GE Digital Energy
Multilin

MM300

Motor Management System

Low voltage motor protection and control

Instruction manual

MM300 revision: 1.21

Manual P/N: 1601-9023-A4

GE publication code: GEK-113022C

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GE Multilin's Quality Management System is registered to ISO9001:2000

QMI # 005094

GE Multilin MM300 Motor Management System instruction manual for revision 1.21.

Part number: 1601-9023-A4 (June 2008)

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MM300 Motor Management System

Chapter 1: Introduction

1.1 Overview

The MM300 is a modular motor protection and control system designed specifically for low-voltage motor applications. The MM300 provides the following key benefits.

- Flexible protection, control, and communication options to suit any low-voltage motor application.
- Small footprint designed specifically for IEC and NEMA MCC applications.
- Modular design reduces the number of spare components for maintenance and testing.
- Integrated pushbuttons and LED indicators reduce external components and wiring.
- DIN rail and Panel Mounting.
- Multiple, simultaneous communication protocols allows simple integration into monitoring and control systems.
- Optional basic control panel or graphical control panel interface provides local control and access to system information.
- Automation FlexLogic™ for applications requiring more complex starter control, or multi-starter scenarios with interlocking or programmable logic control.

1.1.1 Cautions and warnings

Before attempting to install or use this device, it is imperative that all caution and danger indicators in this manual are reviewed to help prevent personal injury, equipment damage, or downtime. The following icons are used to indicate notes, cautions, and dangers.

Figure 1: Note icons used in the documentation

The standard **note** icon emphasizes a specific point or indicates minor problems that may occur if instructions are not properly followed.

The **caution** icon indicates that possible damage to equipment or data may occur if instructions are not properly followed.

The **danger** icon provides users with a warning about the possibility of serious or fatal injury to themselves or others.

1.1.1 Description of the MM300 Motor Management system

The MM300 can be equipped with either of two control panels.

- Basic control panel: includes pushbuttons for Stop, Start A, Start B, Auto, Manual, and Reset, and 12 LED status indicators.
- Graphical control panel: includes a 3.5-inch 320 by 240 pixel backlit colour LCD screen, 14 pushbuttons and 10 LED indicators, which provide access to actual values, trip and alarm lists, event records, and setting configuration. A USB port is provided for laptop computer connection.

The MM300 includes the following input/output capabilities:

- 2 to 18 contact outputs
- 6 to 30 contact inputs

The following additional functions are available:

- Ten process interlocks configurable for trip, stop, or alarm.
- Passcode for up to three security levels.
- Six pre-defined starter types.
- Start inhibits.
- Time between starts.
- Restart block timer.
- Starts per hour.
- Optional undervoltage restart.

The thermal model uses a standard overload curve with multiplier, and incorporates hot/cold biasing, unbalance biasing, RTD biasing, and exponential cooling.

A single-line diagram for the MM300 is shown below.

Figure 2: Single line diagram

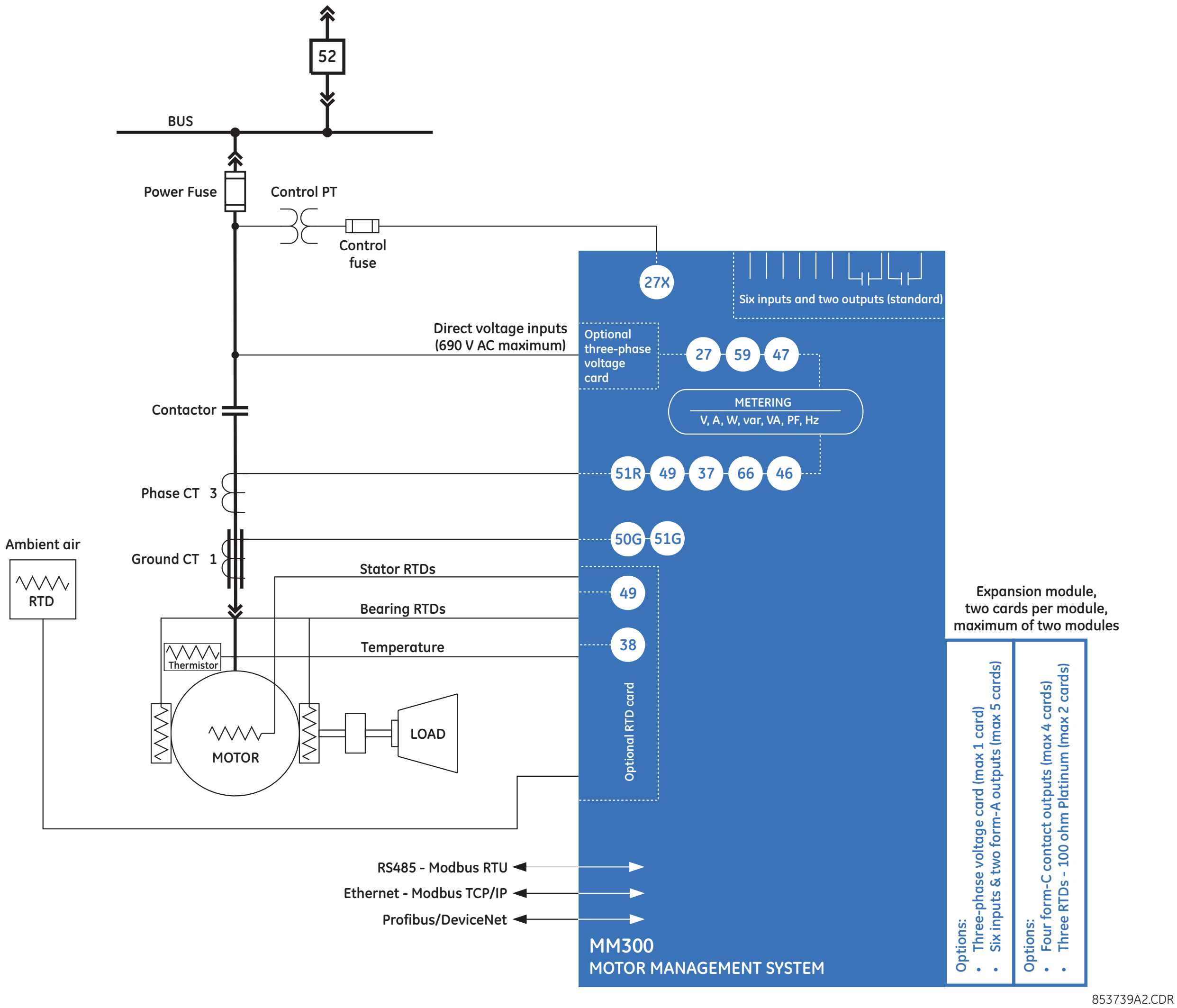
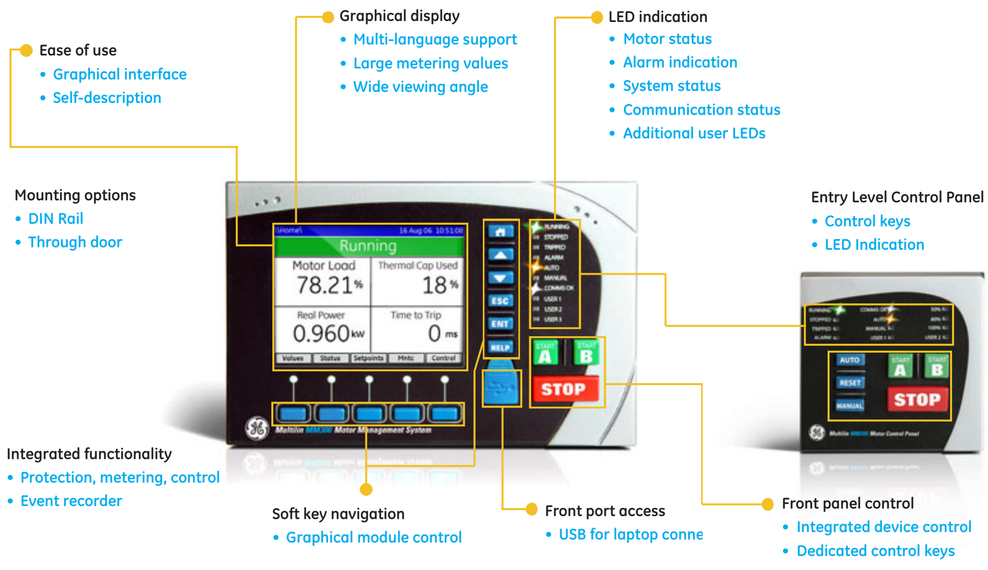


Table 1: MM300 protection functions

ANSI device	Description
27X	Undervoltage, auxiliary input
27	Undervoltage, three-phase
37	Undercurrent and underpower
38	Bearing temperature RTD
46	Current unbalance
47	Voltage phase reversal
49	Thermal overload
50G	Ground instantaneous overcurrent
51G	Ground time overcurrent
51R	Locked/stalled rotor, mechanical jam
59	Overvoltage, three-phase
66	Starts per hour and time between starts

Figure 3: MM300 feature overview



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1.1.2 MM300 order codes

The information to specify an MM300 relay is provided in the following order code figure.

Figure 4: MM300 order codes

	Base								Expanded				
	MM300 –	*	*	*	*	*	*	*	*	*	*	*	
Interface	MM300												MM300 Motor Management System
Control panel		X											No control panel
		B											Basic control panel, no USB
		G											Graphical control panel with USB
Language			E										English
Power supply				H									84 to 250 V DC; 60 to 300 V AC
Communications					S								Standard communications: RS485 Modbus RTU
					D								Standard plus DeviceNet and 10/100 Modbus TCP
					P								Standard plus Profibus and 10/100 Modbus TCP
Options						S							Standard: starter control and event recorder
						1							Option 1: standard plus undervoltage autorestart
						2							Option 2: option 1 plus waveform capture and data logger
						3							Option 3: option 2 plus FlexLogic™
Protection									X	X	X	X	No protection functions or input/output module
								A					Three-phase current and thermal overload, undercurrent, single-phase underpower
									B				Three-phase voltage metering and three-phase underpower, undervoltage, overvoltage, phase reversal
									G	G	G	G	Bank of three (3) RTDs: 100PT (select a maximum of 2 banks)
Input/output modules							C		C	C	C	C	Two (2) 10 A form-A relays and six (6) 60 to 300 V AC digital Inputs (standard, select a maximum of 5)
									D	D	D	D	Four (4) 10 A form-C relays (select a maximum of 4)

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1.1.3 Example of an MM300 order code

MM300GEHS1CAXXXX: MM300 with graphical control panel and USB port, English language display, high voltage 84 to 250 V DC and 60 to 300 V AC power supply, RS485 Modbus RTU communications, starter control, event recorder, undervoltage autorestart, three-phase current, thermal overload, undercurrent, single phase underpower, two 10 A form-A contact output relays, and six digital inputs.

1.2 Specifications

NOTE

Specifications are subject to change without notice.

1.2.1 Protection specifications

ACCELERATION TIMER

Pickup: $I_{av} > I_{cutoff}$
Dropout: $I_{av} < I_{pu}$ or timer expired
Time delay: 0.5 to 250.0 seconds in steps of 0.1
Timing accuracy: ±500 ms or 1.5% of total time
Elements: trip and alarm

AUXILIARY UNDERVOLTAGE

Pickup level: 60 to 90% of NCV
Time delay: 1 to 60 seconds in steps of 1
Timing accuracy: ± 500 ms
Elements: trip and alarm

CURRENT UNBALANCE

Range: 4 to 40% in steps of 1
Accuracy: ±2%
Time delay: 1 to 60 seconds in steps of 1 s
Timing accuracy: ±500 ms
Elements: trip and alarm

CALCULATION METHOD
If $I_{AV} \geq I_{FLA}$: ([I_M - I_{AV}] / I_{AV}) x 100%
If $I_{AV} \leq I_{FLA}$: ([I_M - I_{AV}] / I_{FLA}) x 100%
Where:
I_{AV} = average phase current
I_M = current in a phase with maximum deviation from I_{AV}
I_{FLA} = MOTOR FULL LOAD CURRENT setpoint

FUSE FAILURE (RUNNING STATE ONLY)

Timing: <500 ms
Elements: trip and alarm

GROUND FAULT (CBCT OR RESIDUAL)

Pickup level: 0.5 to 15.0 A in steps of 0.1 (CBCT); 10 to 100% of FLA in steps of 1% (residual)
Trip time delay on start: 0 to 10 s in steps of 0.1 s
Trip time delay on run: 0 to 5 s in steps of 0.1 s
Alarm time delay on start/run: 0 to 60 s in steps of 1 s
Timing accuracy: ±50 ms or ±0.5% of total time
Elements: trip and alarm

LOAD INCREASE

Pickup level: 50 to 150% of FLA in steps of 1%
Timing accuracy: ±500 ms
Elements: Alarm

MECHANICAL JAM

Pickup level: ....1.01 to 4.50 × FLA in steps of 0.01
Time delay: ....0.1 to 30.0 seconds in steps of 0.1
Timing accuracy: ....±500 ms
Elements: ....trip

PHASE OVERVOLTAGE

Pickup level: ....101 to 120% of rated in steps of 1%
Time delay: ....1 to 60 seconds in steps of 1 s
Timing accuracy: ....±500 ms
Elements: ....trip and alarm

PHASE UNDERVOLTAGE

Pickup level: ....60 to 99% of rated in steps of 1
Time delay: ....1 to 60 seconds in steps of 1 s
Timing accuracy: ....±500 ms
Elements: ....trip and alarm

RTD PROTECTION

RTD types: ....three-wire (100 ohm Platinum)
Range: ....–50 to 250°C in steps of 1
Hysteresis: ....2°C

THERMAL MODEL

Standard curve time multiplier: ....1 to 15 in steps of 1
Thermal overload pickup: ....1.01 to 1.25 in steps of 0.01
Motor full load current (FLA): ....0.5 to 1000 A in steps of 0.1
Motor rated voltage: ....100 to 690 V AC
Curve biasing: ....phase unbalance (±5%)
hot/cold ratio
stator RTD
exponential running and stopped cooling rates
Update rate: ....3 cycles
Hot/cold safe stall ratio: ....1 to 100% in steps of 1%
Timing accuracy: ....±200 ms or ±2% of total time (based on measured value)
Elements: ....trip and alarm

THERMISTOR

Sensor types: ....PTC (R_{HOT} = 100 to 30 kohms); NTC (R_{HOT} = 100 to 30 kohms)
Timing accuracy: ....±500 ms
Elements: ....Trip and alarm

UNDERCURRENT

Pickup level: ....1 to 100% of FLA in steps of 1
Time delay: ....1 to 60 seconds in steps of 1
Timing accuracy: ....±500 ms
Elements: ....trip and alarm

UNDERPOWER

Pickup level: ....1 to 100% of kW rating in steps of 1
Time delay: ....1 to 60 seconds in steps of 1
Timing accuracy: ....±500 ms
Elements: ....trip and alarm

VOLTAGE PHASE REVERSAL

Configuration: ....ABC or Rev starter
Timing accuracy: ....±500 ms
Elements: ....trip or alarm

1.2.2 User interface specifications

GRAPHICAL CONTROL PANEL

Size: .... height 102mm, width 153mm, depth 35mm
LCD: .... 3.5-inch colour, 320 by 240 pixels
LED indicators: .... 10 LEDs
Pushbuttons: .... Start A, Start B, Stop, plus 11 LCD screen display control keys
Ports: .... USB 2.0 port for laptop computer connection

1.2.3 Metering and monitoring specifications

EVENT RECORDER

Capacity: .... 256 events
Data storage: .... non-volatile memory

FREQUENCY METERING

Range: .... 40.00 to 70.00 Hz in steps of 0.01
Accuracy: .... ±0.05 Hz

POWER METERING

Real power range: .... –2000.0 to 2000.0 kW in steps of 0.1
Apparent power range: .... 0.0 to 2500.0 kVA in steps of 0.1
Accuracy: .... ±1% of full scale

POWER FACTOR METERING

Range: .... –0.99 to +0.99 in steps of 0.01
Accuracy: .... ±0.05

1.2.4 Control specifications

UNDERVOLTAGE RESTART

Dropout/Pickup Level: .... 60 to 100% NCV in steps of 1%
Short Dip Time: .... 100 to 500 ms or OFF in steps of 10 ms
Medium Dip Time: .... 0.1 to 10.0 s in steps of 0.1 s
Medium Dip Delay: .... 0.2 to 60 s in steps of 0.2 s
Long Dip Time: .... 0.5 to 60.0 min or OFF in steps of 0.5 min
Long Dip Delay: .... 1.0 to 1200.0 s in steps of 1.0 s
Time Accuracy: .... ±1 s or ±5% of total time

1.2.5 Inputs specifications

CONTROL VOLTAGE INPUT (UNDERVOLTAGE RESTART SOURCE)

External VT primary: .... 110 to 690 V AC in steps of 10 (if used)
Input range: .... 60 to 300 V AC
Nominal frequency: .... 50 or 60 Hz
Accuracy: .... ±5% of reading

DIGITAL INPUTS

Fixed pickup: .... 65 V AC
Recognition time: .... 2 cycles
Current draw at rated voltage: .... 60 mA (peak) @ 120 V; 75 mA (peak) @ 240 V Momentarily sampled every cycle
Input impedence: .... 1.7 kΩ
Type: .... opto-isolated inputs
External switch: .... wet contact
Maximum input voltage: .... 300 V AC

GROUND CURRENT INPUT (50:0.025)

CT primary: 0.5 to 15.0 A
Nominal frequency: 50 or 60 Hz
Accuracy (CBCT): ±0.1 A (0.5 to 3.99 A)
±0.2 A (4.0 A to 15 A)

Table 2: MM300 CBCT burden

Input Primary (A)	Input Secondary (mA)	Impedance (Ohms)	VA
0.5	0.25	55	0.004
1	0.5		0.01
5	2.5		0.34
10	5.0		1.37
15	7.5		3.09

PHASE CURRENT INPUTS (INCLUDING RESIDUAL GROUND CURRENT)

Range: 0.2 to 40 A (8 × CT), direct connection up to 5 A FLA
Input type: combined 1 A / 5 A
Frequency: 50 or 60 Hz
Accuracy: ExtCT: ±2% of reading or ±1% of 8× CTPrimary, whichever is greater
Direct: ±2% of reading or ±0.1 A, whichever is greater
Withstand (at 5A nominal): 0.2 s at 100×
1.0 s at 50×
2.0 s at 40×
continuous at 3× rated current

Table 3: MM300 phase and ground CT burden

Secondary Input (A)	Impedance (Ohms)	VA
1.0	0.004	0.004
5.0		0.09
8.0		0.32
40.0		6.04

PHASE VOLTAGE INPUTS (THREE-PHASE VOLTAGE)

Input range: 208 to 690 V
Nominal frequency: 50 or 60 Hz
Accuracy: ±2% of reading, or ±1 V, whichever is greater

RTD INPUTS

Sensor type: Three-wire RTD (100 ohm Platinum)
Sensing current: 5 mA
Accuracy: ±3°C

THERMISTOR INPUTS

Sensor type: Positive temperature coefficient PTC (R_{HOT} = 100 to 30000 ohms), negative temperature coefficient NTC (R_{HOT} = 100 to 30000 ohms)
Accuracy: ±6% of reading or ±100 ohms, whichever is greater

1.2.6 Outputs specifications

OUTPUT RELAYS

Configuration:	electromechanical form-A (IO_C) and form-C (IO_D)
Contact material:	silver-alloy
Operate time:	10 ms
Minimum contact load:	10 mA at 5 V DC
Maximum switching rate:	300 operations per minute (no load), 30 operations per minute (load)
Mechanical life:	10 000 000 operations
Continuous current:	10 A
Make and carry for 0.2s:	30 A per ANSI C37.90

OUTPUT RELAY BREAK CAPACITY (FORM-A RELAY)

AC resistive, 120 V AC:	10 A
AC resistive, 240 V AC:	10 A
AC inductive, PF = 0.4 pilot duty:	2 A
DC resistive, 30 V DC:	10 A

OUTPUT RELAY BREAK CAPACITY (FORM-C RELAY)

AC resistive, 120 V AC:	10 A normally-open, 5 A normally-closed
AC resistive, 240 V AC:	10 A normally-open, 8 A normally-closed
AC inductive, PF = 0.4 pilot duty:	2.5 A
DC resistive, 30 V DC:	10 A

1.2.7 Power supply specifications

POWER SUPPLY

Nominal:	120 to 240 V AC 125 to 250 V DC
Range:	60 to 300 V AC (50 and 60 Hz) 84 to 250 V DC
Ride-Through:	35 ms

ALL RANGES

Voltage withstand:	2 × highest nominal voltage for 10 ms
Power consumption:	16 W typical, 25 W maximum

1.2.8 Communications specifications

DEVICENET (COPPER)

Modes:	slave (125, 250, and 500 kbps)
Connector:	5-pin terminal

ETHERNET (COPPER)

Modes:	10/100 MB (Autodetect)
Connector:	RJ-45
SNTP clock synchronization error:	<200 ms (typical)
Protocol:	Modbus TCP

PROFIBUS (COPPER)

Modes:	DP V0 slave, up to 1.5 Mbps
Connector:	5-pin terminal

RS485 PORT

Port:	opto-isolated
Baud rates:	up to 115 kbps
Protocol:	Modbus RTU, half-duplex
Maximum distance:	1200 m
Isolation:	2 kV

USB PORT (GRAPHIC CONTROL PANEL ONLY)

Standard specification:..................................Compliant with both USB 2.0 and USB 1.1
Data transfer rate:...USB device emulating serial communications port at 115 kbps

1.2.9 Testing and certification

CERTIFICATION

ISO:..Manufactured under an ISO9001 registered program
CE: ....Conforms to EN 60255-26 (EN 50263), EN 5502/CISPR22/EN 61000-6-2
cULus:...Conforms to UL 508 / UL 1053 and C22.2.14-05 (CSA)

TYPE TESTS

Relative Humidity Cyclic: ....IEC 60068-2-30: 55°C at 95% RH
Composite Temperature/Humidity: ....IEC 60068-2-38: 65°C/–10°C at 93% RH
Hot: ....IEC 60068-2-2 (Hot Start) 16 hours
Cold: ....IEC 60068-2-1 (Cold Start) 16 hours
Dielectric Strength:..IEC 60255-5: 2300 V AC
Insulation Resistance:......................................IEC 60255-5: >100 MΩ / 500 V AC / 10 s
Impulse Voltage:...IEC 60255-5: 5kV
Sinusoidal Vibration:...IEC 60255-21-1: 1 g
Shock and Bump:..IEC 60255-21-2: 5 g / 10 g / 15 g
Damped Oscillatory Burst:.............................IEC 60255-22-1: 1 MHz 2.5 kV / 1 kV
Electrostatic Discharge Immunity - Air and Direct:..IEC 60255-22-2: 5 kV / 8 kV
Radiated RF Immunity:....................................IEC 60255-22-3: 10 V/m
Electrical Fast Transient / Burst Immunity: ....IEC 60255-22-4: 4 kV
Surge Immunity:...IEC 60255-22-5: 4 kV / 2 kV
Conducted RF Immunity:................................IEC 60255-22-6: 150 kHz to 80 MHz 10 V/m
Radiated RF Emission: ....IEC 60255-25: Group 1 Class A
Conducted RF Emission: ....IEC 60255-25: Group 1 Class A
Ingress of Solid Objects and Water:...........IEC 60529: IP54 (front), IP20 (back)
Power Frequency Magnetic Field Immunity: ....IEC 61000-4-8: 30 A/m
Pulse Magnetic Field Immunity: ....IEC 61000-4-9: 1000 A/m
Voltage Dip; Voltage Interruption:...............IEC 61000-4-11: 0%, 40%, 100%
Fast Transient SWC:..IEEE C37.90.1: ±4 kV
Oscillatory Transient SWC: ....IEEE C37.90.1: ±2.5 kV
Electrostatic Discharge - Air and Direct: ..IEEE C37.90.3: ±15 kV / ±8 kV
Radiated / Conducted Emissions: ....EN5022: Class A

1.2.10 Physical specifications

DIMENSIONS

Size: ....Base: 120 mm (W) × 90 mm (H) × 113 mm (D) [+ terminals 10mm]
Expansion: 62 mm (W) × 90 mm (H) × 113 mm (D)
GCP: 153 mm (W) × 102 mm (H) × 35 mm (D)
BCP: 75 mm (W) × 75 mm (H) × 31 mm (D)
Weight (Base):..0.75 kg

1.2.11 Environmental specifications

OPERATING ENVIRONMENT

Ambient operating temperature (1" around base unit): .... –20 to 70°C (base unit and basic control panel)
–20 to 50°C (graphical control panel).

