of the motor's full-load current rating. About 45% of locked rotor torque is generated. After a preset interval, the second winding is brought online in parallel with the first and the motor develops normal torque.

You can wire the part winding motor to an SMC-50 controller by connecting both windings in parallel. You can adjust the starting torque to match the load with parameter programming.

Wound Rotor

Wound rotor motors require careful consideration when implementing SMC-50 controllers. A wound rotor motor depends on external resistors to develop high starting torque. It may be possible to develop enough starting torque using the SMC-50 controller and one step of resistors. The resistors are placed in the rotor circuit until the motor reaches approximately 70% of synchronous speed. At this point, the resistors are removed from the secondary by a shorting contactor. Resistor sizing depends on the characteristics of the motor used.

It is not recommended to short the rotor slip rings during startup, because starting torque is greatly reduced, even with full-voltage applied to the motor. The starting torque is even further reduced with the SMC-50 controller because the output voltage to the motor is reduced on startup.

Synchronous

Synchronous, brush-type motors differ from standard squirrel-cage motors in the construction of the rotor. The rotor of a synchronous motor is composed of two separate windings: a starting winding and a DC magnetic field winding.

The starting winding is used to accelerate the motor to about 95% of synchronous speed. After it is at that level, the DC magnetic field winding is energized to pull the motor up to synchronous speed.

You can retrofit the SMC-50 controller to a synchronous controller by replacing the stator contactor with the SMC-50 controller and maintaining the DC field application package.

SMC-50 Motor Winding Heater

Internal

The SMC-50 motor winding heater function provides low levels of current to each of the motor windings to preheat a cold motor before starting. To avoid stressing an individual motor winding, the SMC-50 controller cycles the current to the three motor phases. This feature provides a programmable heating level, heating time, and terminal block input.

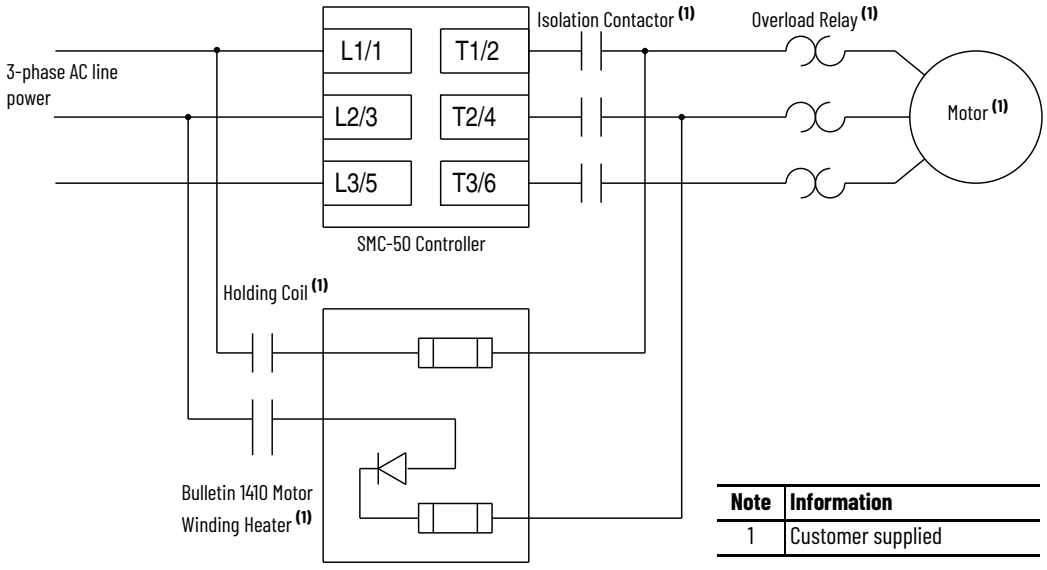
You can activate the motor winding heater after it receives a valid start command. After a valid start, activate the heating function by programming parameter 220 [Heating Time] to a nonzero value or by configuring a terminal block input to “Motor Heater” and activating that input before the start command. The heater function continues for the specified time or until the input is deactivated, at which time the motor starts.

The heater function is disabled if parameter 221 [Heating Level] is set to zero or parameter 220 [Heating Time] is set to zero and the input is inactive (or not configured) at the time of the start command.

External

You can use an external Bulletin 1410 motor winding heater to achieve the motor winding heater function.

Figure 80 - SMC-50 Controller with Bulletin 1410 Motor Winding Heater



Note	Information
1	Customer supplied

Stall Protection and Jam Detection

Motors can experience locked rotor currents and develop high torque levels if there is a stall or a jam. These conditions can result in winding insulation breakdown or mechanical damage to the connected load.

The SMC-50 controller provides both stall and jam detection for enhanced motor and system protection. Stall protection lets you program a maximum stall protection delay time from 0…30 seconds. The stall protection delay time is in addition to the programmed start time and begins only after the start time has elapsed.

Jam detection lets you determine the motor jam detection level as a percentage of the motor's full-load current rating. To help prevent nuisance tripping, you can program a jam detection delay time from 0…99 seconds. This lets you select the time delay that is required before the SMC-50 controller trips on a motor jam condition. The motor current must remain above the jam detection level during the delay time. Jam detection is active only after the motor has reached full speed.

Communication

A serial interface port is furnished as standard on the SMC-50 controller. The connections lets you install a Bulletin 20-COMM communication module. Using the built-in communication capabilities, You can remotely access parameter settings, fault diagnostics, and metering. You can also perform remote start-stop control.

When you use it with the Bulletin 20-COMM communication modules, the SMC-50 controller offers true networking capabilities with several network protocols, including Allen-Bradley Ethernet, Remote I/O, DeviceNet network, RS-485, ControlNet™, PROFIBUS, and Interbus.

Power Monitoring

There are many ways in which you can use power data that is provided by the SMC-50 controller. These include helping to indicate when system maintenance is required, faulty equipment, pump application function, or monitoring power parameters for energy savings. 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 demand numbers are calculated as follows:

- Energy is calculated over a period that is defined by parameter 290 [Demand Period].
- The previous "n" period values are averaged and the result is written to parameter 272 [Real Demand], parameter 281 [Reactive Demand], and parameter 288 [Apparent Demand], which are used to calculate the Max Demand values. This average uses a rolling window algorithm in which the previous "n" periods are averaged.

Table 25 - Power Monitoring Parameters

Parameter No.	Name/Description	Min/Max	Default	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				MVA
290	Demand Period	1...255	1	R/W	Min
291	Number of Periods	1...15	1	R/W	–

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

Table 26 - Power Factor Parameters

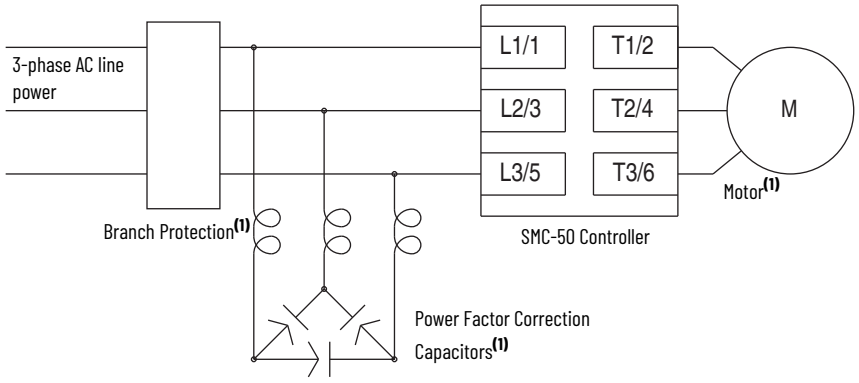
Parameter No.	Name/Description	Min/Max	Default	Access	Units
292	Power Factor A	-1.00...1.00	0.00	R	–
293	Power Factor B				
294	Power Factor C				
17	Power Factor				

Power Factor Correction Capacitors

You can install the SMC-50 controller on a system with power factor correction capacitors (PFCCs). The PFCCs must be on the line side of the controller to help prevent damage to the SCRs in the controller power section. When it is discharged, a capacitor essentially has zero impedance. For switching, sufficient impedance should be connected in series with the capacitor bank to limit the inrush current. One method for limiting the surge current is to add inductance in the PFCC conductors. You can do this by creating turns or coils in the power connections to the capacitors.

- 250V—150 mm (6 in.) diameter coil, 6 loops
- 480...690V—150 mm (6 in.) diameter coil, 8 loops

Figure 81 - PFCC Wiring

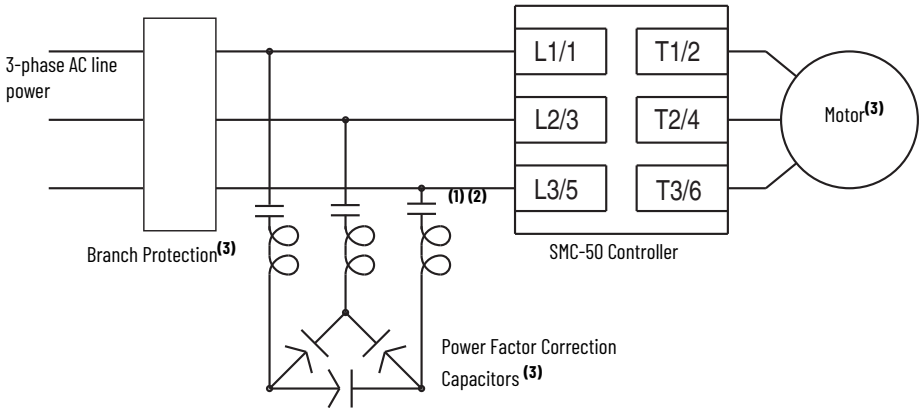


Note	Information
1	Customer supplied

The SMC-50 controller can protect against excessive reactive power (MVAR). You can protect (fault) or issue a warning (alarm) if the motor reactive power (MVAR) consumption (+) or generation (-) is too high. You can use this protection with synchronous motors or motors that have active PFCCs.

ATTENTION: SMC-50 controllers can be installed in a system with power factor correction capacitors (PFCCs). The PFCCs must only be on the line side of the controller. Placing the PFCCs on the load side of the SMC results in damage to the SCRs in the SMC-50 controller.

Figure 82 - PFCC with Contactor



Note	Information
1	Energize for 0.5 s before start command is given to SMC-50 controller
2	Open contactor after the stopping method is complete
3	Customer supplied

Alternate method: use Aux Output that is configured for up-to-speed starting.

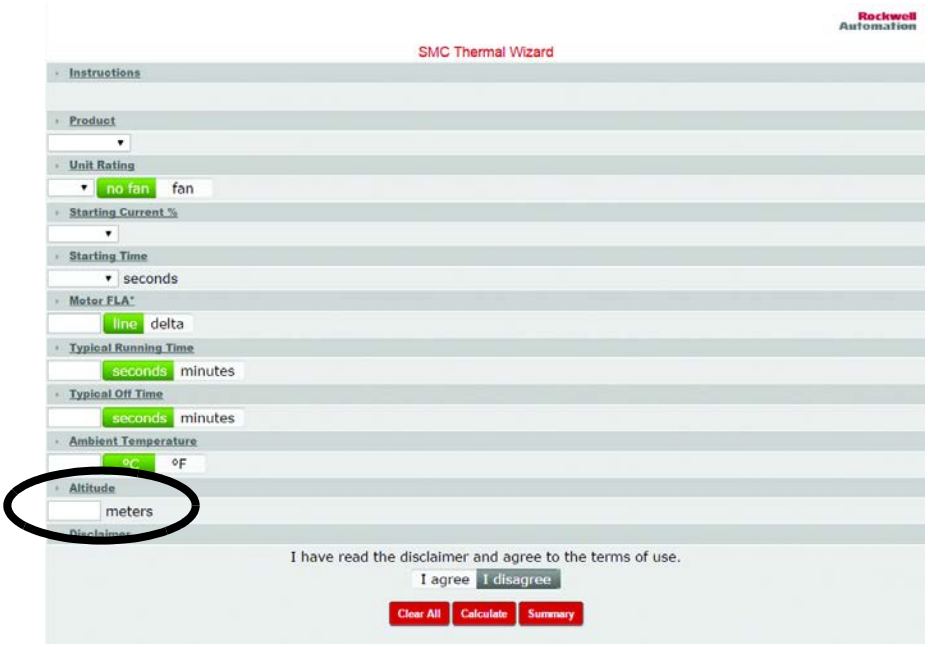
Note	Information
1	Energize the contactor after the motor is up to speed
2	Open contactor before initiating a stop command

Altitude De-rating

Because of the decreased efficiency of fans and heatsinks, it is necessary to de-rate the SMC-50 controller above 6500 feet (approximately 2000 meters). For operation at 2000...7000 meters (6560...22965 feet), use the Thermal Wizard.

You can find the Thermal Wizard at rok.auto/pcdc under the Tools menu in ProposalWorks software.

Depending on the tool you use, your display may differ from what is shown.



You must keep the motor FLA Rating within the current range of the SMC-50 controller.

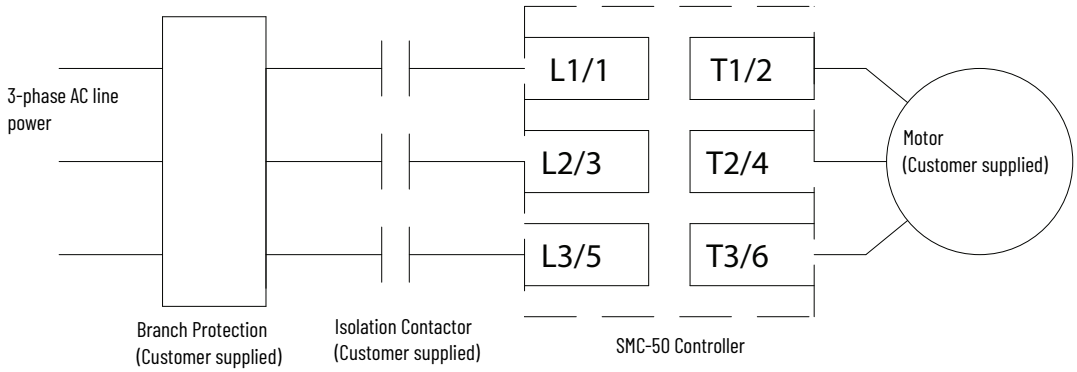
Isolation Contactor

When it is installed with branch circuit protection and an overcurrent device, the SMC-50 controller is compatible with the National Electrical Code (NEC). When an isolation contactor is not used, hazardous voltages are present at the load terminals of the power module even when the controller is turned off. you must attach warning labels that indicate this hazard to the motor terminal box, the controller enclosure, and the control station.

Use the isolation contactor to provide automatic electrical isolation of the controller and motor circuit when the controller is shut down. Shutdown can occur in either of two ways: either manually, by pressing the stop button; or automatically, by the presence of abnormal conditions (such as a motor overload relay trip).

The isolation contactor carries only the load current under normal conditions. During start, the isolation contactor is energized before the SCRs are gated “on.” While stopping, the SCRs are gated “off” before the isolation contactor is de-energized. The isolation contactor does not make or break the load current.

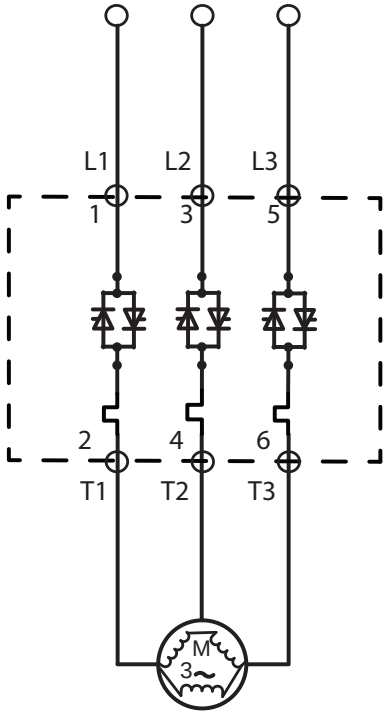
Figure 83 - Typical Connection Diagram with Isolation Contactor



Application Uses for SMC-50 Controller Power Structures

SMC-50 Solid-state Controller

Figure 84 - SMC-50 Controller Solid-state Power Structure



Fully solid-state devices are advantageous in harsh applications where there is a lot of vibration, dust, and dirt.

Conformal-coated circuit boards on the SMC-50 controller help to protect component damage from conductive or corrosive dust in those types of environments. Vibration is not a concern unlike with an electromechanical bypass contactor, where vibration could potentially cause contact bounce.

Other applications for fully solid-state device include those in which there is a high duty cycle. Applications that use a solid-state contactor are potentially appropriate for a solid-state soft starter. The solid-state starter provides starting and stopping methods and feedback that a solid-state contactor is not able to provide.

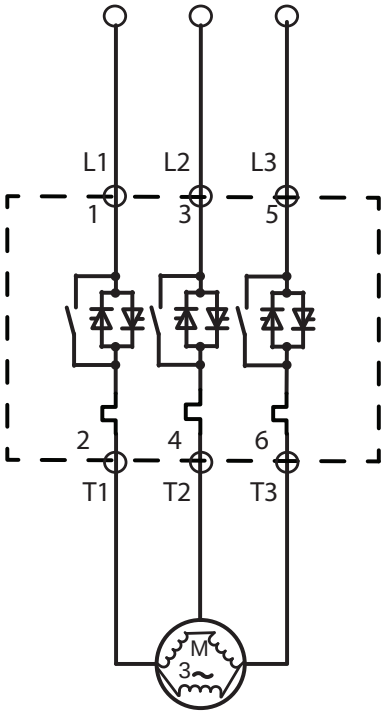
Solid-state soft starters like the SMC-50 controller have predefined ratings for normal duty and heavy-duty applications.

Utilization Categories Defined:

- Normal Duty Rating
  - AC-53a:3.5-10:99-2: 350% current limit, 10 second start, 99% ON load factor and 2 starts per hour; 40 °C (104 °F) surrounding ambient temperature rating
  - Ideal for Pumps and Compressors
- Heavy-Duty Rating
  - AC-53a:3.5-30:99-1: 350%, 30 second start, 99% ON load factor and 1 start per hour; 50 °C (122 °F) surrounding ambient temperature rating
  - Ideal for harsh environments or more demanding applications (for example, chippers, rock crushers)

SMC-50 Controller with Integrated Bypass

Figure 85 - SMC-50 Controller Integrated Bypass Power Structure



The internal bypass contactor is used after the soft starter has brought the motor up to speed. The algorithm of the soft starter determines when the motor is up to speed and then transitions from SCR control to the bypass contactor. Rockwell Automation offers a hybrid soft starter that has the power structure of a solid-state starter and an internal bypass contactor.

Attributes of an internal bypass contactor allow the soft starter to operate at a lower temperature with the motor at speed compared to a fully solid-state starter. A hybrid soft starter is typically smaller than fully rated SCRs with no bypass. This is because smaller components are used to start and carry the load current. The SCRs are rated for intermittent duty (AC-53b). The internal bypass contactors are typically not fully rated (AC-3), because they are typically designed not to make or break load current.

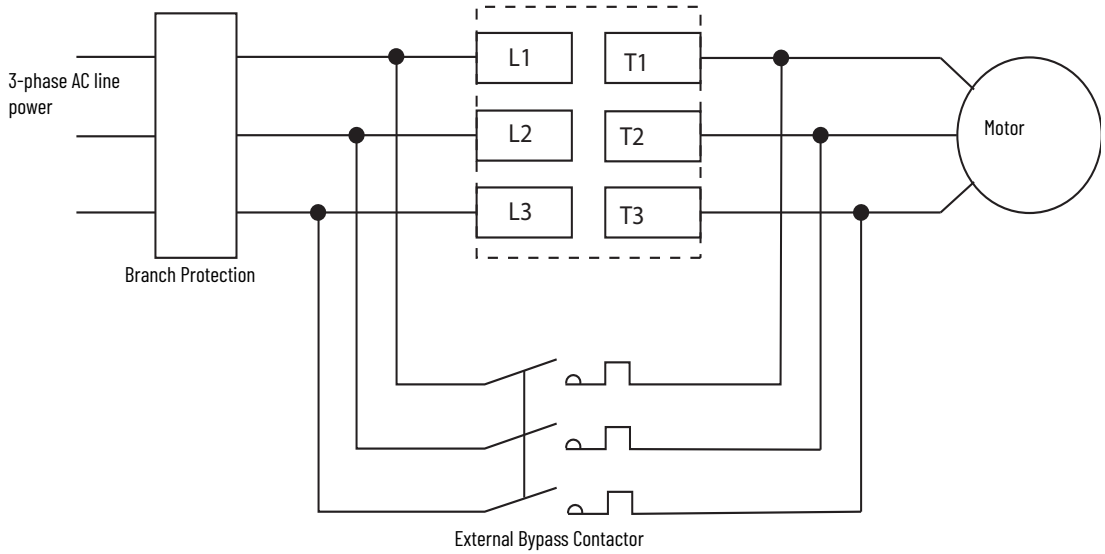
When you use an internal bypass soft starter, you only need power and control wiring. You do not need to purchase any additional devices. Internal bypass on a soft starter is suitable for conveyors, fans, pumps, and other applications where the current and speed does not change while at speed.

The utilization code for the hybrid version:

- AC-53b: 3.0-50:1750
  - 300% current limit, 50 second start, off-time must not be less than 1750 seconds between starts.

SMC-50 Controller with External Bypass

Figure 86 - Soft Starter with External Bypass Contactor



Soft starters can use internal or external bypass contactors. Depending on the application, an external bypass can be a better choice than an internal bypass. In some cases, because of application considerations, a soft starter can have an internal bypass, but be configured to use auxiliary contacts/outputs to control an external bypass.

Applications that are good for external bypass contactors are those where you need a soft start, but while in run mode, current may spike due to product jams or plugging. For example, in a rock-crushing application, there is a high chance of jamming material in a hopper, which causes current spikes. A soft starter with an internal bypass contactor monitors current and may typically drop out of bypass to protect the contactor and return to SCR control. After the current returns to normal, the bypass contactor is pulled back in. This cycling on and off could shorten the life of an internal electromechanical contactor.

Not having all protective features of the soft starter during the run mode may be a benefit to keep an application like rock crushing working. In that application, using an external bypass contactor that is fully rated to handle the current surges keeps the contactor pulled in until a stop command is given or an overload is tripped. External overloads may be needed to protect the motor because some soft starters may not be able to read motor data while in external bypass mode.

An external bypass contactor can also be used on a AC-53a-rated fully solid-state soft starter. Depending on both the soft starter and the mounting and wiring of the bypass contactor, there may or may not be a need for external overloads. The mounting features from the soft start to the bypass contactor dictate whether the soft starter can read data (current and voltage readings) while in bypass mode.

In UL/CSA regulated regions, size the bypass contactor according to the motor Hp and FLA. In IEC-regulated regions, size the bypass conductor per the AC-1 rated bypass contactor rating.

The Hp ratings of the AC-3 rated bypass contactor must match the Hp ratings of the SMC-50 soft starter. The short-circuit ratings of the bypass contactor must not be less than those of the SMC-50 soft starter. This is important for the AC-1 rated bypass contactor selection.

Notes:

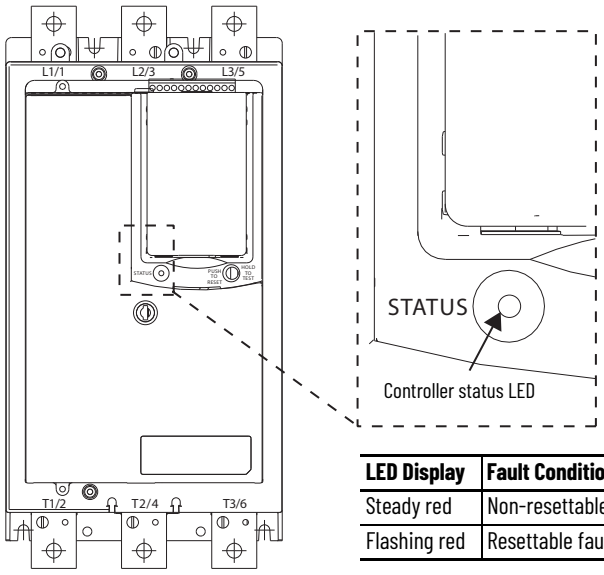
Protection and Diagnostic Functions

Overview

The SMC-50 controller provides both diagnostic and protection functions. Control these functions via user-configured parameters that provide motor and starter alarm and faults. You can individually enable or disable each configurable alarm and fault. Many alarms and faults also have a user-defined time delay to help limit nuisance tripping. A fault condition shuts down the controller. You can use an alarm to alert an operator to a pending fault. You can individually configure motor and starter faults for automatic reset/restart after configuring the number of restart attempts and restart time delay. Restart attempts and restart delay are universal to all faults. See page 135 for additional details.

A multi-colored (red, green, amber) LED status indicator is on the front of the SMC-50 controller directly below the bezel/pocket for the 20-HIM-A6.

Figure 87 - Controller Status Indicator



LED Display	Fault Condition
Steady red	Non-resettable fault has occurred
Flashing red	Resettable fault has occurred

Additional diagnostic LEDs are on the optional Bulletin 150-SM6 Parameter Configuration Module (PCM). This module provides simple and limited parameter configurations. For additional diagnostic LED information, see Chapter 10.

20-HIM-A6, 20-HIM-C6S, and Configuration Software

The 20-HIM-A6, 20-HIM-C6S, and PC configuration/monitoring software (for example, Connected Components Workbench software) provide detailed fault and alarm information. When the SMC-50 controller has a fault, the HIM display indicates FAULTED along with the fault code, a simple fault description, and the elapsed time since the fault occurred. Other HIM screens provide more detailed data and the ability to reset the fault/alarm from the

keypad. For more details about the diagnostic use of these tools, see Chapter 10.

To simplify identifying the source of a DPI port related fault or alarm, the SMC-50 controller displays the DPI port number when posting the fault or alarm number.

EXAMPLE If a 150-SM4 Digital I/O Option Module is in the SMC-50 controller DPI Port 7 and is the source of a fault, port number 7 is displayed with the fault code (for example, Port 7, fault code 26 is displayed as 7026).

Table 27 - SMC-50 Controller DPI-Assigned Port Numbers and Source

DPI Port Number	Source	DPI Port Number	Source
0	SMC-50 Controller	6	Reserved
1	Front-Mounted HIM	7	Control Module Port 7
2	Remote DPI (top of SMC-50 controller)	8	Control Module Port 8
3(1)	Remote DPI	9(2)	Control Module Port 9
4(2)	20-COMM-X Module	10...15	Reserved
5	Reserved		

(1) To access Port 3, you must use a 1203-S03 splitter that is inserted into Port 2.
(2) When using a 20-COMM-X network communication module, it must physically be in Control Module Port 9. However, its DPI Port Number assignment is 4 because of the cable connection to the DPI Port 4, below the front-mounted HIM.

Enable Starter and Motor Faults and Alarms

You can individually configure, enable, and disable motor and starter faults and alarms. Parameter 230 [Motor Fault En], parameter 231 [Motor Alarm En], parameter 136 [Starter Fault En], and parameter 137 [Starter Alarm En] are numbered bit fields for configuration to enable (bit=1) or disable (bit =0) specific motor and/or starter faults and alarms. You can do this by using configuration tools (for example, HIM or PC software) or network communications.

Because there are more than 32 faults and alarms, the configuration bits are in the lower and upper 16-bit fields (numbered 0...31) of the associated SMC-50 controller parameters. The bits are divided into starter faults and motor faults.

These parameters do not enable or disable faults that are generated by expansion modules (for example, 150-SM2, -SM4). When an expansion module is plugged into a control module port (7, 8, or 9), a set of configuration parameters appears to enable configuration of that specific module.

Table 28 and Table 29 provide an overview of the motor and starter fault and alarm enable parameters. All bits are read (R) and write (W) enabled.

Table 28 - Enable/Disable Starter Fault/Alarm Matrix

Parameter No.	Function/ Description(1)	Fault/Alarm Name(1)	Bit Assignment	Bit Access	Units	Default Value
Starter Fault						
136	Starter Fault En	Volt Unbal Overvoltage Undervoltage Phase Rev [Line Loss] [Open Gate] Config Change Freq THD V	0 1 2 3 4 5 6 7 8	R/W	Bit = 0 Disabled Bit = 1 Enabled	Enabled
Starter Alarm						
137	Starter Alarm En	Volt Unbal Overvoltage Undervoltage Phase Rev Line Loss Open Gate Config Change Freq THD V	0 1 2 3 4 5 6 7 8	R/W	Bit = 0 Disabled Bit = 1 Enabled	All Disabled as Default

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

Table 29 - Enable/Disable Motor Fault/Alarm Matrix

Parameter No.	Function/ Description(1)	Fault/Alarm Name(1)	Bit Assignment	Bit Access	Units	Default Value
Motor Fault						
230	Motor Fault En	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 THD1 Lead PF Un Lead PF Ov Lag PF Un Lag PF Ov Locked Rotor	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 27 18 19 20 21 22 23	R/W	Bit = 0 Disabled Bit = 1 Enabled	[All Disabled except Overload, Power Qual, and Open Load]
Motor Alarm						
231	Motor Alarm En	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 THD1 Lead PF Un Lead PF Ov Lag PF Un Lag PF Ov Locked Rotor	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 27 18 19 20 21 22 23	R/W	Bit = 0 Disabled Bit = 1 Enabled	All Disabled as Default

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

Enable Option Module Functional Faults and Alarm

Not all option modules have faults and alarms associated with their specific function(s). For example, the 150-SM4 Option I/O and 150-SM6 Parameter Configuration Modules **do not** have functional faults or alarms. When an option module does have functional faults and alarms, it also can individually configure, enable, and disable them like faults and alarms for the controller and motor.

150-SM2 Option Module

The 150-SM2 Option Module has individually enabled faults and alarms associated with the ground fault and motor PTC functions, which are shown in Table 30.

Table 30 - 150-SM2 Faults and Alarms

Parameter No.	Function/ Description[1]	Fault/Alarm Name[1]	Bit Assignment	Bit Access	Units	Default Value
X02[2]	Fault En	PTC Gnd Flt	0 1	R/W	Bit=0 Disabled Bit=1 Enabled	All Disabled as Default
X03[2]	Alarm En	PTC Gnd Flt	0 1	R/W		

(1) As displayed on the HIM or Connected Components Workbench configuration tools
(2) X = the control module port number (7 or 8) in which the 150-SM2 resides.

150-SM3 Option Module

The 150-SM3 Option Module has individually enabled faults and alarms associated with the analog inputs and outputs, which are shown in Table 31.

Table 31 - 150-SM3 Faults and Alarms

Parameter No.	Function/ Description[1]	Fault/Alarm Name[1]	Bit Assignment	Bit Access	Units	Default Value
X37 [2]	Fault En	IN1 Over IN1 Under IN2 Over IN2 Under OUT1 Shorted OUT1 Open OUT2 Shorted OUT2 Open	0 1 2 3 4 5 6 7	R/W	Bit=0 Disabled Bit=1 Enabled	All Disabled as Default
X38 [2]	Alarm En	IN1 Over IN1 Under IN2 Over IN2 Under OUT1 Shorted OUT1 Open OUT2 Shorted OUT2 Open	0 1 2 3 4 5 6 7	R/W		

(1) As displayed on the HIM or Connected Components Workbench configuration tools
(2) X = the control module port number (7 or 8) in which the 150-SM3 resides.

Protection and Diagnostics

The following section describes the SMC-50 controller protection and diagnostic functions.

Overload—Fault and Alarm

Overload Fault (Code 21)

The SMC-50 controller meets applicable requirements as a motor overload protective device. Thermal memory provides added protection and maintains motor thermal data when control power is removed.

The SMC-50 controller provides overload protection through true RMS current measurement of the individual phase currents of the connected motor. A thermal model that simulates the actual heating of the motor is calculated based on the following:

- measured maximum motor current value,
- parameter 78 [Motor FLC] setting,

- parameter 75 [Overload Class][a] setting, and
- parameter 77 [Service Factor] (obtained from the motor nameplate).

Parameter 18 [Motor Therm Usage], Motor Thermal Usage (MTU), displays the percentage of the motor overload currently utilized. The SMC-50 controller overload fault trips the motor when (1) the motor overload fault is enabled **and** (2) the MTU reaches 100%.

The overload function calculates and provides motor overload data via:

- parameter 18 [Motor Therm Usage],
- parameter 19 [Time to OL Trip], and
- parameter 20 [Time to OL Reset].

Trip rating is 118% of the programmed motor FLC.

The SMC-50 controller continues to calculate the reduction in MTU (decay rate) when the motor is powered down (cooling). Enable this by using the SMC-50 controller's real-time clock (RTC) function. When control power is lost, the SMC-50 controller saves the power down thermal level and time. When power is reapplied, the SMC-50 controller reads the current time, power down time, and power down thermal level. From this data, the SMC-50 controller calculates the new thermal information for the overload.

Overload Alarm

An overload alarm is also available. The desired value or level of the alarm is configured with parameter 83 [Overload A Level], which can be set from 0…100%. When the MTU value reaches the set percentage of the thermal trip level, then the alarm becomes active. When the MTU value falls below the set percentage of the thermal trip level, the alarm becomes inactive.

Parameter 18 [Motor Therm Usage] provides the current motor thermal usage value. This parameter reads from 0…200%, where 100% corresponds to a fault condition.

(a) Trip Class is defined as the maximum time in seconds for an overload trip to occur when the motor's operating current is six times its rated current. The SMC-50 controller overload function offers an adjustable Trip Class range of 5…30, which can be programmed in increments of one via parameter 75 [Overload Class] and parameter 76 [Overload Class 2] (configuration for a second overload Class).

Figure 88 - Overload Trip Curves

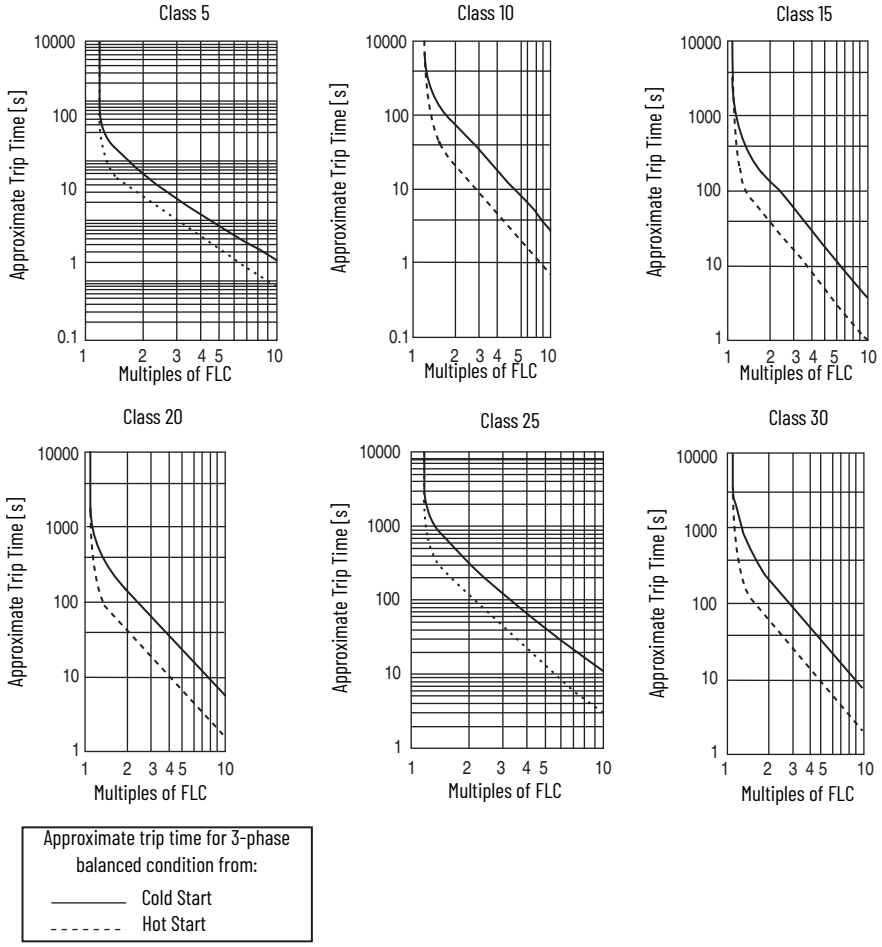
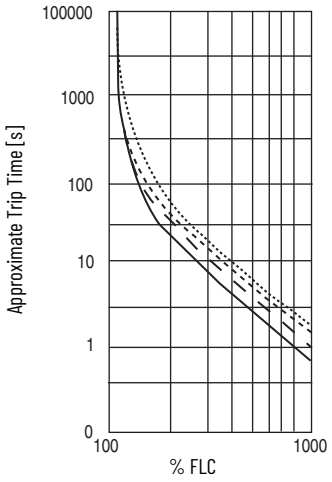


Figure 89 - Restart Trip Curves after Auto Reset



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

Parameter 81 [OL Shunt Time] allows disabling (shunt) the overload at the beginning of the start cycle. This parameter defines the length of time that the overload is disabled (shunted). The motor overload does not accumulate data (MTU) during this period.

You can configure the SMC-50 controller to automatically reset the overload fault when it has cooled to the level that is set in parameter 80 [OL Reset Level]. You must enable parameter 264 [Motor Restart En] (Overload = Set) to allow the Overload Reset Level parameter to function.

Parameter 19 [Time to OL Trip] provides indication of how much time is left before an overload trip occurs under the current operating conditions. If the overload fault is disabled, this parameter reads its maximum value.

Parameter 20 [Time to OL Reset] provides indication of how much time is left before an overload fault clears based on the cooling (decay) algorithm. If the overload parameter is disabled or has not tripped, then this parameter is zero.

Table 32 - Overload Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
75	Overload Class	5...30	10	R/W	–
76	Overload Class 2(2)	5...30	10		–
77	Service Factor	0.01...1.99	1.15		–
78	Motor FLC	1.0...2200.0	1.0		A
80	OL Reset Level	1...99	75		%MTU
18	Motor Therm Usage	0...200	0...200	R	%MTU
81	OL Shunt Time	0...999	0	R/W	s
82	OL Inhibit Time	0...999	0		s
83	Overload A Lvl	0...100	0		%MTU
19	Time to OL Trip	0...10000	0...10000	R	s
20	Time to OL Reset	0...10000	0...10000		s
84	Locked Rtr Level	400...1000	600	R/W	%FLC
85	Locked Rtr Time	1...1000	1	R/W	s

(1) As displayed on the HIM or Connected Components Workbench software configuration tools.
(2) Configuration for a second overload Class.

Underload—Fault and Alarm

The SMC-50 controller lets you trip on underload when the motor current falls below a user-defined level for a user-defined time.

Underload Fault (Code 22)

Motor current less than a specific level may indicate a mechanical malfunction in the installation (for example, a torn conveyor belt, damaged fan blade, broken shaft, or worn tool). Such conditions may not harm the motor, but can lead to loss of production. Rapid underload fault detection helps to minimize damage and loss of production.

Underload Fault current protection, fault code 22, is enabled or disabled via the motor Underload Enable/Disable bit in parameter 230 [Motor Fault En]. Configure the value or level of the fault current by using parameter 86 [Underload F Lvl]. A configurable fault delay time using parameter 87 [Underload F Dly] is also available to help eliminate nuisance faults.

Underload Alarm

A motor underload alarm is also available. Configure this exactly as the underload fault, using parameter 88 [Underload A Lvl] and parameter 89 [Underload A Dly. You can enable or disable the alarm by using the Underload bit in parameter 231 [Motor Alarm En].

The SMC-50 controller checks for a motor underload condition approximately every 0.025 seconds.

Underload protection is active when the motor is at speed.

Table 33 - Underload Parameter List

Parameter No.	Parameter Name (1)	Min/Max Value	Default Value	Access	Units
86	Underload F Lvl	0...99	0	R/W	%FLC
87	Underload F Dly	0.1...99	0.1		Secs
88	Underload A Lvl	0...99	0		%FLC
89	Underload A Dly	0.1...99	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Line Power Undervoltage Protection

Undervoltage Fault (Code 20)

The SMC-50 controller can protect against low line power voltage. The undervoltage fault, fault code 20, provides protection from a line power undervoltage condition. An undervoltage fault condition exists if the average of parameter 46 [Line Voltage] falls below the user-defined voltage level in parameter 98 [Undervolt F Lvl]. See Table 34

Enable or disable undervoltage fault protection via the Undervoltage Enable/Disable bit in parameter 136 [Starter Fault En].

Undervoltage Alarm

An undervoltage alarm is also available. Set this exactly like the fault, using parameter 100 [Undervolt A Lvl] and parameter 101 [Undervolt A Dly]. The undervoltage alarm is enabled or disabled via the Undervoltage Enable/Disable bit in parameter 137 [Starter Alarm En].

Table 34 - Undervoltage Protection Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
46	Line Voltage	0...700	400	R/W	Volts
98	Undervolt F Lvl	0...100	90		%V
99	Undervolt F Dly	0.1...99.0	3.0		Secs
100	Undervolt A Lvl	0...100	90		%V
101	Undervolt A Dly	0.1...99.0	3.0		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Line Power Overvoltage Protection—Fault and Alarm

Overvoltage Fault (Code 19)

The SMC-50 controller can protect against high line power voltage. The overvoltage fault, fault code 19, provides protection from a line power overvoltage condition. An overvoltage condition exists if the average of the three-phase line voltage exceeds a user-defined percent above that level (parameter 102 [Overvolt F Lvl]) for a user-defined time, "Overvolt F Dly" (parameter 103 [Overvolt F Dly]). See Table 35.

Overvoltage protection is enabled or disabled via the Overvoltage Enable/Disable bit in parameter 136 [Starter Fault En].

Overvoltage Alarm

An Overvoltage alarm is also available. This is set up exactly like the Overvoltage Fault, using parameter 104 [Overvolt A Lvl] and parameter 105 [Overvolt A Dly].

The overvoltage alarm is enabled or disabled via the Overvoltage Enable/ Disable bit in parameter 137 [Starter Alarm En].

Table 35 - Overvoltage Protection Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
46	Line Voltage	0...700	400	R/W	Volts
102	Overvolt F Lvl	100...199	440		%
103	Overvolt F Dly	0.1...99.0	3.0		Secs
104	Overvolt A Lvl	100...199	110		%
105	Overvolt A Dly	0.1...99.0	3.0		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Current Imbalance Protection—Fault and Alarm

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. The power pole current is used for the current imbalance calculation.

Current Imbalance Fault (Code 42)

A current imbalance fault condition, fault code 42, occurs when the calculated imbalance level rises above a user-defined level, Current Imbalance Fault Level, for a user-defined time, Current Imbalance Fault Delay. See Table 36.

Current imbalance protection is enabled or disabled using the Current Imbalance bit in parameter 230 [Motor Fault En].

Current Imbalance Alarm

A current imbalance alarm is also available. Set this exactly like the current imbalance fault, using parameter 112 [Cur Imbal A Lvl] and parameter 113 [Cur Imbal A Dly]. You can enable or disable the current imbalance alarm by using the Current Imbalance bit in parameter 231 [Motor Alarm En].

Table 36 - Current Imbalance Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
110	Cur Imbal F Lvl	1...25	15	R/W	%
111	Cur Imbal F Dly	0.1...99.0	3.0		Secs
112	Cur Imbal A Lvl	1...25	10		%
113	Cur Imbal A Dly	0.1...99.0	3.0		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Voltage Unbalance Protection—Fault and Alarm

An unbalance in the voltage supply results in a current imbalance. This causes the motor to experience an additional temperature rise, resulting in degradation of the motor insulation and reducing its life expectancy. Voltage

unbalance detection helps extend the motor life expectancy and minimize potential damage and loss of production.

The voltage unbalance (V_u) calculation is equal to the largest deviation (V_d) of the three-phase voltage signals (RMS phase voltage) from the average of the RMS phase voltage (V_{ave}), divided by the average voltage.

$$V_u\% = 100 \quad (\frac{V_d}{V_{ave}})$$

The phase-to-phase voltage is used in the calculation for voltage unbalance.

Voltage Unbalance Fault (Code 18)

A voltage unbalance fault condition, fault code 18, occurs when the calculated unbalance level rises above a user-defined level, Voltage Unbalance fault Level, for a user-defined time, Voltage Unbalance Fault Delay. See Table 37 on page 119.

Voltage unbalance protection is enabled or disabled using the Voltage Unbalance bit in parameter 136 [Starter Fault En].

Voltage Unbalance Alarm

A voltage unbalance alarm is also available. Set this up exactly like the fault by using the Voltage Unbalance Alarm Level and Voltage Unbalance Alarm Delay parameters. Enable or disable this voltage unbalance alarm by using the Voltage Unbalance bit in parameter 137 [Starter Alarm En].

Table 37 - Voltage Unbalance Protection Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
106	Volt Unbal F Lvl	1...25	15	R/W	%
107	Volt Unbal F Dly	0.1...99.0	3.0		Secs
108	Volt Unbal A Lvl	1...25	10		%
109	Volt Unbal A Dly	0.1...99.0	3.0		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Phase Reversal Protection

Phase Reversal Fault (Code 25)

The SMC-50 controller provides fault protection, cault code 25, against reverse connection (CBA) of line power phases.

You can enable or disable phase reversal protection via the "Phase Rev" bit in parameter 136 [Starter Fault En]. There are no phase reversal fault parameters to configure.

