

SIEMENS

SAMMS-MV™

Siemens Advanced Motor Master System for Medium Voltage Motors

User's Manual





! DANGER

Electrical equipment contains hazardous voltages and high speed moving parts. Will cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSON

For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

- (a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- (b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- (c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

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

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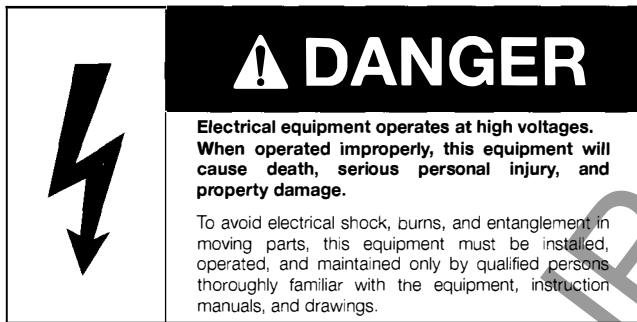
1 Introduction

1 Introduction

The SAMMS-MV electronic motor control and protection device is designed and manufactured in accordance with the latest applicable provisions of the National Electric Code, Underwriters Laboratories Standards and Procedures, NEMA Standards, and the National Electric Safety Code. You must thoroughly read and understand this user's manual before you begin any work with the SAMMS-MV device. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the careful design and fabrication by Siemens.

The purpose of this instruction manual is to assist the user in developing safe and efficient procedures for the installation, maintenance, and use of the equipment.

Contact the nearest Siemens representative if any additional information is desired.



Qualified Person

For the purpose of this manual and product labels, a **“Qualified Person”** is one who is familiar with the installation, construction and operation of this equipment, and the hazards involved. In addition, this person has the following qualifications;

- Training and authorization to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.
- Training in rendering first aid.

Signal Words

The signal words **“Danger”**, **“Warning”**, and **“Caution”** used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

Danger—Indicates an imminently hazardous situation which, if not avoided, **will** result in death or serious injury.

Warning—Indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.

Caution—Indicates a potentially hazardous situation which, if not avoided, **may** result in minor or moderate injury.

Dangerous Procedures

In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work on de-energized equipment. Always de-energize a breaker, or contactor, and remove it from the equipment before performing any tests, maintenance, or repair.
2. Always perform maintenance on equipment employing springs after the spring-charged mechanisms are discharged.
3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

Field Service Operation

Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair, and maintenance of Siemens equipment, processes, and systems. Contact regional service centers, sales offices, or the factory for details.

1.1 About this Manual

This manual introduces you to the Siemens Advanced Motor Master System (SAMMS-MV™) motor protection and control relay which incorporates protection designed for medium voltage machines. This manual also contains information for installing and operating the device, communicating with other devices over the ACCESS™ electrical distribution communications system, and troubleshooting the device. This manual also provides a helpful technical reference for you to use. Refer to table 1.1 to determine which section of the manual contains the information that you need.

These instructions prepare you to handle, install, operate and maintain the SAMMS-MV device and the Hand-Held Communicator (HHC). The individual starters and controllers used are designed for specific applications based upon your equipment and needs. Instructions covering these starters and components are not included in this manual. For this information, refer to instructions and drawings furnished with your equipment, or contact your Siemens representative. You must read these instructions and determine applicability of your equipment. Refer to the nameplate data on your controller and to the electrical diagrams supplied with your controller to determine applicability of your equipment.

1.2 About the SAMMS-MV Device

The SAMMS-MV device, shown in Figure 1.1, is a software-configured electronic motor control and overload protection device that incorporates protection tailored to the special characteristics of medium voltage motors. The SAMMS-MV system includes a microprocessor-based SAMMS-MV device which receives signal inputs from a set of current transformers (either 3-1Ø or 1-3Ø) and power input from a 12 volt tap on the controller's control power transformer. To perform certain monitoring and setup activities, a Hand-Held Communicator (HHC) shown in Figure 1.2, is required. The SAMMS-MV device is a multi-functional device offering the following:

- advanced motor protection for medium voltage motors
- pre-programmed control circuits
- standardized control panel with input/output devices replacing conventional push-buttons, pilot lights and selector switches
- diagnostics
- statistical motor data
- real-time metering
- local display of all motor and control circuit data
- open architecture communications using the ACCESS system

Note: The SAMMS-MV device does not replace the disconnect device (drawout contactor mounting or isolating switch) or the contactor itself.

If you need to...	...refer to this section
learn about the SAMMS-MV device	Section 1, Introduction
install the SAMMS-MV device	Section 2, Installing the SAMMS-MV Device
operate the SAMMS-MV device	Section 3, Operating the SAMMS-MV Device
operate the Hand-Held Communicator	Section 3, Operating the SAMMS-MV Device
connect the SAMMS-MV device to the ACCESS System	Section 2, Installing the SAMMS-MV Device
troubleshoot the SAMMS-MV device	Section 4, Troubleshooting the SAMMS-MV Device
learn about the technical specifications of the SAMMS-MV device	Appendix A, Technical Specifications of the SAMMS-MV Device

Table 1.1 Where to find information

1 Introduction



Figure 1.1 SAMMS-MV, front view

1.2.1 The SAMMS-MV Device Models

The SAMMS-MV device is available in two models: SAMMS-MVE and SAMMS-MVX. Each model meets the various demands of industrial and commercial specifications and installations. Table 1.2 compares the features of each model.

The SAMMS-MV device is designed for critical process control where prevention of downtime is critical. It offers motor control and protection along with motor diagnostic and motor/driven equipment protection. Engineering and operating personnel have access to important data enabling them to optimize motor-driven equipment capabilities, maximize the process system output and facilitate maintenance.

SAMMS-MVX is a full function model, applicable to all control needs, from a simple across-the-line unit to a more complicated reduced voltage scheme. It includes all of the functions listed in table 3.7. Any of the standard control circuits listed in table 3.3, or a custom circuit, may be downloaded. The SAMMS-MVX device accepts up to four remote inputs, while SAMMS-MVE accepts one remote input.

SAMMS-MVE is a model of SAMMS-MV tailored to across-the-line (FVNR) applications. It provides all of the protective functions of the SAMMS-MVX device, except that it has no jam protection

(F23), loss of load protection/alarm (F24), or process current warning (F22) functions. Functions F3 and F5 associated with two-speed applications are not available. No provision for automatic reset (F8) is provided. SAMMS-MVE accepts one remote input, and provides one output to actuate a single contactor. An alarm contact is not available with SAMMS-MVE.

These remote inputs are compatible with all PLCs and electro-mechanical remote control devices that have a 120VAC or 125VDC input signal.

1.2.2 Advanced Protection for Medium-Voltage Motors

For advanced protection of medium voltage motors, the SAMMS-MV device uses a motor model algorithm that continually calculates the stator winding and housing temperature as well as the rotor temperature as a function of the motor rms current. The motor model compares the calculated temperature to trip temperature values and provides a signal that trips the motor off line when the motor reaches a trip temperature value. The model closely emulates the heating and cooling of the motor windings as well as the rotor and provides protection against both transient and steady-state overload conditions.

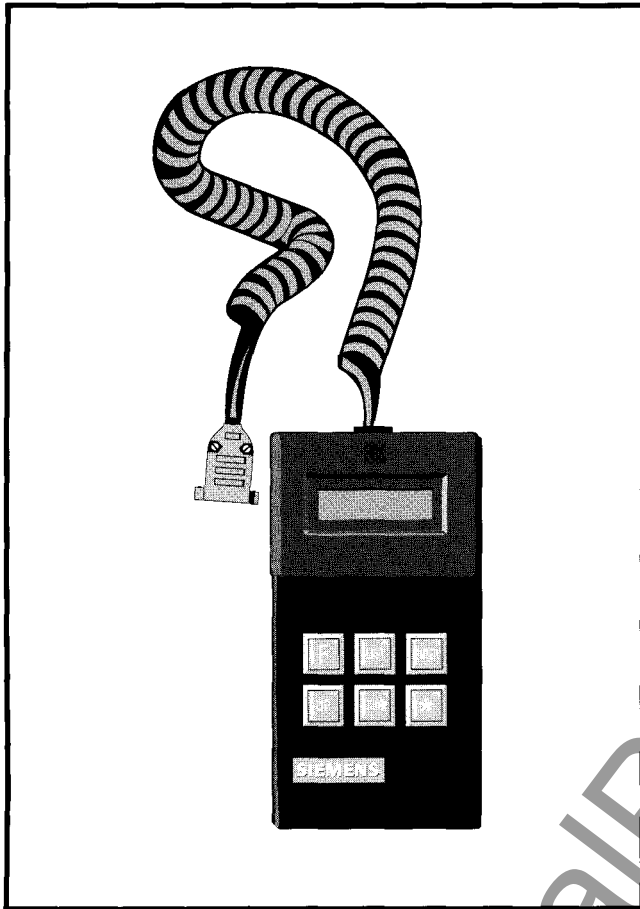


Figure 1.2 Hand-Held Communicator (HHC)

1.2.3 Overload Protection

The motor model offers the selection of overload classes 2 through 23.

The SAMMS-MV device offers more accurate motor protection than traditional thermal overload and most electronic motor protection devices. This prolongs motor life by eliminating nuisance tripping for multiple restarts, and allowing for proper cool down time when the motor winding temperature or rotor temperature reaches a critically high value.

1.2.4 Programming Control Circuits

The SAMMS-MV device allows you to modify its configuration by programming the microprocessor. The SAMMS-MV device replaces conventional timers, overload relays, pushbuttons, and selector switches.

SAMMS-MVE is preloaded with seven across-the-line control circuits, and the desired control circuit can be selected using the Hand-Held Communicator (HHC.) Alternatively, a custom across-the-line circuit may be downloaded from a PC.

A library of more than 40 typical control circuits exists for use with SAMMS-MVX to meet applications ranging from simple across-

the-line starters to complicated reduced-voltage starters. With optional software, the specified control circuit can be loaded either from the library or from a modified version into the microprocessor's memory, in the factory or on site, using an IBM®-PC compatible computer. If you would like to learn more about this software package, refer to *SAMMS Custom Software Manual*, Bulletin CP 3291.

Highly specialized control circuits can be developed and existing circuits can be modified using an optional IBM-PC compatible software package. This software uses conventional engineering symbols along with pull-down menus and a mouse to draw ladder diagrams. When you have finished drawing the diagram, the software translates the diagram into microprocessor machine code and downloads it into the SAMMS-MV device's memory.

1.2.5 Using the Standardized Control Panel

The SAMMS-MV device can be used for local and/or remote control. The SAMMS-MVE device provides two light bars, while the SAMMS-MVX model provides three light bars. Each model includes six pushbuttons with lights and tactile feedback. You can program these light bars and pushbuttons for the various functions of the control circuit used.

The test/reset button is used to test and reset the overload function and to test the front panel lights.

Diagnostics

Eight diagnostic LEDs, located on the front panel, provide information about conditions affecting the motor.

Statistical Data about the Motor

The microprocessor's memory stores statistical data about the motor and displays this data on the Hand-Held Communicator (HHC).

Real-Time Metering Data

The Hand-Held Communicator displays real-time metering data.

Local Displaying of Motor and Circuit Data

The HHC and the eight (8) diagnostic LEDs display motor and control circuit data. The eight (8) diagnostic LEDs are located on the front panel of the device.

Communicating with Other Devices

The SAMMS-MV device communicates with other devices via the ACCESS system. When connected to the ACCESS system, the SAMMS-MV device provides two-way communication with the Power Monitor™ display and monitoring unit, an IBM PC-compatible computer running the Power Monitor PC™ communications and supervisory software or another supervisory device. This ability allows you to control and monitor motors from a centralized location. You can have remote access to all SAMMS-MV data such as diagnostics, statistical data, real-time metering, and controller status. If you would like to learn more about the ACCESS system, refer to *Installing the ACCESS System* (manual no. SG6028).

1 Introduction

SAMMS-MV Model	SAMMS-MVE	SAMMS-MVX
Application		
Across-the-line (FVNR)	X	X
Reversing		X
Two-speed		X
Reduced voltage		X
Functions available (see table 3.7)	F0-F21 plus F25-F27 (except no F3, F5, or F8)	F0-F27
Ridethrough upon loss of power	No	Yes
Ground fault protection/alarm	Yes	Yes
Programmable alarm contact	No	Yes
Control circuits	Seven (preloaded), selectable with HHC. May download any custom across-the-line control circuit	Any downloadable control circuit
Change settings requires password	Yes	Yes
Remote inputs	One	Four
Outputs	One	Three
Light bars	Two	Three

Table 1.2 SAMMS-MV models

2 Installing the SAMMS-MV Device

2 Installing the SAMMS-MV Device

This section provides instructions for installing the SAMMS-MV device. You should adapt these instructions to suit the needs of your installation and equipment.

2.1 Receiving and Storing the SAMMS-MV Device

Thoroughly inspect the equipment before accepting the shipment from the transportation company. Compare each item received against the packing list and report any shortages or damaged equipment to the carrier.

If you are not going to install the SAMMS-MV device immediately, store it in a clean, dry location at ambient temperatures from -40°C to 85°C. The surrounding air should not contain any corrosive fumes or electrically conductive contaminants. The storage location should prevent condensation from forming within the equipment enclosure.

Note: Improper storage can cause equipment damage. Follow all storage instructions carefully. Failure to follow storage instructions will void the warranty.

2.2 Where to Locate the Device

You can locate the SAMMS-MV device and its associated devices in most industrial equipment environments. Unless the device is designed for specific requirements, you should install the SAMMS-MV device and its controller in an area where the following conditions exist:

- Ambient air must be free of dirt, combustible vapor, steam, electrically conductive or corrosive material.
- Area around the controller must provide access to the equipment for inspection, maintenance and operation.

2.3 Mounting the Device

The SAMMS-MV device mounts in a front door panel of the low voltage compartment of Siemens Series 81000™ medium voltage control (MVC) equipment. Mount the device in the normal low-voltage compartment associated with each medium voltage controller.

2.4 Connecting the Device

This section contains general guidelines that you should follow to connect the SAMMS-MV device. These guidelines include instructions for routing the wire, connecting the wire and grounding the device. Use these guidelines to install the SAMMS-MV device and its peripheral devices in a motor controller. Also use these guidelines to connect the motor controller to the motor.

When Siemens supplies a SAMMS-MV device as part of a motor controller, Siemens personnel install the wiring between the SAMMS-MV device and its peripheral devices in the motor

controller at the factory. The schematic diagram used contains three components: a connection diagram, a ladder diagram and a wiring diagram. The connection diagram illustrates the connections between the SAMMS-MV device and its peripheral devices. The ladder diagram illustrates the control circuit loaded into the SAMMS-MV device. Figure 2-1 shows a typical connection diagram for the SAMMS-MV device.

If Siemens does not supply the motor controller, the retrofitter or original equipment manufacturer should develop an equivalent electrical scheme.

2.4.1 Wiring Guidelines

You must observe the following guidelines when installing the SAMMS-MV device and connecting it with its peripheral devices.



⚠ DANGER

Hazardous Voltages
Will result in death, serious injury, or property damage. Turn OFF and lock out all incoming AC power and all foreign power sources before attempting to work on the SAMMS-MV device.

Note: Failure to follow these guidelines can cause pickup of unwanted signals resulting in erratic operation and damage to the SAMMS-MV device.

Guideline 1: Separate the low-voltage (115 VAC or less) from the higher voltage conductors (460 VAC or higher) as much as possible. If low-voltage and medium-voltage wires must cross paths, make sure that they intersect at a right angle.

Guideline 2: To eliminate noise coupling, install all twisted pairs or wrap wires in such a way that a complete twist or wrap occurs at least every two inches.

Guideline 3: Place the low-voltage leads near the controller chassis.

Guideline 4: Use at least AWG 14 stranded copper wire for any low-voltage control wiring that you route outside the motor controller enclosure. Connections to the SAMMS-MV unit must be made with wire no larger than AWG 14.

Guideline 5: To avoid ground loops, ground each motor controller at a single ground point.

The top portion of the device contains 16 terminal locations for connecting control power leads, power supply, ground, inputs and outputs. (Refer to Figure 2.2 for a description of each terminal block assignment.)

2 Installing the SAMMS-MV Device

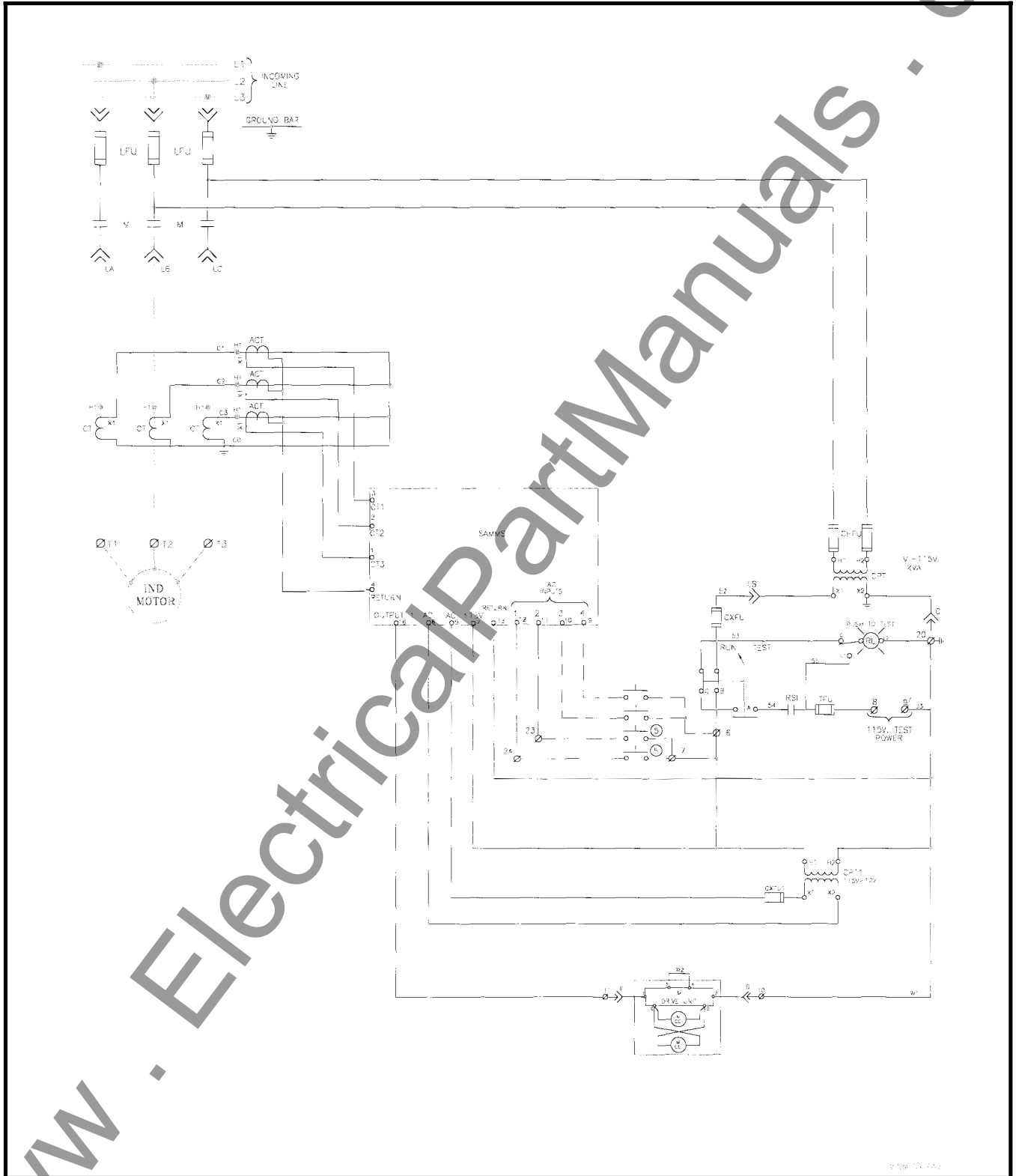



Figure 2.1 Full voltage non-reversing connection diagram

2 Installing the SAMMS-MV Device

2.4.2 Grounding the Device

As stated in Guideline 5, ground each motor controller at a single ground point. The grounding path to earth must be permanent and continuous. It must also be able to safely conduct ground fault currents that may occur in the system to ground through minimum impedance. The earth ground does not carry any current under normal conditions.

Note: Do not ground the SAMMS auxiliary current sensor (ACT) leads. (See figure 2.1.)



! DANGER

Hazardous Voltages
 May be present on external surfaces of un-grounded controllers and will cause death, serious injury, or substantial property damage. Follow grounding instructions carefully.

Connect a ground bus to the chassis of each controller or to the chassis of the mounting equipment containing the earth ground through a grounding conductor.

Refer to Article 250 of the National Electrical Code for information about the types and sizes of wire conductors and methods for safely grounding electrical equipment and components.

2.4.3 Connecting the Device to a Control Power Source

The SAMMS-MV device requires a 12 VAC control power source in order to operate. Connect the control power source to terminals 5 and 6 located on the top of the relay.

2.4.4 Connecting Input and Output Devices to the SAMMS-MV Device

Connect your devices to the input and output connections on the SAMMS-MV device as illustrated in Figure 2.2.

2.4.5 Communications Connection

The SAMMS-MV device is equipped with an RS-485 communications port on the back of the device. The communications port allows connection to a communications module which enables

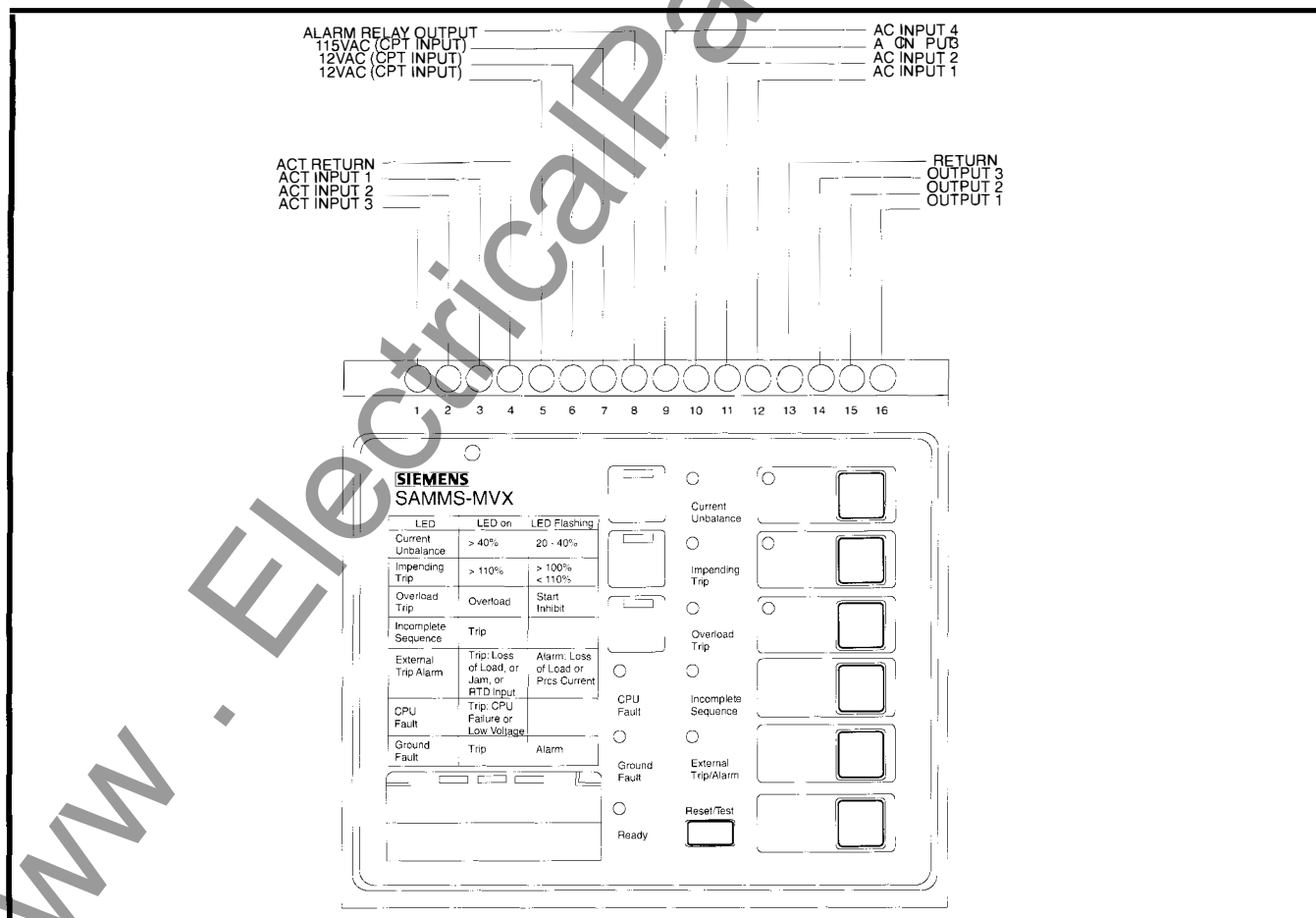


Figure 2.2 Terminal block assignments

2 Installing the SAMMS-MV Device

the SAMMS-MV to communicate with a remote supervisory device. Examples of the remote supervisory device include the Power Monitor display and monitoring unit, a standard personal computer running the Power Monitor PC communications and supervisory software, or Siemens Microsoft® Windows™ based SIEServe™ or WinPM™ software. These supervisory devices and programs can communicate with the SAMMS-MV device and allow it to operate in the ACCESS electrical distribution

communications system.

The SAMMS-MV device connects to the SEABus™ RS-485 via the 5 pin plug on the Communications Module, CM-1. The communications connections are illustrated in Figure 2.3. Refer to *Installing the ACCESS System* (manual no. SG-6028), for detailed information on connecting the SAMMS-MV device to the ACCESS network.

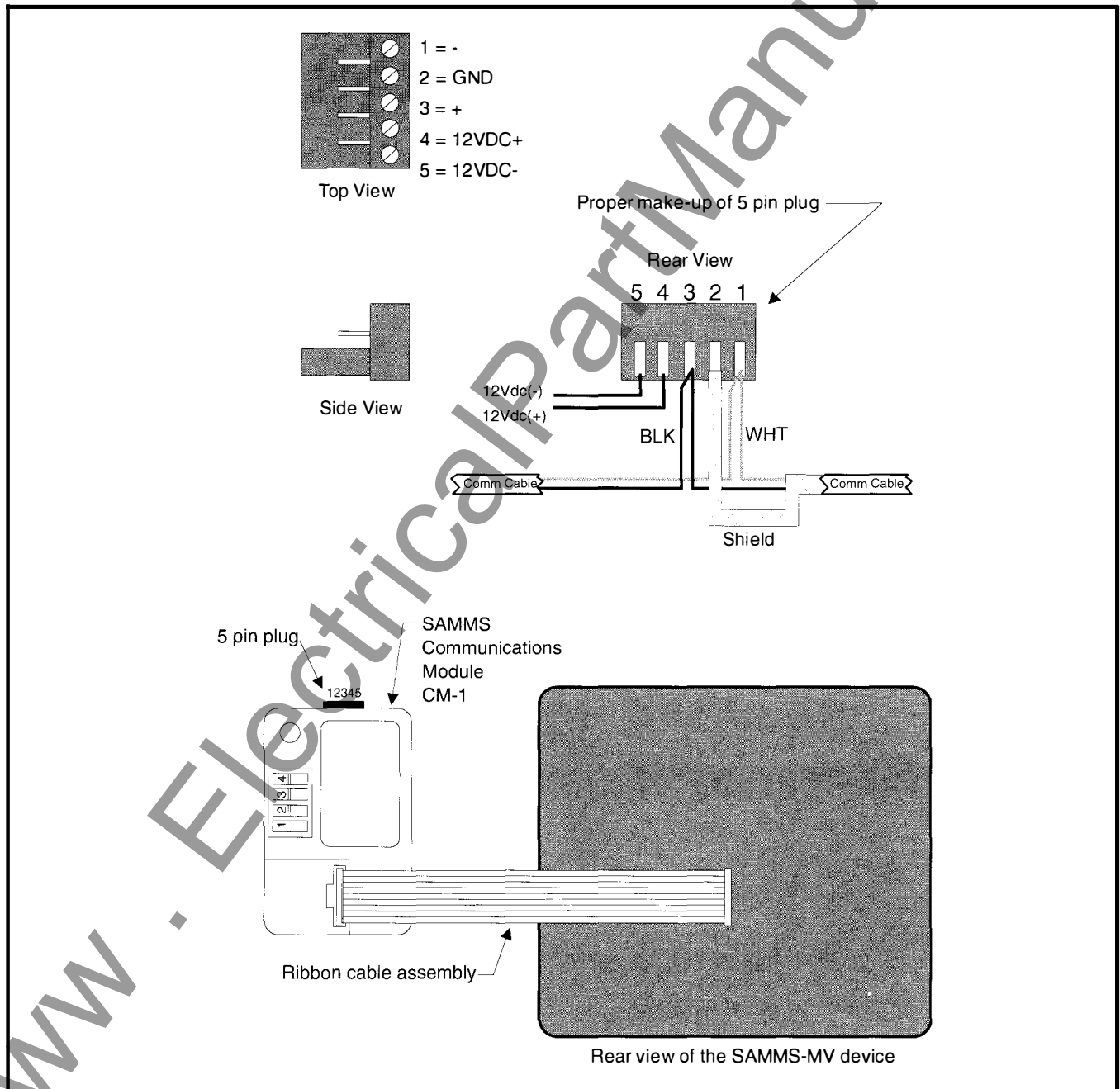


Figure 2.3 SAMMS-MV device communications connections

3 Operating the SAMMS-MV Device

3 Operating the SAMMS-MV Device

This section explains how to operate the SAMMS-MV device.

3.1 Password Protection

Changing the settings of the SAMMS-MV device requires the use of the Hand-Held Communicator (HHC) in the program mode. To access the program mode, the user needs a password. The SAMMS-MV device is shipped from the factory with the password "0000." This password can be changed by the user as described in section 3.29.1. Display of data using the HHC does not require use of a password.

3.2 Using the Reset/Test Push Button

The Reset/Test pushbutton is located at the bottom center of the front panel of the SAMMS-MV device as illustrated in Figure 3.1. You press this pushbutton to manually reset the SAMMS-MV device after a fault or a trip condition occurs so that the motor can be restarted. You can also use the Reset/Test pushbutton to perform a lamp test or an overload relay test.

3.2.1 Performing a Lamp Test

To test the diagnostic LEDs, the control LEDs and the light bars on the front panel, use the following procedure:

1. Press and hold the Reset/Test pushbutton for one to two seconds.
2. Release the Reset/Test pushbutton. (All LEDs and light bars on the front panel illuminate for two seconds.)

If a fault or trip condition exists when you press the Reset/Test pushbutton, the device performs a reset instead of a lamp test.

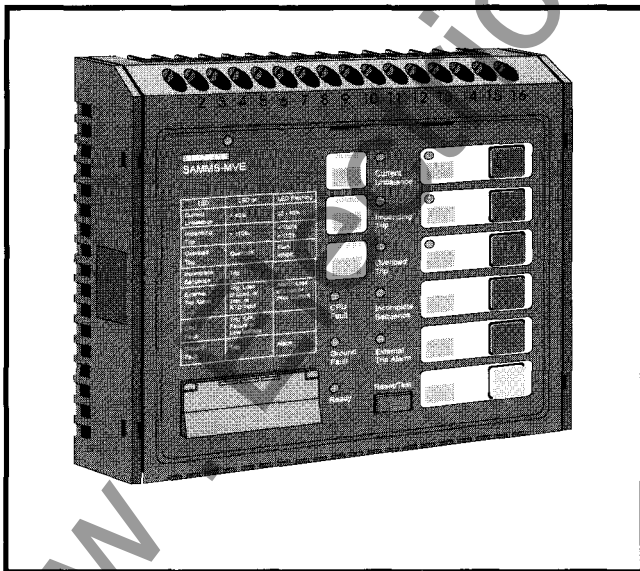


Figure 3.1 Front view of SAMMS-MV

3.2.2 Performing an Overload Relay Test

You may perform an overload relay test whenever the motor is stopped. Use the following procedure to perform an overload relay test.

1. Press and hold the Reset/Test pushbutton for at least the duration of the class time. The class time is set by accessing function F7. If you need to know how to access function F7, see Section 3.29. If you release the Reset/Test pushbutton before the duration of the class time, the device performs a lamp test. If a fault or trip condition exists when you press the Reset/Test pushbutton, the device performs a reset instead of a lamp test.
2. Continue to hold down the Reset/Test pushbutton. After reaching the class time duration, the Overload Trip LED illuminates.
3. Release the Reset/Test pushbutton. The Overload Trip LED goes off, the Impending Trip LED and the Phase Unbalance LED illuminate for two seconds. If the SAMMS-MV device is tripped, it is automatically reset at the end of the overload relay test.

Use the following procedure to reset the SAMMS-MV device after a trip event.

1. Press the Reset/Test pushbutton.
2. Release the Reset/Test pushbutton. The device resets the alarm LEDs. If the motor has cooled sufficiently, you can restart the motor.

3.3 Motor Control

You can configure the SAMMS-MV device to perform many motor starting and control functions. These functions include basic across-the-line, to more complicated reversing, two-speed, and reduced-voltage starting. The SAMMS-MV device stores in its memory the executable code representing the ladder diagram for the user's control application. The SAMMS-MV device and ladder diagram code replace the conventional control logic defined by wired interconnection of electromechanical timers, control relays, pushbuttons, selector switches, and pilot lights. A library of over 40 standard ladder diagrams available for the SAMMS-MV device covers most applications. In addition to the standard ladders, you can construct custom ladder diagrams, using optional software, to handle special applications.

Figures 3.2 and 3.3 illustrate the ladder symbols representing input and output devices available for the SAMMS-MV device. The circular symbols represent output devices such as contactor coil drivers, pilot LEDs on the front panel of the SAMMS-MV device, software time-delay relays and software control relays. All other symbols represent input devices such as software auxiliary contacts, remote AC inputs, front-panel pushbuttons, and software timer instantaneous and timed contacts.

3 Operating the SAMMS-MV Device

3.4 Output Devices

You can use the following SAMMS-MV output devices:

AC Outputs

The SAMMS-MVX device provides up to three AC coil drivers capable of driving contactors up to size H6, while SAMMS-MVE provides one coil driver.

Control Relays

The device provides up to eight software-controlled relays. These relays are helpful in local two-wire and other applications requiring maintained contacts.

Timing Relays

The SAMMS-MV device contains four internal software timing relays. You can configure all four timers as on-delay timers; however, if needed, you can configure the two adjustable timers (timing relays TR1 and TR2) as either on-delay or off-delay timers. Using the Hand Held Communicator, you can program timing relays TR1 and TR2 from 0 through 200 seconds (functions F13 and F14). Timing relay TR3 has a fixed 1 second delay, and timing relay TR4 has a fixed 30 seconds delay. Table 3.1 illustrates the type of timers used on the device and their ranges.

Timer	Type	Time (in seconds)
TR1	Programmable on-delay or off-delay	0 - 200
TR2	Programmable on-delay or off-delay	0 - 200
TR3	Fixed on-delay	1
TR4	Fixed on-delay	30

Table 3.1 Types of software timing relays

Pilot LEDs

The SAMMS-MVX device contains three light bars on the front panel, while the SAMMS-MVE contains two light bars. Light bar L1 is reserved and must be used as the STOP or OFF LED. You can configure L2 and L3 at your discretion. The Hand, Off and Auto LEDs correspond to the Hand, Off and Auto pushbuttons on the front panel as illustrated in Figure 3.4. You can use the Incomplete Sequence LED in reduced-voltage applications or to verify contactor operation. Refer to Figure 3.4 for the location of the LEDs and Table 3.2 for a description of the LED states.

Flashing Pilot LEDs

The front panel contains two or three flashing light bars that indicate various conditions such as on-delay timing. These flashing light bars, L1, L2 and L3 as defined above, indicate different output devices if they are flashing rather than if they are on constantly. Refer to Figure 3.4 for an illustration of pilot LEDs.

3.5 Input Devices

You can use the following input devices with the SAMMS-MV device.

Remote AC Inputs

For SAMMS-MVX you can use four 120 VAC or VDC inputs for remote control, or you can use one input for SAMMS-MVE.

Front Panel Pushbuttons

The SAMMS-MV device has six front-panel pushbuttons for local control of the device. You must use pushbutton 1 (PB1) for stopping the motor. You must use three of the pushbuttons (PB4-PB6) for the Hand, Off and Auto functions if these functions are used in your configuration. If these functions are not used, you may use PB4-PB6 for other functions. You can configure the other two pushbuttons (PB2 and PB3) at your discretion. Refer to Figure 3.4 for assignment of pushbuttons. Insert labels are used to identify the function associated with each pushbutton or light bar.

Software Auxiliary Contacts

Any number of internal (software) auxiliary contacts can be configured. These contacts show either a normally open (NO) or normally closed (NC) status. You can set up these auxiliary contacts using the SAMMS-MV software. Through the SAMMS-MV software, the pilot LEDs also have auxiliary contacts.

LED	STATE	
	On	Flashing
Current Unbalance	> 40%	20 - 40%
Impending Trip	> 110%	> 100% - <110%
Overload Trip	Trip	Start Inhibit
Incomplete Sequence	Trip	
External Trip/Alarm	Trip: Loss of Load or Jam or RTD	Alarm: Loss of Load or Process Current
CPU Fault	Trip: CPU Failure or Low Voltage	
Ground Fault	Trip	Alarm
Light bar (L1)	Stop or Off	Off Delay Timer Timing
Light bar (L2)	Start, On, Forward, Low Speed, Right	On Delay Timer Timing
Light bar (L3)	Reverse, High Speed, Left	On Delay Timer Timing

Table 3.2 Description of pilot LEDs

Software Timer Inputs

Each timer has an unlimited number of normally open (NO) and normally closed (NC) contacts. Timers configured as on-delay timers have an unlimited supply of normally open timed-closed (NOTC), and normally closed timed-open (NCTO) contacts. Timers configured as off-delay timers have an unlimited supply of normally open timed-open (NOTO), and normally closed timed-closed (NCTC) contacts.

Communications Inputs

A serial, RS-485 communications port is located on the back of the device for external communications.

3 Operating the SAMMS-MV Device

The communications inputs must be included in the ladder logic (control circuit).

3.6 Ladder Diagrams

3.6.1 Library of Standard Ladder Diagrams

The SAMMS-MV library of more than 40 ladder diagrams covers most standard motor control applications. Table 3.3 lists the standard control circuits and the input and output assignments for the library. You can use the library with the following starter types:

- across-the-line, non-reversing
- across-the-line, reversing
- two-speed, two winding
- two-speed, one-winding, constant or variable torque
- two-speed, one-winding, constant horsepower
- reduced-voltage, autotransformer
- reduced-voltage, reactor

For each starter type, the library includes seven control types:

- local two-wire
- local three-wire

- local three-wire, remote two-wire
- local two-wire, remote two-wire
- local three-wire, remote three-wire
- remote two-wire
- remote three-wire

SAMMS-MVE has seven preloaded circuits (ladder diagrams) for use with across-the-line (FVNR) applications. SAMMS-MVX may be used with any of the circuits.

For details on the library of standard ladder diagrams, refer to the SAMMS Standard Circuit Manual.

3.6.2 Custom Ladder Diagrams

For special motor control applications not covered by the library of standard ladders, you can construct custom ladder diagrams using the input and output devices and their associated symbols for the SAMMS-MV device. Siemens personnel can build these custom ladder diagrams or you can build your own. You can purchase an optional IBM PC-compatible software package to develop custom ladder diagrams for special control applications. The package also includes a library of standard symbols. The package enables you to reconfigure existing SAMMS-MV devices to meet changing plant needs. Refer to the Custom Software Manual for the SAMMS device, Bulletin CP 3291.