Ambient (1" around base unit) storage and shipping temperature: .... –40 to 90°C ambient

Humidity: .... up to 90% non-condensing

Polution degree: II

IP rating: .... 20 (base unit), 54 (control panel)

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MM300 Motor Management System

Chapter 2: Installation

2.1 Mechanical installation

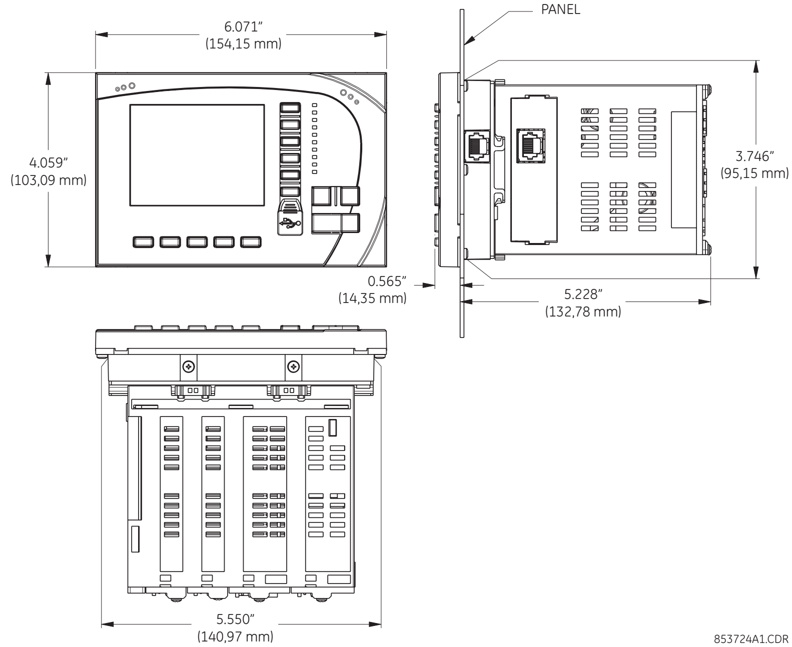
This section describes the mechanical installation of the MM300 system, including dimensions for mounting and information on module withdrawal and insertion.

2.1.1 Dimensions

The MM300 is packaged in a modular arrangement.

The dimensions of the MM300 are shown below. Additional dimensions for mounting and panel cutouts are shown in the following sections.

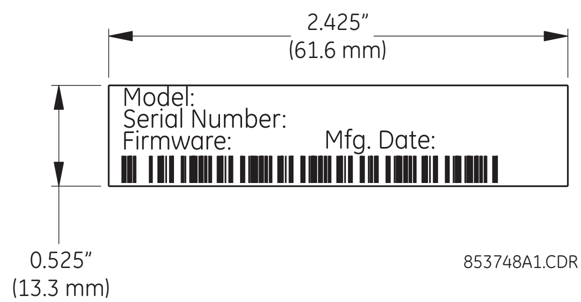
Figure 1: MM300 dimensions



2.1.2 Product identification

The product identification label is located on the side panel of the MM300. This label indicates the product model, serial number, firmware revision, and date of manufacture.

Figure 2: MM300 label

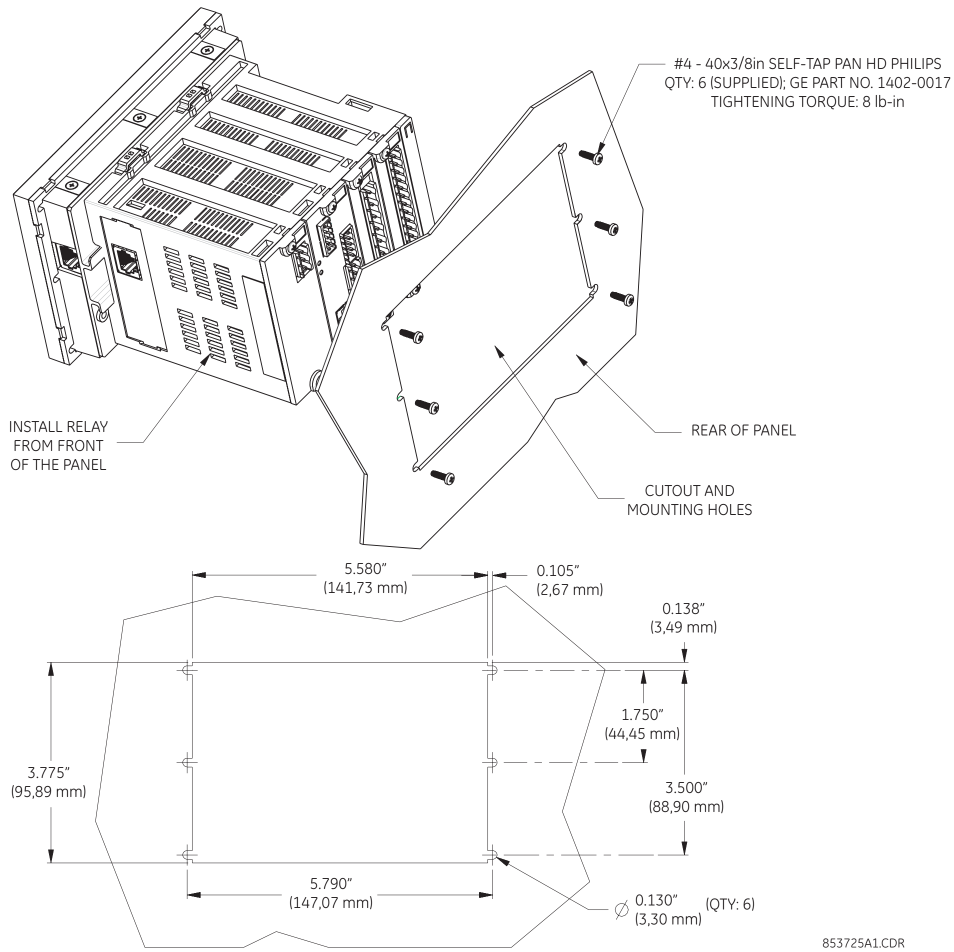


2.1.3 Mounting

The MM300 can be mounted three ways: standard panel mount, DIN rail mount, and screw mount for high vibration environments.

The standard panel mount and cutout dimensions are illustrated below.

Figure 3: Panel mounting and cutout dimensions



The DIN rail mounting is illustrated below. The DIN rail conforms to EN 50022.

CAUTION

To avoid the potential for personal injury due to fire hazards, ensure the unit is mounted in a safe location and/or within an appropriate enclosure.

Figure 4: Basic Control Panel mounting and cutout dimensions

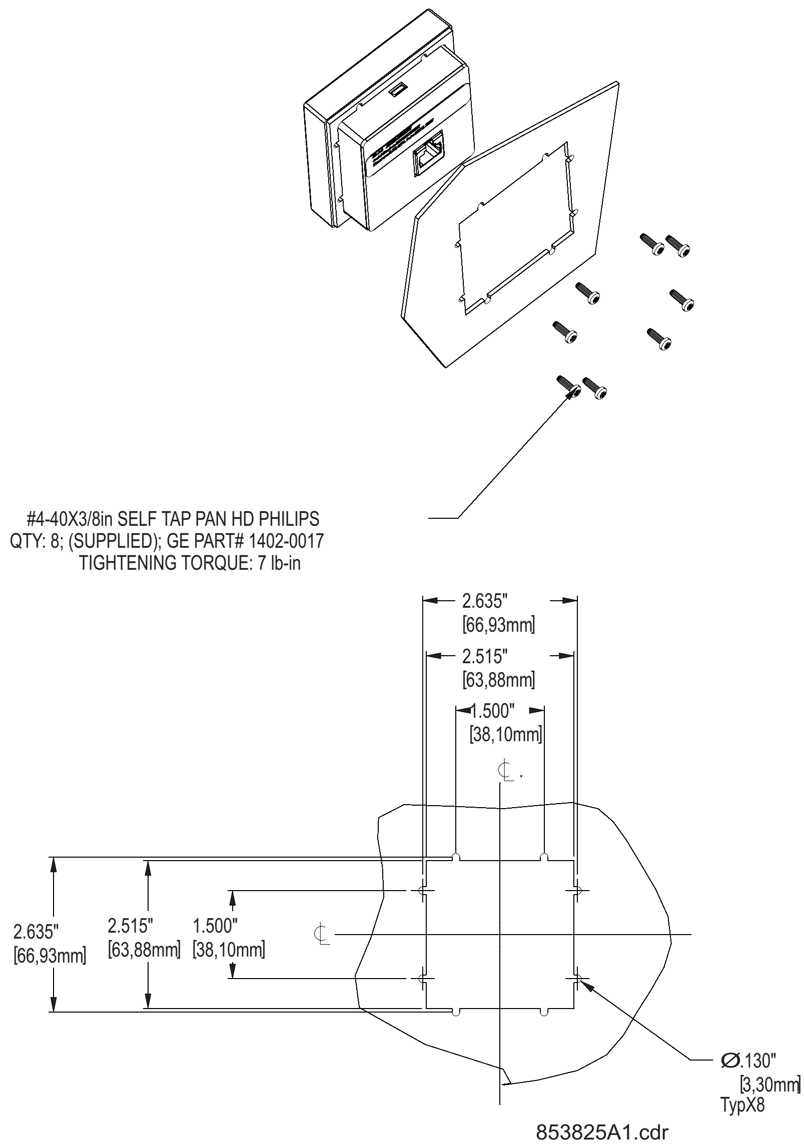
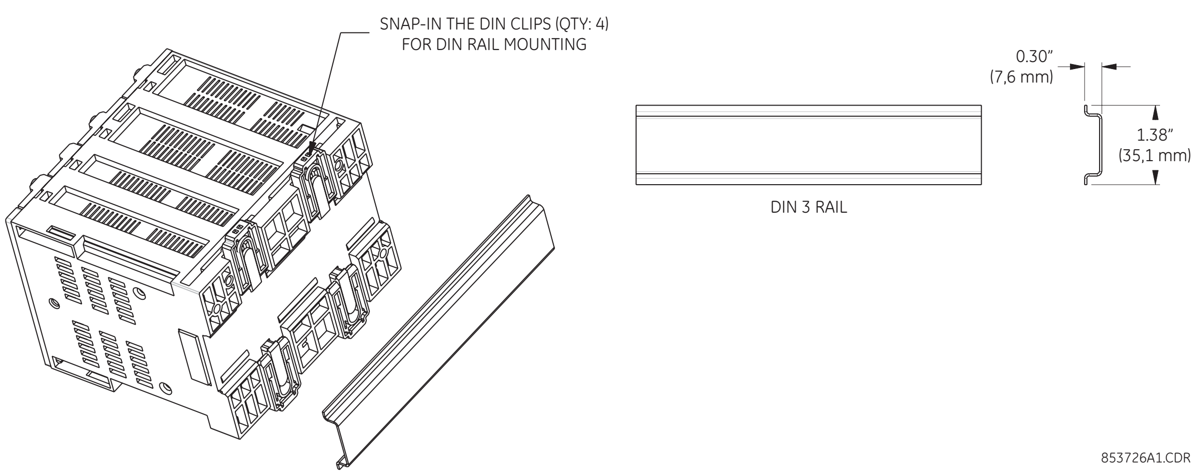
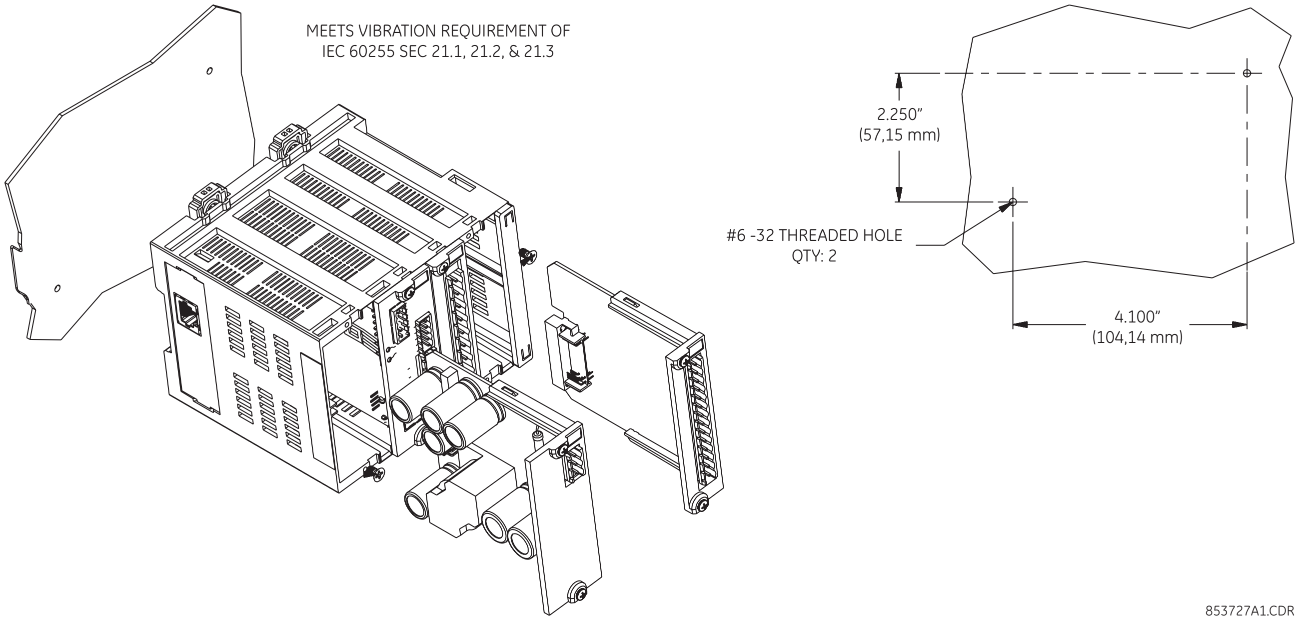


Figure 5: DIN rail mounting



The screw mount for high vibration environments is illustrated below.

Figure 6: Screw mounting



2.1.4 Module withdrawal and insertion

DANGER

Module withdrawal and insertion may only be performed when control power has been removed from the unit. Inserting an incorrect module type into a slot may result in personal injury, damage to the unit or connected equipment, or undesired operation!

CAUTION

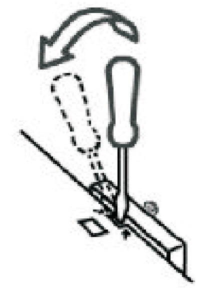
Proper electrostatic discharge protection (for example, a static strap) must be used when coming into contact with modules while they are removed from the MM300.

The MM300 is a modular protection system. This allows for easy withdrawal and insertion of modules for fast replacement. Modules must only be replaced in their original factory configured slots.

Use the following procedure to withdraw a module.

1. Ensure that control power has been removed from the MM300.
2. Record the slot location of the module to ensure that the same or replacement module is inserted into the correct slot.
3. Remove the two captive screws at the top and bottom of the module.
4. Slide a flat-blade screwdriver into the opening above the module marked by the two arrows on top of the MM300 case.
5. Press down on the screwdriver and pivot towards the unit to unlatch the module from the MM300 case.

Figure 7: Removing a module from the MM300



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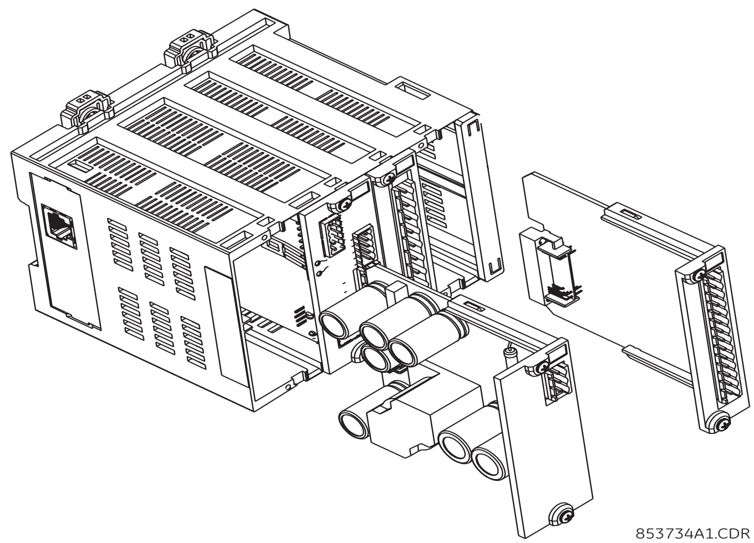
Use the following procedure to insert a module.

1. Ensure that control power has been removed from the MM300.
2. Ensure that the module is being inserted into the correct slot.
3. Align the module card edges with the slot track as shown in the diagram below.
4. Gently slide the modules into the slot until the modules latch into the opening marked by the two arrows on top of the MM300 case.
5. Attach the two captive screws to anchor the module to the case (use a tightening torque of 3.5 lb.-in.).

Figure 8: Inserting modules into the MM300



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2.1.5 Module and terminal identification

The MM300 input/output and protection modules are labeled with the "IO_" prefix followed by a one-character identifier as follows.

Table 1: Input/output module nomenclature

Module	Description
IO_A	CT module
IO_B	VT module
IO_C	Two 10 A form-A relays, six 60 to 300 V AC digital inputs, and Aux VT input module.
IO_D	Four 10 A form-C relays module.
IO_G	3 RTD module.

The MM300 terminals are labeled with a three-character identifier. The first character identifies the module slot position and the second character identifies the terminals within the module. For example, the first terminal in a module in slot C is identified as “C1”.

NOTE

Do not confuse the slot designation with the module ordering designation. That is, terminal “C1” does not imply an IO_C module. Rather, it indicates the first terminal of whatever module is in slot C.

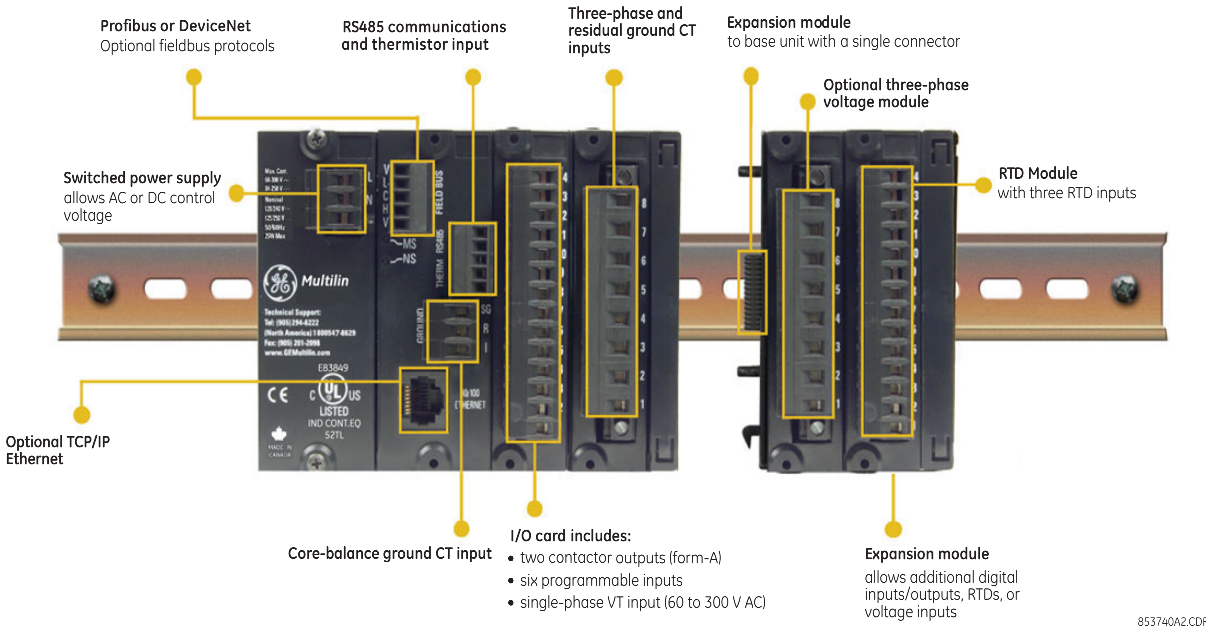
2.2 Electrical installation

This section describes the electrical installation of the MM300 system. An overview of the MM300 terminal connections is shown below.

CAUTION

MM300 is not to be used in any way other than described in this manual.

Figure 9: MM300 terminal connection overview



The MM300 can contain up to eight modules. The first four modules (slots A through D) comprise the base unit, and the next four modules (slots E through H) comprise the optional expanded unit.

Table 2: Module slot position

Slot	Module types
A	Power supply module
B	CPU module with communications
C	IO_C module
D	IO_A module
E	IO_B, IO_C, IO_D, IO_G modules
F	IO_C, IO_D, IO_G modules
G	IO_C, IO_D, IO_G modules
H	IO_C, IO_D, IO_G modules

The following figure shows a typical module arrangement for an expanded unit.

CAUTION

Use gauge size appropriate for the voltage and current draw of the device.

Table 3: Gauge Sizes

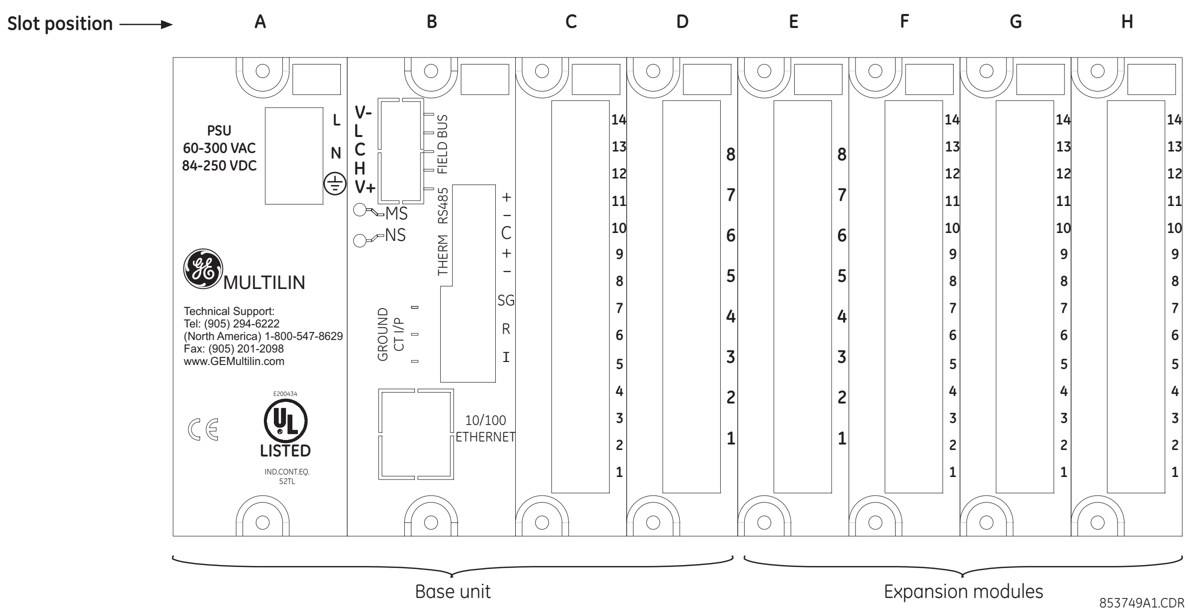
CPU Card: Themistor, RS485 and Fieldbus	16 AWG (3.50mm pitch terminals)
PSU / CBCT /IO_C / IO_D / IO_G	12 AWG (5.00mm pitch terminals)[1]
IO_A / IO_B	12 AWG (7.62mm pitch terminals)1

1. Wire gauge size remains constant; increased pitch distance reflects higher voltage rating.

NOTE

It is recommended that you install a circuit disconnection system for control power, near the device, which should be easily accessible after installation of the unit. This is in case an emergency power shut-down of the unit is required.

Figure 10: Typical module arrangement



2.2.1 Power supply module

The power supply module in slot A supplies control power to the MM300 system. A supply voltage between 60 to 300 V AC or 84 to 250 V DC is required to power the MM300.

CAUTION

Check the voltage rating of the unit before applying control power! Control power outside of the operating range of the power supply will damage the MM300.

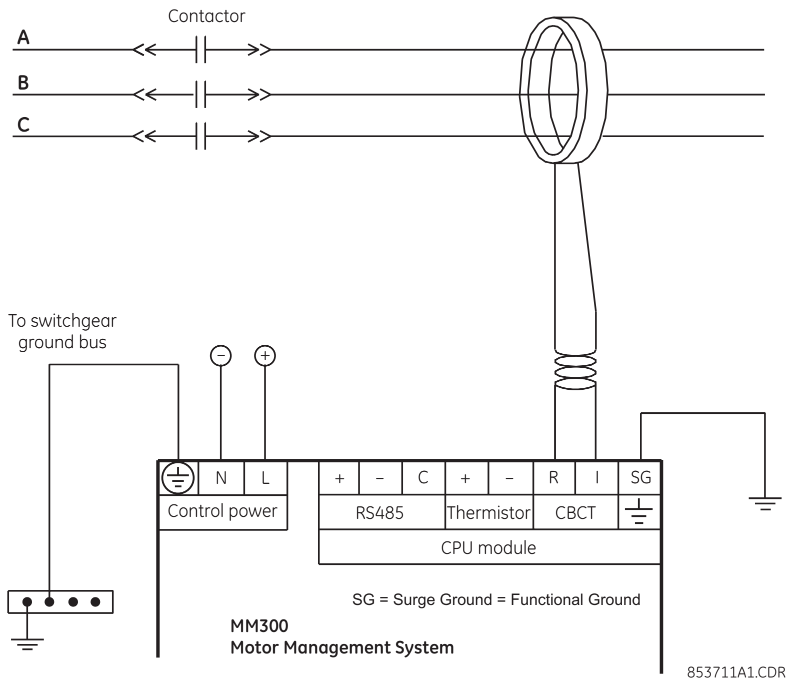
2.2.2 CPU module

The main CPU module and optional communications board is contained in slot B. This module provides a Modbus RTU RS485 port, a thermistor input, and a 50:0.025 CBCT input. The optional communications board provides Fieldbus and Ethernet ports.

2.2.2.1 Ground current input

The MM300 CPU module has a sensitive ground input suitable for a 50:0.025 CT. There is also a residual ground input on the CT module (IO_A) with the same rating as the phase current inputs. Only one ground CT input can be used at any time.