A phase reversal alarm is also available and enabled via the "Phase Rev" bit in parameter 137 [Starter Alarm En]. There are no alarm parameters to configure.

High and Low Line Power Frequency Protection—Fault and Alarm

The SMC-50 controller can protect against poor line power quality by offering programmable frequency-based protection. You can fault the starter if the line power frequency is either too high or too low.

High and low frequency limits for both faults and alarms are configured through the parameters listed in Table 38. Each parameter also has a programmable delay to limit spurious trips.

Frequency Fault (Code 49)

The high/low frequency fault, code 49, is enabled or disabled using the frequency bit "Freq" in parameter 136 [Starter Fault En].

Frequency Alarm

A frequency alarm is also available. The frequency alarm is enabled or disabled using the frequency bit in parameter 137 [Starter Alarm En].

Regardless of the user-defined high or low frequency fault or alarm levels, if the line power frequency falls below 45 Hz or rises above 66 Hz, the SMC-50 controller enters a wait state (controller stops and does not start, or does not start if it is already stopped) until the frequency returns to the 45 ...66 Hz range.

Table 38 - High and Low Line Power Frequency Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
129	Freq High F Lvl	45...66	63	R/W	Hz
225	Freq High F Dly	0.1...99.0	0.1		s
130	Freq Low F Lvl	45...66	47		Hz
227	Freq Low F Dly	0.1...99.0	0.1		s
131	Freq High A Lvl	45...66	63		Hz
226	Freq High A Dly	0.1...99.0	0.1		s
132	Freq Low A Lvl	45...66	47		Hz
228	Freq Low A Dly	0.1...99.0	0.1		s

(1) As displayed on the HIM or in the Connected Components Workbench software.

Stall Protection—Fault and Alarm

When a motor stalls (stops) during its starting sequence, the motor heats up rapidly; after some permissible stall time, the motor reaches the temperature limit of its insulation. Rapid stall detection during the starting sequence can extend the motor's life and minimize the potential damage and loss of production.

Stall Fault (Code 24)

When the SMC-50 controller is instructed to start a motor and the programmed start ramp time has completed before the motor is up to speed, the start sequence continues until one of the following occurs:

- motor reaches full speed,
- Stall fault, fault code 24, occurs,
- indefinitely if the stall fault is disabled, or
- until a motor overload or SCR overtemperature condition

When the stall feature is enabled, the SMC-50 controller starts an internal timer when the programmed ramp time expires. When this timer reaches the time value that is programmed in parameter 188 [Stall Delay], a Stall fault is generated. If the Stall Delay parameter is set to zero, then the fault occurs immediately if the motor is not UTS at the completion of the programmed Ramp Time. If the SMC-50 controller detects that the motor is UTS before the Stall Delay, it considers the start sequence complete, switches to full voltage, and generates a stall fault/alarm.

Because the beginning of the Linear Speed starting mode is an open-loop voltage control, the actual starting time may vary depending on the motor load. For this reason (and to avoid nuisance faults), the SMC-50 controller automatically adds a time to the configured starting ramp time before the stall timer begins to count. The time factor is 50% of the configured start ramp time.

Enable or disable stall fault protection via the "Stall" bit in parameter 230 [Motor Fault En].

Stall Alarm

You can also enable a stall alarm, which activates under the same condition as the stall fault. In this case, the alarm is cleared after the motor leaves the starting state (for example, is UTS, is stopped, or faulted).

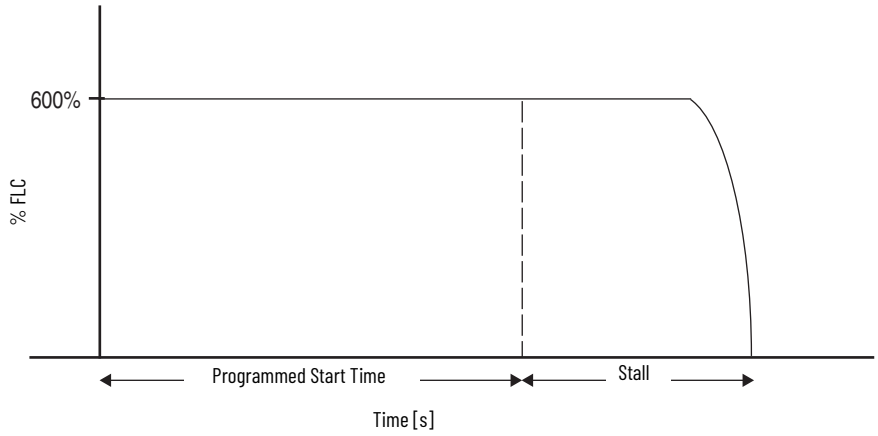
Enable or disable the stall alarm via the "Stall" bit in parameter 231 [Motor Alarm En].

Table 39 - Stall Protection Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
188	Stall Delay	0.0...30.0	10.0	R/W	s

(1) As displayed on the HIM or in the Connected Components Workbench software.

Figure 90 - Stall Protection



Jam Detection—Fault and Alarm

Motor operational (run) current greater than the motor nameplate rating may indicate a jam condition due to a conveyor jam or jammed drive gear. These conditions can result in overheating of the motor and equipment damage. Rapid Jam detection helps to minimize damage and loss of production.

The SMC-50 starter SCR overtemperature fault (page 130) may occur before the jam trip in the case of high current situations.

Jam Fault (Code 23)

The SMC-50 controller Jam Fault, Fault Code 23, provides detection of a motor jam. A jam condition exists if the motor current rises above a user-defined level for a user-defined time while in the run mode.

This fault is not active during starting or stopping.

Parameter 114 [Jam F Lvl] is a percentage of the motor's FLC that is set via parameter 78 [Motor FLC]. If the actual motor current rises above the Jam Fault Level (parameter 114 [Jam F Lvl]) for a time equal to the value that is set in parameter 115 [Jam F Dly] (Jam Fault Delay), a fault is generated. See Table 40 and Figure 91. Jam protection is enabled or disabled using the Jam bit in parameter 230 [Motor Fault En].

Jam Alarm

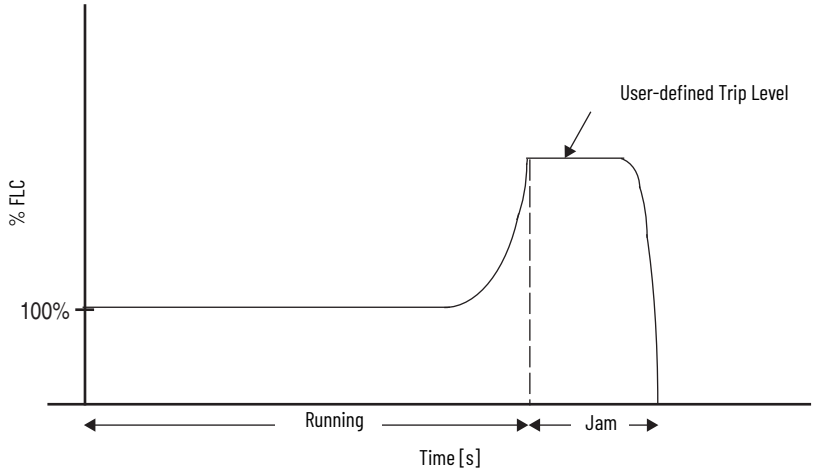
A jam alarm is also available. Set this up like the fault, using Jam Alarm Level and Jam Alarm Delay, parameter 116 [Jam A Lvl] and parameter 117 [Jam A Dly]. You can enable or disable this alarm using the Jam bit in parameter 231 [Motor Alarm En].

Table 40 - Jam Detection Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
78	Motor FLC	1.0...2200.0	1.0	R/W	Amps
114	Jam F Lvl	0...1000	1000		%FLC
115	Jam F Dly	0.1...99.0	0.1		Secs
116	Jam A Lvl	0...1000	1000		%FLC
117	Jam A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Figure 91 - Jam Detection



Real Power Protection (MWatts)

Motor Over Power Real—Fault and Alarm

Motor Over Power Real Fault (Code 44)

A Motor Over Power Real Fault, Code 44, condition occurs when the real power being consumed by the motor has risen above a user-defined level of parameter 90 [MWatts Ov F Lvl] for the user-defined time value of parameter 91 [MWatts Ov F Dly].

You can enable or disable the over power real fault by using the MWatts Over bit in parameter 230 [Motor Fault En].

Motor Over Power Real Alarm

An alarm is also available. Set this up like the motor fault, using parameter 92 [MWatts Ov A Lvl] and parameter 93 [MWatts Ov A Dly]. You can enable or

disable this alarm by using the MWatts Over bit in parameter 231 [Motor Alarm En].

Table 41 - Motor Over Power Real Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
90	MWatts Ov F Lvl	0.000...1000.00	0.000	R/W	MW
91	MWatts Ov F Dly	0.1...99.0	0.1		Secs
92	MWatts Ov A Lvl	0.000...1000.00	0.000		MW
93	MWatts Ov A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Motor Under Power Real—Fault and Alarm

Motor Under Power Real Fault (Code 43)

A Motor Under Power Real fault, fault code 43, condition occurs when the real power that is being consumed by the motor falls below a user-defined level of parameter 94 [MWatts Un F Lvl] for the user-defined time that is set in parameter 95 [MWatts Un F Dly].

You can enable or disable this fault by using the MWatts Under bit in parameter 230 [Motor Fault En].

Motor Under Power Real Alarm

An alarm is also available. Set this up like the motor fault, using parameter 96 [MWatts Un A Lvl] and parameter 97 [MWatts Un A Dly]y. You can enable or disable this alarm by using the MWatts Under bit in parameter 231 [Motor Alarm En].

Table 42 - Motor Under Power Real Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
94	MWatts Un F Lvl	0.000...1000.00	0.000	R/W	MW
95	MWatts Un F Dly	0.1...99.0	0.1		Secs
96	MWatts Un A Lvl	0.000...1000.00	0.000		MW
97	MWatts Un A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Reactive Power Protection (MVAR)

The SMC-50 controller can protect against excessive reactive power (MVAR). You can protect (fault) or issue a warning (alarm) if the motor reactive power (MVAR) consumption (+) or generation (-) is too high. You can use this protection with synchronous motors or motors that have active PFCCs.

Motor Over Power Reactive Positive (Motor Consumed)—Fault and Alarm

Motor Over Power Reactive Positive Fault (Code 46)

A Motor Over Power Reactive Positive Fault condition, Fault Code 46, occurs when the reactive power being consumed by the motor rises above a user-defined level of parameter 232 [+MVAR Ov F Lvl] for the user-defined delay time that is set in parameter 233 [+MVAR Ov F Dly].

You can enable or disable this fault by using the +MVAR Over bit in parameter 230 [Motor Fault En].

Motor Over Power Reactive Positive Alarm

A Motor Over Power Reactive alarm is also available. Set this up like the fault, using parameter 234 [+MVAR Ov A Lvl] and parameter 235 [+MVAR Ov A Dly], as shown in Table 43. You can enable or disable the alarm by using the +MVAR Over bit in parameter 231 [Motor Alarm En].

Table 43 - Motor Over Power Reactive Positive Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
232	+MVAR Ov F Lvl	0.000...1000.00	0.000	R/W	MVAR
233	+MVAR Ov F Dly	0.1...99.0	0.1		Secs
234	+MVAR Ov A Lvl	0.000...1000.00	0.000		MVAR
235	+MVAR Ov A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Motor Under Power Reactive Positive (Motor Consumed)—Fault and Alarm

Motor Under Power Reactive Positive Fault (Code 45)

A Motor Under Power Reactive Positive Fault condition, Fault Code 45, occurs when the reactive power being consumed by the motor falls below the user-defined level of parameter 236 [+MVAR Un F Lvl], for the user-defined delay time that is set in parameter 237 [+MVAR Un F Dly].

You can enable or disable this fault by using the +MVAR Under bit in parameter 230 [Motor Fault En].

Motor Under Power Reactive Positive Alarm

An Under Power Reactive alarm is also available. Set this up like the fault, using parameter 238 [+MVAR Un A Lvl] and parameter 239 [+MVAR Un A Dly], as shown in Table 44. You can enable or disable the alarm by using the +MVAR Under bit in parameter 231 [Motor Alarm En].

Table 44 - Motor Under Power Reactive Positive Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
236	+MVAR Un F Lvl	0.000...1000.00	0.000	R/W	MVAR
237	+MVAR Un F Dly	0.1...99.0	0.1		Secs
238	+MVAR Un A Lvl	0.000...1000.00	0.000		MVAR
239	+MVAR Un A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Motor Over Power Reactive Negative (Motor Generated)—Fault and Alarm

Motor Over Power Reactive Negative Fault (Code 67)

A Motor Over Power Reactive Negative fault, fault code 67, condition occurs when the reactive power being generated by the motor rises above a user-defined level of parameter 297 [-MVAR Ov F Lvl], for a user-defined time that is

set in parameter 298 [-MVAR Ov F Dly]. This only occurs when the Reactive Power is negative.

Enable or disable the Over Power Reactive Negative fault by using the -MVAR Over bit in parameter 230 [Motor Fault En].

Motor Over Power Reactive Negative Alarm

An Over Power Reactive Negative alarm is also available. Set this up like the fault, using parameter 299 [-MVAR Ov A Lvl] and parameter 300 [-MVAR Ov A Dly. Enable or disable this alarm by using the -MVAR Over bit in parameter 231 [Motor Alarm En].

Table 45 - Motor Over Power Reactive Negative Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
297	-MVAR Ov F Lvl	0.000...1000.00	0.000	R/W	MVAR
298	-MVAR Ov F Dly	0.1...99.0	0.1		Secs
299	-MVAR Ov A Lvl	0.000...1000.00	0.000		MVAR
300	-MVAR Ov A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Motor Under Power Reactive Negative (Motor Generated)—Fault and Alarm

Motor Under Power Reactive Negative Fault (Code 68)

A Motor Under Power Reactive Negative fault, Fault Code 68, condition occurs when the Reactive Power being generated by the motor falls below a user-defined level of parameter 301 [-MVAR Un F Lvl] for the user-defined time of parameter 302 [-MVAR Un F Dly]. This only occurs when the reactive power is negative.

Enable or disable the Motor Under Power Reactive Negative fault by using the -MVAR Under bit in parameter 230 [Motor Fault En].

Motor Under Power Reactive Negative Alarm

A Motor Underpower Reactive Negative alarm is also available. Set this up like the Fault, using parameter 303 [-MVAR Un A Lvl] and parameter 304 [-MVAR Un A Dly. Enable or disable this alarm by using the -MVAR Under bit in parameter 231 [Motor Alarm En].

Table 46 - Motor Under Power Reactive Negative Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
301	-MVAR Un F Lvl	0.000...1000.00	0.000	R/W	MVAR
302	-MVAR Un F Dly	0.1...99.0	0.1		Secs
303	-MVAR Un ALvl	0.000...1000.00	0.000		MVAR
304	-MVAR Un A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Apparent Power Protection (MVA)

The SMC-50 controller can protect against excessive apparent power. You can protect (fault) or issue a warning (alarm) if the apparent power (MVA) consumption of the motor being controlled is too high or too low.

Motor Over Power Apparent—Fault and Alarm

Motor Over Power Apparent Fault (Code 48)

A Motor Over Power Apparent fault, fault code 48, condition occurs when the Apparent Power being consumed by the motor rises above a user-defined level in parameter 240 [MVA Ov F Lvl], for a user-defined time that is set in parameter 241 [MVA Ov F Dly]. You can enable or disable this fault by using the MVA Over Power bit in parameter 230 [Motor Fault En].

Motor Over Power Apparent Alarm

A Motor Over Power Apparent alarm is also available. Set this up like the fault, using parameter 242 [MVA Ov A Lvl] and parameter 243 [MVA Ov A Dly. You can enable or disable this alarm by using the MVA Over Power bit in parameter 231 [Motor Alarm En].

Table 47 - Motor Over Power Apparent Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
240	MVA Ov F Lvl	0.000...1000.00	0.000	R/W	MVA
241	MVA Ov F Dly	0.1...99.0	0.1		Secs
242	MVA Ov A Lvl	0.000...1000.00	0.000		MVA
243	MVA Ov A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Motor Under Power Apparent—Fault and Alarm

Motor Under Power Apparent Fault (Code 47)

A Motor Under Power Apparent fault, Fault Code 47, condition occurs when the apparent power being consumed by the motor falls below a user-defined time in parameter 244 [MVA Un F Lvl], for a user-defined time in parameter 245 [MVA Un F Dly]. You can enable or disable this fault by using the MVA Under Power bit in parameter 230 [Motor Fault En].

Motor Under Power Apparent Alarm

A Motor Under Power Apparent alarm is also available. Set this up like the fault, using parameter 246 [MVA Un A Lvl] and parameter 247 [MVA Un A Dly]. You can enable or disable this alarm by using the MVA Under Power bit in parameter 231 [Motor Alarm En].

Table 48 - Motor Under Power Apparent Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
244	MVA Un F Lvl	0.000...1000.00	0.000	R/W	MVA
245	MVA Un F Dly	0.1...99.0	0.1		Secs
246	MVA Un A Lvl	0.000...1000.00	0.000		MVA
247	MVA Un A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Power Factor Protection

Motor Power Factor (PF)—Fault and Alarm

- *Lagging Power Factor Under Fault (Code 63)*
- *Leading Power Factor Under Fault (Code 64)*

- *Lagging Power Factor Over Fault (Code 65)*
- *Leading Power Factor Over Fault (Code 66)*
- *Lagging Power Factor Under Alarm*
- *Leading Power Factor Under Alarm*
- *Lagging Power Factor Over Alarm*
- *Leading Power Factor Over Alarm*

The SMC-50 controller can protect against an excessive PF for specific applications that require monitoring the phase angle difference between voltage and current. You can protect the motor by using the fault function or issue a warning using the alarm function if the PF for an electric motor is either too high or too low for both Leading, fault codes 64 and 66, and Lagging, fault codes 63 and 65, conditions.

Both Motor Leading and Motor Lagging fault and alarm functions provide a configurable delay time to limit nuisance trips in addition to the configurable fault and alarm levels. PF faults and PF alarms are individually enabled and disabled through parameter 230 [Motor Fault En] and parameter 231 [Motor Alarm En].

Table 49 - PF Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
248	Lead PF Ov F Lvl	0...1.00	0	R/W	–
249	Lead PF Ov F Dly	0.1...99.0	0.1		Secs
250	Lead PF Ov A Lvl	0...1.00	0		–
251	Lead PF Ov A Dly	0.1...99.0	0.1		Secs
252	Lead PF Un F Lvl	0...1.00	0		–
253	Lead PF Un F Dly	0.1...99.0	0.1		Secs
254	Lead PF Un A Lvl	0...1.00	0		–
255	Lead PF Un A Dly	0.1...99.0	0.1		Secs
256	Lag PF Ov F Lvl	0...1.00	0		–
257	Lag PF Ov F Dly	0.1...99.0	0.1		Secs
258	Lag PF Ov A Lvl	0...1.00	0		–
259	Lag PF Ov A Dly	0.1...99.0	0.1		Secs
260	Lag PF Un F Lvl	0...1.00	0		–
261	Lag PF Un F Dly	0.1...99.0	0.1		Secs
262	Lag PF Un A Lvl	0...1.00	0		–
263	Lag PF Un A Dly	0.1...99.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Excessive Starts/Hour Protection

Motor Starts/Hour—Fault and Alarm

Starts per Hour Fault (Code 29)

You can program the SMC-50 controller to limit the maximum number of starter/motor starts within a sliding one-hour time window. After the number of starts per hour is reached as you have configured it in parameter 128 [Starts per Hour], any additional starts cause an Excessive Starts fault, fault code 29. You can enable or disable this fault by using the Starts/Hr bit in parameter 230 [Motor Fault En].

Starts per Hour Alarm

A Starts Per Hour alarm is also available. You can enable or disable this alarm by using the Starts/Hr bit in parameter 231 [Motor Alarm En]. The Starts per Hour fault and alarm are activated when the starts within the last hour exceed the value configured in parameter 128 [Starts per Hour]. The starts count value is cleared when the starts in the previous hour are less than or equal to the Starts Per Hour parameter.

Table 50 - Starts per Hour Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
128	Starts Per Hour	1...99	99	R/W	–

(1) As displayed on the HIM or in the Connected Components Workbench software.

Preventive Maintenance Protection

Preventive Maintenance (PM) Hours Protection—Fault and Alarm

PM Hours Fault (Code 50) and Alarm

You can configure the SMC-50 controller 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 parameter 21 [Time to PM], 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, operating in slow speed, and running. When the parameter 21 [Time to PM] 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 parameter 126 [PM Hours] through parameter 16 [Meter Reset] via the HIM or network connection.

Enable the PM Hours fault by using the PM Hours bit in parameter 230 [Motor Fault En]. The PM Hours alarm is enabled using the PM Hours bit in parameter 231 [Motor Alarm En].

Table 51 - PM Hours Protection Parameter List

Parameter No.	Parameter Name(1)	Min/Max 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 in the Connected Components Workbench software.

PM Starts Protection—Fault and Alarm

PM Starts Fault (Code 51) and Alarm

You can configure the SMC-50 controller 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 parameter 127 [PM Starts], parameter 22 [Starts to PM], and parameter 16 [Meter Reset].

Parameter 22 [Starts to PM] 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 parameter 16 [Meter Reset] via a HIM or network communications.

The PM Starts alarm function is enabled using the PM Starts bit in parameter 230 [Motor Fault En]. The alarm is enabled using the PM Starts bit in parameter 231 [Motor Alarm En].

Table 52 - Starts Protection Parameter List

Parameter No.	Parameter Name(1)	Min/Max 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 in the Connected Components Workbench software.

Line Loss Protection

- *Line Loss Fault Phase A (Code1)*
- *Line Loss Fault Phase B (Code 2)*
- *Line Loss Fault Phase C (Code 3)*

The SMC-50 controller 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 parameter 136 [Starter Fault En]. In addition, a Line Loss alarm can be enabled or disabled using the Line Loss bit in parameter 137 [Starter Alarm En].

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

Silicon-Controlled Rectifier (SCR) Protection

Shorted SCR Fault—Phase A, B, or C

- *Shorted SCR Fault Phase A (Code 4)*
- *Shorted SCR Fault Phase B (Code 5)*
- *Shorted SCR Fault Phase C (Code 6)*

The SMC-50 controller can detect whether any one of its SCRs are shorted in any phase. The shorted SCR fault is always enabled (user cannot disable). No user intervention or parameter configuration is required and no shorted SCR alarm exists.

Shorted SCR detection is performed as part of a prestart check.

SCR Overtemperature—Fault

SCR Overtemperature Fault (Code 10)

The SMC-50 controller can detect whether any one of its SCRs has reached an over temperature condition, which could indicate excessive current draw or excessive number of starts. This function is accomplished using an I^2t calculation. There are no SCR Overtemperature parameters for you to configure. The SCR Overtemperature fault is always enabled. There is no SCR Overtemperature alarm.

The SCR temperature calculation/algorithm also controls the cyclic operation of the SMC-50 controller's fan(s) in the power section. The internal fan of the solid-state SMC-50 controller turns on whenever the motor that it controls is running **or** the estimated SCR temperature is above 50 °C (122 °F). The fan turns off when the motor is **not** energized **and** the estimated SCR temperature is below 49 °C (120.2 °F).

For SMC-50 controllers with internal bypass, you can wire the fans directly to the power source. In this case, the fans run constantly. You could also wire an auxiliary to control the fans. Fan control is selected and then the fans are controlled in the same manner as with the solid-state units.

Open SCR Gate Fault and Alarm—Phase A, B, or C

- *Open SCR Phase A (Code 7)*
- *Open SCR Phase B (Code 8)*
- *Open SCR Phase C (Code 9)*

The SMC-50 controller can detect whether an SCR control gate in any power phase has malfunctioned and initiate a fault or alarm. There are no user-configurable Open Gate parameters.

The Open SCR Gate fault is enabled and disabled using the Open Gate bit in parameter 136 [Starter Fault En]. The Open SCR Gate alarm is enabled and disabled in parameter 137 [Starter Alarm En].

Open Bypass—Phase A, B, or C

- *Open Bypass Phase A (Code 13)*
- *Open Bypass Phase B (Code 14)*
- *Open Bypass Phase C (Code 15)*

The SMC-50 controller monitors the power pole bypass contacts for proper operation. If a contact closure is not sensed, the SMC-50 controller indicates an open bypass fault in the appropriate phase.

Power Quality

Power Quality Fault and Alarm—Phase A, B, or C

- *Power Quality Phase A (Code 52)*
- *Power Quality Phase B (Code 53)*
- *Power Quality Phase C (Code 54)*

A power quality fault or alarm occurs when the starter is not properly firing its phase A, B, or C SCRs. This condition is generally attributed to power line

problems that are not detected by other line monitoring functions. There are no user-configurable Power Quality fault or alarm parameters to configure.

Phase A, B, and C Power Quality equates to fault codes 52, 53, or 54 respectively. You can enable or disable this by using the Power Quality bit in parameter 230 [Motor Fault En].

You can also enable or disable a Power Quality alarm by using the Power Quality bit in parameter 231 [Motor Alarm En].

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

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

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 53 - THD Parameter List

Parameter No.	Parameter Name(1)	Min/Max 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 in the Connected Components Workbench software.

Power Pole Overtemperature—Fault

PTC Power Pole Overtemperature Fault (Code 60)

A built-in PTC is used to measure the SMC-50 controller's power pole temperature. The SMC-50 controller generates a Power Pole PTC fault, fault code 60, when the temperature in the power pole rises above the PTC trip temperature.

There are no user-configurable Power Pole Overtemperature fault parameters. You cannot disable it. You cannot reset the fault until the unit cools.

Open Load—Fault and Alarm

- *No Load Motor Fault (Code 14)*
- *Open Motor Phase A Loss Fault (Code 15)*
- *Open Motor Phase B Loss Fault (Code 16)*

- *Open Motor Phase C Loss Fault (Code 17)*

The SMC-50 controller can detect and report a No Load Motor fault (no motor detected), fault code 14, condition and Open Motor Phase Loss fault condition for each individual motor phase A, B, or C, Fault Code 15, 16, and 17. A check for No Load and Open Motor Phase is done as an SMC-50 controller pre-start activity and is checked immediately after the motor start command and before the first SCR gating pulse. There are no user-configurable parameters associated with this fault.

You can enable or disable the No Load and Open Motor Phase Loss fault by using the Open Load bit in parameter 230 [Motor Fault En].

You can also enable or disable an Open Load alarm by using the Open Load bit in parameter 231 [Motor Alarm En].

Current Transformers (CT) Loss—Fault

- *CT Loss Phase A Fault (Code 30)*
- *CT Loss Phase B Fault (Code 31)*
- *CT Loss Phase C Fault (Code 32)*

The CT Loss fault is provided on a per phase basis (phase A, B, and C; fault codes 30, 31, and 32, respectively) and occurs when the current feedback signal from one of the SMC-50 controller's internal CTs is invalid. Indication of an invalid CT feedback signal is when the SMC-50 controller remains at the minimum negative current or maximum positive current for its current range. This fault cannot be disabled and no parameters need to be configured.

Locked Rotor—Fault and Alarm

Locked Rotor Fault (Code 70)

The Locked Rotor fault, fault code 70, provides indication that the rotor of the motor under SMC-50 controller control and operating in **any** running mode (for example, Slow Speed) has become frozen or locked.

The Locked Rotor fault is similar to the Jam fault except it is active during all running modes, not just at full speed.

The value or level of the Locked Rotor fault is configured as a percentage of the motor FLC using parameter 84 [Locked Rtr F Lvl]. A configurable delay time using parameter 85 [Locked Rtr F Dly] is also available to help eliminate nuisance faults.

Locked Rotor protection is enabled or disabled via the Locked Rotor bit in parameter 230 [Motor Fault En].

You can also enable a Locked Rotor alarm that activates under the same condition as the Locked Rotor Fault. The Locked Rotor alarm is enabled or disabled via the Locked Rotor bit in parameter 231 [Motor Alarm En].

Table 54 - Locked Rotor Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
84	Locked Rtr F Lvl	400...1000	600	R/W	% FLC
85	Locked Rtr F Dly	0.1...100.0	0.1		Secs
310	Locked Rtr A Lvl	400...1000	600		% FLC
311	Locked Rtr A Dly	0.1...100.0	0.1		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Expansion Module Functions

Expansion Device Removed Fault

Expansion Module Removed Fault (Code x026)

When an expansion module (for example, 150-SM...) is removed from a powered down control module and power is reapplied, Expansion Removed, fault code 26, is generated. For SMC-50 controller expansion modules, the fault code includes the control module port number (7, 8, or 9) to distinguish which expansion module caused the fault (for example, an expansion module in port 8 would display fault code 8026).

For physical DPI devices that support this function, the fault is generated only when the associated bit is set in parameter 149 [Logic Mask Act].

IMPORTANT Confirm that all line and control power is removed from the SMC-50 controller before you remove or install any expansion or communication module.

Expansion Device Fault

Expansion Module Fault (Code x028)

This fault code is generated directly by any option module or DPI device and is separate from the Expansion Device Removed fault (control module generated). This fault is always enabled (user cannot disable) in the control module. Individual option modules or DPI devices may enable or disable these faults as needed.

Not all devices use this fault.

Expansion Module Incompatible Fault

Incompatible Expansion Module Fault (Code x027)

If an expansion module (for example, 150-SM...) is plugged into an incompatible expansion port or the expansion module is not supported by the control module firmware revision (FRN), an Expansion Incompatible fault, fault code 27, is generated. The SMC-50 controller port number (7, 8, or 9) of the expansion module generating the fault is also displayed (for example, an expansion module in port 7 would display fault code 7027). This fault cannot be disabled.

Real-time Clock (RTC)

Battery Low

RTC Battery Low Alarm (Code 69)

An RTC Battery Low alarm, Code 69, provides indication of a control module battery low condition. This condition is checked upon powerup of the control module. The battery maintains the operation of the control module's RTC when the control power is removed. After the alarm is posted, the battery should be replaced as soon as possible. This alarm cannot be disabled.

To clear this alarm, you must replace the battery and set the time/date by using a HIM or applicable PC software (for example, Connected Components Workbench software). See Appendix D for battery replacement instructions.

Configuration Functions

Configuration Change—Fault and Alarm

Configuration Change Fault (Code 57)

By setting the Configuration Change bit in parameter 136 [Starter Fault En], any change to the controller configuration results in a Configuration Change fault, fault code 57. An alarm can also be initiated by setting the "Config Change" bit in parameter 137 [Starter Alarm En]. The fault can be cleared immediately; the alarm clears upon the next motor start command.

I/O Configuration—Fault

I/O Configuration Fault (Code 61)

The SMC-50 controller generates an I/O Configuration fault, fault code 61, if any control input is programmed as a Start or Slow Speed command and no input is configured for Coast or Stop. The fault occurs when the Start or operational maneuver is attempted (the motor does not start). This fault also generates when an input configuration changes from:

1. one that cannot start the motor to one that can start the motor **OR**
2. an input that can stop the motor to one that cannot.

This fault is always enabled; no parameter adjustments are required and no alarm is available.

Buffers and Storage Functions

Non-volatile Storage (NVS) Fault

NVS Fault (Code 34)

The NVS Error fault, fault code 34, is posted if a read/write checksum error occurs within the user data portion of the SMC-50 controller's nonvolatile memory. This fault can only be cleared if you modify/store a parameter value (this requires changing any parameter). It is recommended that you perform a Load Defaults command to make sure that all controller parameters are within range. you cannot clear this error by cycling the SMC-50 controller power.

Fault Buffer and Fault Storage Parameters

The fault buffer is used to store the last five system faults. The fault buffer is accessed via the Diagnostic screen of a 20-HIM-A6, 20-HIM-C6S, or from the Device Properties screen, which you access via the Connected Components Workbench software. The most recent fault is at the top of the buffer (number 1 for the HIM or number 1.1 for the software configuration tool. The fault buffer also stores the date and time that the fault occurred.

The date and time information is obtained from the SMC-50 controller's RTC. Make sure that the RTC is set correctly.

The five most recent faults are stored in parameter 138...142. Any networked device can access this stored fault history in the parameter list. The fault date and time are not available from the parameters list.

Table 55 - Fault Buffer and Fault Storage Parameter List

Parameter No.	Parameter Name[1]	Fault Code	Access	Units
138	Fault 1	0...10000	R	–
139	Fault 2			
140	Fault 3			
141	Fault 4			
142	Fault 5			

(1) As displayed on the HIM or in the Connected Components Workbench software.

Alarm/Event Buffer and Alarm/Event Storage Parameters

The alarm buffer is used to store several key controller events in addition to storing (buffering) alarm data. The types of events that are stored include:

Table 56 - Buffer Events

Event	Alarm Code
Start	71
Slow Speed	72
Stop Option	73
Coast	74
Clear Fault	75—a fault has been cleared
Fault	76
Parameter Change	77—change to any parameter occurred

You can access the alarm buffer via the Diagnostic screen of a 20-HIM-A6, 20-HIM-C6S, or from the Device Fault/Alarm button of Connected Components Workbench software. The alarm buffer stores the most recent 100 events, with the most recent event numbered as 1 (HIM) or 1.1 (software) in the list. Along with the alarm code, the date and time that the event occurred are also listed.

The date and time information is obtained from the SMC-50 controller's RTC. Make sure that the RTC is set correctly.

The last five alarm events are also available via parameters 143...147. Storing this alarm history in the parameter list provides access by any networked device. The alarm/event date and time are not available from the parameter list.

Table 57 - Alarm/Event Parameter List

Parameter No.	Parameter Name[1]	Alarm Code	Access	Units
143	Alarm 1	0...10000	R	–
144	Alarm 2			
145	Alarm 3			
146	Alarm 4			
147	Alarm 5			

(1) As displayed on the HIM or in the Connected Components Workbench software.

Auto Restart from Fault Function

This function allows the SMC-50 controller to automatically restart from various starter or motor fault conditions. Auto Restart from Fault is individually bit enabled or disabled using parameter 135 [Strtr Restart En] or parameter 264 [Motor Restart En]. See Table 58 on page 136.

Parameter 133 [Restart Attempts] lets you define the allowable number of restart attempts from the fault before ending the retry process. The Retry Counter clears whenever the controller receives a valid Stop command.

In addition, parameter 134 [Restart Dly] lets you define a time delay from when the fault event occurred until a restart attempt can be effective.

This delay is not used with an overload fault. Instead, the restart attempt occurs when the value of parameter 18 [Motor Therm Usage] falls below that of parameter 80 [OL Reset Level].

Table 58 - Auto Restart from Fault Parameter List

Parameter No.	Parameter Name(1)	Fault Name	Bit Assignment	Bit Access	Units	Default Value
135	Strtr Restart En	Volt Unbal Overvoltage Undervoltage Phase Rev Line Loss Open Gate Config Change Freq THD V	0 1 2 3 7 5 6 7 8	R/W	Bit = 0, Disabled Bit = 1, Enabled	All Disabled as Default
264	Motor Restart En	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	0 1 2 3 7 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22. 23	R/W	Bit = 0, Disabled Bit = 1, Enabled	All Disabled as Default

(1) As displayed on the HIM or in the Connected Components Workbench software.

Table 59 - Auto Restart Parameter List

Parameter No.	Parameter Name(1)	Min/Max Value	Default Value	Access	Units
133	Restart Attempts	0...5	0	R/W	–
134	Restart Dly	0...60	0		Secs

(1) As displayed on the HIM or in the Connected Components Workbench software.

Programming

Overview

This chapter provides a basic understanding of the programming/configuration tools available to modify the SMC-50 controller's parameters. Unlike previous SMC products (for example, SMC-3 and SMC Flex), the SMC-50 controller 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)

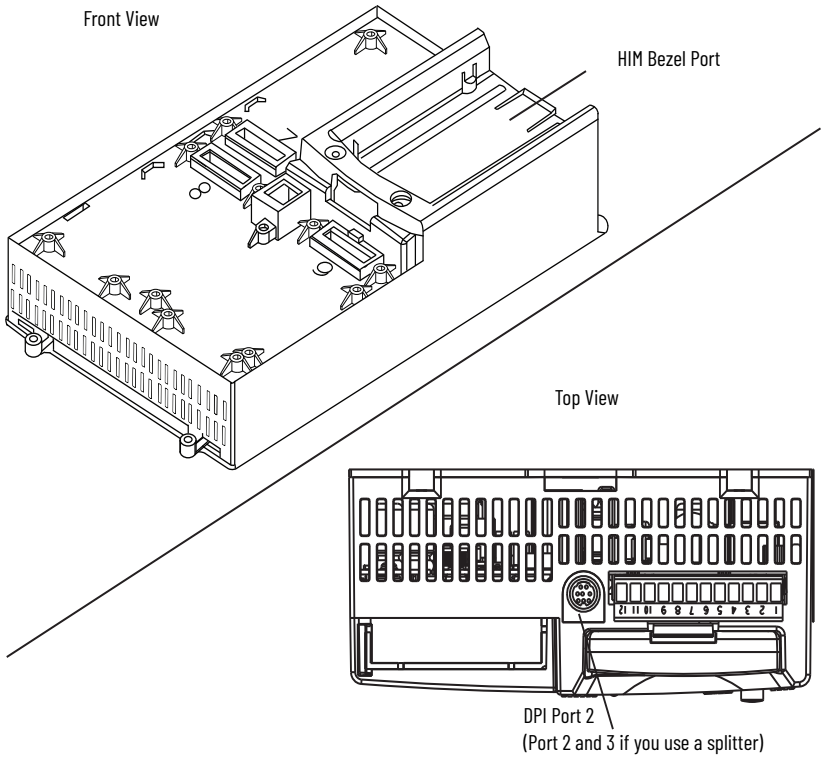
The 20-HIM-A6 lets you:

- configure/monitor all controller parameters,
- configure/monitor all option modules (for example, 150-SM4, digital I/O, 150-SM6 PCM), and
- use the SMC-50 controller'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.

The 20-HIM-A6 is typically inserted into the HIM bezel port 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 controller DPI Port 2 on the top of the controller. For additional information on mounting the 20-HIM-A6 or the 20-HIM-C6S, see the HIM user manual, publication 20HIM-UM001.

Figure 92 - 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 60 - HIM Single-Function Keys

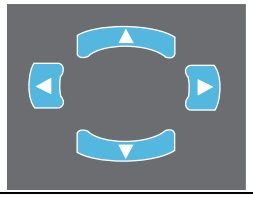
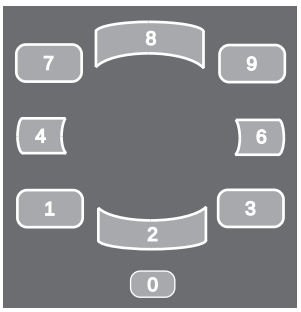
Key	Function
Start	Starts the controller if the SMC-50 controller Logic Mask is enabled for the port the HIM is connected to.(1)
Folders	Accesses folders for parameters, diagnostics, memory functions, preferences, and other tests.
Controls	Accesses jog, direction, auto/manual, and other control functions.
Stop	Stops the SMC-50 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) 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 61 - HIM Soft Key Functions

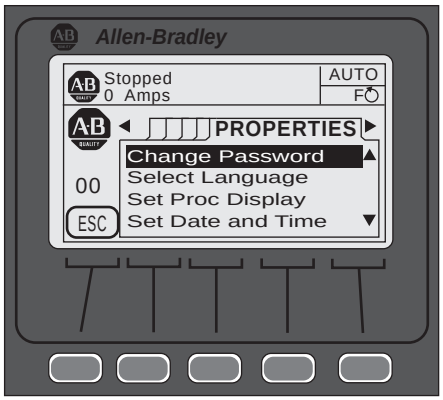
Soft Key	Description	Function
	Multi-Function—Blue	• Scrolls through menus and screens as directed by each arrow • Performs corresponding functions displayed in the data area
	Numeric Keys—Gray	• Enters their respective numeric values
	5/Enter	• Enters the numeric value, 5 • Displays the next level of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

Password Modification Using the HIM

The SMC-50 controller 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 93.

Figure 93 - PROPERTIES Folder Screen



If the default password (0=default) is modified, ensure that 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 93.
3. Select the CHANGE PASSWORD option, then press the Enter (#5) key.
4. Enter a numeric password, then press the Enter (#5) key. This loads the password into the SMC-50 controller's memory.

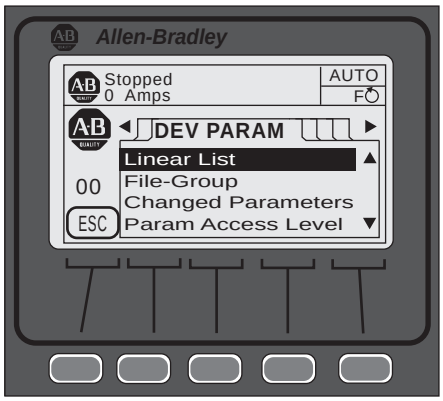
Parameter Access Level Modification Using the HIM

The SMC-50 controller 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 controller is cycled.
- The default access level is Basic.
- The advanced level provides access to all parameters.
- Individual parameter access levels are shown in Table 73 through Table 77, beginning on page 160. Access levels are also included the Parameter Linear List, Table 78 through Table 83, beginning on page 163.

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.

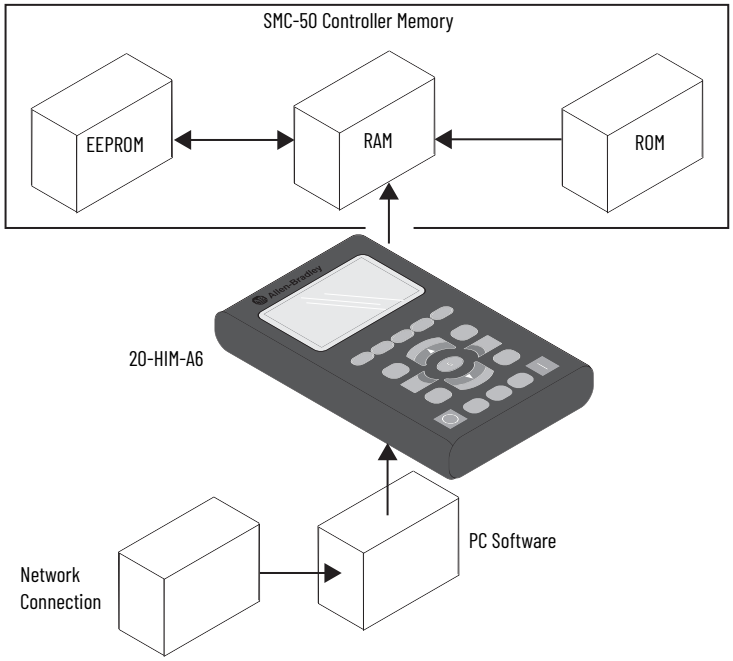


4. Use the up or down arrow to scroll up or down until you reach the desired access level
5. Press Enter (#5) to view that access level.

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.

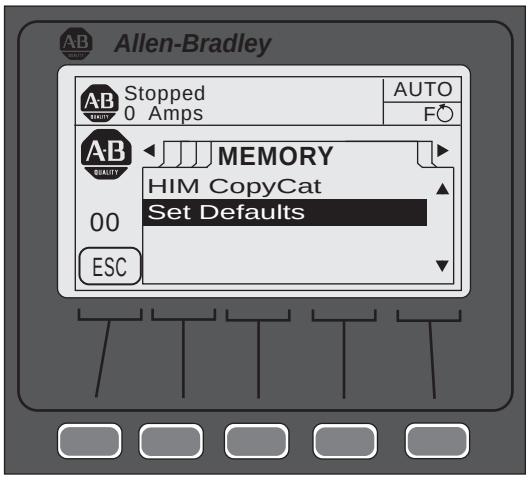
Figure 94 - Memory Block Diagram



RAM (Random Access Memory)

RAM is the work area of the controller after it is powered up. The SMC-50 controller 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), after 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 controller comes with factory default parameter values. These settings are stored in non-volatile ROM and are displayed the first time that 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. Confirm 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 parameter 229 [Parameter Mgmt], available in the Utility File-Group.

EEPROM

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

Parameter Configuration

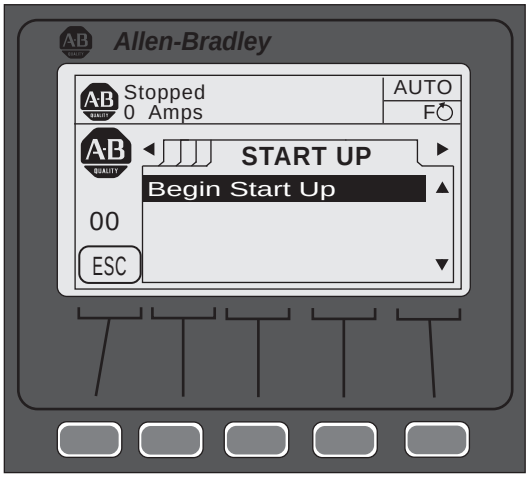
Using the Startup Configuration Tool (20-HIM-A6 or 20-HIM-C6S)

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

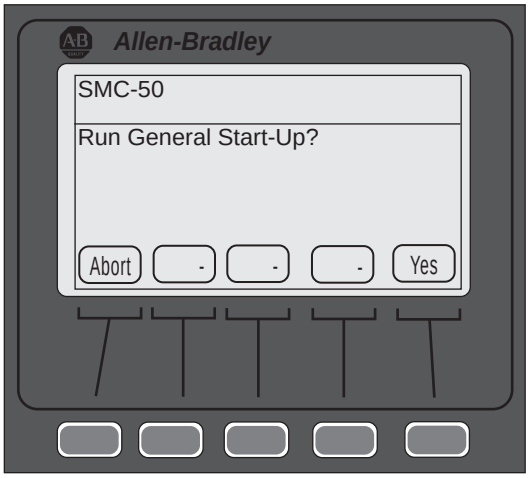
Not all parameters are configured with this tool. You can configure any non-configured startup parameters by using the parameter number or File Group search method. See page 168.