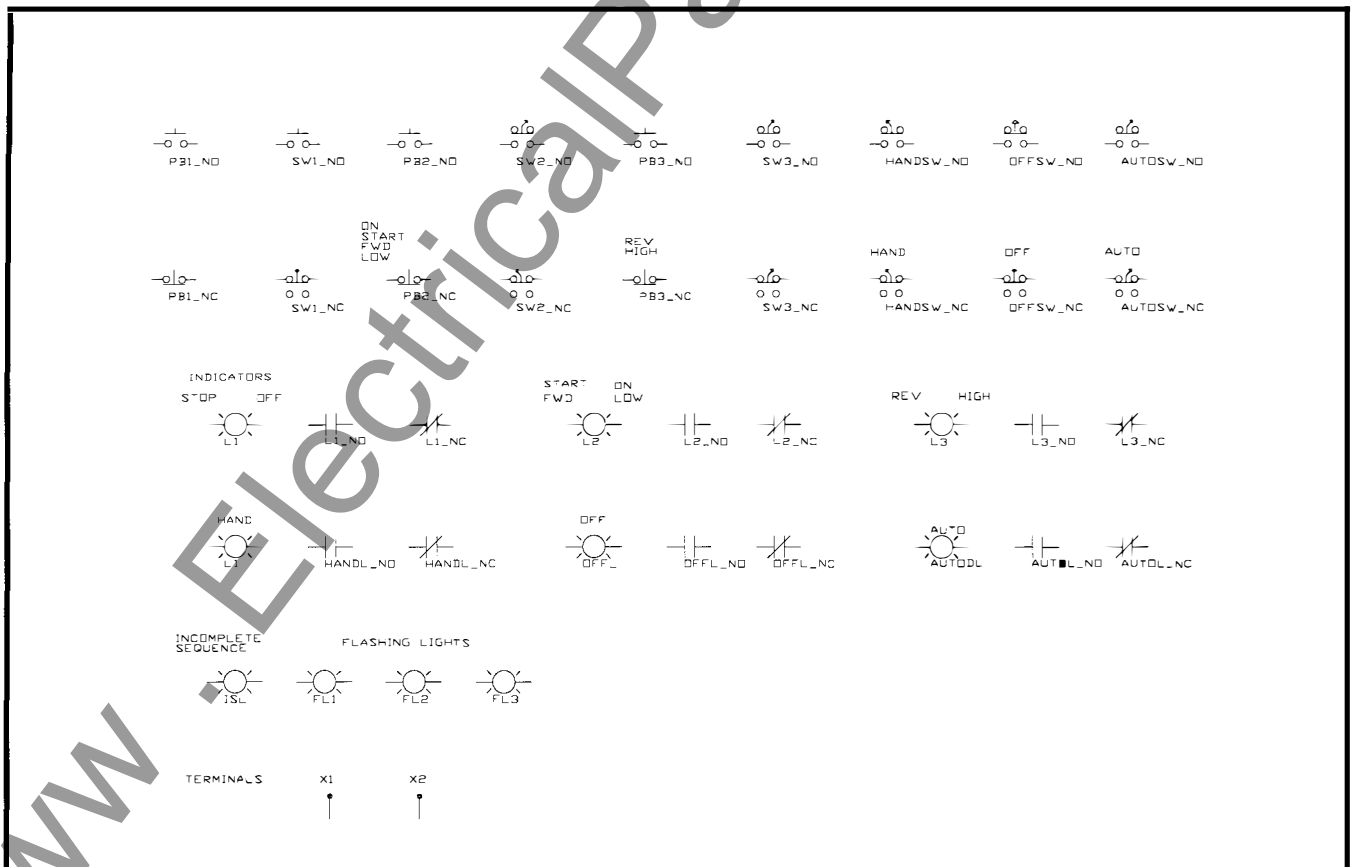


Figure 3.2 Ladder symbols used with the SAMMS-MV device (sheet 1)

3 Operating the SAMMS-MV Device

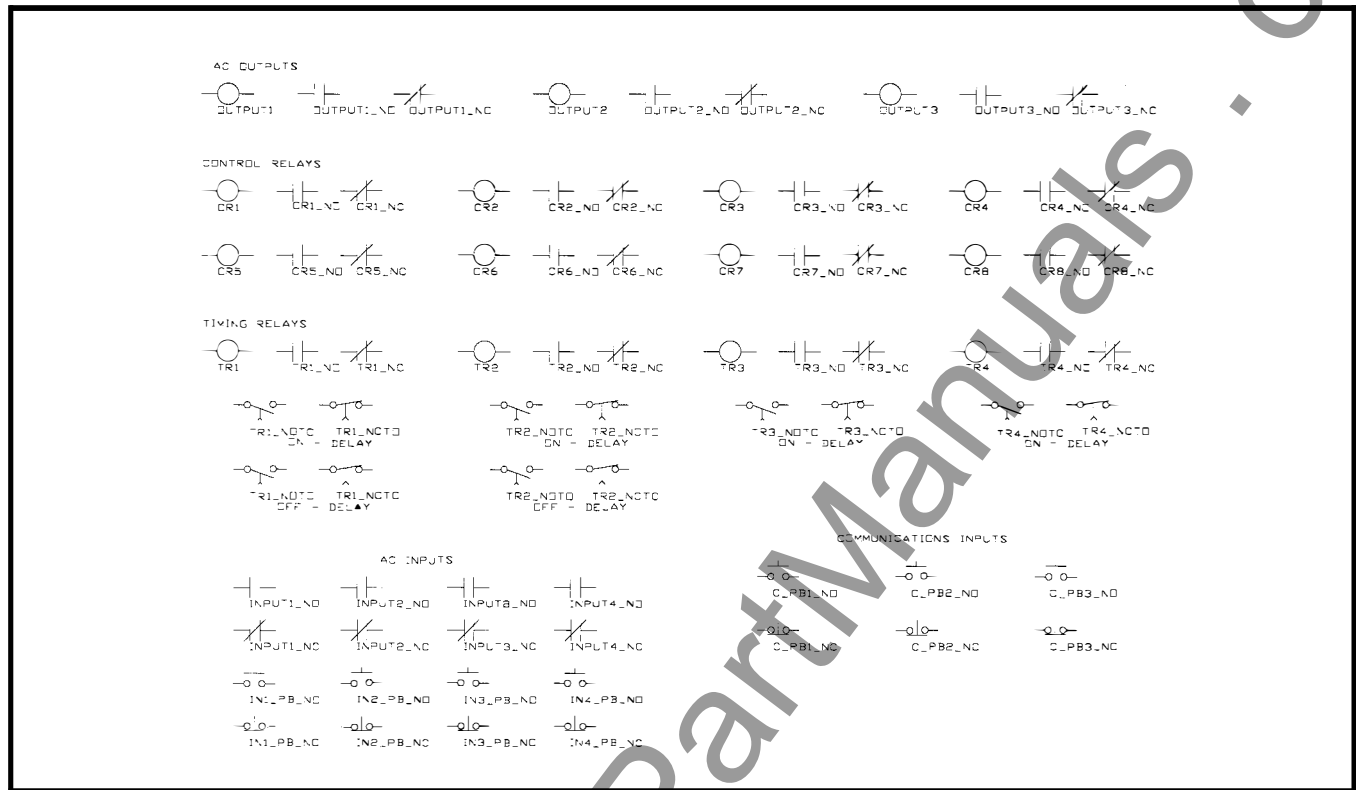


Figure 3.3 Ladder symbols used with the SAMMS-MV device (sheet 2)

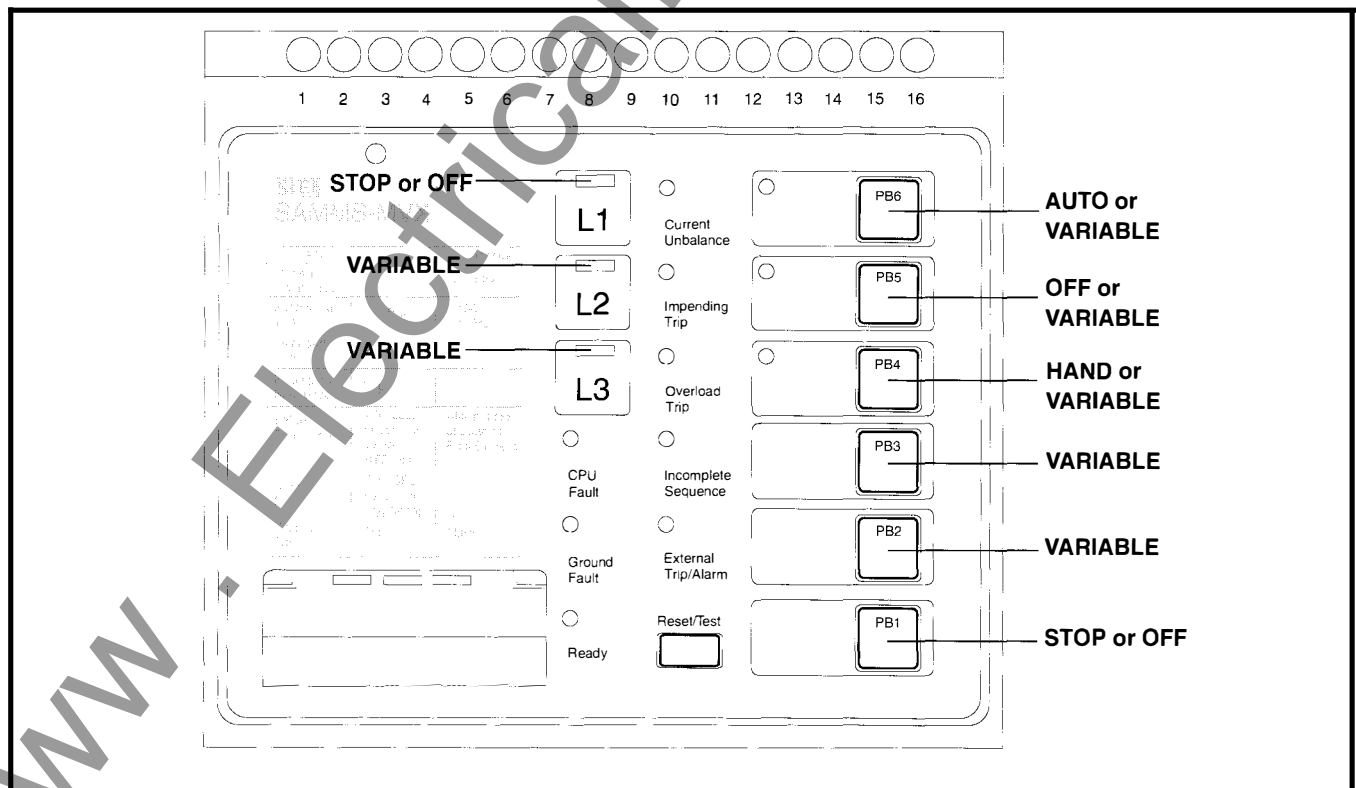


Figure 3.4 Assignment of pushbuttons and light bars

3 Operating the SAMMS-MV Device

	Starter Type	Program Block	Control Type	Input Assignments					
				PB1	PB2	PB3	PB4	PB5	PB6
Preloaded in SAMMS-MVE can be downloaded in SAMMS-MVX	FVNR	PB10	LOCAL, 2-WIRE	OFF	ON				
	FVNR	PB11	LOCAL, 3-WIRE	STOP	START				
	FVNR	PB12	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	START		HAND	OFF	AUTO
	FVNR	PB13	LOCAL/REMOTE 2-WIRE	STOP			HAND	OFF	AUTO
	FVNR	PB14	LOCAL/REMOTE 3-WIRE	STOP	START				
	FVNR	PB15	REMOTE, 2-WIRE						
	FVNR	PB16	REMOTE, 3-WIRE						
Available with SAMMS-MVX only	FVR	PB17	LOCAL, 2-WIRE	OFF	FWD	REV			
	FVR	PB18	LOCAL, 3-WIRE	STOP	FWD	REV			
	FVR	PB19	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	FWD	REV	HAND	OFF	AUTO
	FVR	PB20	LOCAL/REMOTE 2-WIRE	STOP	FWD	REV	HAND	OFF	AUTO
	FVR	PB21	LOCAL/REMOTE 3-WIRE	STOP	FWD	REV			
	FVR	PB22	REMOTE, 2-WIRE						
	FVR	PB23	REMOTE, 3-WIRE						
	FVR	PB24	LOCAL/REMOTE 3-WIRE ELECTRICALLY INTERLOCKED	STOP	FWD	REV			
	2SPD,2W	PB25	LOCAL, 2-WIRE	OFF	LOW	HIGH			
	2SPD,2W	PB26	LOCAL, 3-WIRE	STOP	LOW	HIGH			
	2SPD,2W	PB27	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD,2W	PB28	LOCAL/REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD,2W	PB29	LOCAL/REMOTE 3-WIRE	STOP	LOW	HIGH			
	2SPD,2W	PB30	REMOTE, 2-WIRE						
	2SPD,2W	PB31	REMOTE, 3-WIRE						
	2SPD, 1W, CT OR VT	PB32	LOCAL, 2-WIRE	OFF	LOW	HIGH			
	2SPD, 1W, CT OR VT	PB33	LOCAL, 3-WIRE	STOP	LOW	HIGH			
	2SPD, 1W, CT OR VT	PB34	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
2SPD, 1W, CT OR VT	PB35	LOCAL/REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO	
2SPD, 1W, CT OR VT	PB36	LOCAL/REMOTE 3-WIRE	STOP	LOW	HIGH				
2SPD, 1W, CT OR VT	PB37	REMOTE, 2-WIRE							
2SPD, 1W, CT OR VT	PB38	REMOTE, 3-WIRE							

Table 3.3 Standard control circuits

3 Operating the SAMMS-MV Device

	Starter Type	Program Block	Control Type	Input Assignments					
				PB1	PB2	PB3	PB4	PB5	PB6
Available with SAMMS-MVX only	2SPD, 1W, CH	PB39	LOCAL, 2-WIRE	OFF	LOW	HIGH			
	2SPD, 1W, CH	PB40	LOCAL, 3-WIRE	STOP	LOW	HIGH			
	2SPD, 1W, CH	PB41	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD, 1W, CH	PB42	LOCAL/REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD, 1W, CH	PB43	LOCAL/REMOTE 3-WIRE	STOP	LOW	HIGH			
	2SPD, 1W, CH	PB44	REMOTE, 2-WIRE						
	2SPD, 1W, CH	PB45	REMOTE, 3-WIRE						
	RVA (Auto TX)	PB46	LOCAL, 2-WIRE	OFF	ON				
	RVA (Auto TX)	PB47	LOCAL, 3-WIRE	STOP	START				
	RVA (Auto TX)	PB48	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	START		HAND	OFF	AUTO
	RVA (Auto TX)	PB49	LOCAL/REMOTE 2-WIRE	STOP			HAND	OFF	AUTO
	RVA (Auto TX)	PB50	LOCAL/REMOTE 3-WIRE	STOP	START				
	RVA (Auto TX)	PB51	REMOTE, 2-WIRE						
	RVA (Auto TX)	PB52	REMOTE, 3-WIRE						
	RVA (Reactor)	PB301	LOCAL, 2-WIRE	OFF	ON				
	RVA (Reactor)	PB302	LOCAL, 3-WIRE	STOP	START				
	RVA (Reactor)	PB303	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	START		HAND	OFF	AUTO
	RVA (Reactor)	PB304	LOCAL/REMOTE 2-WIRE	STOP			HAND	OFF	AUTO
RVA (Reactor)	PB305	LOCAL/REMOTE 3-WIRE	STOP	START					
RVA (Reactor)	PB306	REMOTE, 2-WIRE							
RVA (Reactor)	PB307	REMOTE, 3-WIRE							

Table 3.3 Standard control circuits (continued)

3 Operating the SAMMS-MV Device

3.7 Incomplete Sequence

Sometimes the motor contactors do not respond in a timely manner to start, stop, transition, speed or direction change commands from the controller. If the SAMMS-MV device does not detect motor current one second after issuing a start command or if the SAMMS-MV device detects motor current one second after issuing a stop command, an Incomplete Sequence trip occurs. The motor contactors are opened and the Incomplete Sequence LED illuminates solidly. In standard reduced-voltage autotransformer (RVA) starters, an incomplete sequence also occurs if the remote RUN seal-in contact wired to pin 9 does not close within one second of the transition from starting to full-speed operation. This function can be disabled permanently when configured at the factory. You can also disable it with the Hand Held Communicator to the SAMMS-MV device. This is helpful when the controller is tested before connecting to the motor. After connecting the HHC, use the function UP and DOWN buttons to select F1. While pressing the ENTER button for a period of one second push START. Repeating the same process enables the incomplete sequence protection function.

3.8 Intelligent Reduced-Voltage Starting (SAMMS-MVX Only)

Intelligent reduced-voltage starting is provided in all standard reduced-voltage Siemens starters. The advantage of this feature is that the transition from reduced to full voltage is determined by the magnitude of the actual motor current and not by a timer. This optimizes the transition.

When a motor with intelligent reduced-voltage starting is started, a 30 second timer is energized. If the timer times out, the transition to full voltage commences as a fail-safe measure. If, before the 30 second timer times out, the motor current drops to below the full-load current setting, the transition commences.

The state of the RUN contactor, whose auxiliary contact is connected to Remote input 4 (pin 9), is checked one second after the transition. If the contactor is not closed, an incomplete sequence trip occurs.

3.9 Ridethrough Upon Loss of Power (SAMMS-MVX Only)

If a motor is running and control power is lost, the motor restarts automatically with two-wire control as soon as power is restored. With three-wire control, you must restart the motor manually. The optional ridethrough feature available with SAMMS-MVX allows three-wire controls to ride through power outages of up to one second. This feature is especially useful where the power system is subject to momentary interruptions. If, while the motor is running, power is lost to a three-wire control having the ridethrough option, the contactors are opened to prevent chattering and then reclosed automatically if power returns within one second.

3.10 Overload Protection

Medium-voltage motors are rotor limited under locked rotor conditions, and stator limited under running overload conditions. Additionally, the type of motor construction affects the thermal behavior of the rotor. For example, open drip-proof motors have

significantly shorter cold stall times than totally enclosed fan-cooled motors. The motor protection algorithm in the SAMMS-MV device is designed specifically to provide rotor protection based on the type of motor construction, and to differentiate between a stalled rotor and a rotor accelerating to running speed.

The motor overload protection function is based on calculating the motor's winding, housing, and rotor temperatures. These temperatures are compared to the allowable temperature limits for the motor's winding, housing, and rotor. On the basis of this comparison, the SAMMS-MV device either stops the motor or allows it to run.

For example, consider the motor winding and rotor temperature rises illustrated in Figure 3.5. The motor starts for 5 seconds and runs for a period of 2200 seconds. Then, the motor is subjected to a running overload condition that raises the winding temperature to the maximum allowable winding temperature resulting in an overload trip. At this temperature, the motor cannot start until the motor winding temperature cools down to the full-load temperature. The motor can then start and run at full-load current. Figure 3.6 depicts the temperature rise in the rotor and stator winding during a 10 second stall for an ODP motor. In this case, the rotor temperature rises at a rate faster than the winding temperature, and reaches the maximum allowable value resulting in a trip. In order to prevent damage to the motor, SAMMS-MV will not allow the motor to start until the winding and the rotor temperatures cool down to the full load temperature or less.

In the motor model, the greatest of the root mean square (RMS) current values for the motor phases is converted into a heat-like quantity. This is done by a mathematical function that depends on the ratio of the RMS current to the full-load current set for the motor. The function is based not only on ideal overload characteristics, but also on empirical motor data. The heat-like quantity is analogous to an input source of current to the electric-circuit analog. The exact values of the various elements in the circuit depend, in some cases, on nameplate data entered for the particular motor being protected. Unlike the method of protection in conventional overload relays, the motor model is general enough to protect many classes of motors, yet sophisticated enough to offer customized protection to particular motors. To customize protection to the motor enter the following nameplate data:

- full-load current setting (F4)
- service factor (F6)
- type of motor construction (Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (EFC) (F6)
- cold stall time, if available (F7)
- motor ambient temperature (F0)

3.11 Motor Ambient Temperature

Motors are used in a wide range of temperatures. However, motors designed according to NEMA standards are rated at 40°C ambient temperature.

The SAMMS-MV allows you to decrease or increase the motor's thermal capacity according to the motor's ambient temperature. You can select ambient temperature from 0° to 70°C in increments of 5°C, with HHC function F0.

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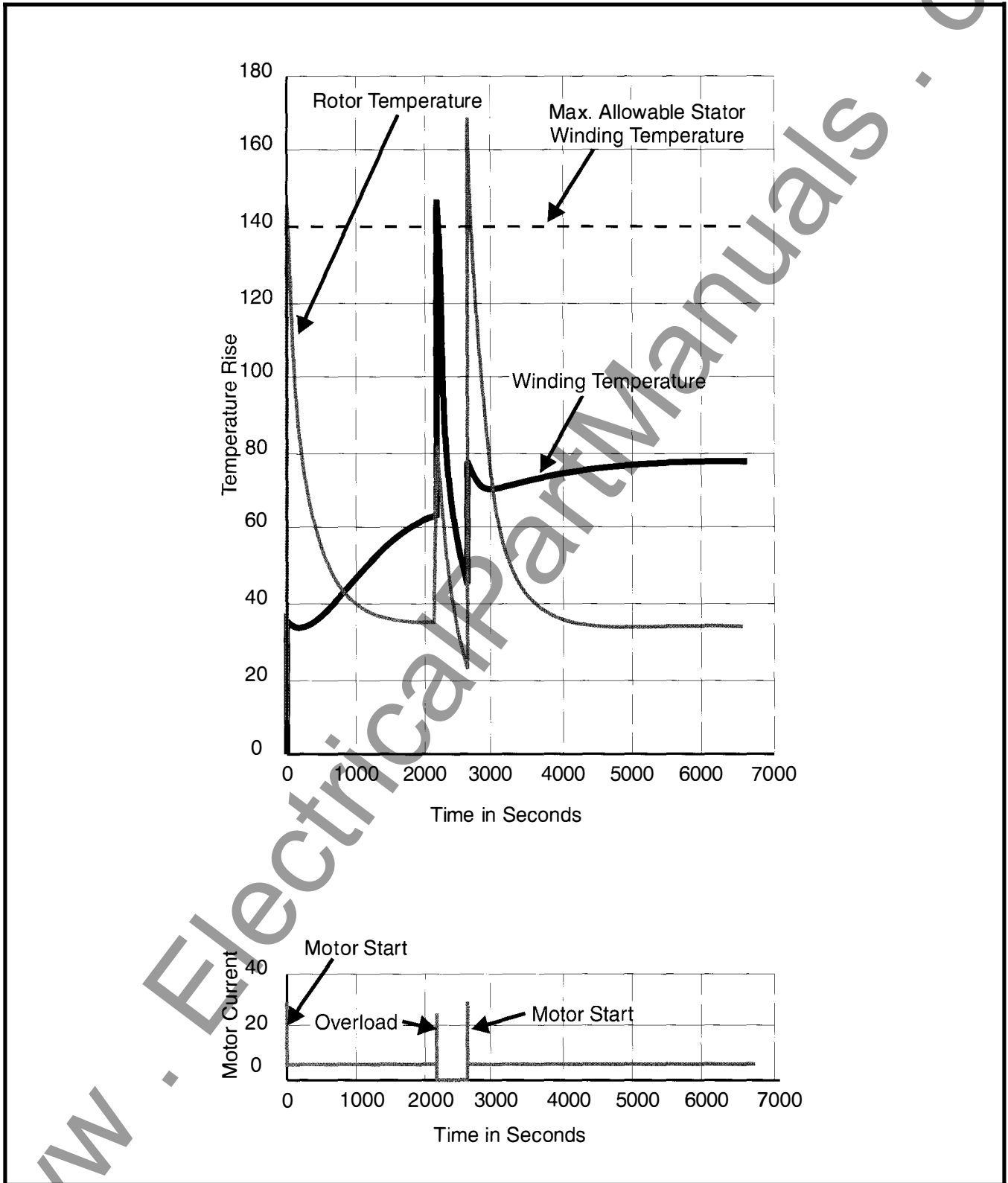


Figure 3.5 ODP motor thermal signature

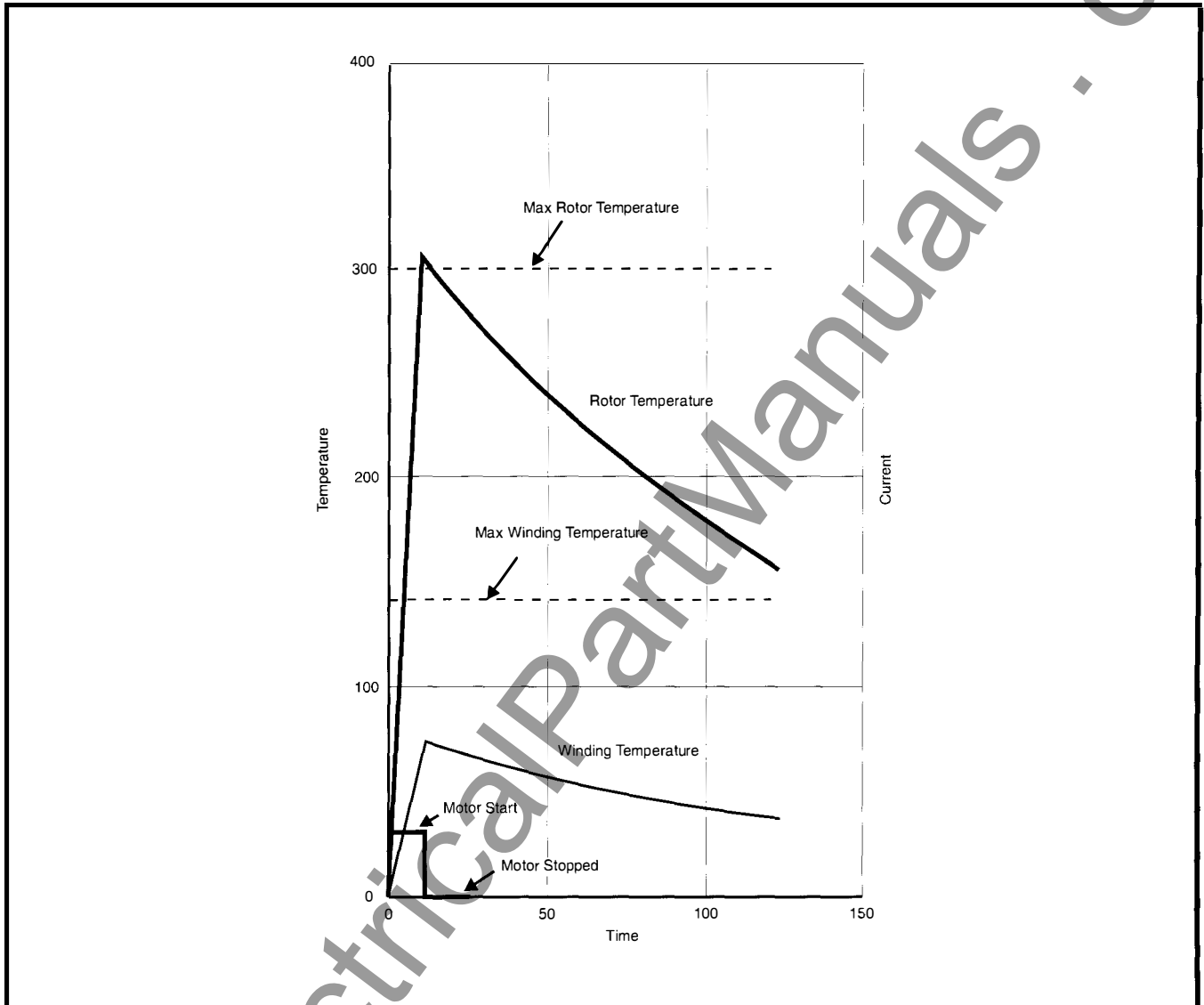


Figure 3.6 Rotor and winding temperature during 10 second motor stall

Important: Do not use this feature with motors rated for ambient temperature other than the standard 40°C.

3.12 Protection Curves and Overload Classes

The specific motor protection curve selected depends upon the overload class setting. The overload class is defined as the maximum tripping time in seconds for a current level of 600% of the full-load current or I_{FLC} . (The typical starting current of motors is 600% of I_{FLC} .) For example, an overload class setting of 10 guarantees that a current of 600% of I_{FLC} will cause a trip in 10 seconds or less. In the SAMMS-MV, the protection curves are designed to cause a trip in 90% to 100% of the class time for a current of 600% of I_{FLC} .

The lowest overload class, greater than or equal to the motor's starting time, gives the best protection. Overload classes 2 through 23 are available in SAMMS-MV. The range of protection curves are shown in Figures 3.7 through 3.10.

Important: In the unlikely event that the motor acceleration time (overload class) exceeds the motor's stall time, use a speed switch as an input source to open the contactor if the switch senses a locked rotor or stall condition.

Note: For clarity, the time-current characteristic curves in this manual are shown with overload classes 2, 5, 10, 15 and 23 only. Use interpolation to derive values of other overload classes not shown.

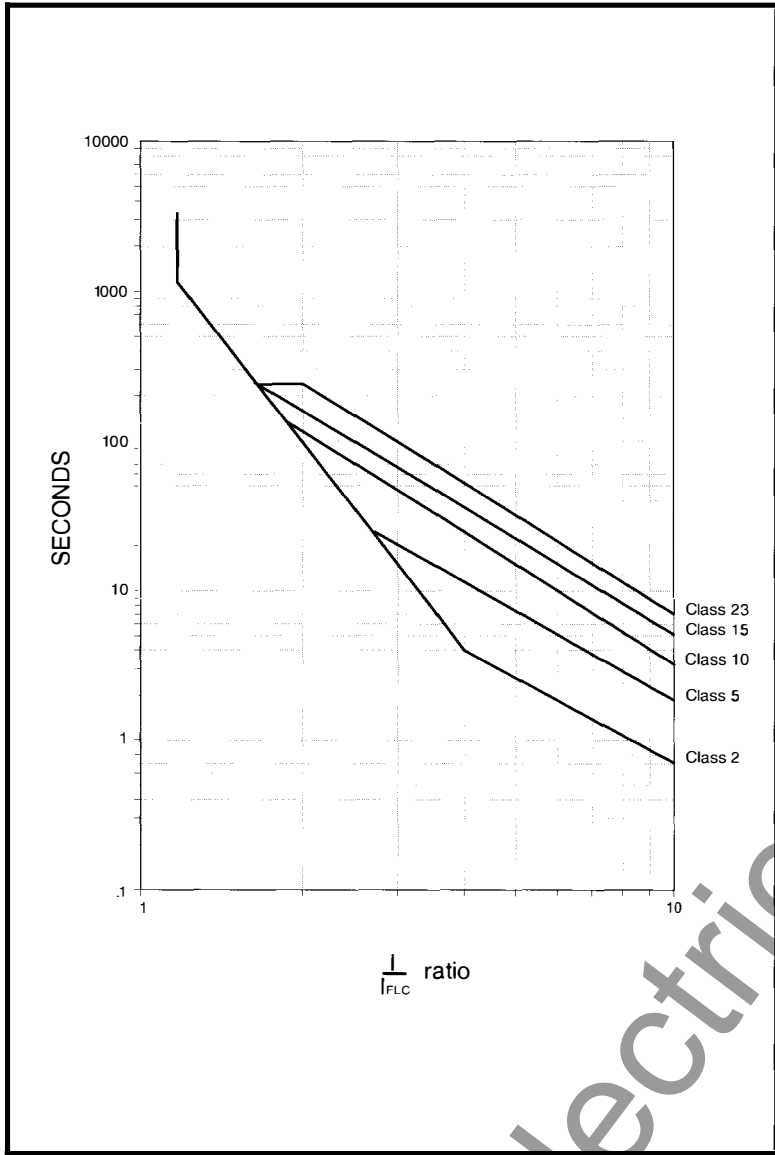


Figure 3.7 Time-current characteristic curve for cold motors with SF=1.00

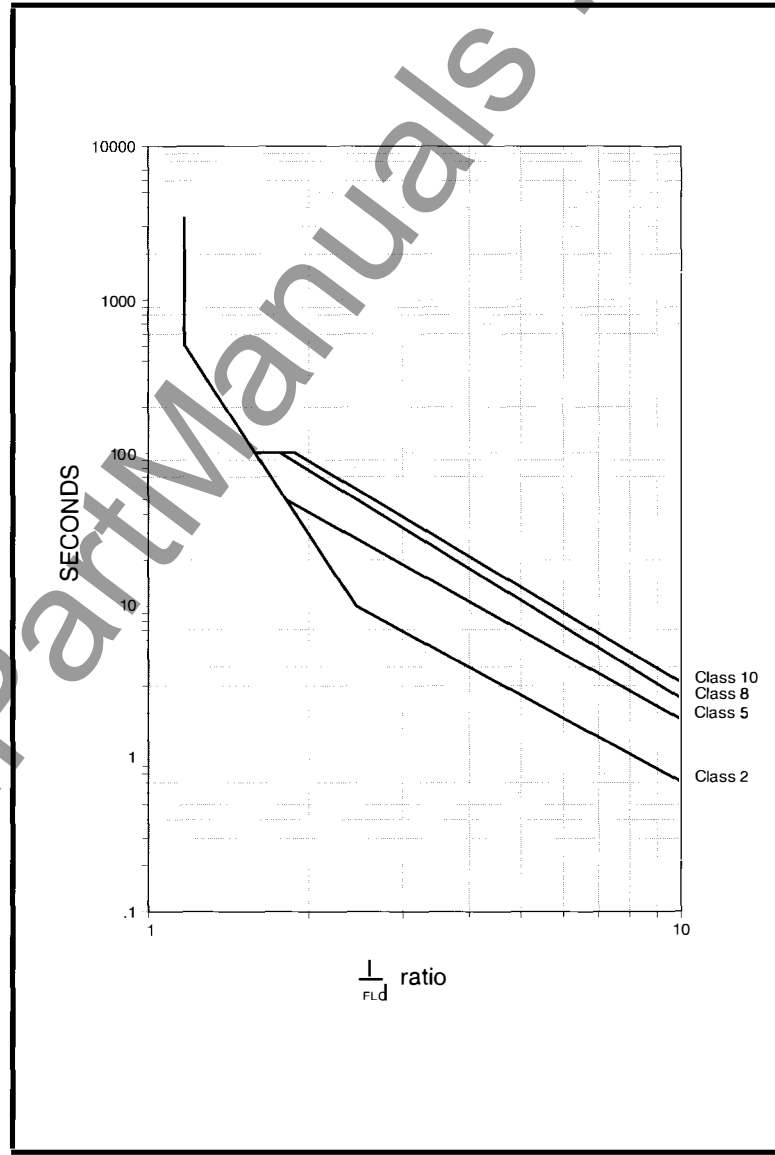


Figure 3.8 Time-current characteristic curve for warm motors with SF=1.00

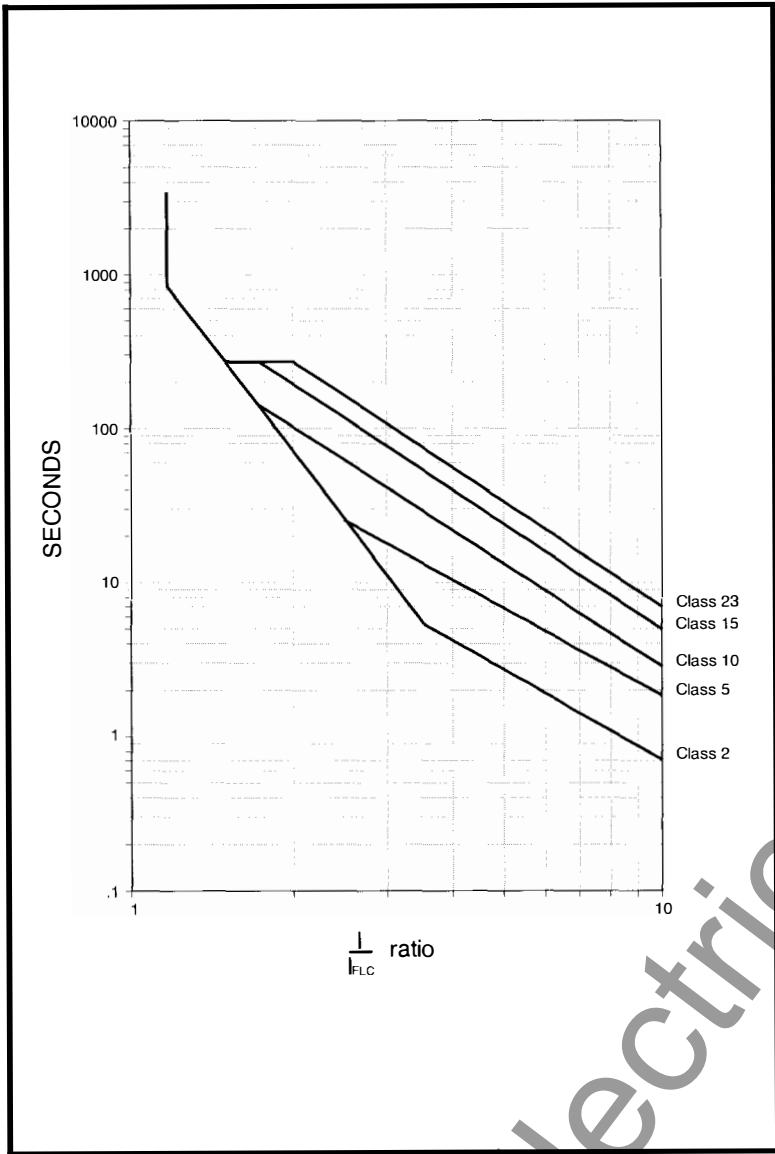


Figure 3.9 Time-current characteristic curve for cold motors with SF=1.15

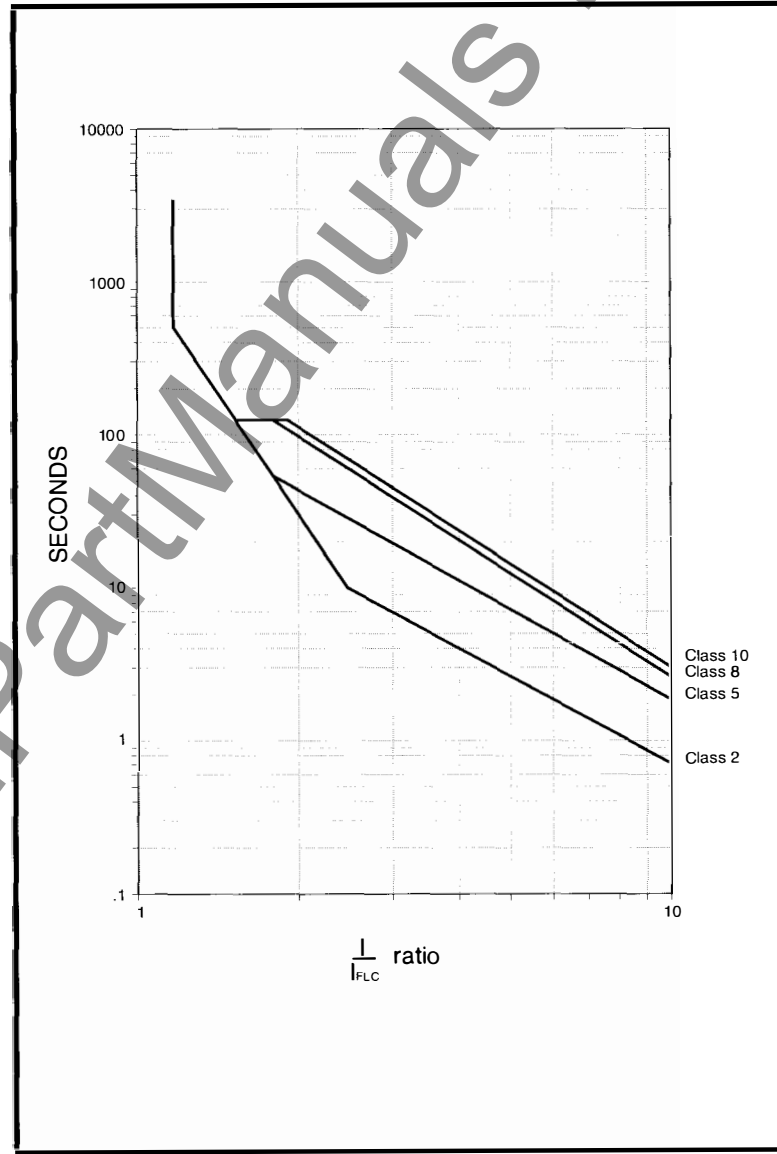


Figure 3.10 Time-current characteristic curve for warm motors with SF=1.15

3 Operating the SAMMS-MV Device

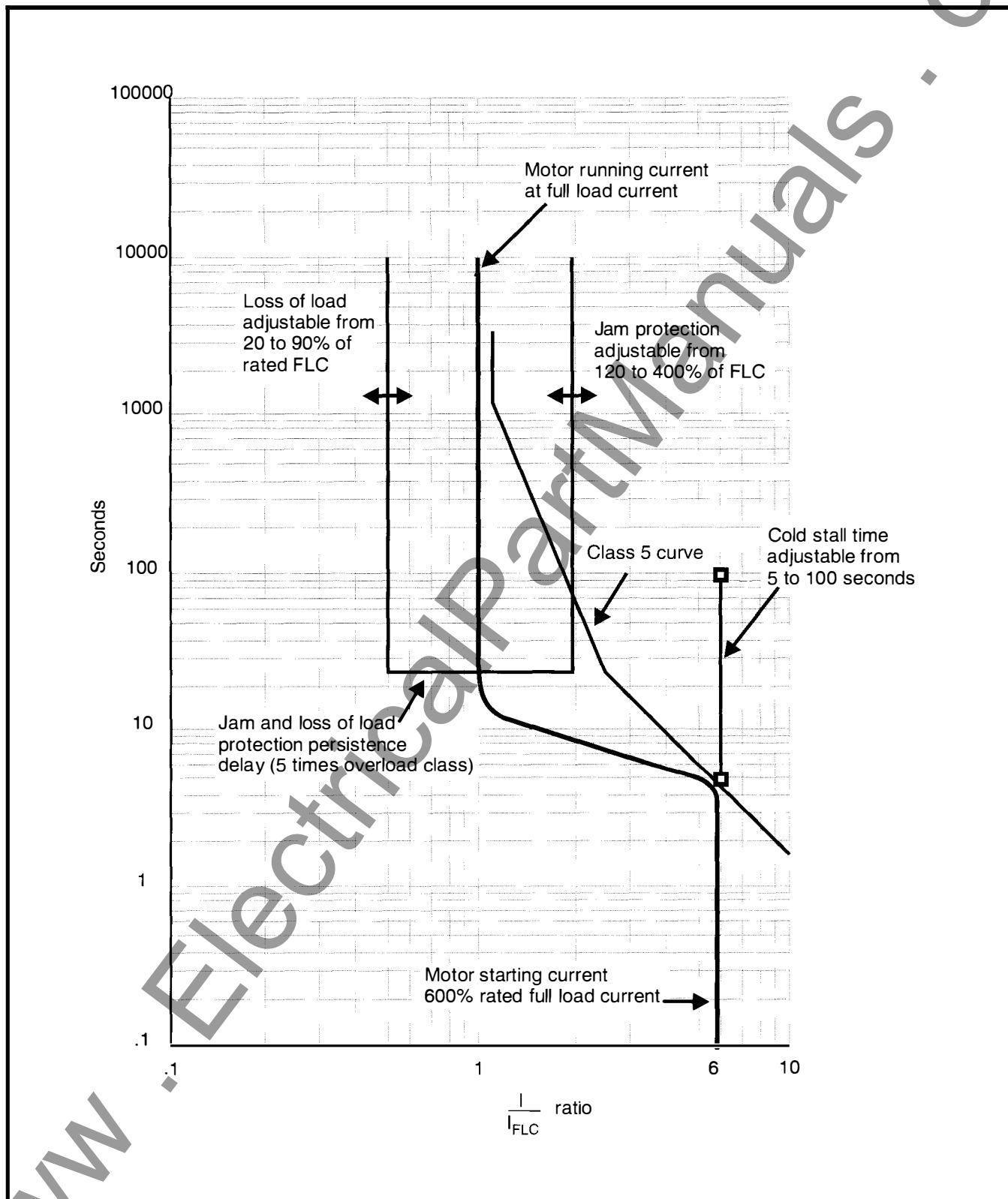


Figure 3.11 Motor protection graph

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3.13 Ultimate Trip Level and Service Factor

The ultimate trip level is the maximum continuous current that does not cause an overload trip. Any higher current applied indefinitely to an unprotected motor will ultimately damage it. The ultimate trip level for motors with a unity service factor is 110% of the full-load current setting. For motors with a service factor of 1.15, the ultimate trip level is 120%. You can select a service factor of 1.00 or 1.15 with HHC function F6.