Figure 11: Residual ground CT connection



CAUTION

The zero-sequence connection is recommended. Unequal saturation of CTs, size and location of motor, resistance of power system, motor core saturation density, and other factors, may cause false readings in the residually connected ground fault circuit.

NOTE

Only one ground input should be wired; the other input should be unconnected.

The exact placement of a zero-sequence CT to detect only ground fault current is shown below. If the core balance CT is placed over shielded cable, capacitive coupling of phase current into the cable shield during motor starts may be detected as ground current unless the shield wire is also passed through the CT window. Twisted-pair cabling on the zero-sequence CT is recommended.

Figure 12: Core balance ground CT installation, shielded cable

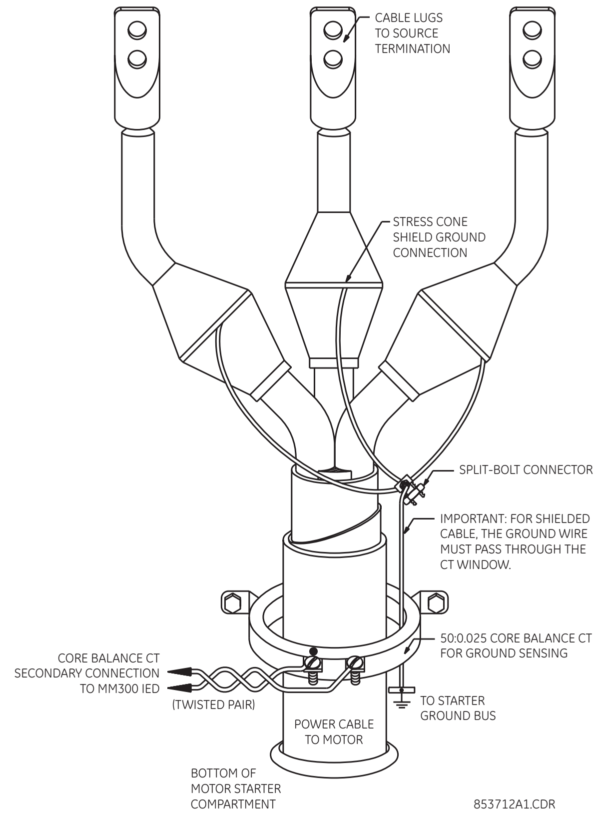
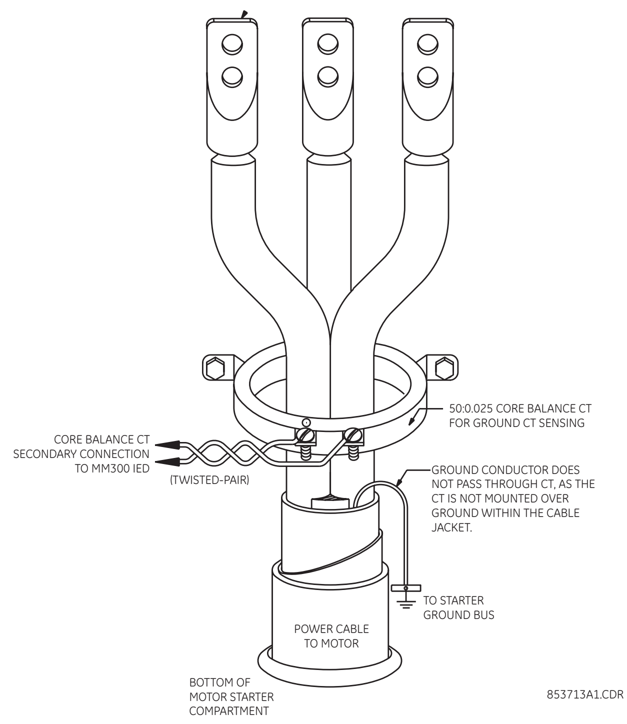


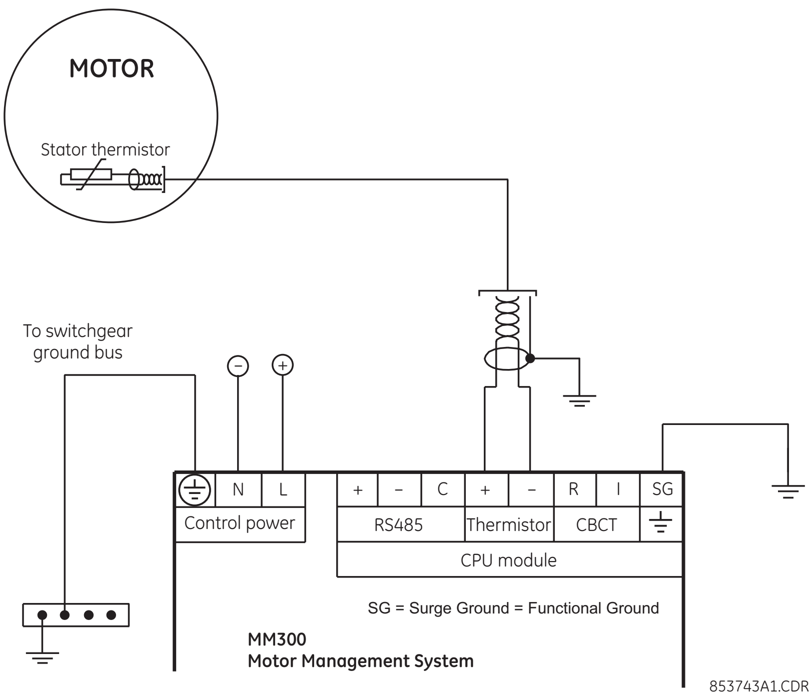
Figure 13: Core balance ground CT installation, unshielded cable



2.2.2.2 Thermistor connections

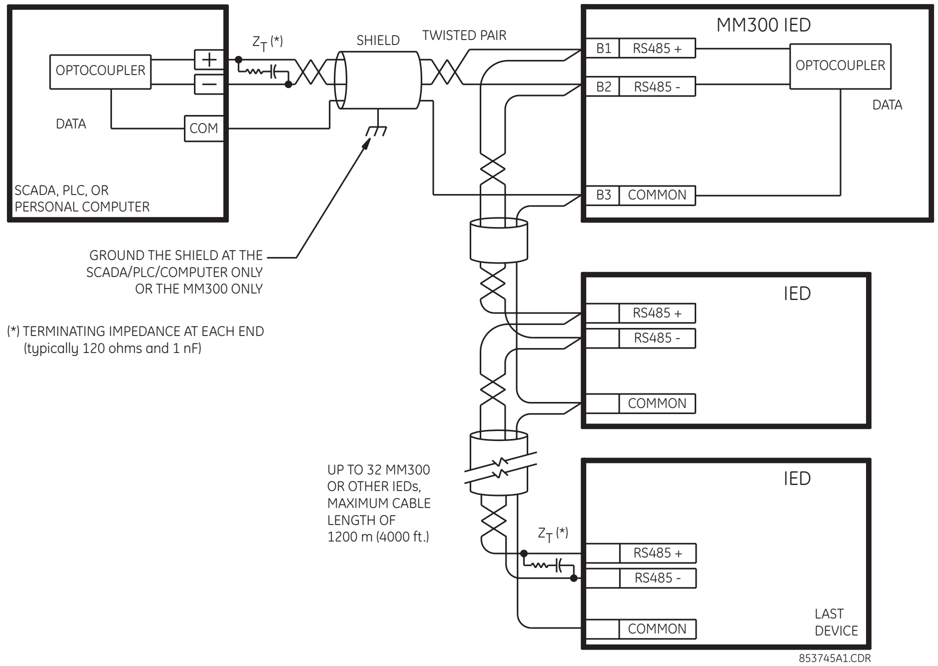
Either a positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor may be directly connected to the + and - terminals on the CPU module. By specifying the hot and cold thermistor resistance, the MM300 automatically determines the thermistor type as NTC or PTC. Use thermistors with hot and cold resistance values in the range 100 to 30000 ohms. If no thermistor is connected, the **Thermistor Alarm** and **Thermistor Trip** settings must be set to "Disabled".

Figure 14: Typical thermistor connection



2.2.2.3 RS485 connections

Figure 15: Typical RS485 connection



One two-wire RS485 port is provided. Up to 32 MM300 IEDs can be daisy-chained together on a communication channel without exceeding the driver capability. For larger systems, additional serial channels must be added. Commercially available repeaters can also be used to add more than 32 relays on a single channel. Suitable cable should have a characteristic impedance of 120 ohms (for example, Belden #9841) and total wire length should not exceed 1200 meters (4000 ft.). Commercially available repeaters will allow for transmission distances greater than 1200 meters.

Voltage differences between remote ends of the communication link are not uncommon. For this reason, surge protection devices are internally installed across all RS485 terminals. Internally, an isolated power supply with an optocoupled data interface is used to prevent noise coupling.

CAUTION

To ensure that all devices in a daisy-chain are at the same potential, it is imperative that the common terminals of each RS485 port are tied together and grounded only once, at the master or at the MM300. Failure to do so may result in intermittent or failed communications.

The source computer/PLC/SCADA system should have similar transient protection devices installed, either internally or externally. Ground the shield at one point only, as shown in the figure above, to avoid ground loops.

Correct polarity is also essential. The MM300 IEDs must be wired with all the positive (+) terminals connected together and all the negative (–) terminals connected together. Each relay must be daisy-chained to the next one. Avoid star or stub connected configurations. The last device at each end of the daisy-chain should be terminated with a 120 ohm ¼ watt resistor in series with a 1 nF capacitor across the positive and negative terminals. Observing these guidelines will ensure a reliable communication system immune to system transients.

2.2.3 Protection modules

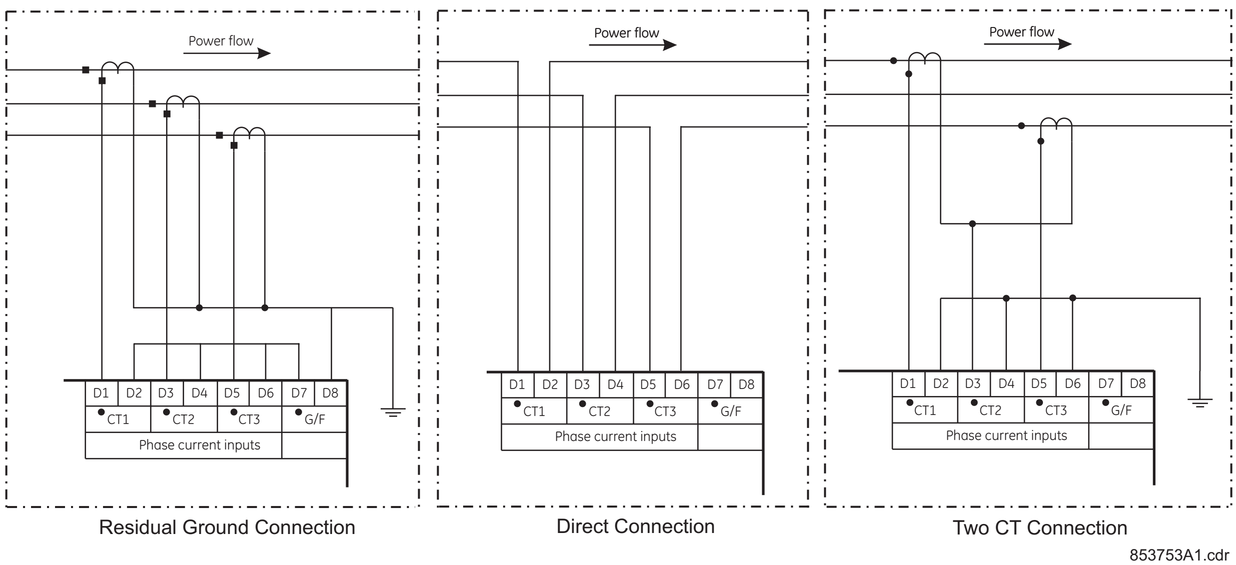
The following protection modules are available for the MM300.

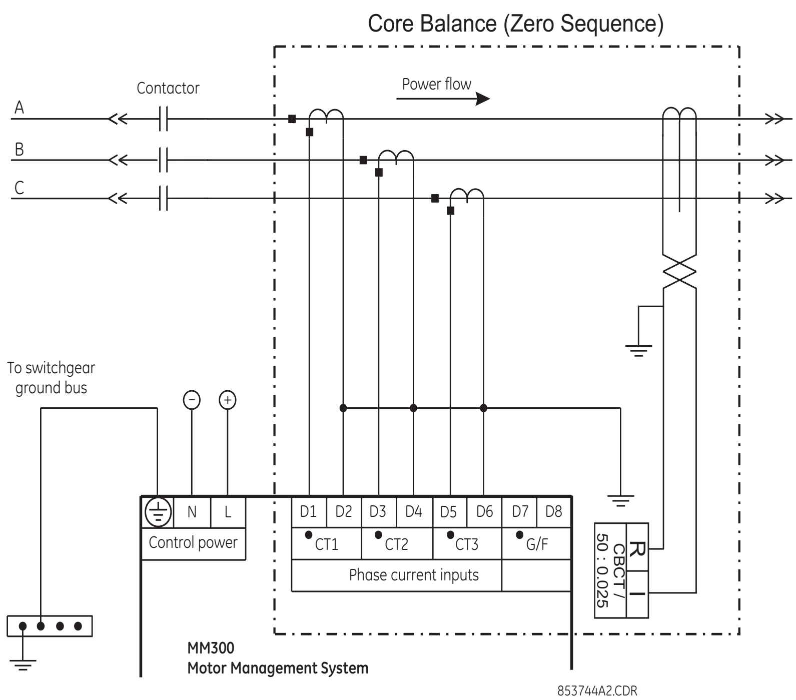
Table 4: MM300 protection modules

Module	Slots	Description
IO_A	D	Three-phase current metering and thermal overload, undercurrent, and single-phase underpower protection.
IO_B	E	Three-phase voltage metering and three-phase underpower, undervoltage, overvoltage, and phase reversal protection.
IO_G	E, F, G	Bank of three RTDs (100 ohm Platinum).

2.2.3.1 Phase current inputs (IO_A module)

Figure 16: Typical phase current input connections





The MM300 has three channels for phase current inputs, each with an isolating transformer. The phase CTs should be chosen so the FLA is not less than 50% of the rated phase CT primary. Ideally, the phase CT primary should be chosen such that the FLA is 100% of the phase CT primary or slightly less, never more. This will ensure maximum accuracy for the current measurements. The maximum phase CT primary current is 1000 A.

CAUTION

Polarity of the phase CTs is critical for negative-sequence unbalance calculation, power measurement, and residual ground current detection (if used).

2.2.3.2 Two CT configuration

Each of the two CTs acts as a current source. The current that comes out of the CT on phase A flows into the interposing CT on the relay marked CT1. From there, the current sums with the current that is flowing from the CT on phase C which has just passed through the interposing CT on the relay marked CT3. This summed current flows through the interposing CT marked CT2 and from there, the current splits up to return to its respective source (CT).

Polarity is very important since the value of phase B must be the negative equivalent of A + C in order for the sum of all the vectors to equate to zero.

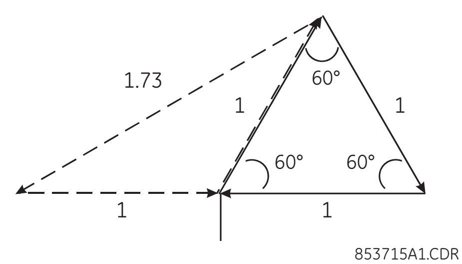
Only one ground connection should be made as shown. If two ground connections are made, a parallel path for current has been created.

In the two CT configuration, the currents will sum vectorially at the common point of the two CTs. The diagram illustrates the two possible configurations. If one phase is reading high by a factor of 1.73 on a system that is known to be balanced, simply reverse the polarity of the leads at one of the two phase CTs (taking care that the CTs are still tied to ground at some point). Polarity is important.

NOTE

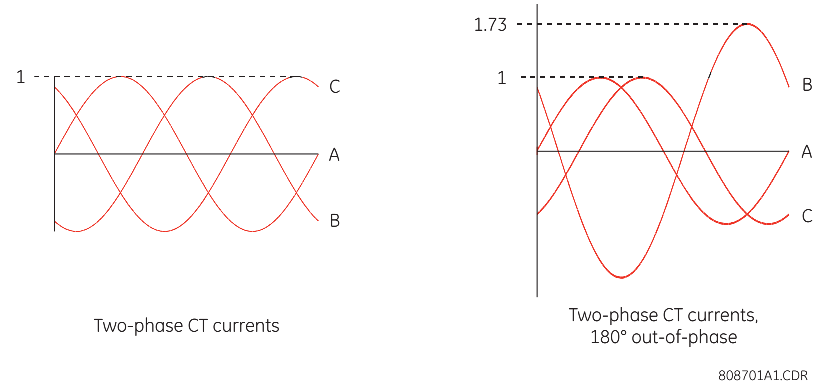
Change CT wiring only if the system is de-energized!

Figure 17: Two CT connection vector diagram



To illustrate the point further, the following diagram shows how the current in phases A and C sum up to create phase "B".

Figure 18: Two CT connection currents



Once again, if the polarity of one of the phases is out by 180°, the magnitude of the resulting vector on a balanced system will be out by a factor of 1.73.

On a three-wire supply, this configuration will always work and unbalance will be detected properly. In the event of a single phase, there will always be a large unbalance present at the interposing CTs of the relay. If for example phase A was lost, phase A would read zero while phase B and C would both read the magnitude of phase C. If on the other hand, phase B was lost, at the supply, phase A would be 180° out-of-phase with phase C and the vector addition would equal zero at phase B.

2.2.3.3 Phase voltage inputs (IO_B module)

The MM300 has three channels for AC voltage inputs. There are no internal fuses or ground connections on the voltage inputs. Polarity is critical for correct power measurement and voltage phase reversal operation.

Figure 19: Wye voltage connection

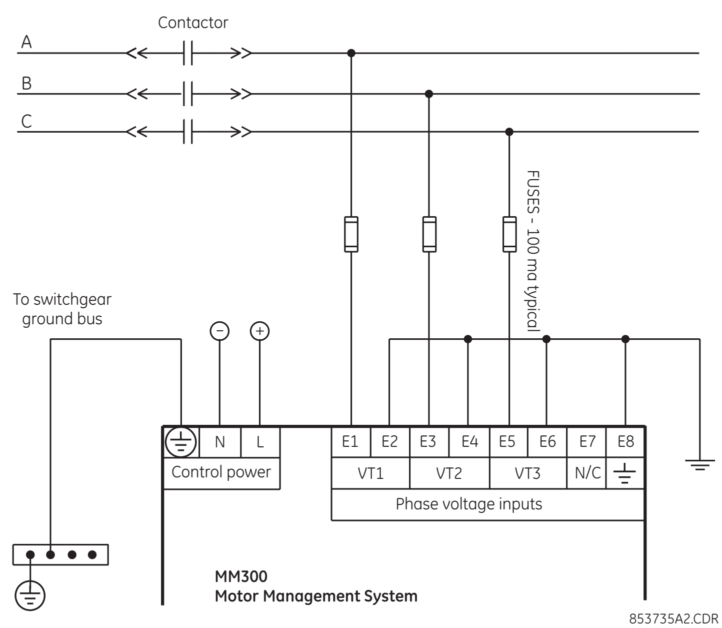
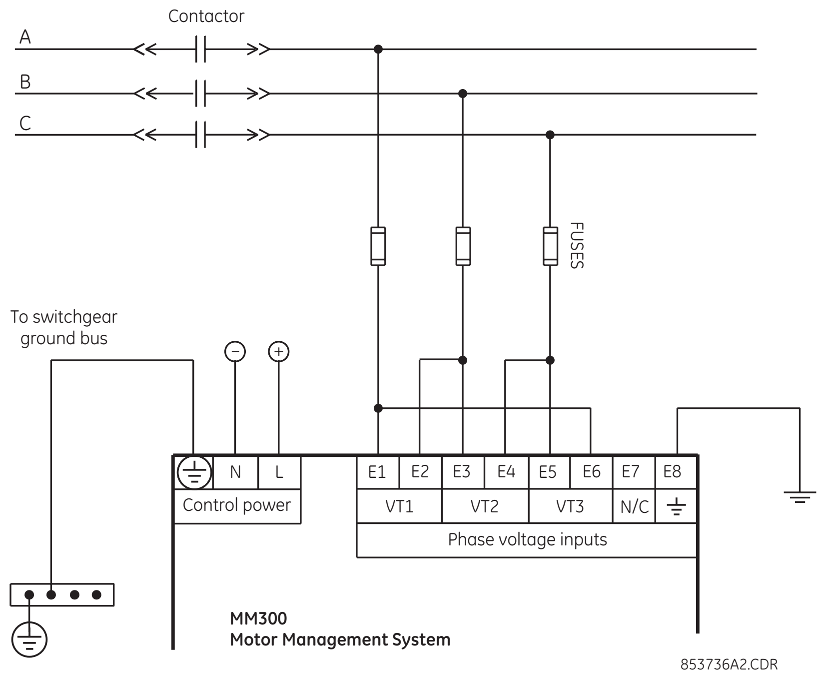


Figure 20: Delta voltage connection



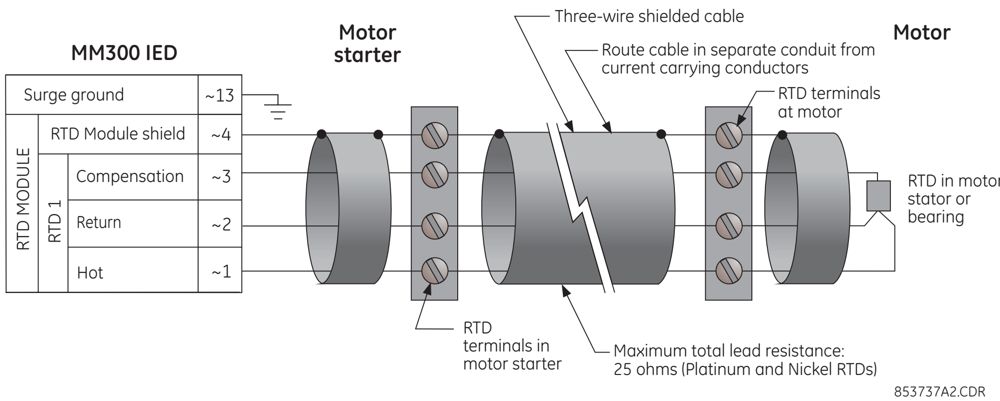
2.2.3.4 RTD sensor connections (I0_G module)

The type IO_G module contains three PT100 RTDs and associated protection functionality.

The MM300 monitors up to six RTD inputs for stator, bearing, ambient, or other temperature monitoring types. The type of each RTD is 100 ohm platinum (DIN 43760). RTDs must be three-wire type.

The RTD circuitry compensates for lead resistance, provided that each of the three leads is the same length. Lead resistance should not exceed 25 ohms per lead. Shielded cable should be used to prevent noise pickup in industrial environments. RTD cables should be kept close to grounded metal casings and away from areas of high electromagnetic or radio interference. RTD leads should not be run adjacent to or in the same conduit as high current carrying wires.

Figure 21: RTD wiring



2.2.4 Input/output modules

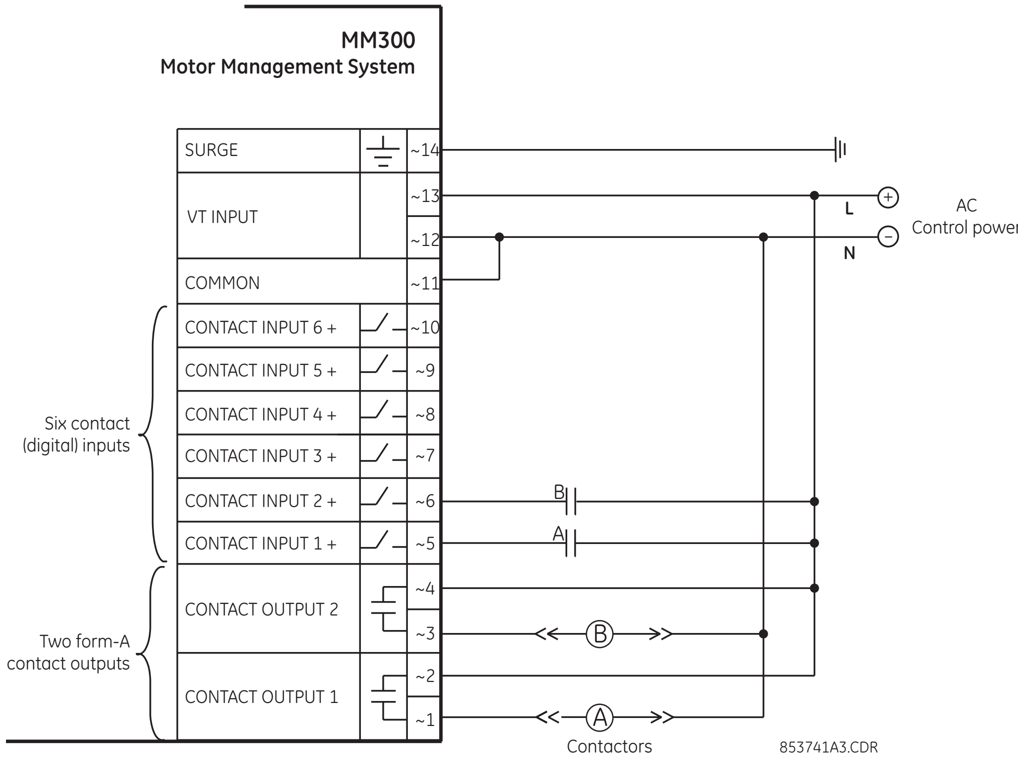
The following input and output modules are available for the MM300.