Accessing the General Startup Tool

1. Select the FOLDERS single-function key 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 are not displayed.

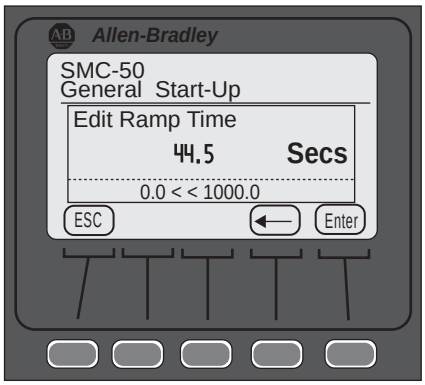
Reason: These parameters are specific to the Torque Start parameter group.

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.

After you have entered all parameters, the START-UP folders screen appears.

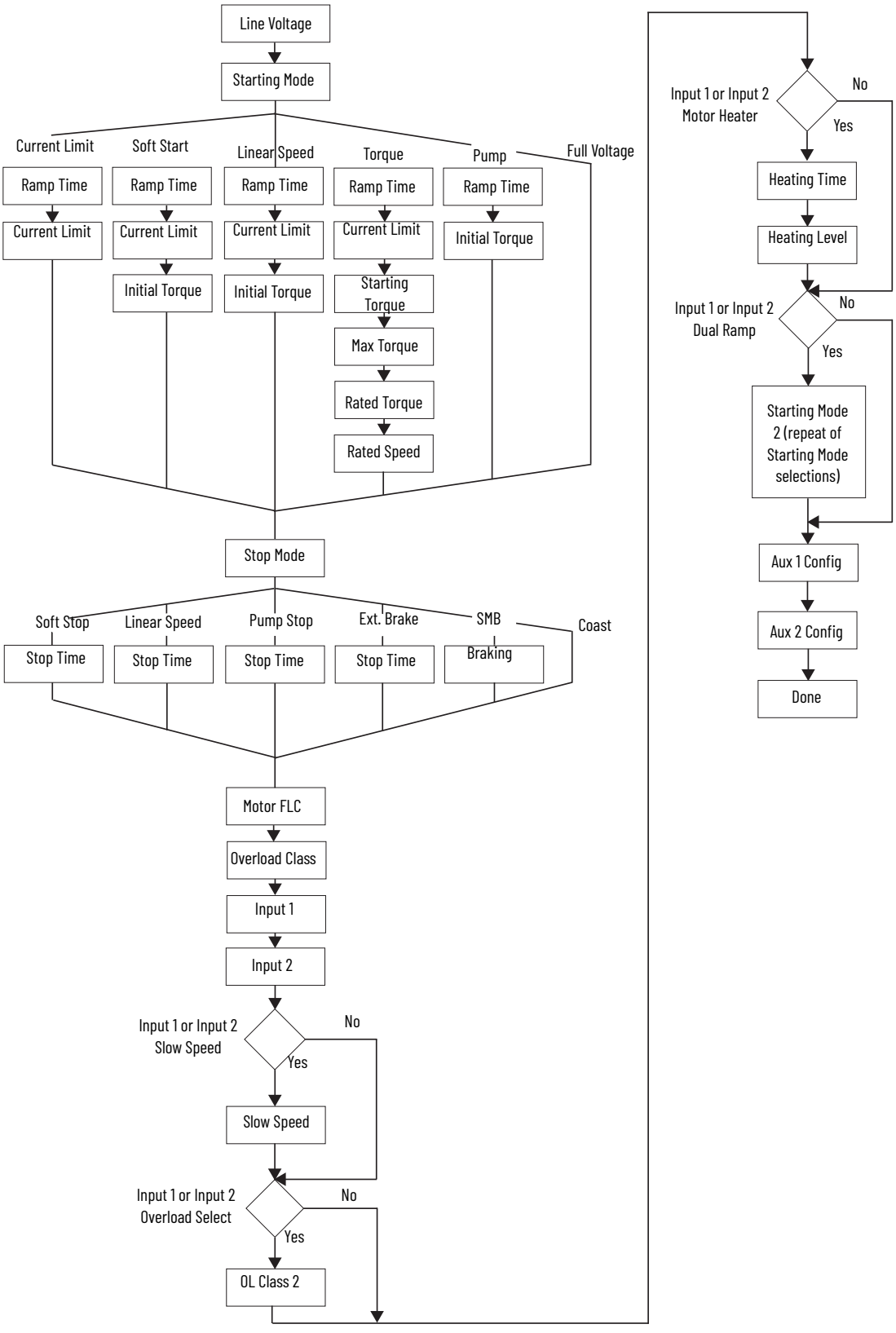
Review/Modify Parameter Data

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 that is outlined on page 143.

Figure 95 - Flowchart—General Startup Parameters



Parameter Search and Configuration

The 20-HIM-A6 or 20-HIM-C6S modules can access all SMC-50 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.

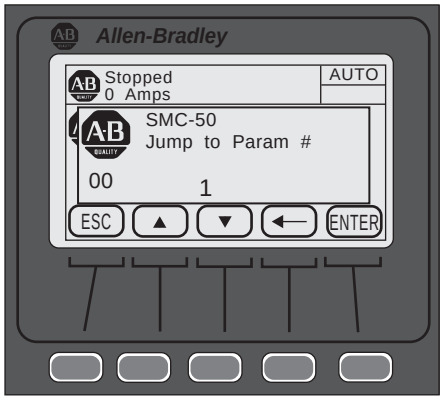
Parameter Search and Configuration by Parameter Number

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

Parameter Search and Configuration by Parameter Number

1. Confirm that the initial SMC-50 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 a complete SMC-50 controller linear list, see Table 78 through Table 83 beginning on page 163

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

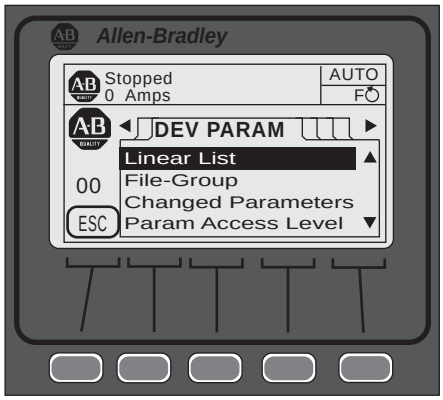
The parameters of the SMC-50 controller are structured into five parameter File-Groups:

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

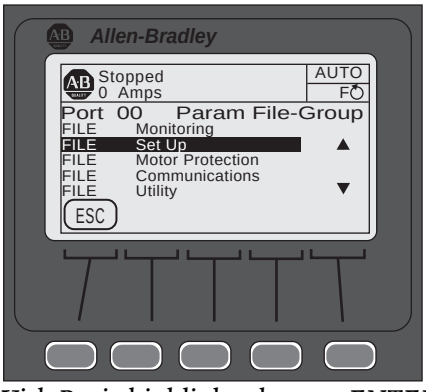
The parameters that are associated with each of these five File-Groups are shown in Table 73 through Table 77 beginning on page 160 of this chapter.

Parameter Search and Configuration by File-Group (SMC-50 Controller 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 that Port 00 SMC-50 controller 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, SMC-50 controller parameters can be selected and configured by functional category. See page 160.

Parameter Configuration—Using the Setup File Group

Overview

Table 62 shows the parameter sets available within the Basic Setup group.

Table 62 - Setup File Group

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

For a complete parameter set listing within each parameter File Group, see page 160.

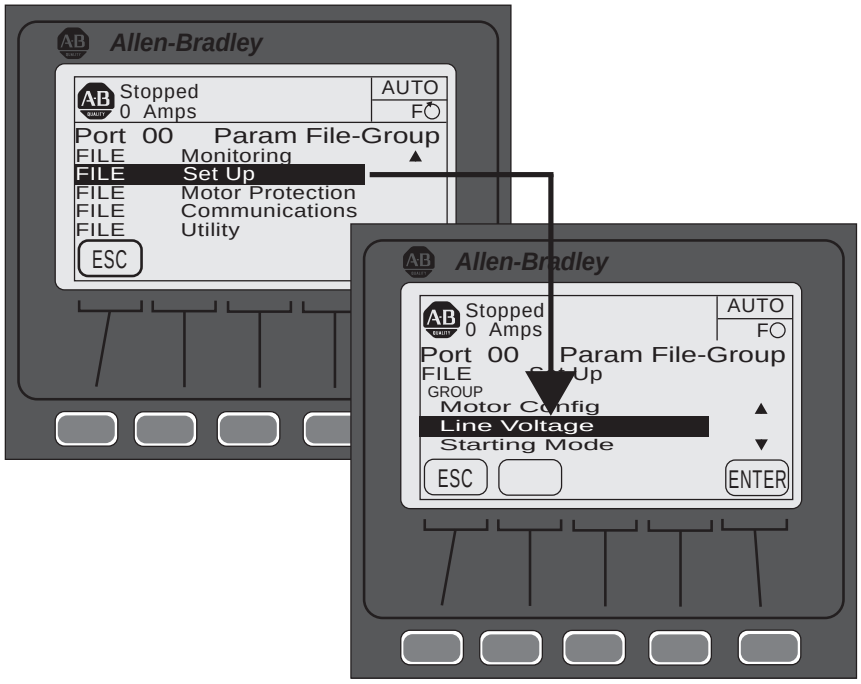
The Basic parameter set in the setup group is limited, yet powerful. It lets you quickly start the system with minimal adjustments and provides quick access to parameters that are required for standard motor connection and overload protection. If you are using advanced controller features (for example, Dual Ramp, Braking), 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 controller as it appears on the motor nameplate.

Figure 96 shows the initial FILE Setup screens using the HIM.

Figure 96 - Initial FILE Setup Screens



Soft Start and Stop

To program a soft start with simple stop mode operation, use the parameters listed in Table 63. 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 63 - 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...700V	480V
Starting Mode	This mode must be programmed for Soft Start.	Soft Start(2)(3)	Soft Start(2)(3)
Ramp Time	Programs the time that the SMC-50 controller ramps 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, SMB(6), Ext Brake(7)	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 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, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run, Motor Heater	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

Table 63 - Soft Start Parameter Group (Continued)

Parameter Name	Description	Options	Default Value
Aux 1 Config	Aux 1 Config Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(8)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(9), 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. (8)		
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...10000 N•m	10 N•m
Rated Speed	NOT used for a soft start.	750, 900, 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 62). Setting either parameter to zero disables Kickstart.
(3) You can also program a start delay time to delay starting for a 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], Linear Stop, or SMB—there is no Current Limit Stop or Torque Stop mode).
(6) You must also configure a Braking Current value from the Group Stopping selection (see Table 62).
(7) To use Ext. Braking, one of the Auxiliary Outputs must be programmed to Ext Brake. When programmed for Ext Brake, the function of this Auxiliary is to energize the external brake device to stop the motor. The relay stays ON from the beginning of the STOP command until the STOP time parameter has timed out.
(8) Relay Operational Options (for example, ON and OFF delay) are provided in the File: Setup, Group: I/O selection sequence. See Table 62.
(9) Any auxiliary output output that is configured for Aux Control using the AuxX Config parameter is under control of its associated bit from parameter 180 [Aux Control]. See parameter 180 [Aux Control] information for bit assignments. 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 controller as it appears on the motor nameplate.

Current Limit Start with Simple Stop Mode

Use the parameters in Table 64 to program a Current Limit Start with simple Stop Mode operation. Access the Basic parameter set with the HIM (see page 168).

Table 64 - 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...700V	480V
Starting Mode	This mode must be programmed for Current Limit.	Current Limit(2)(3)	Current Limit(2)(3)
Ramp Time	Programs the time that the SMC-50 controller HOLDS 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, SMB(6), Ext Brake(7)	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 depends 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, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run, Motor Heater(2)	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

Table 64 - Current Limit Start with Simple Stop Mode Parameters (Continued)

Parameter Name	Description	Options	Default Value
Aux 1 Config	Programs the control function of the Auxiliary Output Contact #1, wired across control terminal #4 and #5.(8)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control (9), 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...10000 N•m	10 N•m
Rated Speed	NOT used for a Current Limit Start.	750, 900, 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 62). Setting either parameter to zero disables Kickstart.
(3) You can also program a start delay time to delay starting for a 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], Linear Stop, or SMB—there is no Current Limit Stop or Torque Stop mode).
(6) You must also configure a Braking Current value from the Group Stopping selection (see Table 62).
(7) To use Ext. Braking, one of the Auxiliary Outputs must be programmed to Ext Brake. When programmed for Ext Brake, the function of this Auxiliary is to energize the external brake device to stop the motor. The relay stays ON from the beginning of the STOP command until the STOP time parameter has timed out.
(8) Relay Operational Options (for example, ON and OFF delay) are provided in the File: Setup, Group: I/O selection sequence. See Table 62.
(9) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from parameter 180 [Aux Control]. See parameter 180 [Aux Control] information for bit assignments. 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 controller as it appears on the motor nameplate.

Linear Acceleration (Linear Speed) Start with Stop

Use the parameters in Table 65 to program a Linear Acceleration Start and Simple Stop Mode operation. Access the Basic parameter set with the HIM (see page 168).

Table 65 - 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...700V	480V
Starting Mode	This mode must be programmed for Linear Speed.	Linear Speed(2)(3)	Linear Speed(2)(3)
Ramp Time	Programs the time that the SMC-50 controller ramps 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, SMB(6), Ext Brake(7)	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

Table 65 - Linear Acceleration (Speed Sense) Start with Stop Parameters (Continued)

Parameter Name	Description	Options	Default Value
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, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run, Motor Heater	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.(8)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(9), 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. (8)		
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 A
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...10000 N•m	10 N•m
Rated Speed	NOT used for a Linear Speed Start.	750, 900, 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 62). Setting either parameter to zero disables Kickstart.
(3) You can also program a start delay time to delay starting for a 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], Linear Stop, or SMB—there is no Current Limit Stop or Torque Stop mode).
(6) You must also configure a Braking Current value from the Group Stopping selection (see Table 62).
(7) To use Ext. Braking, one of the Auxiliary Outputs must be programmed to Ext Brake. When programmed for Ext Brake, the function of this Auxiliary is to energize the external brake device to stop the motor. The relay stays ON from the beginning of the STOP command until the STOP time parameter has timed out.
(8) Relay Operational Options (for example, ON and OFF delay) are provided in the File: Setup, Group: I/O selection sequence. See Table 62.
(9) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from parameter 180 [Aux Control]. See parameter 180 [Aux Control] information for bit assignments. 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 controller as it appears on the motor nameplate.

Torque Start with Stop

Use the parameters in Table 66 to program a Torque Start with simple Stop operation. Access the basic parameter set with the HIM (see page 168).

Table 66 - 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...700V	480V
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 that the SMC-50 controller ramps 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, SMB(7), Ext Brake(8)	Coast

Table 66 - Torque Start with Stop Parameters

Parameter Name	Description	Options	Default Value
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 depends 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, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run, Motor Heater	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. (9)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(10), 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. (9)		
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...10000 N•m	10 N•m
Rated Speed	The actual rated speed of the motor used in the Torque Ramp Start.	750, 900, 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 controller 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.
(3) You can also program a start delay time to delay starting for a time after the initiation of the START command. Access the Start Delay parameter from the Group Starting selection. See Table 62.
(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. 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 62. 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, Linear Stop, or SMB—there is no Current Limit Stop or Torque Stop mode).
(7) You must also configure a Braking Current value from the Group Stopping selection (Table 62).
(8) To use Ext. Braking, you must program one of the Auxiliary Outputs to Ext Brake. When programmed for Ext Brake, this Auxiliary is to energize the external brake device to stop the motor. The relay stays ON from the beginning of the STOP command until the STOP time parameter has timed out.
(9) Relay Operational Options (for example, ON and OFF delay) are provided in the File: Setup, Group: I/O selection sequence. See Table 62.
(10) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from parameter 180 [Aux Control]. See parameter 180 [Aux Control] information for bit assignments. 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 controller as it appears on the motor nameplate.

Pump Start with Stop

Use the parameters in Table 67 to program a Pump Start with simple Stop operation. Access the basic parameter set with the HIM (see page 168).

Table 67 - 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...700V	480V
Starting Mode	This mode must be programmed for Pump Start.	Pump Start(2)(3)	Pump Start(2)(3)
Ramp Time	Programs the time that the SMC-50 controller ramps 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

Table 67 - Pump Start with Stop Parameters (Continued)

Parameter Name	Description	Options	Default Value
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, SMB(6), Ext Brake(7)	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, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run, Motor Heater	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.(8)	Normal, UTS, Fault, Alarm, Ext Bypass, Ext Brake, Aux Control(9), 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.(8)		
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...10000 N•m	10 N•m
Rated Speed	NOT used for Pump Start.	750, 900, 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 you run the tuning cycle. The SMC-50 controller 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 controller'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. Access the Start Delay parameter from the Group Starting selection. See Table 62.
(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, Linear Stop, or SMB—there is no Current Limit Stop or Torque Stop mode).
(6) You must also configure a Braking Current value from the Group Stopping selection (Table 62).
(7) To use Ext. Braking, you must program one of the Auxiliary Outputs to Ext Brake. When programmed for Ext Brake, this Auxiliary is to energize the external brake device to stop the motor. The relay stays ON from the beginning of the STOP command until the STOP time parameter has timed out.
(8) Relay Operational Options (for example, ON and OFF delay) are provided in the File: Setup, Group: I/O selection sequence. See Table 62.
(9) Any auxiliary output configured for Aux Control using the AuxX Config parameter is under control of its associated bit from parameter 180 [Aux Control]. See parameter 180 [Aux Control] information for bit assignments. 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 controller as it appears on the motor nameplate.

Full Voltage Start with Stop

The SMC-50 controller 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 68 to program a Full Voltage Start and Stop Mode operation. Access the basic parameter set with the HIM (see page 168).

Table 68 - 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...700V	480V
Starting Mode	This mode must be programmed for Full Voltage Start.	Full Voltage(2)	Full Voltage(2)
Ramp Time	Programs the time that the SMC-50 controller ramps 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, SMB(4), Ext Brake(5)	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, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emerg Run, Motor Heater	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.(8)		
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...10000 N•m	10 N•m
Rated Speed	NOT used for Full Voltage Start.	750, 900, 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 time after the initiation of the START command. Access the Start Delay parameter from the Group Starting selection. See Table 62.
(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, Linear Stop, or SMB—there is no Current Limit Stop or Torque Stop mode).
(4) You must also configure a Braking Current value from the Group Stopping selection (Table 62).
(5) To use Ext. Braking, you must program one of the Auxiliary Outputs to Ext Brake. When programmed for Ext Brake, this Auxiliary is to energizes the external brake device to stop the motor. The relay stays ON from the beginning of the STOP command until the STOP time parameter has timed out.
(6) Relay Operational Options (for example, ON and OFF delay) are provided in the File: Setup, Group: I/O selection sequence. See Table 62.
(7) Any auxiliary output output that is configured for Aux Control using the AuxX Config parameter is under control of its associated bit from parameter 180 [Aux Control]. See parameter 180 [Aux Control] information for bit assignments. 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 controller as it appears on the motor nameplate.

Dual Ramp Start with Stop

The SMC-50 controller lets you select between two start profiles. Configure Start Profile 1 using the Basic parameter set as explained in the previous sections. Access the basic parameter set with the HIM (see page 168).

The Stop mode selected in the Basic parameter set applies 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.

Configure 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 page 168). Use the parameters in Table 69 to program a Dual Ramp adjustment.

Table 69 - 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 that the SMC-50 controller ramps 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 necessary, a boost of current (torque) is provided to motor for this programmed time.(4)	0...2 s	0 s
Kickstart Level 2	For Start Profile 2, if necessary, this parameter programs the amount of current (torque) applied to the motor during Kickstart time.(4)	750, 900, 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 controller does this automatically the first time the motor is run. You can also force this manually by setting parameter 194 [Forced Tuning] 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 applies to both Start Profile 1 and Start Profile 2. The Start Delay parameter can be accessed from the Group Starting selection (see Table 62).
(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.

Start Options

Motor Winding Heater Function

The motor winding heater can be activated after it receives a valid Start command by either programming parameter 220 [Heating Time] to a non-zero value or by configuring a terminal block input to Motor Heater and activating that input before the Start command. The Motor Winding Heater function continues for the specified time or until the Motor Heater Input is deactivated, at which time the motor starts based on the previous Start command signal. The Motor Winding Heater function is disabled if parameter 221 [Heating Level] is set to zero, parameter 220 [Heating Time] is set to zero, or the Input is inactive (or not configured) at the time of the Start command.

To program the Motor Winding Heater function, use the File Setup, Group Basic parameter list to configure the motor and most of the Start/Stop functions. See any of the previous programming sections for details based on the selected Start mode. The two key parameters (Heating Time and Heating Level), however, are in the File Setup Group Starting parameter list. See Table 62 for a basic understanding of accessing the Starting group. See Table 70 for heating parameter information.

Table 70 - Heating Time and Heating Level Parameters

Parameter Name	Description	Options	Default Value
Heating Time	The amount of time the Motor Winding Heater function remains engaged after receiving a valid Start command.	0...1000 s[1]	0 s
Heating Level	The percent Heating Level is sequentially applied to each winding.	0...100%	0%

(1) If the Terminal Block Input, configured to Motor Heater, is used to initiate the Motor Winding Heater function, Heating Time can be zero, The heater function is active after the terminal input is active and a start command.

Stop Options

SMB—Smart Motor Braking

To use the SMB function, the Stopping file group parameter set must be selected from FILE Setup group using the HIM (see Table 62).

Table 71 - SMB Parameters

Parameter Name	Description	Options	Default Value
Stop Mode	Lets you select the Stop Mode. The mode must be programmed for SMB.	SMB	SMB
Stop Time	**NOT used for SMB.** SMB automatically controls the duration (stop time) of the braking current to the motor from the "running at speed" condition until a zero speed condition is reached (zero speed braking shutoff feature/function). [1]	0...999 s	0 s
Braking Current	The amount of braking current to be applied to the motor.	0...400% FLC	0% FLC
Backspin Timer	The amount of time that must expire before another Start cycle can occur. The timer begins after the Stop maneuver is completed. All Start commands are ignored until the timer has expired. If the Start command is momentary and ends before the timer has expired, the motor does not start. This is used to prevent starting a motor that is still cycling.	0...999 seconds	0 s

(1) Programming a nonzero value for Stop Time overrides the SMB zero-speed detection feature/function and uses the exact time programmed for Stop Time to apply the programmed Braking Current to the motor. Doing this is useful in applications where detecting zero-speed is difficult (for example, a specific motor type or when the purpose is to reduce the number of overload trips associated with driving the motor to a complete stop). Setting the Stop Time to a specific value turns off braking current at a set time and each time a stopping maneuver is performed. To achieve an ideal Stop Time setting, use trial and error and always allow for some small coast time.

Setting the Stop Time to a longer duration causes braking current to be applied to a stopped motor and can result in overload trips.

Slow Speed with Braking

The SMC-50 controller Slow Speed feature provides a slow speed jog capability for general-purpose positioning. This capability is typically used for system setup. Slow Speed can drive the motor within a range of 1...15% of normal speed in the forward or reverse direction without a reversing contactor. Braking from Slow Speed is also provided.

To use the Slow Speed with Braking feature, use the HIM. Navigate from the Port 00 DEV PARAM folder: File-Group, File: Setup, Group: Slow Speed. See Table 62 for detailed information.

Table 72 - Slow Speed with Braking Parameters

Parameter Name	Description	Options	Default Value
Slow Speed 1	Lets you select Slow Speed 1 value for the application.(1)	-15...+15	+10
Slow Speed 2	Lets you select a second Slow Speed value for the application.(1)	-15...+15	+10
Slow Brake Current	The desired brake current to be applied from the programmed Slow Speed.(2)	0...350% FLC	0% FLC
Slow Speed Reference Gain	Lets you adjust the flux reference while the motor is running.	0.1...2.00	1.00
Slow Speed Transient Gain	Lets you adjust the control reference when transitioning between slow speed and any starting mode.	0.1...2.0	1.00

(1) The plus (+) or minus (-) sign determines the motor direction.
(2) A value of zero results in Coast-to-Stop.

Accu-Stop

This function combines the benefits of SMB and Preset Slow Speed features. For general-purpose positioning, the Accu-Stop function provides a brake from full speed to the preset slow speed setting, then a brake from Slow Speed or a Coast-to-Stop.

The Accu-Stop function is enabled whenever a control input is configured for Stop and another control input is configured for Slow Speed; the Stop Mode is configured for SMB and Slow Speed is configured. When the Slow Speed Input is enabled in this configuration, a SMB-to-Slow Speed occurs and Slow Speed continues until the Slow Speed Input is enabled.

To program Accu-Stop with the HIM, Setup Group Slow Speed and Setup Group Stopping must be used. See the two previous programming sections, SMB—Smart Motor Braking and Slow Speed with Braking.

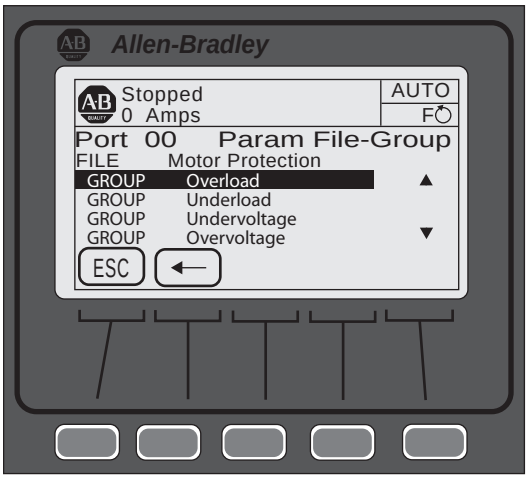
Motor Protection

The Motor Protection Group (see Table 75) 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 controller 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) has at least one selection for Fault Enable, Alarm Enable, and Restart Enable. For bit assignment definitions for the related faults and alarms, see Table 28 and Table 29.

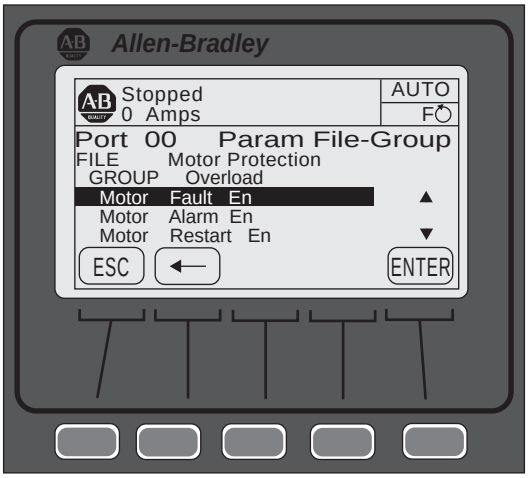
IMPORTANT Most parameters have both a fault and an alarm setting.

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

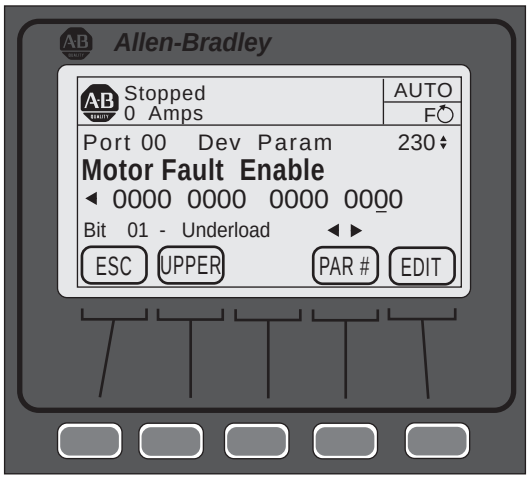
1. From the Motor Protection Group, select the desired group.



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

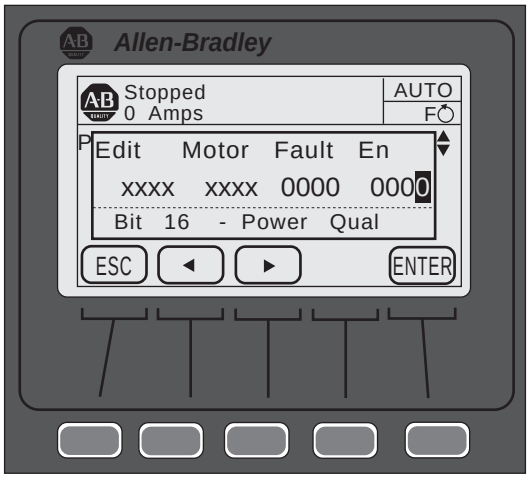


3. Select the desired 16-bit field, then press EDIT.



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 controller.



For details concerning motor and controller (fault and alarm) protection parameters, see Chapter 5.

Parameter File Group Structure

The five parameter file groups are structured as shown in Table 73 through Table 77. The access levels for each parameter are abbreviated as follows:

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

Table 73 - 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 74 - Setup File Group

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

Table 75 - 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

Table 75 - Motor Protection Group

Motor Protection File Group Parameters							
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		
Frequency Low F Delay		Alarm 4		
Frequency Low A Level		Alarm 5		
Frequency Low A Delay				

Table 76 - Communications Group Parameters

Communications File Group Parameters		
Communications Masks (BA)	**Datalinks (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 77 - 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)	

DeviceLogix parameters are parameters 335...346 in the parameter linear list. See Appendix C for additional information and programming examples.

Table 78 - SMC-50 Controller Parameter Linear List—Parameter 1...67

Number[1]	Name	
1 (M, B, A)	Voltage	P-P Ave
2 (M, B, A)	Volts Phase	A-B
3 (M, B, A)		B-C
4 (M, B, A)		C-A
5 (M, B, A)	Current Average	
6 (M, B, A)	Current Phase	A
7 (M, B, A)		B
8 (M, B, A)		C
9 (M, B, A)	Torque	
10 (M, B, A)	Real Power	
11 (M, B, A)	Real Energy	
12 (M, B, A)	Elapsed Time	
13 (M, B, A)	Elapsed Time 2	
14 (M, B, A)	Running Time	
15 (M, B, A)	Energy Savings	
16 (M, B, A)	Meter Reset	
17 (M, B, A)	Power Factor	
18 (M, B, A)	Motor Therm Usage	
19 (M, B, A)	Time to OL	Trip
20 (M, B, A)		Reset
21 (M, B, A)	Time to PM	
22 (M, B, A)	Starts to PM	
23 (M, B, A)	Total Starts	
24 (M, B, A)	Start Time	1
25 (M, B, A)		2
26 (M, B, A)		3
27 (M, B, A)		4
28 (M, B, A)		5
29 (M, B, A)	Peak Current	1
30 (M, B, A)		2
31 (M, B, A)		3
32 (M, B, A)		4
33 (M, B, A)		5
34 (M, B, A)	Motor Speed	

Number[1]	Name	
35 (M, B, A)	THD	V_a
36 (M, B, A)		V_b
37 (M, B, A)		V_c
38 (M, B, A)		V_{ave}
39 (M, B, A)		I_a
40 (M, B, A)		I_b
41 (M, B, A)		I_c
42 (M, B, A)		I_{ave}
43 (M, B, A)	Product Status	
44 (B, A)	Motor Config	
45 (M, B, A)	Motor Connection	
46 (B, A)	Line Voltage	
47 (B, A)	Rated	Torque
48 (B, A)		Speed
49 (B, A)	Starting Mode	
50 (B, A)	Ramp Time	
51 (B, A)	Initial Torque	
52 (B, A)	Maximum Torque	
53 (B, A)	Current Limit Level	
54 (B, A)	Kickstart	Time
55 (B, A)		Level
56 (B, A)	Input	1
57 (B, A)		2
58 (B, A)	Starting Mode 2	
59 (B, A)	Ramp Time 2	
60 (B, A)	Initial Torque 2	
61 (B, A)	Maximum Torque 2	
62 (B, A)	Current Limit Level 2	
63 (B, A)	Kickstart	Time 2
64 (B, A)		Level 2
65 (B, A)	Stop	Mode
66 (B, A)		Time
67 (B, A)	Backspin Timer	

(1) M, B, A = Access Level; see Parameter Access Level Modification Using the HIM on page 140.

Table 79 - SMC-50 Controller Parameter Linear List—Parameter 68...135

Number (1)	Name		Number (1)	Name	
68 (A)	Pump Pedestal		102 (B, A)	Overvolt	F Lvl
69 (B, A)	Braking Current		103 (B, A)		F Dly
70 (B, A)	Brake Load Type		104 (B, A)		A Lvl
71 (B, A)	High Eff Brake		105 (B, A)		A Dly
72 (B, A)	Slow Speed 1		106 (B, A)	Volt Unbal	F Lvl
73 (B, A)	Slow Brake Current		107 (B, A)		F Dly
74 (—)	Reserved		108 (B, A)		A Lvl
75 (B, A)	Overload Class		109 (B, A)		A Dly
76 (B, A)	Overload Class 2		110 (B, A)	Cur Imbal	F Lvl
77 (B, A)	Service Factor		111 (B, A)		F Dly
78 (B, A)	Motor FLC		112 (B, A)		A Lvl
79 (B, A)	Motor FLC 2		113 (B, A)		A Dly
80 (B, A)	OL Reset Level		114 (B, A)	Jam	F Lvl
81 (B, A)	OL Shunt Time		115 (B, A)		F Dly
82 (B, A)	OL Inhibit Time		116 (B, A)		A Lvl
83 (B, A)	Overload A Lvl		117 (B, A)		A Dly
84 (B, A)	Locked Rotor	F Lvl	118 (B, A)	THD V	F Lvl
85 (B, A)		F Dly	119 (B, A)		F Dly
86 (B, A)	Underload	F Lvl	120 (B, A)		A Lvl
87 (B, A)		F Dly	121 (B, A)		A Dly
88 (B, A)		A Lvl	122 (B, A)	THD I	F Lvl
89 (B, A)		A Dly	123 (B, A)		F Dly
90 (B, A)	MWatts Ov	F Lvl	124 (B, A)		A Lvl
91 (B, A)		F Dly	125 (B, A)		A Dly
92 (B, A)		A Lvl	126 (B, A)	PM Hours	
93 (B, A)		A Dly	127 (B, A)	PM Starts	
94 (B, A)	MWatts Un	F Lvl	128 (B, A)	Starts Per Hour	
95 (B, A)		F Dly	129 (B, A)	Frequency High F Lvl	
96 (B, A)		A Lvl	130 (B, A)	Frequency Low F Lvl	
97 (B, A)		A Dly	131 (B, A)	Frequency High A Lvl	
98 (B, A)	Undervolt	F Lvl	132 (B, A)	Frequency Low A Lvl	
99 (B, A)		F Dly	133 (B, A)	Restart Attempts	
100 (B, A)		A Lvl	134 (B, A)	Restart Delay	
101 (B, A)		A Dly	135 (B, A)	Starter Restart Enable	

(1) M, B, A = Access Level; see Parameter Access Level Modification Using the HIM on page 140.

Table 80 - SMC-50 Controller Parameter Linear List—Parameter 136...205

Number[1]	Name		Number[1]	Name	
136 (B, A)	Starter Fault Enable		171 (A)	Factory CT Ratio	
137 (B, A)	Starter Alarm Enable		172 (B, A)	Aux 1	Config
138 (M, B, A)	Fault	1	173 (B, A)		Invert
139 (M, B, A)		2	174 (B, A)		On Delay
140 (M, B, A)		3	175 (B, A)		Off Delay
141 (M, B, A)		4	176 (B, A)	Aux 2	Config
142 (M, B, A)		5	177 (B, A)		Invert
143 (M, B, A)	Alarm	1	178 (B, A)		On Delay
144 (M, B, A)		2	179 (B, A)		Off Delay
145 (M, B, A)		3	180 (B, A)	Aux Control	
146 (M, B, A)		4	181 (B, A)	Language	
147 (M, B, A)		5	182 (B, A)	Start Delay	
148 (B, A)	Logic Mask		183 (A)	Timed Start	
149 (B, A)	Logic Mask Act		184 (A)	V Shut Off Level	
150 (B, A)	Write Mask Cfg		185 (A)	I Shut Off Level	
151 (B, A)	Write Mask Act		186 (A)	UTS Level	
152 (B, A)	Port Mask Act		187 (A)	Stall	Level
153 (B, A)	Data In	A1	188 (B, A)		Delay
154 (B, A)		A2	189 (A)		Position
155 (B, A)		B1	190 (A)	Notch Maximum	
156 (B, A)		B2	191 (A)	Notch Position	
157 (B, A)		C1	192 (A)	Bypass Delay	
158 (B, A)		C2	193 (B, A)	Energy Saver	
159 (B, A)		D1	194 (A)	Force Tuning	
160 (B, A)		D2	195 (M, B, A)	Stator R	
161 (B, A)	Data Out	A1	196 (M, B, A)	Total R	
162 (B, A)		A2	197 (M, B, A)	Coupling Factor	
163 (B, A)		B1	198 (M, B, A)	Inductance	
164 (B, A)		B2	199 (A)	Speed PGain	
165 (B, A)		C1	200 (A)	Transient	Gain
166 (B, A)		C2	201 (A)		Zero
167 (B, A)		D1	202 (A)		Mag
168 (B, A)		D2	203 (A)	Ping Degree	
169 (A)	Voltage Ratio		204 (A)	Pings	
170 (A)	User CT Ratio		205 (A)	Phase Shift 0	

(1) M, B, A = Access Level; see Parameter Access Level Modification Using the HIM on page 140.

Table 81 - SMC-50 Controller Parameter Linear List—Parameter 206...277

Number[1]	Name	
206 (A)	Phase Shift	10
207 (A)		20
208 (A)		30
209 (A)		40
210 (A)		50
211 (A)	Phase Shift	60
212 (A)		70
213 (A)		80
214 (A)		90
215 (A)		100
216 (M, B, A)	Board Temp	
217 (B, A)	Exp 7 Config	
218 (B, A)	Exp 8 Config	
219 (B, A)	Exp 9 Config	
220 (B, A)	Heating	Time
221 (B, A)		Level
222 (B, A)	Fan	Config
223 (M, B, A)		Connection
224 (M, B, A)	Line Frequency	
225 (B, A)	Freq High	F Dly
226 (B, A)		A Dly
227 (B, A)	Freq Low	F Dly
228 (B, A)		A Dly
229 (A)	Parameter Management	
230 (B, A)	Motor	Fault En
231 (B, A)		Alarm En
232 (B, A)	+MVAR[2]	Ov F Lvl
233 (B, A)		Ov F Dly
234 (B, A)		Ov A Lvl
235 (B, A)		Ov A Dly
236 (B, A)		Un F Lvl
237 (B, A)		Un F Dly
238 (B, A)		Un A Lvl
239 (B, A)		Un A Dly
240 (B, A)	MVA	Ov F Lvl
241 (B, A)		Ov F Dly

Number[1]	Name	
242 (B, A)	MVA	Ov A Lvl
243 (B, A)		Ov A Dly
244 (B, A)		Un F Lvl
245 (B, A)		Un F Dly
246 (B, A)		Un A Lvl
247 (B, A)		Un A Dly
248 (B, A)	Lead PF	Ov F Lvl
249 (B, A)		Ov F Dly
250 (B, A)		Ov A Lvl
251 (B, A)		Ov A Dly
252 (B, A)		Un F Lvl
253 (B, A)		Un F Dly
254 (B, A)		Un A Lvl
255 (B, A)		Un A Dly
256 (B, A)	Lag PF	Ov F Lvl
257 (B, A)		Ov F Dly
258 (B, A)		Ov A Lvl
259 (B, A)		Ov A Dly
260 (B, A)		Un F Lvl
261 (B, A)		Un F Dly
262 (B, A)		Un A Lvl
263 (B, A)		Un A Dly
264 (B, A)	Motor Restart En	
265 (M, B, A)	Voltage	P-N Ave
266 (M, B, A)	Volts Phase	A-N
267 (M, B, A)		B-N
268 (M, B, A)		C-N
269 (M, B, A)	Real Power	A
270 (M, B, A)		B
271 (M, B, A)		C
272 (M, B, A)	Real Demand	
273 (M, B, A)	Max Real Demand	
274 (M, B, A)	Reactive Power	A
275 (M, B, A)		B
276 (M, B, A)		C
277 (M, B, A)	Reactive Power	

(1) M, B, A = Access Level; see Parameter Access Level Modification Using the HIM on page 140.
(2) The "+" for MVAR indicates power consumed.

Table 82 - SMC-50 Controller Parameter Linear List—Parameter 278...333

Number[1]	Name	
278 (M, B, A)	Reactive Energy	C[2]
279 (M, B, A)		P[3]
280 (B, A)	Reactive Energy	
281 (M, B, A)	Reactive Demand	
282 (M, B, A)	Max Reactive Demand	
283 (M, B, A)	Apparent Power	A
284 (M, B, A)		B
285 (M, B, A)		C
286 (M, B, A)	Apparent Power	
287 (M, B, A)	Apparent Energy	
288 (M, B, A)	Apparent Demand	
289 (M, B, A)	Max Apparent Demand	
290 (B, A)	Demand Period	
291 (B, A)	Number of Periods	
292 (M, B, A)	Power Factor	A
293 (M, B, A)		B
294 (M, B, A)		C
295 (M, B, A)	Current Imbal	
296 (M, B, A)	Voltage Unbal	
297 (B, A)	-MVAR[4]	Ov F Lvl
298 (B, A)		Ov F Dly
299 (B, A)		Ov A Lvl
300 (B, A)		Ov A Dly
301 (B, A)		Un F Lvl
302 (B, A)		Un F Dly
303 (B, A)		Un A Lvl
304 (B, A)		Un A Dly
305 (B, A)	Starting Torque	
306 (B, A)	Starting Torque 2	
307 (A)	SS Ref Gain	

Number[1]	Name	
307 (A)	SS Ref Gain	
308 (A)	SS Trans Gain	
309 (M, B, A)	Input Status	
310 (B, A)	Locked Rotor	A Lvl
311 (B, A)		A Dly
312 (A)	Product Command	
313 (B, A)	Rebalance Level	
314 (M, B, A)	Peak Voltage	A
315 (M, B, A)		B
316 (M, B, A)		C
317 (M, B, A)	Peak Current	A
318 (M, B, A)		B
319 (M, B, A)		C
320 (M, B, A)	Snap Shot	Phase A-B Voltage
321 (M, B, A)		Phase B-C Voltage
322 (M, B, A)		Phase C-A Voltage
323 (M, B, A)		Phase A Current
324 (M, B, A)		Phase B Current
325 (M, B, A)		Phase C Current
326 (M, B, A)		Power Factor
327 (M, B, A)		Motor Thermal Usage
328 (M, B, A)		Motor Speed
329 (M, B, A)		THD Voltage Average
330 (M, B, A)		THD Current Average
331 (M, B, A)		Product Status
332 (M, B, A)		Board Temp
333 (M, B, A)		Line Frequency
334 (M, B, A)	Restart Auto	

(1) M, B, A = Access Level; see Parameter Access Level Modification Using the HIM on page 140.
(2) C=Consumed
(3) P=Produced
(4) The "-" for MVAR indicates power generated.

Table 83 - SMC-50 Controller Parameter Linear List—Parameter 334...350

Number[1]	Name	
335 (M, B, A)	DeviceLogix	DLX Input 1
336 (M, B, A)		DLX Input 2
337 (M, B, A)		DLX DL Input 1
338(M, B, A)		DLX DL Input 2
339 (M, B, A)		DLX DL Input 3
340 (M, B, A)		DLX DL Input 4
341 (M, B, A)	DeviceLogix	DLX DL Input 5
342 (M, B, A)		DLX DL Input 6
343 (M, B, A)		DLX Output 1
344 (M, B, A)		DLX Output 2

Number[1]	Name	
345 (M, B, A)	DeviceLogix	DLX Command
346 (M, B, A)		DLX Status
347 (M, B, A)	Load Type	
348 (M, B, A)	Ref Source	
349 (M, B, A)	Output V Ref	
350 (M, B, A)	Slow Speed 2	

(1) M, B, A = Access Level; see Parameter Access Level Modification Using the HIM on page 140.

SMC-50 Controller Option Module Configuration

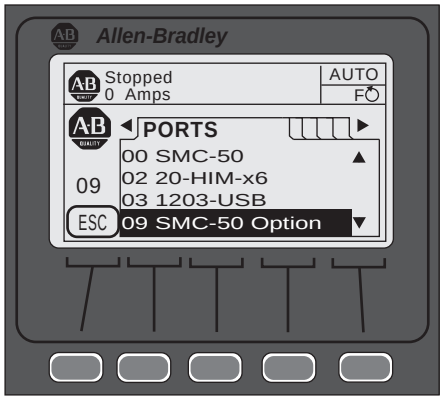
Basic Configuration Using the HIM

When you plug an SMC-50 controller 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 controller ports (07, 08, or 09) and are not included in the SMC-50 controller Controller (Port <00>) parameter list.