3.14 Phase Unbalance

Unbalanced three-phase voltages or loss of one phase can result in unbalanced currents being supplied to the motor. Unbalanced currents include negative-sequence components that produce heat in the motor winding, decreasing the efficiency of the motor for a given load. The SAMMS-MV device measures the magnitude of the current unbalance as the maximum deviation from the average of the three-phase currents, divided by the average of the three-phase currents. In case of loss of a phase, the unbalance is 100% in a three-wire, ungrounded system.

With phase unbalance protection enabled, current unbalances of between 20% and 40% cause the Phase Unbalance LED to flash as a warning. If the unbalance increases to above 40%, the Phase Unbalance LED illuminates solidly and overload tripping accelerates. The effect of an unbalance of greater than 40% is to shift the motor protection curve in the direction of faster tripping.

You enable the phase unbalance protection using HHC function F9.

- Enabled = ON
- Disabled = OFF

With phase unbalance protection enabled, HHC function F17 displays the percentage of current unbalance. Both functions display OFF if phase unbalance protection is disabled.

3.15 Dual Overload Protection (SAMMS-MVX Only)

Because the high-speed and low-speed currents differ in two-speed motors, different full-load current settings are often required. In such applications, use function F5 to select the full-load current for low-speed operation.

3.16 Jam Protection (SAMMS-MVX Only)

Certain mechanical loads, especially those containing gears, are susceptible to jamming. Jam protection can prevent damage to the motor and the driven equipment by quickly tripping the motor off-line in the event of a jam. If you have enabled jam protection, you may adjust the jam trip level from 120-400% of I_{FLC} . The jam trip time is 360 msec. SAMMS-MVX is normally shipped with jam protection enabled, with a trip level of 200% I_{FLC} (See Figure 3.11). Jam protection is locked out for 5 times the overload class after a start, speed, or direction change. If the jam limits are exceeded, the motor is tripped off-line and the External Trip LED on the front panel solidly illuminates. You can enable jam

protection using HHC function F23.

- enabled = ON
- disabled = OFF

3.17 Loss of Load Protection/Warning (SAMMS-MVX Only)

If the running current of the motor suddenly drops below 20 to 95% (adjustable) of its previous reading in 360 msec, a loss of load has occurred. Such a loss of load could be due to a broken belt or loss of back pressure in a pump. Loss of load detection is locked out for five times the overload class time after a start, direction, or speed change (See Figure 3.11). You can select loss of load protection or warning using HHC function F24.

- protection = ON
- warning = OFF

With protection selected, detection of a loss of load trips the motor off-line and illuminates the External Trip LED. With warning selected, the motor does not trip off-line and the External Trip LED flashes until the current returns to its former steady-state level or higher. SAMMS-MVX is normally shipped with loss of load protection OFF (WARNING), and with default setting of 50% I_{FLC} .

3.18 Process Current Warning (SAMMS-MVX Only)

It is often convenient to have an indication that the load current is above its normal operating level so that the process can be checked and, if necessary, adjusted. You can set the process current warning from 0% (displayed as "OFF") to 100% of the full-load current with HHC function F22. As long as the motor running current exceeds the process current warning level, the External Trip LED flashes. Process current warning is locked out for five times the class time after a start or a direction or speed change.

3.19 Stator Protection

By selecting the overload class slightly greater than or equal to the motor's starting time, the motor model defines an energy I^2t value. In this value, I equals 600% of the motor's full load current and t equals the overload class selected.

If the amount of energy exerted by the motor during start, stall or under locked rotor condition exceeds the amount of energy defined by the overload class selected, the SAMMS-MV device will trip. This protects the motor's winding against excessive heat build up. For example, a typical motor starts within 3 to 4 seconds. By selecting an overload class 4 or 5, you can safely start the motor hot or cold and without nuisance tripping. This also provides protection against stall time exceeding 4 or 5 seconds; assuming the locked rotor current equals 600% of the motor's full-load current (See Figure 3.11).

3.20 Rotor Protection

Since medium-voltage motors are rotor limited under locked rotor conditions, and stator limited under running conditions, the SAMMS-MV device computes an accurate thermal signature of

3 Operating the SAMMS-MV Device

the rotor and provides a signal to trip the motor off-line when it reaches a trip temperature value. The motor model takes into account the change of the rotor resistance during motor startup. Rotor resistance is a function of motor slip; therefore, it is highest at locked rotor and decreases as the motor speeds, and the slip decreases.

You can select motor cold stall time from 5 to 100 seconds in increments of 1 second. The selected time will adjust the rotor loop elements so that the maximum temperature limit in the rotor is reached under locked rotor conditions for the time selected. If cold stall time is not known, the rotor model will assume a cold stall time based on the type of motor used. The user is allowed to select an open drip proof (ODP) motor or a totally enclosed fan-cooled motor (TEFC) motor. The default value for the ODP motor is 10 seconds. The default value for the TEFC motor is 20 seconds.

3.21 Repetitive Starts

The motor model allows repetitive starts without nuisance tripping while protecting the motor against overload and stall conditions. Repetitive starts can occur as long as the following conditions are met:

1. The energy exerted by the motor during start does not exceed the energy defined by the overload class selected.
2. The motor winding temperature does not exceed the maximum temperature allowed.
3. The rotor temperature does not exceed the maximum temperature allowed.
4. The SAMMS-MV is not in start inhibit (See Section 3.22).

For example, a motor starting from cold condition could have 4 or more typical starts of 5 seconds without nuisance tripping and without damaging the motor insulation. Figure 3.12 shows a multi-start scenario for an ODP motor.

3.22 Start Inhibit

When the motor temperature reaches the maximum values allowed, the SAMMS-MV device trips. If you attempt a restart, the overload LED flashes and the motor will not start until the motor winding and rotor temperatures cool down to the full load temperature. HHC function F25 displays the motor winding temperature as a percentage of the full-load temperature. HHC function F10 displays the time to enable restart in seconds.

3.23 Cooling Time Constants

The motor time constant is a function of the motor type. The values listed in Table 3.4 are used in the motor model.

Motor Condition	Delta Temperature	Motor Type	
		TEFC	ODP
Stopped	80° C to 29° C	9900 s	6000 s
Running Idle	80° C to 39.4° C	7200 s	4500 s

Table 3.4 Motor time constants

TEFC motors include the following types of motors:

- Totally Enclosed Fan Cooled
- Totally Enclosed Fan Cooled Explosion Proof
- Totally Enclosed Air-to-Air Cooled (TEAAC)

ODP motors include the following types of motors:

- Drip Proof Weather Protected I (WP-1)
- Weather Protected II (WP-2)
- Open Drip Proof
- Totally Enclosed Water-to-Air Cooled (TEWAC)

3.24 Normalized Temperature Rise for Class B and Class F Insulation

Steady state and maximum winding temperature are functions of the motor's insulation class. In this motor model, normalized temperature rise for both Class B and Class F insulation are used. The motor winding temperature is displayed as a percentage of the steady-state full-load temperature rise as shown in Table 3.5.

Boundary Parameters	Class B Insulation	Class F Insulation	% Full Load Temperature Rise
Steady State Temperature rise at full-load current	80° C	105° C	100
Maximum allowed winding temperature	140° C	185° C	175

Table 3.5 Steady state and maximum winding temperature rise

3.25 Ground Fault Detection

In SAMMS-MV devices, HHC function F12 selects ground fault protection or warning.

- protection = ON
- warning = OFF

The device detects a ground fault if the fault current exceeds the pickup level for 360 msec. If you have selected protection (ON), the motor trips and the Ground Fault LED illuminates until reset. If you selected warning (OFF), the Ground Fault LED flashes as long as the fault current exceeds the pickup level. Table 3.6 lists the pickup levels for each overload size. Ground fault protection is locked out for 1.4 seconds following a start.

3 Operating the SAMMS-MV Device

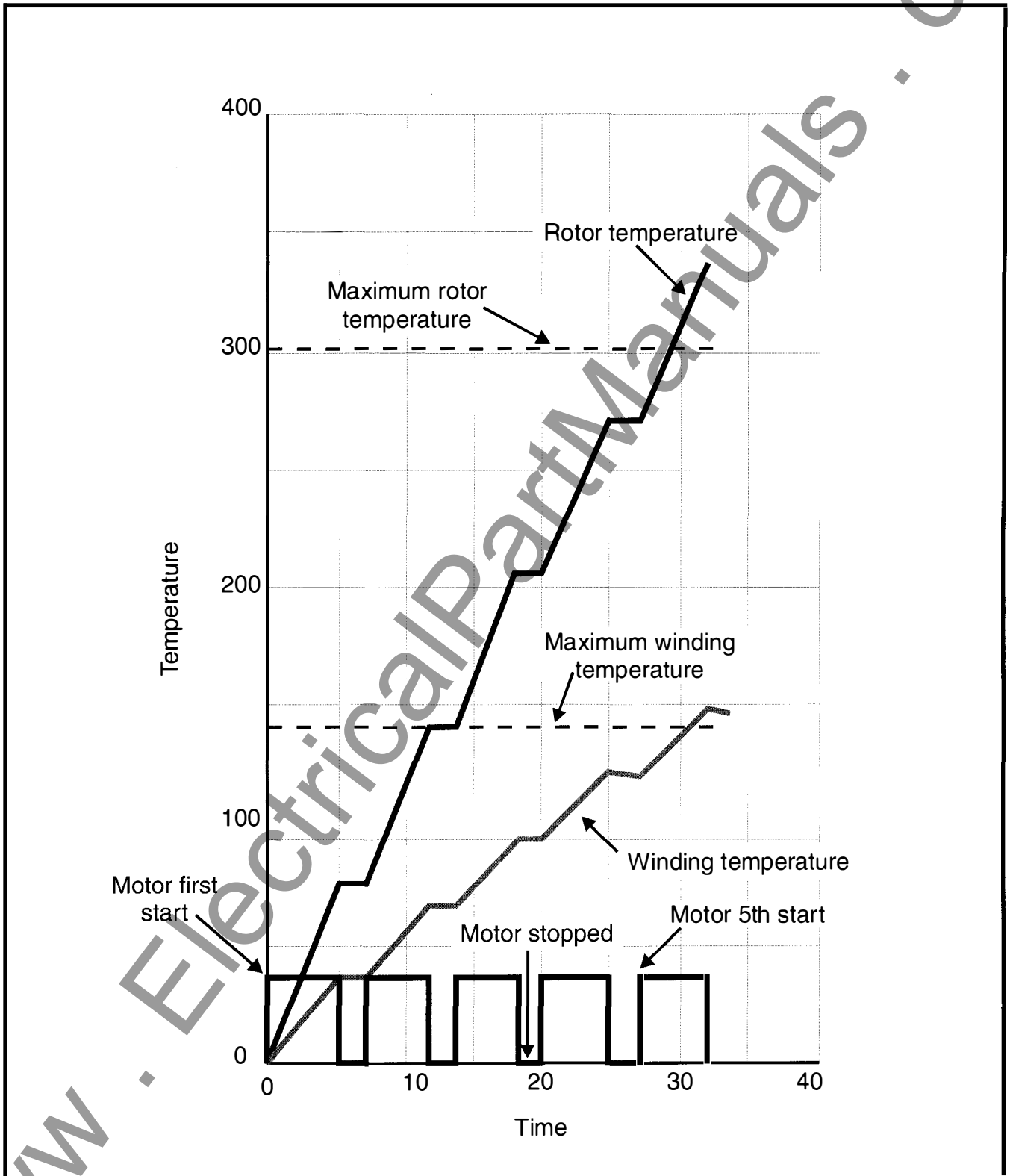


Figure 3.12 Multi-start scenario for an ODP motor

3 Operating the SAMMS-MV Device

Size	Pickup Current Range	Default Pickup Current
H3A	7A to I_{FLC}	10A
H3B	7A to I_{FLC}	10A
H3C	7A to I_{FLC}	10A
H6	7A to I_{FLC}	20A

Table 3.6 Ground fault pickup levels

Ground fault detection requires no additional external circuitry or transformers. Ground fault detection for the SAMMS-MV device is not available for grounded, three-phase systems or single-phase applications. Ground fault pickup time is 360 msec.



3.26 Autoreset After a Trip (SAMMS-MVX Only)

To restart the motor after a trip or a fault, you must first reset the SAMMS-MVX device. You can reset the SAMMS-MV device in one of two ways. First, press the Reset/Test button on the front panel of the device. Second, enable the autoreset with HHC function F8.

- enable = ON
- disable = OFF

With autoreset enabled, overload and external trips automatically reset in 30 seconds after the trip. Once the reset occurs, the SAMMS-MV device can be used to restart the motor, unless the motor has reached its maximum temperature and has not cooled down to the full-load level (start inhibit). Resetting after a trip does not interrupt or otherwise affect the ongoing motor thermal computations.

3.27 Emergency Restarting

In certain critical applications, you may want to restart a hot motor even though restarting will damage or destroy the motor. An emergency restart is a motor start that occurs after an overload trip on maximum allowable winding, housing, or rotor temperature; but before all have cooled down to the full-load temperature level (100%) or below. In other words, an emergency restart is a start that occurs before the restart time displayed by HHC function F10 reaches zero.

With the emergency restart function enabled (HHC function F11), the motor can be restarted regardless of the residual heat. If the SAMMS-MV device performs an emergency restart, the winding, housing, and rotor temperatures in the motor model computations reset to zero. Any time the motor is started, whether an emergency restart or a normal start, the emergency restart HHC function F11 is automatically reset to disable.

- enabled = ON
- disabled = OFF

3.28 Using the Hand Held Communicator (HHC)

The HHC provides you with the capability to monitor and alter various motor control and protection functions provided with the SAMMS-MV device. For example, you can monitor and alter control and protection settings such as on-delay time and overload class. You can also monitor a variety of motor operating conditions such as average current and elapsed running time.

The SAMMS-MV device functions accessible through the HHC are shown in Table 3.7. The number of functions available depends upon the model of the SAMMS-MV device you are using.

The HHC's small size makes it convenient to carry around and use for communication with many SAMMS-MV devices. To use the HHC, connect the HHC's cable, which uses a DB-9 connector, to the communication port located on the front panel of the SAMMS-MV device. The HHC receives power and control from the SAMMS-MV device. When connected to the SAMMS-MV device, data is displayed on the HHC by a four-character, seven-segment liquid crystal display. When disconnected from the SAMMS-MV device, the HHC does not retain or display data.

Once connected, you can access the functions provided by the SAMMS-MV device through the use of the HHC's control keys. The HHC has five (5) control keys: (F)unction, LIST, UP, DOWN, and ENTER. The asterisk (*) key serves no function. The HHC control keys are described in the following sections.

3.28.1 The (F)unction Key

When you press the (F)unction key, the function mode is selected and the HHC displays the number of the selected function preceded by F. With the HHC in the function mode, use the UP and DOWN keys to step from one function to the next.

3.28.2 The LIST Key

When you press the LIST key, the display mode is selected and the HHC displays the value corresponding to the selected function. If the selected function is a set point, the HHC displays the actual setting. If the selected function is a measured quantity, the HHC displays the value of the measured quantity.

In the display mode, use the UP and DOWN keys to step through the range of possible set points for the selected function. Pressing the LIST key returns the active setting to the display.

There is one occasion when the LIST key is disabled making the

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Function Number	Function	SAMMS-MV	
		SAMMS-MVX	SAMMS-MVE
F0	Ambient temperature	•	•
F1	Control circuit number	•	•
F2	Size for overload No. 1	•	•
F3	Size for overload No. 2 (low speed)	•	
F4	Full load current for OLR No. 1	•	•
F4A	5A CT primary current (if used)	•	•
F5	Full load current for OLR No. 2	•	
F5A	5A CT primary current (low speed) (if used)	•	
F6	Service factor	•	•
F6A	Motor type	•	•
F7	Overload trip class (class 2 through 23)	•	•
F7A	Cold stall time	•	•
F8	Automatic reset	•	
F9	Phase unbalance	•	•
F10	Time to restart	•	•
F11	Emergency restart	•	•
F12	Ground fault protection or warning	•	•
F12A	Ground fault pickup current	•	•
F13	Timer No. 1	•	•
F14	Timer No. 2	•	•
F15	Motor current	•	•
F16	Last trip current	•	•
F17	Percent unbalance current	•	•
F18	Total elapsed run-time on motor	•	•
F19	Total number of motor starts	•	•
F20	Number of overload trips	•	•
F21	Reset motor data	•	•
F22	Set process current warning	•	
F23	Jam protection	•	
F23A	Jam pickup current	•	
F24	Loss of load protection or warning	•	
F24A	Loss of load pickup current	•	
F25	Motor winding temperature as % of full load temperature	•	•
F26	Baud rate	•	•
F27	Address	•	•

Table 3.7 SAMMS-MV models and functions

3 Operating the SAMMS-MV Device

corresponding functions inoperative. In a SAMMS-MV device with autoreset disabled at the factory, the LIST key has no effect for F8.

3.28.3 UP and DOWN Keys

Use the UP and DOWN keys to step through the functions while the HHC is in the function mode. When the HHC is in the display mode, use the UP and DOWN keys to step through the values for a selected function. You can use the keys in three ways:

1. Single step - press the key and release it.
2. Slow scroll - press the key and hold the key down for no longer than a two or three seconds.
3. Fast scroll - press the key and hold the key down long enough for the HHC to step through more than five steps.

The following information discusses how to operate the UP and DOWN keys in the function and display modes.

1. In the function mode, the UP key increases the function number by one and the DOWN key decreases the function number by one. If F0 appears on the display, pressing the DOWN key rolls the function over to the highest-numbered function, F27. If the highest-numbered function (F27) appears in the display, pressing the UP key rolls the function over to the lowest-numbered function (F0).
2. In the display mode, use the UP and DOWN keys to step through the range of settings for each set point function. You also use the UP and DOWN keys to step through the individual line currents and the average line current of F15. Just as the UP and DOWN keys cause the function numbers to roll over, they also cause the range of settings to roll over.

3.28.4 Using the ENTER Key

Use the ENTER key to change settings on the HHC display. The SAMMS-MV device disables the ENTER key under the following conditions:

1. The ENTER key is disabled while the device is in the function mode.
2. The ENTER key is disabled for non-setting functions that display a parameter.
3. The ENTER key is disabled while the motor is running to prevent settings from being changed while the motor is running.

Use the following procedure to change a setting. This example shows you how to change the full-load current setting from 112A to 67A.

1. With the HHC in the program mode (see section 3.29.1), press the (F)unction key. The display shows the number of the function most recently selected, (e.g. F9).
2. Use the UP or DOWN key (as described above) to step or

scroll to the desired function. The display shows the desired function, (e.g. F4).

3. Press the LIST key. The display shows the active setting for the selected function, (e.g. 112, representing a full-load current setting of 112A for a motor controlled by a size H3B contactor.)
4. Use the UP or DOWN key (as described above) to step or scroll to the desired setting. The display shows the desired setting, (e.g. 67 for 67A).
5. To view the active setting, press the LIST key. The number 112 appears on the display.
6. Repeat step 4 to return to the desired setting.
7. To enter the desired setting (67) which is displayed, press the ENTER key. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
8. Press the LIST key to show the new setting (67) on the display.
9. To move to the other functions, press the (F)unction key. The display shows, in the example, F4.
10. Press the UP and DOWN keys to step through the function numbers. The SAMMS-MV device is in the function mode.
11. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to display mode.

3.29 Using the SAMMS-MV Device Functions

This section lists the 28 major motor control and protection functions and several related functions (F0-F27, F6A, F9A, F12A, F23A, and F24A) and how to use them. The functions available for each version of the SAMMS-MV device are shown in table 3.7. Table 3.8 provides a description of each function and its associated range, step size, and default value.

To access a function perform the following steps:

1. Connect the HHC's cable to the communications port on the front of the SAMMS-MV device.
2. Locate the desired function using the (F)unction and UP and DOWN keys.
3. Then locate and follow the steps provided with the function you wish to perform.

3.29.1 Program Mode/Passwords

To access the functions in program mode, the user is required to enter a password. The default password is "0000," and may

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Function Number	Function Description	Range	Step Size	Default Value
F0	Select ambient temperature.	0 - 70° C	5° C	40° C
F1	Display (or change for SAMMS-MVE) the control circuit number, Enable/disable incomplete sequence status.	0 - 9999	1	N/A
F2	Display the size for single-speed controller, or the high-speed size for two-speed motor controllers.	H3A, H3B, H3C, H6	As shown	N/A
F3	Display the low-speed size for two-speed controller. F3 is OFF for single-speed motor controllers.	H3A, H3B, H3C, H6	As shown	N/A
F4	Select the full-load current setting (I_{FLC}) for the size for single-speed motor controller or the high-speed size for two-speed motor controllers.	H3A: 18 - 72A H3B: 60 - 240A H3C: 192 - 400A H6: 320 - 720A	1A 1A 1A 2A	18 60 192 320
F4A	Display the primary current if 5A secondary CT's are used.	Function of size in F2	Function of size in F2	OFF (denotes SAMMS sensors in use)
F5	Select the full-load current setting (I_{FLC}) for the low-speed size for two-speed motor controllers. F5 is OFF for single speed motor controllers.	H3A: 18 - 72A H3B: 60 - 240A H3C: 192 - 400A H6: 320 - 720A	1A 1A 1A 1A	18 60 192 320
F5A	Display the primary current if 5A secondary CT's are used.	Function of size in F3	Function of size in F3	OFF (denotes SAMMS sensors in use)
F6	Select the service factor.	1 or 1.15	N/A	1.15
F6A	Select type of motor.	ODP or EFC	N/A	ODP
F7	Select the overload trip class.	2-23	1	10
F7A	Select cold stall time.	5-100	1	10 (ODP) / 20 (EFC)
F8	Enable/disable autoreset of overload and external trips.	ON/OFF	N/A	OFF
F9	Enable/disable phase unbalance protection.	ON/OFF	N/A	ON
F10	Display the time to wait until the motor can be restarted. Applies after an overload trip with the winding, housing, or rotor temperature above the maximum allowed for restarting.	Real Time Value	1s	N/A
F11	Enable/disable the emergency restart capability.	ON/OFF	N/A	OFF

Table 3.8 Motor control and protection functions (page 1 of 2)

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Function Number	Function Description	Range	Step Size	Default Value
F12	Select ground fault protection or warning. ON means protection; OFF means warning.	ON/OFF	N/A	OFF
F12A	Select ground fault pick-up current value.	7A- I_{FLC}	1A	10A (H3A-H3C) 20A (H6)
F13	Set programmable timer #1.	OFF - 200 seconds	1 second	OFF
F14	Set programmable timer #2.	OFF - 200 seconds	1 second	OFF
F15	Display the average line current and the individual line currents.	H3A: 0 - 720A H3B: 0 - 2400A H3C: 0 - 4000A H6: 0 - 7200A	1A 1A 1A 2A	N/A N/A N/A N/A
F16	Display the most recent trip current.	H3A: 0 - 720A H3B: 0 - 2400A H3C: 0 - 4000A H6: 0 - 7200A	1A 1A 1A 2A	N/A N/A N/A N/A
F17	Display the percentage current unbalance. OFF is displayed if unbalanced protection is off.	0 - 100%	1%	N/A
F18	Display the elapsed motor running time in tens of hours.	0.0 - 6553 (x 10 hr.)	0.1x10hr. up to 999.9, 1x10hr. up to 6553	N/A
F19	Display the number of motor starts in tens of hours.	0.0 - 6553 (x 10)	0.1x10 up to 999.9, 1x10 up to 6553	N/A
F20	Display the number of overload trips.	0 - 9999	1	N/A
F21	Reset motor data. Zeroes the elapsed running time, the number of starts, and the number of overload trips.	N/A	N/A	N/A
F22	Set process current warning.	0-100% I_{FLC}	1% I_{FLC}	OFF
F23	Jam protection	ON/OFF	N/A	ON
F23A	Select jam pickup current.	120-400% I_{FLC}	5%	200%
F24	Loss of Load	ON/OFF	N/A	ON
F24A	Select loss of load pickup current	20-95% of running current	5%	50%
F25	Display percentage of motor winding temperature	0 to 250%	1%	N/A
F26	Select baud rate	2400/4800/9600	N/A	4800
F27	Select address	1-224	1	200

Table 3.8 Motor control and protection functions (page 2 of 2)

3 Operating the SAMMS-MV Device

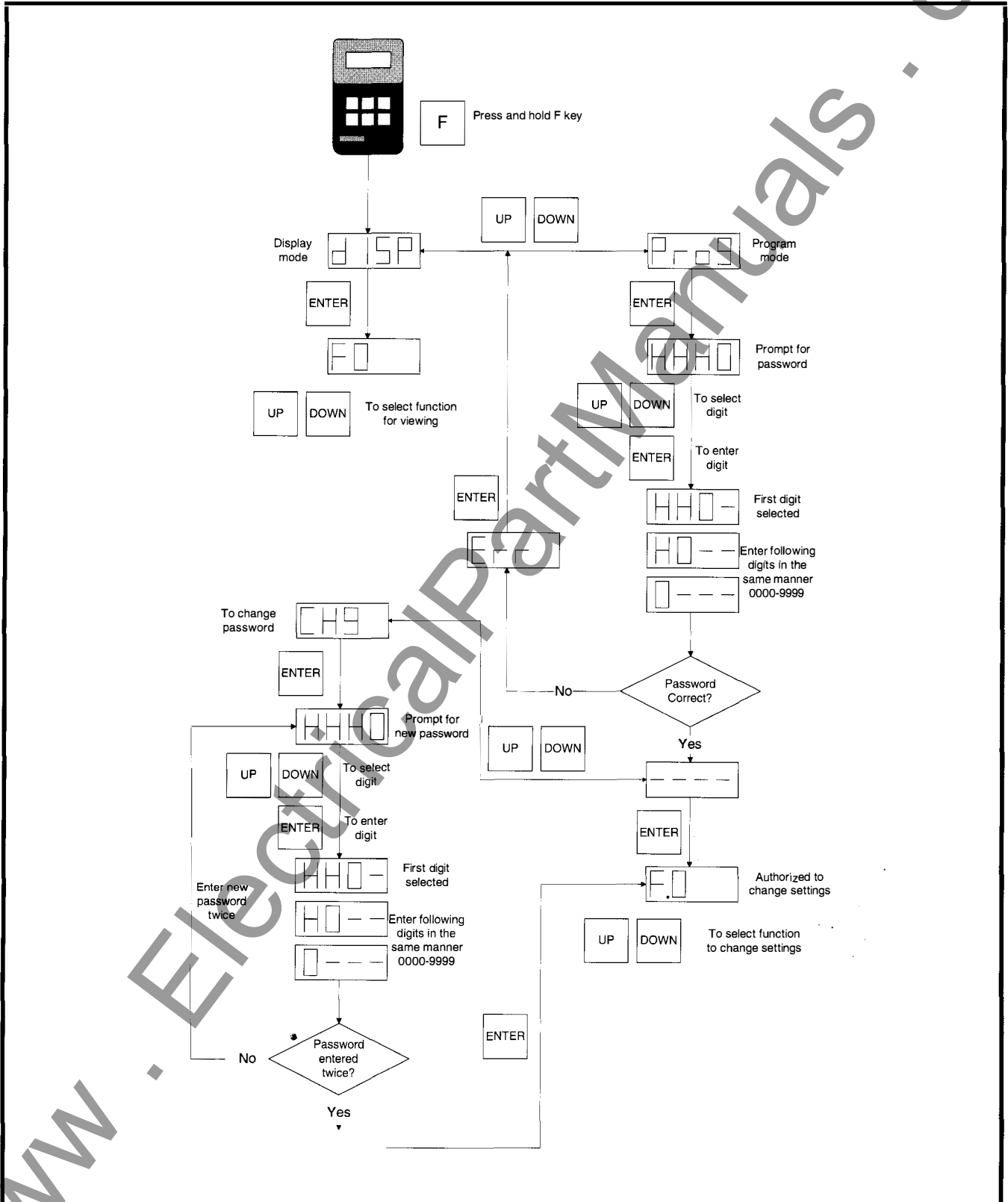


Figure 3.13 Entering and changing passwords

3 Operating the SAMMS-MV Device

be changed at any time. To enter the password and have access to program mode:

1. Press and hold the (F)unction key for several seconds until "dISP" is displayed.
2. Press the UP or DOWN key to change to the program mode. The display reads "Prog."
3. Press the ENTER key, and the display shows "HHH0," the prompt for entering the password.
4. Press the UP or DOWN key to select the first digit, then press ENTER. The display reads "HH0-."
5. Continue to select password digits and press ENTER to enter each digit.
6. After correctly entering the four digit password, the display reads "- - - -," and pressing ENTER gives access to the functions in program mode.
7. If the password was entered incorrectly, the display will read "Err." Press the ENTER key to return to program mode and try again.

To change the password:

1. Enter the password as described above.
2. With the password entered and the display showing "- - - -," press the UP or DOWN key to enter change mode. The display reads "CHG."
3. Press the ENTER key, and the display shows "HHH0," the prompt for entering the new password.
4. Enter the new password in the same way described above. After entering all four digits of the new password, the display will again display "HHH0."
5. Enter the new password a second time. If it was entered correctly the display reads "done," and pressing ENTER gives access to the functions in program mode.
6. If the password was entered incorrectly, the display will read "Err." Press the ENTER key to return to program mode and try again.

3.29.2 SAMMS-MV Functions

F0 - Ambient Temperature

1. Press the LIST key to view the ambient temperature selected. The default value is 40° C and the range of possible values is from 0° C to 70° C in increments of 5° C.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the

selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.

5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

F1 - Control Circuit Number and Incomplete Sequence Status

1. Press the LIST key to view the control circuit number programmed at the factory. The circuit numbers range from 0 through 9999. (The UP, DOWN and ENTER keys become disabled.)
2. For SAMMS-MVE, to change the settings, you must be in the program mode. The available selections are program blocks 10- 16 (refer to table 3.3). If you have loaded a custom circuit, the designation for that circuit will be shown.
3. Press the UP or DOWN key to scroll through the range of circuit numbers, until the desired circuit number appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.
7. To enable or disable incomplete sequence, press the ENTER key for a period of one second or more. A "." will be displayed after the F1 on the HHC if incomplete sequence is enabled. (The SAMMS-MV is shipped from the factory with the incomplete sequence enabled.)

F2 - Size for Overload Relay #1

Overload relay #1 protects single-speed motors and two-speed motors running on high speed. The possible values are H3A, H3B, H3C and H6. Use the following procedure to display the size for overload relay #1.

1. Press the LIST key to view the size selected for overload relay #1.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

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F3 - Size for Overload Relay #2 (SAMMS-MVX Only)

Overload relay #2 protects two-speed motors running on low speed. The possible values are H3A, H3B, H3C, H6 and OFF. OFF appears for single-speed motors. Use the following procedure to display the size for overload relay #2.

1. Press the LIST key to view the size selected for overload relay #2.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

F4 - Full-Load Current for Overload Relay #1

1. Press the LIST key to view the active full-load current setting for overload relay #1. The setting should normally be the full load current as shown on the motor nameplate (high speed for two-speed machine). The range of possible settings and the factory default value depend on the size displayed in F2 as follows:

Overload Relay Size	Setting Range	Step	Default
H3A	18 to 72A	1A	18
H3B	60 to 240A	1A	60
H3C	192 to 400A	1A	192
H6	320 to 720A	2A	320

2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4).
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F4A - 5A CT Primary Current Selection for Overload Relay #1

SAMMS-MV is normally used with SAMMS sensors to provide

the current input signals to the device. Optionally, SAMMS-MV may be used with conventional 5A secondary current transformers.

1. Press the LIST key to view the sensor in use for overload relay #1. If standard SAMMS sensors are used, the display will read "OFF." If 5A secondary CT's are in use, the CT primary current will be displayed.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F5 - Full-Load Current for Overload Relay #2 (SAMMS-MVX Only)

1. Press the LIST key to view the active full-load current setting for overload relay #2. This setting should normally be the full load current for the low speed shown on the motor nameplate. The range of possible settings and the factory default value depend on the size displayed in F3. The values are similar to those found in the table in the procedure for F4. If the control is not a two-speed control, OFF appears on the display, and UP, DOWN and ENTER keys become disabled.

2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4).
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F5A - 5A CT Primary Current Selection for Overload Relay #2 (SAMMS-MVX Only)

SAMMS-MV is normally used with SAMMS sensors to provide the current input signals to the device. Optionally, SAMMS-MV may be used with conventional 5A secondary current transformers.

1. Press the LIST key to view the sensor in use for overload relay #2. If standard SAMMS sensors are used, the display will read "OFF." If 5A secondary CT's are in use, the CT primary

3 Operating the SAMMS-MV Device

current will be displayed.

2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F6 - Service Factor

1. Press the LIST key to view the active service factor, 1.0 or 1.15. The factory default is 1.15. A service factor of 1.15 adjusts the overload trip thresholds up by 15% over their values for a service factor of 1.0. This results in more margin before tripping.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to alternate between the two choices until the selected value is displayed.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4.)
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F6A - Motor Type

1. Press the LIST key to view the motor type in use. The factory default is "OdP" for open drip proof. "EFC" designates totally enclosed fan cooled.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to alternate between the two choices until the selected value is displayed.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4.)
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.

6. Press the (F)unction key to step through to another function.

F7 - Overload Trip Class

The trip class is the time in seconds that it takes the overload relay to trip for a starting current of 600% of the full-load current setting. The range of possible values is 2-23.

1. Press the LIST key to view the active trip class.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4.)
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F7A - Cold Stall Time


1. Press the LIST key to view the active cold stall time in use. (The range of possible values is between 5 and 100 seconds in increments of one second. The factory default value is 10 seconds. If the cold stall time is more than 100 seconds, enter 100.)
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. If the overload class selected exceeds the cold stall time, the word "SUrE" appears on the display requiring reentry before accepting the data.

Important: The word "SUrE" is used as a reminder that supplemental protection is required if the motor acceleration time (overload class) exceeds the allowable stall time for the motor. A speed switch should be used as an input source to open the contactor if the switch senses a locked rotor or stall condition.

5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

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F8 - Autoreset (SAMMS-MVX Only)

	⚠ DANGER
	Automatic Reset Will cause death or serious injury. Do not use automatic reset with two-wire control or where automatic resetting of the SAMMS-MV device restores power to the motor endangering personnel or equipment.

1. Press the LIST key to view the active autoreset setting, either ON or OFF. If autoreset is ON, the SAMMS-MV device automatically resets 30 seconds after an overload or external trip. At this time the motor can start. If autoreset is OFF, you must manually reset the overload relay with the Reset/Test button before restarting the motor. The factory default is OFF.

- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to select the new setting.
- Press and hold the ENTER key. If the displayed setting is ON, go to step 6. If the displayed setting is OFF go to step 5.
- Release the ENTER key while the display appears blank. When you release the key, the setting changes to OFF. Go to step 6.
- Release the ENTER key. "SURE" appears on the display.
- Press the ENTER key to make the change to ON.