Table 5: MM300 input and output modules

Module	Slots	Description
IO_C	C, E, F, G, H	Two 10 A form-A relays and six 60 to 300 V AC digital inputs.
IO_D	E, F, G, H	Four 10 A form-C relays

2.2.4.1 Type IO_C module connections

Figure 22: Typical wiring for type IO_C module



The IO_C module contains two form-A contact output relays, six digital inputs and control voltage input.

Contact inputs can be programmed to any of the input functions, such as field stop or process interlock. The exception is that contactor A status is fixed as the first contact input, and contactor B status (where used) is fixed as the second contact input.

An AC auxiliary supply must be connected to terminals 12 and 13. This auxiliary voltage (from slot C only) is also used for actual value indication, for auxiliary undervoltage, and for undervoltage restart. When three-phase voltages are not available, it is also used to calculate power quantities and is used as a phase angle reference.

When the 10_C module senses an interruption to its auxiliary supply, it raises an AC Low Aux Voltage Inhibit, and freezes the last valid state of the contact inputs, as the interruption prevents sensing the actual states.

The two contact outputs can be programmed to follow any one of the digital signals developed by the MM300, such as alarms and status signals. The exception is that the contactor A relay is fixed as the first contact output, and contactor B relay is fixed as the second contact output (where used).

NOTE

Connect AUX VT to the Control Supply for correct operation of the UV Restart feature and readings of inputs.

NOTE

All IO_C cards must have the auxiliary input VT wired for proper input sensing.

NOTE

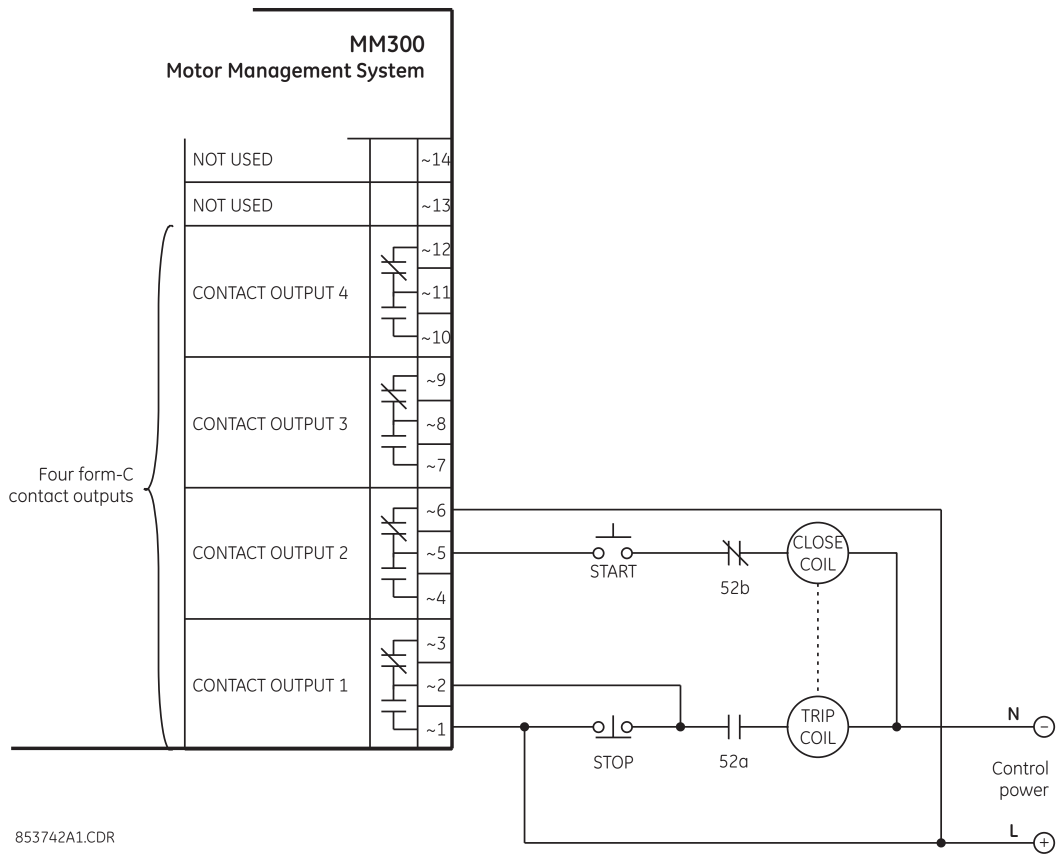
Substitute the slot position of the input/output module (C E, F, G, H) wherever the tilde symbol "~" appears in the diagrams above.

2.2.4.2 Type IO_D module connections

The IO_D module contains four form-C contact output relays.

In general, contact outputs can be programmed to follow any one of the digital signals developed by the MM300, such as alarms and status signals.

Figure 23: Typical wiring for type IO_D contact output module

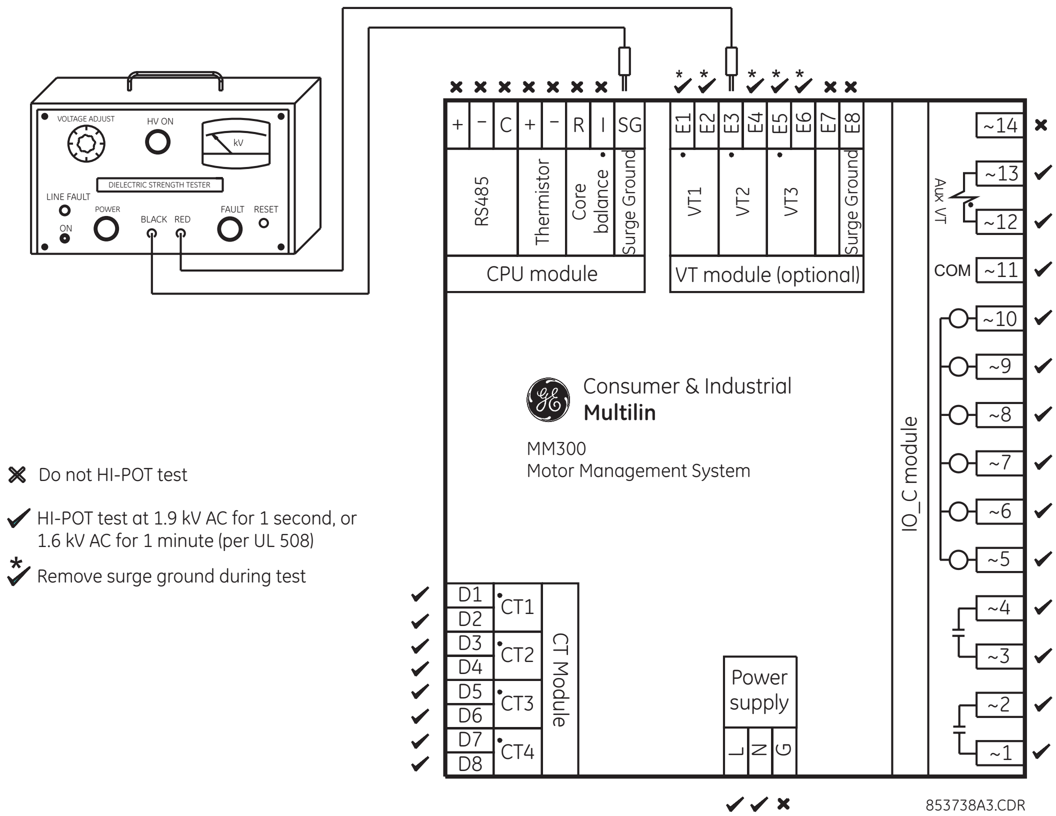


NOTE

Substitute the slot position of the input/output module (E, F, G, or H) wherever the tilde symbol "~" appears in the diagrams above.

2.2.5 Dielectric strength testing

Figure 24: Testing for dielectric strength



It may be required to test a complete motor starter for dielectric strength ("flash" or "HI-POT") with the MM300 installed. The MM300 is rated for 1.9 kV AC for 1 second, or 1.6 kV AC for 1 minute (per UL 508) isolation between relay contacts, CT inputs, VT inputs and the surge ground terminal SG. Some precautions are required to prevent damage to the MM300 during these tests.

Filter networks and transient protection clamps are used between VT input and the surge ground terminal. This is intended to filter out high voltage transients, radio frequency interference (RFI), and electromagnetic interference (EMI). The filter capacitors and transient suppressors may be damaged by continuous high voltage. Disconnect the surge ground terminal (E8) during testing of VT inputs. The CT inputs, control power, and output relays do not require any special precautions. Low voltage inputs (less than 30 volts), RTDs, and RS485 communication ports are not to be tested for dielectric strength under any circumstance (see above).

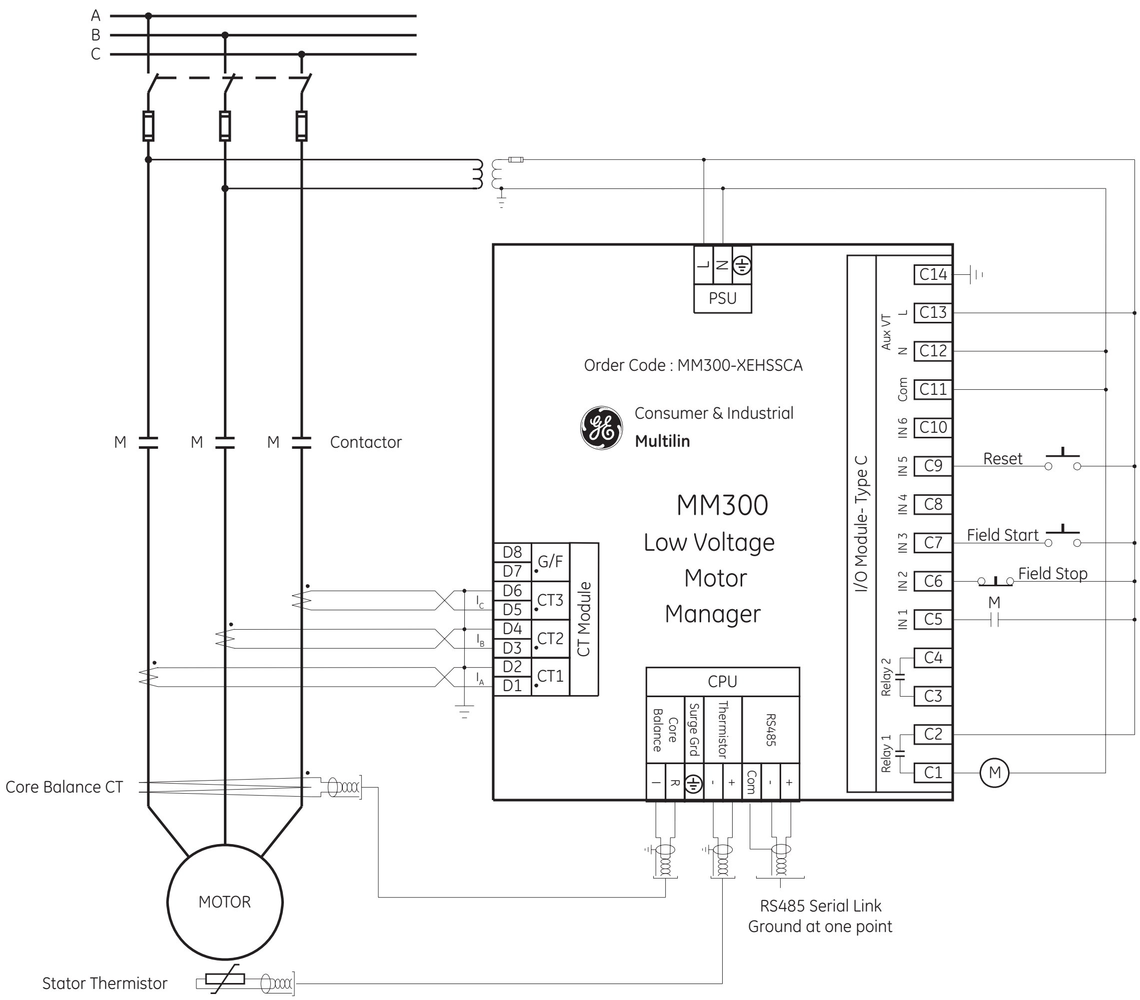
NOTE

Substitute the slot position of the input/output module (D, E, F, G, or H) wherever the tilde symbol "~" appears in the diagram above.

2.3 Starter types

2.3.1 Full-voltage non-reversing starter

Figure 25: Full-voltage non-reversing starter wiring



The full-voltage non-reversing starter type is a full voltage or across-the-line non-reversing starter.

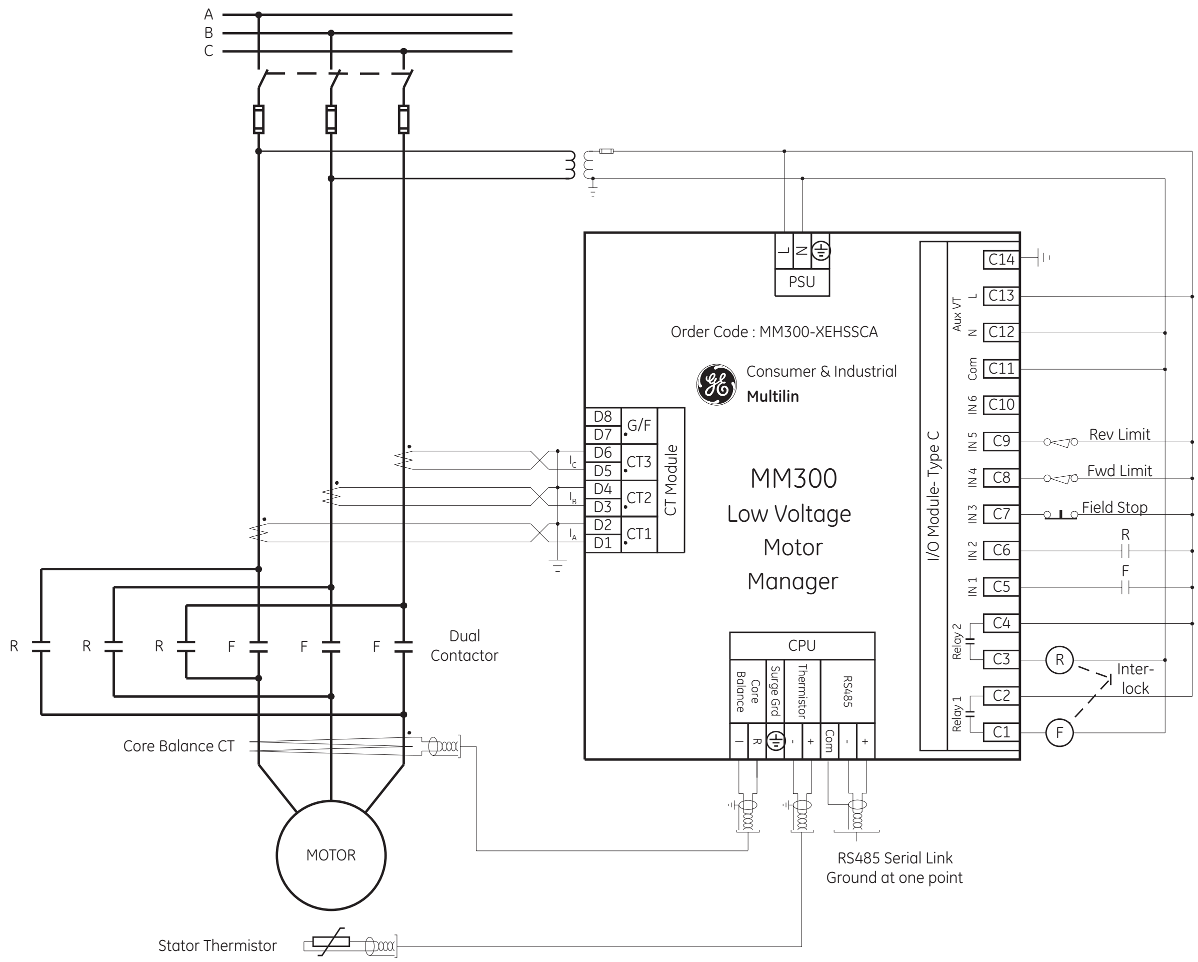
When a start control is received, the pre-contactor relay (if any) is picked up for the set pre-contactor time. When the pre-contactor timer times out, relay1 picks up and seals-in, picking up contactor M, which starts the motor. When a stop control is received, relay1 drops out, contactor M drops out, and the motor stops. The pre-contactor is omitted on forced starts (for example, UVR Immediate, External Start).

NOTE

Connect AUX VT to the Control Supply for correct operation of the UV Restart feature and readings of inputs.

2.3.2 Full-voltage reversing starter

Figure 26: Full-voltage reversing starter wiring



The full-voltage reversing starter type is a full voltage or across-the-line reversing starter.

When a start A (forward) control is received, the pre-contactor relay (if any) is picked up for the set pre-contactor time. When the pre-contactor timer times out, relay1 picks up and seals-in, picking up contactor F, which starts the motor in the forward direction. When a start B (reverse) control is received, relay1drops out, and contactor F drops out. When the contactor F Off status is received, the starter waits for the set transfer time to allow the motor to slow or stop. When the transfer time timer times out, relay2 picks up and seals-in, picking up contactor R, which starts the motor in the reverse direction. When a stop control is received, relays 1 and 2 drop out, contactor F and R drop out, and the motor stops. The starter logic is fully symmetrical between forward and reverse.

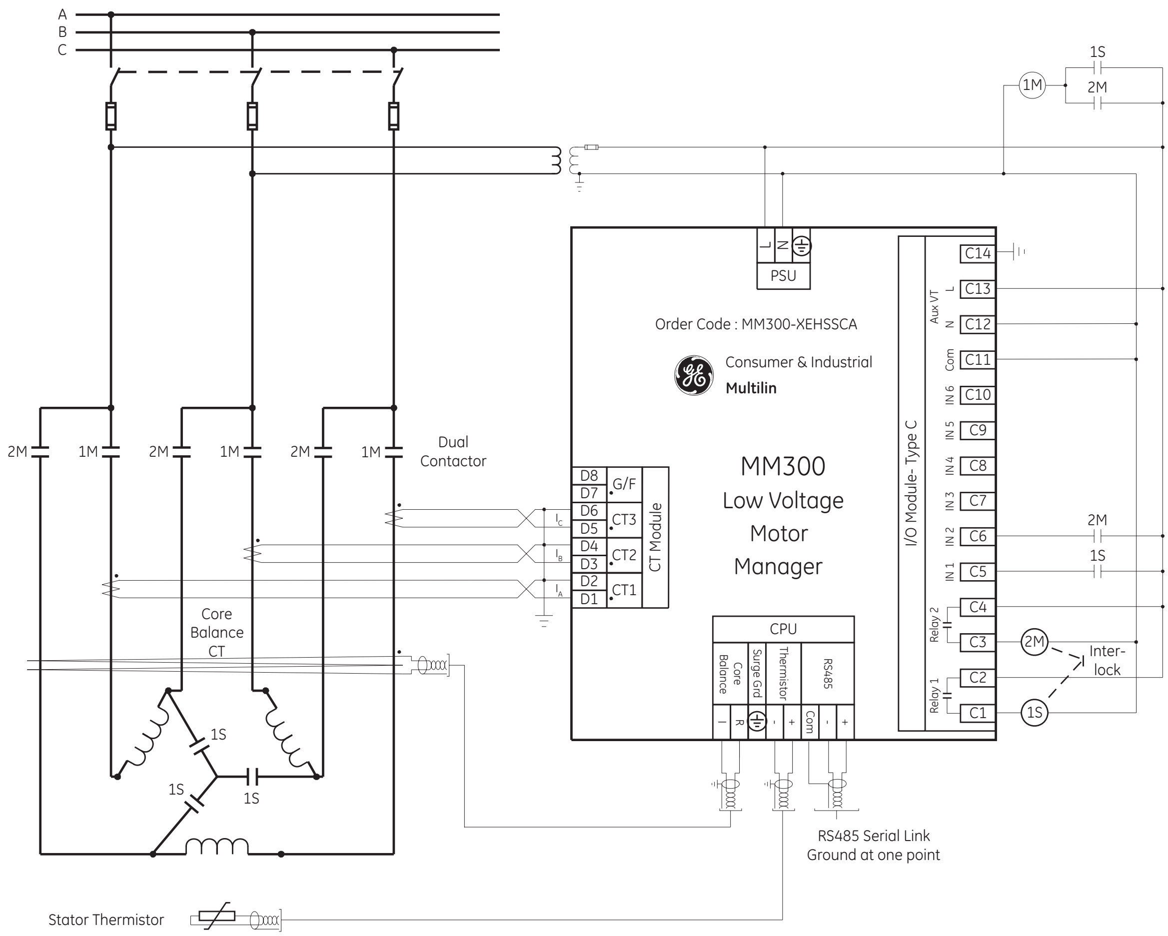
When a contact input has its function set to forward limit, and that contact closes, relay1 will drop out, stopping any forward rotation. When a contact input has its function set to reverse limit, and that contact closes, relay2 will drop out, stopping any reverse rotation. The pre-contactor is omitted on forced starts (for example, UVR Immediate, External Start). Forced starts are not supervised by this starter transfer timer – any external starting circuit must itself respect fast direction change restrictions.

NOTE

Connect AUX VT to the Control Supply for correct operation of the UV Restart feature and readings of inputs.

2.3.3 Wye-delta open transition starter

Figure 27: Wye-delta open transition starter wiring



The wye-delta open transition starter is a reduced voltage starter.

When a start A control is received, the pre-contactor relay (if any) is picked up for the set pre-contactor time. When the pre-contactor timer times out, relay1 picks up and seals-in, picking up the 1S contactor, which connects the motor in wye configuration. The 1S contactor in turn picks up the 1M contactor, which connects the motor to the supply. The motor is now starting at 58% voltage. When the transfer time timer expires, the relay1 is de-energized, contactor 1S drops out, opening the wye and disconnecting the motor from the supply. When the contactor 1S Off status is received, relay2 picks up and seals-in, picking up the 2M contactor, which connects the motor in delta configuration. The 2M contactor in turn picks up the 1M contactor, which connects the motor to the supply. The motor is now running at full voltage. When a stop control is received, relays 1 and 2 drop out, contactor 1S and 2M drop out, contactor 1M drops out, and the motor stops.

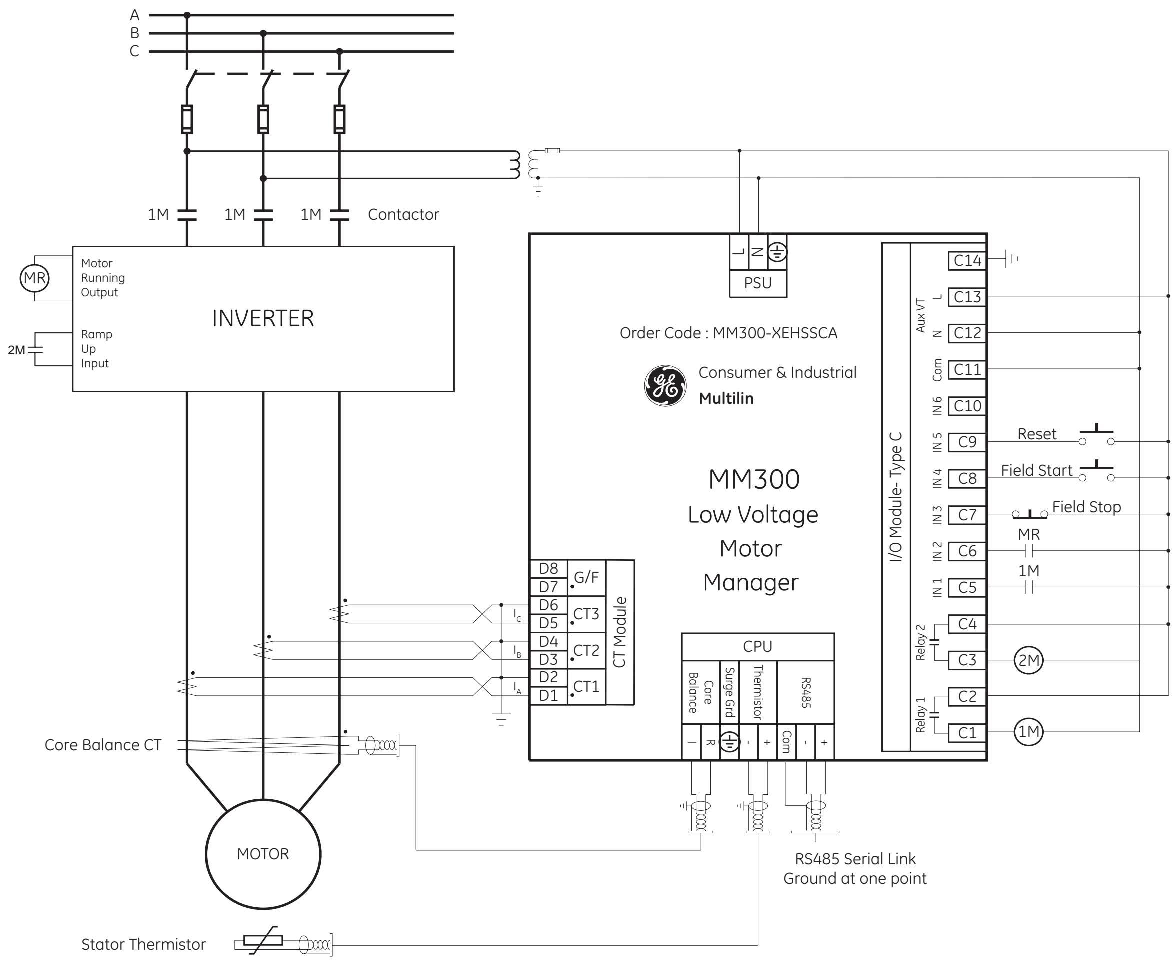
Pre-contactor is omitted on forced starts (for example, UVR Immediate, External Start). Otherwise, type A forced starts operate in the same fashion as other type A starts, with the transfer to full voltage occurring when the transfer time expires. Type B forced starts are not supervised by this starter transfer timer – any external type B starting circuit must itself respect full voltage starting restrictions.