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

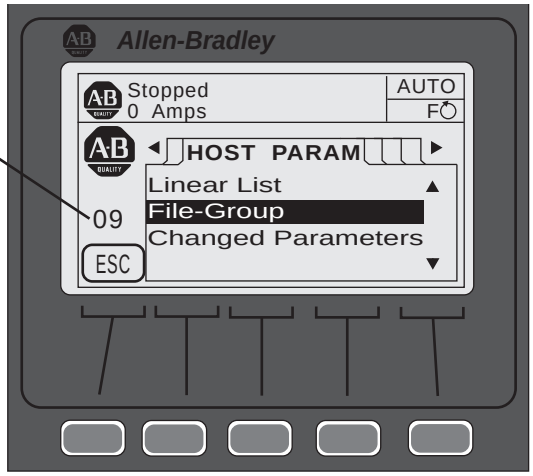
Before proceeding with these steps: Take note of the SMC-50 controller port number (07, 08, or 09) that the option module is connected to.

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 controller number below the AB logo.

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



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

You can restore parameters to factory defaults by using its corresponding Parameter Management parameter or the Set Defaults function from the HIM memory screen. Confirm that 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.

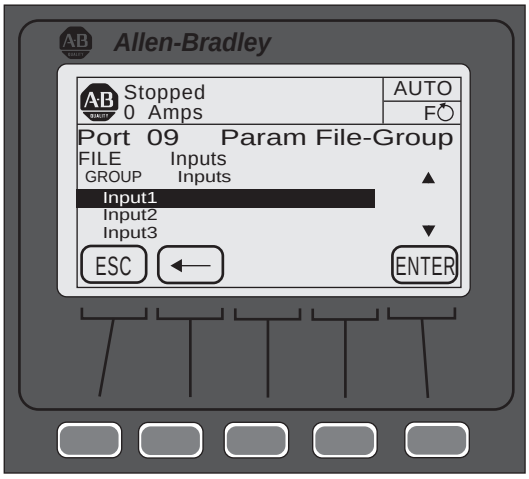
150-SM4 Digital I/O Option Module

In addition to the two on-board 24V DC inputs and two auxiliary relay outputs of the SMC-50 controller, 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 shows 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, Slow Speed), then press the ENTER soft key to load the selection. If necessary, use the back arrow to return to the previous selection.

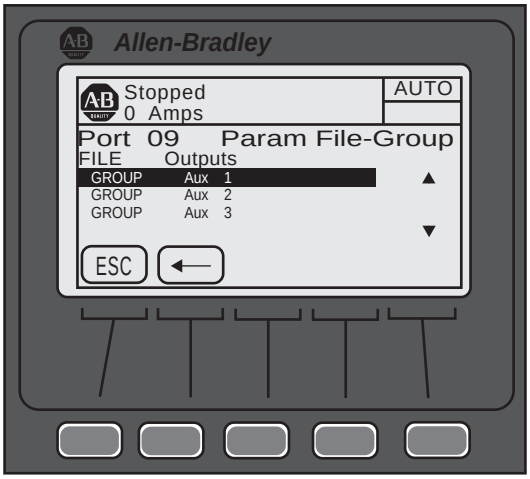
For a complete list of 150-SM4 parameters, see Table 84.

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

Table 84 lists the allowable selections for the 150-SM4 option module.

Table 84 - 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 Slow Speed Dual Ramp OL Select Fault Fault NC Clear Fault Emerg Run Motor Heater	Disable	R/W	–
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	–
X.7	Aux 1 Invert	Disable Enable	Disable	R/W	

Table 84 - 150-SM4 Parameters (Continued)

Parameter		Min/Max Values	Default Value	Access	Units
Number[1]	Name				
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	–
X.11	Aux 2 Invert	Disable Enable	Disable	R/W	–
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	–
X.15	Aux 3 Invert	Disable Enable	Disable	R/W	–
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	–

(1) "X" indicates the port number (07, 08, or 09) the 150-SM4 is connected to on the SMC-50 controller. 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 from parameter 180 [Aux Control]. See page 242 for bit assignments. This function enables forcing an output, ON or OFF.

150-SM6 Parameter Configuration Option Module

Use the 150-SM6 Parameter Configuration Option Module to configure a select group of parameters. The option module itself requires no user configuration. The option module status and switch positions that configure its select parameters can be read using the HIM or PC software.

Only one 150-SM6 is allowed per SMC-50 controller.

To read the 150-SM6 switch positions, follow the steps on page 168. When Linear List is selected, use the up or down arrow to view the module switch positions.

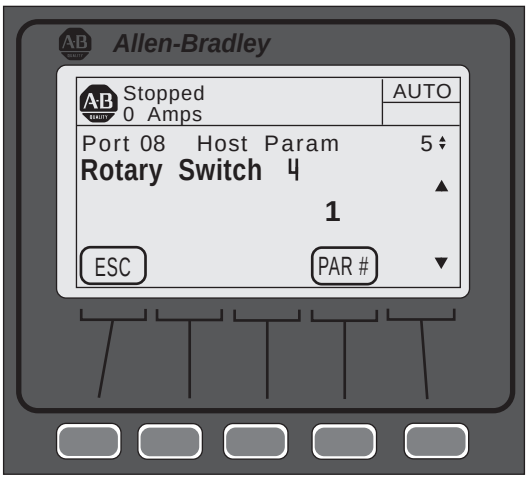


Table 85 provides the parameter detail of the 150-SM6.

Table 85 - 150-SM6 Parameters

Parameter		Min/Max	Access	Units
Number(1)	Name			
X.1	Module Status	Ready	R	1=Ready 0=Disabled
X.2	Rotary Switch 1 (2) (Initial Torque)	0.0...15.0	R	0...1.5=0...F
X.3	Rotary Switch 2 (2) (Current Limit)			
X.4	Rotary Switch 3 (2) (Ramp Time)			
X.5	Rotary Switch 4 (2) (Stop Time)			
X.6	Rotary Switch 5 (2) (Motor FLC)			
X.7	Device Config	0.0...255.0	R/W	Bit Numbered(3)
X.8	Protect Config			
X.9	I/O Config			

(1) "X" indicates the port number (07, 08, or 09) the 150-SM6 is connected to the SMC-50 controller. This port number is displayed on the HIM screen below the AB brand logo.
(2) For 150-SM6: Rotary Switch 1 = S1, Rotary Switch 2 = S2, and so on, Rotary switch positions equal 1 to F. As displayed on the HIM, A=10, B=11, C=12, and so on.
(3) Bit 0 and 1 values represent the ON/OFF switch positions within the associated switch bank (for example, Device Config) where 0=OFF and 1=ON.

Switch #1=Bit 0, Switch #2=Bit 1, and so on, as displayed on the HIM.

For switch setting details, see Table 87 through Table 91.

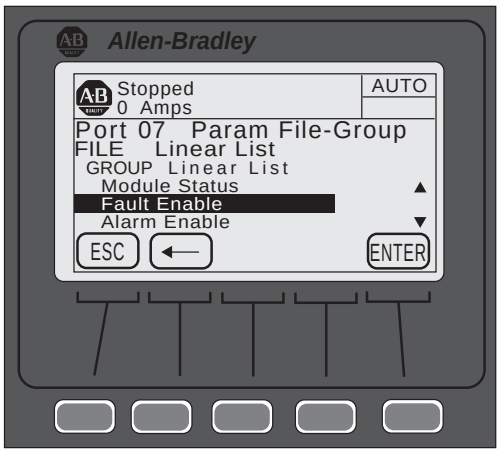
150-SM2 PTC, Ground Fault, and External Current Transformer Module

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

- Only one 150-SM2 can be installed in an SMC-50 controller.
- 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 controller for scaling, phase shift, and inversion. The calibration cycle automatically occurs:

- before the first START occurs after the 150-SM2 installation and when parameter X.12 [CT Enable], = Enable,
- after a Load Default occurs, and
- when you force tuning of the SMC-50 controller through parameter 194 [Forced Tuning] or the HOLD TO TEST button on the SMC-50 controller is held for > 10 seconds when stopped.

To configure the 150-SM2, follow the steps on page 168 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 must 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.

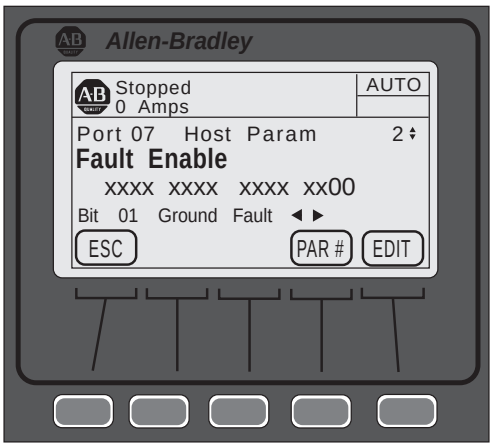


Table 86 provides the parameter detail of the 150-SM2.

Table 86 - 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	–
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	Secs
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	Secs
X.10	Ground Fault Inh Time[4]	0.0...250.0	10.0	R/W	Secs
X.11	Ground Current	0.00...5.00	0.00	R	Amps
X.12	CT Enable	Disable Enable	Disable	R/W	–
X.13	CT Scaling A	0.10...5.00	1.00	R	–
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	–

(1) "X" indicates the port number (07, 08, or 09) the 150-SM6 is connected to the SMC-50 controller. 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 time that is selected during starting.

Parameter Configuration Module

Using the Parameter Configuration Module (150-SM6)

The Cat. No. 150-SM6 parameter configuration module (PCM) provides simple and limited configuration of the SMC-50 controller. you can insert this PCM into any control module option port (7, 8, or 9). Only one PCM is allowed per control module.

Parameters that **are** configured by the PCM and whose values represent the switch settings appear as read/write parameters to other configuration devices. The parameter values set by the PCM are stored in the control module memory. By using the appropriate removal procedure (remove all power to Control Module and Power Module), you can remove the PCM from the control module and retain its parameter settings.

You can configure parameters that **are not** defined and therefore are not configurable by the Cat. No. 150-SM6 PCM through other means (for example, Human Interface Module (HIM), Connected Components Workbench software, or DriveExecutive software), if necessary.

Application considerations for the 150-SM6 PCM are:

- If another configuration tool attempts to configure a parameter set up by an installed 150-SM6, that parameter reverts to the 150-SM6 configuration. The PCM overrides other configuration tools.

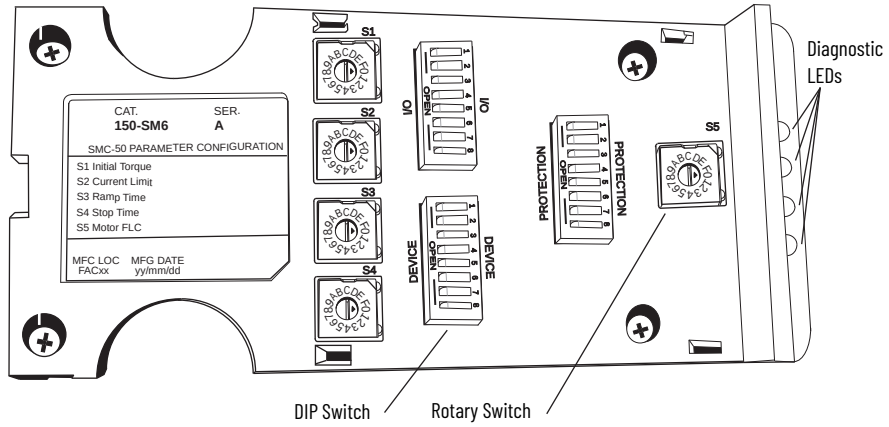
- The 150-SM6 can only configure the on-board control I/O of the Control Module. If additional I/O are added by using a 150-SM4 Digital I/O Option Module, you must configure those I/O with another programming tool.

When using a Cat. No. 150-SM6 PCM to configure the SMC-50 controller, the following features, functions, and modes are not configurable:

- Full voltage start
- Torque ramp start
- External brake stop
- Option card I/O configuration (Cat. No. 150-SM... option modules)
- External bypass
- Specialized output relay configuration (for example, network control, DeviceLogix, auxiliary control)
- Specialized operation modes/features
  - Dual ramp, motor winding heater, emergency run
  - Overload select (Class)
  - Adjustment of slow speed setpoint

If the PCM is removed, another configuration tool (for example, a HIM) can change a parameter that was previously altered by an installed PCM.

Figure 97 - DIP Switch and Rotary Switch Locations



The 150-SM6 PCM contains five rotary switches, S1 through S5, each with designations 0-F and three banks of ON/OFF 8-switch DIP switches.

Table 87 through Table 91 show the resulting values of the position setting functions for each of the five rotary switches and the associated controller parameter numbers. For details on the functions of these parameters, see Chapter 3, 5, 7, and Appendix A.

Table 87 - S1 = Initial Torque Configuration—Controller Parameter 51 [Initial Torque]

Position Setting	Resulting Initial Torque Value [% motor torque]	Position Setting	Resulting Initial Torque Value [% motor torque]
0	10	8	58
1	16	9	64
2	22	A	70 (default)
3	28	B	76
4	34	C	82
5	40	D	88
6	46	E	94
7	52	F	100

Table 88 - S2 = Current Limit Level Configuration—Controller Parameter 53 [Cur Limit Level]

Position Setting	Resulting Current Limit Value [% FLC]	Position Setting	Resulting Current Limit Value [% FLC]
0	200	8	360 (default)
1	220	9	380
2	240	A	400
3	260	B	420
4	280	C	440
5	300	D	460
6	320	E	480
7	340	F	500

Table 89 - S3 = Ramp Time Configuration—Starting—Controller Parameter 50 [Ramp Time]

Position Setting	Starting Ramp Time [seconds]	Position Setting	Starting Ramp Time [seconds]
0	0.1	8	16
1	2	9	18
2	4	A	20
3	6	B	22
4	8	C	24
5	10 (default)	D	26
6	12	E	28
7	14	F	30

Table 90 - S4 = Stop Time Configuration—Controller Parameter 66 [Stop Time]

Position Setting	Stop Time [seconds](1)	Position Setting	Stop Time [seconds](1)
0	Coast-to-stop (default)	8	16
1	2	9	18
2	4	A	20
3	6	B	22
4	8	C	24
5	10	D	26
6	12	E	28
7	14	F	30

(1) When the braking STOP MODE is selected (device configuration bank switch #3 and #4), the controller multiplies the selected stop time by ten.

Table 91 - S5 = Motor FLC Configuration—Controller Parameter 78 [Motor FLC]

Position Setting	FLC(1) (2) [% controller Max]	Position Setting	FLC(1)(2) [%controller Max]
0	40 (default))	8	72
1	44	9	76
2	48	A	80
3	52	B	84
4	56	C	88
5	60	D	92
6	64	E	96
7	68	F	100

(1) Because a set of switches does not provide the resolution to enter all possible FLC combinations like a keypad, switch S5 lets you configure the motor FLC in the SMC-50 controller by using a percent (%) of the controller's rated FLC (for example, 90 A, 110 A, 180 A).

Example: For a 60 A motor and 90 A controller, % of controllers max FLC for a 90 A motor = 64% of 90 A (57.6 A), or Switch Position 6.

(2) To determine the S5 switch setting for an inside-the-delta motor configuration, use the following equations:

Step 1:

$$\frac{\text{Motor Nameplate FLC}}{1.73} = X$$

Step 2:

$$\frac{X}{\text{SMC-50 Controller Rating}} \times 100 = \text{S5 Switch Setting}$$

Step 1:

$$\frac{100\ \text{A}}{1.73} = 57.8\ \text{A}$$

Step 2:

$$\frac{57.8\ \text{A}}{90\ \text{A}} \times 100 = 64\%$$

Therefore, from the result of 64%, the S5 switch setting is position 6

- If the calculated value does not match a switch position, use the previous (lower percent) switch setting.
- You can select the inside-the-delta motor configuration using parameter 44 [Motor Config] or automatically during a controller tuning process. The tuning process is done during the initial system start after changing any of the tuning parameters and initializing a start or by pressing and holding the SMC-50 controller reset push button for at least 10 seconds with the motor stopped and then initializing a start. If another configuration device is available (for example, a 20-HIM-A6 or PC software such as Connected Components Workbench), changing parameter 194 [Forced Tuning] to TRUE or resetting the controller to "Default" also results in tuning to occur.

Table 92 through Table 94 define the functions for the three banks of ON/OFF 8-switch DIP switches. Each of the three banks is defined by a high level, functional name with each switch having a unique function.

Table 92 - ON/OFF 8-Switch DIP Switch Definitions—Device

DEVICE Configuration Bank (0 = Switch OPEN)		Switch Number							
		1	2	3	4	5	6	7	8
Starting Mode— Controller Parameter 49	Linear Speed Acceleration (default)	0	0	–	–	–	–	–	–
	Current Limit	0	1	–	–	–	–	–	–
	Soft Start	1	0	–	–	–	–	–	–
	Pump Start	1	1	–	–	–	–	–	–
Stop Mode [1] [2]—Controller Parameter 65	Linear Speed Deceleration (default)	–	–	0	0	–	–	–	–
	Soft Stop	–	–	0	1	–	–	–	–
	Braking	–	–	1	0	–	–	–	–
	Pump Stop	–	–	1	1	–	–	–	–
Energy Saver[3] —Controller Parameter 193	Enable	–	–	–	–	1	–	–	–
	Disable (default)	–	–	–	–	0	–	–	–
Braking Current—Controller Parameter 69	50%	–	–	–	–	–	0	0	0
	100%	–	–	–	–	–	0	0	1
	150%	–	–	–	–	–	0	1	0
	200% (default)	–	–	–	–	–	0	1	1
	250%	–	–	–	–	–	1	0	0
	300%	–	–	–	–	–	1	0	1
	350%	–	–	–	–	–	1	1	0
	400%	–	–	–	–	–	1	1	1

(1) When the "Stop Mode" is configured as (a) "Linear Speed Decel", (b) " Soft Stop", (c) "Pump Stop", and the "Stop Time" (rotary switch S4) is set to zero, a "Coast" stop results. A nonzero "Stop Time" value for the three previously listed "Stop Modes" defines the time to stop period that is based on that specific configuration.

(2) If the "Stop Mode" is configured as "Braking", then the "Stop Time" setting (Rotary Switch S4) is used to select either the "Automatic Zero Speed Detection" method ("Stop Time" is set to zero) or the "Timed Brake" method ("Stop Time" is not set to zero).

(3) With the Energy Saver switch (#5) set to Enable, the PCM automatically configures parameter 193 [Energy Saver] to 0.25.

- With the “Automatic Zero Speed Detection” method, the controller applies the user-selected “Braking Current” defined by the Device Configuration Switch Bank. Switch #6, #7, and #8 senses a motor “Zero Speed” condition and automatically stops the braking process (brake current OFF).
- With the “Timed Brake” method, the user-selected “Braking Current” is applied for the user-configured “Stop Time” regardless of the motor speed (for example, “Automatic Zero Speed Detection” disabled). The “Timed Brake” method can be used in applications where detecting zero speed is ineffective or when braking the motor to a complete stop results in random overload trips. With this method, braking is applied for a fixed time equal to the "Stop Time" setting (Rotary Switch S4) and multiplied by ten. An ideal "Stop Time" setting can be determined by trial and error, but should always allow for some coast time. Setting the "Stop Time" for too long of a time can result in braking current to be applied to a stopped motor and can result in overload trips.

Table 93 - ON/OFF 8-Switch DIP Switch Definitions—Protection

PROTECTION Configuration Bank (0 = Switch OPEN)		Switch Number							
		1	2	3	4	5	6	7	8
Preset Protection Level Parameter(1)	Enabled (default)	1	–	–	–	–	–	–	–
	Disabled	0	–	–	–	–	–	–	–
Stall Fault Parameter 230	Enabled (default)	–	1	–	–	–	–	–	–
	Disable	–	0	–	–	–	–	–	–
Phase Reversal Fault Parameter 136	Enable	–	–	1	–	–	–	–	–
	Disable (default)	–	–	0	–	–	–	–	–
OL Restart Parameter 264	Enable	–	–	–	1	–	–	–	–
	Disable (default)	–	–	–	0	–	–	–	–
OL Enable Parameter 230	Enabled (default)	–	–	–	–	1	–	–	–
	Disable	–	–	–	–	0	–	–	–
OL Class Parameter 75	10 (default)	–	–	–	–	–	0	0	–
	15	–	–	–	–	–	0	1	–
	20	–	–	–	–	–	1	0	–
	30	–	–	–	–	–	1	1	–

(1) The Preset Production Level DIP switch allows the following Faults to be enabled (1) or disabled (0) as a group.
Current Imbalance fault—parameter 110 [Cur Imbal F Lvl] (default value: 15)
Voltage Unbalance fault—parameter 106 [Volt Unbal F Lvl] (default value: 15)
Line Loss fault—parameter: – (default value: no value required) - see page 129.
Open Gate fault—parameter: – (default value: no value required) - see page 130.
No/Open Load fault—parameter: – (default value: no value required) - see page 131.
The PCM configuration setting for each of these faults follows the currently entered/loaded parameter value for each Fault. This is typically the default setting unless a 20-HIM-A6 or other configuration tool (for example, PC software or network device) is used to change a parameter setting. The switch setting also overrides parameter 230 [Motor Fault En], and parameter 136 [Starter Fault En] function to enable or disable these faults.
With the Preset Protection Level switch set to Disable, all Starter and Motor faults are disabled as defaults, except the Power Quality fault.

Table 94 - ON/OFF 8-Switch DIP Switch Definitions—Configuration

I/O Configuration(1) Bank (0 = Switch OPEN)		Switch Number							
		1	2	3	4	5	6	7	8
Aux #1 Configuration parameter 172 [Aux1 Config]	Normal (default)	0	0	–	–	–	–	–	–
	Up-to-Speed (UTS)	0	1	–	–	–	–	–	–
	Fault	1	0	–	–	–	–	–	–
	Alarm	1	1	–	–	–	–	–	–
Aux #2 Configuration parameter 176 [Aux2 Config]	Normal	–	–	0	0	–	–	–	–
	UTS [default]	–	–	0	1	–	–	–	–
	Fault	–	–	1	0	–	–	–	–
	Alarm	–	–	1	1	–	–	–	–
Input #1 parameter 56 [Input 1]	Start/Coast (default)	–	–	–	–	0	–	–	–
	Start/Stop Option	–	–	–	–	1	–	–	–
Input #2 parameter 57 [Input 2]	Stop Option (default)	–	–	–	–	–	0	0	–
	Clear Fault	–	–	–	–	–	0	1	–
	Slow Speed	–	–	–	–	–	1	0	–
	Fault	–	–	–	–	–	1	1	–

(1) The I/O Configuration ability of the 150-SM6 is limited to the Control Module's standard I/O.

Notes:

Metering

Overview

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

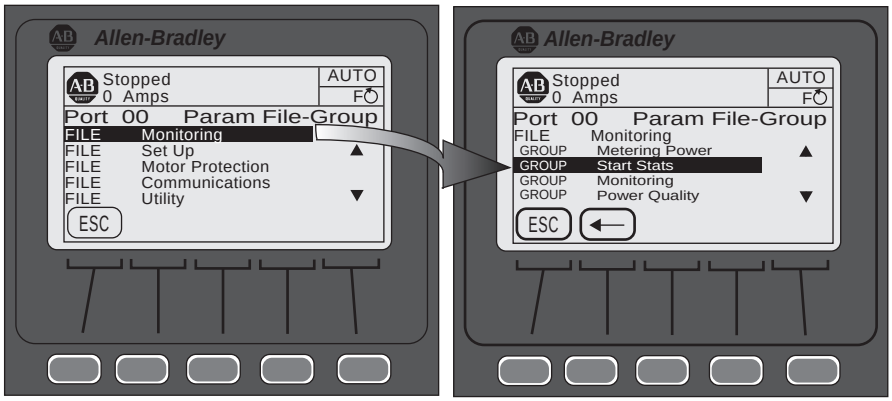
Viewing Metering Data

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

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

Confirm that you have selected Advanced Access Level at the bottom of the DEV PARAM screen. For additional configuration details, see page 140.

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.

Except for parameter 16 [Meter Reset], the metering parameters contained in the Monitoring File-Group are Read (R) only. See page 23 and page 182 for a detailed list of metering parameters.

Resetting Metering Parameters

Parameter 16 [Meter Reset] is used to clear (reset to 0) the contents of metering parameter 12 [Elapsed Time], parameter 11 [Real Energy], parameter 21 [Time to PM] (Preventive Maintenance), and parameter 22 [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 then clears the Elapsed Time and the value of Meter Reset returns to Ready 0.

To access Meter Reset using the 20-HIM-A6, perform steps 1 through 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 to be reset,(parameter 12 [Elapsed Time], parameter 11 [Real Energy], parameter 21 [Time to PM] (Preventive Maintenance), and parameter 22 [Starts to PM]) then press the soft ENTER soft key. The selected parameter is reset to zero with the exception of parameter 22 [Starts to PM].

When the ENTER key is pressed and Starts to PM is selected, its value is set to the value contained in parameter 127 [PM Starts].

Metering Parameters

Current

The SMC-50 controller 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 and Slow Speed 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 95 - Metering Parameters Associated with Current

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
5	Current Average	0...15,000	0	R	A
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 96 - Metering Parameters Associated with Voltage

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
1	Voltage P-P Average	[0]...700	[0]...700	R	V
2	Volts Phase A-B				
3	Volts Phase B-C				
4	Volts Phase C-A				
265	Voltage P-N Average	[0]....450	[0]....450	R	V
266	Volts Phase A-N				
267	Volts Phase B-N				
268	Volts Phase C-N				

Torque

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

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

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

Table 97 - Metering Parameters Associated with Torque

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
9	Torque	-50...3000	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 parameter 16 [Meter Reset]. See Resetting Metering Parameters on page 181 for further details.

For Reactive Energy, parameter 278 [Reactive Energy C] and parameter 279 [Reactive Energy P], the system keeps 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 time defined by parameter 290 [Demand Period].
- The previous "n" period values are averaged and the result is written to the Demand, parameter 272 [Real Demand], parameter 281 [Reactive Demand] and parameter 288 [Apparent Demand]. This result is used in calculating the Max Demand values. This averaging uses a rolling window algorithm where the previous "n" periods are averaged.

Table 98 - 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				MVA
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 Slow Speed and Braking operations.

Table 99 - 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	–
293	Power Factor B				
294	Power Factor C				
17	Power Factor				

Energy Savings

The energy saver function only applies during light motor load situations, at which time the SMC-50 controller reduces current to the motor and thereby saves energy.

When it is in energy saver operation, the controller sets the Energy Savings status bit. Parameter 15 [Energy Savings] indicates the percentage energy savings.

You should also monitor and record the value of parameter 17 [Power Factor] when the motor is running at no/light load and at full/heavy load. The power factor value where the controller enters Energy Saver mode is determined by

setting parameter 193 [Energy Saver] to a value between the no/light load and full/heavy load recorded values.

Table 100 - Energy Saver Mode Parameter List

Parameter Number	Parameter Name	Min/Max Value	Default Value	Access	Units
15	Energy Savings	0...100	0...100	R	%
17	Power Factor	-1.00...1.00	-1.00...1.00	R	–
193	Energy Saver	0.00...1.00	0.00	R/W	–

Set parameter 193 [Energy Saver] = 0 to disable Energy Saver mode.

Elapsed Time

The SMC-50 controller keeps a log of the total accumulated hours the controlled motor has been running via parameter 12 [Elapsed Time]. 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 parameter 16 [Meter Reset] (see Resetting Metering Parameters on page 181).

Parameter 13 [Elapsed Time 2] is similar to Elapsed Time. Elapsed Time 2 differs in that you cannot reset it and counts up to 50,000 hours and then holds that value (it does not roll over).

Table 101 - 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/W	Hours
13	Elapsed Time 2			R	

Running Time

Parameter 14 [Running Time] 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 SMC-50 controller is stopped, the parameter displays the length of time the motor was previously operating.

Table 102 - Metering Parameters Associated with Running Time

Parameter Number	Name/Description	Min/Max Value	Default Value	Access	Units
14	Running Time	0.0...5000.0	0.0	R	Hours

Motor Speed

Parameter 34 [Motor Speed] 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 controller is not in these modes, Parameter 34 [Motor Speed] reads zero except when the unit is at speed. In this case, the parameter displays 100%.

Table 103 - 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 controller logs the start time of the last five motor starts and stores that information in parameters 24...28. The start time data is stored in a first-in, first-out method so that the record of the last five starts is always maintained.

Table 104 - 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 controller logs the peak average RMS current during each start and stores that information in parameters 29...33. The Peak Start Current data is stored in a first-in, first-out method so that the record of the last five starts is always maintained.

Table 105 - 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	A
30	Peak Current 2				
31	Peak Current 3				
32	Peak Current 4				
33	Peak Current 5				

Total Starts

The SMC-50 controller maintains a Total Start counter that is incremented each time the controller is started (parameter 23 [Total Starts]). 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 increments after SCR gating begins.

Table 106 - 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	–

Total Harmonic Distortion (THD)

The SMC-50 controller provides the IEEE calculated THD value for the three Line Voltages (Line-to-Neutral) and the three Motor Phase Currents (current through SMC-50 controller Power Pole[a]). 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.

(a) 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.

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

Table 107 - 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	0.0...1000.0	0.0	R	%
40	THD I_b				
41	THD I_c				
42	THD I_{ave}				

Line Frequency

The SMC-50 controller measures and displays the system 3-phase AC Line Frequency. Upon powerup, parameter 224 [Line Frequency] displays zero until a valid AC Line Frequency is measured. When three-phase power is removed from the SMC-50 controller, the parameter maintains the value of the previous frequency reading.

Table 108 - 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

Current Imbalance

The SMC-50 controller provides a calculated Current Imbalance value (parameter 295 [Current Imbal]). 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. The SMC-50 controller Power Pole Current is used for the Current Imbalance calculation.

Table 109 - 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 controller provides a calculated Voltage Unbalance value (parameter 296 [Voltage Imbal]). 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. The phase-to-neutral voltage is used in the calculation for voltage unbalance.

Table 110 - Metering Parameters Associated with Voltage Unbalance

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

Notes:

Optional HIM Operation

Overview

The SMC-50 controller offers various 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 111, Table 112, and Table 113 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 page 194 for instructions.

The control terminals must be wired according to Figure 33or Figure 44.

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 111 - 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 resets a fault.
		This button brings up the Control Screen to enable the stop option maneuver. See page 190.
Preset Slow Speed		The green start button begins motor acceleration to full speed.
		The red stop button provides a coast stop and/or resets a fault.
		This button displays the Control screen. * Slow Speed cannot be operated via the HIM.

Table 112 - 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 resets a fault.
		Displays the Control Screen with the Jog button. The jog button initiates a pump stop maneuver.

Table 113 - 20-HIM-A6 Control Button Functionality, Braking Control

Option	Action	Operation When Pressed
Smart Motor Braking		The green start button begins motor acceleration to full speed.
		The red stop button provides a coast stop, and/or resets a fault.
		Displays the Control Screen with the Jog button. The jog button initiates a brake stop.
Accu-Stop(1)		The green start button begins motor acceleration to full speed.
		The red stop button provides a coast stop, and/or resets a fault.
		Displays the Control Screen with the Jog button. The jog button initiates braking to slow speed operation. The controller maintains slow speed operation as long as the jog button is pressed.
Slow Speed with Braking		The green start button begins motor acceleration to full speed.
		The red stop button provides a coast stop, and/or resets a fault.
		Displays the Control Screen with the Jog button. The jog button initiates a brake stop from slow speed. * Slow Speed cannot be operated via the HIM.

(1) Accu-Stop is not included as a parameter/function. However, Accu-Stop is accomplished with the Stop option and Slow Speed with Braking.

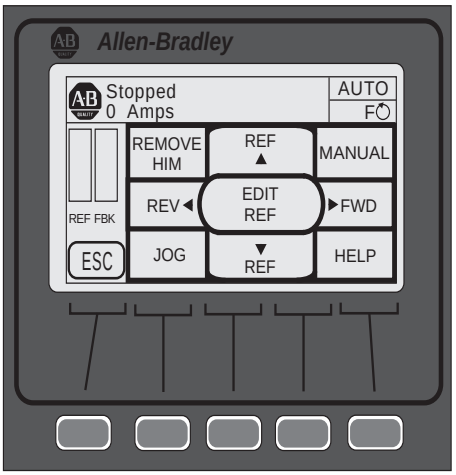
HIM Control Screen

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

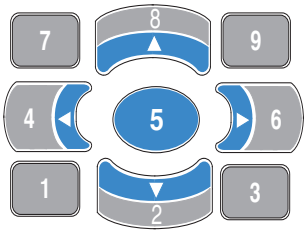
IMPORTANT To navigate from the Control Screen to another HIM menu screen, you must press the ESC soft key. This deactivates the Control Screen and displays the previous screen.

Figure 98 - HIM Control Screen

Control Screen Key Function



Control Screen Navigation Number Keys



The Control Screen Key Function map corresponds with the Control Screen Navigation/Number Keys on the HIM.

Table 114 - Control Screen Soft Key Functionality

Label	Name	Function
ESC	Escape	Reverts to the previous screen.

Table 115 - Control Screen Navigation/Number Keys

Label	Name	Function
JOG		Stop Option for SMC-50 controller
REF ▲		–
HELP		Displays the direct phone number, website address, and email address for Rockwell Automation Drives Technical Support.(1)
REV ◀		–
EDIT REF		–
FWD ▶		–
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 ▼		–
MANUAL		–

(1) Technical Support for drives does not apply to the SMC-50 controller. You can contact Technical Support for the SMC-50 controller at: 440-646-5800 (option 2 and option 4) or raictechsupport@ra.rockwell.com.

Copycat Function of the 20-HIM-A6

The SMC-50 controller 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 controller provides advanced communications capabilities that allow you to start and stop it from multiple sources and provide diagnostic information by using communication interfaces. The SMC-50 controller 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 controller. The SMC-50 controller does not support ScanPort™ devices.

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 116 shows a list of available modules.

Table 116 - 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
RS-485 HVAC	20-COMM-H	20COMM-UM009
ControlNet (Fiber)	20-COMM-Q	20COMM-UM003
CANopen	20-COMM-K	20COMM-UM012

Communication Ports

The SMC-50 controller 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 116 to the internal DPI communication card connection (SMC-50 controller hardware controller port 9).

HIM Keypad and Displays

You can program the SMC-50 controller 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 Controller

Figure 99 shows how to connect a HIM and DPI device to the SMC-50 controller. Table 117 provides a description of each port. See Figure 33 for wiring information.

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

Figure 99 - SMC-50 controller with a HIM

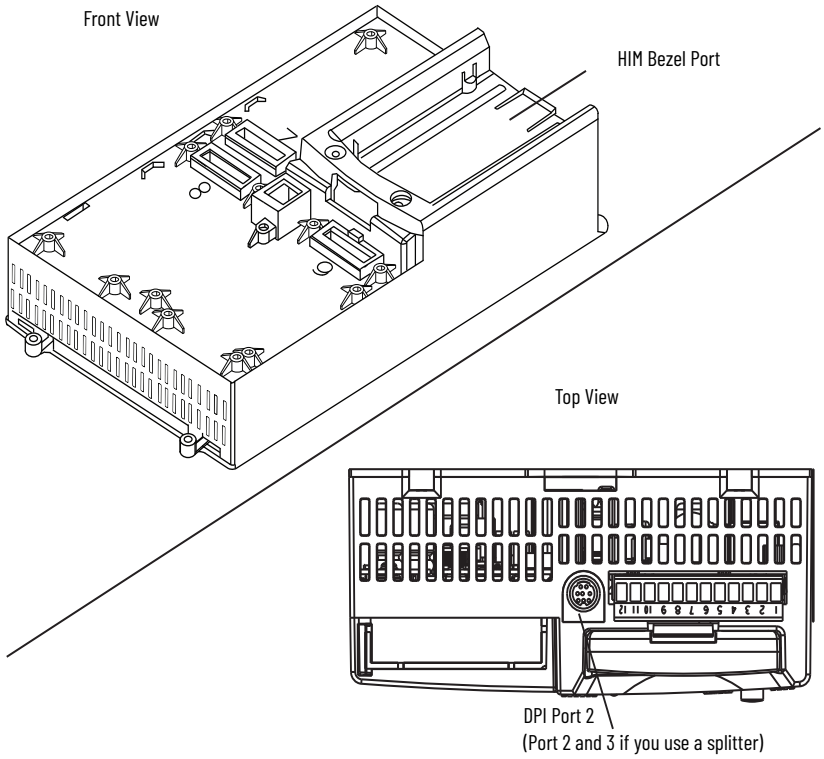


Table 117 - Description of Ports

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

(1) When using a 20-COMM-x network communication module, it must physically be in control module hardware port 9. However, its DPI Port Number assignment is 4. The cable connection for the DPI Port 4 is below the HIM bezel (see Figure 99).

Control Enable

Parameter 148 [Logic Mask] 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. Disconnecting any device with the logic mask enabled results in an Exp Removed (X026)(a) communication fault. You can disconnect a device that is disabled through the logic mask without causing a fault(b)

(a) 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.
(b) 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 8.

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.

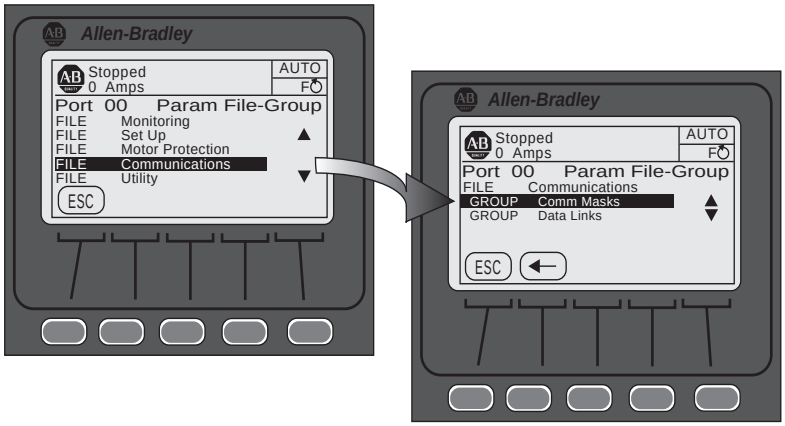
The Bulletin 20-HIM-A6 provides start and stop control of the SMC-50 controller. However, the Logic Mask factory default settings disable control commands other than Stop through the controller's DPI ports 1, 2, 3, or 4.

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 controller standard power-up screen.

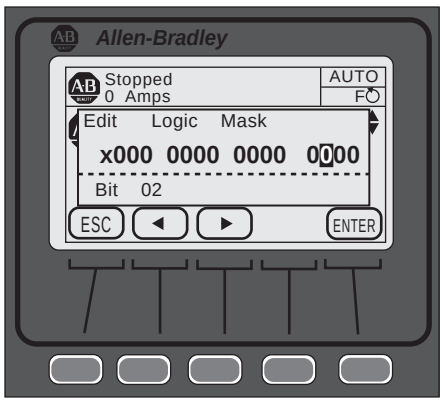
1. Press the  key. Use the right or left arrow key on the keypad to display the <00> DEV PARAM folder screen.
2. Select/highlight the File-Group.
3. Press the  (enter) key. The Port 00 Param File-Group screen appears.

Ensure that you have selected Advanced Access Level at the bottom of the DEV PARAM screen. For additional configuration details, see page 140.

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



5. With Comm Mask selected/highlighted, press the  key. The GROUP Comm Masks screen appears with the associated Logic Mask Action selected.
6. Select/highlight Logic Mask, then press the  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 118 - Logic Mask and Logic Mask Active Parameter Specifications

Parameter		Bit Number	DPI Assignment	Access	Units [default]	Default Value
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	Disabled
149	Logic Mask Act			R	Bit = 0 disabled Bit = 1 enabled [Follows Logic Mask]	Disabled

IMPORTANT
- Parameter 148 [Logic Mask] must be set to 0 or the "REMOVE HIM" key is depressed via the HIM controller screen (see Chapter 8) before you disconnect the HIM from the SMC-50 controller. If not, the unit faults on a “Exp. Removed”.
- Parameter 149 [Logic Mask Act] is a read-only parameter that shows the logic mask actually in use at any given time. It typically follows parameter 148 [Logic Mask], 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. Table 119 shows the default configuration.

Table 119 - 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 controller; 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 that you are using with the SMC-50 controller.

Variable Input/Output Configuration

The SMC-50 controller supports 32-bit Data Links, which lets you configure the device to return additional information. The I/O message size depends on how many Datalinks are enabled. Table 120 summarizes the I/O data sizes.

Table 120 - 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 page 199.

SMC-50 Controller—Bit Identification

Product Functional (Logic) Status, parameter 43 [Product Status], is used to provide SMC-50 controller functional (logic) status to communication devices. Table 121 details parameter 43 [Product Status], which is a read-only parameter.

Table 121 - 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 (slow speed not included)	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 122 - 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
4	Slow Speed 1	Run at slow speed 1	No action
5	Emergency Run	Enable emergency run mode	Disable emergency run mode
6	Motor Winding Heater	Enable motor winding heater	Disable motor winding heater
7	Slow Speed 2	Run at slow speed 2	No action
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
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 controller does not offer the analog Reference feature. The analog Feedback feature is supported and provides Current Average, parameter 5 [Current Phase Ave], automatically as the feedback word.

Parameter Information

Appendix A lists the complete list of parameters for the SMC-50 controller.

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.

EXAMPLE Read Example

- parameter 17 [Power Factor]—the stored value is 85. Because this value has two decimal places, divide the value by 100. The correctly read value is 0.85.

EXAMPLE Write Example

- parameter 78 [Motor FLC]—the example value that is to be written to the SMC-50 controller 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 you view them 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. Table 123 shows an example of parameter 16 [Meter Reset] and the appropriate relationship between the text descriptor and the equivalent value. This relationship is identical for other similar parameters.

Table 123 - Meter Reset Parameter Example

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

Configure Datalinks

Datalinks are supported in the SMC-50 controller. Datalinks are a mechanism used to transfer data to and from the controller without using an explicit message. The SMC-50 controller supports 32-bit Datalinks, letting you configure the device to return up to eight additional pieces of information without the need for an explicit message.

Criteria for Using Datalinks

- Each set of Datalinks 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 Datalinks.
- Parameter settings (contents) in the SMC-50 controller determine the data passed through the Datalinks mechanism.
- When Datalinks are used to change a value in the SMC-50 controller, the value is written to RAM. If the SMC-50 controller is powered down, the current value is written to Non-Volatile Storage (NVS).

To configure Datalinks, you must use parameters 153...168 of the SMC-50 controller. See Table 124 for a detailed listing of these parameters. You must perform any additional configuration in the respective communications option module, such as setting DPI I/O Cfg, M-S Input and M-S Output parameters. For additional information about Datalinks, see the communication interface user manual.

Table 124 - 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 Datalinks function is the setting (content(s)) of the parameter number that you enter.

Update Firmware

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

Diagnostics

Overview

This chapter describes the fault diagnostics of the SMC-50 controller and the conditions that cause various faults to occur.

Protection Programming

Many of the protective features available with the SMC-50 controller can be enabled and adjusted through the programming parameters provided. For further details on programming, see page 158.

Diagnostic LEDs

The SMC-50 controller multi-color diagnostic LED status indicator and HOLD TO TEST, PUSH TO RESET button are below the HIM bezel port. The status LED indicates the status and fault conditions of the SMC-50 controller.

Table 125 - Corresponding LED Status Indicator Color and Fault Conditions

Status LED Color	Device Mode	SMC-50 Controller 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 126 - 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)

Using the Controller Status LED and Parameter Configuration Module (150-SM6) LEDs

When you install a 150-SM6 module in one of the three control module ports (7, 8, or 9) of the SMC-50 controller, it provides additional LED diagnostic information beyond that of the Status LED.

The 150-SM6 has four diagnostic/status LEDs to display an LED code for each fault/alarm. When the SMC-50 controller's Status LED indicates that the control module has faulted, the 150-SM6 displays a specific fault code. If the unit is not faulted but in an alarm condition, the 150-SM6 displays the alarm

code. If the unit is not faulted or in an alarm condition, all 150-SM6 LEDs do not illuminate.

The 150-SM6 > (<) LED indicates whether the fault/alarm is an SMC-50 controller device fault/alarm or a motor fault/alarm. The on/off status of the other three LEDs indicates the actual fault/alarm codes.

Depending on which SMC-50 controller port the 150-SM6 is installed into, the position of the LEDs (for example, >, III, II, and I versus I, II, III, and <) change. Table 127 displays the LED order when the 150-SM6 is installed in port 7. When the 150-SM6 is installed in port 8 or 9, the order is reversed, but the LED diagnostic code is the same.

Table 127 - LED Order When 150-SM6 is Installed in Port 7 of the SMC-50 controller

LED Error Code	LED On/Off State			
	>	III	II	I
0	Red = SMC Yellow = Motor Off = No Fault or Alarm	Off	Off	Off
1		Off	Off	On
2		Off	On	Off
3		Off	On	On
4		On	Off	Off
5		On	Off	On
6		On	On	Off
7		On	On	On

The displayed LED error code is either a fault or an alarm code depending on the cause. For example, if the LED code is 1, Line Loss A is either a fault or an alarm. If you want a more detailed display of the error code source, a human interface module (HIM) or configuration software is recommended.