Note: The reason for displaying "SURE" and requiring you to press the ENTER key a second time is because the motor can restart immediately after an overload trip if autoreset is ON.

- If you made an incorrect selection, repeat steps 3 through 7.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to step through other functions.

F9 - Phase Unbalance Protection

- Press the LIST key to view the active phase unbalance protection setting (ON or OFF). The factory default setting is ON.
 - When phase unbalance protection is enabled (ON), current unbalances of greater than 40% accelerate overload tripping. The Phase Unbalance LED flashes for unbalances between 20% and 40%. It remains steadily illuminated for unbalances greater than 40%.
 - When phase unbalance protection is disabled (OFF), the Phase Unbalance LED remains off, unbalanced conditions have no effect on protection, and F17 (Display Unbalanced Current) displays OFF.
- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

F10 - Display Time to Restart

- Press the LIST key to view the time remaining before the motor can be restarted. The time is displayed in seconds. While the motor is cooling, the time to restart counts down from the maximum winding or rotor temperature allowed to the steady-state, full-load temperature. The display is always zero if the motor is not in a start inhibit mode. If a time to restart displays, the motor can only be restarted by an emergency restart (see F11).
- The UP, DOWN, and ENTER keys are disabled.
- Press the (F)unction key to go to other functions.

F11 - Emergency Restarting

- Press the LIST key to view the emergency restart setting (ON or OFF). The factory default is OFF. With emergency restart enabled (ON), you can restart the motor after the overload relay is reset (manually or automatically), even when the time to reset is not zero. When you initiate an emergency restart, the motor conditions are reset to zero to simulate a completely cold start. The emergency restart function is automatically disabled after any restart (emergency or normal), and you must manually re-enable the emergency restart function by setting F11 to ON.
- Emergency restart can be enabled in either the program mode or the display mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. If the selected setting is ON, skip to Step 5.
- If the selected setting is OFF, the display blanks while the ENTER key is pressed. When the ENTER key is released, the setting is changed to OFF. Skip to Step 6.
- If the selected setting is ON, "SURE" is displayed when you release the ENTER key. Press ENTER again to make the change to ON.

Note: The motor can be damaged if restarted before it is allowed to cool. The "SURE" display allows you to reconsider

3 Operating the SAMMS-MV Device

your actions before pressing the ENTER key a second time to select the ON setting.

6. Repeat Step 3 if you select an incorrect setting.
7. If you are in the program mode, press and hold the (F)unction key for several seconds to exit. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
8. Press the (F)unction key to go to other functions.

F12 - Ground Fault Protection or Warning

1. Press the LIST key to view the active ground fault detection setting (ON or OFF). The factory default setting is warning (OFF), and the other setting is protection (ON).
 - a. When warning (OFF) is selected, the Ground Fault LED flashes if the ground current increases beyond the pickup level. The LED stops flashing as soon as the current drops below the pickup level.
 - b. When protection (ON) is selected, a ground current above the pickup level will cause a trip. The motor stops, and the Ground Fault LED is steadily lit. You must reset the unit before the motor can be restarted.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
4. Repeat Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F12A - Ground Fault Pickup Current

1. Press the LIST key to view the active ground fault pickup current in use. The range of values and default values are shown in the table below:

Size	Pickup Current	Default
H3A-H3C	7A-I _{FLC}	10A
H6	7A-I _{FLC}	20A

2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
4. Repeat Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the

UP or DOWN key to change to the display mode.

6. Press the (F)unction key to go to other functions.

F13 - Set Programmable Timer #1

1. Press the LIST key to view the active setting for timer #1. The default setting is OFF. If the timer is not used in the control circuit, OFF is displayed and the UP, DOWN, and ENTER keys are disabled. OFF is also displayed for a setting of 0 seconds. The timer may be adjusted from 0 - 200 seconds in one second increments.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired value is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
4. Repeat Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F14 - Set Programmable Timer #2

1. Press the LIST key to view the active setting for timer #2. The default setting is OFF. If the timer is not used in the control circuit, OFF is displayed and the UP, DOWN, and ENTER keys are disabled. OFF is also displayed for a setting of 0 seconds. The timer may be adjusted from 0 - 200 seconds in one second increments.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired value is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
4. Repeat Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F15 - Display Current

1. Press the LIST key to view the instantaneous line currents or the average instantaneous line current. (The LIST key is disabled for full voltage, part-winding starters.) For instantaneous line currents, the display shows the phase designator (**A**, **b**, or **C**) in the left-most character followed by three significant digits of the value of the current. For the average instantaneous line current, four digits are displayed without a phase designator.

3 Operating the SAMMS-MV Device

- a. Because only four characters can display at a time, individual line currents of 1000 amps and above are displayed as three dashes following the phase designator, e.g., **A---**.
- b. For sizes H3A, H3B, and H3C, the current is displayed to the nearest 1 amp. For size H6, currents are displayed to the nearest 2 amps.

2. To view another line current, press the UP or DOWN key to scroll through the four selections.
3. The ENTER key is disabled for this function.
4. Press the (F)unction key to go to other functions.

F16 - Trip Current

1. Press the LIST key to view the value of the current that caused the most recent trip.
2. The UP, DOWN, and ENTER keys are disabled for this function.
3. Press the (F)unction key to go to other functions.

F17 - Current Unbalance

1. Press the LIST key to view the percentage current unbalance. When unbalance protection is disabled (F9 = OFF), OFF is displayed. The percentage unbalance is the ratio of the greatest deviation of the three phase currents from their average to the average of the three phase currents expressed as a percentage.
2. The UP, DOWN, and ENTER keys are disabled for this function.
3. Press the (F)unction key to go to other functions.

F18 - Display Total Elapsed Run Time of the Motor

1. Press the LIST key to view the total elapsed running time of the motor. The run time is displayed in tens of hours as follows:

Actual Number of Hours	Displayed Time
0	0.0
9999	999.9
10000	1000
65535	6553
65536	0.0 (roll over)

The displayed value does not increment until a full hour, or for elapsed times greater than 10000 hours a full ten hours, have elapsed. Internally, however, the elapsed time is maintained to the nearest 0.1 second.

Note: The value can be reset to zero with F21.

2. The UP, DOWN, and ENTER keys are disabled for this function.
3. Press the (F)unction key to go to other functions.

F19 - Number of Motor Starts

1. Press the LIST key to view the number of motor starts. The number of starts is displayed in tens of starts as follows:

Actual Number of Starts	Displayed Number
0	0.0
9999	999.9
10000	1000
65535	6553
65536	0.0 (roll over)

Note: The value can be reset to zero with F21.

2. The UP, DOWN, and ENTER keys are disabled for this function.
3. Press the (F)unction key to go to other functions.

F20 - Number of Overload Trips

1. Press the LIST key to view the number of overload trips, up to 9999.

Note: The value can be reset to zero with F21.

2. The UP, DOWN, and ENTER keys are disabled for this function.
3. Press the (F)unction key to go to other functions.

F21 - Reset Motor Data

1. To reset to zero the elapsed running time, the number of starts, and the number of overload trips, press the LIST key. "CLr" is displayed.
2. Press the ENTER key. "SuRE" is displayed.
3. Press the ENTER key again to zero the motor data.
4. To return to Step 1, press the LIST key at any time.
5. The UP and DOWN keys are disabled for this function.
6. Press the (F)unction key to go to other functions.

3 Operating the SAMMS-MV Device

F22 - Process Current Warning Level (SAMMS-MVX Only)

1. Press the LIST key to view the active process current level. The value represents the percentage of the full load current setting above which a motor current causes the External Trip LED to flash. The function is disabled for five times the class time after starting, or after a speed or direction change. The range of settings is in 1% increments from zero (OFF) through 100. The factory default is OFF.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired setting is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
3. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F23 Jam Protection (SAMMS-MVX Only)

1. Press the LIST key to view the active jam protection setting (ON or OFF). The factory default setting is ON. If jam protection is enabled (ON) and the motor running current increases to the pickup current value within 360 msec, the motor will trip off-line and the External Trip LED is steadily lit. The function is disabled for five times the class time after starting, or after a speed or direction change.
2. To change the setting, you must be in program mode.
3. To change the protection setting, press the UP or DOWN key to display ON or OFF, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
4. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F23A Jam Pickup Current (SAMMS-MVX Only)

1. Press the LIST key to view the jam current pickup value in use. The range of possible values is between 120% and 400% to the FLC, in increments of 5%. The factory default is 200%.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired setting is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
4. To exit the program mode, press and hold the (F)unction key

for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

5. Press the (F)unction key to step through to another function.

F24 - Loss of Load Protection or Warning (SAMMS-MVX Only)

1. Press the LIST key to view the active loss of load setting (ON or OFF). The factory default setting is warning (OFF), and the other setting is protection (ON). This function is disabled for five times the class time after starting or speed or direction changes.
 - a. When protection (ON) is selected and the motor current drops below the pickup current value, within 360 msec, the External Trip LED will light and the SAMMS-MV trips.
 - b. When warning (OFF) is selected and the motor current drops below the pickup current value within 360 msec, the External Trip LED flashes but the SAMMS-MV does not trip.
2. To change the setting, you must be in program mode.
3. To change the protection setting, press the UP or DOWN key to display ON or OFF options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
4. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F24A - Loss of Load Pickup Current (SAMMS-MVX Only)

1. Press the LIST key to view the active setting. The range of possible values is between 20% and 95% to the FLC, in increments of 5%. The factory default is 50%.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired setting is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
4. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F25 - Percentage of Motor Winding Temperature

1. Press the LIST key to view the temperature of the motor windings as a percentage of the steady-state, full-load winding temperature. The maximum allowable winding temperature percentage is 175%.

3 Operating the SAMMS-MV Device

2. The UP, DOWN, and ENTER keys are disabled for this function.

3. Press the (F)unction key to go to other functions.

F26 - Baud Rate

1. Press the LIST key to view the active setting. Allowable settings are 2400, 4800, or 9600 baud. The factory default is 4800.

2. To change the setting, you must be in program mode.

3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.

4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.

5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

6. Press the (F)unction key to step through to another function.

F27 - Address

1. Press the LIST key to view the active setting. Allowable addresses are 1-224. The factory default is 200.

2. To change the setting, you must be in program mode.

3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.

4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.

5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

6. Press the (F)unction key to step through to another function.

4 Troubleshooting

4 Troubleshooting the SAMMS-MV Device

This section discusses how to troubleshoot the SAMMS-MV device. The troubleshooting guide below lists basic errors that can occur while operating the SAMMS-MV device. Use the guide as necessary to solve error conditions as they arise. Do not attempt to solve any error condition that is not listed in the troubleshooting guide. Instead, contact your Siemens representative.

Note: When contacting your Siemens representative, refer to the SAMMS-MV production control label to identify production date, hardware version, and software version. This label is mounted on the right side of the unit when viewed from the front. For example, 93-250-456-01/03 represents a device that was produced in 93, the 250th day of the year, unit number 456, hardware version 01, and software version 03.

Troubleshooting Guide		
Error Condition	Main Cause	Remedy
Current Unbalance	Current unbalance LED is illuminated if current unbalance exceeds 40%, or it flashes if current unbalance is between 20 and 40%. Current unbalance may be due to voltage or load unbalance.	<ol style="list-style-type: none">1. Correct the cause of voltage or load unbalance.2. Verify current transformer secondary voltage is unbalanced at SAMMS-MV terminals 1, 2, and 3 with reference to 4.
Overload Trip	Indicates motor exceeded winding, housing, or rotor temperature threshold.	<ol style="list-style-type: none">1. Verify that the full load current F4 and service factor F6 on the HHC matches the full load current and the service factor on the motor nameplate.2. If the motor tripped during start, increment the overload class one step and start again. If still unsuccessful, the motor's rotor may be locked or stalled. Correct motor malfunction before restarting.3. If the motor tripped after running for a period more than the overload class selected, the trip may be due to a running overload such as excessive loading on a conveyor belt or bad bearings. Remove the cause of the overload before restarting the motor.4. F16 on HHC displays the most recent overload trip current value.

4 Troubleshooting

Troubleshooting Guide		
Error Condition	Main Cause	Remedy
Incomplete Sequence	Indicates the SAMMS-MV unit does not detect current one second after a start command, or it detects current one second after a stop command.	<ol style="list-style-type: none"> 1. If the unit trips one second after start, verify that current transformer secondary input is present in the range of 100 mVAC to 3.54 VAC at terminals 1, 2, and 3 with reference to 4. Verify that the coil voltage is 115 VAC at terminals 14, 15, or 16 with reference to 13 when the motor is started. Verify 115 VAC at terminal 7 with reference to 13. Correct conditions if necessary. Call Siemens if unit continues to trip. 2. If the unit trips one second after a stop command, verify the contactor is open. Repair or replace the contactor if it is not functioning properly. 3. Verify operation of mechanical interlock, and replace or adjust. 4. Verify absence of voltage at terminals 1, 2, and 3 with reference to 4, and at terminals 14, 15, or 16 with reference to 13. If voltage is present, define the source and reconnect so that the motor current only passes through the current transformer. 5. To disable incomplete sequence, select F1 on the HHC, press the ENTER key for one or more seconds and start the motor. The incomplete sequence will remain disabled until the above procedure is repeated.
External Trip	If the external trip LED is solidly illuminated and the motor is stopped, it indicates a jam or loss of load condition, or a trip caused by an overtemperature indication from an RTD.	<ol style="list-style-type: none"> 1. Jam conditions such as a blocked conveyor belt or gear train cause a sudden increase in motor current, which can damage the motor's insulation in a short period of time. 2. Loss of load conditions, such as a broken blade of an impeller or loss of back pressure of a pump, result in a sudden decrease in motor current. 3. RTD trip indicates that the stator temperature or the temperature of one of the bearings has exceeded its threshold. RTD stator trip indicates either that the motor cooling system is blocked, or that the fan is broken. RTD bearing trip indicates overheating of the motor or load bearings. In any case, the motor should not be restarted until the cause of the overheating has been corrected. 4. F16 on the HHC displays the external trip current at the time of the trip, or the RTD number which caused the trip. In any case, determine the reason for the external trip and correct the problem before restarting the motor. If the external trip LED flashes and the motor continues to run, it indicates loss of load warning or process current warning.

4 Troubleshooting

Troubleshooting Guide		
Error Condition	Main Cause	Remedy
CPU Fault	Indicates a problem in the microprocessor or a low voltage condition.	Verify voltage between terminals 5 and 6 is more than 10 VAC. If fault persists, call Siemens.
Ground Fault	Indicates the ground fault current exceeded the threshold. If ground fault protection was selected, the ground fault LED illuminates solidly and the motor stops. If ground fault warning was selected, the ground fault LED flashes and the motor continues to run.	The cause of the ground fault should be determined and removed before using the motor again. F16 on the HHC displays the ground fault trip current.
Ready Light not Illuminated	Usually indicates lack of control power.	<ol style="list-style-type: none"> 1. Verify the presence of 12 VAC between terminals 5 and 6 of the SAMMS-MV unit. 2. If control power is not present, check the control power fuses or the control power transformer and replace if defective. 3. If control power is present, push the RESET button to test lights and unit. If the Ready light does not illuminate, call Siemens.
Improper Remote Operation	Indicates connection or operator error.	<ol style="list-style-type: none"> 1. Verify the SAMMS-MV unit is in the Auto mode. 2. Verify 115 VAC input at SAMMS-MV terminals 9, 10, 11, and 12 with reference to 13, and at terminal 7 with reference to 13. 3. If remote operation is intermittent, verify connections are made in a manner to avoid noise interference. Refer to Section 2 of this manual for instructions.
Improper Alarm Contact Operation	Indicates connection error.	Verify 115 VAC at terminals 7 and 8 with reference to 13.
Improper Light Operation	Usually indicates programming error.	<ol style="list-style-type: none"> 1. Perform lamp test by pressing RESET button. 2. Verify ladder diagram.
Improper Local Operation	Operator error.	Verify SAMMS-MV is in Local mode.
Improper Contactor Operation	Connection error.	Verify 115 VAC at terminal 7 with reference to 13, and at output terminals 14, 15, or 16 with reference to 13 when the motor is started.
Cannot Change HHC Settings	Usually indicates motor is running.	Change parameters after motor is stopped.
Improper SAMMS-MV Operation	Usually indicates improper grounding or noise interference.	Refer to Section 2 of this manual for instructions.

Appendix A Technical Specifications

Appendix A - Technical Specifications of the SAMMS-MV Device

Motor Control Specifications

Inputs	Six pushbuttons Four remote inputs
Outputs	SAMMS-MVX: Three coil drivers Three light bars One programmable alarm contact SAMMS-MVE: One coil driver Two light bars
Diagnostic LEDs	<ul style="list-style-type: none"> * Current unbalance * Impending trip * Overload trip * External trip * Incomplete sequence * Ground fault * CPU fault * Ready * Light bar flashes (timer timing) * Impending trip LED flashes (motor temperature warning) * Overload trip LED flashes (start inhibit) * CPU LED ON (momentary loss of voltage)
Current Ranges: 18 - 72A 60 - 240A 192 - 400A 320 - 720A	Overload Relay Size: H3A H3B H3C H6

Permissible CT Ratios

5A secondary CT ratios (functions F4A & F5A)	Overload Relay Size	Permissible CT Ratios
	H3A	30:5, 40:5, 50:5, 75:5, 100:5
	H3B	100:5, 150:5, 200:5, 250:5, 300:5, 400:5
	H3C	300:5, 400:5, 500:5, 600:5
	H6	500:5, 600:5, 800:5, 1000:5

Appendix A Technical Specifications

Overload Specifications

Overload classes	Overload classes 2 through 23 with one second increments.															
Trip Characteristics	Tripping time at $6 \times I_{FLC}$ = 95% of the overload class ($\pm 5\%$). Tripping time at $1.5 \times I_{FLC}$ within two minutes for warm conditions for all classes.															
Tripping threshold	$(1.1 \pm 0.05) \times I_{FLC}$ for motors with 1.00 service factor, and $(1.2 \pm 0.05) \times I_{FLC}$ for motors with 1.15 service factor.															
Tripping time	20 minutes @ $1.15 \times I_{FLC}$ for motors with service factor 1.															
Mechanical jam protection SAMMS-MVX only	Sudden increase of the motor running current. Pick-up current adjustable from 120 to 400% in increments of 5% of I_{FLC} . Pick-up time 360 msec. Default values: 200% I_{FLC} .															
Loss of load protection SAMMS-MVX only	Sudden decrease of motor running current. Pick-up current adjustable from 20 to 95% in increments of 5% of I_{FLC} . Pick-up time 360 msec. Default values: 50% I_{FLC} .															
Process current warning SAMMS-MVX only	Settings from 0 to 100% of I_{FLC} .															
Accuracy	$\pm 5\%$ of overload trip curve values. $\pm 2\%$ repeat accuracy.															
Phase unbalance protection	Response time after 1 second Shifted trip threshold value to $0.9 \times I_{FLC}$ at 40% phase unbalance.															
Equipment ground fault protection	Response time after 1.4 seconds. Pick-up time: 360 msec. Pick-up current: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Overload Relay Size</th> <th>Pick-up Current</th> <th>Default</th> </tr> </thead> <tbody> <tr> <td>H3A</td> <td>$7A - I_{FLC}$</td> <td>10A</td> </tr> <tr> <td>H3B</td> <td>$7A - I_{FLC}$</td> <td>10A</td> </tr> <tr> <td>H3C</td> <td>$7A - I_{FLC}$</td> <td>10A</td> </tr> <tr> <td>H6</td> <td>$7A - I_{FLC}$</td> <td>20A</td> </tr> </tbody> </table>	Overload Relay Size	Pick-up Current	Default	H3A	$7A - I_{FLC}$	10A	H3B	$7A - I_{FLC}$	10A	H3C	$7A - I_{FLC}$	10A	H6	$7A - I_{FLC}$	20A
Overload Relay Size	Pick-up Current	Default														
H3A	$7A - I_{FLC}$	10A														
H3B	$7A - I_{FLC}$	10A														
H3C	$7A - I_{FLC}$	10A														
H6	$7A - I_{FLC}$	20A														
Rotor protection	Cold stall time adjustable from 5 to 100 seconds in increments of 1 second. If cold stall time is not known, default value shall be according to the type of motor used. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Motor Type</th> <th>Cold Stall Time</th> </tr> </thead> <tbody> <tr> <td>Open Drip Proof (ODP)</td> <td>10 Seconds</td> </tr> <tr> <td>Totally Enclosed Fan Cooled (EFC)</td> <td>20 Seconds</td> </tr> </tbody> </table>	Motor Type	Cold Stall Time	Open Drip Proof (ODP)	10 Seconds	Totally Enclosed Fan Cooled (EFC)	20 Seconds									
Motor Type	Cold Stall Time															
Open Drip Proof (ODP)	10 Seconds															
Totally Enclosed Fan Cooled (EFC)	20 Seconds															
Ambient temperature	Motor ambient temperature adjustable 0 - 70°C in increments of 5°C. Default value: 40°C.															

Appendix A Technical Specifications

Statistical Data

Elapsed motor running time	- x10 - Range: 0.0 to 6553 (65,536 hours) - Unit increments: 10 hours										
Number of motor starts	- x10 - Range: 0.0 to 6553 (65,536 hours) - Unit increments: 10 operations										
Number of overload trips	- Range: 0 to 9999 - Increments: 1 trip										
Current display	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Overload Relay Size</th> <th style="text-align: left;">Current Increments</th> </tr> </thead> <tbody> <tr> <td>H3A</td> <td>1A</td> </tr> <tr> <td>H3B</td> <td>1A</td> </tr> <tr> <td>H3C</td> <td>1A</td> </tr> <tr> <td>H6</td> <td>2A</td> </tr> </tbody> </table>	Overload Relay Size	Current Increments	H3A	1A	H3B	1A	H3C	1A	H6	2A
Overload Relay Size	Current Increments										
H3A	1A										
H3B	1A										
H3C	1A										
H6	2A										

Alarm Contacts (SAMMS-MVX Only)

Configuration	- N.C. - N.O.
Functions	- Impending Trip - Overload Trip - External Trip - Ground Fault - All of the above

Software Configured Control Devices

Timers	4
Timing range	Timers 1 and 2: 0 - 200 seconds selectable Timer 3: 1 second fixed value Timer 4: 30 seconds fixed value
Timer auxiliary contacts	Software instantaneous and timed contacts
Control relays	8
Auxiliary contacts	Software instantaneous contacts

Appendix A Technical Specifications

Dimensions

SAMMS-MV	6.25 inches W; 6.00 inches H; 2.125 inches D
Handheld Communicator	3.15 inches W; 5.7 inches H; 1.37 inches D

Environments

Operating temperature range	-25° C to +70° C.
Storage temperature	-40° C to +85° C.
Relative humidity	5 to 95% non-condensing.
Altitude	6600 ft.
Vibration	5 g's at a frequency range of 10 to 60 Hz.
Electrostatic discharge	No hardware failures at 15 kV at any point in the front of the unit.
Electromagnetic interference	5 kV repeated pulses, per UL-991 and ANSI C37.90A.
Radio frequency interference	Up to 95 MHz and 61.3 V/M field strength

Control Power Specifications

Unit powered by	12.00 VAC (+10%, -15%) supply
Power requirements	4VA
Control circuit inputs	120 VAC or 125 VDC (+10%, -15%)
Control circuit outputs	120 VAC (+10%, -15%)
Maximum output loading allowed for continuous operation	1.0A for each output energized Maximum leakage current allowed: 5mA
Frequency	50 Hz: +4%, -5% 60 Hz: ± 5%

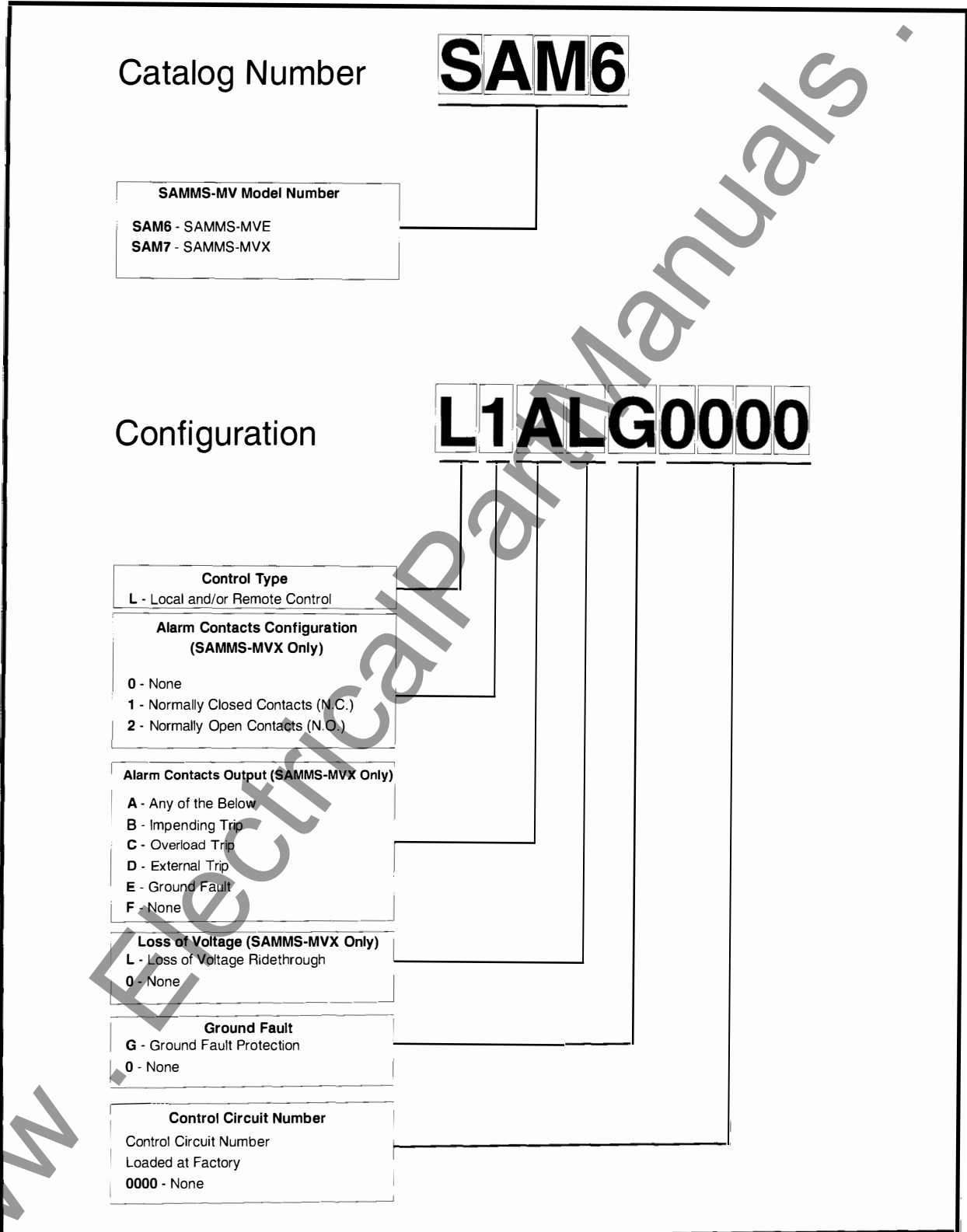


Figure A-1 Catalog Number and Configuration Breakdown for SAMMS-MV

Appendix A Technical Specifications

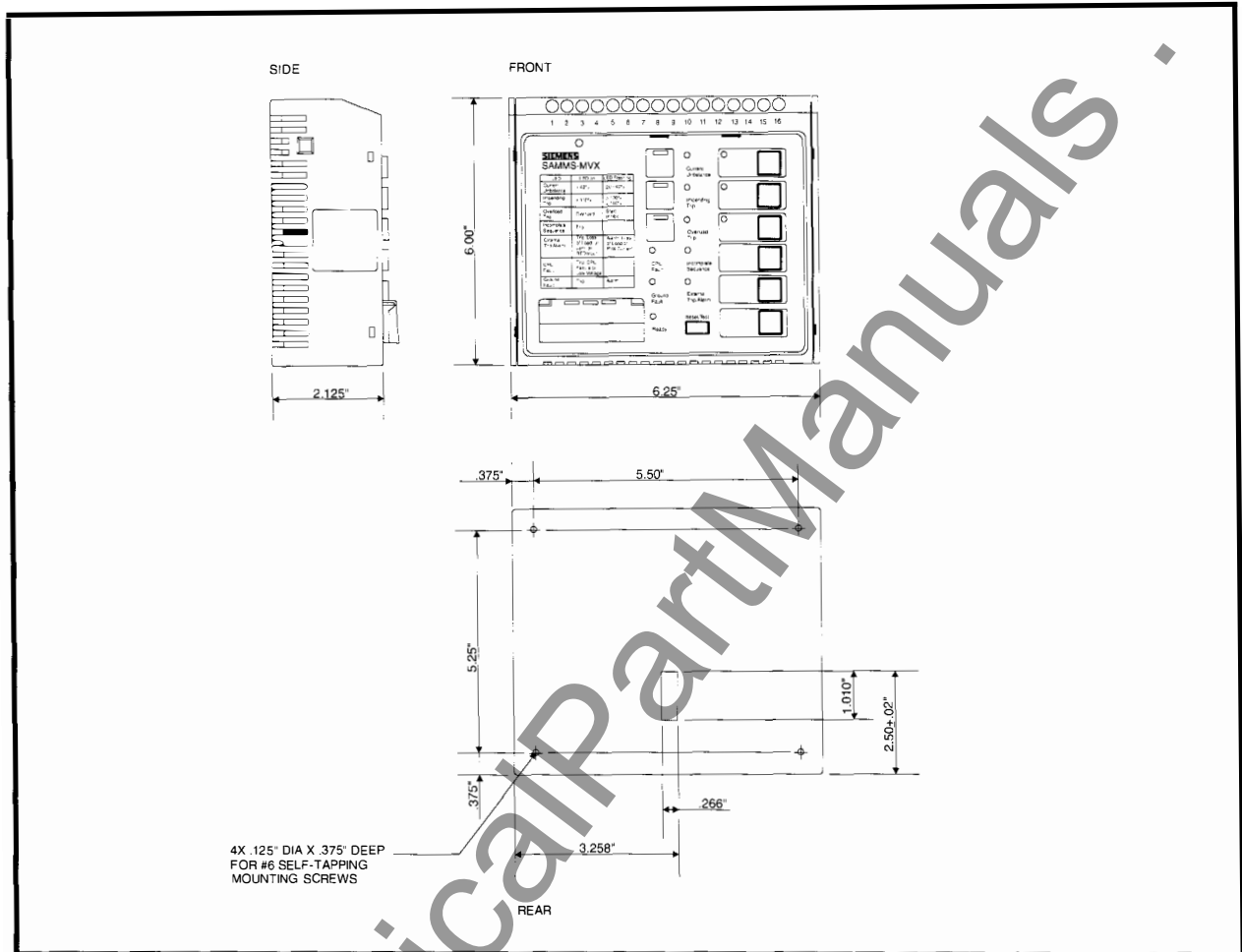


Figure A-2 Overall Dimensions and Mounting Diagram

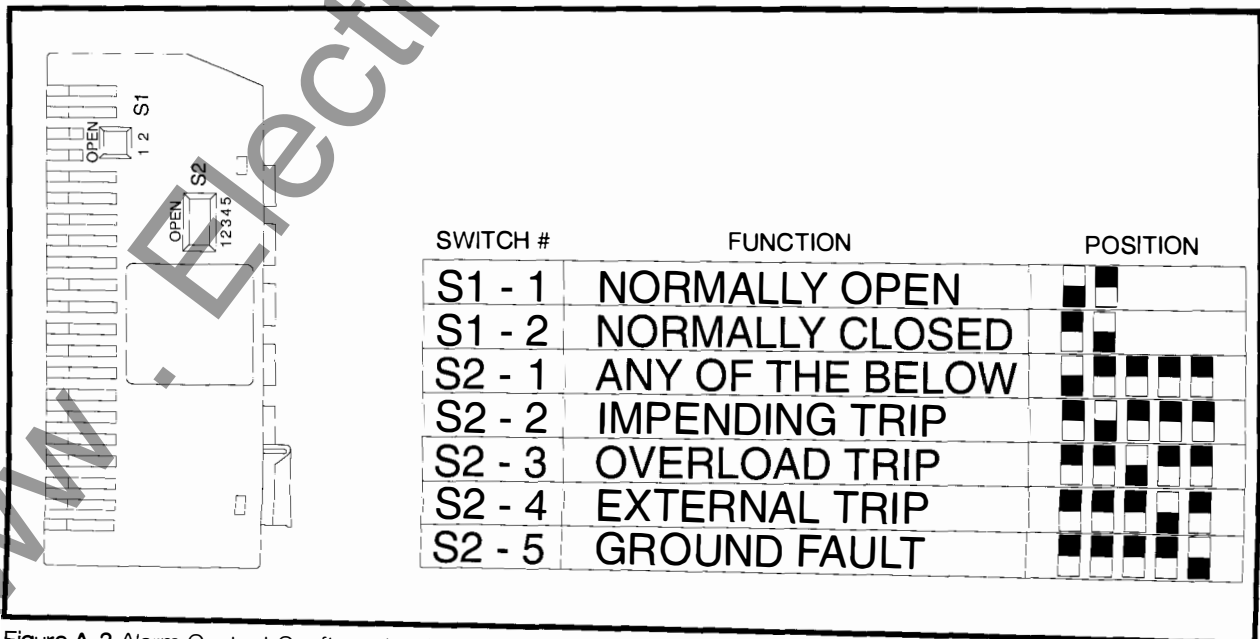


Figure A-3 Alarm Contact Configuration Switches (SAMMS-MVX Only)

Appendix A Technical Specifications

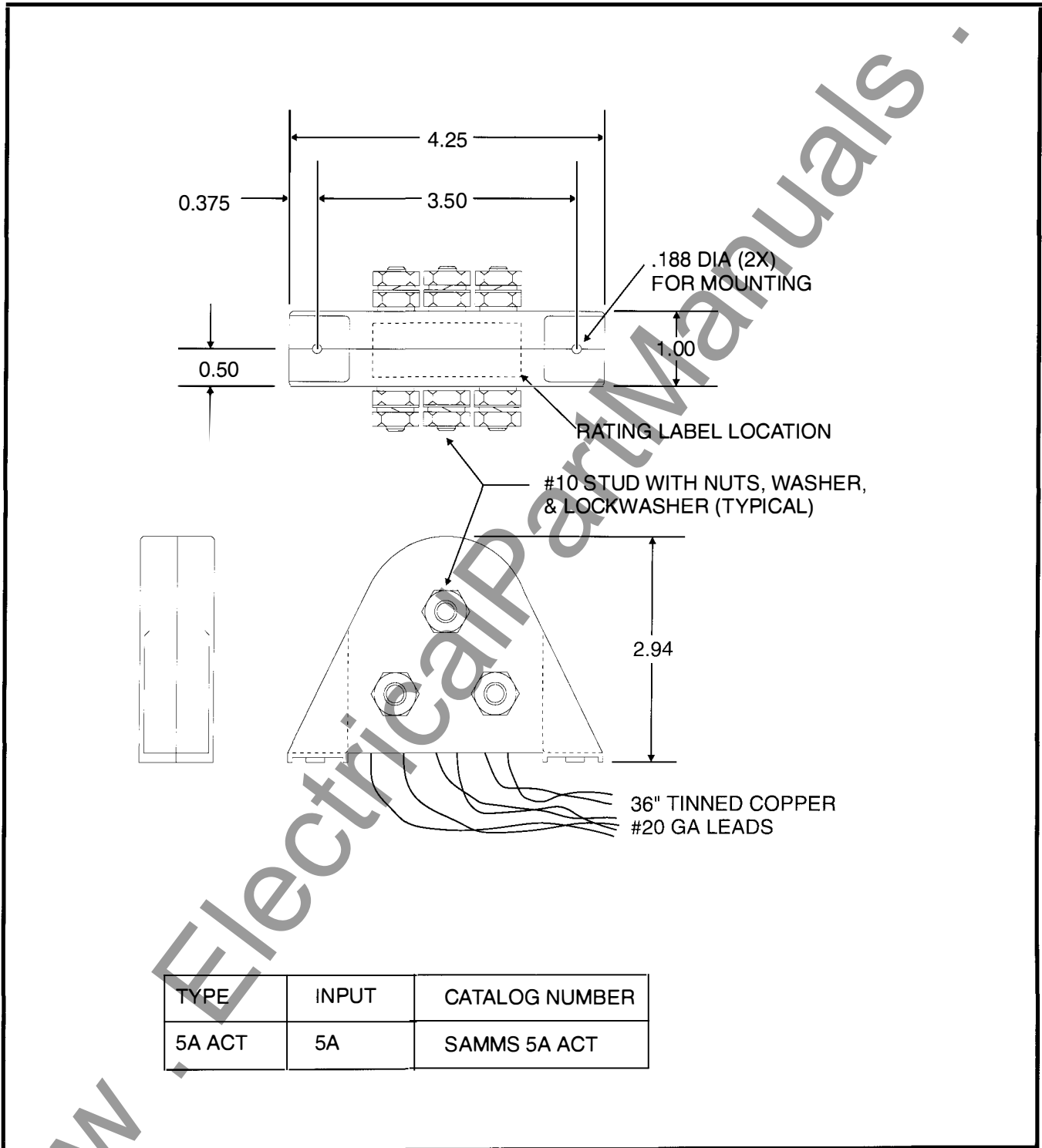


Figure A-4 SAMMS 5A Auxiliary Current Transformer

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SIEMENS

SAMMS-MV™

Siemens Advanced Motor Master System for
Medium Voltage Motors

User's Manual





⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts. Will cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSON

For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

- (a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- (b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- (c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office.

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

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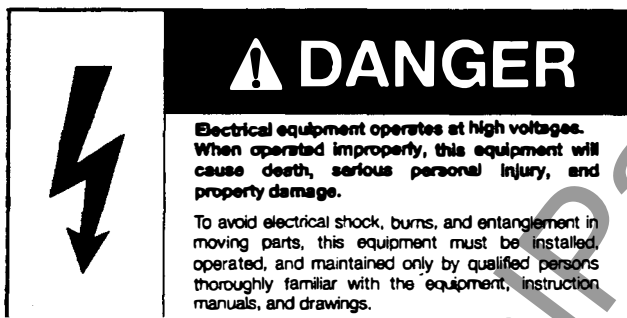
1 Introduction

1 Introduction

The SAMMS-MV electronic motor control and protection device is designed and manufactured in accordance with the latest applicable provisions of the National Electric Code, Underwriters Laboratories Standards and Procedures, NEMA Standards, and the National Electric Safety Code. You must thoroughly read and understand this user's manual before you begin any work with the SAMMS-MV device. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the careful design and fabrication by Siemens.

The purpose of this instruction manual is to assist the user in developing safe and efficient procedures for the installation, maintenance, and use of the equipment.

Contact the nearest Siemens representative if any additional information is desired.



Qualified Person

For the purpose of this manual and product labels, a **"Qualified Person"** is one who is familiar with the installation, construction and operation of this equipment, and the hazards involved. In addition, this person has the following qualifications;

- Training and authorization to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.
- Training in rendering first aid.

Signal Words

The signal words **"Danger"**, **"Warning"**, and **"Caution"** used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

Danger—Indicates an imminently hazardous situation which, if not avoided, **will** result in death or serious injury.

Warning—Indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.

Caution—Indicates a potentially hazardous situation which, if not avoided, **may** result in minor or moderate injury.

Dangerous Procedures

In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work on de-energized equipment. Always de-energize a breaker, or contactor, and remove it from the equipment before performing any tests, maintenance, or repair.
2. Always perform maintenance on equipment employing springs after the spring-charged mechanisms are discharged.
3. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

Field Service Operation

Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair, and maintenance of Siemens equipment, processes, and systems. Contact regional service centers, sales offices, or the factory for details.