NOTE

Connect AUX VT to the Control Supply for correct operation of the UV Restart feature and readings of inputs.

2.3.4 Inverter starter

Figure 28: Inverter starter typical wiring



The inverter starter is used with an external inverter that ramps the motor speed up on start and ramps it down on stop.

The B Open Contactor Control Circuit and B Welded Contactor alarms are defeated when the inverter starter is selected.

When a start A control is received, relay1picks up and seals-in, picking up contactor 1M. This provides power for the inverter to start up and to drive the motor. The pre-contactor relay (if any) is also picked up for the set pre-contactor time. When the pre-contactor timer times out, relay2 picks up and seals-in, which signals the inverter to ramp the motor up. When a stop control is received, the relay2 drops out, and the inverter ramps down. When the ramp down time timer has expired, relay1 is opened, contactor 1M drops out, cutting power to the inverter and motor.

The inverter signals the relay that it is up to speed by closing auxiliary relay MR. If the auxiliary relay MR unexpectedly opens while running, signalling a possible inverter trouble, relay2drops out, and the inverter ramps down if it has not done so already. An Inverter Trip Alarm alarm is issued, but relay1 remains closed, so contactor 1M stays picked up, and the supply to the inverter is maintained. This is done so that the inverter has power to retain its event records for subsequent diagnosis of the problem. Relay1 is opened removing power to the inverter and the alarm is reset when a stop control is received.

Forced starts (for example, External Start) operate in the same fashion as other starts, with relay2 not calling for the inverter to ramp up till the pre-contactor timer times out. If up to speed feedback is not received from auxiliary relay MR within the **Ramp Up Time** setting during a start, a Drive Start Failed alarm is generated. If up to speed feedback resets before a stop control, an Inverter Fail alarm is generated, and relay2 opens as described above. If inverter speed feedback remains when the ramp down time expires during a stop, a Drive Stop Fail alarm is generated. Neither results in a trip or a stop. The Drive Start Failed alarm is latched till reset or cleared by a stop control. The Inverter Fail alarm is cleared by a stop control.

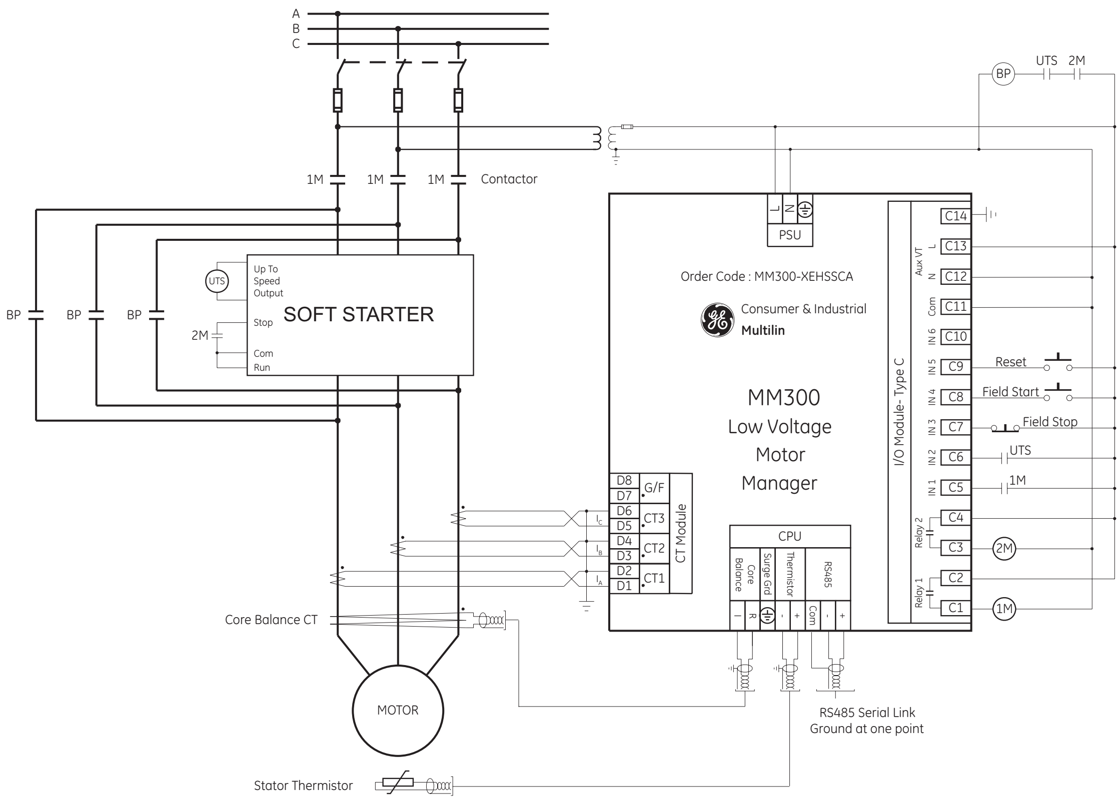
The Undervoltage Autorestart feature is disabled for the Inverter Starter.

NOTE

Connect AUX VT to the Control Supply for correct operation of the UV Restart feature and readings of inputs.

2.3.5 Soft starter type

Figure 29: Soft starter typical wiring



The soft starter type is used with an external soft starter that ramps the motor speed up on start and down on stop. Once the motor is ramped up, the soft starter can be bypassed.

When a start A control is received, the relay1 picks up and seals-in, picking up contactor 1M. This provides power for the soft starter to start up and to drive the motor. The pre-contactor relay (if any) is also picked up for the set pre-contactor time. When the pre-contactor timer times out, the relay2 is picks up and seals-in, picking up auxiliary relay 2M. Relay 2M signals the soft starter to ramp the motor up. When the soft starter signals up to speed by picking up auxiliary relay UTS, the starter generates the soft starter bypass signal. When a stop control is received, relay2 drops out, signalling the soft starter to ramp down. When the ramp down time timer has expired, relay1 is opened, M1 drops out, cutting power to the soft starter and motor.

Forced starts (for example, External Start) operate in the same fashion as other starts, with relay2 not calling for the soft starter to ramp up till the pre-contactor timer times out. If up to speed feedback is not received from auxiliary relay UTS within the **RAMP UP TIME** setting during a start, a Drive Start Failed alarm is generated. If soft starter speed feedback remains when the ramp down time expires during a stop, a Drive Stop Fail alarm is generated. Neither results in a trip or a stop. The Drive Start Failed alarm is cleared by a stop control.

The B Open Contactor Control Circuit and B Welded Contactor alarms implemented in the start/stop control element are defeated when the soft starter is selected.

The Undervoltage Autorestart feature is disabled for the Soft Starter.

NOTE

Connect AUX VT to the Control Supply for correct operation of the UV Restart feature and readings of inputs.

MM300 Motor Management System

Chapter 3: Control panel operation

There are three methods of interfacing with the MM300 Motor Management System.

- Interfacing via the graphical control panel.
- Interfacing via the basic control panel.
- Interfacing via the EnerVista MM300 Setup software.

This section provides an overview of the interfacing methods available with the MM300 using the Graphical and Basic control panels. For additional details on interface parameters (for example, settings, actual values, etc.), refer to the individual chapters.

3.1 Graphical control panel

The MM300 graphical control panel provides the operator with rapid access to relevant information and controls using intuitive sequences. It also provides all available information and setting control, again with intuitive sequences.

3.1.1 Introduction to the graphical control panel

The central feature of the graphical control panel is a 3.5-inch 320 by 240 pixel backlit color LCD screen. The panel also contains keys (pushbuttons) that control the display and perform commands. In addition, the interface contains START A, START B, and STOP direct acting control pushbuttons.

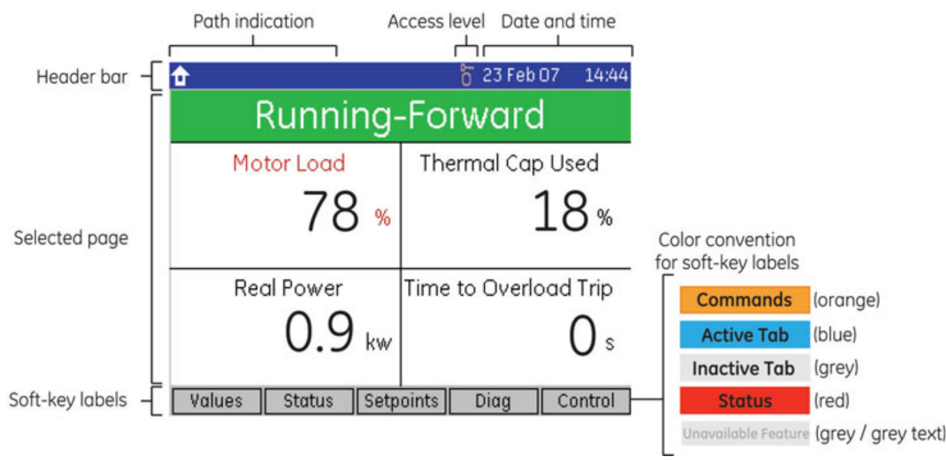
The display also contains several LED indicators that provide a summary of the machine status. Details are displayed on the screen when the user navigates to the appropriate page.

Figure 1: MM300 front panel with example default display

3.1.1.1 Graphical display

Each display page consists of the three components shown below.

Figure 2: Graphical display overview



The header bar (white text on a blue background) displays the hierarchical path name, the date and time in 24-hour format, and the current password access level. The hierarchical path is always displayed on the left top side of the graphical display. The present time is displayed on the right top side. If the test switch is on, the time is replaced with the text **TEST MODE** in red.

The soft-key labels are indicated on the bottom line. The soft-keys are used for navigation, performing functions, and for acknowledgement.

- Navigation: soft-keys can be used to traverse across and down the hierarchy of pages.
- Functional: soft-keys can be used to perform page-specific functions.
- Acknowledgement: soft keys can be used to acknowledge popup windows.

Soft-keys labels change to show relevant selections for the displayed screen. The color of each soft-key label indicates its functionality. Soft-keys are highlighted for the displayed page, unauthorized keys are "greyed-out", and unused keys are not displayed.

The remainder of the screen shows the selected page. Pages are organized in a hierarchical or tree-based menu structure. To improve readability, some pages are labeled with rectangular outlines or colored backgrounds. Some pages contain too many fields to display at once. These pages display arrows bars at the right edge to indicate that the page continues below the screen. When recalled, scrolled pages are re-positioned at the top of the page.

Fields display actual value or setting information, and have behaviours that allow help display, editing, and control.

Each Actual Value analog field displayed on the home page has an associated alarm limit and changes color to orange when that limit is exceeded. Fields with an associated trip limit change their color to red when that limit has tripped. Fields that are disabled or unavailable are greyed-out.

3.1.1.2 Keypad

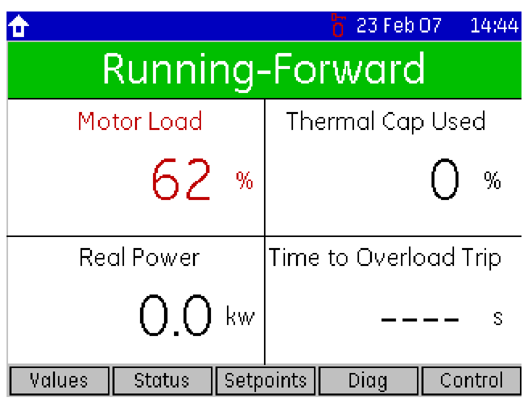
The function keys perform the labeled functionality. The summary of function key operation is shown below.

Table 1: Summary of function key operations

Key	Operation
HOME	Single press recalls the home page; double press recalls the default display
UP	Scroll up page, select field, tab to next field, increment value
DOWN	Scroll down page, select field, tab to previous field, decrement value
ESC	Single press closes pop-up, cancels editing, deselects field, moves to previous page; sustained press logs out (cancels security passcode entry)
ENTER	Single press freezes scrolling and selects field, edits selected field, saves edited value; double press sets the selected field/page as default; sustained press logs in (enter security passcode)
HELP	Displays context sensitive help and Modbus address

The HOME key always recalls the root or home page. The home page allows access to all sub-pages and also contains a status and process values summary. Double pressing the HOME key recalls the default display. Like a screen-saver, the default display appears after a period of inactivity and displays user-selected information. A typical default display is shown below, indicating a running motor in the forward direction.

Figure 3: Typical default display (actual size)



The UP and DOWN keys function in different ways depending on their context.

- Where a scroll bar is displayed, the UP and DOWN keys scroll the page up and down.
- Where there is no scroll bar or it is greyed-out, the first press of the UP and DOWN keys selects the first field. Subsequent presses tab up and down through the fields, scrolling as required.

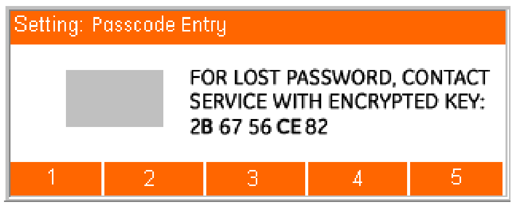
- When a field is open for editing, the UP and DOWN keys increment/decrement the value of that field.

The ENTER key functions in different ways depending on its context.

- If there are no selected fields, the ENTER key will freeze any scroll bars and select the first field on the display.
- If a field is selected, pressing ENTER will attempt to open it for editing.
- If a field is opened for editing, pressing enter will exit the edit sequence.
- Double pressing the ENTER key at any time selects the displayed page as the default display.
- A sustained press on ENTER prompts the security passcode and displays a dialog box that allows passcode entry.

For example, pressing and holding the ENTER key, or attempting a control where a password is required, displays the following page.

Figure 4: Passcode entry dialog box



The ESC key functions in different ways depending on its context.

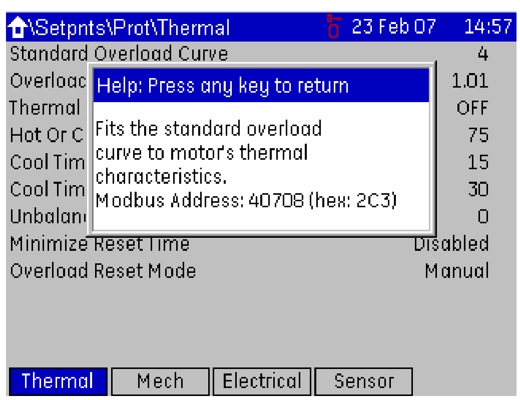
- If a pop-up dialog box is displayed, the ESC key closes it.
- If an edit sequence is in progress, the ESC key cancels the edit.
- If a field is selected, the ESC key de-selects it.
- In all other instances, the ESC key moves back one page in the menu structure.
- A sustained press on the ESC key clears the security passcode and prompts for confirmation.

The HELP key functions in different ways depending on its context.

- If a field is selected, the HELP key displays a help window for the field.
- If a help window is displayed, the HELP key closes it.

Help windows are also closed when any other key is pressed. A typical help window is shown below.

Figure 5: Typical MM300 help window



Pressing an invalid key displays a message explaining the problem and recommending a solution. Where the keypress is invalid because a security passcode is required, the dialog window will be a passcode entry window.

When a lockout occurs that clears when a count-down timer expires or when the thermal capacity recovers for a restart, the **Status > Message** page is displayed indicating timer value or thermal capacity.

3.1.1.3 Control keys

The MM300 has three large direct control keys: START A, START B, and STOP.

- STOP: The STOP key allows the user to stop the motor directly from the MM300 faceplate interface. Pressing this key causes the contactor A and contactor B output relays to de-energize, therefore dropping out the motor contactor.
- START A and START B: Pressing these keys initiates the programmed start sequence. The START A and START B keys are used to start the motor from the MM300 faceplate (if MCC control is enabled). The start A and start B sequences can also be initiated via communications, field control, or hardwired input.

3.1.1.4 LED indicators

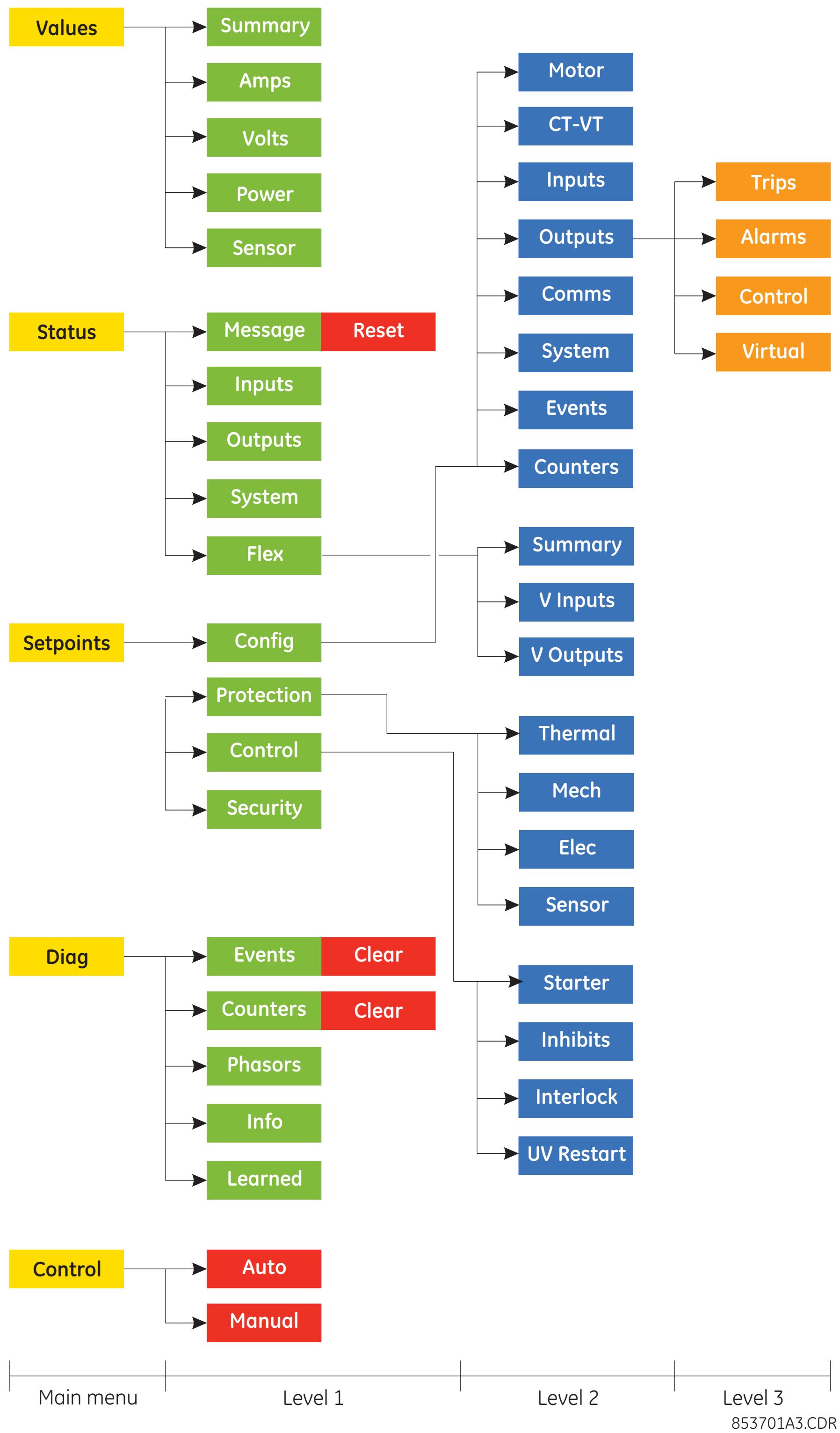
The control panel LEDs summarize the status of the device and up to three user-programmable parameters. The LED colors can be independently configured by the user to display either red, orange, or green, as required by local operating conventions. The following LEDs are available for the MM300.

- Running LED: Indicates that the motor is running. It will be on whenever the contactor A or B relays are closed and the contactor status inputs acknowledge the correct state. Current flow does not affect the indicator.
- Stopped LED: Indicates that the motor is stopped based on both contactors A and B being de-energized.
- Tripped LED: Indicates that the A and B contactor relays are de-energized. The motor cannot be restarted as long as this indicator remains on.
- Alarm LED: Indicates that an alarm condition is present.
- Auto LED: Indicates if the MM300 is in auto control mode.
- Manual LED: Indicates if the MM300 is in manual control mode.
- Comms OK LED: Indicates the status of selected communication interface activity. User can select an individual or a combination of communications interfaces by configuring the "Comms OK Evaluation" (Modbus address 40517, 0204H) setpoint, under \\home\setpoints\configure\Comms. If all interfaces are communicating, then the LED is green. If all interfaces are failed, then the LED is red. If one or more, but not all, interfaces are failed, then this LED is orange.
- User 1 to User 3 LEDs: These LEDs can be programmed by the user to indicate any digital condition.

3.1.2 MM300 graphical display pages

A summary of the MM300 page hierarchy is shown below.

Figure 6: MM300 display page hierarchy

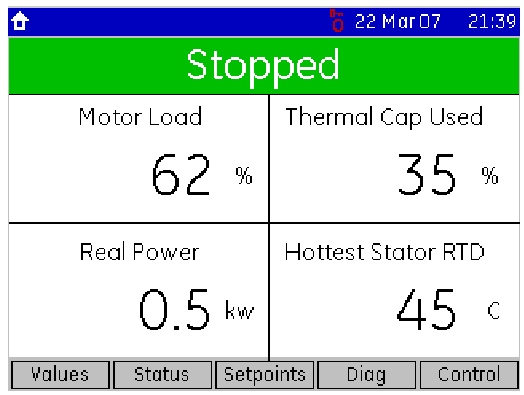


3.1.2.1 Home display page

The home page represents the root of the entire menu structure. An overview of the system status is displayed which includes the following items.

- Locked out, tripped, blocked, stopped, pre-contactor, starting, running status, and inhibit.
- Motor load, thermal capacity used, and power.
- Estimated time to trip (if motor is loaded above its service factor).
- The longest current timeout from any of the pre-contactor time, time to overload, time to reset, starts/hour block, time between starts, transfer time, undervoltage restart time, and restart block timers.
- Temperature of the hottest stator RTD (if there is an RTD and the two previous items are not applicable).
- Average line-to-line voltage (if there is no RTD).

Figure 7: Typical MM300 home display



The **Values**, **Status**, **Setpoints**, **Diag**, and **Control** soft-keys are displayed on the home page. The **Status** soft-key will be highlighted red if any trip conditions are active, orange if relay is not tripped and any alarm conditions are present. Otherwise it will be grey. If the 'tripped LED flasher' setpoint is set to 'ON', the softkey will flash red if there is a trip or lockout.

Pressing any of the soft-keys displays the first sub-page in the hierarchy. Pressing the ESC key within any of these sub-pages returns directly to the home page.

3.1.2.2 Default display

The default display is automatically shown when no control key has been pressed for five minutes. It can also be recalled at any time by double-clicking the **HOME** key.

The default display can be set to the home page, any actual values page, or any status page. A page can be set to be the default display by navigating to that page and double-pressing the **ENTER** key. The default display setting is saved in non-volatile memory.

If a page is set as the default display, the soft-keys will be those of the selected page.

3.1.2.3 Actual values pages

The actual values pages are divided into five sections.

- Summary (overview of primary actual values)
- Amps (metered current values)
- Volts (metered voltage values)
- Power (metered power values)

- Sensor (metered temperature and thermistor values)

The actual values summary page displays a summary of the analog actual values. The current, voltage, power, and sensor actual values pages are accessible from the summary page through the corresponding soft-keys at the bottom of the screen.

Some typical actual values screens are shown below.