Table 128 provides a list of faults with LED fault/alarm codes for the 150-SM6 Parameter Configuration Module.

Table 128 - LED Error Code with Respective Fault/Alarm Source

LED Error Code	Fault/Alarm Source		Referenced HIM/ Configuration Software Code[1]
Red = SMC			
1	Line Loss	A	1
		B	2
		C	3
	Shorted SCR	A	4
		B	5
		C	6
2	Open Gate	A	7
		B	8
		C	9
3	SCR Overtemp		10
	Pwr Pole PTC		60
4	CT Loss	A	30
		B	31
		C	32
Yellow = Motor			
2	No Load		14
	Open Load	A	15
		B	16
		C	17
3	Volt Imbalance		18

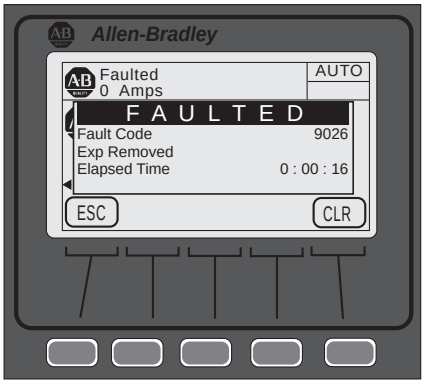
LED Error Code	Fault/Alarm Source		Referenced HIM/ Configuration Software Code[1]
5	HAL ID		33
	NVS Error		34
	V24 Recovery		35
	V24 Loss		36
	V Control Loss		37
	RTC Battery Low		69
	System Faults		100...199
6	Terminal Block Input	1	38
		2	39
		3	40
		4	41
	Test Fault		62
7	Open Bypass	A	11
		B	12
		C	13
4	Overload		21
5	Stall		24
6	Phase Reversal		25
7	Current Imbalance		42

(1) The fault/alarm code, available from a HIM or configuration software, provides more detailed information concerning the source of the fault/alarm. Fault and alarm codes for the same event (for example, Line Loss) are the same.

Fault Display (20-HIM-A6)

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

Figure 100 - 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 controller reinitializes, 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 controller is still in a faulted state.

Clear Fault

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

- Program the SMC-50 controller to automatically clear a fault using Restart Enable, parameter 135 [Strtr Restart En] or parameter 264 [Motor Restart En].
- Press the SMC-50 controller 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 [Input 1] or parameter 57 [Input 2].

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 parameter 18 [Motor Therm Usage] is below the value that is programmed in parameter 80 [OL Reset Level]. See page 112 for further details.

Fault and Alarm Buffer - Parameter List

The SMC-50 controller stores the five most recent fault and alarm codes (fault parameters 138...142, alarm parameters 143...147) in parameter memory from newest to oldest.

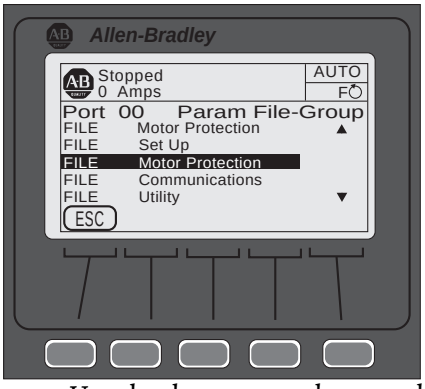
Accessing the Fault and Alarm Parameters

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 parameters 138...142, alarm parameters 143...147). To use the File-Group method, perform the following steps:

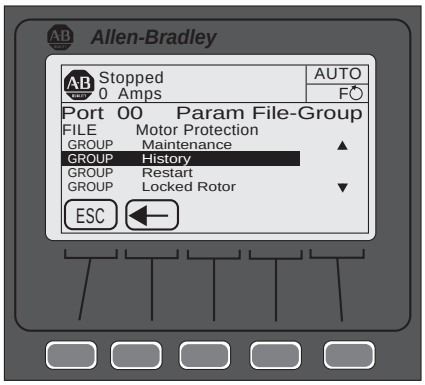
1. From the SMC-50 controller standard power-up screen, press the Folders keypad key at the lower left of the display.

Make sure that the Advanced access level (at the bottom of the <00> DEV PARAM screen) is selected before you press ENTER. See Parameter Access Level Modification Using the HIM on page 140 for additional details.

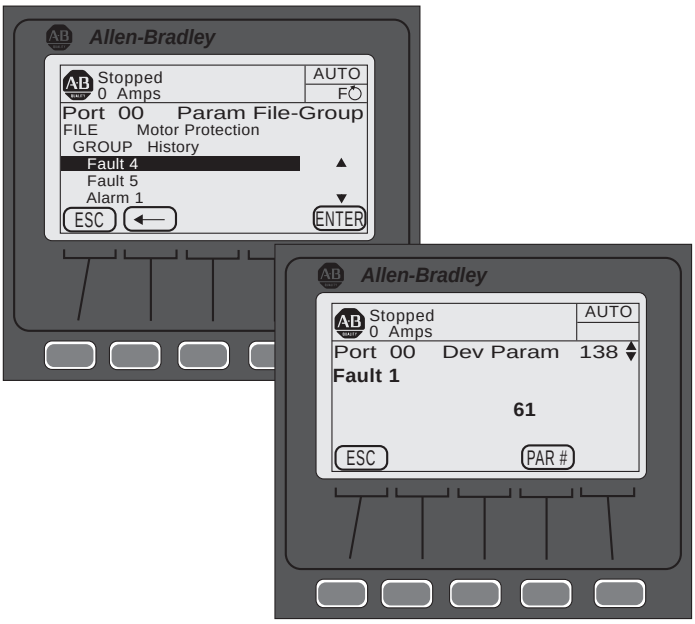
2. From the <00> DEV PARAM folder screen select File-Group, then press ENTER (number 5 from the keypad). The Port 00 Param File Group screen appears.
3. Use the down arrow key to select (highlight) FILE Motor Protection, then press ENTER (number 5 from the keypad).



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).

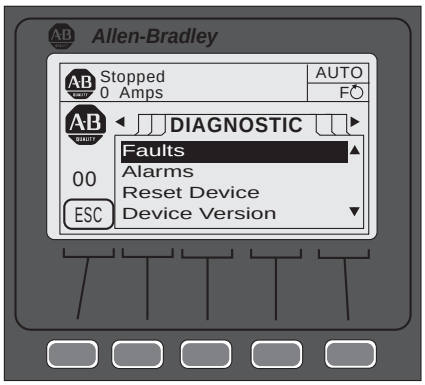


In step 5, Fault 61 is displayed. For fault/alarm code data, see Table 130.

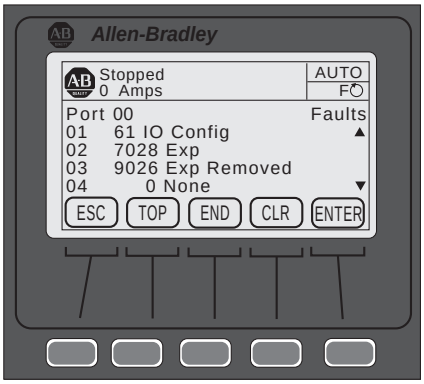
Accessing the Fault and Alarm Buffers

In addition to the SMC-50 controller 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.

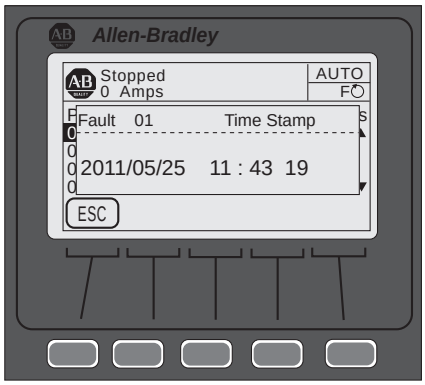
1. From the SMC-50 controller standard power up screen, press the Folders key at the lower left of the display.
2. Using the right or left arrow key, display the DIAGNOSTIC folder.
3. Using the up or down arrow key, select either Faults or Alarms, then press ENTER. In this example, Faults is used.



The HIM displays the five most recent fault codes if Faults is selected. The HIM displays the 100 most recent alarm codes with an abbreviated description if Alarms is 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 pull-down menu. Confirm 0-SMC-50 controller is selected from the list of Devices.

Fault Codes

Table 129 provides a complete cross-reference of the available fault codes and corresponding fault descriptions.

Table 129 - Fault/Alarm Code Cross-Reference

Fault/Alarm Name		Code	LED Code	Category[1]	Host	DPI/HIM/COMM	Exp 7, 8, 9
Line Loss	A	1	1	D	X	–	–
	B	2				–	–
	C	3				–	–
Shorted SCR	A	4	1	D	X	–	–
	B	5				–	–
	C	6				–	–
Open Gate	A	7	2	D	X	–	–
	B	8				–	–
	C	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

Fault/Alarm Name		Code	LED Code	Category[1]	Host	DPI/HIM/COMM	Exp 7, 8, 9
Current Imbal		42	7	M	X	–	–
Under Power Real		43	–	M	X	–	–
Over Power Real		44	–	M	X	–	–
Un Power Reac +		45	–	M	–	–	–
Ov Power Reac +		46	–	M	–	–	–
Und Power App		47	–	M	–	–	–
Ov Power App		48	–	M	–	–	–
Frequency		49	–	M	X	–	–
PM Hours		50	–	M	X	–	–
PM Starts		51	–	M	X	–	–
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	–	–	–	–	–
Slow Speed[2]		72	–	–	–	–	–
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 130 provides an overview of the fault and alarm codes with Time Delay and Restart options and 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 spurious trips (Time Delay Aval). Many can automatically restart after the condition is cleared (Restart En). See Chapter 5 for additional information on faults and alarms.

Table 130 - 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	–	**A** During prestart checks (motor stopped not running), the SMC-50 controller 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	–	**F** The SMC-50 controller protects the SCRs from damage that is caused by overtemperature operation using an internally configured I^2t. **NOTE:** This fault is always enabled.	
Open Bypass	A	11	N	N	–	**F** Open Bypass Phase A	Device senses that the bypass contactor did not close on the respective phase.
	B	12	N	N	–	**F** Open Bypass Phase B	
	C	13	N	N	–	**F** Open Bypass Phase C	
No Load		14	N	Y	Y	**F/A** The SMC-50 controller 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 page 118 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: Overload Class, Overload Reset, Motor FLC, and Service Factor.	
Underload		22	Y	Y	Y	**F/A** Motor operation halts (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 controller senses that the motor is NOT 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 controller is in any sequence other than ABC.	
Exp Removed		26	N	N	–	**F** Removing an expansion module (device) (for example, a 150-SM4) from an SMC-50 controller results in a x026 fault, where "x" is the SMC-50 controller port number (7, 8, or 9) the expansion module was installed. DPI devices (for example, 20-HIM-A6 or 20-COMM-X) only generate this fault if its associated bit in parameter 148 [Logic Mask] is set. **NOTE:** If an expansion module (device) (for example, a 150-SM4 is removed from an SMC-50 controller), the message "Device Conflicts Port xy Not Found" is displayed on the HIM or PC software) when power returns.	
Exp Incompat		27	N	N	–	**F** Inserting an expansion module or DPI device into an incompatible controller port number or inserting an expansion module into a controller 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	–	**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. After the number of starts per hour is reached, any additional starts cause a fault/alarm code 29.	
CT Loss	A	30	N	N	–	**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)	

Table 130 - 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	
HAL ID		33	N	N	—	**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	—	**F** Indicates an error in the SMC-50 controller'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	—	**F** Indicates that the voltage level of the SMC-50 controller's internal 24V DC supply, which provides power to the controller logic and onboard 24V DC I/O, has fallen outside of the allowable range. This fault is always enabled.	
VControl Loss		37	N	N	—	**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	—	**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. See page 118 for calculated value details.	
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		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		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		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 that 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 that sets the number of starts before a fault/alarm is signaled indicating that preventive maintenance should be performed.	
Power Quality	A	52	N	Y	Y	**F/A** Fault condition that indicates that the starter is not properly firing the:	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 controller 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	—	**F** Built-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	—	**F** Occurs when any input is programmed as a start or slow speed and no input is configured as a coast or stop. The fault occurs when the start or maneuver is attempted (the motor does not start). This fault is also generated when the input configuration changes from one that cannot start the motor to one that can. It is also 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	—	**F** Occurs when the Push-to-Reset, Hold-to-Test push button on the SMC-50 controller 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.	

Table 130 - 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	
RTC Battery Low	69	N	N	—	**A** Occurs when the SMC-50 controller battery that maintains the value of the real-time clock (RTC) is low and must 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	—	—	—	This is an event code and is stored in the Alarm Buffer for:	Start event tracking.
Slow Speed	72	—	—	—		Slow Speed event tracking.
Stop Option	73	—	—	—		Stop Option event tracking.
Coast	74	—	—	—		Coast event tracking.
Clear Fault	75	—	—	—		Clear Fault event tracking.
Fault	76	—	—	—		Fault event tracking.
Parm Change	77	—	—	—		Parameter Change event tracking.
Reserved	78...99	N	N	N	Future use.	
System Faults	100...199	N	N	—	A general fault/alarm typically associated with the SMC-50 controller 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 SMC-50 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, and so on, 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 insulation resistance tester.

The flowchart in Figure 101 aids in quick troubleshooting.

- The time that it takes for the motor to come up to speed can differ from the time programmed. This depends upon the motor and load characteristics.
- Depending upon the application, the braking options (SMB and Slow Speed) may cause some vibration or noise during the stopping cycle. To minimize vibration or noise, lower the braking current adjustment. If this is a concern in your application, consult your local Rockwell Automation sales office or Allen-Bradley distributor before you implement the braking options.

Figure 101 - Troubleshooting Flowchart

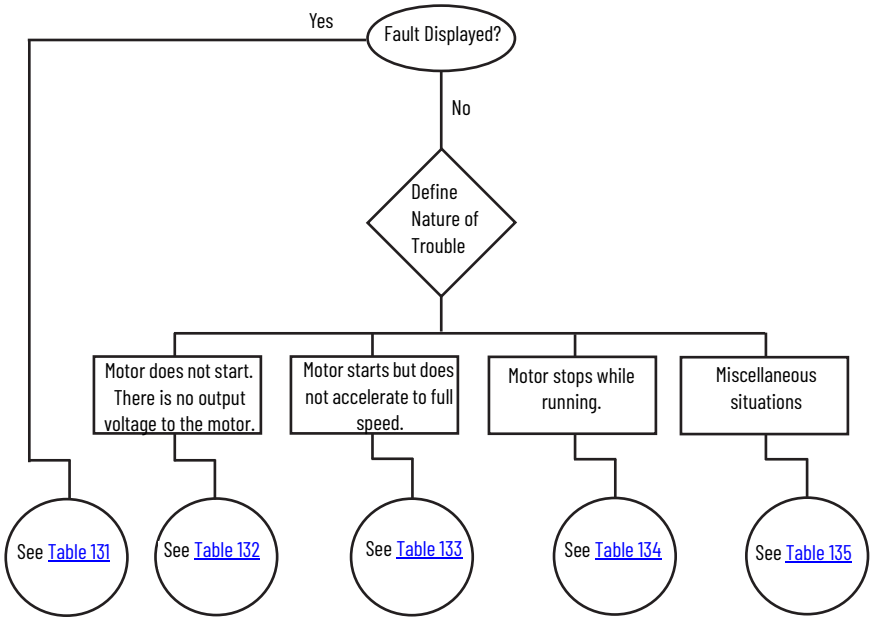


Table 131 - Fault Display Explanation

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 page 218), 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 page 218), or 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 • Fan failure • 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 • Check for fan operation. Replace fan, if necessary • 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 • Replace power module • 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 tester)
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 that is programmed are not suited for the application	• Check the power system and correct if necessary (1) • Modify the parameter and/or extend the delay time to match the application requirements • Disable this fault/alarm feature

Table 131 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
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 [1] • 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[2]
Underload	22	Running	• Broken motor shaft, belt, grating, and so on • 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
Exp Removed	x026[3]	In All Modes	• Expansion module is loose or removed • Expansion module is defective	• Re-seat or replace the expansion module connector to the control module and tighten module screws • Replace defective module
Exp Incompat	x027[3]	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 [3]	In All Modes	• SMC-50 controller is being controlled via network connection and controller transitioned from Run to Program mode • 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	• Reset the SMC-50 controller • Re-seat 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	–	–	–

Table 131 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
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 SMC-50 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[4]	43	Running	• Abnormally reduced real (MW) power draw by the motor possibly due to broken mechanical connection (belt, gears, and so on) between motor and load • Pump cavitation • Programmed setting is incorrect for the application	• Repair/replace the condition that caused the reduced real power load • Modify the programmed fault/alarm parameters to better suit the application • Disable the fault/alarm feature
Ovr Pwr Real[4]	44	Running	• Abnormally high real (KW) power draw by the motor • Programmed setting is incorrect for the application	• Repair/replace the condition that causedthe high KW power draw • Modify the programmed fault/alarm parameters to better suit the application • Disable the fault/alarm feature
Un Pwr Reac+ [4]	45	Running	• Abnormally reduced reactive (+MVAR) power produced by the motor • Programmed setting is incorrect for the application	• Repair/replace the condition that caused the reduced +MVAR power draw • Modify the programmed fault/alarm parameters to better suit the application • Disable the fault/alarm feature
Ov Pwr Reac+[4]	46	Running	• Abnormally high reactive (+MVAR) power produced by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition that caused the high +MVAR power draw • Modify the programmed fault/alarm parameters to better suit the application • Disable the fault/alarm feature
Und Pwr App [4]	47	Running	• Abnormally reduced apparent (MVA) power draw by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition that caused the reduced +MVA power draw • Modify the programmed fault/alarm parameters to better suit the application • Disable the fault/alarm feature
Ovr Pwr App [4]	48	Running	• Abnormally high apparent (MVA) power draw by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition that caused 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 that is 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 that is programmed in the PM Start Parameter has been reached	• Perform required maintenance and reset the PM Hours parameter • Disable this fault/alarm feature

Table 131 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
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[5]	X058 [3]	Running	• The ground fault current level has exceeded the programmed value • The delay time is too short for the application	• 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[5]	X059 [3]	In All Modes	• Motor ventilation is blocked. • Motor duty cycle is exceeded • PTC open or shorted	• 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 • Fan failure • 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 • Check for fan operation. Replace fan, if necessary • Replace power module or control module as needed.
I/O Config	61	Pre-Start	• The configuration of the control I/O does not meet the system rules as defined in Configuration Functions on page 134,	• Modify the control I/O configuration to meet the established rules
Test Fault	62	In All Modes	• The SMC-50 controller's Push to Reset/Hold to Test push button was pressed for more than 3 seconds, but less than10 • The SMC-50 controller'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 2 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 [4]	67	Running	• Abnormally high reactive (-MVAR) power consumed by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition that caused the high -MVAR • Modify the programmed fault/alarm parameters to better suit the application • Disable the fault/alarm feature

Table 131 - Fault Display Explanation (Continued)

Display	Fault Code	Fault Enabled	Possible Causes	Possible Solutions
-MVAR Under[4]	68	Running	• Abnormally reduced reactive (-MVAR) power consumed by the motor • Programmed settings are incorrect for the application	• Repair/replace the condition that caused 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.	–
Slow Speed	72	Slow Speed	• A slow speed event (command) has occurred. This is not a fault.	–
Stop Option	73	Stop Option	• A stop option event (command) has occurred. This is not a fault.	–
Coast	74	Coast	• A coast-to-stop event (command) has occurred. This is not a fault.	–
Clear Fault	75	Faulted	• A clear fault event (command) has occurred. This does not generate a fault.	–
Fault	76	Faulted	• A fault event (command) has occurred. This is not a fault.	–
Param Change	77	Stopped	• A change to one of the controller parameters has occurred. This is not a fault.	–
Reserved	78...99	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 that the ground terminal is secure and connected to the system's earth ground. Confirm an RC snubber/suppressor is connected to all inductive loads in the control circuit. See input wiring. • Replace the control module

(1) If the power source is a backup generator, check the stability of the generator voltage regulator. Replace if necessary.
(2) If controller-based motor overload is disabled, external motor overload protection should be used.
(3) "X" indicates a port number in which the expansion module resides in the SMC-50 controller.
(4) 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) does not provide. To understand what an abnormal running operation is, you need to determine a "normal" or "typical" value, usually established during system startup.
(5) An optional 150-SM2 Ground Fault PTC Module is required for this fault.

Table 132 - Motor Does Not Start—No Output Voltage to the Motor

Display	Possible Cause	Possible Solutions
Fault displayed	• See fault description	• See Table 131
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 194 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 SMC-50 controller Aux. relay output controlling the Isolation Contactor is configured to "Normal" • Check the Isolation Contactor for proper operation

Table 133 - Motor Rotates but Does Not Accelerate to Full Speed

Display	Possible Cause	Possible Solutions
Fault displayed	• See fault description	• See Table 131 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 134 - 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 135 - Miscellaneous Situations

Situation	Possible Cause	Possible Solutions
Motor current and voltage fluctuates	• Motor • Erratic Load	• Verify 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
Fan does not operate(1)	• Control wiring • Failed fan(s)	• Check control wiring and correct if necessary • Replace fan module
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 time. In the case of pumps, the voltage may drop too rapidly to prevent surges. Linear Speed Accel/Decel or Pump Start would be more appropriate.
Motor overheats	• Duty cycle	• Preset Slow Speed and SMB options: Extended operation at slow speeds reduces motor cooling efficiency. Consult motor manufacturer for motor limitations. • Smart Motor Braking option: Check duty cycle. Consult motor manufacturer for motor limitations.
Motor short circuit	• Winding fault	• Identify fault and correct. • Check for shorted SCR; replace if necessary. • Confirm power terminals are secure.

(1) Fan operation is controlled by the SMC-50 Control Module. The fan may not run in low ambient temperature conditions.

Power Module Check

If you need to check a power module, use this procedure.

ATTENTION: To avoid shock hazard, disconnect main and control power before working on the controller, motor, or control devices such as Start/Stop push buttons.

ATTENTION: Make sure that wires are properly marked and programmed parameter values are recorded.

Shorted SCR Test

- Using an Ohm meter, measure the resistance between the line and load terminals of each phase on the controller. (L1-T1, L2-T2, and L3-T3)

The resistance should be greater than 5,000 Ω. Replace the power assembly if this reading is not reached. See publication 150-TD009 for the list of Spare/Replacement SMC-50 controller parts.

Parameter Information

SMC-50 Controller Information

This section details the parameter information for the SMC-50 controller.

Table 136 - Parameter 1...18

No.	Name		Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
1	Volts Phase	PP Ave	Volt	0/700	0	–	Displays the calculated average voltage of the applied three-phase to phase line voltages being measured by the SMC-50 controller.	R
2		A-B					Displays the Phase A to Phase B voltage that is applied to the SMC-50 controller at the supply terminals.	
3		B-C					Displays the Phase B to Phase C voltage that is applied to the SMC-50 controller at the supply terminals.	
4		C-A					Displays the Phase C to Phase A voltage that is applied to the SMC-50 controller at the supply terminals.	
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		A					Displays the Current flowing through the Phase A power pole of the SMC Power section to the load.	
7		B					Displays the Current flowing through the Phase B power pole of the SMC Power section to the load.	
8		C					Displays the Current flowing through the Phase C power pole of the SMC Power section to the load.	
9	Torque		%	50/300	0	–	Displays the true electromechanical torque calculated based on current and voltage feedback. For this reading to display correctly, you must set the values for parameter 9 [Torque] and parameter 10 [Real Power] and perform Autotune.	R
10	Real Power		MW	-1000.000/ 1000.00	0.000	–	Displays the total Real Power.	R
11	Real Energy		MWH	-1000.000/ 1000.00	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	0.0/50000.0	0.0	–	Displays the elapsed motor run time since you last reset the Elapsed timer.	R
13	Elapsed Time 2		Hours	0.0/50000.0	0.0	–	Displays the elapsed motor run time since the control module was manufactured.	R
14	Running Time		Hours	0.0/50000.0	0.0	–	Displays the motor run time since the last start command. This value goes to zero when a motor restarts after a stop command or fault.	R
15	Energy Savings		%	0/100	0	–	Displays the energy saving when the energy saving mode is enabled.	R
16	Meter Reset		–	0/4	0	–	Lets you reset various timers and counters by selecting the appropriate reset option.	R/W
						Ready	Ready state of parameter, waiting for selection.	
						Elapsed Timer	Zero the elapsed timer.	
						Time to PM	Resets the Time to PM timer to the value that is set in parameter 126 [PM Hours].	
						Starts to PM	Reset the Starts to PM counter to the value that is set in parameter 127 [PM Starts].	
17	Power Factor		–	-1.00/1.00	0.00	–	Displays the cosine of the phase angle between the voltage and current. A positive value 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% results in a motor overload fault. This value can exceed 100%, depending on the rate at which the motor is heating before an overload trip.	R

Table 137 - Parameter 19...42[1]

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
19	Time to OL Trip	Secs	0/1000	0	Displays the estimated time before an overload trip occurs if the present operating conditions persist. If operating below ultimate trip current, the value displays 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 parameter 80 [OL Reset Level].	R
21	Time to PM	Hrs	0/1000	0	Displays the estimated time to a preventive maintenance event if enabled. The scheduled time for a PM event is set by you via parameter 126 [PM Hours]. Use parameter 16 [Meter Reset] to reset this value after an event.	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 you via parameter 127 [PM Starts]. Use parameter 16 [Meter Reset] to reset this value after an event.	R
23	Total Starts	—	0/30000	0	Displays the total number of SMC starts. The SMC keeps a Start Counter, which is incremented each time the SMC is started. This parameter leaves the factory with a value of 0 and cannot be reset.	R
24	Start Time 1	Secs	0/1000	0	Displays the measured start time of the previous start.	R
25	Start Time 2				Displays the measured start time of the 2nd previous start.	
26	Start Time 3				Displays the measured start time of the 3rd previous start.	
27	Start Time 4				Displays the measured start time of the 4th previous start.	
28	Start Time 5				Displays the measured start time of the 5th previous start.	
29	Peak Current 1	Amps	0/150000	0	Displays the measured peak current of the previous start.	R
30	Peak Current 2				Displays the measured peak current of the 2nd previous start.	
31	Peak Current 3				Displays the measured peak current of the 3rd previous start.	
32	Peak Current 4				Displays the measured peak current of the 4th previous start.	
33	Peak Current 5				Displays the measured peak current of the 5th previous start.	
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[2] Va	%	0/1000.0	0	Measures the THD of the applied Phase A line voltage.	R
36	THD Vb				Measures the THD of the applied Phase B line voltage.	
37	THD Vc				Measures the THD of the applied Phase C line voltage.	
38	THD Vave				Displays the calculated average of the three voltage THD measurements.	
39	THD[2] Ia	%	0/1000.0	0	Measures the THD of the applied Phase A current.	R
40	THD Ib				Measures the THD of the applied Phase B current.	
41	THD Ic				Measures the THD of the applied Phase C current.	
42	THD Iave				Displays the calculated average of the three current THD measurements.	

(1) ENUM Text is not applicable for the parameters in this table.
(2) THD = A Power Quality measurement that lets you measure total harmonic distortion levels.

Table 138 - Parameter 43...49

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
43	Product Status	—	0/65535	0	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.		R
					bit 0 = Enabled/Ready	1 – Ready 0 – Not ready	
					bit 1 = Running	1 – Power applied to motor (gating SCRs or bypass closed) 0 – Power NOT applied to motor	
					bit 2 = Phasing	1 – ABC Phasing 0 – CBA Phasing	
					bit 3 = Phasing Active	1 – 3-phase is valid 0 – No valid 3-phase detected	
					bit 4 = Starting (Accel)	1 – Performing a start maneuver (slow speed not included) 0 – Not performing a start maneuver	
					bit 5 = Stopping (Decel)	1 – Performing a stop maneuver (coast-to-stop not included) 0 – Not performing a stop maneuver	
					bit 6 = Alarm	1 – Alarm present 0 – No alarm present	
					bit 7 = Fault	1 – Fault condition exists and hasn't been cleared 0 – No fault condition	
					bit 8 = At Speed	1 – Full voltage applied (bypass or full SCR conduction) 0 – Full voltage not applied	
					bit 9 = Start/Isolate	1 – Start/isolate contactor enabled 0 – Start/isolate contactor disabled	
					bit 10 = Bypass	1 – Bypass contactor enabled 0 – Bypass contactor disabled	
					bit 11 = Ready	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...13 = Reserved	Always 0.	
					bit 14 = Input #1	Control module Input #1 status. 1 = Input closed.	
					bit 15 = Input #2	Control module Input #2 status. 1 = Input closed.	
44	Motor Config	—	0/2	2	Line Delta [Auto]	Lets you select the type of motor connection the SMC-50 controller is being applied to, 'Line' or 'Delta'. If set to 'Auto Config', the SMC-50 controller determines the motor connection.	R/W
45	Motor Connection	—	0/1	0	[Line] Delta	Displays the type of motor connection the SMC-50 controller is configured to operate with.	R
46	Line Voltage	Volt	0/700	480	—	The line voltage applied to the SMC-50 controller L1, L2, L3 terminals.	R/W
47	Rated Torque	N•m	0/10000	10	—	Enters the rated torque of the motor as read from the motor specifications (typically nameplate). Required for proper torque mode starts and stops.	R/W
48	Rated Speed	rpm	0/5	3	0 = 750 1 = 900 2 = 1500 3 = [1800] 4 = 3500 5 = 3600	Enters the rated motor speed as read from the motor specifications (typically nameplate). Required for proper torque mode starts and stops.	R/W
49	Starting Mode	—	0/5	2	Used to program the SMC controller for the type of starting mode that best fits the application.		R/W
					0 = Full Voltage	Apply full voltage to the motor at start.	
					1 = Current Limit	Apply limited current for a programmed time.	
					2 = [Soft Start]	Slowly increase current to load over a programmed time.	
					3 = Linear Speed	Increase current to cause a linear acceleration of the motor.	
					4 = Torque Ramp	Slowly increase torque generated by motor over fixed time.	
					5 = Pump Start	Special starting algorithm for pump applications.	

Table 139 - Parameter 50...57

No.	Name	Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
50	Ramp Time	Secs	0.0/1000.0	10.0	–	Lets you configure the time during which the controller ramps the output voltage.	R/W
51	Initial Torque	%LRT	0/90	70	–	Establishes and adjusts initial reduced voltage output level for the voltage ramp.	R/W
52	Max Torque	%	0/300	250	–	Lets you configure the max 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	Secs	0.0/2.0	0.0	–	A boost of current is applied to the motor for this programmed time.	R/W
55	Kickstart Level	%LRT	0/90	0	–	Lets you adjust the amount of current boost that is applied to the motor during the kickstart period.	R/W
56	Input 1	–	0/14	4	Lets you select the operation of Terminal 11, Input 1 on the control module.		R/W
					0 = Disable	Disable the input - ignores any assertion to Input 1, Terminal 11.	
					1 = Start	Initiates a start as configured by the start parameters at Input 1, Terminal 11 (High).	
					2 = Coast	Initiates a coast stop.- no current to motor at Input 1, Terminal 11 (Low).	
					3 = Stop Option	Initiates a stop maneuver as configured by the stopping parameters at Input 1 (Low).	
					4 = [Start/Coast]	• if Input 1 = 0 - Stops motor • if Input 1 = 1- Initiates a start as configured by the start parameters	
					5 = Start/Stop	• if Input 1 = 0- Initiates a stop maneuver as configured by stopping parameters • if Input 1 = 1- Initiates a start as configured by the start parameters	
					6 = Slow Speed 1	Runs motor in slow speed mode 1 as configured by slow speed 1 parameters (High).	
					7 = Slow Speed 2	Runs motor in slow speed mode 2 as configured by slow speed 2 parameters (High).	
					8 = Dual Ramp	• if Input 1 = 0 - Use parameter 49 [Starting Mode] • if Input 1 = 1 - Use parameter 58 [Starting Mode 2]	
					9 = OL Select	• if Input 1 = 0 - Use parameter 75 [Overload Class] • if Input 1 = 1 - Use parameter 76 [Overload Class 2]	
					10 = Fault	A fault condition that is forced if Input 1= 1.	
					11 = Fault NC	A fault condition that is forced if Input 1 = 0.	
					12 = Clear Fault	Clear a fault from input 1 Terminal 11 (High).	
					13 = Emerg Run	Allows motor to run in emergency run mode if asserted from Input 1, Terminal 11 - does not start motor (High).	
					14 = Motor Heater	Run motor heating algorithm if asserted from Input 1, Terminal 11 (High).	
57	Input 2	–	0/14	0	Lets you select the operation of Terminal 10, Option Input 2, on the control module.		R/W
					0 = [Disable]	Disable the input - ignores any assertion to Input 2 Terminal 10.	
					1 = Start	Initiate a start as configured by the start parameters at Input 2 Terminal 10 (High).	
					2 = Coast	Initiates a coast stop. No current to motor at Input 2 Terminal 10 (Low).	
					3 = Stop Option	Initiates a stop maneuver as configured by the stopping parameters at Input 2 (Low).	
					4 = Start/Coast	• If Input 2= 0 - Stops motor • if Input 2 = 1- Initiates a start as configured by the start parameters	
					5 = Start/Stop	• If Input 2 = 0- Initiates a stop maneuver as configured by stopping parameters • if Input 2 = 1- Initiates a start as configured by the start parameters	
					6 = Slow Speed 1	Runs motor in slow speed mode 1 as configured by slow speed 1 parameters (High).	
					7 = Slow Speed 2	Runs motor in slow speed mode 2 as configured by slow speed 2 parameters (High).	
					8 = Dual Ramp	• if Input 1 = 0 - Use parameter 49 [Starting Mode] • if Input 1 = 1 - Use parameter 58 [Starting Mode 2]	
					9 = OL Select	• if Input 1 = 0 - Use parameter 75 [Overload Class] • if Input 1 = 1 - Use parameter 76 [Overload Class 2]	
					10 = Fault	A fault condition is forced if Input 2= 1.	
					11 = Fault NC	A fault condition is forced if Input 2 = 0.	
					12 = Clear Fault	Clear a fault from Input 2 (High).	
					13 = Emerg Run	Lets motor run in emergency run mode if asserted on Input 2 - does not start motor (High).	
					14 = Motor Heater	Run motor heating algorithm if asserted at Input 2 (High).	

Table 140 - Parameter 58...71

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/write Access
58	Starting Mode 2	–	0/5	2	Lets you program an alternate starting mode for the SMC-50 controller that suits the application.		R/W
					0 = Full Voltage	Apply full voltage to the motor at start.	
					1 = Current Limit	Apply limited current for a programmed time.	
					2 = [Soft Start]	Slowly increase current to load over a programmed time.	
					3 = Linear Speed	Increase current to cause a linear acceleration of the motor.	
					4 = Torque Ramp	Slowly increase torque generated by the motor over a fixed time.	
					5 = Pump Start	Special starting algorithm for pump applications.	
59	Ramp Time 2	Secs	0.0/1000.0	10.0	–	Alternate time during which the controller ramps the output voltage.	R/W
60	Initial Torque 2	%LRT	0/90	70	–	Alternate initial reduced voltage output level for the voltage ramp.	R/W
61	Max Torque 2	%	0/300	250	–	Alternate maximum torque limit of a torque ramp during a torque start operation.	R/W
62	Cur Limit Level 2	%FLC	50/600	350	–	Alternate current limit level that is applied for the ramp time selected.	R/W
63	Kickstart Time 2	Secs	0/2	0	–	Alternate boost current to be applied to the motor for the programmed time.	R/W
64	Kickstart Level 2	%LRT	0/90	0	–	Alternate adjustment of the amount of current applied to the motor during the kickstart period.	R/W
65	Stop Mode	–	0/5	0	Programs the SMC-50 controller for the type of stopping that best suits the application.		R/W
					0 = [Coast]	Coast-to-Rest	
					1 = Soft Stop	Slowly reduces current by reducing voltage that is applied to the motor over a programmed time.	
					2 = Linear Speed	Stops the motor following a linear speed ramp over a programmed time.	
					3 = Pump Stop	Slowly reduces current by reducing voltage that is applied to the motor using the pump stop algorithm over a programmed time.	
					4 = SMB	Brakes the motor to a stop using an SCR firing pattern to create current flow to brake the motor per the configuration of the braking parameters.	
					5 = External Brake	Closes an external contactor to apply braking current to the motor.	
66	Stop Time	Secs	0/999	0	–	The time for which the controller ramps the voltage during a stopping maneuver.	R/W
67	Backspin Timer	Secs	0/999	0	–	Avoids starting into a backspin condition. The timer begins counting after a stop is completed (coast, stop maneuver, fault, and so on). All start inputs are ignored until the backspin timer has timed out.	R/W
68	Pump Pedestal	%	0/50	0	–	0% means that pump pedestal is disabled. Increasing the Pump Pedestal decreases the time that the Pump Stop algorithm is in the initial phases before it reaches the more aggressive Pump Stop maneuver. This parameter is typically used for applications that experience overload trips during the stopping maneuver.	R/W
69	Braking Current	%FLC	0/400	0	–	Programs the intensity of the braking current applied to the motor.	R/W
70	Brake Load Type	–	0/3	0	Identifies the load type to enable appropriate braking algorithms. The different load types align with the user application. "Standard" is most common, followed by "High Inertia". Each of the profiles slightly adjusts the braking current profile and the speed at which the motor slows.		R/W
					0 = Standard	–	
					1 = High Inertia	–	
					2 = High Friction	–	
					3 = Ramp 89	Special braking mode that reduces braking torques.	
71	High Eff Brake	%	0/99	0	–	Adds additional time to a braking sequence after the SMC-50 controller detects a zero speed condition that indicates the end of the braking sequence. Adjustable if additional time is required to stop the load.	R/W

Table 141 - Parameter 72...94 (1)

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
72	Slow Speed 1	%	-15/15	10	The percent of motor base speed at which the system operates when Slow Speed 1 is active. Negative values reverse the direction of the motor.	R/W
73	Slow Brake Cur	%FLC	0/350	0	Provides braking from slow speed. If set to 0, no braking is provided. Any other setting results in motor braking when the slow speed operation is ended.	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 parameter 136 [Starter Fault En] and parameter 137 [Starter Alarm].	R/W
76	Overload Class 2	—	5/30	10	Sets 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	—	0.01/1.990	1.15	Parameter to enter the value of the motor's service factor from the nameplate.	R/W
78	Motor FLC	Amps	1.0/2200.0	1.0	Parameter to enter the full-load current (FLC) value from the motor's nameplate. **IMPORTANT:** Motor FLA rating **must** fall within the specified current range for SMC-50 unit to operate properly. Deviation could cause the SMC-50 controller to operate incorrectly, display inaccurate phase current readings, or stop running on an F22 Overload Fault.	R/W
79	Motor FLC 2	Amps	1.0...2200.0	1.0	Second motor FLC setting to be used when Overload #2 is selected using the "Overload 2" input.	R/W
80	OL Reset Level	%MTU	1/99	75	When the level of parameter 18 [Motor Therm Usage] drops below this limit after an OL fault, an overload reset can occur. If restart is enabled, the motor overload automatically resets 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 after a start or stop command is initiated.	R/W
82	OL Inhibit Time	Secs	0/999	0	Disables the overload from tripping during slow speed and stopping maneuvers. Parameter 18 [Motor Therm Usage] continues to increment during these maneuvers.	R/W
83	Overload A Level	%MTU	0/100	90	The MTU level that sets off an alarm when exceeded. You must set the overload bit of parameter 231 [Motor Alarm En] 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 defined in parameter 85 [Locked Rtr F Dly], signals a fault. You must set the locked rotor bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
85	Locked Rtr F Dly	Secs	0.1/100.0	0.1	The time that the peak phase current exceeds the value of parameter 84 [Locked Rtr F Lvl] to signal a fault. You must set the locked rotor bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
86	Underload F Lvl	%FLC	0/99	0	If phase current drops below this level for the time that is set in parameter 87 [Underload F Dly] parameter, an Underload Fault is signaled. You must set the underload bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
87	Underload F Dly	Secs	0.1/99.0	0.1	The time that the phase current must be below the level set in parameter 86 [Underload F Lvl] before an underload fault is signaled. You must set the underload bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
88	Underload A Lvl	%FLC	0/99	0	If phase current drops below this level for the time that is set in parameter 89 [Underload A Dly], an underload alarm is signaled. You must set the underload bit in parameter 231 [Motor Alarm En] to signal a fault.	R/W
89	Underload A Dly	Secs	0.1/99.0	0.1	The time that the phase current must be below the level set in parameter 88 [Underload A Lvl] before an underload alarm is signaled. You must set the underload bit in parameter 231 [Motor Alarm En] to signal a fault.	R/W
90	MWatts Ov F Lvl	MW	0.000/ 1000.00	0.000	If the Real Power exceeds this level for the time that is set in parameter 91 [MWatts Ov F Dly] parameter, an MWatts Ov fault is signaled. You must set the MWatts Ov bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
91	MWatts Ov F Dly	Secs	0.1/99.0	0.1	The time for which Real Power must exceed parameter 90 [MWatts Ov F Lvl] to signal a fault. You must set the MWatts Ov bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
92	MWatts Ov A Lvl	MW	0.000/ 1000.00	0.000	If the Real Power exceeds this level for the time that is set in parameter 93 [MWatts Ov A Dly], a MWatts Ov alarm is signaled. You must set the MWatts Ov bit in parameter 231 [Motor Alarm En] to signal a fault.	R/W
93	MWatts Ov A Dly	Secs	0.1/99.0	0.1	The time for which Real Power must exceed parameter 92 [MWatts Ov A Lvl] to signal an alarm. You must set the MWatts Ov bit in parameter 231 [Motor Alarm En] to signal a fault.	R/W
94	MWatts Un F Lvl	MW	0.000/ 1000.00	0.000	If the Real Power drops below this level for the time that is set in parameter 95 [MWatts Un F Dly], an MWatts Un Fault is signaled. You must set the MWatts Un bit in parameter 230 [Motor Fault En] to signal a fault.	R/W

(1) ENUM Text is not applicable for the parameters in this table.

Table 142 - Parameter 95...113 (1)

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
95	MWatts Un F Dly	Secs	0.1/99.0	0.1	The time that Real Power must drop below the value that is set in parameter 94 [MWatts Un F Lvl] to signal a fault. You must set the MWatts Un bit in parameter 231 [Motor Alarm En] to signal a fault.	R/W
96	MWatts Un A Lvl	MW	0.000/ 1000.00	0.000	If the Real Power drops below this level for the time that is set in parameter 97 [MWatts Un A Dly], an MWatts Un alarm is signaled. You must set the MWatts Un bit in parameter 231 [Motor Alarm En] to signal a fault	R/W
97	MWatts Un A Dly	Secs	0.1/99.0	0.1	The time that Real Power must drop below the value that is set in parameter 96 [MWatts Un A Lvl] to signal an alarm. You must set the MWatts Un bit in parameter 231 [Motor Alarm En] to signal a fault	R/W
98	Undervolt F Lvl	%V	0/100	90	If the average three-phase line voltage drops below this level for the time that is set in parameter 99 [Undervolt F Dly], an Undervolt fault is signaled. You must set the Undervolt bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
99	Undervolt F Dly	Secs	0.1/99.0	3.0	The time that the average three-phase voltage must remain below the value that is set in parameter 98 [Undervolt F Lvl] to signal a fault. You must set the Undervolt bit in parameter 136 [Starter Fault En] 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 that is set in parameter 101 [Undervolt A Dly], an Undervolt Alarm is signaled. You must set the Undervolt bit in parameter 137 [Starter Alarm En] to signal an Alarm.	R/W
101	Undervolt A Dly	Secs	0.1/99.0	3.0	The time that the average three-phase voltage must remain below the value that is set in parameter 100 [Undervolt A Lvl] to signal an Alarm. You must set the Undervolt bit in parameter 137 [Starter Alarm En] to signal an Alarm.	R/W
102	Overvolt F Lvl	%V	100/199	110	If the average three-phase line voltage exceeds this level for the time that is set in parameter 103 [Overvolt F Dly], an Overvolt fault is signaled. You must set the Overvolt bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
103	Overvolt F Dly	Secs	0.1/99.0	3.0	The time that the average three-phase voltage must exceed the value that is set in parameter 102 [Overvolt F Lvl] to signal a fault. You must set the Overvolt bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
104	Overvolt A Lvl	%V	100/199	110	If the average three-phase line voltage exceeds this level for the time that is set in parameter 103 [Overvolt F Dly], an Overvolt alarm is signaled. You must set the Overvolt bit in parameter 137 [Starter Alarm En] to signal an alarm.	R/W
105	Overvolt A Dly	Secs	0.1/99.0	3.0	The time that the average three-phase voltage must exceed the value that is set in parameter 104 [Overvolt A Lvl] to signal an alarm. You must set the Overvolt bit in parameter 137 [Starter Alarm En] to signal an alarm	R/W
106	Volt Unbal F Lvl	%	1/25	15	If the line-to-line voltage imbalance condition exceeds the time that is set in parameter 107 [Volt Unbal F Dly], a fault is signaled. You must set the Volt Unbal bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
107	Volt Unbal F Dly	Secs	0.1/99.0	3.0	The time that the voltage imbalance exceeds the value that is set parameter 106 [Volt Unbal F Lvl] to signal a fault. You must set the Volt Unbal bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
108	Volt Unbal A Lvl	%	1/25	15	If the line-to-line voltage imbalance condition exceeds this level for the time that is set in parameter 109 [Volt Unbal A Dly], an alarm is signaled. You must set the Volt Unbal bit in parameter 137 [Starter Alarm En] to signal an alarm.	R/W
109	Volt Unbal A Dly	Secs	0.1/99.0	3.0	The time that the voltage imbalance exceeds the value that is set in parameter 108 [Volt Unbal A Lvl] to signal an alarm. You must set the Volt Unbal bit in parameter 137 [Starter Alarm En] to signal an alarm.	R/W
110	Cur Imbal F Lvl	%	1/25	15	If the line-to-line current imbalance condition exceeds this level for the time that is set in parameter 111 [Cur Imbal F Dly], a fault is signaled. You must set the Cur Imbal bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
111	Cur Imbal F Dly	Secs	0.1/99.0	3.0	The time that the current imbalance exceeds the value that is set in parameter 110 [Cur Imbal F Lvl] to signal a fault. You must set the Cur Imbal bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
112	Cur Imbal A Lvl	%	1/25	15	If the line-to-line current imbalance condition exceeds this level for the time that is set in parameter 113 [Cur Imbal A Dly], an alarm is signaled. You must set the Cur Imbal bit in parameter 231 [Motor Alarm En] to signal a fault.	R/W
113	Cur Imbal A Dly	Secs	0.1/99.0	3.0	The time that the current imbalance exceeds the value that is set in parameter 112 [Cur Imbal A Lvl] to signal an alarm. You must set the Cur Imbal bit in parameter 231 [Motor Alarm En] to signal a fault	R/W

(1) ENUM Text is not applicable for the parameters in this table.