1.1 About this Manual

This manual introduces you to the Siemens Advanced Motor Master System (SAMMS-MV™) motor protection and control relay which incorporates protection designed for medium voltage machines. This manual also contains information for installing and operating the device, communicating with other devices over the ACCESS™ electrical distribution communications system, and troubleshooting the device. This manual also provides a helpful technical reference for you to use. Refer to table 1.1 to determine which section of the manual contains the information that you need.

These instructions prepare you to handle, install, operate and maintain the SAMMS-MV device and the Hand-Held Communicator (HHC). The individual starters and controllers used are designed for specific applications based upon your equipment and needs. Instructions covering these starters and components are not included in this manual. For this information, refer to instructions and drawings furnished with your equipment, or contact your Siemens representative. You must read these instructions and determine applicability of your equipment. Refer to the nameplate data on your controller and to the electrical diagrams supplied with your controller to determine applicability of your equipment.

1.2 About the SAMMS-MV Device

The SAMMS-MV device, shown in Figure 1.1, is a software-configured electronic motor control and overload protection device that incorporates protection tailored to the special characteristics of medium voltage motors. The SAMMS-MV system includes a microprocessor-based SAMMS-MV device which receives signal inputs from a set of current transformers (either 3-1Ø or 1-3Ø) and power input from a 12 volt tap on the controller's control power transformer. To perform certain monitoring and setup activities, a Hand-Held Communicator (HHC) shown in Figure 1.2, is required. The SAMMS-MV device is a multi-functional device offering the following:

- advanced motor protection for medium voltage motors
- pre-programmed control circuits
- standardized control panel with input/output devices replacing conventional push-buttons, pilot lights and selector switches
- diagnostics
- statistical motor data
- real-time metering
- local display of all motor and control circuit data
- open architecture communications using the ACCESS system

Note: The SAMMS-MV device does not replace the disconnect device (drawout contactor mounting or isolating switch) or the contactor itself.

If you need to...	...refer to this section
learn about the SAMMS-MV device	Section 1, Introduction
install the SAMMS-MV device	Section 2, Installing the SAMMS-MV Device
operate the SAMMS-MV device	Section 3, Operating the SAMMS-MV Device
operate the Hand-Held Communicator	Section 3, Operating the SAMMS-MV Device
connect the SAMMS-MV device to the ACCESS System	Section 2, Installing the SAMMS-MV Device
troubleshoot the SAMMS-MV device	Section 4, Troubleshooting the SAMMS-MV Device
learn about the technical specifications of the SAMMS-MV device	Appendix A, Technical Specifications of the SAMMS-MV Device

Table 1.1 Where to find information

1 Introduction

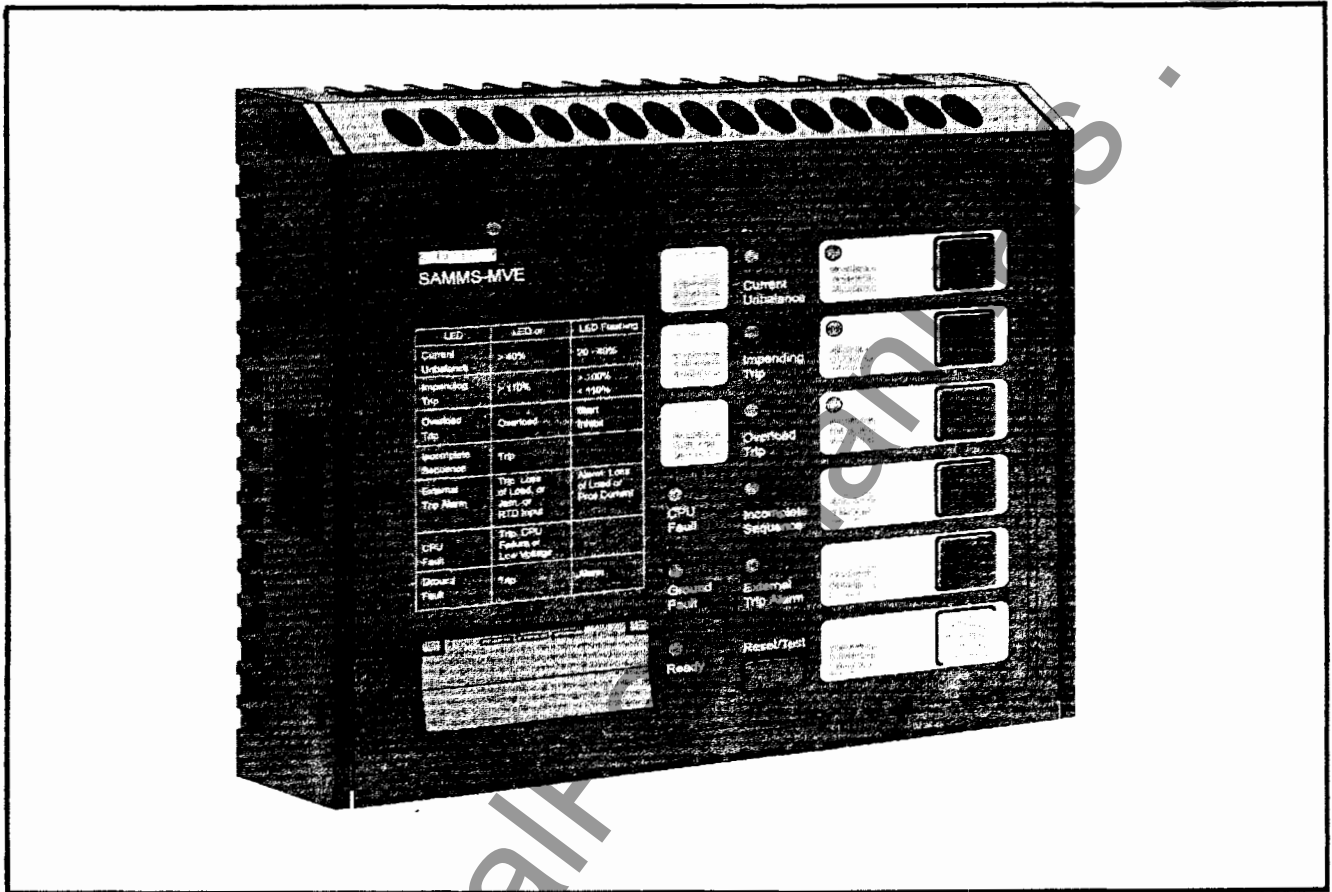


Figure 1.1 SAMMS-MV, front view

1.2.1 The SAMMS-MV Device Models

The SAMMS-MV device is available in two models: SAMMS-MVE and SAMMS-MVX. Each model meets the various demands of industrial and commercial specifications and installations. Table 1.2 compares the features of each model.

The SAMMS-MV device is designed for critical process control where prevention of downtime is critical. It offers motor control and protection along with motor diagnostic and motor/driven equipment protection. Engineering and operating personnel have access to important data enabling them to optimize motor-driven equipment capabilities, maximize the process system output and facilitate maintenance.

SAMMS-MVX is a full function model, applicable to all control needs, from a simple across-the-line unit to a more complicated reduced voltage scheme. It includes all of the functions listed in table 3.7. Any of the standard control circuits listed in table 3.3, or a custom circuit, may be downloaded. The SAMMS-MVX device accepts up to four remote inputs, while SAMMS-MVE accepts two remote inputs.

SAMMS-MVE is a model of SAMMS-MV tailored to across-the-line (FVNR) applications. It provides all of the protective functions of the SAMMS-MVX device, except that it has no jam

protection (F23), loss of load protection/alarm (F24), or process current warning (F22) functions. Functions F3 and F5 associated with two-speed applications are not available. No provision for automatic reset (F8) is provided. SAMMS-MVE accepts one remote input, and provides one output to actuate a single contactor. An alarm contact is not available with SAMMS-MVE.

These remote inputs are compatible with all PLCs and electro-mechanical remote control devices that have a 120VAC or 125VDC input signal.

1.2.2 Advanced Protection for Medium-Voltage Motors

For advanced protection of medium voltage motors, the SAMMS-MV device uses a motor model algorithm that continually calculates the stator winding and housing temperature as well as the rotor temperature as a function of the motor rms current. The motor model compares the calculated temperature to trip temperature values and provides a signal that trips the motor off line when the motor reaches a trip temperature value. The model closely emulates the heating and cooling of the motor windings as well as the rotor and provides protection against both transient and steady-state overload conditions.

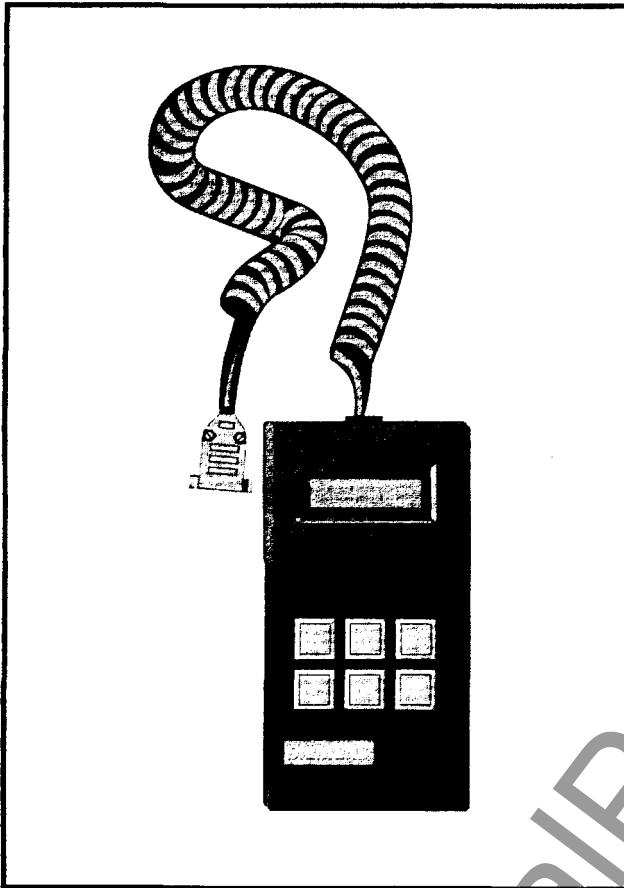


Figure 1.2 Hand-Held Communicator (HHC)

1.2.3 Overload Protection

The motor model offers the selection of overload classes 2 through 23.

The SAMMS-MV device offers more accurate motor protection than traditional thermal overload and most electronic motor protection devices. This prolongs motor life by eliminating nuisance tripping for multiple restarts, and allowing for proper cool down time when the motor winding temperature or rotor temperature reaches a critically high value.

1.2.4 Programming Control Circuits

The SAMMS-MV device allows you to modify its configuration by programming the microprocessor. The SAMMS-MV device replaces conventional timers, overload relays, pushbuttons, and selector switches.

SAMMS-MVE is preloaded with seven across-the-line control circuits, and the desired control circuit can be selected using the Hand-Held Communicator (HHC.) Alternatively, a custom across-the-line circuit may be downloaded from a PC.

A library of more than 40 typical control circuits exists for use with SAMMS-MVX to meet applications ranging from simple across-

the-line starters to complicated reduced-voltage starters. With optional software, the specified control circuit can be loaded either from the library or from a modified version into the microprocessor's memory, in the factory or on site, using an IBM®-PC compatible computer. If you would like to learn more about this software package, refer to *SAMMS Custom Software Manual*, Bulletin CP 3291.

Highly specialized control circuits can be developed and existing circuits can be modified using an optional IBM-PC compatible software package. This software uses conventional engineering symbols along with pull-down menus and a mouse to draw ladder diagrams. When you have finished drawing the diagram, the software translates the diagram into microprocessor machine code and downloads it into the SAMMS-MV device's memory.

1.2.5 Using the Standardized Control Panel

The SAMMS-MV device can be used for local and/or remote control. The SAMMS-MVE device provides two light bars, while the SAMMS-MVX model provides three light bars. Each model includes six pushbuttons with lights and tactile feedback. You can program these light bars and pushbuttons for the various functions of the control circuit used.

The test/reset button is used to test and reset the overload function and to test the front panel lights.

Diagnostics

Eight diagnostic LEDs, located on the front panel, provide information about conditions affecting the motor.

Statistical Data about the Motor

The microprocessor's memory stores statistical data about the motor and displays this data on the Hand-Held Communicator (HHC).

Real-Time Metering Data

The Hand-Held Communicator displays real-time metering data.

Local Displaying of Motor and Circuit Data

The HHC and the eight (8) diagnostic LEDs display motor and control circuit data. The eight (8) diagnostic LEDs are located on the front panel of the device.

Communicating with Other Devices

The SAMMS-MV device communicates with other devices via the ACCESS system. When connected to the ACCESS system, the SAMMS-MV device provides two-way communication with the Power Monitor™ display and monitoring unit, an IBM PC-compatible computer running the Power Monitor PC™ communications and supervisory software or another supervisory device. This ability allows you to control and monitor motors from a centralized location. You can have remote access to all SAMMS-MV data such as diagnostics, statistical data, real-time metering, and controller status. If you would like to learn more about the ACCESS system, refer to *Installing the ACCESS System* (manual no. SG6028).

1 Introduction

SAMMS-MV Model	SAMMS-MVE	SAMMS-MVX
Application		
Across-the-line (FVNR)	X	X
Reversing		X
Two-speed		X
Reduced voltage		X
Functions available (see table 3.7)	F0-F21 plus F25-F27 (except no F3, F5, or F8)	F0-F27
Ridethrough upon loss of power	No	Yes
Ground fault protection/alarm	Yes	Yes
Programmable alarm contact	No	Yes
Control circuits	Seven (preloaded), selectable with HHC. May download any custom across-the-line control circuit	Any downloadable control circuit
Change settings requires password	Yes	Yes
Remote inputs	One	Four
Outputs	One	Three
Light bars	Two	Three

Table 1.2 SAMMS-MV models

2 Installing the SAMMS-MV Device

2 Installing the SAMMS-MV Device

This section provides instructions for installing the SAMMS-MV device. You should adapt these instructions to suit the needs of your installation and equipment.

2.1 Receiving and Storing the SAMMS-MV Device

Thoroughly inspect the equipment before accepting the shipment from the transportation company. Compare each item received against the packing list and report any shortages or damaged equipment to the carrier.

If you are not going to install the SAMMS-MV device immediately, store it in a clean, dry location at ambient temperatures from -40° C to 85° C. The surrounding air should not contain any corrosive fumes or electrically conductive contaminants. The storage location should prevent condensation from forming within the equipment enclosure.

Note: Improper storage can cause equipment damage. Follow all storage instructions carefully. Failure to follow storage instructions will void the warranty.

2.2 Where to Locate the Device

You can locate the SAMMS-MV device and its associated devices in most industrial equipment environments. Unless the device is designed for specific requirements, you should install the SAMMS-MV device and its controller in an area where the following conditions exist:

- Ambient air must be free of dirt, combustible vapor, steam, electrically conductive or corrosive material.
- Area around the controller must provide access to the equipment for inspection, maintenance and operation.

2.3 Mounting the Device

The SAMMS-MV device mounts in a front door panel of the low voltage compartment of Siemens Series 81000™ medium voltage control (MVC) equipment. Mount the device in the normal low-voltage compartment associated with each medium voltage controller.

2.4 Connecting the Device

This section contains general guidelines that you should follow to connect the SAMMS-MV device. These guidelines include instructions for routing the wire, connecting the wire and grounding the device. Use these guidelines to install the SAMMS-MV device and its peripheral devices in a motor controller. Also use these guidelines to connect the motor controller to the motor.


When Siemens supplies a SAMMS-MV device as part of a motor controller, Siemens personnel install the wiring between the SAMMS-MV device and its peripheral devices in the motor

controller at the factory. The schematic diagram used contains three components: a connection diagram, a ladder diagram and a wiring diagram. The connection diagram illustrates the connections between the SAMMS-MV device and its peripheral devices. The ladder diagram illustrates the control circuit loaded into the SAMMS-MV device. Figure 2-1 shows a typical connection diagram for the SAMMS-MV device.

If Siemens does not supply the motor controller, the retrofitter or original equipment manufacturer should develop an equivalent electrical scheme.

2.4.1 Wiring Guidelines

You must observe the following guidelines when installing the SAMMS-MV device and connecting it with its peripheral devices.

	! DANGER
	Hazardous Voltages Will result in death, serious injury, or property damage. Turn OFF and lock out all incoming AC power and all foreign power sources before attempting to work on the SAMMS-MV device.

Note: Failure to follow these guidelines can cause pickup of unwanted signals resulting in erratic operation and damage to the SAMMS-MV device.

Guideline 1: Separate the low-voltage (115 VAC or less) from the higher voltage conductors (460 VAC or higher) as much as possible. If low-voltage and medium-voltage wires must cross paths, make sure that they intersect at a right angle.

Guideline 2: To eliminate noise coupling, install all twisted pairs or wrap wires in such a way that a complete twist or wrap occurs at least every two inches.

Guideline 3: Place the low-voltage leads near the controller chassis.

Guideline 4: Use at least AWG 14 stranded copper wire for any low-voltage control wiring that you route outside the motor controller enclosure. Connections to the SAMMS-MV unit must be made with wire no larger than AWG 14.

Guideline 5: To avoid ground loops, ground each motor controller at a single ground point.

The top portion of the device contains 16 terminal locations for connecting control power leads, power supply, ground, inputs and outputs. (Refer to Figure 2.2 for a description of each terminal block assignment.)

2 Installing the SAMMS-MV Device

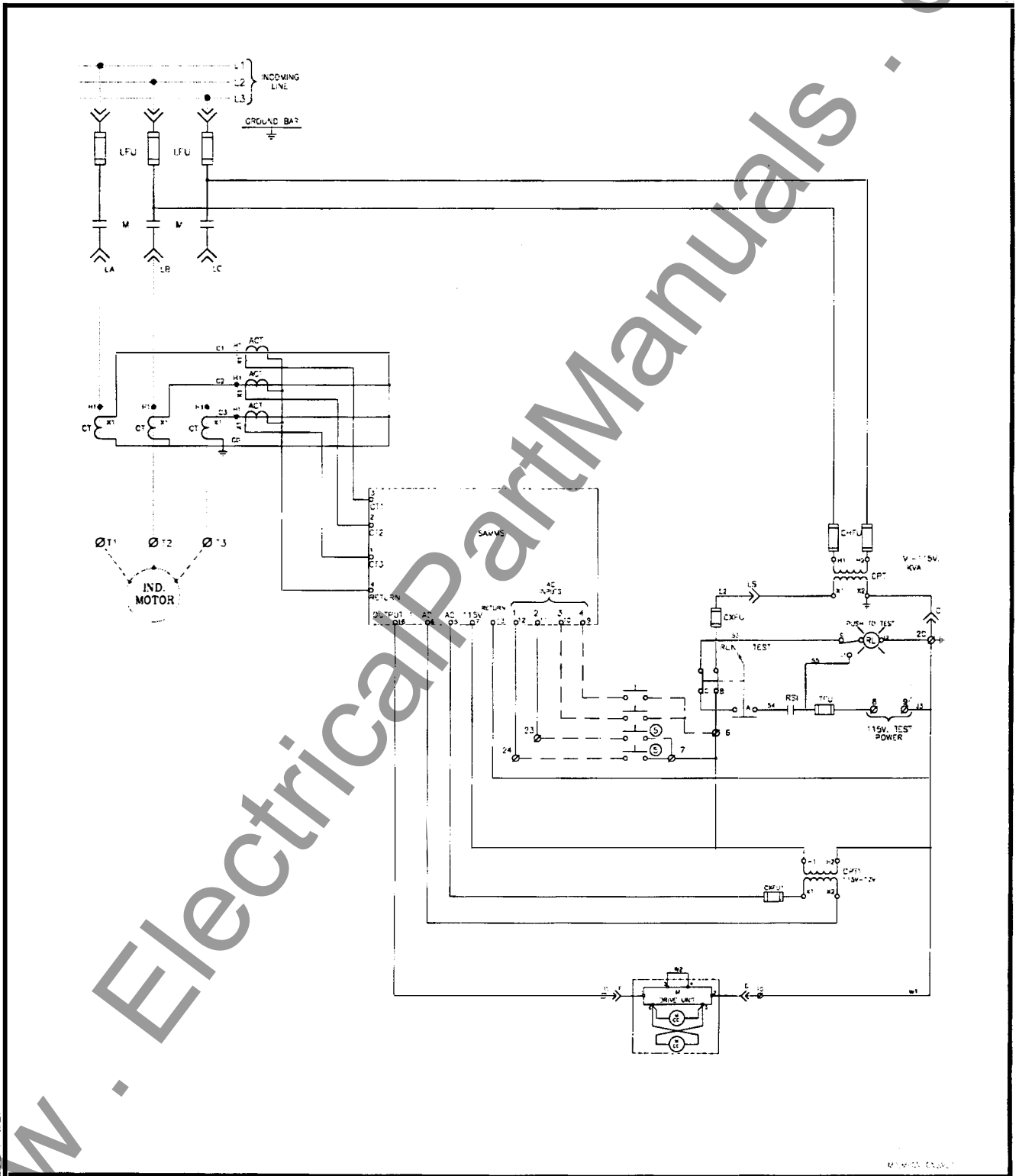


Figure 21 Full voltage non-reversing connection diagram

2 Installing the SAMMS-MV Device

2.4.2 Grounding the Device

As stated in Guideline 5, ground each motor controller at a single ground point. The grounding path to earth must be permanent and continuous. It must also be able to safely conduct ground fault currents that may occur in the system to ground through minimum impedance. The earth ground does not carry any current under normal conditions.

Note: Do not ground the SAMMS auxiliary current sensor (ACT) leads. (See figure 2.1.)

⚠ DANGER

Hazardous Voltages
May be present on external surfaces of un-grounded controllers and will cause death, serious injury, or substantial property damage. Follow grounding instructions carefully.

Connect a ground bus to the chassis of each controller or to the chassis of the mounting equipment containing the earth ground through a grounding conductor.

Refer to Article 250 of the National Electrical Code for information about the types and sizes of wire conductors and methods for safely grounding electrical equipment and components.

2.4.3 Connecting the Device to a Control Power Source

The SAMMS-MV device requires a 12 VAC control power source in order to operate. Connect the control power source to terminals 5 and 6 located on the top of the relay.

2.4.4 Connecting Input and Output Devices to the SAMMS-MV Device

Connect your devices to the input and output connections on the SAMMS-MV device as illustrated in Figure 2.2.

2.4.5 Communications Connection

The SAMMS-MV device is equipped with an RS-485 communications port on the back of the device. The communications port allows connection to a communications module which enables

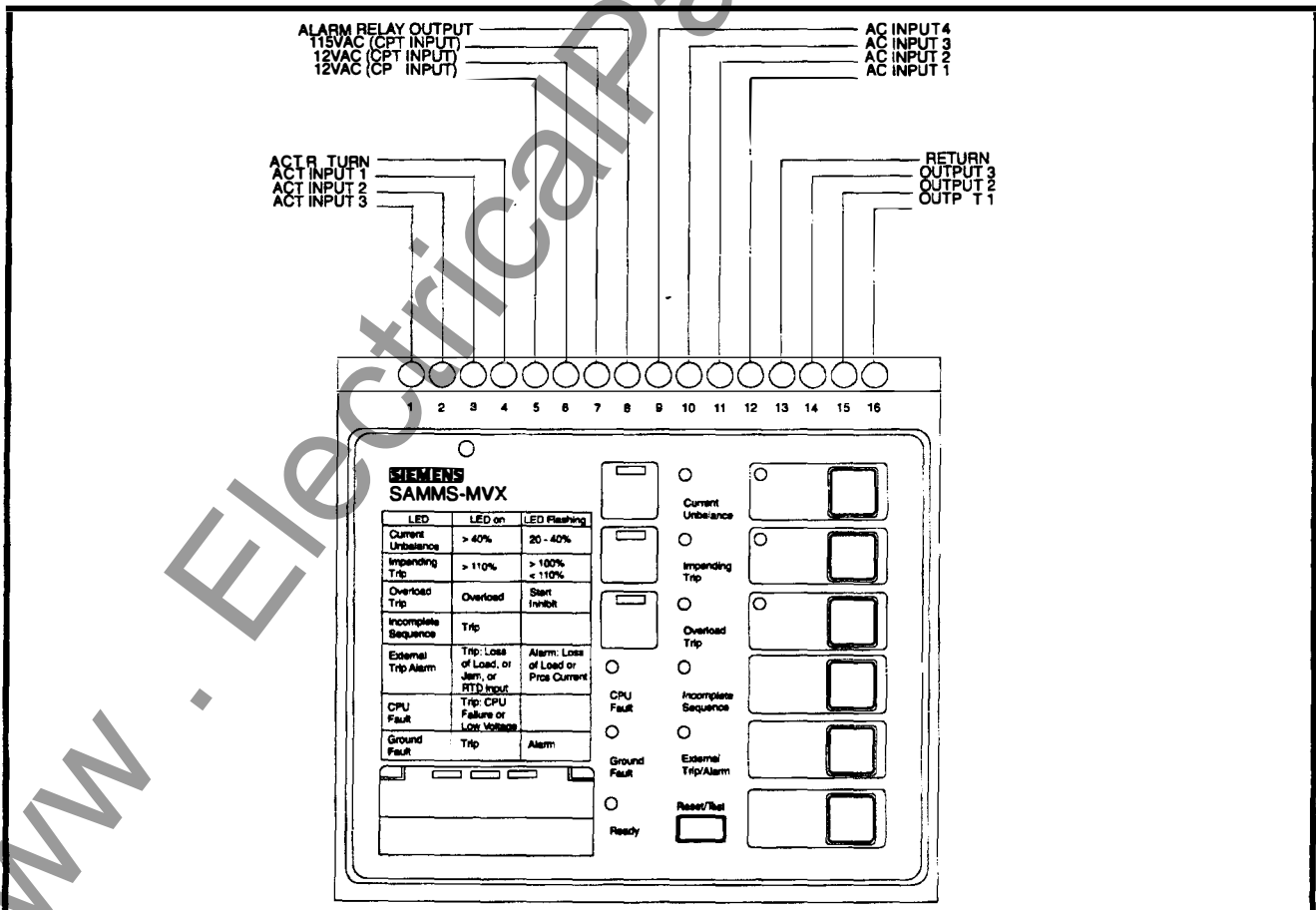


Figure 2.2 Terminal block assignments

2 Installing the SAMMS-MV Device

the SAMMS-MV to communicate with a remote supervisory device. Examples of the remote supervisory device include the Power Monitor display and monitoring unit, a standard personal computer running the Power Monitor PC communications and supervisory software, or Siemens Microsoft® Windows™ based SIEServe™ or WinPM™ software. These supervisory devices and programs can communicate with the SAMMS-MV device and allow it to operate in the ACCESS electrical distribution

communications system.

The SAMMS-MV device connects to the SEAbus™ RS-485 via the 5 pin plug on the Communications Module CM-1. The communications connections are illustrated in Figure 2.3. Refer to *Installing the ACCESS System* (manual no. SG-6028), for detailed information on connecting the SAMMS-MV device to the ACCESS network.

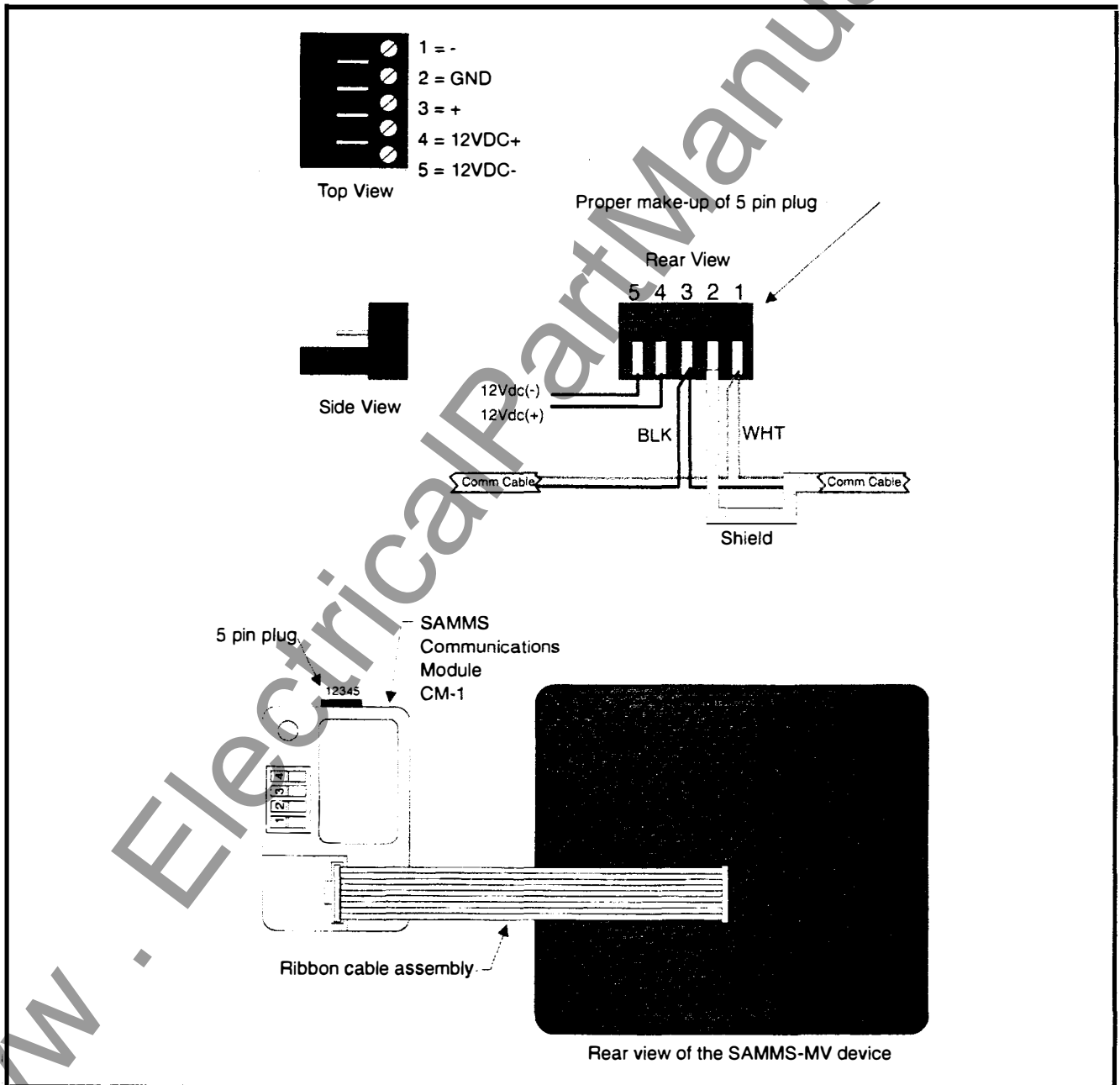


Figure 2.3 SAMMS-MV device communications connections

3 Operating the SAMMS-MV Device

3 Operating the SAMMS-MV Device

This section explains how to operate the SAMMS-MV device.

3.1 Password Protection

Changing the settings of the SAMMS-MV device requires the use of the Hand-Held Communicator (HHC) in the program mode. To access the program mode, the user needs a password. The SAMMS-MV device is shipped from the factory with the password "0000." This password can be changed by the user as described in section 3.29.1. Display of data using the HHC does not require use of a password.

3.2 Using the Reset/Test Push Button

The Reset/Test pushbutton is located at the bottom center of the front panel of the SAMMS-MV device as illustrated in Figure 3.1. You press this pushbutton to manually reset the SAMMS-MV device after a fault or a trip condition occurs so that the motor can be restarted. You can also use the Reset/Test pushbutton to perform a lamp test or an overload relay test.

3.2.1 Performing a Lamp Test

To test the diagnostic LEDs, the control LEDs and the light bars on the front panel, use the following procedure:

1. Press and hold the Reset/Test pushbutton for one to two seconds.
2. Release the Reset/Test pushbutton. (All LEDs and light bars on the front panel illuminate for two seconds.)

If a fault or trip condition exists when you press the Reset/Test pushbutton, the device performs a reset instead of a lamp test.

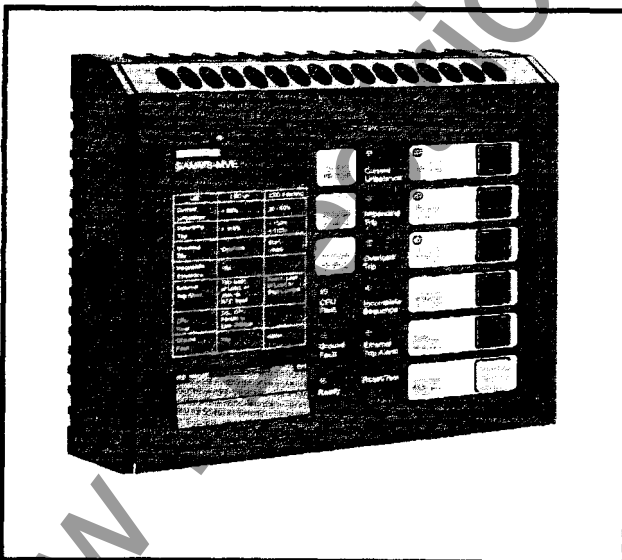


Figure 3.1 Front view of SAMMS-MV

3.2.2 Performing an Overload Relay Test

You may perform an overload relay test whenever the motor is stopped. Use the following procedure to perform an overload relay test.

1. Press and hold the Reset/Test pushbutton for at least the duration of the class time. The class time is set by accessing function F7. If you need to know how to access function F7, see Section 3.29. If you release the Reset/Test pushbutton before the duration of the class time, the device performs a lamp test. If a fault or trip condition exists when you press the Reset/Test pushbutton, the device performs a reset instead of a lamp test.
2. Continue to hold down the Reset/Test pushbutton. After reaching the class time duration, the Impending Trip and the Phase Unbalance LEDs illuminate.
3. Release the Reset/Test pushbutton. The Impending Trip and Phase Unbalance LEDs go off, and the Overload Trip LED illuminates for two seconds. If the SAMMS-MV device is tripped, it is automatically reset at the end of the overload relay test.

Use the following procedure to reset the SAMMS-MV device after a trip event.

1. Press the Reset/Test pushbutton.
2. Release the Reset/Test pushbutton. The device resets the alarm LEDs. If the motor has cooled sufficiently, you can restart the motor.

3.3 Motor Control

You can configure the SAMMS-MV device to perform many motor starting and control functions. These functions include basic across-the-line, to more complicated reversing, two-speed, and reduced-voltage starting. The SAMMS-MV device stores in its memory the executable code representing the ladder diagram for the user's control application. The SAMMS-MV device and ladder diagram code replace the conventional control logic defined by wired interconnection of electromechanical timers, control relays, pushbuttons, selector switches, and pilot lights. A library of over 40 standard ladder diagrams available for the SAMMS-MV device covers most applications. In addition to the standard ladders, you can construct custom ladder diagrams, using optional software, to handle special applications.

Figures 3.2 and 3.3 illustrate the ladder symbols representing input and output devices available for the SAMMS-MV device. The circular symbols represent output devices such as contactor coil drivers, pilot LEDs on the front panel of the SAMMS-MV device, software time-delay relays and software control relays. All other symbols represent input devices such as software auxiliary contacts, remote AC inputs, front-panel pushbuttons, and software timer instantaneous and timed contacts.

3 Operating the SAMMS-MV Device

3.4 Output Devices

You can use the following SAMMS-MV output devices:

AC Outputs

The SAMMS-MVX device provides up to three AC coil drivers capable of driving contactors up to size H6, while SAMMS-MVE provides one coil driver.

Control Relays

The device provides up to eight software-controlled relays. These relays are helpful in local two-wire and other applications requiring maintained contacts.

Timing Relays

The SAMMS-MV device contains four internal software timing relays. You can configure all four timers as on-delay timers; however, if needed, you can configure the two adjustable timers (timing relays TR1 and TR2) as either on-delay or off-delay timers. Using the Hand Held Communicator, you can program timing relays TR1 and TR2 from 0 through 200 seconds (functions F13 and F14). Timing relay TR3 has a fixed 1 second delay, and timing relay TR4 has a fixed 30 seconds delay. Table 3.1 illustrates the type of timers used on the device and their ranges.

Timer	Type	Time (in seconds)
TR1	Programmable on-delay or off-delay	0 - 200
TR2	Programmable on-delay or off-delay	0 - 200
TR3	Fixed on-delay	1
TR4	Fixed on-delay	30

Table 3.1 Types of software timing relays

Pilot LEDs

The SAMMS-MVX device contains three light bars on the front panel, while the SAMMS-MVE contains two light bars. Light bar L1 is reserved and must be used as the STOP or OFF LED. You can configure L2 and L3 at your discretion. The Hand, Off and Auto LEDs correspond to the Hand, Off and Auto pushbuttons on the front panel as illustrated in Figure 3.4. You can use the Incomplete Sequence LED in reduced-voltage applications or to verify contactor operation. Refer to Figure 3.4 for the location of the LEDs and Table 3.2 for a description of the LED states.

Flashing Pilot LEDs

The front panel contains two or three flashing light bars that indicate various conditions such as on-delay timing. These flashing light bars, L1, L2 and L3 as defined above, indicate different output devices if they are flashing rather than if they are on constantly. Refer to Figure 3.4 for an illustration of pilot LEDs.

3.5 Input Devices

You can use the following input devices with the SAMMS-MV device.

Remote AC Inputs

For SAMMS-MVX you can use four 120 VAC or VDC inputs for remote control, or you can use one input for SAMMS-MVE.

Front Panel Pushbuttons

The SAMMS-MV device has six front-panel pushbuttons for local control of the device. You must use pushbutton 1 (PB1) for stopping the motor. You must use three of the pushbuttons (PB4-PB6) for the Hand, Off and Auto functions if these functions are used in your configuration. If these functions are not used, you may use PB4-PB6 for other functions. You can configure the other two pushbuttons (PB2 and PB3) at your discretion. Refer to Figure 3.4 for assignment of pushbuttons. Insert labels are used to identify the function associated with each pushbutton or light bar.

Software Auxiliary Contacts

Any number of internal (software) auxiliary contacts can be configured. These contacts show either a normally open (NO) or normally closed (NC) status. You can set up these auxiliary contacts using the SAMMS-MV software. Through the SAMMS-MV software, the pilot LEDs also have auxiliary contacts.

LED	STATE	
	On	Flashing
Current Unbalance	> 40%	20 - 40%
Impending Trip	> 110%	> 100% - <110%
Overload Trip	Trip	Start Inhibit
Incomplete Sequence	Trip	
External Trip/Alarm	Trip: Loss of Load or Jam or RTD	Alarm: Loss of Load or Process Current
CPU Fault	Trip: CPU Failure or Low Voltage	
Ground Fault	Trip	Alarm
Light bar (L1)	Stop or Off	Off Delay Timer Timing
Light bar (L2)	Start, On, Forward, Low Speed, Right	On Delay Timer Timing
Light bar (L3)	Reverse, High Speed, Left	On Delay Timer Timing

Table 3.2 Description of pilot LEDs

Software Timer Inputs

Each timer has an unlimited number of normally open (NO) and normally closed (NC) contacts. Timers configured as on-delay timers have an unlimited supply of normally open timed-closed (NOTC), and normally closed timed-open (NCTO) contacts. Timers configured as off-delay timers have an unlimited supply of normally open timed-open (NOTO), and normally closed timed-closed (NCTC) contacts.

Communications Inputs

A serial, RS-485 communications port is located on the back of the device for external communications.

3 Operating the SAMMS-MV Device

The communications inputs must be included in the ladder logic (control circuit).