Figure 8: Typical actual values summary page

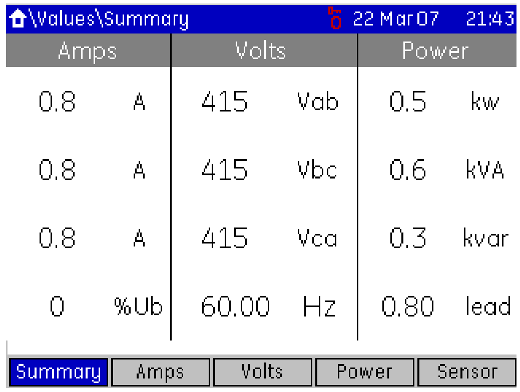


Figure 9: Typical actual values current page

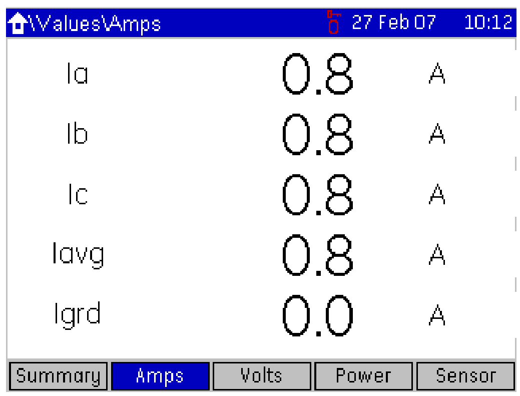
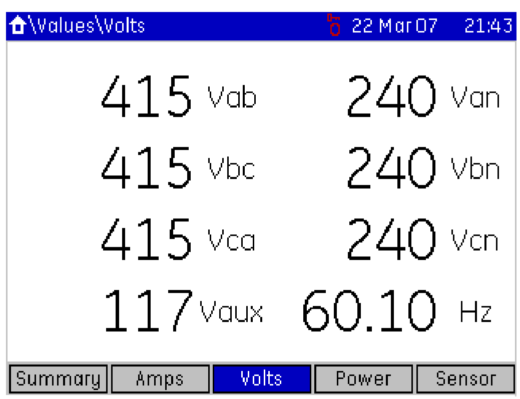


Figure 10: Typical actual values voltage page



3.1.2.4 Status pages

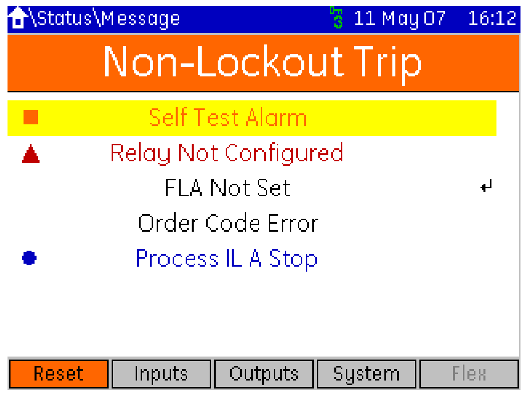
The status pages provide the user with up-to-date information on the current status of the MM300.

Status pages are divided into five sections.

- Message (displays all locked out conditions plus conditions such as alarms, internal faults, control status, etc.).
- Inputs (displays the present state of assigned contact inputs).
- Outputs (displays the present state of assigned contact outputs).
- System (displays the present state of the communications interface).
- Flex (displays the present state of the FlexLogic™ engine and number of lines used.)

A typical display is shown below:

Figure 11: Typical status message page



Message types are classified by color and associated icon type, as follows::

- Red Triangle = Trip
- Orange Square = Alarm
- Blue Circle = Inhibit
- Black Text = Information Message

Message can have an associated countdown timer.

When the relay is first powered up, the status page lists why the relay is not available for service. This is not an exhaustive list of setpoints to be configured, but is a list of key items such as FLA, CT Type, starter type and control Source, that must be configured before the unit will be available for use. Protection values must still be configured for the motor to be protected correctly.

Inhibits

These include Process Interlock Stop, and Field Stop.

Trips / Alarms

These trigger depending on the protection setpoints. A typical example would be; “Overload Trip”.

Information Messages

Information pages are split into two groups

- With navigation (shown above, as an **Enter** symbol on the right side of the display)
- Without navigation

When a line showing a message (with navigation) is highlighted, pressing **Enter** will take the GCP directly to the page in question, so that the situation can be quickly resolved. A typical example would be “FLA not set”. Selecting this entry on the page will take you to the \setpoints\config\motor page.

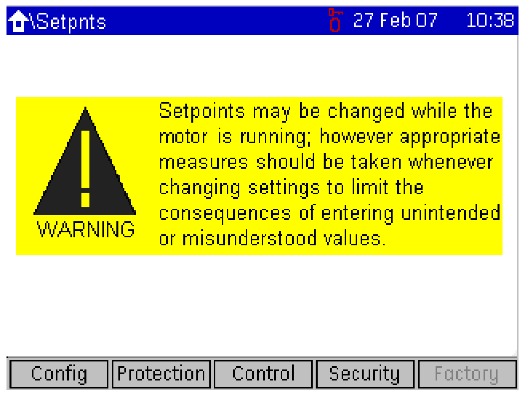
3.1.2.5 Setpoints pages

The setpoints pages are divided into five sections.

- Config (contains basic configuration setpoints)
- Protection (contains the protection setpoints)
- Control (contains the control setpoints)
- Security (contains the password security setpoints)
- Factory (contains settings used by GE Multilin personnel for testing and calibration purposes.)

The **Home > Setpoints** page displays a warning message concerning unexpected performance if setpoints are improperly changed. It is recommended that all relay outputs capable of causing damage or harm be blocked before a setpoints change is made and it is clear the relay is performing as intended with the new setpoints.

Figure 12: setpoints home page

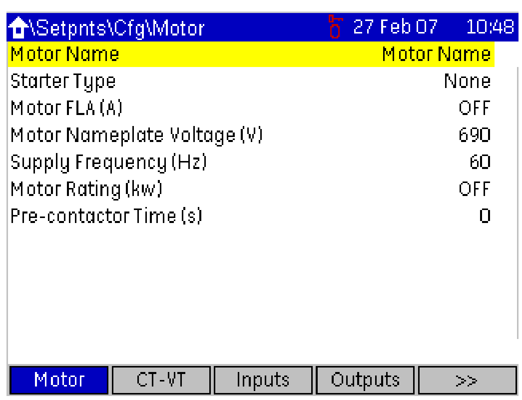


To streamline the setpoint entry process, the graphical control panel will not display setpoints that are not relevant at the specific instance. For instance, if a process interlock function is disabled, the six setpoints associated with that interlock function will not be displayed. If all ten process interlock functions are disabled, the MM300 will display only 10 successive “Disabled” list items. If one of the interlock functions were then enabled, then room is made on the display for the six setpoints which are now functional.

The setpoint pages are in a common format of twelve rows and two columns displaying setpoint name, value, and units.

The **Home > Setpoints > Config > Motor** page is shown below.

Figure 13: Typical setpoints page, motor setpoints



3.1.2.6 Diagnostics pages

The diagnostic pages are divided into five sections.

- Events (event recorder data for up to 256 events)
- Counters (accumulated system counter data)
- Phasors (metered phasor data)
- Info (product information)
- Learned (learned values based upon metered data)

Typical diagnostic pages for phasors and product information are shown below.

Figure 14: Typical phasors page

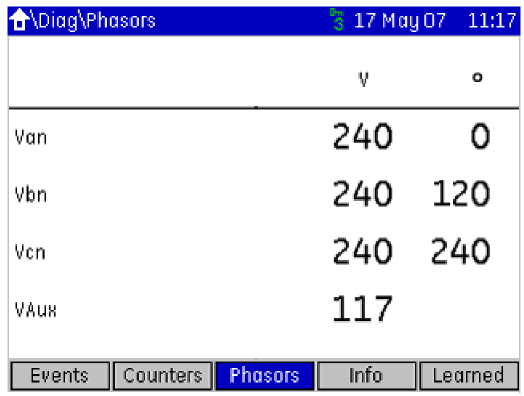
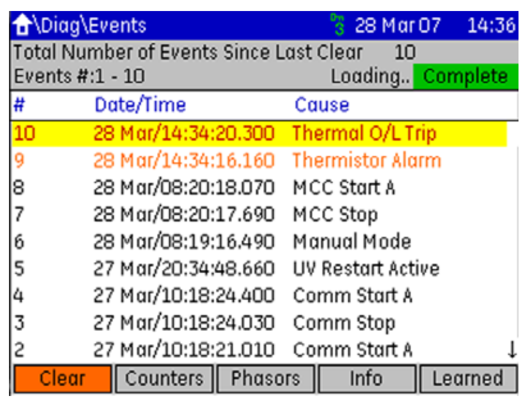
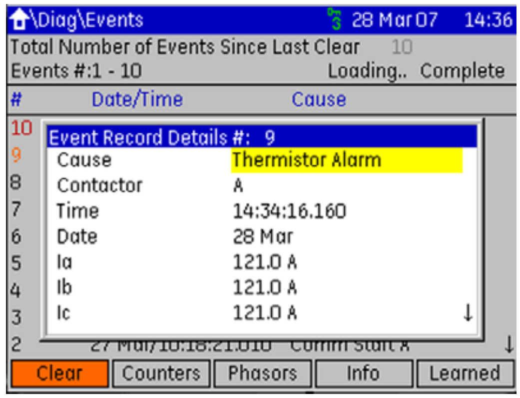


Figure 15: Typical events page



Pressing Enter on the highlighted line (line 9 above) will take you directly into the detailed event analysis screen:

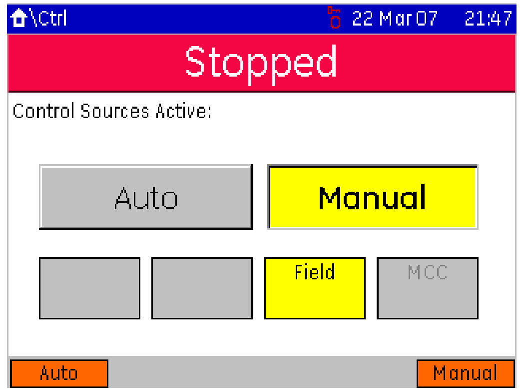
Figure 16: Typical event diagnosis page



3.1.2.7 Control page

This page is used to view the active control mode and switch between Auto/Manual if the softkeys are enabled.

Figure 17: Typical control page display



Refer to the *Control* section for details on control page functionality.

3.1.2.8 Popup windows

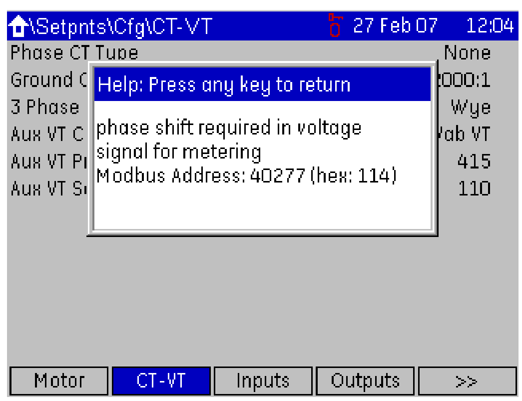
There are three types of popup windows:

- Setpoint editor popup windows.
- Help popup windows.
- Invalid operation popup windows.

Refer to the *Setpoints* chapter for details on setpoint editor popup windows.

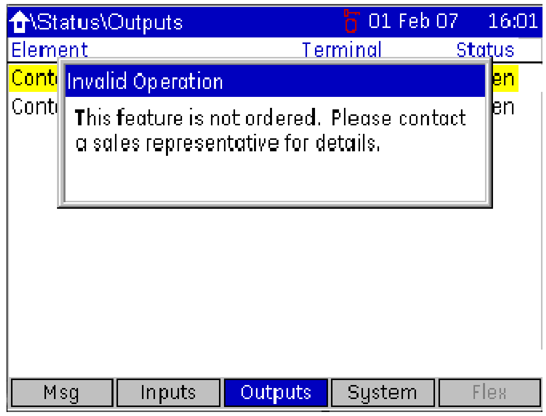
Help popup windows are initiated by pressing the **HELP** key. This will display help text for the active setpoint field.

Figure 18: Typical help popup window



Invalid operation popups explain the problem and provide direction on how to rectify it. This may also include invalid features or uninstalled options (for example, accessing the undervoltage restart page when undervoltage restart option is not ordered). Where a keypress is illegal because a security passcode is required, the popup is a passcode entry dialog box.

Figure 19: Typical invalid operation popup window



Help and illegal action popup windows remain open until they are acknowledged by clicking any soft or hard key, or until a pre-determined period of inactivity has passed.

3.1.3 MM300 programming techniques

To streamline the setting entry process, the graphical control panel omits non-functional settings from the display.

CAUTION

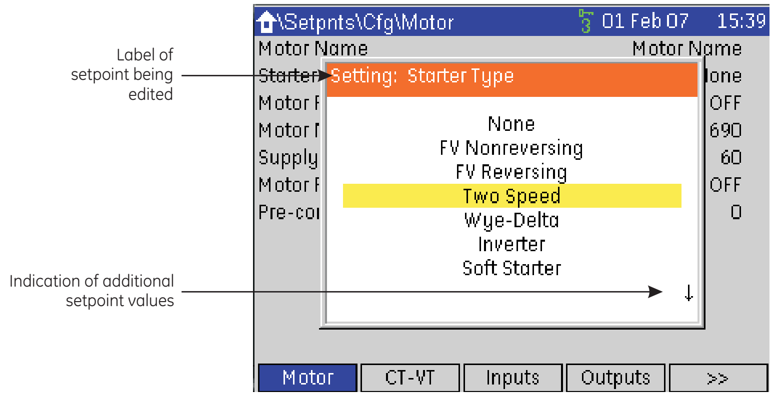
Settings may be changed while the motor is running. However, appropriate measures must be taken to limit the consequences of entering unintended or misunderstood setting values. Consequences of inappropriate settings to the specific application at hand include loss of protection, loss of control, and undesired starting or stopping.

3.1.3.1 Enumeration setpoints

Enumeration settings select from a limited set of values (for example, enabled or disabled). The following procedure describes how to edit an enumeration setting.

1. Use the soft-keys to select the relevant setting page.
2. Use the UP and DOWN keys to select the relevant setting field.
3. Press the **ENTER** key. A popup window will appear with a list of available values.
4. Use the **UP** and **DOWN** keys to select from the available values. If there are more than seven available values, then an arrow indicator will appear on the lower right of the popup to indicate additional selections.
5. Press the **ENTER** key when complete to exit the edit sequence. The selection will be automatically saved.
6. Press Esc to cancel the edit and leave the setpoint unchanged.

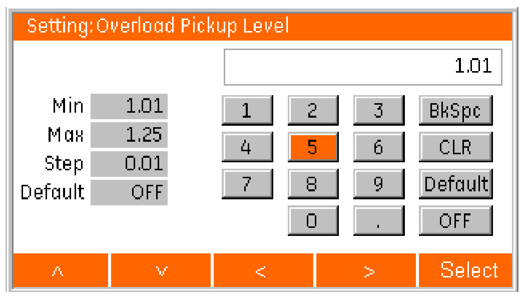
Figure 20: Enumeration setpoint editing



3.1.3.2 Numeric setpoints

Numeric setpoints accept a numerical value within a specific range. The numeric setpoint editor is a numeric input panel, with the current value shown on the number display. The minimum, maximum, step, and default values are shown on the left of the keypad, and the label of the setpoint being edited is displayed on the menu bar of the setpoint editor.

Figure 21: Numeric setpoint editor window



The navigational soft keys change the numeric key in focus, which is highlighted in orange. There are also five functional soft-buttons in the popup window.

- BkSpc: This key performs the backspace function, clearing the last digit or decimal from the display.
- CLR: This key clears the field's value from the display
- Default: This key returns the setpoint value to its default value.
- OFF: This key disables the setpoint and is visible only for setpoints that can be disabled.

In order to activate the functions offered by these buttons, the user has to highlight the appropriate button and press "Select".

The **UP** and **DOWN** front panel keys can also be used to increment and decrement the setpoint by its step value. Clicking the **ENTER** key verifies the displayed value. If the setpoint value is valid, it is stored as the new setpoint value and the editor is closed. Otherwise, an error statement is displayed and the **Default** soft-button is brought to focus. Clicking **HOME** before the value is stored cancels the edit sequence and recalls the home page.

The following procedure describes how to edit a numeric setting.

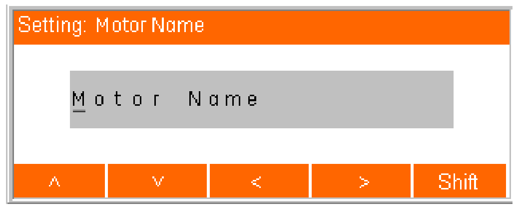
1. Use the navigation keys to select the relevant setting page.
2. Use the navigation keys to select the relevant setting field.
3. Press the **ENTER** key to open the numeric setpoint editor.

4. Use the navigational soft-keys to highlight the first digit of the new setpoint value.
5. Press the "Select" soft-key to select the highlighted digit.
6. Use the navigational soft-keys to highlight the next digit, then press "Select."
7. When the new value has been fully entered, press the "Enter" key to store the value and close the window.

3.1.3.3 Alphanumeric setpoints

Alphanumeric setpoints accept any alphanumeric value of a specified size and are generally used for labeling and identification purposes. When an alphanumeric setpoint is selected, the MM300 displays an alphanumeric setpoint editor window.

Figure 22: Alphanumeric setpoint editor



A flashing underline marks the current character. The “<” and “>” soft-keys shift the cursor left and right. When the cursor is at the extreme right hand side of the field and the field has not reached its maximum length of string input, the “>” key shifts the cursor to the right and sets the selected character to the space character. Up to 20 characters can be stored for alphanumeric setpoints. A long click of the “<” and “>” soft keys move the cursor to the first or last character in the string.

The up and down soft-keys increment and decrement the selected character through the character set. A long click of the up or down soft-keys sets the selected character to “a” and “Z”, respectively. The shift soft-key toggles the case of the character set. Pressing **ENTER** stores the selected value, while pressing **ESC** cancels the editing sequence and closes the popup editor.

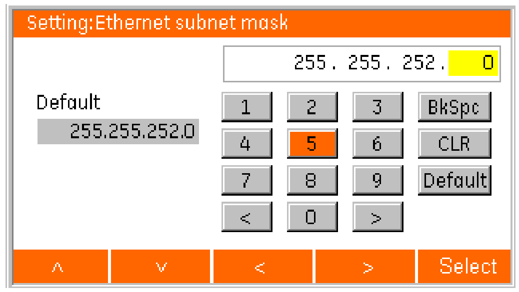
The following procedure describes how to edit an alphanumeric setting.

1. Use the soft-keys to select the relevant setting page.
2. Use the arrow soft-keys to select the relevant alphanumeric setpoint field.
3. Press the ENTER key to open the alphanumeric setpoint editor.
4. The first character of the alphanumeric setting value will be marked with a flashing cursor (underline).
5. Use the up, down, left, right, shift, and space soft-keys to change the indicated character.
6. Use the left and right arrow soft-keys to select and change more characters.
7. Press the ENTER key when complete to exit the edit sequence. The changes are automatically saved.

3.1.3.4 Date, time, and IP entry

The entry process for date, time, and IP setpoints follows the same convention as numeric setpoints, where the day, month, year, hour, minute, second, and each octet of the IP address are entered as separate fields. Input verification is performed for all fields of the setpoint when the **ENTER** key is pressed. As these are standard formats, the minimum, maximum and step value displays are removed. For date and time setpoints, a format string of DD/MM/YYYY or HH:MM:SS is included as a part of the setpoint label for reference when entering a new value.

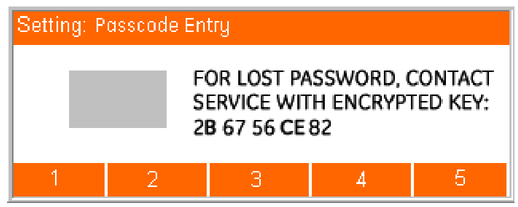
Figure 23: IP address setpoint editor



3.1.3.5 Security access

There are three levels of security access allowing write access to setpoints, lockout reset, and firmware download. When there are no pop-ups present, a sustained press on the **ESC** key clears the security passcode. When operations are performed that require a higher level of security, a passcode entry dialog box automatically opens (for example, in entering factory page at read only security access).

Figure 24: Password entry dialog box

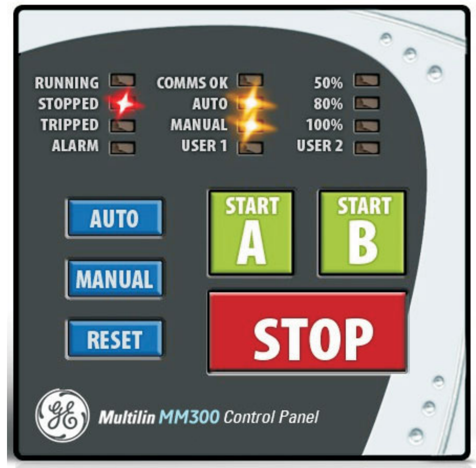


The encrypted key information appears only when the current security access level is 0.

3.2 Basic control panel

The MM300 basic control panel provides the basic start and stop panel functionality, as well as a series of LED indications. The basic control panel is illustrated below.

Figure 25: Basic control panel



853750A1.CDR

The following LEDs are provided:

- Two USER LEDs (USER 1 and USER 2). the user can select parameters from a list
- 50%/80%/100% - showing motor load
- RUNNING, STOPPED, TRIPPED, and ALARM
- COMMS OK
- AUTO and MANUAL

MM300 Motor Management System

Chapter 4: Software operation

There are three methods of interfacing with the MM300 Motor Management System.

- Interfacing via the graphical control panel.
- Interfacing via the basic control panel.
- Interfacing via the EnerVista MM300 Setup software.

This section provides an overview of the interfacing methods available with the MM300 using the Graphical and Basic control panels. For additional details on interface parameters (for example, settings, actual values, etc.), refer to the individual chapters.

4.1 EnerVista MM300 Setup Software

Although settings can be entered manually using the control panel keys, a PC can be used to download values through the communications port. The EnerVista MM300 Setup software is available from GE Multilin to make this as convenient as possible. With EnerVista MM300 Setup running, it is possible to:

- Program and modify settings
- Load and save setting files to and from a disk
- Read actual values
- Monitor status
- Read pre-trip data and event records
- Get help on any topic
- Upgrade the MM300 firmware

The EnerVista MM300 Setup software allows immediate access to all MM300 features with easy to use pull down menus in the familiar Windows environment. This section provides the necessary information to install EnerVista MM300 Setup, upgrade the relay firmware, and write and edit setting files.

The EnerVista MM300 Setup software can run without a MM300 connected to the computer. In this case, settings may be saved to a file for future use. If an MM300 is connected to a PC and communications are enabled, the MM300 can be programmed from the setting screens. In addition, measured values, status and trip messages can be displayed with the actual value screens.

4.1.1 Software requirements

The following requirements must be met for the EnerVista MM300 Setup software.

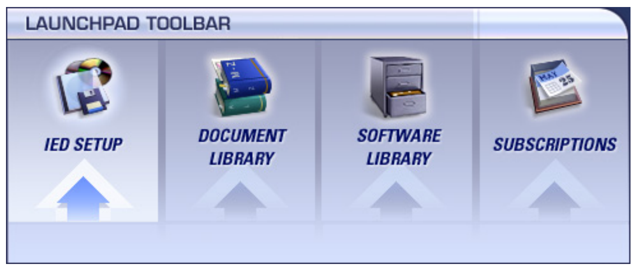
- Microsoft Windows™ XP / 2000 is installed and running properly.
- At least 20 MB of hard disk space is available.
- At least 128 MB of RAM is installed.

The EnerVista MM300 Setup software can be installed from either the GE EnerVista CD or the GE Multilin website at http://www.GEmultilin.com.

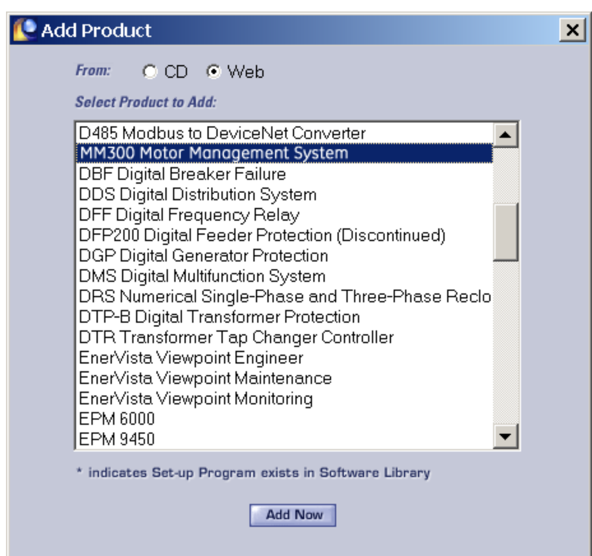
4.1.2 Installing the EnerVista MM300 Setup software

After ensuring the minimum requirements indicated earlier, use the following procedure to install the EnerVista MM300 Setup software from the enclosed GE EnerVista CD.

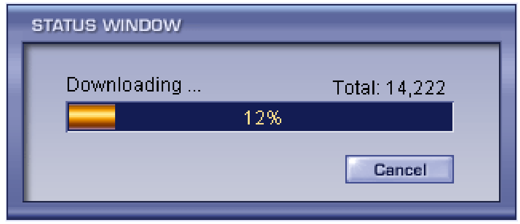
1. Insert the GE EnerVista CD into your CD-ROM drive.
2. Click the **Install Now** button and follow the installation instructions to install the no-charge EnerVista software on the local PC.
3. When installation is complete, start the EnerVista Launchpad application.
4. Click the **IED Setup** section of the Launch Pad toolbar.



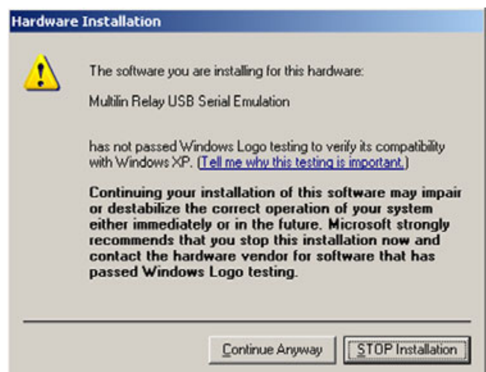
5. In the EnerVista Launchpad window, click the **Add Product** button and select the MM300 Motor Management System as shown below. Select the Web option to ensure the most recent software release, or select CD if you do not have a web connection, then click the **Add Now** button to list software items for the MM300.