Table 143 - Parameter 114...134 (1)

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
114	Jam F Lvl	%FLC	0/1000	1000	If the peak phase current exceeds this level for the time that is set in parameter 115 [Jam F Dly], a fault is signaled. You must set the Jam bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
115	Jam F Dly	Secs	0.1/99.0	0.1	The time that the peak phase current exceeds the value that is set in parameter 114 [Jam F Lvl] to signal a fault. You must set the Jam bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
116	Jam A Lvl	%FLC	0/1000	1000	If the peak phase current exceeds this level for the time that is set in parameter 117 [Jam A Dly], an alarm is signaled. You must set the Jam bit in parameter 231 [Motor Alarm En] to signal an alarm.	R/W
117	Jam A Dly	Secs	0.1/99.0	0.1	The time that the peak phase current exceeds the value that is set in parameter 116 [Jam A Lvl] to signal an alarm. You must set the Jam bit in parameter 231 [Motor Alarm En] to signal an alarm.	R/W
118	THD V F Lvl	%	0/1000	1000	If the average total harmonic distortion (THD) on the line voltage exceeds this level for the time that is set in parameter 119 [THD V F Dly], a fault is signaled. You must set the THD V bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
119	THD V F Dly	Secs	0.1/99.0	0.1	The time that the average THD on the line voltage exceeds the value that is set in parameter 118 [THD V F Lvl] to signal a fault. You must set the THD V bit in parameter 136 [Starter Fault En] to signal a fault.	R/W
120	THD V A Lvl	%	0/1000	1000	If the average THD on the line voltage exceeds this level for the time that is set in parameter 121 [THD V A Dly], an alarm is signaled. You must set the THD V bit in parameter 137 [Starter Alarm En] to signal an alarm.	R/W
121	THD V A Dly	Secs	0.1/99.0	0.1	The time that the average THD on the line voltage exceeds the value that is set in parameter 120 [THD V A Lvl] to signal an alarm. You must set the THD V bit in parameter 137 [Starter Alarm En] to signal an alarm.	R/W
122	THD I F Lvl	%	0/1000	1000	If the average THD on the phase current exceeds this level for the time that is set in parameter 123 [THD I F Dly], a fault is signaled. You must set the THD I bit in parameter 230 [Motor Fault En] to signal a fault.	R/W
123	THD I F Dly	Secs	0.1/99.0	0.1	The time that the average THD on the phase current exceeds the value that is set in parameter 122 [THD I F Lvl] to signal a fault. You must set the THD I bit in parameter 230 [Motor Fault En] to signal a fault	R/W
124	THD I A Lvl	%	0/1000	1000	If the average THD on the phase current exceeds this level for the time that is set in parameter 125 [THD I A Dly], an alarm is signaled. You must set the THD I bit in parameter 231 [Motor Alarm En] to signal an alarm.	R/W
125	THD I A Dly	Secs	0.1/99.0	0.1	The time that the average THD on the phase current exceeds value that is set in parameter 124 [THD I A Lvl] to signal an alarm. You must set the THD I bit in parameter 231 [Motor Alarm En] to signal an alarm	R/W
126	PM Hours	Hrs	1/100	1000	You can set this counter to generate an alarm or fault to signal a need for preventive maintenance. The Hours to PM parameter initializes to this value and counts down when the motor is running.	R/W
127	PM Starts	—	1/50000	100	You can set this counter to generate an alarm or fault to signal a need for preventive maintenance. The Starts to PM parameter initializes to this value and counts down each time the motor is started.	R/W
128	Starts per Hour	—	1/99	99	You can program the maximum number of starts within a sliding one-hour window. After the number of starts per hour is reached, any additional starts 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 controller before causing a Freq High F Lvl fault. You must set the Freq High bit in parameter 136 [Starter Fault En] 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 controller before causing a Freq Low F Lvl fault. You must set the Freq Low bit in parameter 136 [Starter Fault En] 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 controller before causing a Freq High F Lvl alarm. You must set the Freq High bit in parameter 137 [Starter Alarm En] 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 controller before causing a Freq Low F Lvl alarm. You must set the Freq Low bit in parameter 137 [Starter Alarm En] to signal an alarm.	R/W
133	Restart Attempts	—	0/5	0	Lets you enable the SMC-50 controller 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 before the SMC-50 controller's attempt to restart the motor after a fault.	R/W

(1) ENUM Text is not applicable for the parameters in this table.

Table 144 - Parameter 135...148 (1)

No.	Name	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
135	Strtr Restart En	0/511	0	0 = Volt Unbal 1 = Overvoltage 2 = Undervoltage 3 = Phase Rev 4 = Line Loss 5 = Open Gate 6 = Config Change 7 = Freq 8 = THD V	Lets you select which type of fault that the SMC-50 controller can try to restart from after the restart delay period has expired. To enable a restart from a fault, the function must be selected. You must configure parameter 133 [Restart Attempts] and parameter 134 [Restart Delay].	R/W
136	Starter Fault En	0/511	0 0 0 0 1 1 0 0 0	0 = Volt Unbal 1 = Overvoltage 2 = Undervoltage 3 = Phase Rev 4 = Line Loss 5 = Open Gate 6 = Config Change 7 = Freq 8 = THD V	Lets you enable faults that are associated with the control module. You must set the bit for a fault for the fault to be asserted.	R/W
137	Starter Alarm En	0/511	0	0 = Volt Unbal 1 = Overvoltage 2 = Undervoltage 3 = Phase Rev 4 = Line Loss 5 = Open Gate 6 = Config Change 7 = Freq 8 = THD V	Lets you enable alarms that are associated with the control module. You must set the bit for an alarm for the alarm to be asserted.	R/W
138	Fault 1	0/1000	0	–	First entry in the fault buffer and is the most recent fault to have occurred.	R/W
139	Fault 2				Second entry in the fault buffer.	
140	Fault 3				Third entry in the fault buffer.	
141	Fault 4				Fourth entry in the fault buffer.	
142	Fault 5				Fifth entry in the fault buffer. The oldest fault displayed in the fault buffer.	
143	Alarm 1	0/1000	0	–	First entry in the alarm buffer and is the most recent alarm to have occurred.	R/W
144	Alarm 2				Second entry in the alarm buffer.	
145	Alarm 3				Third entry in the alarm buffer.	
146	Alarm 4				Fourth entry in the alarm buffer.	
147	Alarm 5				Fifth entry in the alarm buffer. The alarm buffer can store up to 100 events. To see the whole buffer, go the diagnostics tab on the HIM or Connected Components Workbench software.	
148	Logic Mask	0/65535	0	The bits in this parameter let you enable (bit=1) or disable (bit=0) the DPI ports from which the SMC-50 controller accepts Start and Maneuver commands. Coast Stop commands are always accepted from any port.		R/W
				1 = port 1	HIM slot on front of control module	
				2 = port 2	DPI port on control module	
				3 = port 3	DPI port on control module with splitter	
				4 = port 4	Internal Comm module	
				5...13 = unused	–	
				14 = port 14	DeviceLogix engine	
				15 = unused	–	

(1) Unit data is not valid for the parameters in this table.

Table 145 - Parameter 149...171 (1)

No.	Name	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
149	Logic Mask Act	0/65535	0	Displays which DPI port the SMC-50 controller accepts a start command from. It can differ from the Logic Mask set locally if someone changes it over the network.		R
				1 = port 1	HIM slot on front of control module	
				2 = port 2	DPI port on control module	
				3 = port 3	DPI port on control module with splitter	
				4 = port 4	Internal Comm module	
				5...15 = reserved	–	
150	Logic Mask Cfg	0/65535	0	The bits in this parameter let you enable (bit=1) or disable (bit=0) the DPI ports from which the SMC-50 controller accepts write commands. Only selected ports can modify parameters.		R/W
			1	1 = port 1	HIM slot on front of control module	
			1	2 = port 2	DPI port on control module	
			1	3 = port 3	DPI port on control module with splitter	
			1	4 = port 4	Internal Comm module	
			0	5...15 = reserved	–	
151	Write Mask Act	0/65535	0	Displays the DPI ports from which the SMC-50 controller accepts write commands that can change parameters. It may differ from the Write Mask Act parameter set locally if someone changes it over the network.		R/W
				1 = port 1	HIM slot on front of control module	
				2 = port 2	DPI port on control module	
				3 = port 3	DPI port on control module with splitter	
				4 = port 4	Internal Comm module	
				5...15 = reserved	–	
152	Port Mask Act	0/65535	0	Displays which DPI ports are active on the control module and from which the SMC-50 controller accepts operational commands.		R/W
				1 = port 1	HIM slot on front of control module	
				2 = port 2	DPI port on control module	
				3 = port 3	DPI port on control module with splitter	
				4 = port 4	Internal Comm module	
				5...15 = reserved	–	
153	Data In A1	0/159999	0	–	Channel A1	R/W
154	Data In A2				Channel A2	
155	Data In B1				Channel B1	
156	Data In B2				Channel B2	
157	Data In C1				Channel C1	
158	Data In C2				Channel C2	
159	Data In D1				Channel D1	
160	Data In D2				Channel D2	
					In Datalinks index: this channel holds the parameter number of the parameter that is written to during Datalinks communications. 0 = disabled	
161	Data Out A1	0/159999	0	–	Channel A1	R/W
162	Data Out A2				Channel A2	
163	Data Out B1				Channel B1	
164	Data Out B2				Channel B2	
165	Data Out C1				Channel C1	
166	Data Out C2				Channel C2	
167	Data Out D1				Channel D1	
168	Data Out D2				Channel D2	
					Out Datalinks index: this channel holds the parameter number of the parameter that is read from during Datalinks communications. 0 = disabled	
169	Voltage Ratio	1/32767	3079	Configure and fine-tune voltage dividers. Voltage Ratio is a Medium Voltage (MV)-specific parameter and has no function at 690V and below.		R/W
170	User CT Ratio	10/500	100	Configure current ratio for FLC ratings when using external CTs. User CT Ratio is an MV-specific parameter and has no function at 690V and below.		R/W
171	Factory CT Ratio	1/15000	50	Set at the factory to achieve proper current ratio for FLC ratings when using external CTs. Factory CT Ratio is an MV-specific parameter and has no function at 690V and below.		R/W

(1) Unit data is not valid for the parameters in this table.

Table 146 - Parameter 172...177

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
172	Aux1 Config	–	0/12	0	Lets you configure the functionality of the Aux1 relay output on the control module based on the following selections.		R/W
					0 = [Normal]	Aux 1 closes when start command asserted and opens when motor stops.	
					1 = UTS (Up-To-Speed)	Aux 1 closes when motor reaches up to speed and opens when motor is not at speed.	
					2 = Fault	Aux1 closes when the SMC-50 controller enters a fault state and opens when the fault is cleared.	
					3 = Alarm	Aux1 closes when the SMC-50 controller detects an alarm condition and opens when alarm is cleared.	
					4 = Ext Bypass	Aux1 closes when the SMC-50 controller enters the external bypass mode and opens when it leaves that mode.	
					5 = Ext Brake	Aux1 closes when Ext Braking command is active and opens when it is not active.	
					6 = DeviceLogix	Aux1 is controlled by DeviceLogix program	
					7 = Aux Control	When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary.	
					8 = Network 1	With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1.	
					9 = Network 2	With an auxiliary configured as Network 2, it is controlled over the LAN as Relay 2.	
					10 = Network 3	With an auxiliary configured as Network 3, it is controlled over the LAN as Relay 3.	
					11 = Network 4	With an auxiliary configured as Network 4, it is controlled over the LAN as Relay 4.	
					12 = Fan Control	Used to control fans. Fan turns on when the motor is running or the estimated SCR temperature is above 50 °C.	
173	Aux 1 Invert	–	0/1	0	Lets you invert the logic of the Aux 1 output. When disabled, it is a N.O. relay output contact when de-energized. By enabling the invert function, the relay contact becomes a N.C. contact when de-energized.		R/W
					0 = [Disable]	Aux 1 relay output not inverted (N.O.).	
					1 = Enable	Aux 1 relay output inverted (N.C.) (N.C. is electrically held).	
174	Aux1 On Delay	Secs	0.0/10.0	0.0	–	Time delay for activating the Aux1 relay contact.	R/W
175	Aux1 Off Delay	Secs	0.0/10.0	0.0	–	Time delay for de-activating the Aux1 relay contact.	R/W
176	Aux2 Config	–	0/12	0	Lets you configure the functionality of the Aux2 relay output on the control module based on the following selections.		R/W
					0 = [Normal]	Aux 2 closes when start command asserted and opens when motor stops [Default].	
					1 = UTS (Up-To-Speed)	Aux 2 closes when motor reaches up to speed and opens when motor is not at speed.	
					2 = Fault	Aux2 closes when the SMC-50 controller enters a fault state and opens when the fault is cleared.	
					3 = Alarm	Aux2 closes when the SMC-50 controller detects an alarm condition and opens when alarm is cleared.	
					4 = Ext Bypass	Aux2 closes when the SMC-50 controller enters the external bypass mode and opens when it leaves that mode.	
					5 = Ext Brake	Aux2 closes when Ext Braking command is active and opens when it is not active.	
					6 = DeviceLogix	Aux2 is controlled by DeviceLogix program	
					7 = Aux Control	When an auxiliary is configured for Aux Control, a bit within the parameter Aux Control controls the state of that auxiliary.	
					8 = Network 1	With an auxiliary configured as Network 1, it is controlled over the Local Area Network (LAN) as Relay 1.	
					9 = Network 2	With an auxiliary configured as Network 2, it is controlled over the LAN as Relay 2.	
					10 = Network 3	With an auxiliary configured as Network 3, it is controlled over the LAN as Relay 3.	
					11 = Network 4	With an auxiliary configured as Network 4, it is controlled over the LAN as Relay 4.	
					12 = Fan Control	Used to control fans. Fan is turned on when the motor is running or the estimated SCR temperature is above 50 °C	
177	Aux 2 Invert	–	0/1	0	–	Lets you 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.	R/W
					0 = Disable	Aux2 relay output not inverted (N.O.).	
					1 = Enable	Aux2 relay output inverted (N.C.) (N.C. is electrically held.)	

Table 147 - Parameter 178...185

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
178	Aux2 On Delay	Secs	0.0/10.0	0.0	–	Time delay for activating the Aux2 relay contact.	R/W
179	Aux2 Off Delay	Secs	0.0/10.0	0.0	–	Time delay for de-activating the Aux2 relay contact.	R/W
180	Aux Control	–	0	0	When an Auxiliary Relay output is configured for "Aux Control" a bit within this parameter controls the state of the auxiliary.		R/W
					Aux 1	Bit 0 - Control Module Aux Relay 1	
					Aux 2	Bit 1 - Control Module Aux Relay 2	
					Aux 7-1	Bit 2 - Expansion Port 7 Aux Relay 1	
					Aux 7-2	Bit 3- Expansion Port 7 Aux Relay 2	
					Aux 7-3	Bit 4- Expansion Port 7 Aux Relay 3	
					Aux 7-4	Bit 5- Expansion Port 7 Aux Relay 4	
					Aux 8-1	Bit 6 - Expansion Port 8 Aux Relay 1	
					Aux 8-2	Bit 7- Expansion Port 8 Aux Relay 2	
					Aux 8-3	Bit 8- Expansion Port 8 Aux Relay 3	
					Aux 8-4	Bit 9- Expansion Port 8 Aux Relay 4	
					Aux 9-1	Bit 10 - Expansion Port 9 Aux Relay 1	
					Aux 9-2	Bit 11 - Expansion Port 9 Aux Relay 2	
					Aux 9-3	Bit 12 - Expansion Port 9 Aux Relay 3	
					Aux 9-4	Bit 13 - Expansion Port 9 Aux Relay 4	
					–	Bit 14 - Reserved Bit 15 - Reserved	
181	Language	–	0/6	0	0 = [English]	Lets you configure the language that is displayed for any interface device. The selected language is the same for all devices connected to the SMC-50 controller.	R/W
					1 = French		
					2 = Spanish		
					3 = Italian		
					4 = German		
					5 = Portuguese		
					6 = Mandarin		
182	Start Delay	Secs	0/30	0	–	The time between asserting a start command with valid 3-phase applied and the SMC-50 controller starting the motor. A stop that is asserted during the delay period cancels the start.	R/W
183	Timed Start	–	0/1	0	This parameter forces the starting profile to complete its entire time ramp period. This can help to avoid conditions where an up-to-speed is sensed before the motor is actually up to speed.		R/W
					0 = [Disable]	Complete starting mode when up-to-speed detected.	
					1 = Enable	Complete starting mode when ramp time expires.	
184	V Shutoff Level	%	0/100	25	–	Manually adjusts the threshold for the controller's voltage (notch) shutoff detection level. Because this parameter has the potential to modify the SCR operational control scheme, it is important that you make any change 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. When running high-efficiency motors with Energy Saver, you may need to adjust this value downward. **Contact Rockwell Automation Technical Support for assistance.**	R/W
185	I Shutoff Level	%	0/37	0	–	Adjusts the level at which the SMC-50 controller expects to see current or the level of current which the SMC-50 controller determines the SCR has turned off. A common reason for increasing this value is to compensate for the inability of the control to sense a voltage notch due to significant LINE voltage noise or LINE distortion. Because this parameter has the potential to modify the SCR operational control scheme, it is important that any change made is done 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

Table 148 - Parameter 186...204

No.	Name	Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
186	UTS Level	%	0/100	75	–	The SMC-50 controller can determine if the motor is up-to-speed (UTS). If the SMC-50 controller encounters a problem detecting motor UTS, you can modify this parameter to compensate. If the SMC-50 controller is detecting the UTS condition to soon (for example, abrupt speed change), this number should be increased (this typically occurs on high efficiency motors). If the SMC-50 controller is detecting the UTS condition too late or not at all (display does not indicate At Speed), decrease this number. Contact Rockwell Automation Technical Support for assistance.	R/W
187	Stall Level	%	0/100	75	–	Sets the motor winding voltage level (as a percentage of line voltage) at which the SMC-50 controller considers the motor stalled.	R/W
188	Stall Delay	Secs	0.0/30.0	10.0	–	Configures the time after the start maneuver start time that the motor has to reach UTS, or else a stall fault occurs.	R/W
189	Stall Position	%	0/100	75	–	Sets the change in the notch position at which the SMC-50 controller considers the motor stalled.	R/W
190	Notch Maximum (Pump Control)	–	50.0/70.0	60.0	–	Changes the maximum notch value during pump stop.(1)	R/W
191	Notch Position	%	40.0/100.0	87.5	–	Manually adjusts an internal value that is used for notch control gain, which impacts the SMC-50 controller starting control algorithm.(1)	R/W
192	Bypass Delay	Secs	1/15	1	–	For applications with fast current spikes or overload conditions (>120% of the controller rating), you can use this parameter to reduce the cycling between SCR and bypass control modes on units with internal bypass. This parameter causes a time delay in closing the bypass contactor.	R/W
193	Energy Saver	–	0.00/1.00	0.00	–	Enables the controller's energy saving control scheme, which opens the "notch" (reduces power applied) to lightly loaded motors thereby reducing the motor terminal voltage and winding losses. This value should be set between the no/light load value and the full/ heavy load value of parameter 17 [Power Factor]. To disable Energy Saver mode, set parameter 193 [Energy Saver] = 0.	R/W
194	Forced Tuning	–	0/1	1	–	Enables the controller's tuning algorithms to analyze the load and supply and adjust parameters for easy setup and optimum performance.	R/W
					0 = FALSE	Do not run tuning algorithm (was already run or disabled by user).	
					1 = [TRUE]	Run tuning algorithm at next start command [Default].	
195	Stator R	Ohms	0.00/50.00	0.00	–	The motor stator resistance value that was measured during the tuning process.	R
196	Total R	Ohms	0.00/50.00	0.00	–	The motor total load resistance that was measured during the tuning process.	R
197	Coupling Factor	–	0.00/10.00	0.00	–	A coefficient that the controller inserts during the tuning process.	R
198	Inductance	mH	0.00/ 1000.00	0.00	–	The motor inductance that was measured during the tuning process.	R
199	Speed PGain	–	1/10000	1000	–	The proportional gain of the speed controller used when running in linear speed mode.(1)	R/W
200	Transient Mag	–	0.00/2.00	0.90	Speed measurement algorithm parameters (200...202) for when the speed signal decays to 0 and cannot be measured. To continue to measure the signal, a transient is provided into the firing of the SCRs to excite the speed signal. This transient is a sine wave of the same frequency as the speed signal with a specific phase relationship required to excite the speed signal. These parameters define the magnitude of the transient.		
					–	Defines the normal level of the transient.(1)	
201	Transient Zero	–	0.00/10.00	5.00	–	The speed signal level above which the transient goes to zero.(1)	
202	Transient Gain	–	0.00/4.00	1.00	–	Multiplied by the speed signal peak to determine the maximum transient level.(1)	
203	Ping Degree	–	0.0/180.0	50.0	Parameters 203 and 204 are also related to the speed measurement algorithm. If the speed signal is not able to be maintained using the transient, the motor is "pinged". This is done by periodically modifying the SCR firing time. The goal is to excite the speed signal so that it can be measured again.		
					–	Defines the change in the SCR firing angle to generate the "Ping" (in degrees).(1)	R/W
204	Pings	–	0/20	2	–	The number of consecutive SCR timings that are modified to generate the ping.(1)	R/W

(1) This parameter is not typically modified and it is recommended that you contact Rockwell Automation Technical Support for assistance before attempting to do so.

Table 149 - Parameter 205...226

No.	Name	Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
205	Phase Shift 0	—	-360/360	0	—	These parameters define the phase relationship between the speed signal and the transient being generated. The relationship is not linear; a piecewise linear algorithm is used to determine the phase relationship. There is a table internal to the product that linearizes this as much as possible. This set of parameters lets you change that table. Each parameter represents the change in phase at that speed (Phase Shift 10 is the phase shift at 10% speed, and so on). If the phase relationship is not correct, the speed signal is not excited and decays. (1)	R/W
206	Phase Shift 10						
207	Phase Shift 20						
208	Phase Shift 30						
209	Phase Shift 40						
210	Phase Shift 50						
211	Phase Shift 60						
212	Phase Shift 70						
213	Phase Shift 80						
214	Phase Shift 90						
215	Phase Shift 100						
216	Board Temp	°C	-25/100	20	—	Displays the internal temperature of the SMC control module.	R
217	Exp 7 Config	—	0/5	0	Displays the type of expansion board that is plugged into Expansion Port 7.		R
					0 = None	No expansion board.	
					1 = Input/Output	AC Input Card (4 inputs, 3 relay outputs), Cat No 150-SM4.	
					2 = Analog I/O	Analog Card (2 inputs, 2 outputs), Cat No 150-SM3.	
					3 = GndF/PTC/CT	Ground Fault, Motor PTC, External CT Card, Cat No 150-SM2.	
					4 = DIP Switch	Parameter Configuration Module, Cat No 150-SM6.	
					5 = Seq Start (future)	Future option.	
218	Exp 8 Config	—	0/5	0	Displays the type of expansion board that is plugged into Expansion Port 8.		R
					0 = None	No expansion board.	
					1 = Input/Output	AC Input Card (4 inputs, 3 relay outputs), Cat No 150-SM4.	
					2 = Analog I/O	Analog Card (2 inputs, 2 outputs), Cat No 150-SM3.	
					3 = GndF/PTC/CT	Ground Fault, Motor PTC, External CT Card, Cat No 150-SM2.	
					4 = DIP Switch	Parameter Configuration Module, Cat No 150-SM6.	
					5 = Seq Start (future)	Future option.	
219	Exp 9 Config	—	0/5	0	Displays the type of expansion board that is plugged into Expansion Port 9.		R
					0 = None	No expansion board.	
					1 = Input/Output	AC Input Card (4 inputs, 3 relay outputs), Cat No 150-SM4.	
					2 = Analog I/O	Analog Card (2 inputs, 2 outputs), Cat No 150-SM3.	
					3 = GndF/PTC/CT	Ground Fault, Motor PTC, External CT Card, Cat No 150-SM2.	
					4 = DIP Switch	Parameter Configuration Module, Cat No 150-SM6.	
					5 = Seq Start (future)	Future option.	
220	Heating Time	Secs	0/1000	0	—	Configures the time the motor winding heating algorithm is active after asserting the motor heating command.	R/W
221	Heating Level	%	0/100	0	—	The amount of current applied during the motor winding heating process.	R/W
222	Fan Config	—	0/2	0	0 = [Auto Detect]	Configures the voltage applied to the internal SMC-50 controller cooling fans. If configured for Auto Detect, the SMC-50 controller uses the control voltage that is applied to it as the level and configures the fans to work at that level.	R/W
					1 = 120V		
					2 = 240V		
223	Fan Connection	—	0/1	0	0 = 120V	Displays the voltage configuration of the fans. If Auto Detect is selected in parameter 222 [Fan Config], this displays the result of the Auto Detect process.	R
					1 = 240V		
224	Line Frequency	Hz	0/100	0	—	Displays the line frequency of the three-phase voltage that is applied to the SMC-50 controller at terminals L1, L2, and L3.	R
225	Freq High F Dly	Secs	0.1/99.0	0.1	—	Configures the time that the supplied line voltage frequency must exceed the value of parameter 129 [Freq High F Lvl] before causing a Freq High fault. You must set the Freq High bit in parameter 136 [Starter Fault En] for the fault to activate.	R
226	Freq High A Dly	Secs	0.1/99.0	0.1	—	Configures the time that the supplied line voltage frequency must exceed the value of parameter 131 [Freq High A Lvl] before causing a Freq High alarm. You must set the Freq High bit in parameter 137 [Starter Alarm En] for the fault to activate.	R

(1) This parameter is not typically modified and it is recommended that you contact Rockwell Automation Technical Support for assistance before attempting to do so.

Table 150 - 227...230

No.	Name	Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
227	Freq Low F Dly	Secs	0.1/99.0	0.1	–	Configures the time that the supplied line voltage frequency must drop below the value of parameter 130 [Freq Low F Lvl] before causing a Freq Low fault. You must set the Freq Low bit in parameter 136 [Starter Fault En] for the fault to activate	R
228	Freq Low A Dly	Secs	0.1/99.0	0.1	–	Lets you configure the time that the supplied line voltage frequency must drop below the value of parameter 132 [Freq Low A Lvl] before causing a Freq Low alarm. You must set the Freq Low bit in parameter 137 [Starter Alarm En] for the fault to activate.	R
229	Parameter Mgmt	–	0/1	0	Lets you force all control module parameters to default values. This has no impact on any option modules that are installed. Each option module has its own associated parameter management parameter		R/W
					Ready	Waiting for command to set factory defaults	
					Factory Default	Command for SMC-50 controller to set all Control Module Writable Parameters to factory default values. This command does not impact Option Module parameters.	
230	Motor Fault En	–	0/ 16777216	1	0 = [Overload]	Enables motor-related faults that can be detected by the SMC-50 controller. 0 = Fault Disabled 1 = Fault Enabled	R/W
				0	1 = Underload		
				0	2 = MWatts Over		
				0	3 = MWatts Under		
				0	4 = +MVAR Over		
				0	5 = +MVAR Unde		
				0	6 = -MVAR Over		
				0	7 = -MVAR Under		
				0	8 = MVA Under		
				0	9 = MVA Over		
				0	10 = Curr Imbal		
				0	11 = Jam		
				0	12 = Stall		
				0	13 = Starts/Hr		
				0	14 = PM Hours		
				0	15 = PM Starts		
				1	16 = Power Qual		
				1	17 = Open Load		
				0	18 = THD I		
				0	19 = Lead PF Un		
				0	20 = Lead PF Ov		
				0	21 = Lag PF Un		
				0	22 = Lag PF Ov		
				0	23 = Locked Rotor		

Table 151 - Parameter 231...241

No.	Name	Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
231	Motor Alarm En	—	0/ 16777215	0	0 = [Overload] 1 = Underload 2 = MWatts Over 3 = MWatts Under 4 = +MVAR Over 5 = +MVAR Unde 6 = -MVAR Over 7 = -MVAR Under 8 = MVA Under 9 = MVA Over 10 = Curr Imbal 11 = Jam 12 = Stall 13 = Starts/Hr 14 = PM Hours 15 = PM Starts 16 = Power Qual 17 = Open Load 18 = THD I 19 = Lead PF Un 20 = Lead PF Ov 21 = Lag PF Un 22 = Lag PF Ov 23 = Locked Rotor	Enables motor-related alarms that can be detected by the SMC-50 controller. All Disabled as Default. 0 = Fault Disabled 1 = Fault Enabled	R/W
232	+MVAR Ov F Lvl	MVAR	0.000/ 1000.000	0.000		Enters a value for the Consumed Reactive Power Over Fault Level (+MVAR Ov F Lvl). If the actual +MVAR value exceeds this level for a time that exceeds the value that is set in parameter 233 [+MVAR Ov F Dly], a fault is signaled.(1)	R/W
233	+MVAR Ov F Dly	Secs	0.1	0.1		Enters a time value for the +MVAR Over Fault delay. If the actual value of Consumed Reactive Power (+MVAR) exceeds that defined by parameter 232 [+MVAR OV F Lvl] for a time that exceeds this value, a fault is signaled.(1)	R/W
234	+MVAR Ov A Lvl	MVAR	0.000/ 1000.000	0.000		Enters a value for the Consumed Reactive Power Over Alarm Level (+MVAR OV A Lvl). If the actual +MVAR value exceeds this level for a time that exceeds parameter 235 [+MVAR Ov A Dly], an alarm is signaled.(1)	R/W
235	+MVAR Ov A Dly	Secs	0.1/99.0	0.1		Enters a time value for the +MVAR Over Alarm Delay (+MVAR Ov A Dly). If the actual value of Consumed Reactive Power (+MVAR) exceeds the value of parameter 234 [+MVAR Ov A Lvl] for a time that exceeds this value, an alarm is signaled. (1)	R/W
236	+MVAR Un F Lvl	MVAR	0.000/ 1000.000	0.000		Enters a value for the Consumed Reactive Power Under Fault Level (+MVAR Un F Lvl). If the actual +MVAR value is less than this level for a time that exceeds parameter 237 [+MVAR Un F Dly], a fault is signaled.(1)	R/W
237	+MVAR Un F Dly	Secs	0.1/99.0	0.1		Enters a time value for the +MVAR Under Fault delay. If the Consumed Reactive Power (+MVAR) is less than parameter 236 [+MVAR Un F Lvl] for a time that exceeds this value, a fault is signaled. (1)	R/W
238	+MVAR Un A Lvl	MVAR	0.000/ 1000.000	0.000		Enters a value for the Consumed Reactive Power Under Alarm Level (+MVAR Un A Lvl). If the actual value of Consumed Reactive Power (+MVAR) is less than this level for a time that exceeds the value of parameter 239 [+MVAR Un A Dly], an alarm is signaled.(1)	R/W
239	+MVAR Un A Dly	Secs	0.1/99.0	0.1		Enters a time for the +MVAR Under Alarm Delay (+MVAR Un A Dly). If the actual value of Consumed Reactive Power (+MVAR) is less than the value that is set in parameter 238 [+MVAR Un A Lvl] for a time that exceeds this value, an alarm is signaled. (1)	R/W
240	MVA Ov F Lvl	MVA	0.000/ 1000.000	0.000		Enters a value for the MVA Over Fault Level (MVA Ov F Lvl). If the actual value of Apparent Power (MVA) is greater than this level for a time that exceeds parameter 241 [MVA Ov F Dly], a fault is signaled. (1)	R/W
241	MVA Ov F Dly	Secs	0.1/99.0	0.1		Enters a time for the Apparent Power Over Fault Delay (MVA Ov F Dly). If the actual value of Apparent Power (MVA) exceeds that of parameter 240 [MVA Ov F Lvl] for a time that exceeds this value, a fault is signaled. (1)	R/W

(1) To implement an Alarm or Fault, you must also set the appropriate bit in parameter 230 [Motor Fault En] or parameter 231 [Motor Alarm En].

Table 152 - Parameter 242...259[1]

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
242	MVA Ov A Lvl	MVA	0.000/ 1000.000	0.00	Enters a value for the MVA Over Alarm Level (MVA Ov A Lvl). If the actual value of the Apparent Power (MVA) is greater than this level for a time that exceeds the value that is set in parameter 243 [MVA Ov A Dly], an alarm is signaled.[2]	R/W
243	MVA Ov A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Apparent Power Over Alarm Delay (MVA Ov A Dly). If the actual value of the Apparent Power (MVA) is greater than this level for a time that exceeds this value, an MVA Ov Alarm is signaled.[2]	R/W
244	MVA Un F Lvl	MVA	0.000/ 1000.000	0.00	Enters a value for the MVA Under Fault Level (MVA Un F Lvl). If the actual value of the Apparent Power (MVA) is less than this level for a time that exceeds the value that is set in parameter 245 [MVA Un F Dly], a fault is signaled.[2]	R/W
245	MVA Un F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Apparent Power Under Fault Delay (MVA Un F Dly). If the actual value of the Apparent Power (MVA) is less than the value that is set in parameter 244 [MVA Un F Lvl] for a time that exceeds this value, a fault is signaled.[2]	R/W
246	MVA Un A Lvl	MVA	0.000/ 1000.000	0.00	Enters a value for the MVA Under Alarm Level (MVA Un A Lvl). If the current value of the Apparent Power (MVA) is less than this value for a time that exceeds the value that is set in parameter 245 [MVA Un A Dly], an alarm is signaled.[2]	R/W
247	MVA Un A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Apparent Power Under Alarm Delay (MVA Un A Dly). If the actual value of the Apparent Power (MVA) is less than the value that is set in parameter 246 [MVA Un A Lvl] for a time that exceeds this value, an alarm is signaled.[2]	R/W
248	Lead PF Ov F Lvl	—	0.00/1.00	0.00	Enters a value for the Leading Power Factor Over Fault Level (Lead PF Ov F Lvl). If the actual Power Factor value is leading more than this value for a time that exceeds the value that is set in parameter 249 [Lead PF Ov F Dly], a fault is signaled. [2]	R/W
249	Lead PF Ov F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Leading Power Factor Over Fault Delay (Lead PF Ov F Dly). If the actual Power Factor value exceeds the value that is set in parameter 249 [Lead PF Ov F Lvl] for a time that exceeds Lead PF Ov F Dly, a fault is signaled. [2]	R/W
250	Lead PF Ov A Lvl	—	0.00/1.00	0.00	Enters a value for the Leading Power Factor Over Alarm Level (Lead PF Ov A Lvl). If the actual Power Factor value is leading more than this value for a period that exceeds the value that is set in parameter 249 [Lead PF Ov A Dly], an alarm is signaled.[2]	R/W
251	Lead PF Ov A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Leading Power Factor Over Alarm Delay (Lead PF Ov A Dly). If the actual Power Factor value is leading more than the value that is set in parameter 250 [Lead PF Ov A Lvl] for a period that exceeds this value, an alarm is signaled.[2]	R/W
252	Lead PF Un F Lvl	—	0.00/1.00	0.00	Enters a value for the Leading Power Factor Under Fault Level (Lead PF Un F Lvl). If the actual Power Factor value is leading less than this value for a time that exceeds the value that is set in parameter 253 [Lead PF Un F Dly], a Lead PD Un Fault is signaled.[2]	R/W
253	Lead PF Un F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Leading Power Factor Under Fault Delay (Lead PF Un F Dly). If the actual Power Factor value is leading less than the value that is set in parameter 252 [Lead PF Un F Lvl] for a time that exceeds this value, a Lead PD Un Fault is signaled. [2]	R/W
254	Lead PF Un A Lvl	—	0.00/1.00	0.00	Enters a value for the Leading Power Factor Under Alarm Level (Lead PF Un A Lvl). If the actual Power Factor value is leading less than this value for a time that exceeds the value that is set in parameter 255 [Lead PF Un A Dly], an alarm is signaled.[2]	R/W
255	Lead PF Un A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Leading Power Factor Under Alarm Delay (Lead PF Un A Dly). If the actual Power Factor value is leading less than the value that is set in parameter 254 [Lead PF Un A Lvl] for a time that exceeds this value, an alarm is signaled.[2]	R/W
256	Lag PF Ov F Lvl	—	-1.00/0.00	0.00	Enters a value for the Lagging Power Factor Over Fault Level (Lag PF Ov F Lvl). If the actual Power Factor value lags more than this value for a time that exceeds the value that is set in parameter 257 [Lag PF Ov F Dly], a Lag PF Ov Fault is signaled.[2]	R/W
257	Lag PF Ov F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Lagging Power Factor Over Fault Delay (Lag PF Ov F Dly). If the actual Power Factor value lags more than the value that is set in parameter 256 [Lag PF Ov F Lvl] for a time that exceeds this value, a Lag PF Ov Fault is signaled. [2]	R/W
258	Lag PF Ov A Lvl	—	-1.00/0.00	0.00	Enters a value for the Lagging Power Factor Over Alarm Level (Lag PF Ov A Lvl). If the actual Power Factor value lags more than this value for a time that exceeds the value that is set in parameter 259 [Lag PF Ov A Dly], an alarm is signaled. [2]	R/W
259	Lag PF Ov A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Lagging Power Factor Over Alarm Delay (Lag PF Ov A Dly). If the actual Power Factor value lags more than the value that is set in parameter 258 [Lag PF Ov A Lvl] for a time that exceeds this value, an alarm is signaled. [2]	R/W

(1) ENUM Text is not applicable for the parameters in this table.
(2) To implement an Alarm or Fault, you must also set the appropriate bit in parameter 230 [Motor Fault En] or parameter 231 [Motor Alarm En].

Table 153 - Parameter 260...273

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
260	Lag PF Un F Lvl	–	-1.00/0.00	0.00	Enters a value for the Lagging Power Factor Under Fault Level (Lag PF Un F Lvl). If the actual Power Factor value lags less than this value for a time that exceeds the value that is set in parameter 261 [Lag PF Un F Dly], a fault is signaled.(1)		R/W
261	Lag PF Un F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Lagging Power Factor Under Fault Delay (Lag PF Un F Dly). If the actual Power Factor value lags less than the value that is set in parameter 260 [Lag PF Un F Lvl] for a time that exceeds this value, a fault is signaled. (1)		R/W
262	Lag PF Un A Lvl	–	-1.00/0.00	0.00	Enters a value for the Lagging Power Factor Under Alarm Level (Lag PF Un A Lvl). If the actual Power Factor value lags less than this value for a time that exceeds the value that is set in parameter 263 [Lag PF Un A Dly], an alarm is signaled.(2)		R/W
263	Lag PF Un A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Lagging Power Factor Under Alarm Delay (Lag PF Un A Dly). If the actual Power Factor value lags less than the value that is set in parameter 262 [Lag PF Un A Lvl] for a period that exceeds this value, an alarm is signaled.(2)		R/W
264	Motor Restart En	–	0/16777215	0	0 = Overload 1 = Underload 2 = MWatts Over 3 = MWatts Under 4 = +MVAR Over 5 = +MVAR Unde 6 = -MVAR Over 7 = -MVAR Under 8 = MVA Under 9 = MVA Over 10 = Curr Imbal 11 = Jam 12 = Stall 13 = Starts/Hr 14 = PM Hours 15 = PM Starts 16 = Power Qual 17 = Open Load 18 = THD I 19 = Lead PF Un 20 = Lead PF Ov 21 = Lag PF Un 22 = Lag PF Ov 23 = Locked Rotor	Adjusts 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 signaled 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:** You must also configure parameter 133 [Restart Attempts] and parameter 134 [Restart Dly]. [All Disabled as Default]	R/W
265	Voltage Pn Ave	Volts	0/450	0	–	Displays the average of the sum of the three-phase voltages to neutral.	R
266	Voltage Phase A-N					Displays Phase A (L1) to neutral voltage.	
267	Voltage Phase B-N					Displays Phase B (L2) to neutral voltage.	
268	Voltage Phase C-N					Displays Phase C (L3) to neutral voltage.	
269	Real Power A	MW	-1000.000/ 1000.000	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					Displays the Real Power of the Phase B branch, which is equal to Phase B Voltage x Phase B Current x PF.	
271	Real Power C					Displays the real power of the Phase C branch, which is equal to Phase C Voltage x Phase C Current x PF.	
272	Real Demand	MW	-1000.000/ 1000.000	0.000	–	Displays Real Energy (MWH) averaged over a period that is defined by Demand Period.	R
273	Max Real Demand	MW	-1000.000/ 1000.000	0.000	–	Displays the Maximum energy demand recorded since the last energy meter reset.	R

(1) To implement an Alarm or Fault, you must also set the appropriate bit in parameter 230 [Motor Fault En] or parameter 231 [Motor Alarm En].

Table 154 - Parameter 274...302[1]

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
274	Reactive Power A	MVAR	-1000.000/ 1000.000	0.000	Displays the reactive power of the Phase A branch.	R
275	Reactive Power B				Displays the reactive power of the Phase B branch.	
276	Reactive Power C				Displays the reactive power of the Phase C branch.	
277	Reactive Power	MVAR	-1000.000/ 1000.000	0.000	Displays the total reactive power.	R
278	Reactive Energy C	MVRH	-1000.000/ 1000.000	0.000	Displays the reactive energy being consumed by the load.	R
279	Reactive Energy P				Displays the reactive energy being produced by the load.	
280	Reactive Energy				Displays the total reactive energy, which is equal to Reactive Power x time.	
281	Reactive Demand	MVAR	-1000.000/ 1000.000	0.000	Displays the Reactive Energy consumed or generated by the system over the Demand time.	R
282	Max Reactive Dmd	MVAR	-1000.000/ 1000.000	0.000	Displays the maximum reactive energy demand recorded since the energy meters were reset	R
283	Apparent Power A	MVA	-1000.000/ 1000.000	0.000	Displays the Apparent Power (VA) measured in the phase A branch.	R
284	Apparent Power B				Displays the VA measured in the phase B branch.	
285	Apparent Power C				Displays the VA measured in the phase C branch.	
286	Apparent Power	MVA	-1000.000/ 1000.000	0.000	Displays the total apparent power consumed (-) or produced (+) by the load.	R
287	Apparent Energy	MVAH	-1000.000/ 1000.000	0.000	Displays the Apparent Energy, which is equal to Apparent Power x Time.	R
288	Apparent Demand	MVA	-1000.000/ 1000.000	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	-1000.000/ 1000.000	0.000	Displays the maximum apparent demand recorded since energy meters were reset.	R
290	Demand Period	Mins	1/255	1	Enters the time that energy samples are taken to calculate demand.	R/W
291	Num of Periods	—	1/15	1	Enters the number of periods that energy measurements are taken in calculating demand.	R/W
292	Power Factor A	—	-1.00/1.00	0.00	Displays the power factor in the Phase A branch of the load circuit.	R
293	Power Factor B				Displays the power factor in the Phase B branch of the load circuit.	
294	Power Factor C				Displays the power factor in the Phase C branch of the load circuit.	
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 voltage of three voltages).	R
297	-MVAR Ov F Lvl	MVAR	-1000.000/ 0.000	0.000	Enters a value for the Generated Reactive Power Over Fault Level (-MVAR Ov F Lvl). If the actual value for Generated Reactive Power is more than this level for a period that exceeds the value that is set in parameter 298 [-MVAR Ov F Dly], a fault is signaled.[2]	R/W
298	-MVAR Ov F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Generated Reactive Power Over Fault Delay (-MVAR Ov F Dly). If the actual value for the Generated Reactive Power exceeds the value that is set in parameter 297 [-MVAR Ov F Lvl] for a time that exceeds this value, a fault is signaled.[2]	R/W
299	-MVAR Ov A Lvl	MVAR	-1000.000/ 0.000	0.000	Enters a value for the Generated Reactive Power Over Alarm Level (-MVAR Ov A Lvl). If the actual value for Generated Reactive Power is more than this value for a period that exceeds the value that is set in parameter 300 [-MVAR Ov A Dly], an alarm is signaled. [2]	R/W
300	-MVAR Ov A Dly	Secs	0.1/99.0	0.1	Enters a time value for the Generated Reactive Power Over Alarm Delay (-MVAR Ov A Dly). If the actual value for the Generated Reactive Power exceeds the value that is set in parameter 299 [-MVAR Ov A Lvl] for a period that exceeds this value, an alarm is signaled.[2]	R/W
301	-MVAR Un F Lvl	MVAR	-1000.000/ 0.000	0.000	Enters a value for the Generated Reactive Power Under Fault Level (-MVAR Un F Lvl). If the actual value for Generated Reactive Power is less than this value for a period that exceeds the value that is set in parameter 302 [-MVAR Un F Dly], a fault is signaled. [2]	R/W
302	-MVAR Un F Dly	Secs	0.1/99.0	0.1	Enters a time value for the Generated Reactive Power Under Fault Delay (-MVAR Un F Dly). If the actual value for Generated Reactive Power is less than the value that is set in parameter 301 [-MVAR Un F Lvl] for a period that exceeds this level, a fault is signaled. [2]	R/W

(1) ENUM Text is not applicable for the parameters in this table.
(2) To implement an Alarm or Fault, you must also set the appropriate bit in parameter 230 [Motor Fault En] or parameter 231 [Motor Alarm En].