3.6 Ladder Diagrams

3.6.1 Library of Standard Ladder Diagrams

The SAMMS-MV library of more than 40 ladder diagrams covers most standard motor control applications. Table 3.3 lists the standard control circuits and the input and output assignments for the library. You can use the library with the following starter types:

- across-the-line, non-reversing
- across-the-line, reversing
- two-speed, two winding
- two-speed, one-winding, constant or variable torque
- two-speed, one-winding, constant horsepower
- reduced-voltage, autotransformer
- reduced-voltage, reactor

For each starter type, the library includes seven control types:

- local two-wire
- local three-wire

- local three-wire, remote two-wire
- local two-wire, remote two-wire
- local three-wire, remote three-wire
- remote two-wire
- remote three-wire

SAMMS-MVE has seven preloaded circuits (ladder diagrams) for use with across-the-line (FVNR) applications. SAMMS-MVX may be used with any of the circuits.

For details on the library of standard ladder diagrams, refer to the SAMMS Standard Circuit Manual.

3.6.2 Custom Ladder Diagrams

For special motor control applications not covered by the library of standard ladders, you can construct custom ladder diagrams using the input and output devices and their associated symbols for the SAMMS-MV device. Siemens personnel can build these custom ladder diagrams or you can build your own. You can purchase an optional IBM PC-compatible software package to develop custom ladder diagrams for special control applications. The package also includes a library of standard symbols. The package enables you to reconfigure existing SAMMS-MV devices to meet changing plant needs. Refer to the Custom Software Manual for the SAMMS device, Bulletin CP 3291.

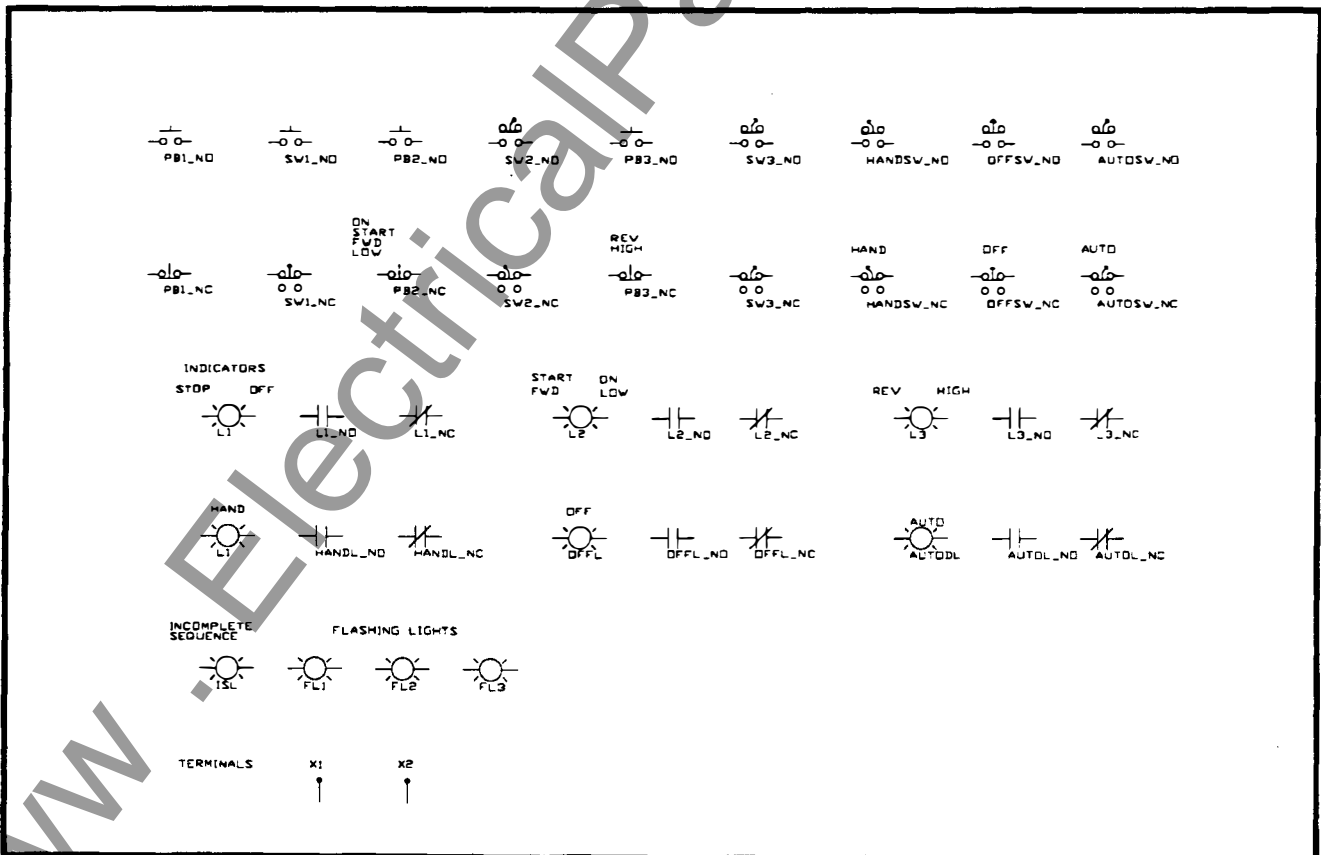


Figure 3.2 Ladder symbols used with the SAMMS-MV device (sheet 1)

3 Operating the SAMMS-MV Device

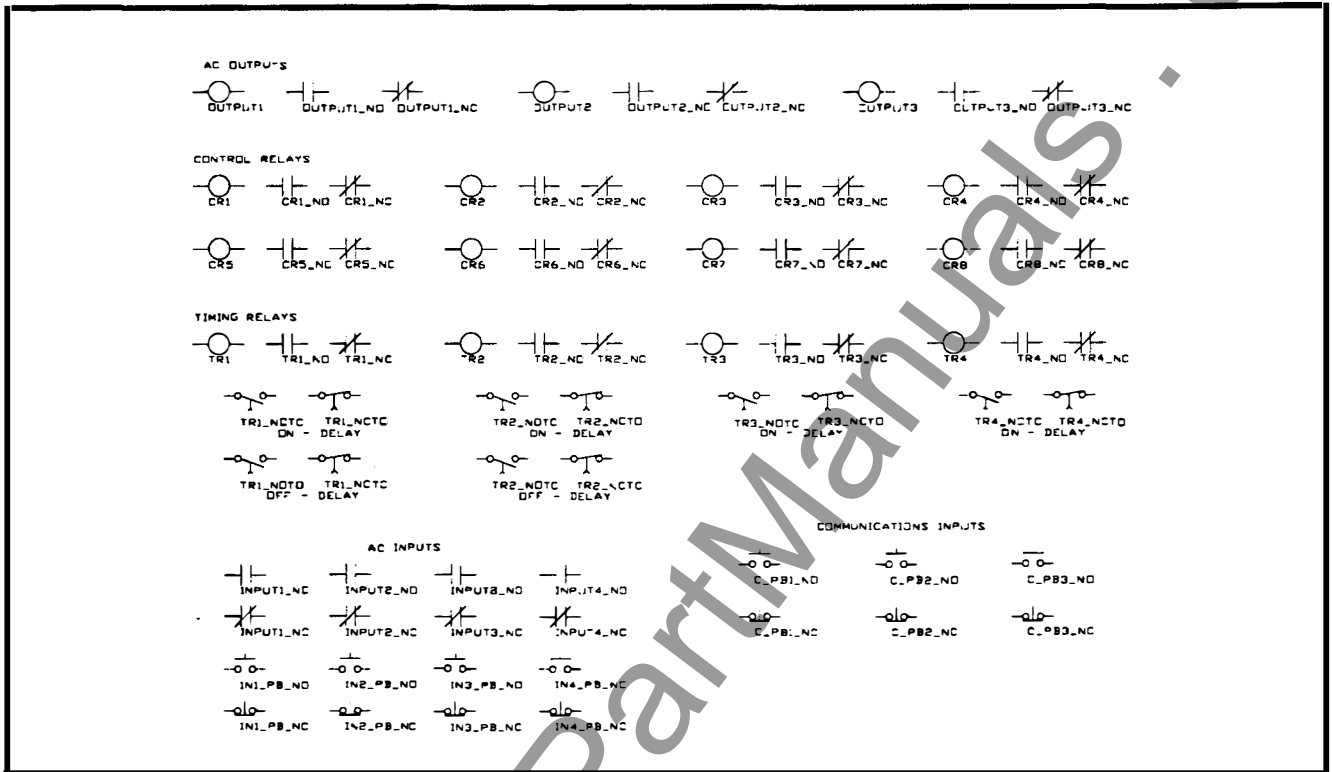


Figure 3.3 Ladder symbols used with the SAMMS-MV device (sheet 2)

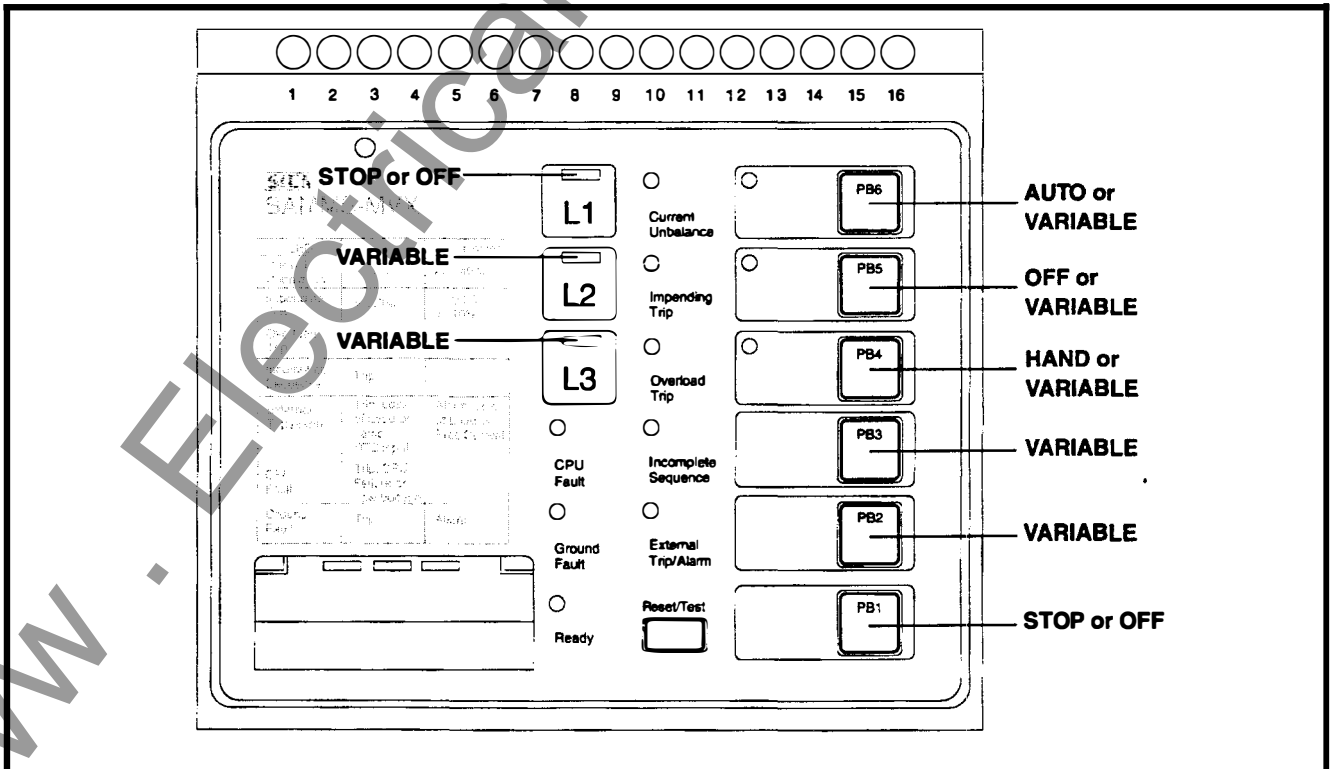


Figure 3.4 Assignment of pushbuttons and light bars

3 Operating the SAMMS-MV Device

	Starter Type	Program Block	Control Type	Input Assignments					
				PB1	PB2	PB3	PB4	PB5	PB6
Preloaded in SAMMS-MVE can be downloaded in SAMMS-MVX	FVNR	PB10	LOCAL, 2-WIRE	OFF	ON				
	FVNR	PB11	LOCAL, 3-WIRE	STOP	START				
	FVNR	PB12	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	START		HAND	OFF	AUTO
	FVNR	PB13	LOCAL/REMOTE 2-WIRE	STOP			HAND	OFF	AUTO
	FVNR	PB14	LOCAL/REMOTE 3-WIRE	STOP	START				
	FVNR	PB15	REMOTE, 2-WIRE						
	FVNR	PB16	REMOTE, 3-WIRE						
Available with SAMMS-MVX only	FVR	PB17	LOCAL, 2-WIRE	OFF	FWD	REV			
	FVR	PB18	LOCAL, 3-WIRE	STOP	FWD	REV			
	FVR	PB19	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	FWD	REV	HAND	OFF	AUTO
	FVR	PB20	LOCAL/REMOTE 2-WIRE	STOP	FWD	REV	HAND	OFF	AUTO
	FVR	PB21	LOCAL/REMOTE 3-WIRE	STOP	FWD	REV			
	FVR	PB22	REMOTE, 2-WIRE						
	FVR	PB23	REMOTE, 3-WIRE						
	FVR	PB24	LOCAL/REMOTE 3-WIRE ELECTRICALLY INTERLOCKED	STOP	FWD	REV			
	2SPD,2W	PB25	LOCAL, 2-WIRE	OFF	LOW	HIGH			
	2SPD,2W	PB26	LOCAL, 3-WIRE	STOP	LOW	HIGH			
	2SPD,2W	PB27	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD,2W	PB28	LOCAL/REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD,2W	PB29	LOCAL/REMOTE 3-WIRE	STOP	LOW	HIGH			
	2SPD,2W	PB30	REMOTE, 2-WIRE						
	2SPD,2W	PB31	REMOTE, 3-WIRE						
	2SPD, 1W, CT OR VT	PB32	LOCAL, 2-WIRE	OFF	LOW	HIGH			
	2SPD, 1W, CT OR VT	PB33	LOCAL, 3-WIRE	STOP	LOW	HIGH			
	2SPD, 1W, CT OR VT	PB34	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
2SPD, 1W, CT OR VT	PB35	LOCAL/REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO	
2SPD, 1W, CT OR VT	PB36	LOCAL/REMOTE 3-WIRE	STOP	LOW	HIGH				
2SPD, 1W, CT OR VT	PB37	REMOTE, 2-WIRE							
2SPD, 1W, CT OR VT	PB38	REMOTE, 3-WIRE							

Table 3.3 Standard control circuits

3 Operating the SAMMS-MV Device

	Starter Type	Program Block	Control Type	Input Assignments					
				PB1	PB2	PB3	PB4	PB5	PB6
Available with SAMMS-MVX only	2SPD, 1W, CH	PB39	LOCAL, 2-WIRE	OFF	LOW	HIGH			
	2SPD, 1W, CH	PB40	LOCAL, 3-WIRE	STOP	LOW	HIGH			
	2SPD, 1W, CH	PB41	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD, 1W, CH	PB42	LOCAL/REMOTE 2-WIRE	STOP	LOW	HIGH	HAND	OFF	AUTO
	2SPD, 1W, CH	PB43	LOCAL/REMOTE 3-WIRE	STOP	LOW	HIGH			
	2SPD, 1W, CH	PB44	REMOTE, 2-WIRE						
	2SPD, 1W, CH	PB45	REMOTE, 3-WIRE						
	RVA (Auto TX)	PB46	LOCAL, 2-WIRE	OFF	ON				
	RVA (Auto TX)	PB47	LOCAL, 3-WIRE	STOP	START				
	RVA (Auto TX)	PB48	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	START		HAND	OFF	AUTO
	RVA (Auto TX)	PB49	LOCAL/REMOTE 2-WIRE	STOP			HAND	OFF	AUTO
	RVA (Auto TX)	PB50	LOCAL/REMOTE 3-WIRE	STOP	START				
	RVA (Auto TX)	PB51	REMOTE, 2-WIRE						
	RVA (Auto TX)	PB52	REMOTE, 3-WIRE						
	RVA (Reactor)	PB301	LOCAL, 2-WIRE	OFF	ON				
	RVA (Reactor)	PB302	LOCAL, 3-WIRE	STOP	START				
	RVA (Reactor)	PB303	LOCAL, 3-WIRE, REMOTE 2-WIRE	STOP	START		HAND	OFF	AUTO
	RVA (Reactor)	PB304	LOCAL/REMOTE 2-WIRE	STOP			HAND	OFF	AUTO
RVA (Reactor)	PB305	LOCAL/REMOTE 3-WIRE	STOP	START					
RVA (Reactor)	PB306	REMOTE, 2-WIRE							
RVA (Reactor)	PB307	REMOTE, 3-WIRE							

Table 3.3 Standard control circuits (continued)

3 Operating the SAMMS-MV Device

3.7 Incomplete Sequence

Sometimes the motor contactors do not respond in a timely manner to start, stop, transition, speed or direction change commands from the controller. If the SAMMS-MV device does not detect motor current one second after issuing a start command or if the SAMMS-MV device detects motor current one second after issuing a stop command, an Incomplete Sequence trip occurs. The motor contactors are opened and the Incomplete Sequence LED illuminates solidly. In standard reduced-voltage autotransformer (RVA) starters, an incomplete sequence also occurs if the remote RUN seal-in contact wired to pin 9 does not close within one second of the transition from starting to full-speed operation. This function can be disabled permanently when configured at the factory. You can also disable it with the Hand Held Communicator to the SAMMS-MV device. This is helpful when the controller is tested before connecting to the motor. After connecting the HHC, use the function UP and DOWN buttons to select F1. While pressing the ENTER button for a period of one second push START. Repeating the same process enables the incomplete sequence protection function.

3.8 Intelligent Reduced-Voltage Starting (SAMMS-MVX Only)

Intelligent reduced-voltage starting is provided in all standard reduced-voltage Siemens starters. The advantage of this feature is that the transition from reduced to full voltage is determined by the magnitude of the actual motor current and not by a timer. This optimizes the transition.

When a motor with intelligent reduced-voltage starting is started, a 30 second timer is energized. If the timer times out, the transition to full voltage commences as a fail-safe measure. If, before the 30 second timer times out, the motor current drops to below the full-load current setting, the transition commences.

The state of the RUN contactor, whose auxiliary contact is connected to Remote input 4 (pin 9), is checked one second after the transition. If the contactor is not closed, an incomplete sequence trip occurs.

3.9 Ridethrough Upon Loss of Power (SAMMS-MVX Only)

If a motor is running and control power is lost, the motor restarts automatically with two-wire control as soon as power is restored. With three-wire control, you must restart the motor manually. The optional ridethrough feature available with SAMMS-MVX allows three-wire controls to ride through power outages of up to one second. This feature is especially useful where the power system is subject to momentary interruptions. If, while the motor is running, power is lost to a three-wire control having the ridethrough option, the contactors are opened to prevent chattering and then reclosed automatically if power returns within one second.

3.10 Overload Protection

Medium-voltage motors are rotor limited under locked rotor conditions, and stator limited under running overload conditions. Additionally, the type of motor construction affects the thermal behavior of the rotor. For example, open drip-proof motors have

significantly shorter cold stall times than totally enclosed fan-cooled motors. The motor protection algorithm in the SAMMS-MV device is designed specifically to provide rotor protection based on the type of motor construction, and to differentiate between a stalled rotor and a rotor accelerating to running speed.

The motor overload protection function is based on calculating the motor's winding, housing, and rotor temperatures. These temperatures are compared to the allowable temperature limits for the motor's winding, housing, and rotor. On the basis of this comparison, the SAMMS-MV device either stops the motor or allows it to run.

For example, consider the motor winding and rotor temperature rises illustrated in Figure 3.5. The motor starts for 5 seconds and runs for a period of 2200 seconds. Then, the motor is subjected to a running overload condition that raises the winding temperature to the maximum allowable winding temperature rise resulting in an overload trip. At this temperature, the motor cannot start until the motor winding temperature cools down to the full-load temperature. The motor can then start and run at full-load current. Figure 3.6 depicts the temperature rise in the rotor and stator winding during a 10 second stall for an ODP motor. In this case, the rotor temperature rises at a rate faster than the winding temperature, and reaches the maximum allowable value resulting in a trip. In order to prevent damage to the motor, SAMMS-MV will not allow the motor to start until the winding and the rotor temperatures cool down to the full load temperature or less.

In the motor model, the greatest of the root mean square (RMS) current values for the motor phases is converted into a heat-like quantity. This is done by a mathematical function that depends on the ratio of the RMS current to the full-load current set for the motor. The function is based not only on ideal overload characteristics, but also on empirical motor data. The heat-like quantity is analogous to an input source of current to the electric-circuit analog. The exact values of the various elements in the circuit depend, in some cases, on nameplate data entered for the particular motor being protected. Unlike the method of protection in conventional overload relays, the motor model is general enough to protect many classes of motors, yet sophisticated enough to offer customized protection to particular motors. To customize protection to the motor enter the following nameplate data:

- full-load current setting (F4)
- service factor (F6)
- type of motor construction (Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (EFC) (F6)
- cold stall time, if available (F7)
- motor ambient temperature (F0)

3.11 Motor Ambient Temperature

Motors are used in a wide range of temperatures. However, motors designed according to NEMA standards are rated at 40°C ambient temperature.

The SAMMS-MV allows you to decrease or increase the motor's thermal capacity according to the motor's ambient temperature. You can select ambient temperature from 0° to 70°C in increments of 5°C, with HHC function F0.

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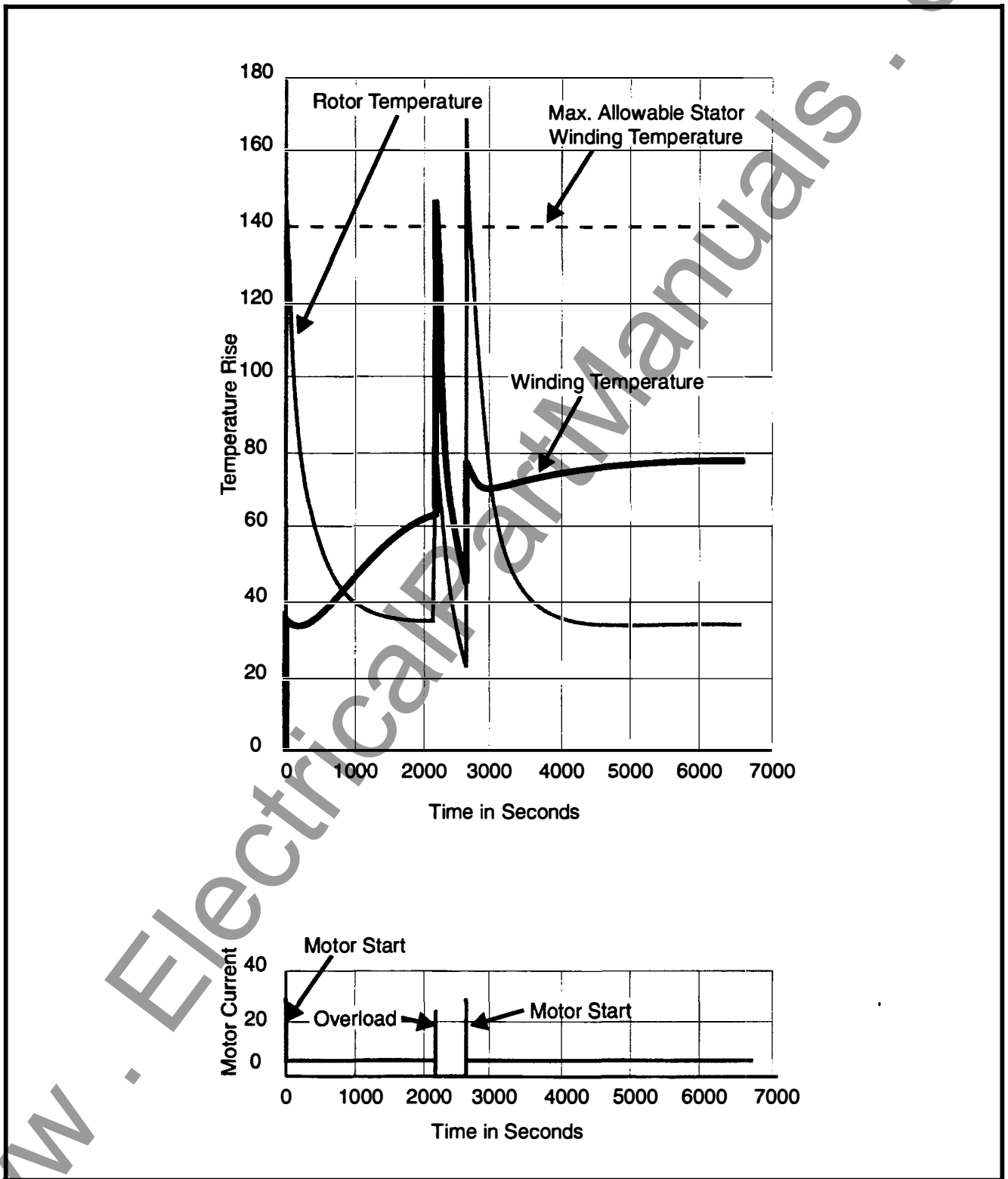


Figure 3.5 ODP motor thermal signature

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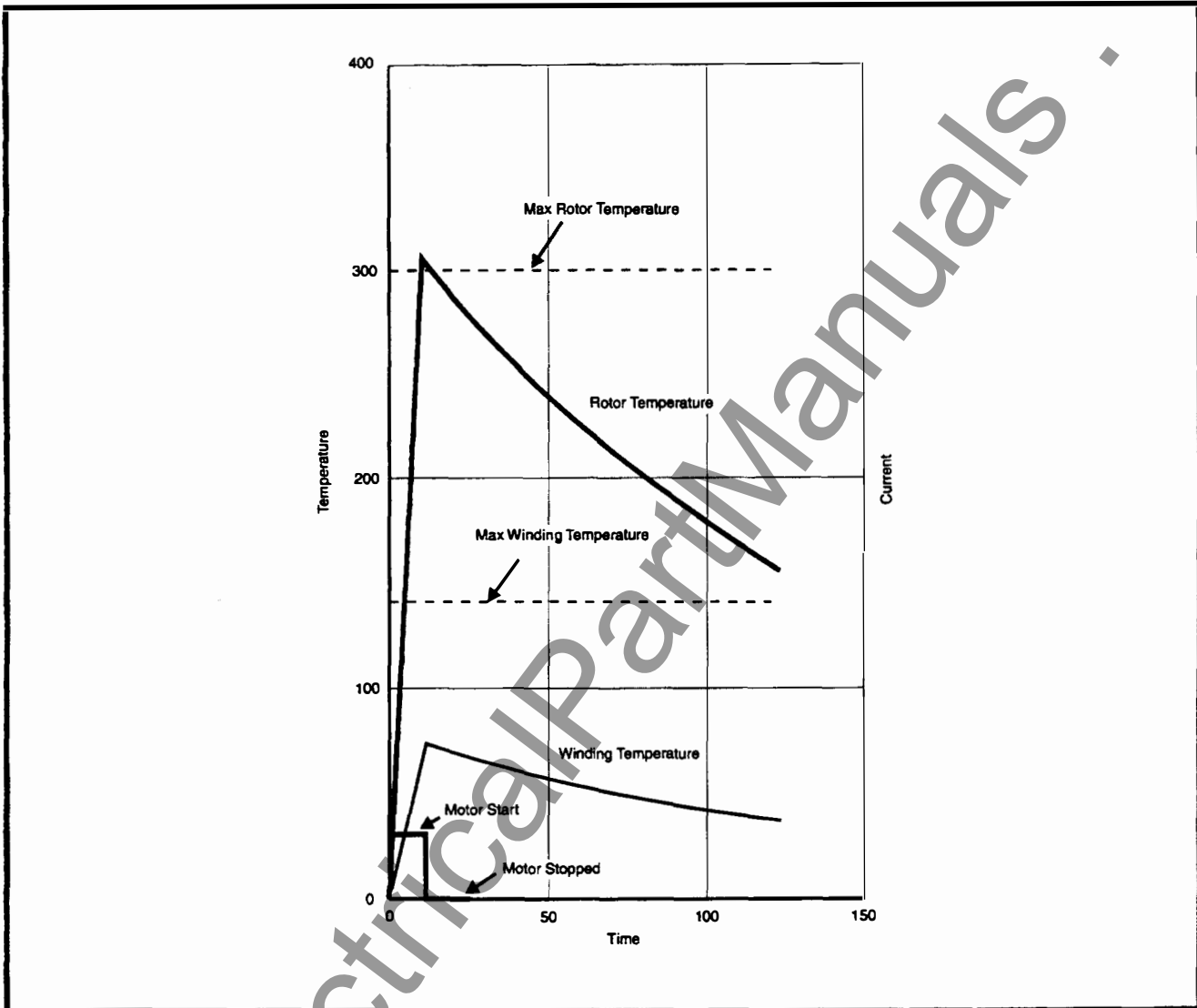


Figure 3.6 Rotor and winding temperature during 10 second motor stall

Important: Do not use this feature with motors rated for ambient temperature other than the standard 40°C.

3.12 Protection Curves and Overload Classes

The specific motor protection curve selected depends upon the overload class setting. The overload class is defined as the maximum tripping time in seconds for a current level of 600% of the full-load current or I_{FLC} . (The typical starting current of motors is 600% of I_{FLC} .) For example, an overload class setting of 10 guarantees that a current of 600% of I_{FLC} will cause a trip in 10 seconds or less. In the SAMMS-MV, the protection curves are designed to cause a trip in 90% to 100% of the class time for a current of 600% of I_{FLC} .

The lowest overload class, greater than or equal to the motor's starting time, gives the best protection. Overload classes 2 through 23 are available in SAMMS-MV. The range of protection curves are shown in Figures 3.7 through 3.10.

Important: In the unlikely event that the motor acceleration time (overload class) exceeds the motor's stall time, use a speed switch as an input source to open the contactor if the switch senses a locked rotor or stall condition.

Note: For clarity, the time-current characteristic curves in this manual are shown with overload classes 2, 5, 10, 15 and 23 only. Use interpolation to derive values of other overload classes not shown.

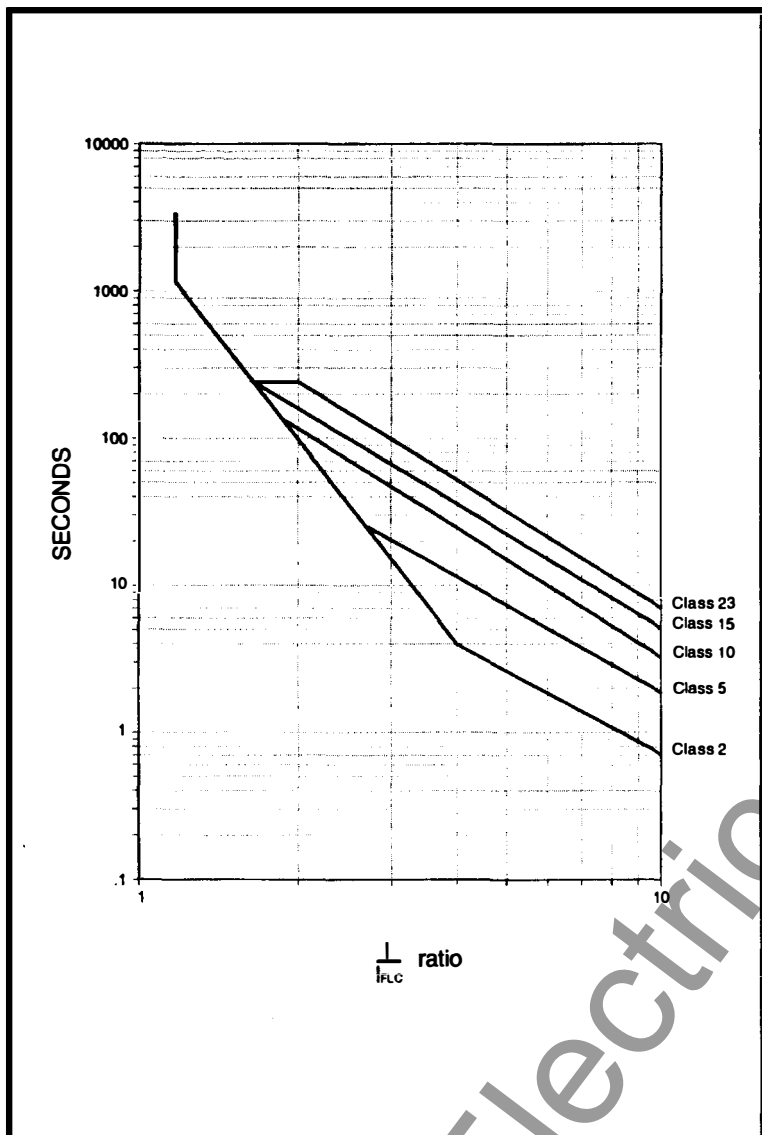


Figure 3.7 Time-current characteristic curve for cold motors with SF=1.00

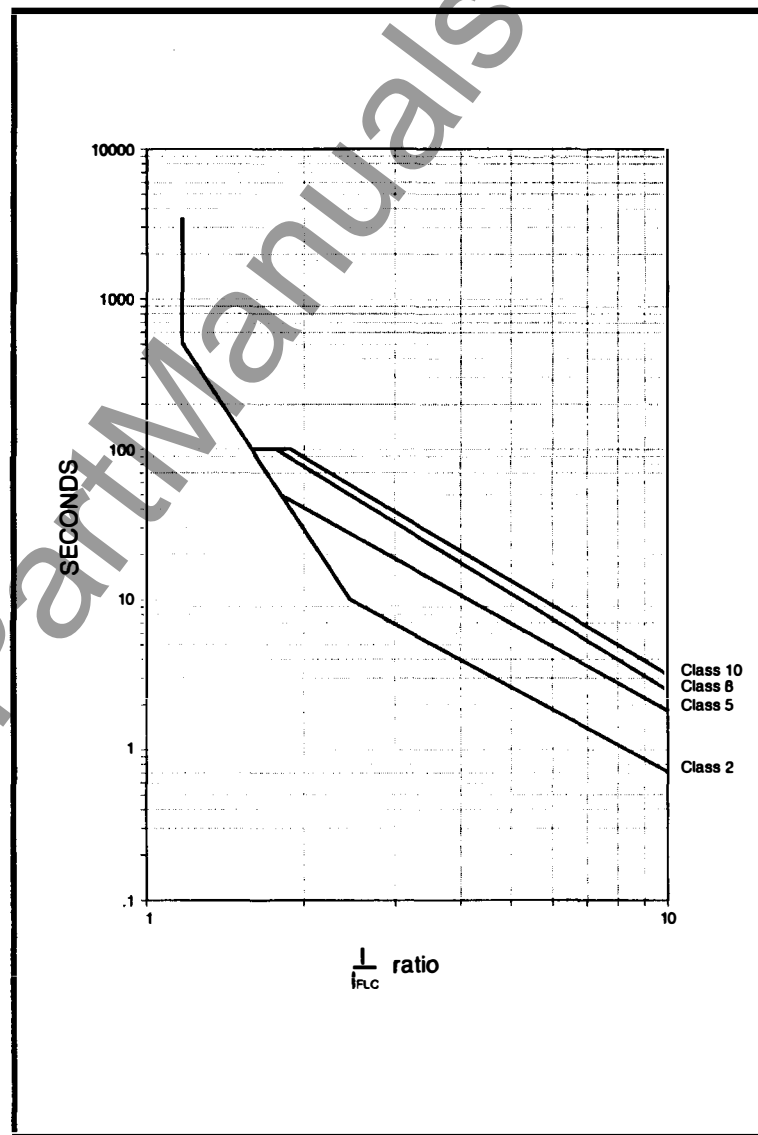


Figure 3.8 Time-current characteristic curve for warm motors with SF=1.00

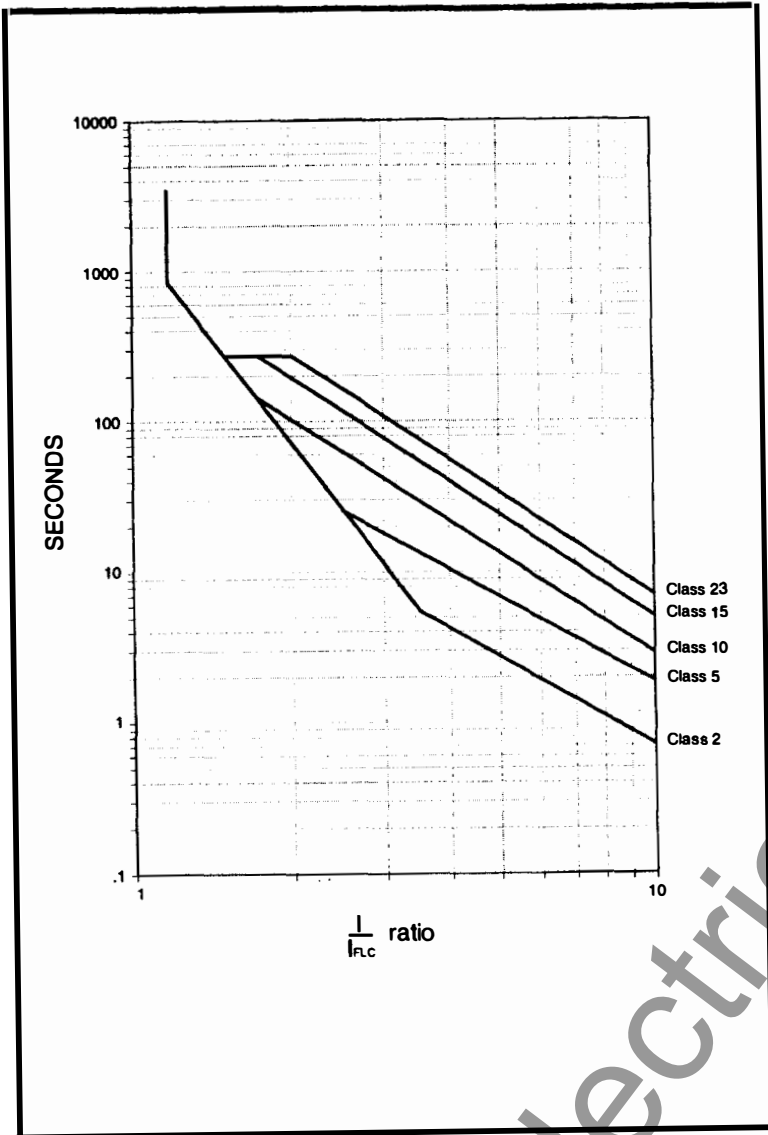


Figure 3.9 Time-current characteristic curve for cold motors with SF=1.15

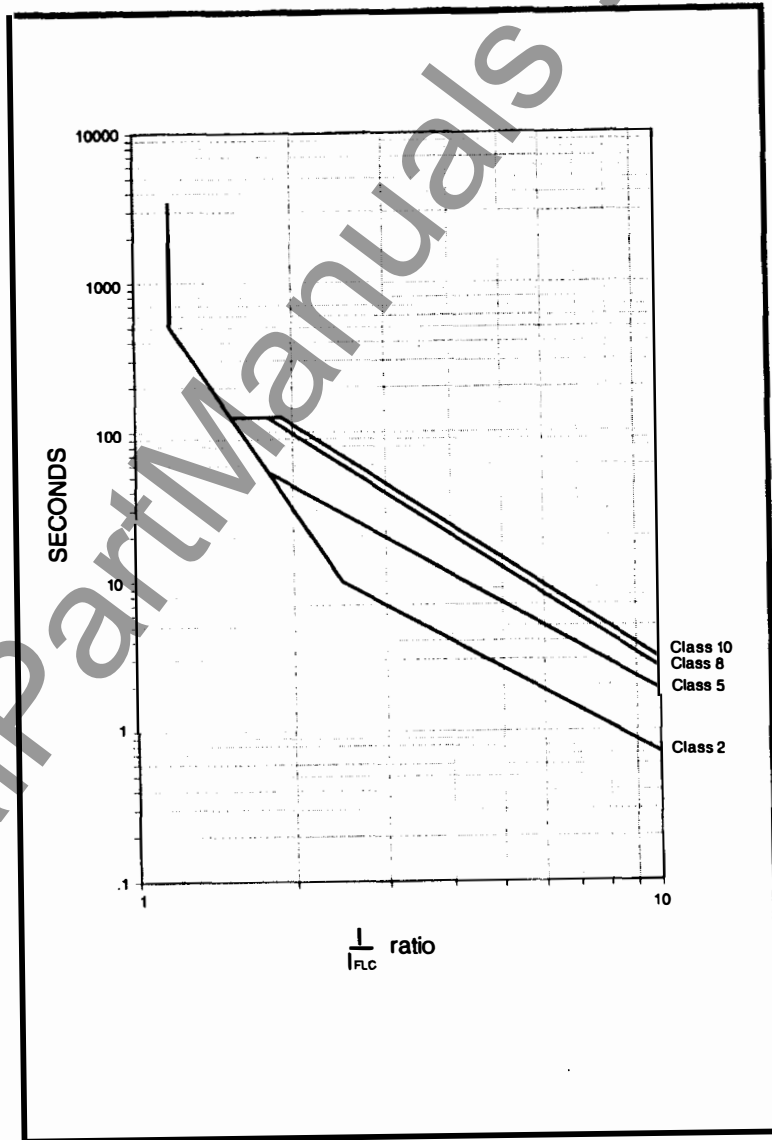


Figure 3.10 Time-current characteristic curve for warm motors with SF=1.15

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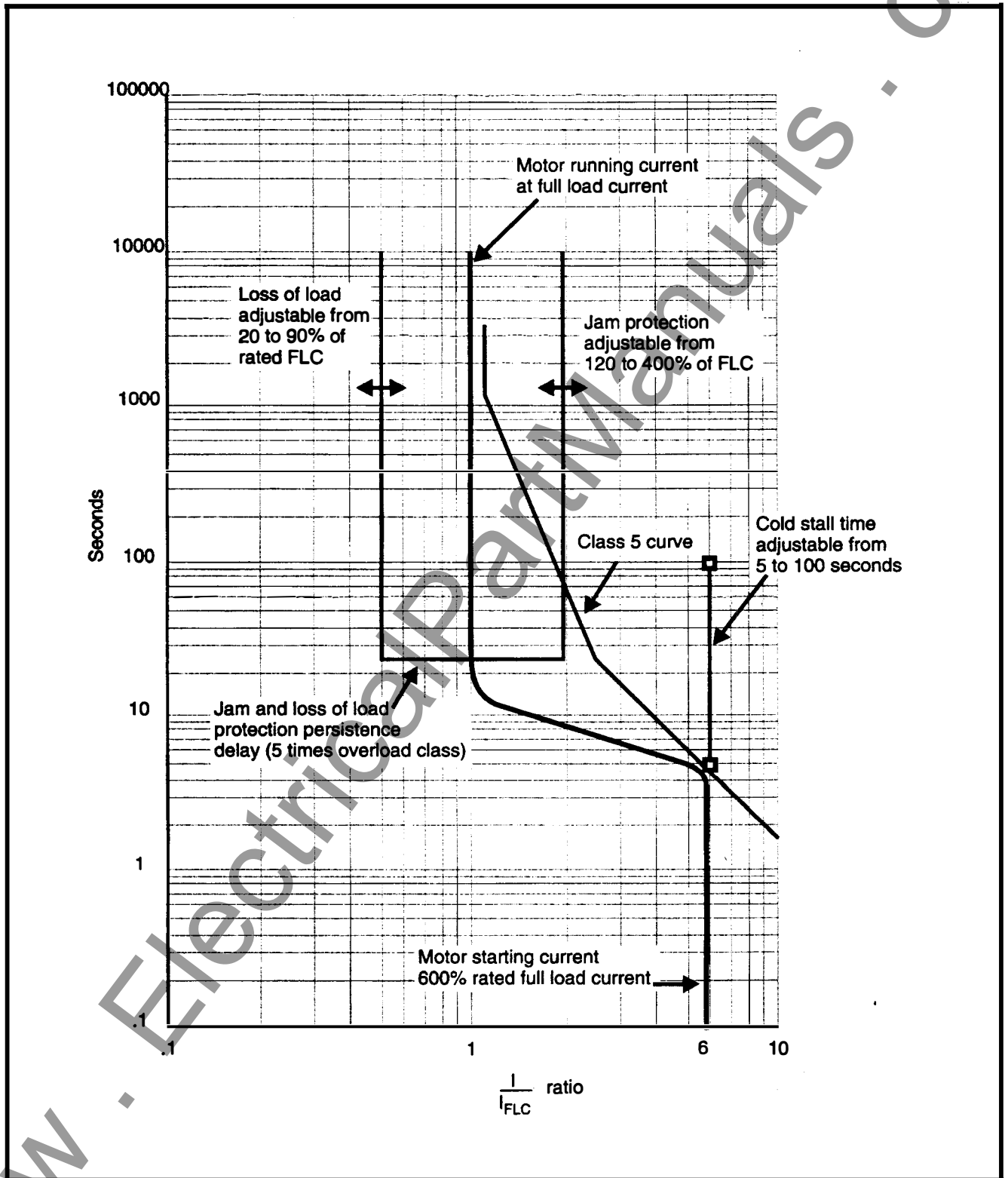


Figure 3.11 Motor protection graph

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3.13 Ultimate Trip Level and Service Factor

The ultimate trip level is the maximum continuous current that does not cause an overload trip. Any higher current applied indefinitely to an unprotected motor will ultimately damage it. The ultimate trip level for motors with a unity service factor is 110% of the full-load current setting. For motors with a service factor of 1.15, the ultimate trip level is 120%. You can select a service factor of 1.00 or 1.15 with HHC function F6.