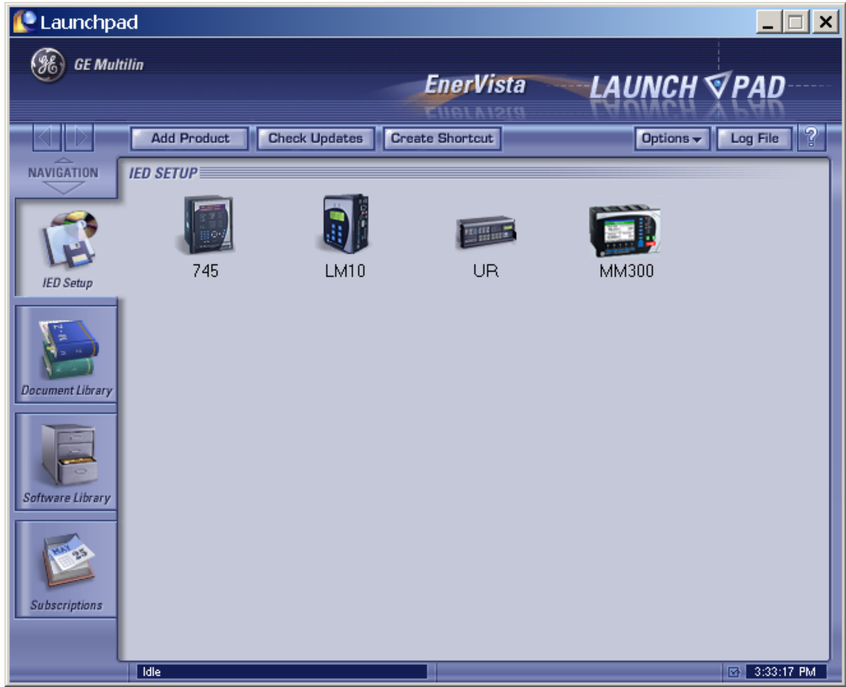
6. EnerVista Launchpad will obtain the latest installation software from the Web or CD and automatically start the installation process. A status window with a progress bar will be shown during the downloading process.



7. Select the complete path, including the new directory name, where the EnerVista MM300 Setup software will be installed.
8. Click on **Next** to begin the installation. The files will be installed in the directory indicated, the USB driver will be loaded into the computer, and the installation program will automatically create icons and add EnerVista MM300 Setup software to the Windows start menu. The following screen will appear:



9. Press the **Continue Anyway** button, then click **Finish** to end the installation. The MM300 device will be added to the list of installed IEDs in the EnerVista Launchpad window, as shown below.

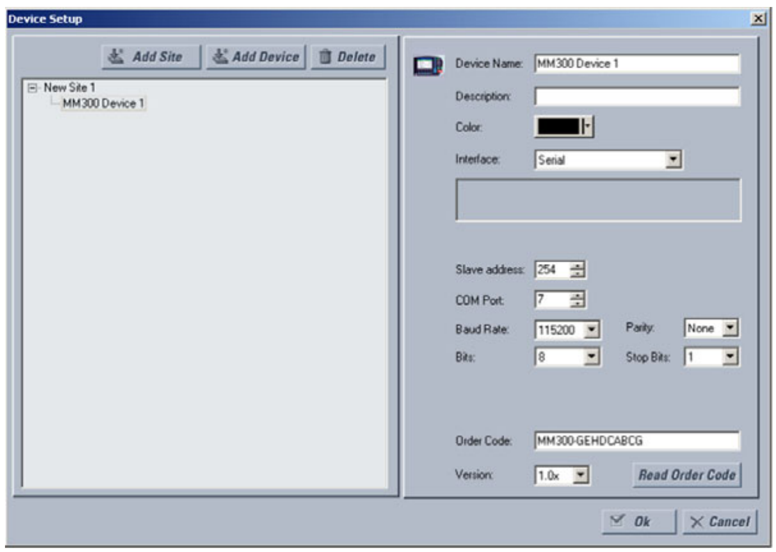


If you are going to communicated from your computer to the MM300 Relay using the USB port:

10. Plug the USB cable into the USB port on the MM300 Relay then into the USB port on your computer. The following screen will appear:

11. Select **Install... Automatically**

12. **Select No, not this time.**The above Hardware Installation warning screen will reappear. Press the Continue Anyway button.
13. In **EnerVista > Device Setup**:



14. Select **Serial** as the Interface type.
15. Select **port 7** as the COM Port.

4.2 Power analysis

4.2.1 Waveform capture

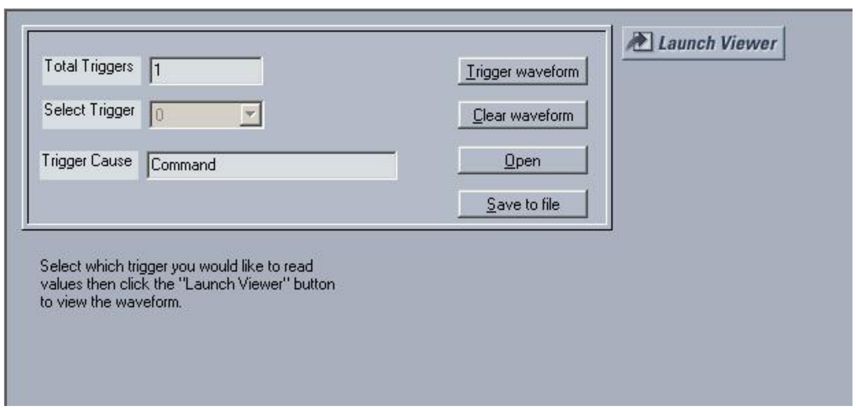
The EnerVista MM300 Setup software can be used to capture waveforms (or view trace memory) from the MM300 relay at the instance of a trip, activation of a virtual output, or other conditions. A maximum of 64 cycles (32 samples per cycle) can be captured and the trigger point can be adjusted to anywhere within the set cycles.

If the trigger mode is set to "ONE-SHOT," then the trace memory is triggered once; if it is set to "RETRIGGER," then it automatically retriggers and overwrites the previous data.

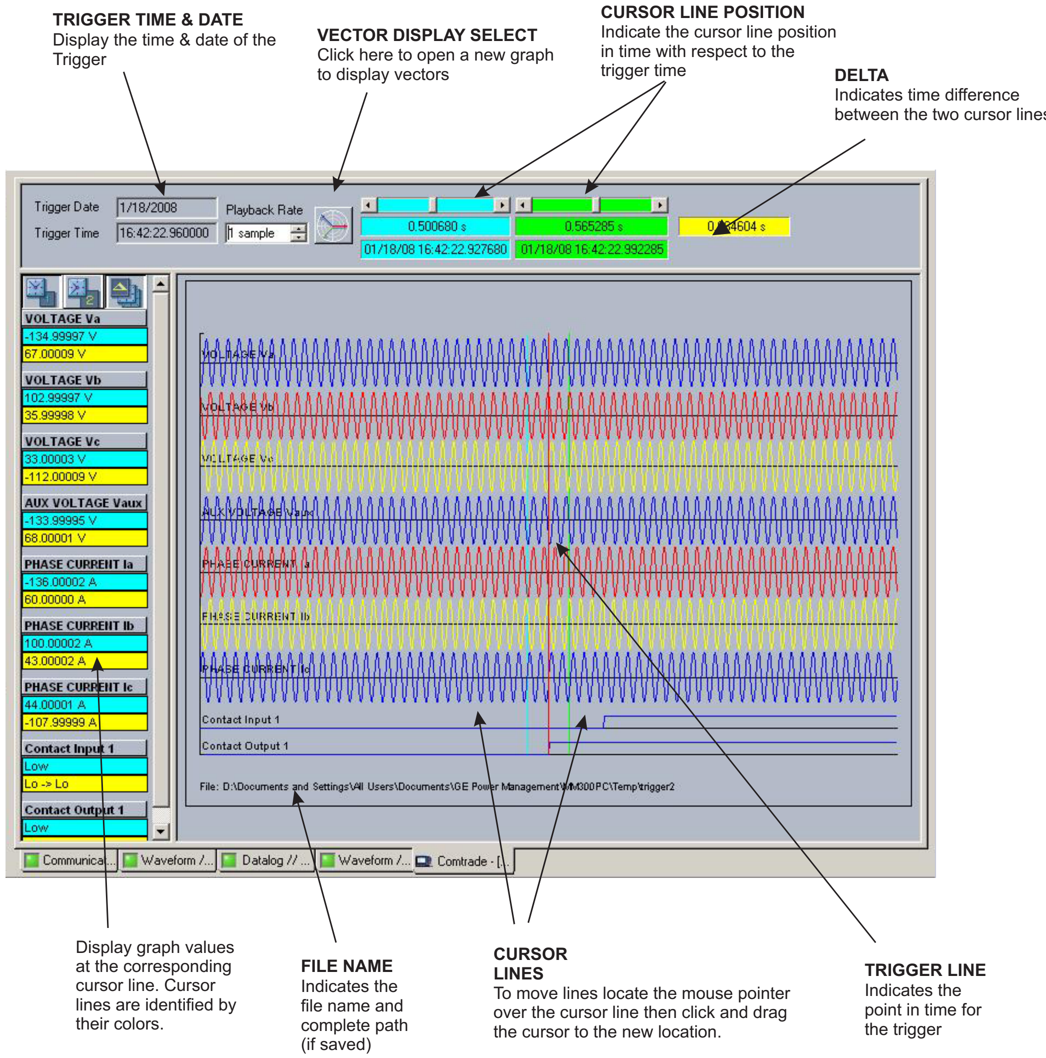
The following waveforms can be captured:

- Phase A, B, and C currents (Ia, Ib, and Ic)
- Ground current (Ig)
- Phase A-N, B-N, and C-N voltages (Van, Vbn, and Vcn) if wye-connected. Phase A-B, B-C, and C-A voltages (Vab, Vbc, and Vca) if delta-connected.
- Digital data for output relays and contact input states.

1. With EnerVista MM300 Setup running and communications established, select the **Diagnostics > Waveform** menu item to open the **Waveform Capture** setup window.



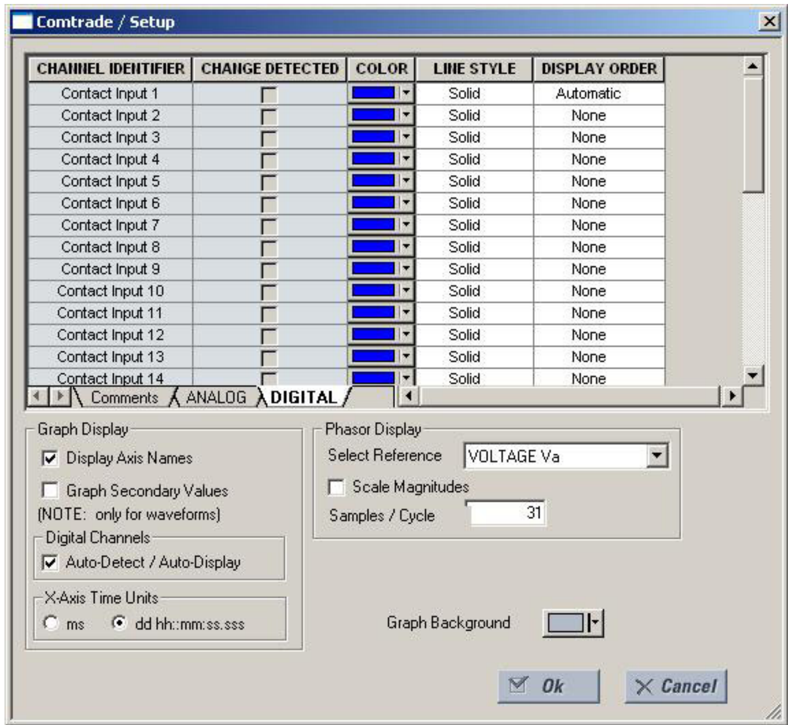
2. Click on **Trigger Waveform** to trigger a waveform capture. Waveform file numbering starts with the number zero in the MM300, so that the maximum trigger number will always be one less than the total number of triggers available.
3. Click on the **Save to File** button to save the selected waveform to the local PC. A new window will appear, requesting the file name and path. One file is saved as a COMTRADE file, with the extension "CFG." The other file is a "DAT" file, required by the COMTRADE file for proper display of waveforms
4. To view a previously-saved COMTRADE file, click the **Open** button and select the corresponding COMTRADE file.
5. To view the captured waveforms, click on the **Launch Viewer** button. A detailed Waveform Capture window will appear as shown below.



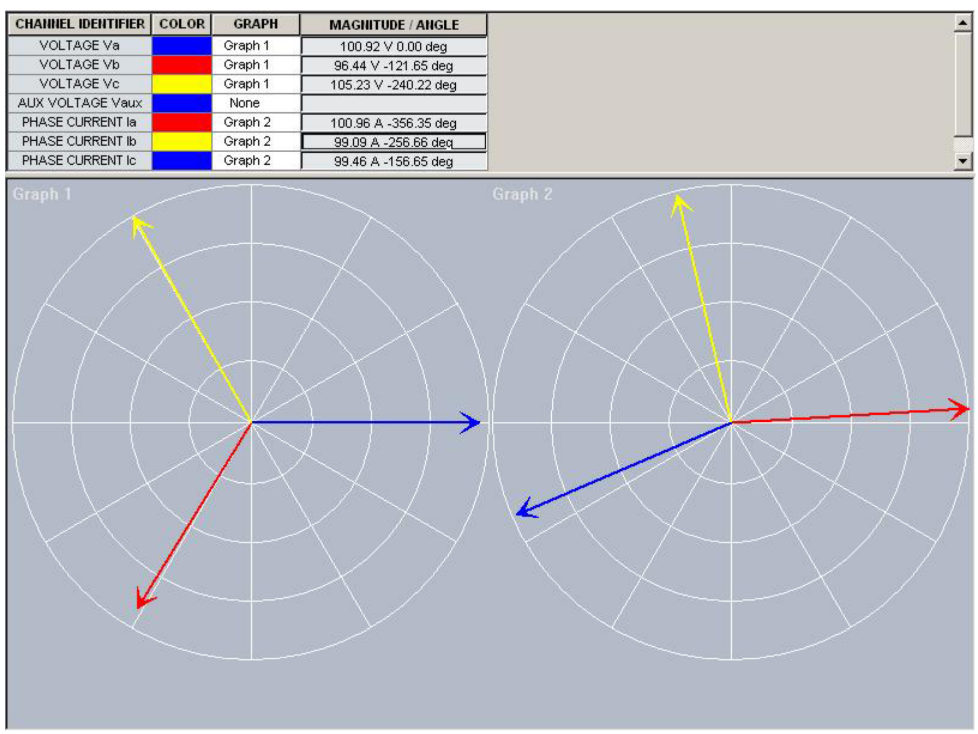
6. The red vertical line indicates the trigger point.
7. The date and time of the trigger is displayed at the top left corner of the window. To match the captured waveform with the event that triggered it, make note of the time and date shown in the graph. Then find the event that matches the same time and date in the event recorder. The event record will provide additional information on the cause and the system conditions at the time and date of the event.
8. From the window main menu bar, press the **Preference** button to open the COMTRADE Setup page, in order to change the graph attributes.

Preference button

9. The following window will appear:



10. Change the color of each graph as desired, and select other options as required, by checking the appropriate boxes. Click **OK** to store these graph attributes , and to close the window. The **Waveform Capture** window will reappear with the selected graph attributes available for use.
11. To view a vector graph of the quantities contained in the waveform capture, press the **Vector Display** button to display the following window:



12. Use the graph attribute utility described in step 9, to change the vector colors.

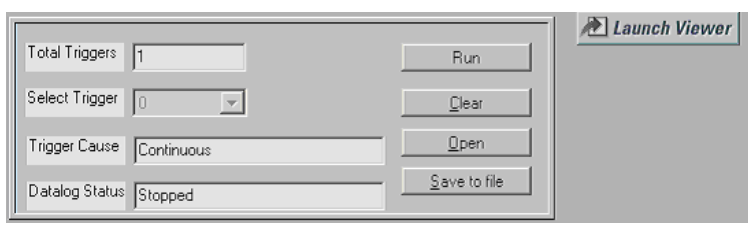
4.2.2 Data logger

The data logger feature is used to sample and record up to ten actual values at a selectable interval. The datalogger can be run with Continuous mode Enabled, which will continuously record samples until stopped by the user; or with Continuous mode Disabled, which will trigger the datalog once without overwriting previous data.

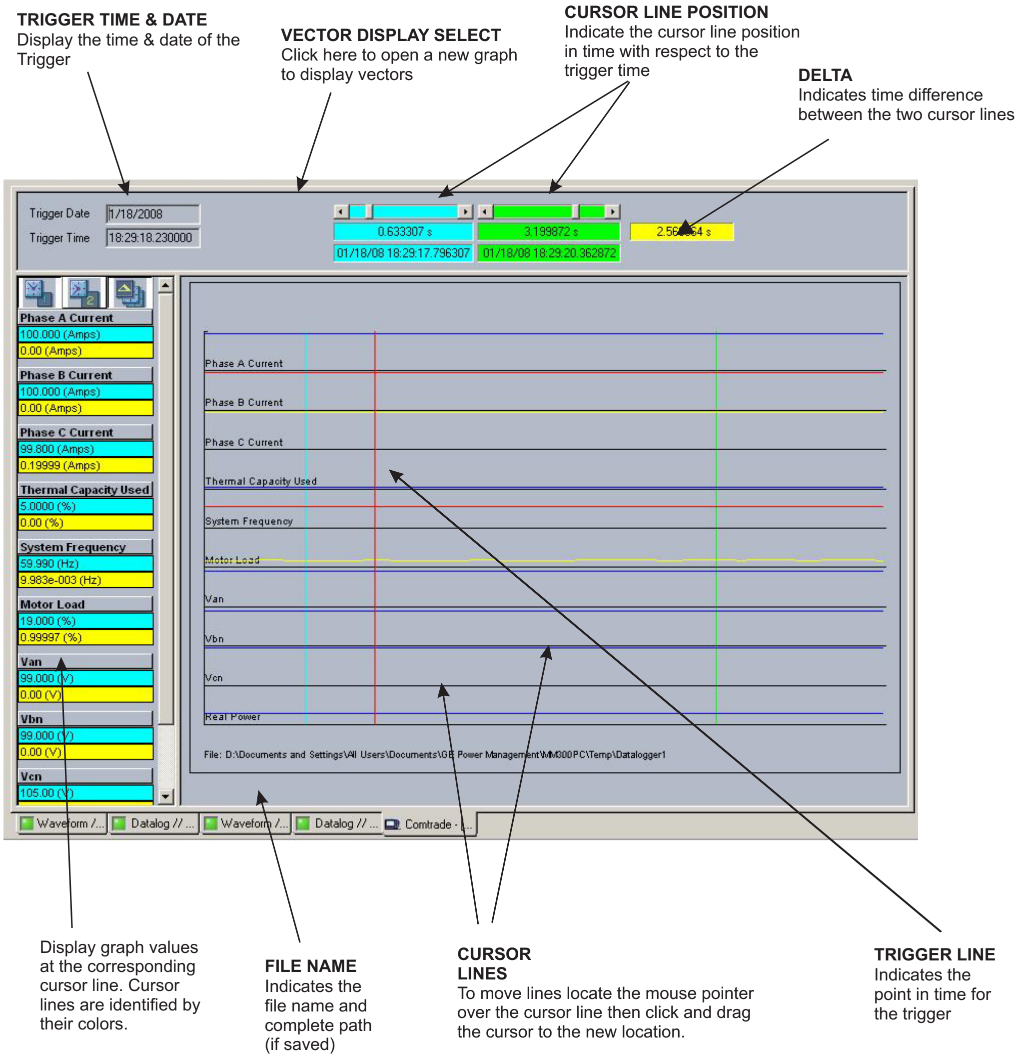
Setting	**Parameter**
Sample Rate	1 Second
Continuous Mode	Disabled
Data Log Trigger Position	25%
Data Log Trigger Source	None
Channel 1 Source	Phase A Current
Channel 2 Source	Phase B Current
Channel 3 Source	Phase C Current
Channel 4 Source	Disabled
Channel 5 Source	Disabled
Channel 6 Source	Disabled
Channel 7 Source	Disabled
Channel 8 Source	Disabled
Channel 9 Source	Disabled
Channel 10 Source	Disabled

Viewing and saving of the Datalogger is performed as follows:

1. With EnerVista MM300 Setup running and communications established, select the Diagnostics > Datalog menu item to open the datalog setup window:



2. If Continuous mode is enabled, click on **Stop** to stop the datalog
3. Click on the **Save to File** button to save the datalog to the local PC. A new window will appear requesting for file name and path.
4. One file is saved as a COMTRADE file, with the extension 'CFG'. The other file is a DAT file, required by the COMTRADE file for proper display of data.
5. To view a previously saved COMTRADE file, click the **Open** button and select the corresponding COMTRADE file.
6. To view the datalog, click the **Launch Viewer** button. A detailed Datalog window will appear as shown below.



7. The method of customizing the datalog view is the same as the Waveform Capture described above.
8. The datalog can be set to capture another buffer by clicking on **Run** (when Continuous mode is enabled), or by clicking on **Release** (when Continuous mode is disabled).

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Chapter 5: Actual values

5.1 Actual values overview

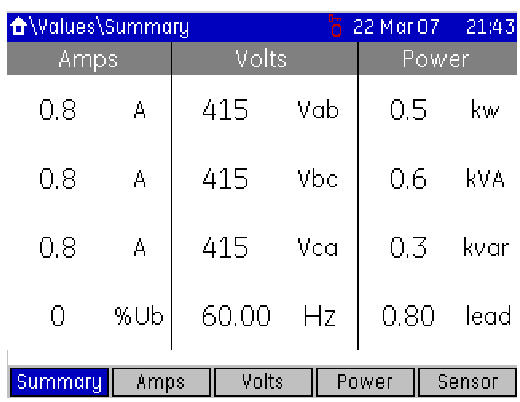
Measured values, maintenance and fault analysis information are accessed in the actual values screens. Actual values may be accessed via one of the following methods.

- Through the graphical control panel, using the keys and display.
- With the EnerVista MM300 Setup software supplied with the relay.
- Through the RS485 or Ethernet ports and a PLC/SCADA system running user-written software.

Actual value messages are organized into logical groups, or pages, for easy reference.

Pressing the **Values** soft-key displays the actual values summary window. A summary of metered current, voltage, and power values are shown for all three phases.

Figure 1: Actual values summary window

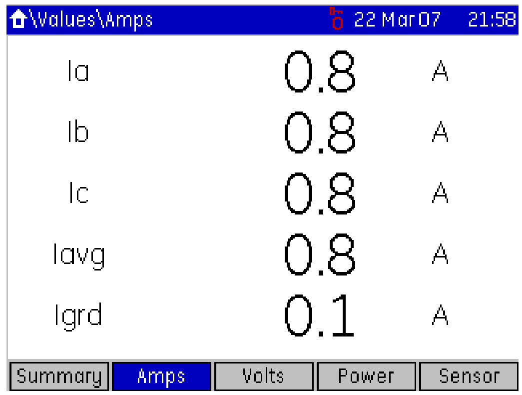


5.2 Metering

5.2.1 Current metering

Select the **Values > Amps** page to display the metered current for all three phases and ground.

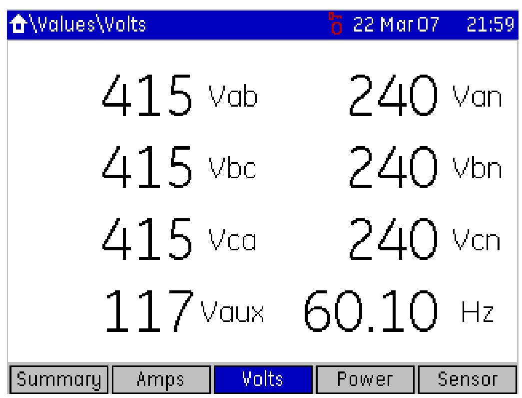
Figure 2: Current metering page



5.2.2 Voltage metering

Select the **Values > Volts** page to display the metered voltage for all three phases and auxiliary. The system frequency is also displayed.

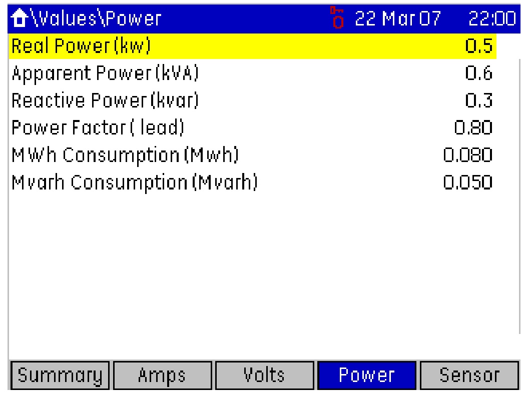
Figure 3: Voltage metering page



5.2.3 Power metering

Select the **Values > Power** page to display the power and energy metering values.