Table 155 - Parameter 303...311

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
303	-MVAR Un A Lvl	MVAR	-1000.000/ 0.000	0.000	–	Enters a value for the Generated Reactive Power Under Alarm Level (-MVAR Un A Lvl). If the actual value for Generated Reactive Power is less than this value for a period that exceeds parameter 304 [-MVAR Un A Dly], an alarm is signaled. (1)	R/W
304	-MVAR Un A Dly	Secs	0.1/99.0	0.1	–	Enters a time value for the Generated Reactive Power Under Alarm Delay (-MVAR Un A Dly). If the actual value for Generated Reactive Power is less than parameter 303 [-MVAR Un A Lvl] for a period that exceeds this value, an alarm is signaled.(1)	R/W
305	Starting Torque	%	0/300	100	–	Enters Starting Torque value that is required for a torque start operation.	R/W
306	Starting Torque 2				–	Enters an alternate Starting Torque value that is required for a torque start operation.	
307	SS Ref Gain	–	0.10/2.00	1.00	–	Enters Slow Speed Reference Gain (SS Ref Gain) value that is used to adjust slow speed operation.(2)	R/W
308	SS Trans Gain				–	Enters Slow Speed Transfer Gain (SS Trans Gain) value that is used to adjust slow speed operation.(2)	
309	Input Status	–	0/65535	0	Displays the status of all digital inputs for the SMC-50 controller.		R
					Input 1	Bit 0 - Displays status of Control Module Input #1.	
					Input 2	Bit 1 - Displays status of Control Module Input #2.	
					Input 7-1	Bit 2 - Displays status of Control Module Port 7, 150-SM4 Option Module Input #1.	
					Input 7-2	Bit 3 - Displays status of Control Module Port 7, 150-SM4 Option Module Input #2.	
					Input 7-3	Bit 4- Displays status of Control Module Port 7, 150-SM4 Option Module Input #3.	
					Input 7-4	Bit 5- Displays status of Control Module Port 7, 150-SM4 Option Module Input #4.	
					Input 8-1	Bit 6 - Displays status of Control Module Port 8, 150-SM4 Option Module Input #1.	
					Input 8-2	Bit 7- Displays status of Control Module Port 8, 150-SM4 Option Module Input #2.	
					Input 8-3	Bit 8- Displays status of Control Module Port 8, 150-SM4 Option Module Input #3.	
					Input 8-4	Bit 9- Displays status of Control Module Port 8, 150-SM4 Option Module Input #4.	
					Input 9-1	Bit 10 - Displays status of Control Module Port 9, 150-SM4 Option Module Input #1.	
					Input 9-2	Bit 11 - Displays status of Control Module Port 9, 150-SM4 Option Module Input #2.	
					Input 9-3	Bit 12 - Displays status of Control Module Port 9, 150-SM4 Option Module Input #3.	
					Input 9-4	Bit 13 - Displays status of Control Module Port 9, 150-SM4 Option Module Input #4.	
					–	Bit 14 and 15 - Reserved.	
310	Locked Rotor A Lvl	%FLC	400/1000	600	–	Enters 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 parameter 311 [Locked Rtr A Dly] signals a fault.(1)	R/W
311	Locked Rotor A Dly	Secs	0.1/100.0	0.1	–	The time that the peak phase current exceeds the value that is set in parameter 310 [Locked Rotor A Lvl] to signal a fault.(1)	R/W

(1) To implement an Alarm or Fault, you must also set the appropriate bit in parameter 230 [Motor Fault En] or parameter 231 [Motor Alarm En].
(2) This parameter is rarely adjusted. Contact Rockwell Automation Technical Support for further information.

Table 156 - Parameters 312...322

No.	Name	Units	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
312	Product Command	–	0/65535	0	Displays an image of the DPI product command required for DPI communications.		R
					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	
					Slow Speed	1 – Run at Slow Speed 0 – No Action	
					Emer Run	1 – Enable Emergency Run Mode 0 – Disable Emergency Run Mode	
					Motor Heater	1 – Enable Motor Winding Heater 0 – Disable Motor Winding Heater	
					Reserved	0	
					Reserved	0	
					Reserved	0	
					Reserved	0	
					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”	
313	Rebalance Level	%	0/100	0	–	The percentage of motor current imbalance above which the SMC-50 controller rebalances the motor current	R/W
314	Va Peak	Volt	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	Volt	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	Volt	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	Volt	0/700	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	Volt	0/700	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	Volt	0/700	0	–	Snapshot of the Phase C-A voltage when a fault occurs. The value is overwritten if a subsequent fault occurs.	R

Table 157 - Parameter 323...333[1]

No.	Name	Units	Min/Max Values	Default Value	Description	Read/ write Access
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	—	-1.00/1.00	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	%	0.0/ 1000.0	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	%	0.0/ 1000.0	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	Snapshot of the product status when a fault occurs. The value is overwritten if a subsequent fault occurs. Bit 0 = Enabled Bit 1 = Running Bit 2 = Phasing Bit 3 = Phase Active Bit 4 = Starting Bit 5 = Stopping Bit 6 = Alarm Bit 7 = Fault Bit 8 = At Speed Bit 9 = Start Bit 10 = Bypass Bit 11 = Ready Bit 12 = DeviceLogix Bit 13 = Reserved Bit 14 = Input 1 Bit 15 = Input 2	R
332	SSBoard Temp	degC	-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

(1) ENUM Text is not applicable for the parameters in this table.

Table 158 - Parameter 334...346[1]

No.	Name	Units	Min/Max Values	Default Value	Enum Text [Default]	Description	Read/ write Access
334	Restart Auto	—	—	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	—	-2147483648... 2147483647	0	—	General-purpose parameter that is used as an input to the DeviceLogix Engine.	R/W
336	DLX Input 2	—	-2147483648... 2147483647	0	—		R/W
337	DLX DL Input 1	—	0 / 159999	1	—	General-purpose Datalinks used to select another parameter within the SMC-50 controller as an input to the DeviceLogix Engine.	R/W
338	DLX DL Input 2	—	0 / 159999	1	—		R/W
339	DLX DL Input 3	—	0 / 159999	1	—		R/W
340	DLX DL Input 4	—	0 / 159999	1	—		R/W
341	DLX DL Input 5	—	0 / 159999	1	—		R/W
342	DLX DL Input 6	—	0 / 159999	1	—		R/W
343	DLX Output 1	—	-2147483648... 2147483647	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	—	-2147483648... 2147483647	0	—		R
345	DLX Command	—	—	—	Ready Enable Disable	Lets you enable or disable the DeviceLogix engine. After the "Enable" or "Disable" command has been executed, the parameter automatically reverts to "Ready".	R/W
346	DLX Status	—	—	—	Enable Disable	Indicates the current state of the DeviceLogix engine.	R
347	Load Type	—	0/1	0	Allows choice of Motor Load or Resistive Heater Load		R/W
					[Motor]	Motor Load	
					Resistive	Resistive Heater Load	
348	Ref Source	--	0/8	0	Allows selection of Source for Resistive Heater Output Voltage		R/W
					[Output V Ref]	Output Voltage Reference Parameter	
					P7 In1	Analog Input #1 from 150-SM3 option module in Expansion Port 7	
					P7 In2	Analog Input #2 from 150-SM3 option module in Expansion Port 7	
					P8 In1	Analog Input #1 from 150-SM3 option module in Expansion Port 8	
					P8 In2	Analog Input #2 from 150-SM3 option module in Expansion Port 8	
					P9 In1	Analog Input #1 from 150-SM3 option module in Expansion Port 9	
					P9 In2	Analog Input #2 from 150-SM3 option module in Expansion Port 9	
					DLX Output 1	DeviceLogix Output #1	
					DLX Output 2	DeviceLogix Output #2	
349	Output V Ref	%	1/100	1	—	Parameter that can be set from 1...100% output voltage for Resistive Heating Mode.	R/W
350	Slow Speed 2	%	-15 / +15	+10	—	Lets you program a second Slow Speed Reference	R/W

(1) Unit data is not valid for the parameters in this table.

150-SM6 PCM Information

Table 159 - Parameter X.1...X.9 (1)

No.(2)	Name	Min/Max Values	Default Value	Enum Text	Description	Read/ write Access
X.1	Module Status	0/1	1	–	Displays information about the operational status of the 150-SMB Parameter Configuration Option I/O Module.	R
				Ready	Bit 0 - Ready; Bit Set = 1 indicates that the module is ready for operation.	R
X.2	Rotary Switch 1	0/15	0	–	Displays the numeric position of Rotary Switch 1 = Initial Torque	R
X.3	Rotary Switch 2	0/15	0	–	Displays the numeric position of Rotary Switch 2 = Current Limit.	R
X.4	Rotary Switch 3	0/15	0	–	Displays the numeric position of Rotary Switch 3 = Ramp Time.	R
X.5	Rotary Switch 4	0/15	0	–	Displays the numeric position of Rotary Switch 4 = Stop Time.	R
X.6	Rotary Switch 5	0/15	0	–	Displays the numeric position of Rotary Switch 5 = Motor FLC.	R
X.7	Device Config	0/255	0	–	Displays the Device Config DIP switch bit status (1=Sw ON and 2=Sw OFF).	R
X.8	Protect Config	0/255	0	–	Displays the Protect Config DIP switch bit status (1=Sw ON and 2=Sw OFF).	R
X.9	IO Config	0/255	0	–	Displays the IO Config DIP switch bit status (1=Sw ON and 2=Sw OFF).	R

(1) Unit data is not valid for the parameters in this table.
(2) X indicates the Control Module port number in which the 150-SM6 Option Module is installed. Allowable ports = 7, 8, or 9.

150-SM4 Digital I/O Module Information

Table 160 - Parameter X.1...X.18

No.(1)	Name	Min/Max Values	Default Value	Units	Enum Text [Default]	Description	Read/ write Access
X.1	Module Status	0/256	0	–	Displays information about the operational status of the 150-SM4 Digital I/O Option Module.		R
					Ready	Bit 0 = Ready; Bit Set = indicates that the module is ready for operation.	
					Input 1	Bit 1 = Input 1; Bit Set (1) indicates that the input is ON.	
					Input 2	Bit 2 = Input 2; Bit Set (1) indicates that the input is ON.	
					Input 3	Bit 3 = Input 3; Bit Set (1) indicates that the input is ON.	
					Input 4	Bit 4 = Input 4; Bit Set (1) indicates that the input is ON.	
					Aux 1	Bit 5 = Aux 1; Bit Set (1) indicates that the auxiliary relay output is ON.	
					Aux 2	Bit 6 = Aux 2; Bit Set (1) indicates that the auxiliary relay output is ON.	
					Aux 3	Bit 7 = Aux 3; Bit Set (1) indicates that the auxiliary relay output is ON.	
					Bit 8...15 Spare	Bit 8...15 Spare	

Table 160 - Parameter X.1...X.18 (Continued)

No.[1]	Name	Min/Max Values	Default Value	Units	Enum Text [Default]	Description	Read/ write Access
X.2	Input 1	0/13	0	–	Selects the operation of Input Terminal A1, Option Input 1 on the 150-SM4 Digital I/O Option Module.		R/W
					[Disable]	Disable the input; ignores any assertion to Input Terminal A1 (High).	
					Start	Initiate a start as configured by the start parameters at Input Terminal A1.	
					Coast	Initiates a coast stop; no current to motor at Input Terminal A1 (Low).	
					Stop Option	Initiates a stop maneuver as configured by the stopping parameters at Input Terminal A1 (Low).	
					Start/Coast	If Input Terminal A1 = 0, stops motor; 1 initiates a start as configured by the start parameters.	
					Start/Stop	If Input Terminal A1 = 0, initiates a stop maneuver as configured by stopping parameters; 1 initiates a start as configured by the start parameters.	
					Slow Speed 1	Runs motor in slow speed mode 1 as configured by slow speed 1 parameters (High).	
					Slow Speed 2	Runs motor in slow speed mode 2 as configured by slow speed 2 parameters (High).	
					Dual Ramp	If Input Terminal A1 = 0, use starting mode 1; if Input Terminal A1 = 1, use starting mode 2.	
					OL Select	If Input Terminal A1 = 0, use Motor Overload Class 1; if Input Terminal A1 = 1, use Motor Overload Class 2.	
					Fault	A fault condition is forced if Input Terminal A1 = 1.	
					Fault NC	A fault condition is forced if Input Terminal A1 = 0.	
					Clear Fault	Clear a fault from Input Terminal A1 (High).	
					Emerg Run	Allow the motor to run in emergency run mode if asserted from Input Terminal A1; does not start motor (High).	
					Motor Heater	Runs motor heating algorithm if asserted at Input Terminal A1 (High).	
X.3	Input 2	0/13	0	–	Lets you select the operation of Input Terminal A2, Option Input 2 on the 150-SM4 Digital I/O Option Module.		R/W
					[Disable]	Disable the input; ignores any assertion to Input A2 Terminal.	
					Start	Initiate a start as configured by the start parameters at Input Terminal A2 (High).	
					Coast	Initiates a coast stop; no current to motor at Input Terminal A2 (Low).	
					Stop Option	Initiates a stop maneuver as configured by the stopping parameters at Input Terminal A2 (High).	
					Start/Coast	If Input Terminal A2 = 0 stops motor, if Input Terminal A2 = 1 initiates a start as configured by the start parameters.	
					Start/Stop	If Input Terminal A2 = 0 initiates a stop maneuver as configured by stopping parameters, if Input Terminal A2= 1 initiates a start as configured by the start parameters.	
					Slow Speed 1	Runs motor in slow speed mode 1 as configured by slow speed 1 parameters (High).	
					Slow Speed 2	Runs motor in slow speed mode 2 as configured by slow speed 2 parameters (High).	
					Dual Ramp	If Input Terminal A2 = 0, use starting mode 1; if Input Terminal A2= 1, use starting mode 2.	
					OL Select	If Input Terminal A2 = 0, use Motor Overload Class 1; if Input Terminal A2= 1, use Motor Overload Class 2.	
					Fault	A fault condition is forced if Input Terminal A2 = 1.	
					Fault NC	A fault condition is forced if Input Terminal A2 = 0.	
					Clear Fault	Clear a fault from Input Terminal A2 (High).	
					Emerg Run	Allow the motor to run in emergency run mode if asserted from Input Terminal A2; does not start motor (High).	
					Motor Heater	Runs motor heating algorithm if asserted at Input Terminal A2 (High).	

Table 160 - Parameter X.1...X.18 (Continued)

No.[1]	Name	Min/Max Values	Default Value	Units	Enum Text [Default]	Description	Read/ write Access
X.4	Input 3	0/13	0	–	Lets you select the operation of Input Terminal A3, Option Input 3 on the 150-SM4 Digital I/O Option Module.		R/W
					[Disable]	Disable the input; ignores any assertion to Input A3 Terminal.	
					Start	Initiate a start as configured by the start parameters at Input Terminal A3 (High).	
					Coast	Initiates a coast stop; no current to motor at Input Terminal A3 (Low).	
					Stop Option	Initiates a stop maneuver as configured by the stopping parameters at Input Terminal A3 (Low).	
					Start/Coast	If Input Terminal A3 = 0 stops motor, if Input Terminal A3 = 1 initiates a start as configured by the start parameters.	
					Start/Stop	If Input Terminal A3 = 0 initiates a stop maneuver as configured by stopping parameters, if Input Terminal A3 = 1 initiates a start as configured by the start parameters.	
					Slow Speed 1	Runs motor in slow speed mode 1 as configured by slow speed 1 parameters (High).	
					Slow Speed 2	Runs motor in slow speed mode 2 as configured by slow speed 2 parameters (High).	
					Dual Ramp	If Input Terminal A3 = 0, use starting mode 1; if Input Terminal A3 = 1, use starting mode 2.	
					OL Select	If Input Terminal A3 = 0, use Motor Overload Class 1; if Input Terminal A3 = 1, use Motor Overload Class 2.	
					Fault	A fault condition is forced if Input Terminal A3 = 1.	
					Fault NC	A fault condition is forced if Input Terminal A3 = 0.	
					Clear Fault	Clear a fault from Input Terminal A3 (High).	
					Emerg Run	Allow the motor to run in emergency run mode if asserted from Input Terminal A3; does not start motor (High).	
					Motor Heater	Runs motor heating algorithm if asserted at Input Terminal A3 (High).	
X.5	Input 4	0/13	0	–	Lets you select the operation of Input Terminal A4, Option Input 4 on the 150-SM4 Digital I/O Option Module.		R/W
					[Disable]	Disable the input; ignores any assertion to Input A4 Terminal.	
					Start	Initiate a start as configured by the start parameters at Input Terminal A4 (High).	
					Coast	Initiates a coast stop; no current to motor at Input Terminal A4 (Low).	
					Stop Option	Initiates a stop maneuver as configured by the stopping parameters at Input Terminal A4.	
					Start/Coast	If Input Terminal A4 = 0 stops motor, if Input Terminal A4 = 1 initiates a start as configured by the start parameters.	
					Start/Stop	If Input Terminal A4 = 0 initiates a stop maneuver as configured by stopping parameters, if Input Terminal A4 = 1 initiates a start as set up by the start parameters.	
					Slow Speed 1	Runs motor in slow speed mode 1 as configured by slow speed 1 parameters (High).	
					Slow Speed 2	Runs motor in slow speed mode 2 as configured by slow speed 2 parameters (High).	
					Dual Ramp	If Input Terminal A4 = 0, use starting mode 1; if Input Terminal A4 = 1, use starting mode 2.	
					OL Select	If Input Terminal A4 = 0, use Motor Overload Class 1; if Input Terminal A4 = 1, use Motor Overload Class 2.	
					Fault	A fault condition is forced if Input Terminal A4 = 1.	
					Fault NC	A fault condition is forced if Input Terminal A4 = 0.	
					Clear Fault	Clear a fault from Input Terminal A4 (High).	
					Emerg Run	Allow the motor to run in emergency run mode if asserted from Input Terminal A4; does not start motor (High).	
					Motor Heater	Runs motor heating algorithm if asserted at Input Terminal A4 (Low).	

Table 160 - Parameter X.1...X.18 (Continued)

No.[1]	Name	Min/Max Values	Default Value	Units	Enum Text [Default]	Description	Read/ write Access
X.6	Aux1 Config	0/12	0	–	Configures the functionality of the Aux1 Relay Output on the 150-SM4 Digital I/O Option Module.		R/W
					[Normal]	Aux1 closes when start asserted, opens when motor stops.	
					Up-to-Speed	Aux1 closes when motor reaches up-to-speed and opens when the motor is not at speed.	
					Fault	Aux1 closes when the SMC-50 controller enters a fault state and opens when the fault is cleared.	
					Alarm	Aux1 closes when the SMC-50 controller detects an alarm condition and opens when the alarm is cleared.	
					Ext Bypass	Aux1 closes when the SMC-50 controller enters the external bypass mode and opens when it leaves that mode (SCR Control).	
					Ext Brake	Aux1 closes when the external braking command is active and opens when it is not active.	
					DeviceLogix	Aux1 is controlled by the DeviceLogix program.	
					Aux Control	When an auxiliary output is configured for Aux Control, a bit within the parameter Aux Control controls the state of the auxiliary.	
					Network 1	With an auxiliary configured as Network 1, it is controlled over the 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 3, it is controlled over the LAN as Relay 3.	
					Network 4	With an auxiliary configured as Network 4, it is controlled over the LAN as Relay 4.	
					Fan Control	Used to control fans.Fan is turned on when the motor is running or the estimated SCR temperature is above 50 °C	
X.7	Aux1 Invert	0/1	0	–	Inverts the logic of the Aux1 output. When disabled, it is a N.O. relay output contact when de-energized. By enabling the invert function, the relay contact becomes a N.C. contact when de-energized.		R/W
					[Disable]	Aux1 Relay Output is not inverted (N.O.).	
					Enable	Aux1 Relay Output is inverted (N.C.)[2].	
X.8	Aux1 On Delay	0.0/10.0	0.0	Secs	–	A user-selected time delay in activating the Aux1 Relay Contact.	R/W
X.9	Aux1 Off Delay	0.0/10.0	0.0	Secs	–	A user-selected time delay in de-activating the Aux1 Relay Contact.	R/W
X.10	Aux2 Config	0/12	0	–	Configures the functionality of the Aux2 Relay Output on the 150-SM4 Digital I/O Option Module.		R/W
					[Normal]	Aux2 closes when start asserted, opens when motor stops.	
					Up-to-Speed	Aux2 closes when motor reaches up-to-speed and opens when the motor is not at speed.	
					Fault	Aux2 closes when the SMC-50 controller enters a fault state and opens when the fault is cleared.	
					Alarm	Aux2 closes when the SMC-50 controller detects an alarm condition and opens when the alarm is cleared.	
					Ext Bypass	Aux2 closes when the SMC-50 controller enters the external bypass mode and opens when it leaves that mode (SCR Control).	
					Ext Brake	Aux2 closes when the external braking command is active and opens when it is not active.	
					DeviceLogix	Aux2 is controlled by the DeviceLogix program	
					Aux Control	When an auxiliary output is configured for Aux Control, a bit within the parameter Aux Control controls the state of the auxiliary.	
					Network 1	With an auxiliary configured as Network 1, it is controlled over the 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 3, it is controlled over the LAN as Relay 3.	
					Network 4	With an auxiliary configured as Network 4, it is controlled over the LAN as Relay 4.	
					Fan Control	Used to control fans.Fan is turned on when the motor is running or the estimated SCR temperature is above 50 °C	
X.11	Aux2 Invert	0/1	0	–	Inverts 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.		R/W
					[Disable]	Aux2 Relay Output is not inverted (N.O.).	
					Enable	Aux2 Relay Output is inverted (N.C.).	
X.12	Aux2 On Delay	0.0/10.0	0.0	Secs	–	A user-selected time delay in activating the Aux2 Relay Contact.	R/W

Table 160 - Parameter X.1...X.18 (Continued)

No.[1]	Name	Min/Max Values	Default Value	Units	Enum Text [Default]	Description	Read/ write Access
X.13	Aux2 Off Delay	0.0/10.0	0.0	Secs	–	A user-selected time delay in de-activating the Aux2 Relay Contact.	R/W
X.14	Aux3 Config	0/12	0	–	Configures the functionality of the Aux3 Relay Output on the 150-SM4 Digital I/O Option Module.		R/W
					[Normal]	Aux3 closes when start asserted, opens when motor stops.	
					Up-to-Speed	Aux3 closes when motor reaches Up-to-Speed and opens when the motor is not at speed.	
					Fault	Aux3 closes when the SMC-50 controller enters a fault state and opens when the fault is cleared.	
					Alarm	Aux3 closes when the SMC-50 controller detects an alarm condition and opens when the alarm is cleared.	
					Ext Bypass	Aux3 closes when the SMC-50 controller enters the external bypass mode and opens when it leaves that mode (SCR Control).	
					Ext Brake	Aux3 closes when the external braking command is active and opens when it is not active.	
					DeviceLogix	Aux3 is controlled by the DeviceLogix program	
					Aux Control	When an auxiliary output is configured for Aux Control, a bit within the parameter Aux Control controls the state of the auxiliary.	
					Network 1	With an auxiliary configured as Network 1, it is controlled over the 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 3, it is controlled over the LAN as Relay 3.	
					Network 4	With an auxiliary configured as Network 4, it is controlled over the LAN as Relay 4.	
					Fan Control	Used to control fans.Fan is turned on when the motor is running or the estimated SCR temperature is above 50 °C	
X.15	Aux3 Invert	0/1	0	–	Iinverts 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.		R/W
					[Disable]	Aux3 Relay Output is not inverted (N.O.).	
					Enable	Aux3 Relay Output is inverted (N.C.)[2].	
X.16	Aux3 On Delay	0.0/10.0	0.0	Secs	–	A user-selected time delay in activating the Aux3 Relay Contact.	R/W
X.17	Aux3 Off Delay	0.0/10.0	0.0	Secs	–	A user-selected time delay in de-activating the Aux3 Relay Contact.	R/W
X.18	Parameter Management	0/1	0	–	Lets you set all 150-SM4 Digital I/O Option Module parameters to default values.		R/W
					[Ready]	Waiting for command to set defaults.	
					Factory Default	Set all writable parameters to factory default values.	

(1) X indicates the Control Module port number in which the 150-SM4 Option Module is installed. Allowable ports = 7, 8, or 9.
(2) N.C. is electrically held closed.

150-SM2 Ground Fault Module Information

Table 161 - Parameter X.1...X.19

No.(1)	Name	Min/Max Values	Default Value	Units	Enum Text	Description	Read/ write Access
X.1	Module Status	0/7	7	–	Displays information about the operational status of the 150-SM2 PTC, Ground Fault, and External Current Transformer (CT) Option Module.		R
					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	
X.2	Fault Enable	0/3	0	–	PTC	0 = PTC Fault Disabled; 1 = PTC Fault Enabled	R/W
					Ground Fault	0 = Ground Fault Disabled; 1 = Ground Fault Enabled	
x.3	Alarm Enable	0/3	0	–	PTC	0 = PTC Alarm Disabled; 1 = PTC Alarm Enabled	R/W
					Ground Fault	0 = Ground Fault Alarm Disabled; 1 = Ground Fault Alarm Enabled	
X.4	Restart Enable	0/3	0	–	PTC	0 = does not restart after PTC Fault is cleared; 1 = restart after PTC Fault is cleared	R/W
					Ground Fault	0 = does not restart after the Ground Fault is cleared; 1 = restart after the Ground Fault is cleared	
X.5	Turns Ratio	100/2000	1000	:1	–	Lets you configure the turns ratio for the CT being used.	R/W
X.6	Gnd Flt Level	0.00/5.00	2.50	Amps	–	Lets you configure the level (value) of ground current that determines a ground fault condition.	R/W
X.7	Gnd Flt Delay	0.1/250.0	0.5	Secs	–	Sets the time limit that the ground fault level must be exceeded before signaling a fault.	R/W
X.8	Gnd Flt A Level	0.00/5.00	2.50	Amps	–	Sets the level of ground current that determines a ground fault alarm condition.	R/W
X.9	Gnd Flt A Delay	0.1/250.0	0.5	Secs	–	Sets the time limit that the ground fault level must be exceeded before signaling an alarm.	R/W
X.10	Gnd Flt Inh Time	0.0/250.0	10.0	Secs	–	User configurable time delay to inhibit ground fault after a start.	R/W
X.11	Ground Current	0.00/5.00	0.00	Amps	–	Measured ground current.	R/W
X.12	CT Enable	0/1	0	–	Disable	Disables the CT function.	R/W
					Enable	Enables the CT function.	
X.13	CT Scaling A	0.00/5.00	0.01	–	–	Displayed result of the SMC-50 controller tuning feature determination of the scaling between external CT and the internal current measuring circuitry.	R
X.14	CT Scaling B						
X.15	CT Scaling C						
X.16	Phase Shift A	-12.5/12.5	0.00	Deg	–	Displayed result of the SMC-50 controller tuning feature determination of the phase shift between external CT and the internal current measuring circuitry.	R
X.17	Phase Shift B						
X.18	Phase Shift C						
X.19	Parameter Mgmt	0/1	0	–	Ready	Waiting for command to set defaults.	R/W
					Factory Default	Set all writable parameters to factory default values.	

(1) X indicates the Control Module port number in which the 150-SM2 PTC, Ground Fault, and External CT Option Module is installed. Allowable ports = 7 or 8.

150-SM3 Analog I/O Module Information

Table 162 - Parameter X.1...X.7

No.(1)	Name	Min/Max Values	Default Value	Units	Enum Text	Description	Read/ write Access
X.1	Module Status	0/4096	0	–	Displays information about the operational status of the 150-SM3 Analog I/O Option Module		R
					Ready	Bit 0 = Ready Bit Set = indicates the module is ready for operation	
					In1 Over Flt	Bit 1 = Input 1 Over Fault Bit Set = Input 1 Overrange fault	
					In1 Over Alm	Bit 2 = Input 1 Over Alarm Bit Set = Input 1 Overrange alarm	
					In1 Undr Flt	Bit 3 = Input 1 Under Fault Bit Set = Input 1 Underrange fault	
					In1 Undr Alm	Bit 4 = Input 1 Under Alarm Bit Set = Input 1 Underrange Alarm	
					In2 Over Flt	Bit 5 = Input 2 Over Fault Bit Set = Input 2 Overrange fault	
					In2 Over Alm	Bit 6 = Input 2 Over Alarm Bit Set = Input 2 Overrange alarm	
					In2 Undr Flt	Bit 7 = Input 2 Under Fault Bit Set = Input 2 Underrange fault	
					In2 Undr Alm	Bit 8 = Input 2 Under Alarm Bit Set = Input 2 Underrange Alarm	
					Out 1 Shorted	Bit 9 = Output 1 Shorted Bit Set = indicates Output 1 is shorted	
					Out 1 Open	Bit 10 = Output 1 Open Bit Set = indicates Output 1 is an open circuit	
					Out 2 Shorted	Bit 11 = Output 2 Shorted Bit Set = indicates Output 2 is shorted	
					Out 2 Open	Bit 12 = Output 2 Open Bit Set = indicates Output 2 is an open circuit	
					Bits 13...15	Reserved	
X.2	Sample Rate	0/1	0	–	60 Hz	Selects a 60 Hz filter on Input 1 and Input 2	R/W
					250 Hz	Selects a 250 Hz filter on Input 1 and Input 2	
X.3	Input 1 Scaled	-3000.0/ 3000.0	0.0	–	–	Input 1 scaled to user units	R
X.4	Input 1 Analog	-21.000/ 21.000	0.000	V or mA	–	Input 1 in electrical units (Volts or mA)	R
X.5	Input 1 Percent	-105.00/105.00	0.00	–	–	Input 1 as a percentage of configured range	R
X.6	Input 1 Raw	-32768/32768	0	–	–	Input 1 unscaled	R
X.7	Input 1 Range	0/5	1	–	±10V	Input 1 set to voltage mode with range of -10...+10V	R/W
					10V	Input 1 set to voltage mode with range of 0...10V	
					5V	Input 1 set to voltage mode with range of 0...5V	
					1...5V	Input 1 set to voltage mode with range of 1...5V	
					0...20 mA	Input 1 set to current mode with range of 0...20 mA	
					4...20 mA	Input 1 set to current mode with range of 4...20 mA	

(1) X indicates the Control Module port number in which the Cat. No. 150-SM3 Analog I/O option module is installed. Allowable ports = 7 or 8.

Table 163 - Parameter X.8...X.30

No.(1)	Name	Min/Max Values	Default Value	Units	Enum Text	Description	Read/ write Access
X.8	Input 1 Offset	-10000/10000	0	–	–	Offset value of Input 1 subtracted from the value of parameter X.6 [Input 1 Raw] (positive offset lowers the resulting value).	R/W
X.9	Input 1 Data Hi	-3000.0/3000.0	1000.0	–	–	User-defined maximum value of Input 1 custom value range	R/W
X.10	Input 1 Data Lo	-3000.0/3000.0	0.0	–	–	User-defined minimum value of Input 1 custom value range	R/W
X.11	Input 1 High	-21.000/21.000	10.000	V or mA	–	Correlates parameter X.9 [Input 1 Data Hi] to the value of parameter X.6 [Input 1 Raw].	R/W
X.12	Input 1 Low	-21.000/21.000	0.000	V or mA	–	Correlates parameter X.10 [Input 1 Data Lo] to the value of parameter X.6 [Input 1 Raw].	R/W
X.13	Input 2 Scaled	-3000.0/3000.0	0.0	–	–	Input 2 scaled to user units	R
X.14	Input 2 Analog	-21.000/21.000	0.000	V or mA	–	Input 2 in electrical units (V or mA)	R
X.15	Input 2 Percent	-105.00/105.00	0.00	–	–	Input 2 as a percentage of configured range	R
X.16	Input 2 Raw	-32768/32768	0	–	–	Input 2 unscaled	R
X.17	Input 2 Range	0/5	1	–	±10V	Input 2 set to voltage mode with range of -10...+10V	R/W
					10V	Input 2 set to voltage mode with range of 0...10V	
					5V	Input 2 set to voltage mode with range of 0...5V	
					1...5V	Input 2 set to voltage mode with range of 1...5V	
					0...20 mA	Input 2 set to current mode with range of 0...20 mA	
					4...20 mA	Input 2 set to current mode with range of 4...20 mA	
X.18	Input 2 Offset	-10000/10000	0	–	–	Offset value of Input 2 subtracted from the Input 2 Raw value. Positive offset lowers the resulting value.	R/W
X.19	Input 2 Data Hi	-3000.0/3000.0	1000.0	–	–	User defined maximum value of Input 2 custom value range	R/W
X.20	Input 2 Data Lo	-3000.0/3000.0	0.0	–	–	User defined minimum value of Input 2 custom value range	R/W
X.21	Input 2 High	-21.000/21.000	10.000	V or mA	–	Correlates Input 2 Data Hi to the Input 2 Raw value	R/W
X.22	Input 2 Low	-21.000/21.000	0.000	V or mA	–	Correlates Input 2 Data Low to the Input 2 Raw value	R/W
X.23	Output 1 Range	0/4	1	–	±10V	Output 1 set to voltage mode with range of -10...+10V	R/W
					10V	Output 1 set to voltage mode with range of 0...10V	
					5V	Output 1 set to voltage mode with range of 0...5V	
					0...20 mA	Output 1 set to current mode with range of 0...20 mA	
					4...20 mA	Output 1 set to current mode with range of 4...20 mA	
X.24	Output 1 Select	0/15999	1	–	–	Selects the parameter used to drive Output 1	R/W
X.25	Output 1 High	-20.000/20.000	10.000	V or mA	–	Output level when parameter X.24 [Output 1 Select] reaches the level that is set in parameter X.27 [Output 1 Data Hi]	R/W
X.26	Output 1 Low	-20.000/20.000	0.000	V or mA	–	Output level when parameter X.24 [Output 1 Select] reaches the level that is set in parameter X.28 [Output 1 Data Lo].	R/W
X.27	Output 1 Data Hi	-300000000/ 300000000	480	V or mA	–	Level of parameter X.24 [Output 1 Select] that corresponds to an output of parameter X.25 [Output 1 High].	R/W
X.28	Output 1 Data Lo	-300000000/ 300000000	0	V or mA	–	Level of parameter X.24 [Output 1 Select] that corresponds to an output of parameter X.25 [Output 1 High].	R/W
X.29	Output1 Setpoint	0/65535	0	–	–	Raw value sent to Output 1 when parameter X.24 [Output 1 Select] is set to "Disabled"	R/W
X.30	Output 2 Range	0/4	1	–	±10V	Output 2 set to voltage mode with range of -10...+10V	R/W
					10V	Output 2 set to voltage mode with range of 0...10V	
					5V	Output 2 set to voltage mode with range of 0...5V	
					0...20 mA	Output 2 set to current mode with range of 0...20 mA	
					4...20 mA	Output 2 set to current mode with range of 4...20 mA	

(1) X indicates the Control Module port number in which the Cat. No. 150-SM3 Analog I/O option module is installed. Allowable ports = 7 or 8.

Table 164 - Parameter X.31...X.36[1]

No.[2]	Name	Min/Max Values	Default Value	Units	Description	Read/ write Access
X.31	Output 2 Select	0/15999	1	–	Selects the parameter used to drive Output 2	R/W
X.32	Output 2 High	-20.000/20.000	10.000	V or mA	Output level when parameter X.31 [Output 2 Select] reaches the level that is set in parameter X.34 [Output 2 Data Hi].	R/W
X.33	Output 2 Low	-20.000/20.000	0.000	V or mA	Output level when parameter X.31 [Output 2 Select] reaches the level that is set in parameter X.35 [Output 2 Data Lo].	R/W
X.34	Output 2 Data Hi	-300000000/ 300000000	480	V or mA	Level of parameter X.31 [Output 2 Select] that corresponds to an output of parameter X.32 [Output 2 High].	R/W
X.35	Output 2 Data Lo	-300000000/ 300000000	0	V or mA	Level of parameter X.31 [Output 2 Select] that corresponds to an output of parameter X.35 [Output 2 Lo].	R/W
X.36	Output2 Setpoint	0/65535	0	–	Raw value sent to Output 2 when parameter X.31 [Output 2 Select] is set to "Disabled"	R/W

(1) ENUM Text is not applicable for the parameters in this table.
(2) X indicates the Control Module port number in which the Cat. No. 150-SM3 Analog I/O option module is installed. Allowable ports = 7 or 8.

Table 165 - Parameter X.37...X.39

No.[1]	Name	Min/Max Values	Default Value	Units	Enum Text	Description	Read/ write Access
X.37	Fault Enable	0/255	0	–	In1 Over In1 Under In2 Over In2 Under Out1 Shorted Out1 Open Out2 Shorted Out2 Open	Lets you enable the Input/Output faults 0 = Fault Disabled 1 = Fault Enabled	R/W
X.38	Alarm Enable	0/255	0	–	In1 Over In1 Under In2 Over In2 Under Out1 Shorted Out1 Open Out2 Shorted Out2 Open	Lets you enable the Input/Output alarms 0 = Alarm Disabled 1 = Alarm Enabled	R/W
X.39	Restart Enable[2]	0/255	0	–	In1 Over In1 Under In2 Over In2 Under Out1 Shorted Out1 Open Out2 Shorted Out2 Open	0 = Do not attempt a restart after fault is cleared 1 = Attempt a restart after fault is cleared	R/W

(1) X indicates the Control Module port number in which the Cat. No. 150-SM3 Analog I/O option module is installed. Allowable ports = 7 or 8.
(2) You must also configure parameter 133 [Restart Attempts] and parameter 134 [Restart Dly].

Table 166 - Parameter X.40...X.56

No.(1)	Name	Min/Max Values	Default Value	Units	Enum Text	Description	Read/ write Access
X.40	In1 Over F Lvl	-3000.0/3000.0	1050.0	–	–	If Input 1 exceeds this level for the time that is set in parameter X.41 [In1 Over F Dly], a fault is signaled. You must set the In1 Over bit in parameter X.37 [Fault Enable].	R/W
X.41	In1 Over F Dly	0.1/99.0	3.0	sec	–	The time that Input 1 must exceed the value that is set in parameter X.40 [In1 Over F Lvl] to signal a fault. You must set the In1 Over bit in parameter X.37 [Fault Enable].	R/W
X.42	In1 Over A Lvl	-3000.0/3000.0	1000.0	–	–	If Input 1 exceeds this level for the time that is set in parameter X.43 [In1 Over A Dly], an alarm is signaled. You must set the In1 Over bit in parameter X.38 [Alarm Enable].	R/W
X.43	In1 Over A Dly	0.1/99.0	3.0	sec	–	The time that Input 1 must exceed the value that is set in parameter X.42 [In1 Over A Lvl] to signal a fault. You must set the In1 Over bit in parameter X.38 [Alarm Enable].	R/W
X.44	In1 Under F Lvl	-3000.0/3000.0	-50.0	–	–	If Input 1 remains below this level for the time that is set in parameter X.45 [In1 Under F Dly], a fault is signaled. You must set the In1 Under bit in parameter X.37 [Fault Enable].	R/W
X.45	In1 Under F Dly	0.1/99.0	3.0	sec	–	The time that Input 1 must remain below the value that is set in parameter X.44 [In1 Under F Lvl] to signal a fault. You must set the In1 Under bit in parameter X.37 [Fault Enable].	R/W
X.46	In1 Under A Lvl	-3000.0/3000.0	0.0	–	–	If Input 1 remains below this level for the time that is set in parameter X.47 [In1 Under A Dly], an alarm is signaled. You must set the In1 Under bit in parameter X.38 [Alarm Enable].	R/W
X.47	In1 Under A Dly	0.1/99.0	3.0	sec	–	The time that Input 1 must remain below the value that is set in parameter X.44 [In1 Under A Lvl] to signal a fault. You must set the In1 Under bit in parameter X.38 [Alarm Enable].	R/W
X.48	In2 Over F Lvl	-3000.0/3000.0	1050.0	–	–	If Input 2 exceeds this level for the time that is set in parameter X.49 [In2 Over F Dly], a fault is signaled. You must set the In2 Over bit in parameter X.37 [Fault Enable].	R/W
X.49	In2 Over F Dly	0.1/99.0	3.0	sec	–	The time that Input 2 must exceed the value that is set in parameter X.48 [In2 Over F Lvl] to signal a fault. You must set the In2 Over bit in parameter X.37 [Fault Enable].	R/W
X.50	In2 Over A Lvl	-3000.0/3000.0	1000.0	–	–	If Input 2 exceeds this level for the time that is set in parameter X.51 [In2 Over A Dly], an alarm is signaled. You must set the In2 Over bit in parameter X.38 [Alarm Enable].	R/W
X.51	In2 Over A Dly	0.1/99.0	3.0	sec	–	The time that Input 2 must exceed the value that is set in parameter X.48 [In2 Over A Lvl] to signal a fault. You must set the In2 Over bit in parameter X.38 [Alarm Enable].	R/W
X.52	In2 Under F Lvl	-3000.0/3000.0	-3000.0/ 3000.0	–	–	If Input 2 remains below this level for the time that is set in parameter X.53 [In2 Under F Dly], a fault is signaled. You must set the In2 Under bit in parameter X.37 [Fault Enable].	R/W
X.53	In2 Under F Dly	0.1/99.0	0.1/99.0	sec	–	The time that Input 2 must remain below the value that is set in parameter X.52 [In2 Under F Lvl] to signal a fault. You must set the In2 Under bit in parameter X.37 [Fault Enable].	R/W
X.54	In2 Under A Lvl	-3000.0/3000.0	-3000.0/ 3000.0	–	–	If Input 2 remains below this level for the time that is set in parameter X.55 [In2 Under A Dly], an alarm is signaled. The In2 Under bit must be set in parameter X.38 [Alarm Enable].	R/W
X.55	In2 Under A Dly	0.1/99.0	0.1/99.0	sec	–	The time that Input 2 must remain below the value that is set in parameter X.52 [In2 Under A Lvl] to signal a fault. The In2 Under bit must be set in parameter X.38 [Alarm Enable].	R/W
X.56	Parameter Mgmt	0/1	0/1	–	Ready	Waiting for command to set defaults	R/W
					Set Defaults	Set all writable parameters to factory default values	

(1) X indicates the Control Module port number in which the Cat. No. 150-SM3 Analog I/O option module is installed. Allowable ports = 7 or 8.

Notes:

Option Modules

Introduction

The SMC-50 controller has three expansion ports for optional modules. These ports let you add control modules (such as additional inputs and outputs (I/O), simple start/stop parameter configuration capability, and ground fault). Brief functional explanations are provided here with the wiring termination identifications. See Chapter 6 for more detailed functional and configuration information. See Figure 102 for compatible port locations of the selected module.

ATTENTION: There is the potential to have voltage values above 220V AC on the option modules. Before removing the control module cover to access option modules, disconnect ALL power to the SMC-50 Controller.