3.14 Phase Unbalance

Unbalanced three-phase voltages or loss of one phase can result in unbalanced currents being supplied to the motor. Unbalanced currents include negative-sequence components that produce heat in the motor winding, decreasing the efficiency of the motor for a given load. The SAMMS-MV device measures the magnitude of the current unbalance as the maximum deviation from the average of the three-phase currents, divided by the average of the three-phase currents. In case of loss of a phase, the unbalance is 100% in a three-wire, ungrounded system.

With phase unbalance protection enabled, current unbalances of between 20% and 40% cause the Phase Unbalance LED to flash as a warning. If the unbalance increases to above 40%, the Phase Unbalance LED illuminates solidly and overload tripping accelerates. The effect of an unbalance of greater than 40% is to shift the motor protection curve in the direction of faster tripping.

You enable the phase unbalance protection using HHC function F9.

- Enabled = ON
- Disabled = OFF

With phase unbalance protection enabled, HHC function F17 displays the percentage of current unbalance. Both functions display OFF if phase unbalance protection is disabled.

3.15 Dual Overload Protection (SAMMS-MVX Only)

Because the high-speed and low-speed currents differ in two-speed motors, different full-load current settings are often required. In such applications, use function F5 to select the full-load current for low-speed operation.

3.16 Jam Protection (SAMMS-MVX Only)

Certain mechanical loads, especially those containing gears, are susceptible to jamming. Jam protection can prevent damage to the motor and the driven equipment by quickly tripping the motor off-line in the event of a jam. If you have enabled jam protection, you may adjust the jam trip level from 120-400% of I_{FLC} . The jam trip time is 360 msec. SAMMS-MVX is normally shipped with jam protection enabled, with a trip level of 200% I_{FLC} (See Figure 3.11). Jam protection is locked out for 5 times the overload class after a start, speed, or direction change. If the jam limits are exceeded, the motor is tripped off-line and the External Trip LED on the front panel solidly illuminates. You can enable jam

protection using HHC function F23.

- enabled = ON
- disabled = OFF

3.17 Loss of Load Protection/Warning (SAMMS-MVX Only)

If the running current of the motor suddenly drops below 20 to 95% (adjustable) of its previous reading in 360 msec, a loss of load has occurred. Such a loss of load could be due to a broken belt or loss of back pressure in a pump. Loss of load detection is locked out for five times the overload class time after a start, direction, or speed change (See Figure 3.11). You can select loss of load protection or warning using HHC function F24.

- protection = ON
- warning = OFF

With protection selected, detection of a loss of load trips the motor off-line and illuminates the External Trip LED. With warning selected, the motor does not trip off-line and the External Trip LED flashes until the current returns to its former steady-state level or higher. SAMMS-MVX is normally shipped with loss of load protection OFF (WARNING), and with default setting of 50% I_{FLC} .

3.18 Process Current Warning (SAMMS-MVX Only)

It is often convenient to have an indication that the load current is above its normal operating level so that the process can be checked and, if necessary, adjusted. You can set the process current warning from 0% (displayed as "OFF") to 100% of the full-load current with HHC function F22. As long as the motor running current exceeds the process current warning level, the External Trip LED flashes. Process current warning is locked out for five times the class time after a start or a direction or speed change.

3.19 Stator Protection

By selecting the overload class slightly greater than or equal to the motor's starting time, the motor model defines an energy I^2t value. In this value, I equals 600% of the motor's full load current and t equals the overload class selected.

If the amount of energy exerted by the motor during start, stall or under locked rotor condition exceeds the amount of energy defined by the overload class selected, the SAMMS-MV device will trip. This protects the motor's winding against excessive heat build up. For example, a typical motor starts within 3 to 4 seconds. By selecting an overload class 4 or 5, you can safely start the motor hot or cold and without nuisance tripping. This also provides protection against stall time exceeding 4 or 5 seconds; assuming the locked rotor current equals 600% of the motor's full-load current (See Figure 3.11).

3.20 Rotor Protection

Since medium-voltage motors are rotor limited under locked rotor conditions, and stator limited under running conditions, the SAMMS-MV device computes an accurate thermal signature of

3 Operating the SAMMS-MV Device

the rotor and provides a signal to trip the motor off-line when it reaches a trip temperature value. The motor model takes into account the change of the rotor resistance during motor startup. Rotor resistance is a function of motor slip; therefore, it is highest at locked rotor and decreases as the motor speeds, and the slip decreases.

You can select motor cold stall time from 5 to 100 seconds in increments of 1 second. The selected time will adjust the rotor loop elements so that the maximum temperature limit in the rotor is reached under locked rotor conditions for the time selected. If cold stall time is not known, the rotor model will assume a cold stall time based on the type of motor used. The user is allowed to select an open drip proof (ODP) motor or a totally enclosed fan-cooled motor (TEFC) motor. The default value for the ODP motor is 10 seconds. The default value for the TEFC motor is 20 seconds.

3.21 Repetitive Starts

The motor model allows repetitive starts without nuisance tripping while protecting the motor against overload and stall conditions. Repetitive starts can occur as long as the following conditions are met:

1. The energy exerted by the motor during start does not exceed the energy defined by the overload class selected.
2. The motor winding temperature does not exceed the maximum temperature allowed.
3. The rotor temperature does not exceed the maximum temperature allowed.
4. The SAMMS-MV is not in start inhibit (See Section 3.22).

For example, a motor starting from cold condition could have 4 or more typical starts of 5 seconds without nuisance tripping and without damaging the motor insulation. Figure 3.12 shows a multi-start scenario for an ODP motor.

3.22 Start Inhibit

When the motor temperature reaches the maximum values allowed, the SAMMS-MV device trips. If you attempt a restart, the overload LED flashes and the motor will not start until the motor winding and rotor temperatures cool down to the full load temperature. HHC function F25 displays the motor winding temperature as a percentage of the full-load temperature. HHC function F10 displays the time to enable restart in seconds.

3.23 Cooling Time Constants

The motor time constant is a function of the motor type. The values listed in Table 3.4 are used in the motor model.

Motor Condition	Delta Temperature	Motor Type	
		TEFC	ODP
Stopped	80° C to 29° C	9900 s	6000 s
Running Idle	80° C to 39.4° C	7200 s	4500 s

Table 3.4 Motor time constants

TEFC motors include the following types of motors:

- Totally Enclosed Fan Cooled
- Totally Enclosed Fan Cooled Explosion Proof
- Totally Enclosed Air-to-Air Cooled (TEAAC)

ODP motors include the following types of motors:

- Drip Proof Weather Protected I (WP-1)
- Weather Protected II (WP-2)
- Open Drip Proof
- Totally Enclosed Water-to-Air Cooled (TEWAC)

3.24 Normalized Temperature Rise for Class B and Class F Insulation

Steady state and maximum winding temperature are functions of the motor's insulation class. In this motor model, normalized temperature rise for both Class B and Class F insulation are used. The motor winding temperature is displayed as a percentage of the steady-state full-load temperature rise as shown in Table 3.5.

Boundary Parameters	Class B Insulation	Class F Insulation	% Full Load Temperature Rise
Steady State Temperature rise at full-load current	80° C	105° C	100
Maximum allowed winding temperature	140° C	185° C	175

Table 3.5 Steady state and maximum winding temperature rise

3.25 Ground Fault Detection

In SAMMS-MV devices, HHC function F12 selects ground fault protection or warning.

- protection = ON
- warning = OFF

The device detects a ground fault if the fault current exceeds the pickup level for 360 msec. If you have selected protection (ON), the motor trips and the Ground Fault LED illuminates until reset. If you selected warning (OFF), the Ground Fault LED flashes as long as the fault current exceeds the pickup level. Table 3.6 lists the pickup levels for each overload size. Ground fault protection is locked out for 1.4 seconds following a start.

3 Operating the SAMMS-MV Device

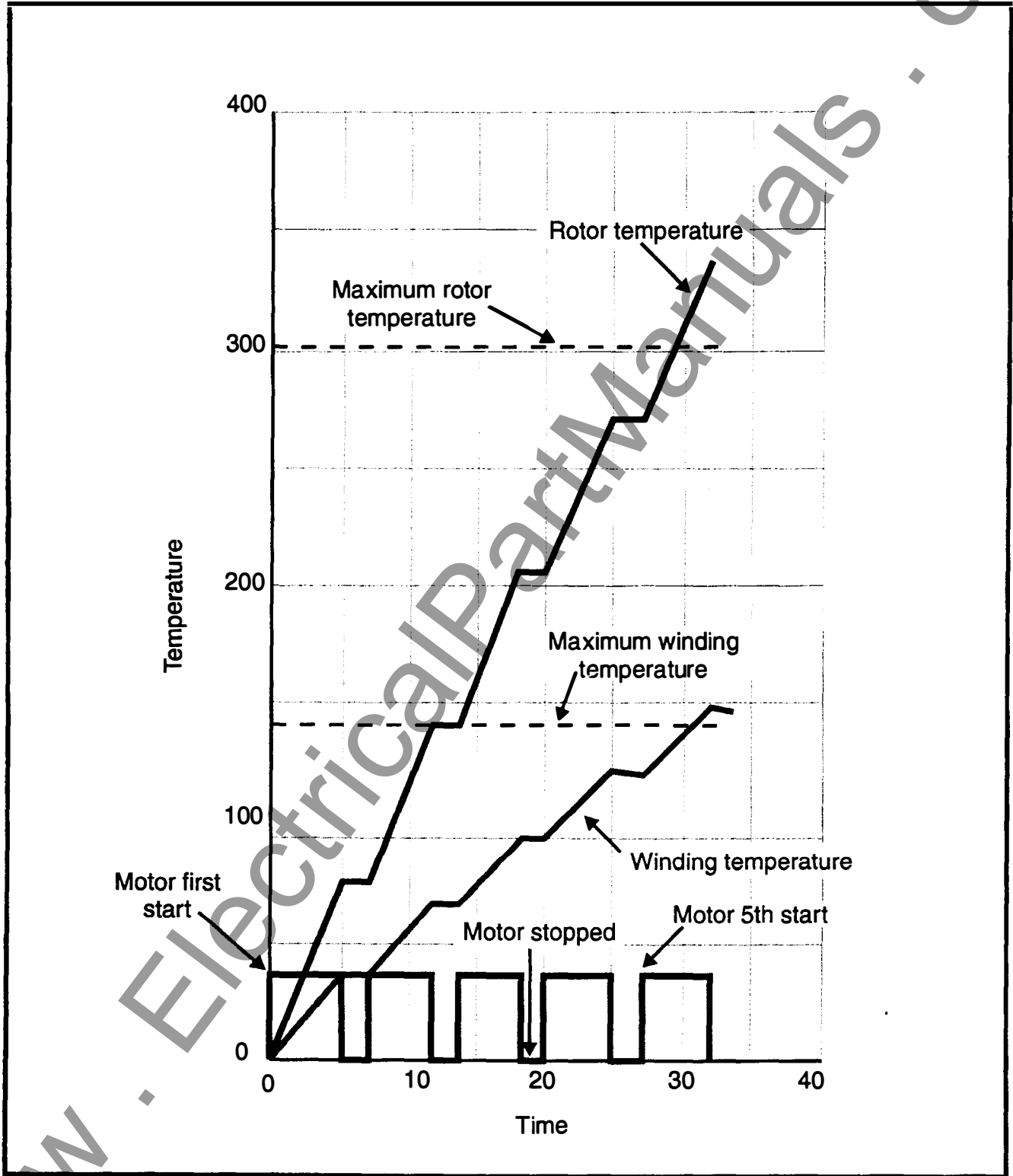


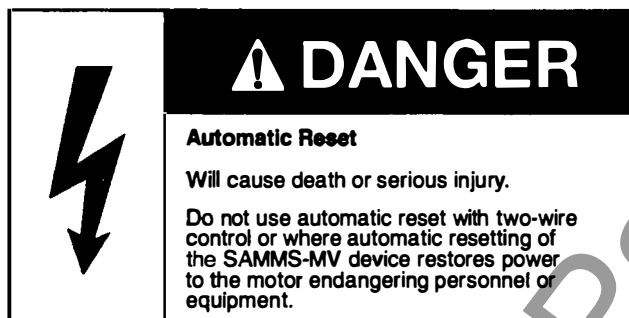
Figure 3.12 Multi-start scenario for an ODP motor

3 Operating the SAMMS-MV Device

Size	Pickup Current Range	Default Pickup Current
H3A	7A to I_{FLC}	10A
H3B	7A to I_{FLC}	10A
H3C	7A to I_{FLC}	10A
H6	7A to I_{FLC}	20A

Table 3.6 Ground fault pickup levels

Ground fault detection requires no additional external circuitry or transformers. Ground fault detection for the SAMMS-MV device is not available for grounded, three-phase systems or single-phase applications. Ground fault pickup time is 360 msec.



3.28 Autoreset After a Trip (SAMMS-MVX Only)

To restart the motor after a trip or a fault, you must first reset the SAMMS-MVX device. You can reset the SAMMS-MV device in one of two ways. First, press the Reset/Test button on the front panel of the device. Second, enable the autoreset with HHC function F8.

- enable = ON
- disable = OFF

With autoreset enabled, overload and external trips automatically reset in 30 seconds after the trip. Once the reset occurs, the SAMMS-MV device can be used to restart the motor, unless the motor has reached its maximum temperature and has not cooled down to the full-load level (start inhibit). Resetting after a trip does not interrupt or otherwise affect the ongoing motor thermal computations.

3.27 Emergency Restarting

In certain critical applications, you may want to restart a hot motor even though restarting will damage or destroy the motor. An emergency restart is a motor start that occurs after an overload trip on maximum allowable winding, housing, or rotor temperature; but before all have cooled down to the full-load temperature level (100%) or below. In other words, an emergency restart is a start that occurs before the restart time displayed by HHC function F10 reaches zero.

With the emergency restart function enabled (HHC function F11), the motor can be restarted regardless of the residual heat. If the SAMMS-MV device performs an emergency restart, the winding, housing, and rotor temperatures in the motor model computations reset to zero. Any time the motor is started, whether an emergency restart or a normal start, the emergency restart HHC function F11 is automatically reset to disable.

- enabled = ON
- disabled = OFF

3.28 Using the Hand Held Communicator (HHC)

The HHC provides you with the capability to monitor and alter various motor control and protection functions provided with the SAMMS-MV device. For example, you can monitor and alter control and protection settings such as on-delay time and overload class. You can also monitor a variety of motor operating conditions such as average current and elapsed running time.

The SAMMS-MV device functions accessible through the HHC are shown in Table 3.7. The number of functions available depends upon the model of the SAMMS-MV device you are using.

The HHC's small size makes it convenient to carry around and use for communication with many SAMMS-MV devices. To use the HHC, connect the HHC's cable, which uses a DB-9 connector, to the communication port located on the front panel of the SAMMS-MV device. The HHC receives power and control from the SAMMS-MV device. When connected to the SAMMS-MV device, data is displayed on the HHC by a four-character, seven segment liquid crystal display. When disconnected from the SAMMS-MV device, the HHC does not retain or display data.

Once connected, you can access the functions provided by the SAMMS-MV device through the use of the HHC's control keys. The HHC has five (5) control keys: (F)unction, LIST, UP, DOWN, and ENTER. The asterisk (*) key serves no function. The HHC control keys are described in the following sections.

3.28.1 The (F)unction Key

When you press the (F)unction key, the function mode is selected and the HHC displays the number of the selected function preceded by F. With the HHC in the function mode, use the UP and DOWN keys to step from one function to the next.

3.28.2 The LIST Key

When you press the LIST key, the display mode is selected and the HHC displays the value corresponding to the selected function. If the selected function is a set point, the HHC displays the actual setting. If the selected function is a measured quantity, the HHC displays the value of the measured quantity.

In the display mode, use the UP and DOWN keys to step through the range of possible set points for the selected function. Pressing the LIST key returns the active setting to the display.

There is one occasion when the LIST key is disabled making the

3 Operating the SAMMS-MV Device

Function Number	Function	SAMMS-MV	
		SAMMS-MVX	SAMMS-MVE
F0	Ambient temperature	•	•
F1	Control circuit number	•	•
F2	Size for overload No. 1	•	•
F3	Size for overload No. 2 (low speed)	•	
F4	Full load current for OLR No. 1	•	•
F4A	5A CT primary current (if used)	•	•
F5	Full load current for OLR No. 2	•	
F5A	5A CT primary current (low speed) (if used)	•	
F6	Service factor	•	•
F6A	Motor type	•	•
F7	Overload trip class (class 2 through 23)	•	•
F7A	Cold stall time	•	•
F8	Automatic reset	•	
F9	Phase unbalance	•	•
F10	Time to restart	•	•
F11	Emergency restart	•	•
F12	Ground fault protection or warning	•	•
F12A	Ground fault pickup current	•	•
F13	Timer No. 1	•	•
F14	Timer No. 2	•	•
F15	Motor current	•	•
F16	Last trip current	•	•
F17	Percent unbalance current	•	•
F18	Total elapsed run-time on motor	•	•
F19	Total number of motor starts	•	•
F20	Number of overload trips	•	•
F21	Reset motor data	•	•
F22	Set process current warning	•	
F23	Jam protection	•	
F23A	Jam pickup current	•	
F24	Loss of load protection or warning	•	
F24A	Loss of load pickup current	•	
F25	Motor winding temperature as % of full load temperature	•	•
F26	Baud rate	•	•
F27	Address	•	•

Table 3.7 SAMMS-MV models and functions

3 Operating the SAMMS-MV Device

corresponding functions inoperative. In a SAMMS-MV device with autoreset disabled at the factory, the LIST key has no effect for F8.

3.28.3 UP and DOWN Keys

Use the UP and DOWN keys to step through the functions while the HHC is in the function mode. When the HHC is in the display mode, use the UP and DOWN keys to step through the values for a selected function. You can use the keys in three ways:

1. Single step - press the key and release it.
2. Slow scroll - press the key and hold the key down for no longer than a two or three seconds.
3. Fast scroll - press the key and hold the key down long enough for the HHC to step through more than five steps.

The following information discusses how to operate the UP and DOWN keys in the function and display modes.

1. In the function mode, the UP key increases the function number by one and the DOWN key decreases the function number by one. If F0 appears on the display, pressing the DOWN key rolls the function over to the highest-numbered function, F27. If the highest-numbered function (F27) appears in the display, pressing the UP key rolls the function over to the lowest-numbered function (F0).
2. In the display mode, use the UP and DOWN keys to step through the range of settings for each set point function. You also use the UP and DOWN keys to step through the individual line currents and the average line current of F15. Just as the UP and DOWN keys cause the function numbers to roll over, they also cause the range of settings to roll over.

3.28.4 Using the ENTER Key

Use the ENTER key to change settings on the HHC display. The SAMMS-MV device disables the ENTER key under the following conditions:

1. The ENTER key is disabled while the device is in the function mode.
2. The ENTER key is disabled for non-setting functions that display a parameter.
3. The ENTER key is disabled while the motor is running to prevent settings from being changed while the motor is running.

Use the following procedure to change a setting. This example shows you how to change the full-load current setting from 112A to 67A.

1. With the HHC in the program mode (see section 3.29.1), press the (F)unction key. The display shows the number of the function most recently selected, (e.g. F9).
2. Use the UP or DOWN key (as described above) to step or

scroll to the desired function. The display shows the desired function, (e.g. F4).

3. Press the LIST key. The display shows the active setting for the selected function, (e.g. 112, representing a full-load current setting of 112A for a motor controlled by a size H3B contactor.)
4. Use the UP or DOWN key (as described above) to step or scroll to the desired setting. The display shows the desired setting, (e.g. 67 for 67A).
5. To view the active setting, press the LIST key. The number 112 appears on the display.
6. Repeat step 4 to return to the desired setting.
7. To enter the desired setting (67) which is displayed, press the ENTER key. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
8. Press the LIST key to show the new setting (67) on the display.
9. To move to the other functions, press the (F)unction key. The display shows, in the example, F4.
10. Press the UP and DOWN keys to step through the function numbers. The SAMMS-MV device is in the function mode.
11. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to display mode.

3.29 Using the SAMMS-MV Device Functions

This section lists the 28 major motor control and protection functions and several related functions (F0-F27, F6A, F9A, F12A, F23A, and F24A) and how to use them. The functions available for each version of the SAMMS-MV device are shown in table 3.7. Table 3.8 provides a description of each function and its associated range, step size, and default value.

To access a function perform the following steps:

1. Connect the HHC's cable to the communications port on the front of the SAMMS-MV device.
2. Locate the desired function using the (F)unction and UP and DOWN keys.
3. Then locate and follow the steps provided with the function you wish to perform.

3.29.1 Program Mode/Passwords

To access the functions in program mode, the user is required to enter a password. The default password is "0000," and may

3 Operating the SAMMS-MV Device

Function Number	Function Description	Range	Step Size	Default Value
F0	Select ambient temperature.	0 - 70° C	5° C	40° C
F1	Display (or change for SAMMS-MVE) the control circuit number, Enable/disable incomplete sequence status.	0 - 9999	1	N/A
F2	Display the size for single-speed controller, or the high-speed size for two-speed motor controllers.	H3A, H3B, H3C, H6	As shown	N/A
F3	Display the low-speed size for two-speed controller. F3 is OFF for single-speed motor controllers.	H3A, H3B, H3C, H6	As shown	N/A
F4	Select the full-load current setting (I_{FLd}) for the size for single-speed motor controller or the high-speed size for two-speed motor controllers.	H3A: 18 - 72A H3B: 60 - 240A H3C: 192 - 400A H6: 320 - 720A	1A 1A 1A 2A	18 60 192 320
F4A	Display the primary current if 5A secondary CT's are used.	Function of size in F2	Function of size in F2	OFF (denotes SAMMS sensors in use)
F5	Select the full-load current setting (I_{FLd}) for the low-speed size for two-speed motor controllers. F5 is OFF for single speed motor controllers.	H3A: 18 - 72A H3B: 60 - 240A H3C: 192 - 400A H6: 320 - 720A	1A 1A 1A 1A	18 60 192 320
F5A	Display the primary current if 5A secondary CT's are used.	Function of size in F3	Function of size in F3	OFF (denotes SAMMS sensors in use)
F6	Select the service factor.	1 or 1.15	N/A	1.15
F6A	Select type of motor.	ODP or EFC	N/A	ODP
F7	Select the overload trip class.	2-23	1	10
F7A	Select cold stall time.	5-100	1	10 (ODP) / 20 (EFC)
F8	Enable/disable autoreset of overload and external trips.	ON/OFF	N/A	OFF
F9	Enable/disable phase unbalance protection.	ON/OFF	N/A	ON
F10	Display the time to wait until the motor can be restarted. Applies after an overload trip with the winding, housing, or rotor temperature above the maximum allowed for restarting.	Real Time Value	1s	N/A,
F11	Enable/disable the emergency restart capability.	ON/OFF	N/A	OFF

Table 3.8 Motor control and protection functions (page 1 of 2)

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Function Number	Function Description	Range	Step Size	Default Value
F12	Select ground fault protection or warning. ON means protection; OFF means warning.	ON/OFF	N/A	OFF
F12A	Select ground fault pick-up current value.	7A- I_{FLC}	1A	10A (H3A-H3C) 20A (H6)
F13	Set programmable timer #1.	OFF - 200 seconds	1 second	OFF
F14	Set programmable timer #2.	OFF - 200 seconds	1 second	OFF
F15	Display the average line current and the individual line currents.	H3A: 0 - 720A H3B: 0 - 2400A H3C: 0 - 4000A H6: 0 - 7200A	1A 1A 1A 2A	N/A N/A N/A N/A
F16	Display the most recent trip current.	H3A: 0 - 720A H3B: 0 - 2400A H3C: 0 - 4000A H6: 0 - 7200A	1A 1A 1A 2A	N/A N/A N/A N/A
F17	Display the percentage current unbalance. OFF is displayed if unbalanced protection is off.	0 - 100%	1%	N/A
F18	Display the elapsed motor running time in tens of hours.	0.0 - 6553 (x 10 hr.)	0.1x10hr. up to 999.9, 1x10hr. up to 6553	N/A
F19	Display the number of motor starts in tens of hours.	0.0 - 6553 (x 10)	0.1x10 up to 999.9, 1x10 up to 6553	N/A
F20	Display the number of overload trips.	0 - 9999	1	N/A
F21	Reset motor data. Zeroes the elapsed running time, the number of starts, and the number of overload trips.	N/A	N/A	N/A
F22	Set process current warning	0-100% I_{FLC}	1% I_{FLC}	OFF
F23	Jam protection	ON/OFF	N/A	ON
F23A	Select jam pickup current	120-400% I_{FLC}	5%	200%
F24	Loss of Load	ON/OFF	N/A	ON
F24A	Select loss of load pickup current	20-95% of running current	5%	50%
F25	Display percentage of motor winding temperature	0 to 250%	1%	N/A
F26	Select baud rate	2400/4800/9600	N/A	4800
F27	Select address	1-224	1	200

Table 3.8 Motor control and protection functions (page 2 of 2)

3 Operating the SAMMS-MV Device

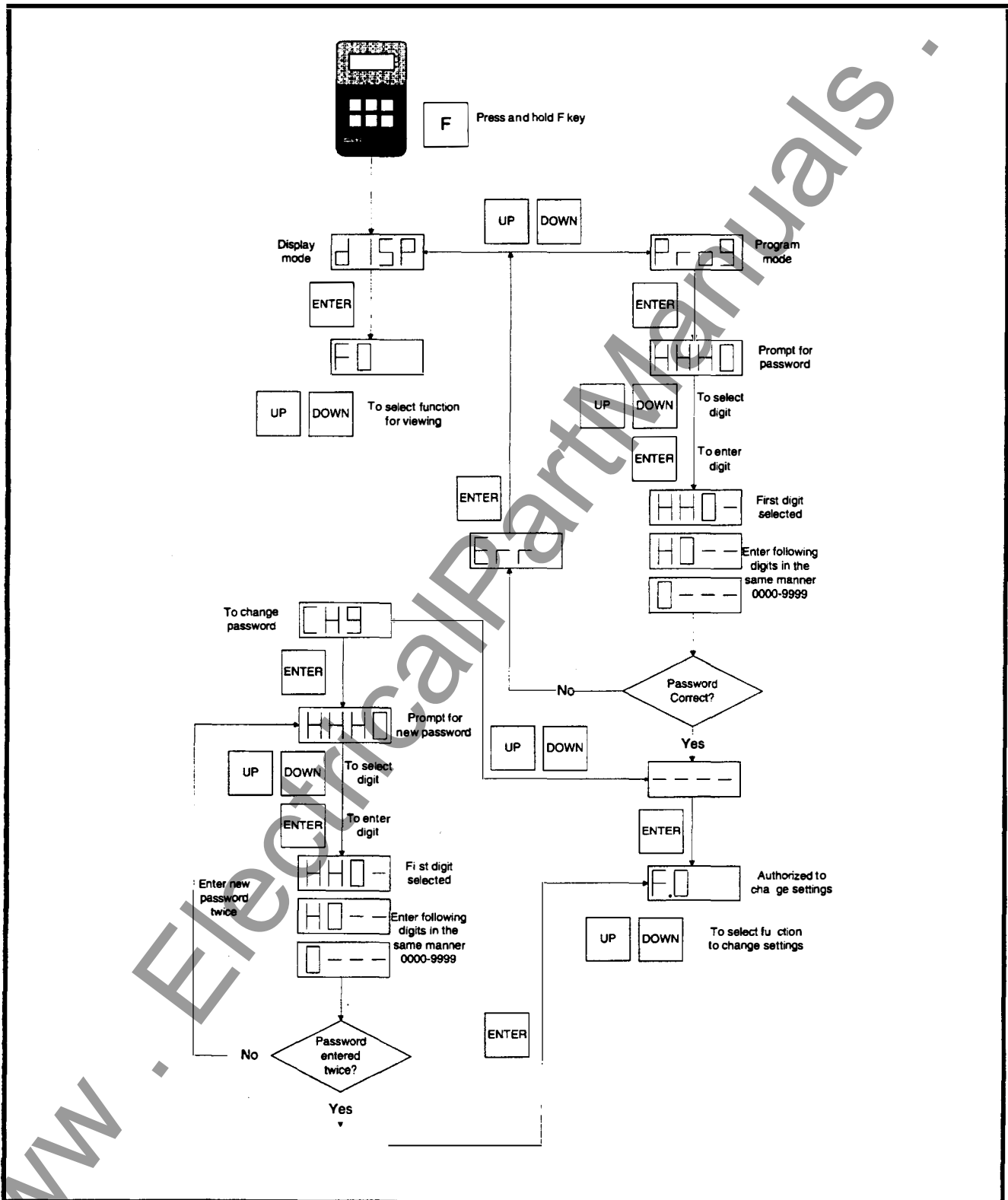


Figure 3.13 Entering and changing passwords

3 Operating the SAMMS-MV Device

be changed at anytime. To enter the password and have access to program mode:

1. Press and hold the (F)unction key for several seconds until "dISP" is displayed.
2. Press the UP or DOWN key to change to the program mode. The display reads "Prog."
3. Press the ENTER key, and the display shows "HHH0," the prompt for entering the password.
4. Press the UP or DOWN key to select the first digit, then press ENTER. The display reads "HH0-."
5. Continue to select password digits and press ENTER to enter each digit.
6. After correctly entering the four digit password, the display reads "- - - -," and pressing ENTER gives access to the functions in program mode.
7. If the password was entered incorrectly, the display will read "Err." Press the ENTER key to return to program mode and try again.

To change the password:

1. Enter the password as described above.
2. With the password entered and the display showing "- - - -," press the UP or DOWN key to enter change mode. The display reads "CH0."
3. Press the ENTER key, and the display shows "HHH0," the prompt for entering the new password.
4. Enter the new password in the same way described above. After entering all four digits of the new password, the display will again display "HHH0."
5. Enter the new password a second time. If it was entered correctly the display reads "done," and pressing ENTER gives access to the functions in program mode.
6. If the password was entered incorrectly, the display will read "Err." Press the ENTER key to return to program mode and try again.

3.29.2 SAMMS-MV Functions

F0 - Ambient Temperature

1. Press the LIST key to view the ambient temperature selected. The default value is 40° C and the range of possible values is from 0° C to 70° C in increments of 5° C.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the

selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.

5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

F1 - Control Circuit Number and Incomplete Sequence Status

1. Press the LIST key to view the control circuit number programmed at the factory. The circuit numbers range from 0 through 9999. (The UP, DOWN and ENTER keys become disabled.)
2. For SAMMS-MVE, to change the settings, you must be in the program mode. The available selections are program blocks 10-16 (refer to table 3.3). If you have loaded a custom circuit, the designation for that circuit will be shown.
3. Press the UP or DOWN key to scroll through the range of circuit numbers, until the desired circuit number appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.
7. To enable or disable incomplete sequence, press the ENTER key for a period of one second or more. A "." will be displayed after the F1 on the HHC if incomplete sequence is enabled. (The SAMMS-MV is shipped from the factory with the incomplete sequence enabled.)

F2 - Size for Overload Relay #1

Overload relay #1 protects single-speed motors and two-speed motors running on high speed. The possible values are H3A, H3B, H3C and H6. Use the following procedure to display the size for overload relay #1.

1. Press the LIST key to view the size selected for overload relay #1.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

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F3 - Size for Overload Relay #2 (SAMMS-MVX Only)

Overload relay #2 protects two-speed motors running on low speed. The possible values are H3A, H3B, H3C, H6 and OFF. OFF appears for single-speed motors. Use the following procedure to display the size for overload relay #2.

1. Press the LIST key to view the size selected for overload relay #2.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

F4 - Full-Load Current for Overload Relay #1

1. Press the LIST key to view the active full-load current setting for overload relay #1. The setting should normally be the full load current as shown on the motor nameplate (high speed for two-speed machine). The range of possible settings and the factory default value depend on the size displayed in F2 as follows:

Overload Relay Size	Setting Range	Step	Default
H3A	18 to 72A	1A	18
H3B	60 to 240A	1A	60
H3C	192 to 400A	1A	192
H6	320 to 720A	2A	320

2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4).
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F4A - 5A CT Primary Current Selection for Overload Relay #1

SAMMS-MV is normally used with SAMMS sensors to provide

the current input signals to the device. Optionally, SAMMS-MV may be used with conventional 5A secondary current transformers.

1. Press the LIST key to view the sensor in use for overload relay #1. If standard SAMMS sensors are used, the display will read "OFF." If 5A secondary CT's are in use, the CT primary current will be displayed.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F5 - Full-Load Current for Overload Relay #2 (SAMMS-MVX Only)

1. Press the LIST key to view the active full-load current setting for overload relay #2. This setting should normally be the full load current for the low speed shown on the motor nameplate. The range of possible settings and the factory default value depend on the size displayed in F3. The values are similar to those found in the table in the procedure for F4. If the control is not a two-speed control, OFF appears on the display, and UP, DOWN and ENTER keys become disabled.

2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4).
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F5A - 5A CT Primary Current Selection for Overload Relay #2 (SAMMS-MVX Only)

SAMMS-MV is normally used with SAMMS sensors to provide the current input signals to the device. Optionally, SAMMS-MV may be used with conventional 5A secondary current transformers.

1. Press the LIST key to view the sensor in use for overload relay #2. If standard SAMMS sensors are used, the display will read "OFF." If 5A secondary CT's are in use, the CT primary

3 Operating the SAMMS-MV Device

current will be displayed.

2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F6 - Service Factor

1. Press the LIST key to view the active service factor, 1.0 or 1.15. The factory default is 1.15. A service factor of 1.15 adjusts the overload trip thresholds up by 15% over their values for a service factor of 1.0. This results in more margin before tripping.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to alternate between the two choices until the selected value is displayed.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4.)
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F6A - Motor Type

1. Press the LIST key to view the motor type in use. The factory default is "OdP" for open drip proof. "EFC" designates totally enclosed fan cooled.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to alternate between the two choices until the selected value is displayed.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4.)
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.

6. Press the (F)unction key to step through to another function.

F7 - Overload Trip Class

The trip class is the time in seconds that it takes the overload relay to trip for a starting current of 600% of the full-load current setting. The range of possible values is 2-23.

1. Press the LIST key to view the active trip class.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. (If you make an incorrect selection, repeat steps 3 and 4.)
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F7A - Cold Stall Time


1. Press the LIST key to view the active cold stall time in use. (The range of possible values is between 5 and 100 seconds in increments of one second. The factory default value is 10 seconds. If the cold stall time is more than 100 seconds, enter 100.)
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key to scroll through the range of settings until the selected setting appears.
4. Press the ENTER key to change the active setting to the selected value. The display becomes blank while you hold down the ENTER key, and the SAMMS-MV device stores the new setting. If the overload class selected exceeds the cold stall time, the word "SURE" appears on the display requiring reentry before accepting the data.

Important: The word "SURE" is used as a reminder that supplemental protection is required if the motor acceleration time (overload class) exceeds the allowable stall time for the motor. A speed switch should be used as an input source to open the contactor if the switch senses a locked rotor or stall condition.

5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

3 Operating the SAMMS-MV Device

F8 - Autoreset (SAMMS-MVX Only)

	⚠ DANGER
	Automatic Reset
	Will cause death or serious injury. Do not use automatic reset with two-wire control or where automatic resetting of the SAMMS-MV device restores power to the motor endangering personnel or equipment.

1. Press the LIST key to view the active autoreset setting, either ON or OFF. If autoreset is ON, the SAMMS-MV device automatically resets 30 seconds after an overload or external trip. At this time the motor can start. If autoreset is OFF, you must manually reset the overload relay with the Reset/Test button before restarting the motor. The factory default is OFF.

- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to select the new setting.
- Press and hold the ENTER key. If the displayed setting is ON, go to step 6. If the displayed setting is OFF go to step 5.
- Release the ENTER key while the display appears blank. When you release the key, the setting changes to OFF. Go to step 6.
- Release the ENTER key. "SURE" appears on the display.
- Press the ENTER key to make the change to ON.

Note: The reason for displaying "SURE" and requiring you to press the ENTER key a second time is because the motor can restart immediately after an overload trip if autoreset is ON.

- If you made an incorrect selection, repeat steps 3 through 7.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to step through other functions.

F9 - Phase Unbalance Protection

1. Press the LIST key to view the active phase unbalance protection setting (ON or OFF). The factory default setting is ON.

a. When phase unbalance protection is enabled (ON), current unbalances of greater than 40% accelerate overload tripping. The Phase Unbalance LED flashes for unbalances between 20% and 40%. It remains steadily illuminated for unbalances greater than 40%.

b. When phase unbalance protection is disabled (OFF), the Phase Unbalance LED remains off, unbalanced conditions have no effect on protection, and F17 (Display Unbalanced Current) displays OFF.

- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

F10 - Display Time to Restart

- Press the LIST key to view the time remaining before the motor can be restarted. The time is displayed in seconds. While the motor is cooling, the time to restart counts down from the maximum winding or rotor temperature allowed to the steady-state, full-load temperature. The display is always zero if the motor is not in a start inhibit mode. If a time to restart displays, the motor can only be restarted by an emergency restart (see F11).
- The UP, DOWN, and ENTER keys are disabled.
- Press the (F)unction key to go to other functions.

F11 - Emergency Restarting

- Press the LIST key to view the emergency restart setting (ON or OFF). The factory default is OFF. With emergency restart enabled (ON), you can restart the motor after the overload relay is reset (manually or automatically), even when the time to reset is not zero. When you initiate an emergency restart, the motor conditions are reset to zero to simulate a completely cold start. The emergency restart function is automatically disabled after any restart (emergency or normal), and you must manually re-enable the emergency restart function by setting F11 to ON.
- Emergency restart can be enabled in either the program mode or the display mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. If the selected setting is ON, skip to Step 5.
- If the selected setting is OFF, the display blanks while the ENTER key is pressed. When the ENTER key is released, the setting is changed to OFF. Skip to Step 6.
- If the selected setting is ON, "SURE" is displayed when you release the ENTER key. Press ENTER again to make the change to ON.

Note: The motor can be damaged if restarted before it is allowed to cool. The "SURE" display allows you to reconsider

3 Operating the SAMMS-MV Device

your actions before pressing the ENTER key a second time to select the ON setting.

- Repeat Step 3 if you select an incorrect setting.
- If you are in the program mode, press and hold the (F)unction key for several seconds to exit. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

F12 - Ground Fault Protection or Warning

- Press the LIST key to view the active ground fault detection setting (ON or OFF). The factory default setting is warning (OFF), and the other setting is protection (ON).
 - When warning (OFF) is selected, the Ground Fault LED flashes if the ground current increases beyond the pickup level. The LED stops flashing as soon as the current drops below the pickup level.
 - When protection (ON) is selected, a ground current above the pickup level will cause a trip. The motor stops, and the Ground Fault LED is steadily lit. You must reset the unit before the motor can be restarted.

- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

F12A - Ground Fault Pickup Current

- Press the LIST key to view the active ground fault pickup current in use. The range of values and default values are shown in the table below:

Size	Pickup Current	Default
H3A-H3C	7A-I _{FLC}	10A
H6	7A-I _{FLC}	20A

- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key to display the setting options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the

UP or DOWN key to change to the display mode.

- Press the (F)unction key to go to other functions.

F13 - Set Programmable Timer #1

- Press the LIST key to view the active setting for timer #1. The default setting is OFF. If the timer is not used in the control circuit, OFF is displayed and the UP, DOWN, and ENTER keys are disabled. OFF is also displayed for a setting of 0 seconds. The timer may be adjusted from 0 - 200 seconds in one second increments.
- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key until the desired value is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

F14 - Set Programmable Timer #2

- Press the LIST key to view the active setting for timer #2. The default setting is OFF. If the timer is not used in the control circuit, OFF is displayed and the UP, DOWN, and ENTER keys are disabled. OFF is also displayed for a setting of 0 seconds. The timer may be adjusted from 0 - 200 seconds in one second increments.
- To change the setting, you must be in program mode.
- To change the setting, press the UP or DOWN key until the desired value is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
- Repeat Step 3 if you select an incorrect setting.
- To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
- Press the (F)unction key to go to other functions.

F15 - Display Current

- Press the LIST key to view the instantaneous line currents or the average instantaneous line current. (The LIST key is disabled for full voltage, part-winding starters.) For instantaneous line currents, the display shows the phase designator (A, B, or C) in the left-most character followed by three significant digits of the value of the current. For the average instantaneous line current, four digits are displayed without a phase designator.

3 Operating the SAMMS-MV Device

a. Because only four characters can display at a time, individual line currents of 1000 amps and above are displayed as three dashes following the phase designator, e.g., **A - - -**.

b. For sizes H3A, H3B, and H3C, the current is displayed to the nearest 1 amp. For size H6, currents are displayed to the nearest 2 amps.

2. To view another line current, press the UP or DOWN key to scroll through the four selections.

3. The ENTER key is disabled for this function.

4. Press the (F)unction key to go to other functions.

F16 - Trip Current

1. Press the LIST key to view the value of the current that caused the most recent trip.

2. The UP, DOWN, and ENTER keys are disabled for this function.

3. Press the (F)unction key to go to other functions.

F17 - Current Unbalance

1. Press the LIST key to view the percentage current unbalance. When unbalance protection is disabled (F9 = OFF), OFF is displayed. The percentage unbalance is the ratio of the greatest deviation of the three phase currents from their average to the average of the three phase currents expressed as a percentage.

2. The UP, DOWN, and ENTER keys are disabled for this function.

3. Press the (F)unction key to go to other functions.

F18 - Display Total Elapsed Run Time of the Motor

1. Press the LIST key to view the total elapsed running time of the motor. The run time is displayed in tens of hours as follows:

Actual Number of Hours	Displayed Time
0	0.0
9999	999.9
10000	1000
65535	6553
65536	0.0 (roll over)

The displayed value does not increment until a full hour, or for elapsed times greater than 10000 hours a full ten hours, have elapsed. Internally, however, the elapsed time is maintained to the nearest 0.1 second.

Note: The value can be reset to zero with F21.

2. The UP, DOWN, and ENTER keys are disabled for this function.

3. Press the (F)unction key to go to other functions.

F19 - Number of Motor Starts

1. Press the LIST key to view the number of motor starts. The number of starts is displayed in tens of starts as follows:

Actual Number of Starts	Displayed Number
0	0.0
9999	999.9
10000	1000
65535	6553
65536	0.0 (roll over)

Note: The value can be reset to zero with F21.

2. The UP, DOWN, and ENTER keys are disabled for this function.

3. Press the (F)unction key to go to other functions.

F20 - Number of Overload Trips

1. Press the LIST key to view the number of overload trips, up to 9999.

Note: The value can be reset to zero with F21.

2. The UP, DOWN, and ENTER keys are disabled for this function.

3. Press the (F)unction key to go to other functions.

F21 - Reset Motor Data

1. To reset to zero the elapsed running time, the number of starts, and the number of overload trips, press the LIST key. "CLR" is displayed.

2. Press the ENTER key. "SURE" is displayed.

3. Press the ENTER key again to zero the motor data.

4. To return to Step 1, press the LIST key at any time.

5. The UP and DOWN keys are disabled for this function.

6. Press the (F)unction key to go to other functions.

3 Operating the SAMMS-MV Device

F22 - Process Current Warning Level (SAMMS-MVX Only)

1. Press the LIST key to view the active process current level. The value represents the percentage of the full load current setting above which a motor current causes the External Trip LED to flash. The function is disabled for five times the class time after starting, or after a speed or direction change. The range of settings is in 1% increments from zero (OFF) through 100. The factory default is OFF.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired setting is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
3. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F23 Jam Protection (SAMMS-MVX Only)

1. Press the LIST key to view the active jam protection setting (ON or OFF). The factory default setting is ON. If jam protection is enabled (ON) and the motor running current increases to the pickup current value within 360 msec, the motor will trip off-line and the External Trip LED is steadily lit. The function is disabled for five times the class time after starting, or after a speed or direction change.
2. To change the setting, you must be in program mode.
3. To change the protection setting, press the UP or DOWN key to display ON or OFF, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
4. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F23A Jam Pickup Current (SAMMS-MVX Only)

1. Press the LIST key to view the jam current pickup value in use. The range of possible values is between 120% and 400% to the FLC, in increments of 5%. The factory default is 200%.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired setting is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
4. To exit the program mode, press and hold the (F)unction key

for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.

5. Press the (F)unction key to step through to another function.

F24 - Loss of Load Protection or Warning (SAMMS-MVX Only)

1. Press the LIST key to view the active loss of load setting (ON or OFF). The factory default setting is warning (OFF), and the other setting is protection (ON). This function is disabled for five times the class time after starting or speed or direction changes.
 - a. When protection (ON) is selected and the motor current drops below the pickup current value, within 360 msec, the External Trip LED will light and the SAMMS-MV trips.
 - b. When warning (OFF) is selected and the motor current drops below the pickup current value within 360 msec, the External Trip LED flashes but the SAMMS-MV does not trip.
2. To change the setting, you must be in program mode.
3. To change the protection setting, press the UP or DOWN key to display ON or OFF options, then press ENTER to select the setting that is shown. The display blanks while the ENTER key is pressed.
4. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F24A - Loss of Load Pickup Current (SAMMS-MVX Only)

1. Press the LIST key to view the active setting. The range of possible values is between 20% and 95% to the FLC, in increments of 5%. The factory default is 50%.
2. To change the setting, you must be in program mode.
3. To change the setting, press the UP or DOWN key until the desired setting is displayed then press the ENTER key to select the setting. The display blanks while the ENTER key is pressed.
4. Return to Step 3 if you select an incorrect setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Pro9." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to go to other functions.

F25 - Percentage of Motor Winding Temperature

1. Press the LIST key to view the temperature of the motor windings as a percentage of the steady-state, full-load winding temperature. The maximum allowable winding temperature percentage is 175%.

3 Operating the SAMMS-MV Device

2. The UP, DOWN, and ENTER keys are disabled for this function.
3. Press the (F)unction key to go to other functions.

F26 - Baud Rate

1. Press the LIST key to view the active setting. Allowable settings are 2400, 4800, or 9600 baud. The factory default is 4800.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

F27 - Address

1. Press the LIST key to view the active setting. Allowable addresses are 1-224. The factory default is 200.
2. To change the setting, you must be in program mode.
3. Press the UP or DOWN key to scroll through the range of settings, until the selected setting appears on the display.
4. Press the ENTER key to change the active setting to the selected setting. The display becomes blank while you hold down the ENTER key and the SAMMS-MV device stores the new setting.
5. To exit the program mode, press and hold the (F)unction key for several seconds. The display will show "Prog." Press the UP or DOWN key to change to the display mode.
6. Press the (F)unction key to step through to another function.

4 Troubleshooting

4 Troubleshooting the SAMMS-MV Device

This section discusses how to troubleshoot the SAMMS-MV device. The troubleshooting guide below lists basic errors that can occur while operating the SAMMS-MV device. Use the guide as necessary to solve error conditions as they arise. Do not attempt to solve any error condition that is not listed in the troubleshooting guide. Instead, contact your Siemens representative.

Note: When contacting your Siemens representative, refer to the SAMMS-MV production control label to identify production date, hardware version, and software version. This label is mounted on the right side of the unit when viewed from the front. For example, 93-250-456-01/03 represents a device that was produced in 93, the 250th day of the year, unit number 456, hardware version 01, and software version 03.

Troubleshooting Guide		
Error Condition	Main Cause	Remedy
Current Unbalance	Current unbalance LED is illuminated if current unbalance exceeds 40%, or it flashes if current unbalance is between 20 and 40%. Current unbalance may be due to voltage or load unbalance.	<ol style="list-style-type: none">1. Correct the cause of voltage or load unbalance.2. Verify current transformer secondary voltage is unbalanced at SAMMS-MV terminals 1, 2, and 3 with reference to 4.
Overload Trip	Indicates motor exceeded winding, housing, or rotor temperature threshold.	<ol style="list-style-type: none">1. Verify that the full load current F4 and service factor F6 on the HHC matches the full load current and the service factor on the motor nameplate.2. If the motor tripped during start, increment the overload class one step and start again. If still unsuccessful, the motor's rotor may be locked or stalled. Correct motor malfunction before restarting.3. If the motor tripped after running for a period more than the overload class selected, the trip may be due to a running overload such as excessive loading on a conveyor belt or bad bearings. Remove the cause of the overload before restarting the motor.4. F16 on HHC displays the most recent overload trip current value.

4 Troubleshooting

Troubleshooting Guide		
Error Condition	Main Cause	Remedy
Incomplete Sequence	Indicates the SAMMS-MV unit does not detect current one second after a start command, or it detects current one second after a stop command.	<ol style="list-style-type: none"> 1. If the unit trips one second after start, verify that current transformer secondary input is present in the range of 100 mVAC to 3.54 VAC at terminals 1, 2, and 3 with reference to 4. Verify that the coil voltage is 115 VAC at terminals 14, 15, or 16 with reference to 13 when the motor is started. Verify 115 VAC at terminal 7 with reference to 13. Correct conditions if necessary. Call Siemens if unit continues to trip. 2. If the unit trips one second after a stop command, verify the contactor is open. Repair or replace the contactor if it is not functioning properly. 3. Verify operation of mechanical interlock, and replace or adjust. 4. Verify absence of voltage at terminals 1, 2, and 3 with reference to 4, and at terminals 14, 15, or 16 with reference to 13. If voltage is present, define the source and reconnect so that the motor current only passes through the current transformer. 5. To disable incomplete sequence, select F1 on the HHC, press the ENTER key for one or more seconds and start the motor. The incomplete sequence will remain disabled until the above procedure is repeated.
External Trip	If the external trip LED is solidly illuminated and the motor is stopped, it indicates a jam or loss of load condition, or a trip caused by an overtemperature indication from an RTD.	<ol style="list-style-type: none"> 1. Jam conditions such as a blocked conveyor belt or gear train cause a sudden increase in motor current, which can damage the motor's insulation in a short period of time. 2. Loss of load conditions, such as a broken blade of an impeller or loss of back pressure of a pump, result in a sudden decrease in motor current. 3. RTD trip indicates that the stator temperature or the temperature of one of the bearings has exceeded its threshold. RTD stator trip indicates either that the motor cooling system is blocked, or that the fan is broken. RTD bearing trip indicates overheating of the motor or load bearings. In any case, the motor should not be restarted until the cause of the overheating has been corrected. 4. F16 on the HHC displays the external trip current at the time of the trip, or the RTD number which caused the trip. In any case, determine the reason for the external trip and correct the problem before restarting the motor. If the external trip LED flashes and the motor continues to run, it indicates loss of load warning or process current warning.

4 Troubleshooting

Troubleshooting Guide		
Error Condition	Main Cause	Remedy
CPU Fault	Indicates a problem in the microprocessor or a low voltage condition.	Verify voltage between terminals 5 and 6 is more than 10 VAC. If fault persists, call Siemens.
Ground Fault	Indicates the ground fault current exceeded the threshold. If ground fault protection was selected, the ground fault LED illuminates solidly and the motor stops. If ground fault warning was selected, the ground fault LED flashes and the motor continues to run.	The cause of the ground fault should be determined and removed before using the motor again. F16 on the HHC displays the ground fault trip current.
Ready Light not Illuminated	Usually indicates lack of control power.	<ol style="list-style-type: none"> 1. Verify the presence of 12 VAC between terminals 5 and 6 of the SAMMS-MV unit. 2. If control power is not present, check the control power fuses or the control power transformer and replace if defective. 3. If control power is present, push the RESET button to test lights and unit. If the Ready light does not illuminate, call Siemens.
Improper Remote Operation	Indicates connection or operator error.	<ol style="list-style-type: none"> 1. Verify the SAMMS-MV unit is in the Auto mode. 2. Verify 115 VAC input at SAMMS-MV terminals 9, 10, 11, and 12 with reference to 13, and at terminal 7 with reference to 13. 3. If remote operation is intermittent, verify connections are made in a manner to avoid noise interference. Refer to Section 2 of this manual for instructions.
Improper Alarm Contact Operation	Indicates connection error.	Verify 115 VAC at terminals 7 and 8 with reference to 13.
Improper Light Operation	Usually indicates programming error.	<ol style="list-style-type: none"> 1. Perform lamp test by pressing RESET button. 2. Verify ladder diagram.
Improper Local Operation	Operator error.	Verify SAMMS-MV is in Local mode.
Improper Contactor Operation	Connection error.	Verify 115 VAC at terminal 7 with reference to 13, and at output terminals 14, 15, or 16 with reference to 13 when the motor is started.
Cannot Change HHC Settings	Usually indicates motor is running.	Change parameters after motor is stopped.
Improper SAMMS-MV Operation	Usually indicates improper grounding or noise interference.	Refer to Section 2 of this manual for instructions.

Appendix A Technical Specifications

Appendix A - Technical Specifications of the SAMMS-MV Device

Motor Control Specifications

Inputs	Six pushbuttons Four remote inputs
Outputs	SAMMS-MVX: Three coil drivers Three light bars One programmable alarm contact SAMMS-MVE: One coil driver Two light bars
Diagnostic LEDs	<ul style="list-style-type: none"> * Current unbalance * Impending trip * Overload trip * External trip * Incomplete sequence * Ground fault * CPU fault * Ready * Light bar flashes (timer timing) * Impending trip LED flashes (motor temperature warning) * Overload trip LED flashes (start inhibit) * CPU LED ON (momentary loss of voltage)
Current Ranges: 18 - 72A 60 - 240A 192 - 400A 320 - 720A	Overload Relay Size: H3A H3B H3C H6

Permissible CT Ratios

5A secondary CT ratios (functions F4A & F5A)	Overload Relay Size	Permissible CT Ratios
	H3A	30:5, 40:5, 50:5, 75:5, 100:5
	H3B	100:5, 150:5, 200:5, 250:5, 300:5, 400:5
	H3C	300:5, 400:5, 500:5, 600:5
	H6	500:5, 600:5, 800:5, 1000:5

Appendix A Technical Specifications

Overload Specifications

Overload classes	Overload classes 2 through 23 with one second increments.															
Trip Characteristics	Tripping time at $6 \times I_{FLC}$ = 95% of the overload class ($\pm 5\%$). Tripping time at $1.5 \times I_{FLC}$ within two minutes for warm conditions for all classes.															
Tripping threshold	$(1.1 \pm 0.05) \times I_{FLC}$ for motors with 1.00 service factor, and $(1.2 \pm 0.05) \times I_{FLC}$ for motors with 1.15 service factor.															
Tripping time	20 minutes @ $1.15 \times I_{FLC}$ for motors with service factor 1.															
Mechanical jam protection SAMMS-MVX only	Sudden increase of the motor running current. Pick-up current adjustable from 120 to 400% in increments of 5% of I_{FLC} . Pick-up time 360 msec. Default values: 200% I_{FLC} .															
Loss of load protection SAMMS-MVX only	Sudden decrease of motor running current. Pick-up current adjustable from 20 to 95% in increments of 5% of I_{FLC} . Pick-up time 360 msec. Default values: 50% I_{FLC} .															
Process current warning SAMMS-MVX only	Settings from 0 to 100% of I_{FLC} .															
Accuracy	$\pm 5\%$ of overload trip curve values. $\pm 2\%$ repeat accuracy.															
Phase unbalance protection	Response time after 1 second. Shifted trip threshold value to $0.9 \times I_{FLC}$ at 40% phase unbalance.															
Equipment ground fault protection	Response time after 1.4 seconds. Pick-up time: 360 msec. Pick-up current: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Overload Relay Size</th> <th>Pick-up Current</th> <th>Default</th> </tr> </thead> <tbody> <tr> <td>H3A</td> <td>$7A - I_{FLC}$</td> <td>10A</td> </tr> <tr> <td>H3B</td> <td>$7A - I_{FLC}$</td> <td>10A</td> </tr> <tr> <td>H3C</td> <td>$7A - I_{FLC}$</td> <td>10A</td> </tr> <tr> <td>H6</td> <td>$7A - I_{FLC}$</td> <td>20A</td> </tr> </tbody> </table>	Overload Relay Size	Pick-up Current	Default	H3A	$7A - I_{FLC}$	10A	H3B	$7A - I_{FLC}$	10A	H3C	$7A - I_{FLC}$	10A	H6	$7A - I_{FLC}$	20A
Overload Relay Size	Pick-up Current	Default														
H3A	$7A - I_{FLC}$	10A														
H3B	$7A - I_{FLC}$	10A														
H3C	$7A - I_{FLC}$	10A														
H6	$7A - I_{FLC}$	20A														
Rotor protection	Cold stall time adjustable from 5 to 100 seconds in increments of 1 second. If cold stall time is not known, default value shall be according to the type of motor used. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Motor Type</th> <th>Cold Stall Time</th> </tr> </thead> <tbody> <tr> <td>Open Drip Proof (ODP)</td> <td>10 Seconds</td> </tr> <tr> <td>Totally Enclosed Fan Cooled (EFC)</td> <td>20 Seconds</td> </tr> </tbody> </table>	Motor Type	Cold Stall Time	Open Drip Proof (ODP)	10 Seconds	Totally Enclosed Fan Cooled (EFC)	20 Seconds									
Motor Type	Cold Stall Time															
Open Drip Proof (ODP)	10 Seconds															
Totally Enclosed Fan Cooled (EFC)	20 Seconds															
Ambient temperature	Motor ambient temperature adjustable 0 - 70°C in increments of 5°C. Default value: 40°C.															

Appendix A Technical Specifications

Statistical Data

Elapsed motor running time	- x10 - Range: 0.0 to 6553 (65,536 hours) - Unit increments: 10 hours										
Number of motor starts	- x10 - Range: 0.0 to 6553 (65,536 hours) - Unit increments: 10 operations										
Number of overload trips	- Range: 0 to 9999 - Increments: 1 trip										
Current display	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Overload Relay Size</th> <th style="text-align: left;">Current Increments</th> </tr> </thead> <tbody> <tr> <td>H3A</td> <td>1A</td> </tr> <tr> <td>H3B</td> <td>1A</td> </tr> <tr> <td>H3C</td> <td>1A</td> </tr> <tr> <td>H6</td> <td>2A</td> </tr> </tbody> </table>	Overload Relay Size	Current Increments	H3A	1A	H3B	1A	H3C	1A	H6	2A
Overload Relay Size	Current Increments										
H3A	1A										
H3B	1A										
H3C	1A										
H6	2A										

Alarm Contacts (SAMMS-MVX Only)

Configuration	- N.C. - N.O.
Functions	- Impending Trip - Overload Trip - External Trip - Ground Fault - All of the above

Software Configured Control Devices

Timers	4
Timing range	Timers 1 and 2: 0 - 200 seconds selectable Timer 3: 1 second fixed value Timer 4: 30 seconds fixed value
Timer auxiliary contacts	Software instantaneous and timed contacts
Control relays	8
Auxiliary contacts	Software instantaneous contacts

Appendix A Technical Specifications

Dimensions

SAMMS-MV	6.25 inches W; 6.00 inches H; 2.125 inches D
Handheld Communicator	3.15 inches W; 5.7 inches H; 1.37 inches D

Environments

Operating temperature range	-25° C to +70° C.
Storage temperature	-40° C to +85° C.
Relative humidity	5 to 95% non-condensing.
Altitude	6600 ft.
Vibration	5 g's at a frequency range of 10 to 60 Hz.
Electrostatic discharge	No hardware failures at 15 kV at any point in the front of the unit.
Electromagnetic interference	5 kV repeated pulses, per UL-991 and ANSI C37.90A.
Radio frequency interference	Up to 95 MHz and 61.3 V/M field strength

Control Power Specifications

Unit powered by	12.00 VAC (+10%, -15%) supply
Power requirements	4VA
Control circuit inputs	120 VAC or 125 VDC (+10%, -15%)
Control circuit outputs	120 VAC (+10%, -15%)
Maximum output loading allowed for continuous operation	1.0A for each output energized Maximum leakage current allowed: 5mA
Frequency	50 Hz: +4%, -5% 60 Hz: ± 5%

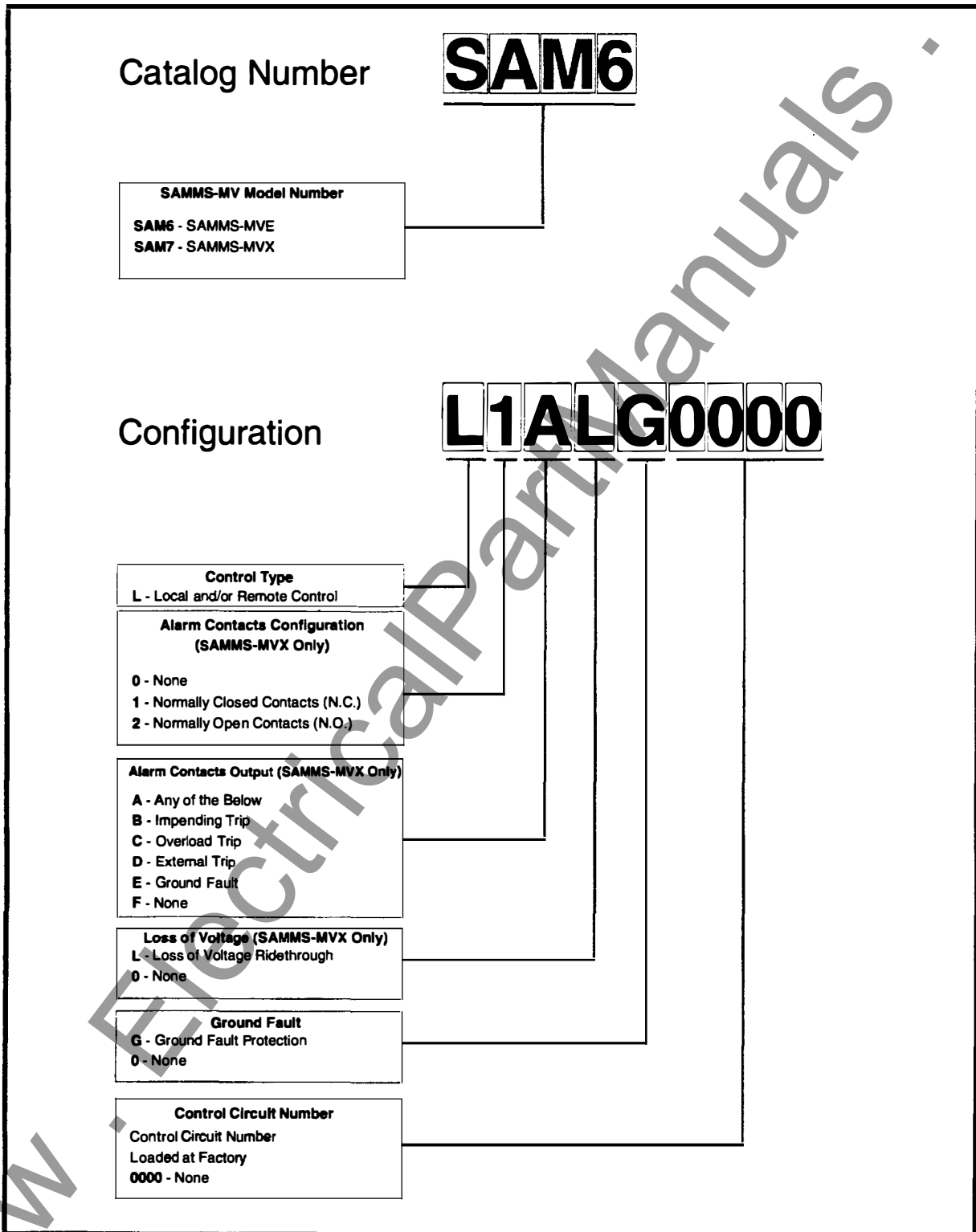


Figure A-1 Catalog Number and Configuration Breakdown for SAMMS-MV

Appendix A Technical Specifications

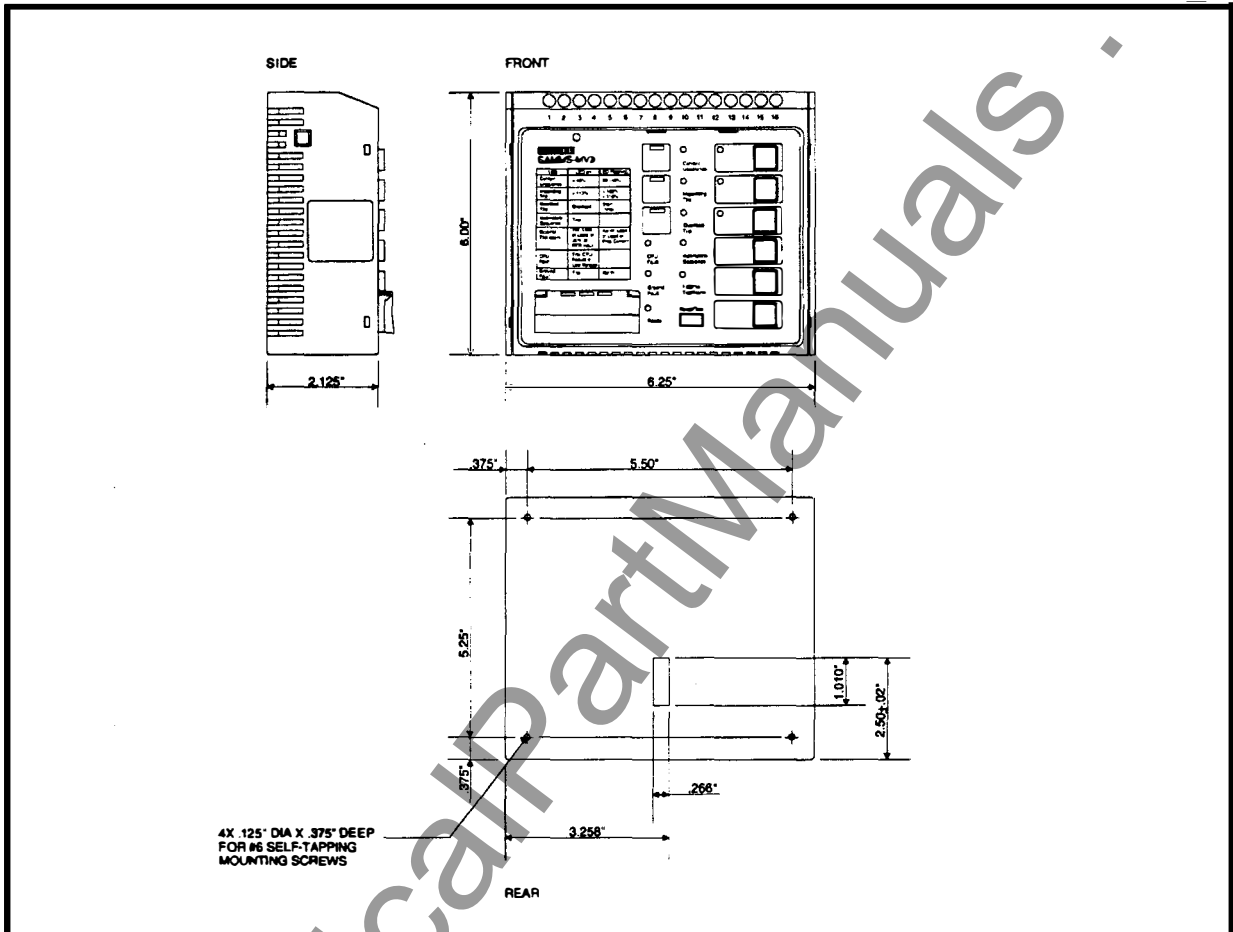


Figure A-2 Overall Dimensions and Mounting Diagram

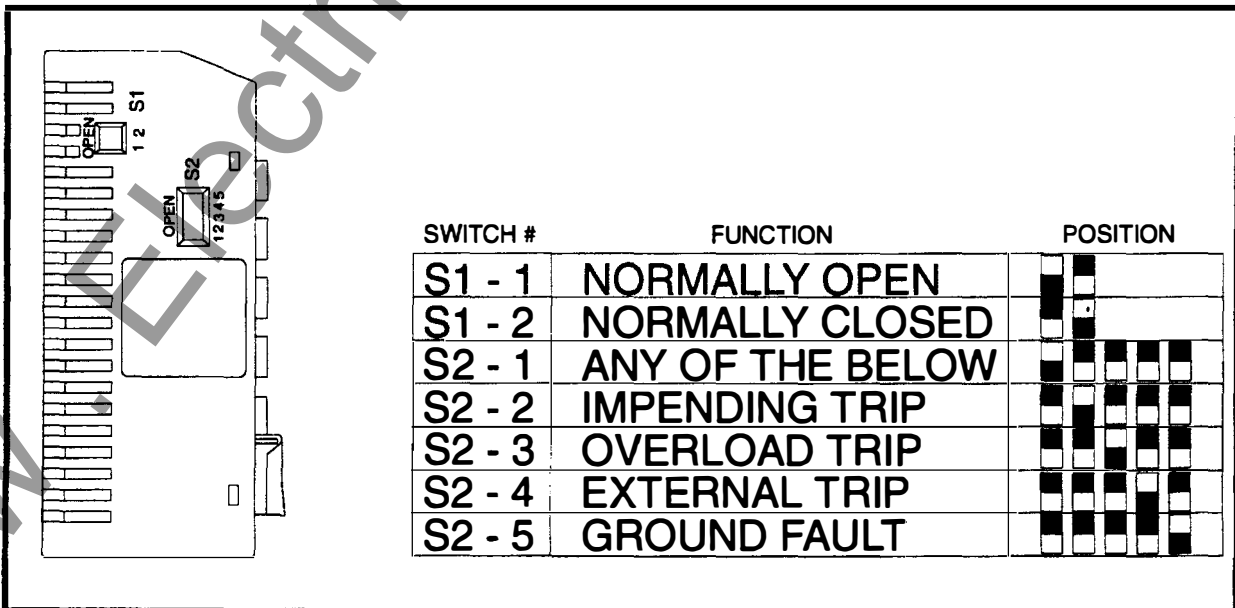


Figure A-3 Alarm Contact Configuration Switches (SAMMS-MVX Only)

Appendix A Technical Specifications

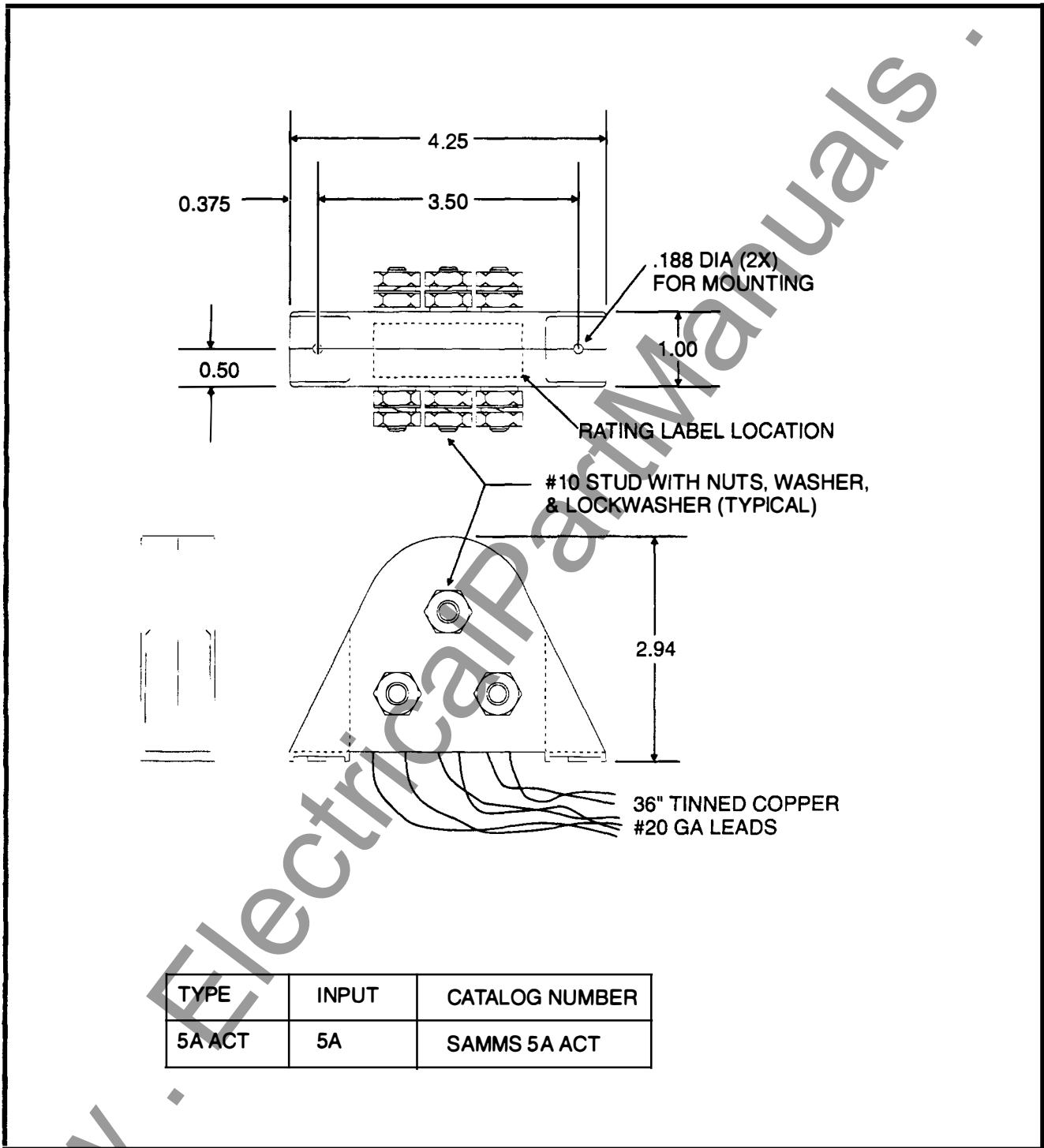


Figure A-4 SAMMS 5A Auxiliary Current Transformer

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