Figure 102 - Port Number Identification

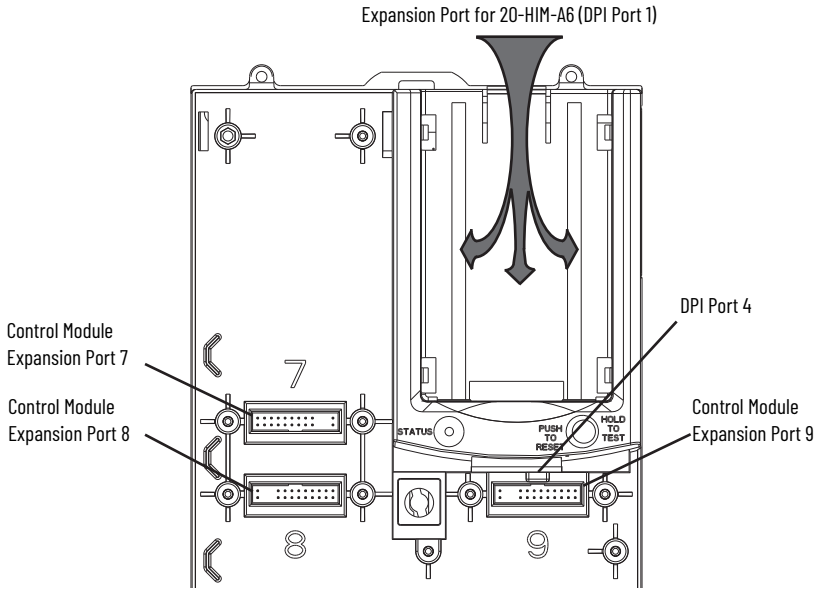


Table 167 - Port Location for Compatible Option Modules

SMC-50 Control Module Compatible Option Modules Cat. Nos.	Compatible Control Module Port			Max Number of this Type of Option Module per Control Module
	Port 7	Port 8	Port 9	
150-SM2: Ground Fault/PTC/External CT	Yes	Yes	No	1
150-SM3: Analog I/O	Yes	Yes	Yes	3
150-SM4: Digital I/O	Yes	Yes	Yes	3
150-SM6: Parameter Configuration	Yes	Yes	Yes	1
20-COMM-X(1) (2) Communications	No	No	Yes	1

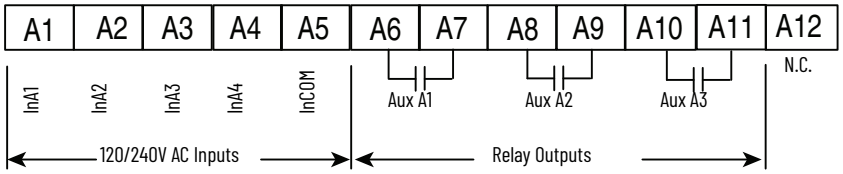
(1) See Chapter 9 for a list of compatible 20-COMM-X modules.
(2) When installed in an SMC-50 controller, 20-COMM-X modules physically reside in the space that is assigned to Port 9, but connects to DPI Port 4 with the ribbon cable that is supplied with the module.

Cat. No. 150-SM4 Digital I/O Module

A Cat. No. 150-SM4 Digital I/O Option Module provides four 120...240V AC digital on/off inputs and three relay outputs to provide additional auxiliary control or indications (for example, up-to-speed (UTS), alarm) functions. You can install the 150-SM4 module in any of the three control module option ports (See Figure 102). You can use up to three 150-SM4 modules with one control module. The 150-SM4 module terminal block that is used to wire the I/O is removable.

When installed in Control Module Port 7, the orientation of the module terminal block is rotated 180° along with its terminals.
The Cat. No. 150-SM4 Digital I/O Module can NOT be configured using a 150-SM6 PCM. This module can be configured using a 20-HIM-A6, network card, or communications software.

Figure 103 - Optional Digital I/O Module Terminal Identification



Terminal Number	Description
A1(1)	Optional Input #1 (120/240V AC)
A2(1)	Optional Input #2 (120/240V AC)
A3(1)	Optional Input #3 (120/240V AC)
A4(1)	Optional Input #4 (120/240V AC)
A5(2)	Input Common
A6(2)(3)	Optional Auxiliary Relay Contact #1
A7(2)(3)	Optional Auxiliary Relay Contact #1
A8(2) (3)	Optional Auxiliary Relay Contact #2
A9(2)(3)	Optional Auxiliary Relay Contact #2
A10(2)(3)	Optional Auxiliary Relay Contact #3
A11(2)	Optional Auxiliary Relay Contact #3
A12	NO CONNECT

(1) Do not connect additional loads to this terminal. Parasitic loads can cause problems with operation.
(2) RC snubbers are required when inductive loads are connected to terminal.
(3) When set to external bypass mode, the auxiliary contact is used to control a properly sized external contactor and overload after the motor is at full speed.

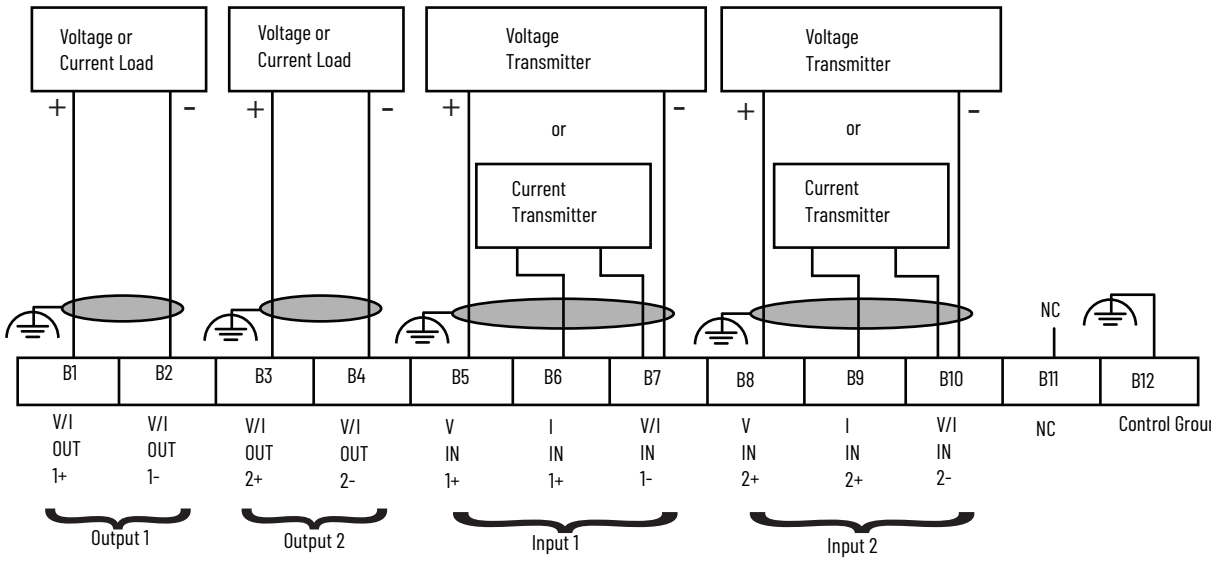
Optional Cat. No. 150-SM3 Analog I/O Module

An optional Cat. No. 150-SM3 Analog I/O Module provides two analog inputs (voltage or current) and two analog outputs (voltage or current).

The 150-SM3 module can be installed in any of the three control module option ports (See Figure 102). You can use up to three 150-SM3 modules with one control module. The 150-SM3 module terminal block used to wire the I/O is removable.

When installed in Control Module Port 7, the orientation of the module terminal block is rotated 180° along with its terminals.
The Cat. No. 150-SM3 Analog I/O Module can NOT be configured using a 150-SM6 PCM. This module can be configured using a 20-HIM-A6, network card, or communications software.

Figure 104 - Analog I/O Module Wiring Diagram



Cat. No. 150-SM2 Positive Temperature Coefficient (PTC), Ground Fault, and External Current Transformer Option Module

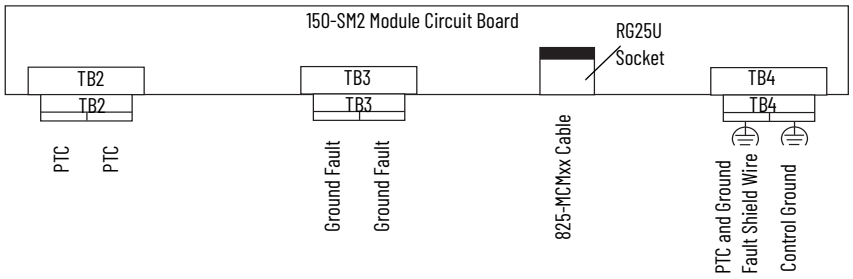
An optional Cat. No. 150-SM2 module provides connectivity to external PTC motor winding temperature sensors, ground fault, and current transformer sensors.

The 150-SM2 module can be installed in control module Port 7 or 8. Only one 150-SM2 module can be used with the control module (See Figure 102). All of the individual terminal blocks (TB2, TB3, and TB4) are removable. The RG25U socket provides a connection point for the male-to-male cable provided with the 825-MCM current sensor/converter module.

When installed in Control Module Port 7, the orientation of the module terminal block is rotated 180° along with its terminals.

The Cat. No. 150-SM2 Option Module can NOT be configured using a 150-SM6 PCM. This module can be configured using a 20-HIM-A6, network card, or communications software.

Figure 105 - 150-SM2 Circuit Board



Positive Temperature Coefficient (PTC) Sensor — Motor Temperature Sensing

The optional 150-SM2 module lets the SMC-50 controller 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.

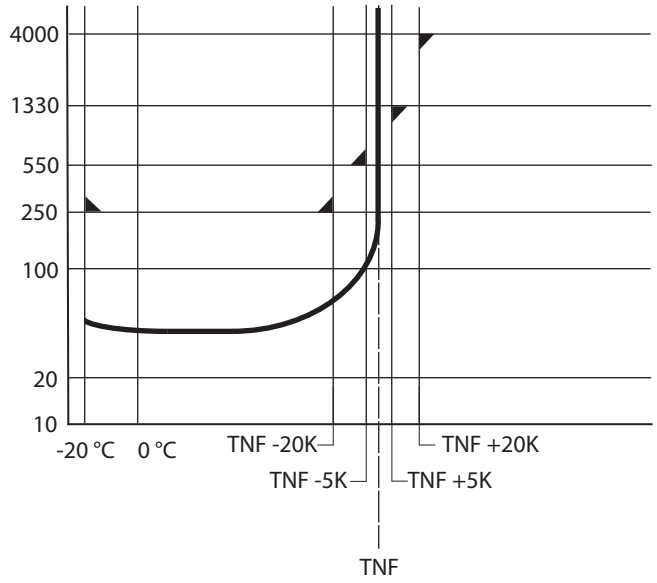
Table 168 defines the required PTC thermistor input and response ratings for operation with the 150-SM2 module.

Table 168 - PTC Thermistor Input and 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 kΩ)	< 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 106 shows the required PTC sensor characteristics for operation with the 150-SM2 Option Module, per IEC-34-11-2.

Figure 106 - PTC Sensor Characteristics per IEC-34-11-2



For additional information concerning the configuration and diagnostic information that is provided by the PTC part of the 150-SM2 Option Module, see Chapter 6, Programming.

Ground Fault Sensing

In isolated or high impedance-grounded systems, core-balanced current sensors are typically used to detect low-level ground faults that could be due to motor insulation breakdown or entry of foreign objects. Detection of ground faults can help prevent further damage or alert personnel to perform maintenance.

The SMC-50 controller can provide ground fault indication when you use it with the 150-SM2 Option Module and the 825-CBCT External Ground Fault (Core Balance) Current Sensor. The ground fault current sensor mounts separately from the SMC-50 controller and must be placed within three meters of the SMC-50 controller. A customer-supplied cable for wiring the ground fault sensor to the 150-SM2 module must meet the requirements that are outlined in Table 169.

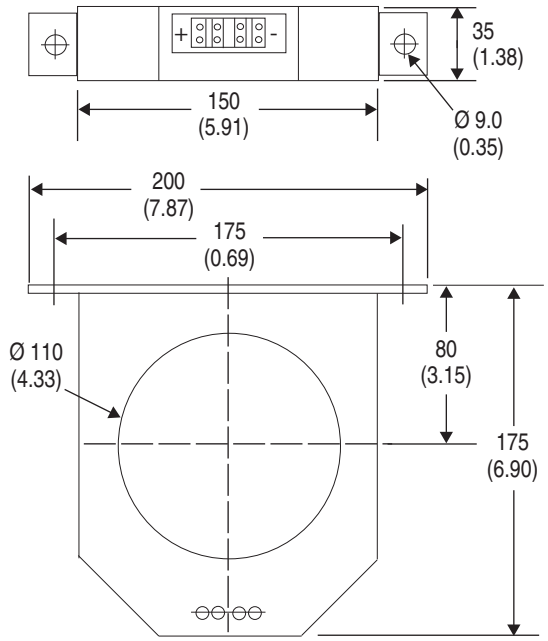
ATTENTION: The ground fault sensing feature of the SMC-50 controller is intended for monitoring only. It is not intended as a ground fault circuit interrupter for personnel protection as defined in Article 100 of the National Electric Code (NEC) and has not been evaluated to UL 1053.

Table 169 - Ground Fault Sensor Cable Requirements

Wire Type(1)	Shielded, twisted pair
Wire Size	0.2...2.5 mm^2 (#24...14 AWG)
Terminal Torque	0.8 N•m (7.0 lb•in.)

(1) See Figure 110 for wiring details.

Figure 107 - 825-CBCT Dimensions



External Current Transformer — Current Sensing in Bypass Mode

The 150-SM2 Option Module and an external current sensing device such as an 825-MCM converter can be used to provide current feedback to the SMC-50 controller when it is used with an external bypass contactor. The external current feedback device provides all current measurement and current protection functions while the controller is in external bypass mode (running). One 825-MCM converter provides external current feedback from all three motor phases. All other modes (such as starting, stopping, and slow speed) use the SMC-50 controller's internal current feedback signals.

External current transformers (CTs) can be used and enabled even without an external bypass.

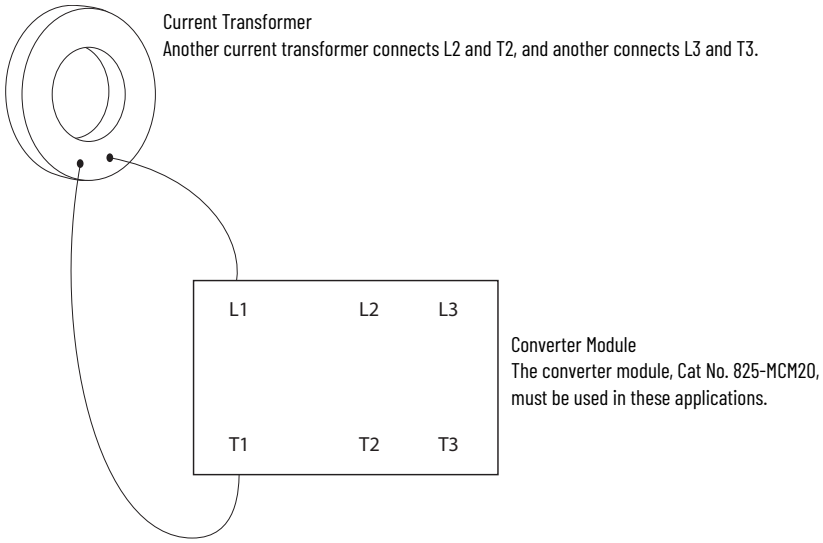
Table 170 shows which converter to use based on the motor FLC range.

Table 170 - 825 Converter Selection

Motor FLC Range	Catalog Number
30...180 A	825-MCM180
181...520 A	825-MCM20(1)

(1) User-supplied current transformers with 5 A secondary are required. See Figure 108.

Figure 108 - Current Transformer Connection to Converter Module



To enable the 150-SM2 External CT function, the CT Enable parameter in the 150-SM2 must be set to "Enable" and the 825-MCM hardware must be correctly configured. When the 150-SM2 External CT function is enabled, the SMC-50 controller calibrates the external CT for scaling, phase shift, and inversion during the SMC-50 controller tuning cycle.

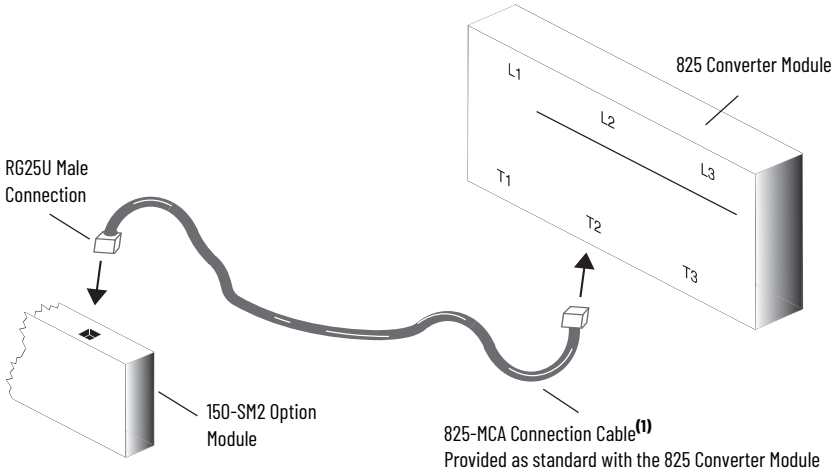
The tuning cycle automatically occurs:

- before the first start after the controller installation
- after a "Load Default" parameter occurs
- when you force tuning of the SMC-50 controller through the Force Tuning parameter or the control module's Hold to Reset button

The scaling is displayed relative to the unit's rating where 1.00 indicates that the external CTs and the internal CTs are scaled the same.

Figure 109 shows the connection of the 825-MCM Converter to the SMC-50 controller's 150-SM2 Option Module.

Figure 109 - Converter to Option Module Connection



Note	Information
1	The cable length is fixed at 4 meters. Only the cable that is provided with the converter can be used. The use of any other cable results in incorrect data from the converter and incorrect controller operation.

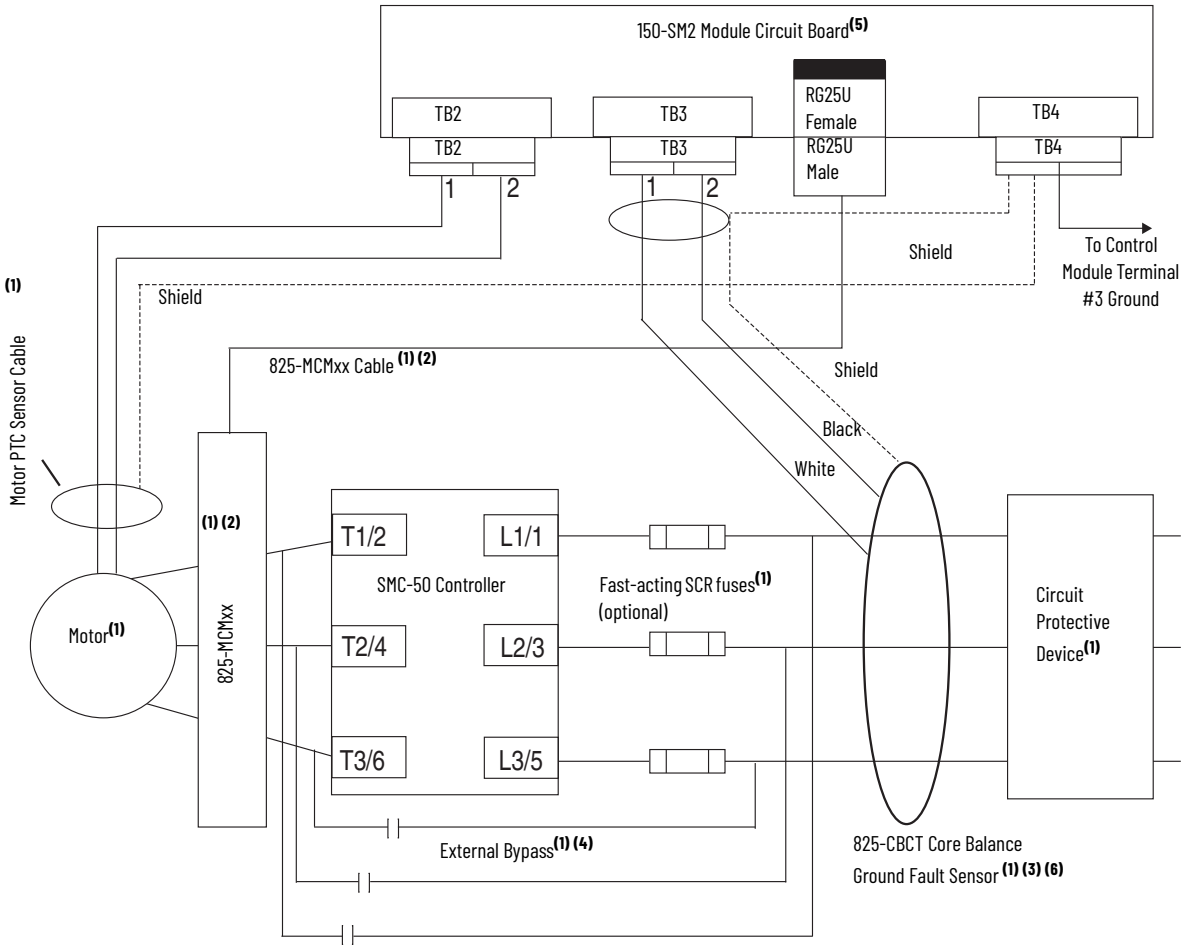
Table 171 provides the terminal and wire specifications for the 150-SM2 (terminals TB2, TB3, and TB4).

Table 171 - Control and Option Module 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

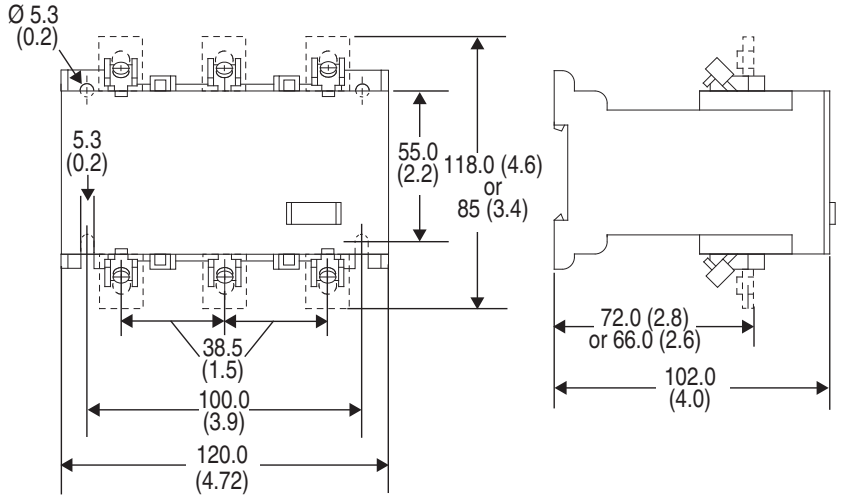
Figure 110 provides information for wiring all sensors to the 150-SM2 module.

Figure 110 - Combined Wiring Diagram of all 150-SM2 Sensors



Note	Information
1	Customer supplied
2	You can use the 825-MCM with or without an external bypass contactor. If an external bypass contactor is used, the 825-MCM must be installed in order to use current-based motor protective features, including the motor overload feature. Cable length is 4 meters. Only the cable that is provided with the 825-MCM is compatible with the 150-SM2. See Figure 111 for 825-MCM dimensions
3	The 825-CBCT Core Balance Sensor mounts separately from the SMC-50 controller and must be placed within 3 meters of the SMC-50 controller. When connecting the 825-CBCT ground-fault sensor, the secondary of the CT must be shorted until connection to the 150-SM2 module is complete
4	See Figure 42 for additional bypass configurations (such as emergency run-off bypass) and application considerations
5	To meet product susceptibility requirements, one ferrite core must be placed around any or all sensor (such as PTC or ground fault) wires connected to the 150-SM2 Option Module. The recommended core is a Fair-Rite Products Corp Part Number 0431167281 or equivalent
6	Confirm that 150-SM2 parameter X.5 [Turns Ratio], is configured to match the 825-CBCT turns ratio 100:1 (X.5=100)

Figure 111 - 825-MCM180 and -MCM20 Dimensions



Cat. No. 150-SM6 Parameter Configuration Module (PCM)

The Cat. No. 150-SM6 PCM provides simple and limited configuration of the SMC-50 controller. You can insert this PCM into any control module option port (7, 8, or 9).

This module contains five rotary dials and three banks of two-position, eight-switch DIP switches.

Parameters that **are** configured by the PCM will appear as read-write parameters to other configuration devices whose values represent the switch settings. The parameter values set by the PCM are stored in the control module memory. If an external device changes any of these parameters, the value will revert to the PCM setting.

Parameters that **are not** defined and therefore are not configurable by the PCM can be configured through other means (like Human Interface Module (HIM), Connected Components Workbench software, or DriveExecutive software), if necessary.

Only one 150-SM6 Option Module can be installed in the control module. Any of the three control module expansion ports can be used. A fault is generated if you attempt to install more than one 150-SM6 into the control module.

You can use one PCM to configure multiple SMC-50 controllers. After setup of the initial SMC-50 controller is complete, remove all power and move the PCM to the next SMC-50 controller that needs to be programmed. Upon powerup of the initial SMC-50 controller, the parameters set by the PCM are retained.

Notes:

Using DeviceLogix

Introduction

DeviceLogix is a standard feature in the SMC-50 controller (firmware revision 4.002 and higher) and can be used to control and monitor the SMC-50 controller. Program DeviceLogix for the SMC-50 controller through a DeviceLogix Editor component (icon), available in Connected Components Workbench software version 6 and later or the SMC-50 Add-on Profile in Studio 5000 Logix Designer application. You cannot use other DeviceLogix Editors, such as RSNetWorx for DeviceNet.

Table 172 - Basic features

Feature	SMC-50 controller 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 SMC-50 controller 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 standalone environments. DeviceLogix continues execution independent of the SMC-50 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, and other data are cleared.

Controlling the SMC-50 controller operating modes (such as starting, stopping, slow speed) via DeviceLogix requires you to set bit #14 of parameter 148 [Logic Mask].

Parameters

See Table 158 for DeviceLogix parameter descriptions.

Function Block Elements

The following function block elements are available:

- Bit and Analog I/O[(a)]
- Process ALM | TDG
- Select/Limit SEL | HLL
- Timer/Counter TONR | TOFR | PULR | CTU | CTD | CTUD
- Compare MEQ | EQU | NEQ | LES | GRT | LEQ | GEQ

(a) Bit and Analog I/O do not count against the Function Block total. All other elements count; each instance counts as one Function Block.

- 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. See 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:

Table 173 - Available Bit Inputs for DeviceLogix

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 indicates whether the expansion card that is 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 Table 177
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 121
	Network Bit 1 Network Bit 2 Network Bit 3 Network Bit 4	These Boolean inputs correspond to the statuses listed in Table 122

The function of the expansion port inputs depends on the card that is installed in the given port. Table 174 shows how the bit inputs are mapped for each card type:

Table 174 - Bit Input Mapping

Bit Input	Digital I/O (150-SM4)	Analog I/O (150-SM3)	PTC / Ground Fault (150-SM2)	Parameter Config (150-SM6)
PX Input 1	Input #1	DAC #1 Open Status	PTC Status	None (always 0)
PX Input 2	Input #2	DAC #1 Shorted Status	CT Loss Status	None (always 0)
PX Input 3	Input #3	DAC #2 Open Status	None (always 0)	None (always 0)
PX Input 4	Input #4	DAC #1 Shorted Status	None (always 0)	None (always 0)

Bit Outputs

Bit Outputs are used to connect to real-world output devices (example: pilot lights, relays) that are wired to an auxiliary relay in the SMC-50 controller. Available bit outputs are shown in Table 175.

Table 175 - Bit Output Mapping

Bit Outputs	Name	Description
11 Hardware Boolean Outputs	Aux1, 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 Slow Speed Emergency Run Motor Heater	These outputs can be used to control the SMC-50 controller in the same way a PLC can control the SMC-50 controller. See Table 122 for a definition of these control bits.

(1) The Auxiliary Relays must be programmed to "DeviceLogix" 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 parameter 172 [Aux1 Config] to "Device Logix". Similarly, to control Aux 1 in a Digital I/O (150-SM4) expansion card, you must configure parameter 6 [Aux 1 Config] 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 176.

Table 176 - Analog Input Data Points

Analog Inputs	Name	Parameter No.	Description	Units
22 Network Analog Inputs	Volt PP Ave	1	Average phase-to-phase Voltage	Volts
	I Ave	5	Average Current	Amps
	Torque	9	Average Torque	%
	Real Power	10	Total Real Power	kW
	Power Factor	17	Average Power Factor	in hundredths
	Volt PN Ave	265	Average Phase to Neutral Voltage	Volts
	Reactive Power	277	Total Reactive Power	kW
	Apparent Power	286	Total Apparent Power	kW
	DLX In 1, DLX In 2	335, 336	DLX General-purpose Input parameters	
	DLX DL1 – DLX DL6	337...342	DLX Datalinks Input Parameters	
	PX In 1 – PX In 2	—	Analog inputs from the expansion cards – See Table 177	

The function of the expansion port inputs depends on the card installed in the given port. Table 177 shows how the analog inputs are mapped for each card type.

Table 177 - Expansion Card Input Mapping

Bit Input	Digital I/O (150-SM4)	Analog I/O (150-SM3)	PTC/Ground Fault (150-SM2)	Parameter Config (150-SM6)
PX In 1	None (always 0)	Parameter X.6 [Analog In #1]	Parameter 11 [Ground Current]	None (always 0)
PX In 2	None (always 0)	Parameter X.16 [Analog In #2]	None (always 0)	None (always 0)

Analog Outputs 

Available analog outputs from the DeviceLogix program are all 32-bit integers and include the data points in Table 178.

Table 178 - Analog Output Data Points

Analog Outputs	Name	Description
2 Network Analog Outputs	A Out 1 – A Out 2	General-purpose Output parameters (parameter 343 [DLX Output 1 and parameter 344 [DLX Output 2])

Helpful Information

Data Types

The SMC-50 controller DeviceLogix implementation supports 32-bit integers only.

DeviceLogix Scratchpad Registers

The SMC-50 controller provides 2 input (parameters 335 and 336) and 2 output (parameter 343 and 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 Controller DeviceLogix Input Datalinks (Parameters 337...342)

The SMC-50 controller provides parameters directly to DeviceLogix as analog inputs. Additional parameters from the host and expansion cards can be made available through the DeviceLogix Datalinks inputs. The value of the parameter linked to by the Datalinks is made available to DeviceLogix. For example, configuring a Datalink to parameter 18 [Mtr Therm Usage] makes the motor thermal usage value available to DeviceLogix.

Program Examples

Example 1: Selector Switch Operation

This example demonstrates how you could use a selector switch to select one or four parameters to write to one of the scratchpad output parameters.

Table 179 represents the inputs and outputs for a 4-position selector switch.

Table 179 - 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

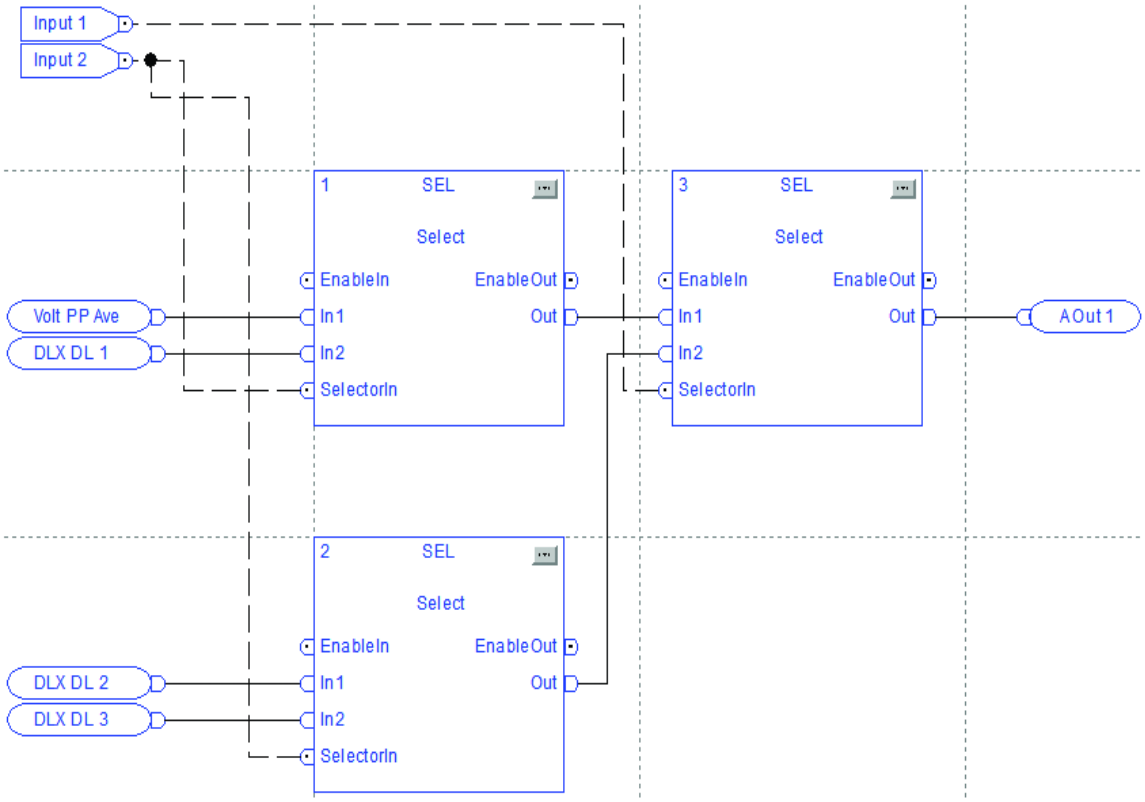
Parameter Configuration

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 Datalinks parameters to make those values available to DeviceLogix as shown in Table 180

Table 180 - DeviceLogix Datalinks 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 112 - Function Block Programming

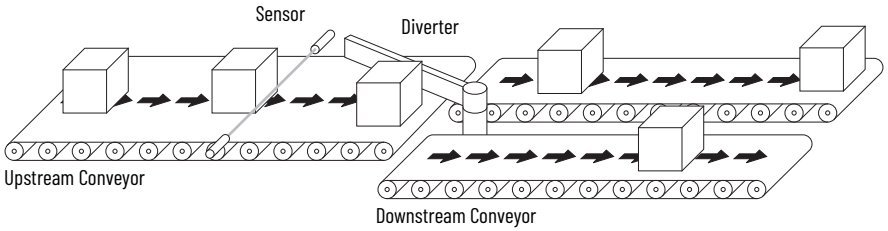


Example 2: Diverter Operation

This example demonstrates basic control logic to operate a diverter in a conveyor system by using a Digital I/O (150-SM4) option module card installed in Port #8. The diverter directs parts from an upstream conveyor to one of two downstream conveyors. Parameter 335 [DLX Input 1] defines the total number of boxes that are diverted to conveyor "A" (when the diverter control signal is

off). Parameter 336 [DLX Input 2] defines the total number of boxes that are diverted to conveyor “B” (when the diverter control signal is on).

Figure 113 - Diverter Operation



The application consists of the discrete I/O that is shown in Table 181

Table 181 - Diverter I/O

Type	Name	Description
Inputs	Part Present Sensor	Identifies that a part is present – Connected to Input #1 on a Digital I/O (150-SM4) card installed in Port #8
Outputs	Diverter Actuator	Controls the diverter actuator to direct the flow of parts – Connected to Aux #1 on a Digital I/O (150-SM4) card installed in Port #8

Example logic requirements:

- When Part Present Sensor transitions to ON, increment the parts counter
- If parts counter ≥ “DLX Input 1”, set the diverter actuator
- When the counter reaches “DLX Input 1” + “DLX Input 2”, reset the counter.

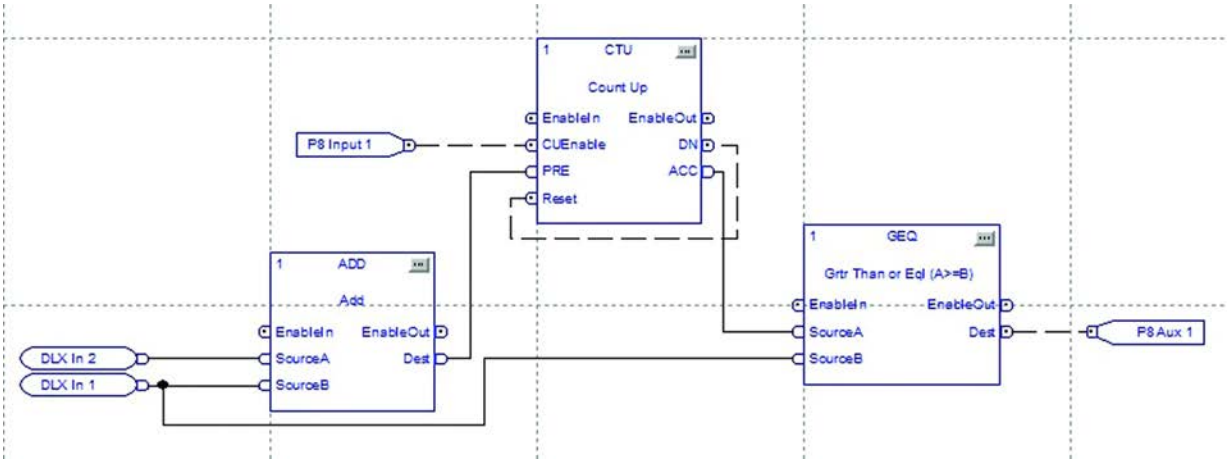
Parameter Configuration

The parameters in Table 182 are configured for this example.

Table 182 - Diverter Parameter Configuration

Port Parameter No.	Parameter	Value	Description
335	DLX Input 1	5	Send 5 boxes down conveyor “A”
336	DLX Input 2	5	Send 5 boxes down conveyor “B”
8.6 Port #8 Parameter #6	Aux 1 Config	DeviceLogix	Auxiliary #1 is used to control the Diverter. In order for DeviceLogix to control the Auxiliary it must be configured to “DeviceLogix”.

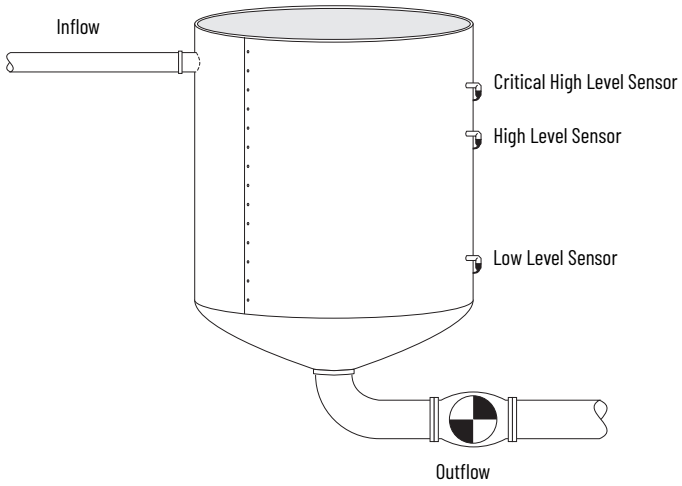
Figure 114 - Function Block Programming



Example 3: 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 115 - Wet Well



The application consists of the digital I/O that is listed in Table 183

Table 183 - Wet Well Digital 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 that the well is at a high level and it is time to start pumping using the SMC-50 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 SMC-50 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 controller.
	No External Wiring	Stop	Stop signal to the SMC-50 controller.

Example logic requirements:

- Start the motor when the High Level sensor is ON.
- Stop the motor when all level sensors are OFF.
- Annunciate a Sensor fault condition and stop the SMC-50 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.

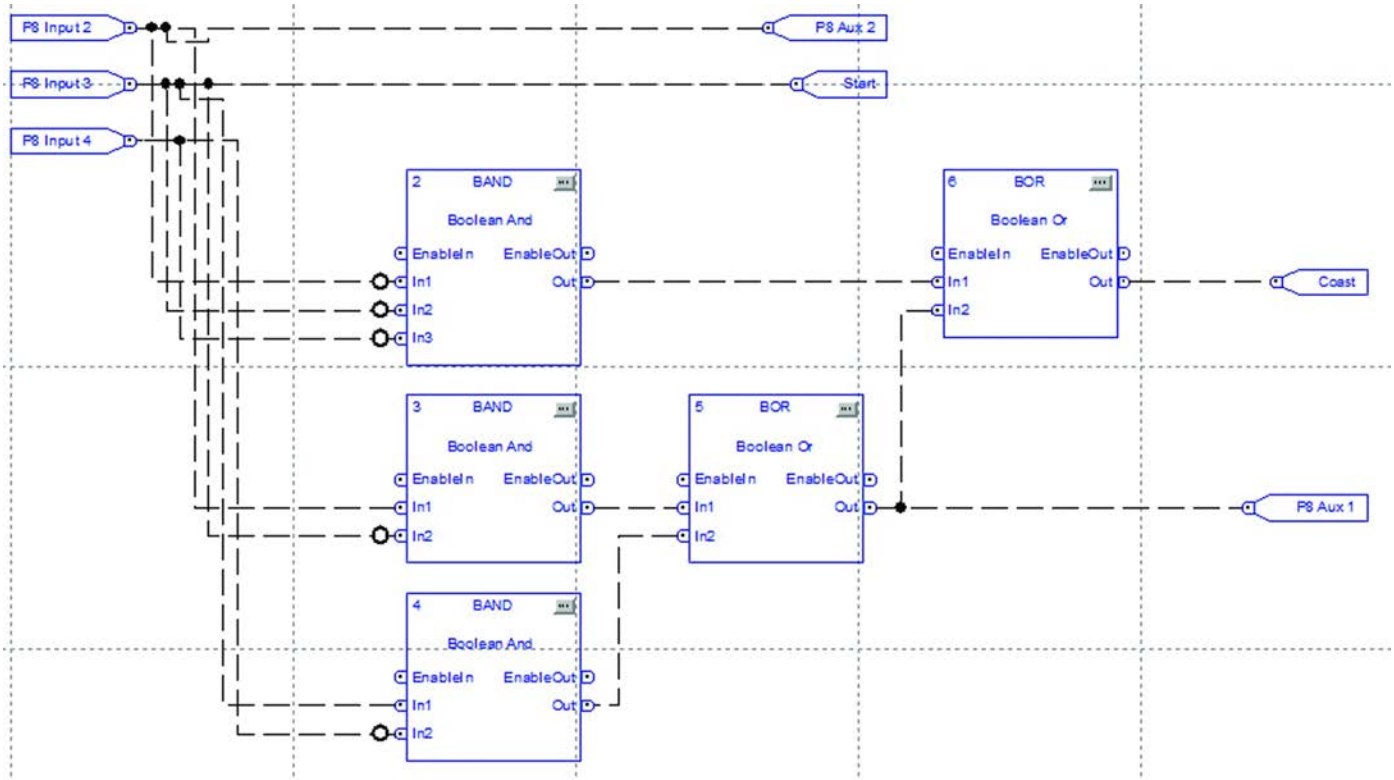
Parameter Configuration

The parameters that are listen in Table 184 are configured for this example.

Table 184 - Wet Well Parameter Configuration

Port Parameter No.	Parameter Name	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 116 - Function Block Programming



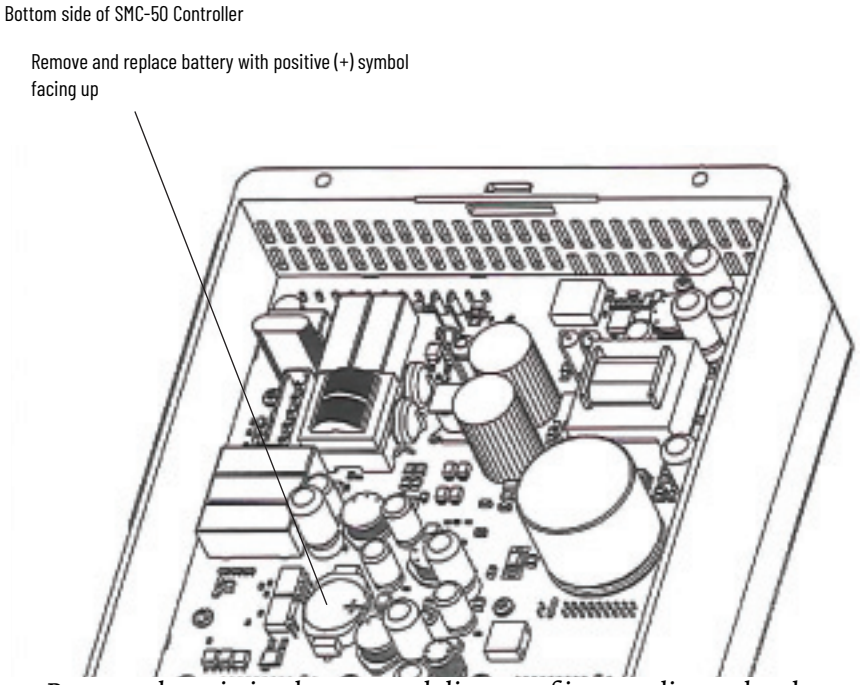
Real-time Clock (RTC) Battery Replacement

RTC Battery

The SMC-50 Control Module comes standard with an RTC that is 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 that the positive symbol faces up.



3. Remove the existing battery and dispose of it according to local environmental codes.
4. With the positive symbol of the new battery facing up, 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.

Notes:

History of Changes

Change Log

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.

150-UM011D-EN-P, November 2017 and Earlier

Change
Added enhanced information about operating modes, wiring, and application profiles.
Removed information about specifications, spare parts, and accessories that has moved to the technical data, publication 150-TD009.

Notes:

Numerics

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

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

Documentation Feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

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 compliance information on its website at rok.auto/pec.

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