Figure 4: Power metering display



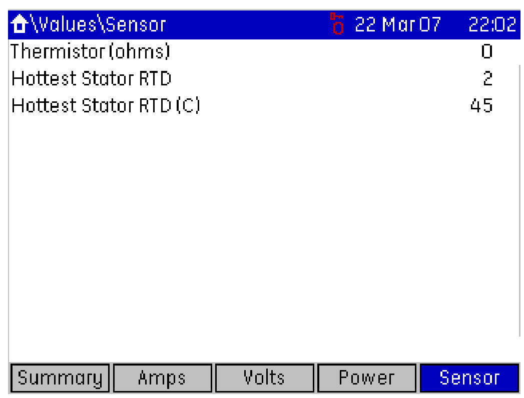
NOTE

An induction motor by convention consumes watts and vars (+watts and +vars).

5.2.4 Sensor metering

Select the **Values > Sensor** page to display the metered temperature sensor values. The values for each RTD and thermistor (if installed) are displayed.

Figure 5: Temperature metering page

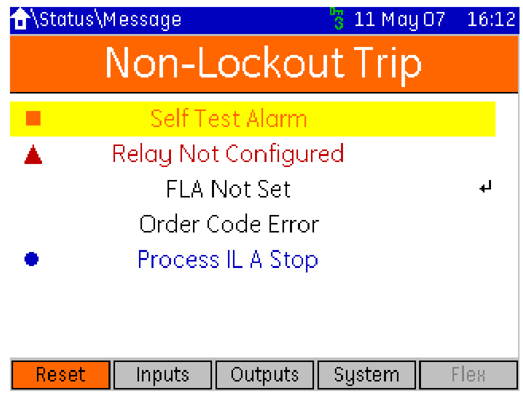


5.3 Status

The MM300 status messages are categorized as trip, alarm, and stop messages. The following trip, alarm, and stop messages are displayed.

5.3.1 Status messages

Figure 6: Typical status message display



Color indicates message type:

- Red Triangle = Trip
- Orange Square = Alarm
- Blue Circle = Inhibit
- Black Text = msg

Msg can have an associated countdown timer.

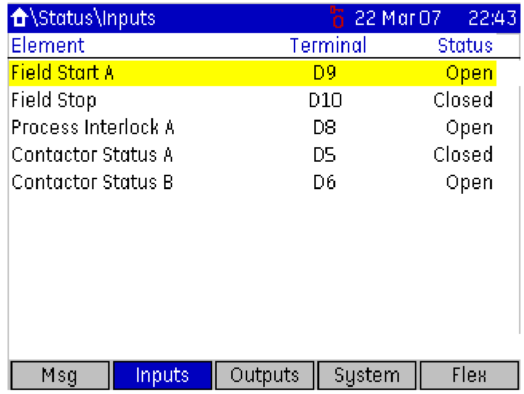
? shows that a link is available. Use ?? to highlight the line, then press Enter to zoom to the setpoint page that contains this setpoint.

Select the **Status > Msg** page to display a list of status messages. Trips, alarms, and control messages are displayed as status messages. The up and down keys can be used to scroll through large lists of status messages.

5.3.2 Input and output messages

Select the **Status > Inputs** and **Status > Outputs** pages to display a list of input and output status messages.

Figure 7: Typical input status message page



5.3.3 System Page

Shows the communication status of all configuration interfaces (serial, Ethernet, DeviceNet, and Profibus).

5.3.4 Flex Page

Shows the status of Flex engine and the number of 512 lines in use.

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Chapter 6: Setpoints

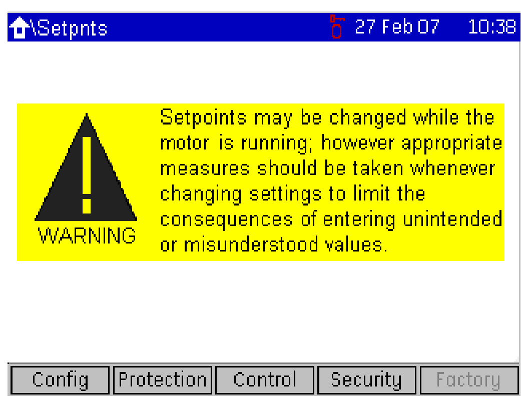
6.1 Understanding setpoints

Any of the motor trip and alarm setpoints may be viewed or altered by pressing the **Setpoints** soft-key. Setpoints data is divided into four pages.

- Configuration page: Information about the motor configuration as well as system setup, inputs, outputs, communications, CTs, and VTs.
- Protection page: Information about the protection features.
- Control page: Information about the process control features.
- Security page: Information about the security and password features.

Press the **Setpoint** soft-key to scroll through the setpoints pages. When pressed for the first time, the following screen is displayed.

Figure 1: Setpoints home page



The soft-keys on the **Home > Setpoints** page open pages two levels down, since the pages immediately below this page are blank. For example, the Config soft-key opens the **Home > Setpoints > Config > Motor** page.

The pages containing setpoint fields, except for the inputs and outputs pages, are in a common format. This is a simple tabular format with two columns: setpoint name and units, and setpoint value. Setpoints for features that are not enabled are omitted from the page.

CAUTION

Setpoints may be changed while the motor is running; however it is not recommended to change important protection parameters without first stopping the motor.

Setpoints will remain stored indefinitely in the internal non-volatile memory even when control power to the unit is removed. Protection parameters are based on the entered data. This data must be complete and accurate for the given system for reliable protection and operation of the motor.

6.1.1 Setting text abbreviations

The following abbreviations are used in the setpoints pages.

- A, Amps: amperes
- AUX: auxiliary
- CBCT: core balance current transformer
- COM, Comms: communications
- CT: current transformer
- FLA: full load amps
- FV: full voltage
- G/F: ground fault
- GND: ground
- Hz: Hertz
- kohms: kilo-ohms
- MAX: maximum
- MIN: minimum
- SEC, s: seconds
- UV & U/V: undervoltage
- VT: voltage transformer
- %MNV: percent of motor voltage
- %UB: percent unbalance
- %NCV: percent of nominal control voltage
- %MNR: percent of motor nominal rating
- Ctrl: control
- Hr & hr: hour
- O/L: overload
- UTC: co-ordinated universal time
- ops: operations
- mcc: motor control center

6.2 Configuration setpoints

The configuration setpoints contains data on motor configuration as well as system setup, inputs, outputs, communications, CTs, and VTs. The following sub-pages are available.

- Motor (setpoints related to motor configuration).
- CT-VT (setpoints related to CT and VT configuration).
- Inputs (setpoints related to digital input configuration)
- Outputs (setpoints related to digital output configuration)
- Comms (setpoints related to communications configuration)
- System (setpoints related to MM300 system configuration, such as the faceplate LEDs)
- Events (setpoints related to the event recorder)
- Counters (setpoints related to the digital counters)

6.2.1 Motor setpoints

The MM300 starter function is responsible for executing the motor startup sequence, including the pre-contactor start warning. The MM300 provides six pre-defined starters.

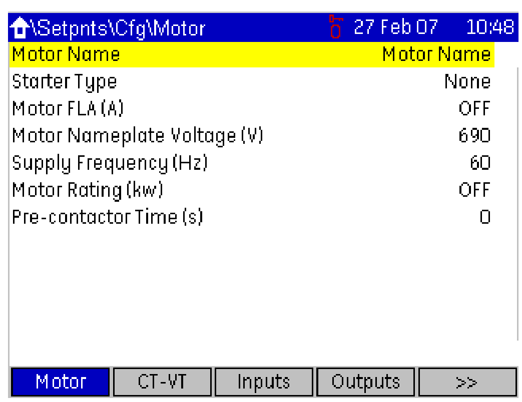
- Full-voltage non-reversing
- Full-voltage reversing
- Two-speed
- Wye-delta open transition
- Inverter
- Soft start

NOTE

By selecting a pre-defined starter, inputs and outputs are automatically assigned.

Select the **Home > Setpoints > Config > Motor** page to edit the motor data settings.

Figure 2: Motor data settings page



6.2.1.1 Common motor setpoints

Several motor setpoints are dependent on the chosen starter type. The setpoints shown below are common to all starter types.

Motor Name

Range: up to 20 alphanumeric characters
Default: Motor Name

This setpoint specifies a name for the motor. This name will appear in the actual values, sequence of events record, and other reports.

Starter Type (Mandatory Setpoint)

Range: None, FV Non-Reversing, FV Reversing, Two Speed, Wye-Delta, Inverter, Soft Starter, Custom Starter
Default: FV Non-Reversing

This setpoint selects the starter type. The relay is essentially disabled when the value is set to “None”. The following figure illustrates typical starter timing beginning from the stopped state for all starter types.

Motor FLA (Mandatory Setpoint)

Range: 0.5 to 1000.0 amps in steps of 0.1
Default: OFF

This setpoint must be specified for motor protection. The value may be taken from the motor nameplate data sheets.

Motor Nameplate Voltage (Mandatory Setpoint)

Range: 100 to 690 volts in steps of 1
Default: 690 volts

This setpoint specifies the rated motor nameplate voltage. This value represents the base phase-to-phase voltage, and is used by the undervoltage and overvoltage protection elements.

Supply Frequency (Mandatory Setpoint)

Range: 50 Hz, 60 Hz
Default: 60 Hz

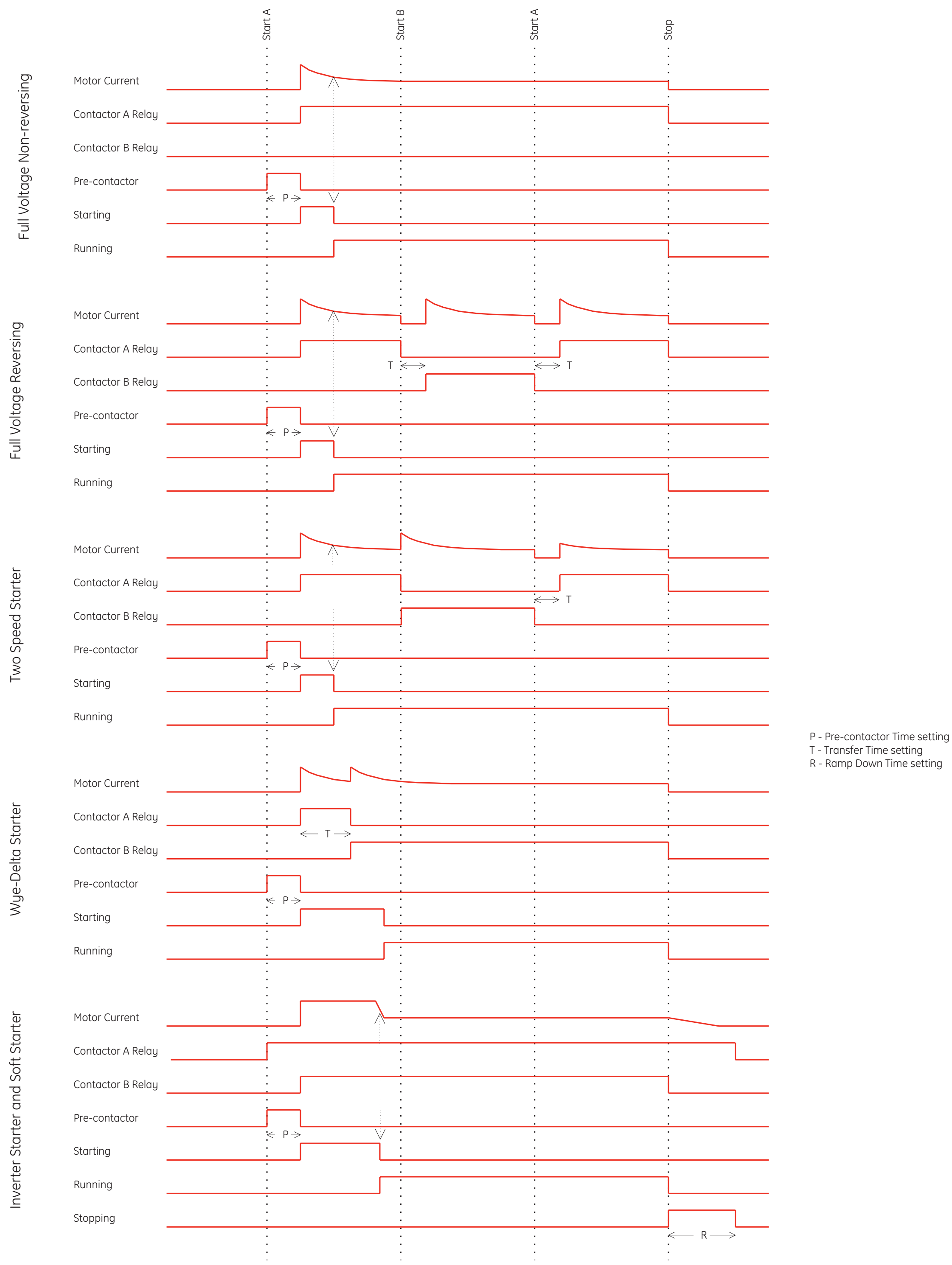
This setpoint specifies the nominal system frequency.

Motor Rating (Mandatory Setpoint)

Range: 0.3 to 1100.0 kW in steps of 0.1 or OFF
Default: OFF

This setpoint specifies the motor rating (or low speed motor rating for two-speed starters) in kWs.

Figure 3: Typical starter timing



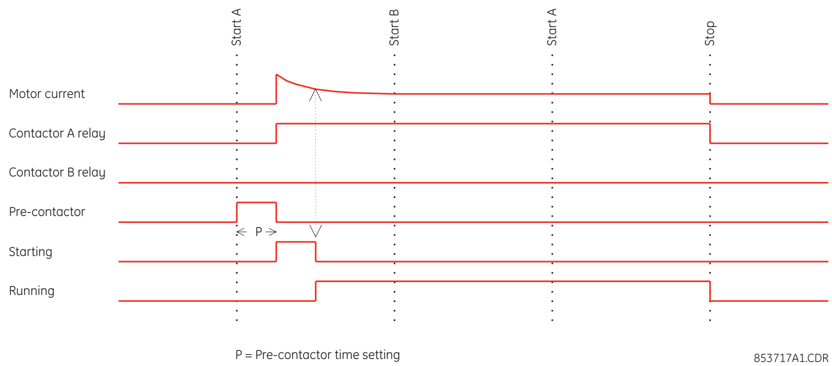
The following sections provide additional information for each starter type.

6.2.1.2 Full-voltage non-reversing starter

If the **Starter Type** setpoint is programmed to “FV Non-Reversing”, the pre-contactor relay (if any) is picked up for the set **Pre-Contactor Time** when a start control is received. When the pre-contactor timer times out, the contactor A relay picks up and seals-in, starting the motor. When a stop control is received, the contactor A relay is dropped out and the motor stops.

The following figure illustrates typical starter timing beginning from the stopped state.

Figure 4: Typical starter timing for full-voltage non-reversing starter



The following additional setpoint is available for the full-voltage non-reversing starter.

Pre-Contactor Time

Range: 0 to 60 seconds in steps of 1

Default: 0 seconds

This setpoint represents the time after a start command before the motor is started. Most starters do not use this delay for forced starts such as undervoltage restart immediate and external start. This setpoint is also used by the inverter starter and the soft start starter to set the amount of time between powering up an inverter or soft starter and sending the ramp-up command. An audible or other warning signal can be activated in this interval by connecting the signal to a contact output set to the pre-contactor function.

6.2.1.3 Full-voltage reversing starter

The full-voltage reversing starter type is a full-voltage or across-the-line reversing starter.

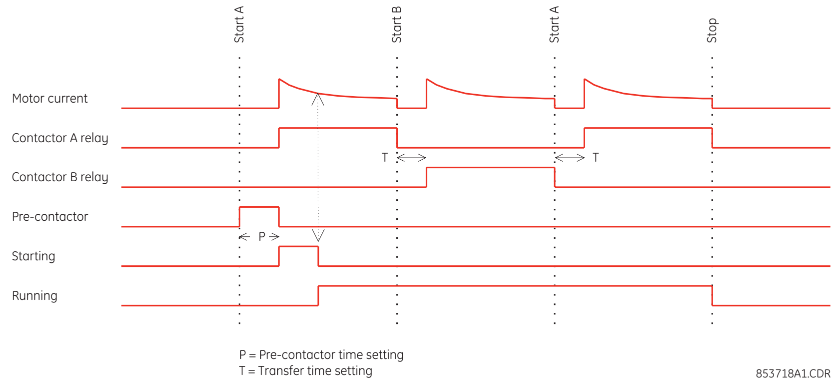
When a start A (forward) control is received, the pre-contactor relay (if any) is picked up for the set **Pre-Contactor Time**. When the pre-contactor timer times out, the contactor A relay picks up and seals-in, starting the motor in the forward direction. When a start B (reverse) control is received, the A contactor is dropped out. When contactor A status off is received, the starter waits for the set **Transfer Time** to allow the motor to slow or stop. When the transfer time timer times out, the contactor B relay picks up and seals-in, starting the motor in the reverse direction. When a stop control is received, the contactor A and B relays are dropped out and the motor stops. The starter logic is fully symmetrical between forward and reverse.

When a contact input has its function set to “Forward Limit”, and that contact closes, the contactor A relay will drop out. When a contact input has its function set to “Reverse Limit”, and that contact closes, the contactor B relay will drop out.

The pre-contactor is omitted on forced starts (for example, undervoltage restart immediate or external start). Forced starts are not supervised by this starter transfer timer – any external starting circuit must itself respect fast direction change restrictions.

The following figure illustrates typical starter timing beginning from the stopped state.

Figure 5: Typical starter timing for full-voltage reversing starter



The following additional setpoints are available for the full-voltage reversing starter.

Pre-Contactor Time

Range: 0 to 60 seconds in steps of 1

Default: 0 seconds

This setpoint represents the time after a start command before the motor is started. Most starters do not use this delay for forced starts such as undervoltage restart immediate and external start. This setpoint is also used by the inverter starter and the soft start starter to set the amount of time between powering up an inverter or soft starter and sending the ramp-up command. An audible or other warning signal can be activated in this interval by connecting the signal to a contact output set to the pre-contactor function.

Transfer Time

Range: 0 to 125 seconds in steps of 1

Default: 1 second

This setpoint represents the time between stopping and starting in a new direction for the reversing starter.

6.2.1.4 Two-speed starter

The “Two Speed” starter type is a full-voltage or across-the-line two speed starter.

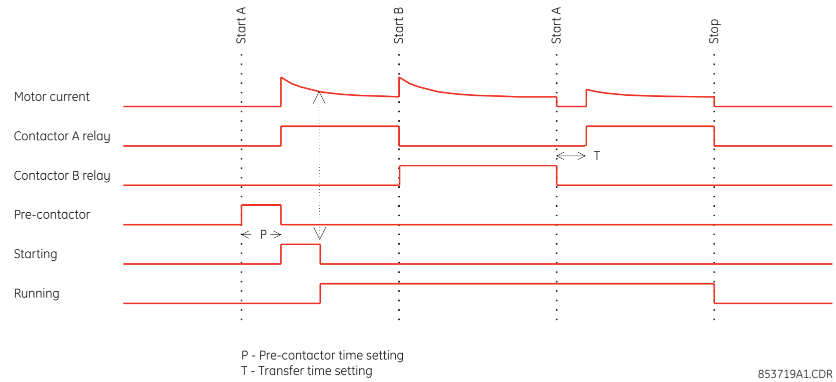
When a start A (low speed) control is received, the pre-contactor relay (if any) is picked up for the set **Pre-Contactor Time**. When the pre-contactor timer times out, the contactor A relay picks up and seals-in, starting the motor in low speed. When a start B (high speed) control is received, the A contactor is dropped out. When contactor A status Off is received, the contactor B relay picks up and seals-in, starting the motor in high speed. Should a start A (low speed) control be received when the high speed contactor B is picked up, contactor B is dropped out. When contactor B status Off is received, the starter waits for the set **Transfer Time** to allow the motor to slow. When the transfer time timer times out, the contactor A relay picks up and seals-in, starting the motor in low speed. When a stop control is received, the contactor A and B relays are dropped out and the motor stops.

If the **High Speed Start Block** setpoint is “Enabled”, this starter will not allow a start B (high speed) control unless already running on contactor A (low speed).

The pre-contactor is omitted on forced starts (for example, undervoltage restart immediate or external start). Forced starts are not supervised by this starter transfer timer – any external starting circuit must itself respect high to low speed transition restrictions and starting in high speed restrictions.

The following figure illustrates typical starter timing beginning from the stopped state.

Figure 6: Typical starter timing for two-speed starter



The following additional setpoints are available for the two-speed starter.

High Speed FLA

Range: 0.5 to 1000.0 amps in steps of 0.1

Default: OFF

This setpoints specifies the maximum continuous phase current when running in high speed.

High Speed Motor Rating

Range: 0.3 to 1100.0 kW in steps of 0.1 or OFF

Default: OFF

This setpoint specifies the high-speed motor rating for two-speed starters in kWs on the line. This setpoint is for reference only and does not affect operation of the MM300.

High Speed Start Block

Range: Enabled, Disabled

Default: Enabled

When this setpoint is programmed as “Disabled”, the relay allows the motor to be started directly to high speed. When programmed as “Enabled”, the motor must be running in low-speed before switching to high-speed.

Transfer Time

Range: 0 to 125 seconds in steps of 1

Default: 1 second

This setpoint represents the time between running at high speed and starting at low speed for the two speed starter.

6.2.1.5 Wye-delta open transition starter

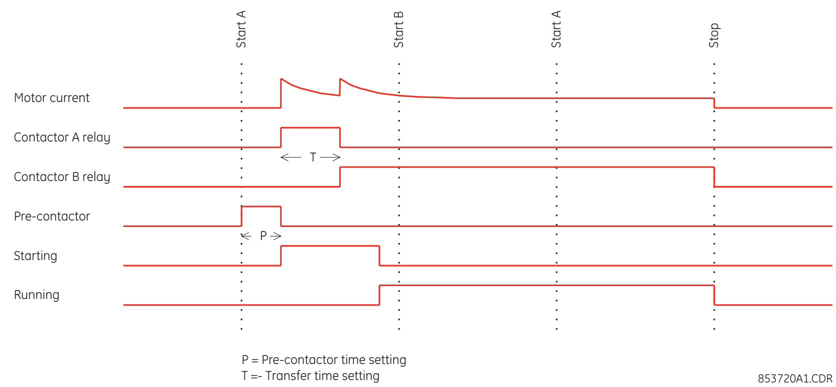
The wye-delta open transition starter is a reduced voltage starter.

When a start A control is received, the pre-contactor relay (if any) is picked up for the set **Pre-Contactor Time**. When the pre-contactor timer times out, the contactor A relay picks up and seals-in, picking up the 1S contactor, which connects the motor in wye configuration. The 1S contactor in turn picks up the 1M contactor, which connects the motor to the supply. The motor is now starting at 58% voltage. When the transfer time timer expires, the contactor A relay is de-energized, contactor 1S drops out, opening the wye and disconnecting the motor from the supply. When the contactor 1S status off is received, the contactor B relay picks up and seals-in, picking up the 2M contactor, which connects the motor in delta configuration. The 2M contactor in turn picks up the 1M contactor, which connects the motor to the supply. The motor is now running at full voltage. When a stop control is received, the contactor A and B relays are dropped out, contactor 1S and 2M drop out, contactor 1M drops out, and the motor stops.

Pre-contactor is omitted on forced starts (for example, undervoltage restart immediate or external start). Otherwise, contactor A forced starts operate in the same fashion as other contactor A starts, with the transfer to full voltage occurring when the transfer time expires. Contactor B forced starts are not supervised by this starter transfer timer – any external contactor B starting circuit must itself respect full voltage starting restrictions.

The following figure illustrates typical starter timing beginning from the stopped state.

Figure 7: Typical starter timing for wye-delta open transition starter



The following additional setpoints are available for the wye-delta open transition starter.

Pre-Contactor Time

Range: 0 to 60 seconds in steps of 1

Default: 0 seconds

This setpoint represents the time after a start command before the motor is started. Most starters do not use this delay for forced starts such as undervoltage restart immediate and external start. This setpoint is also used by the inverter starter and the soft start starter to set the amount of time between powering up an inverter or soft starter and sending the ramp-up command. An audible or other warning signal can be activated in this interval by connecting the signal to a contact output set to the pre-contactor function.

Transfer Time

Range: 0 to 125 seconds in steps of 1

Default: 1 second

If the value specified by this setpoint has expired, the transition from wye (contactor A) to delta (contactor B) will occur.

6.2.1.6 Inverter starter

The "Inverter" starter type is used with an external inverter that ramps the motor speed up on start and ramps it down on stop.

When a start A control is received, the contactor A relay picks up and seals-in. This provides power for the inverter to start up and to drive the motor. The pre-contactor relay (if any) is also picked up for the set **Pre-Contactor Time**. When the pre-contactor timer times out, the contactor B relay is picked up signalling the inverter to ramp the motor up. When a stop control is received, the contactor A and B relays drop out immediately, signalling the inverter to ramp down.

If the contactor B status unexpectedly opens while running, signalling a possible inverter trouble, the contactor B relay is dropped out and an Inverter Trip Alarm is issued, but no trip is issued and the contactor A relay remains closed. This is done so that the inverter has power to retain its event records for subsequent diagnosis of the problem. The contactor A relay is opened and the alarm is reset when a stop control is received.

Forced starts (for example, external start) operate in the same fashion as other starts, with the B contactor not calling for the inverter to ramp until the pre-contactor timer times out.

If up-to-speed feedback is not received from the inverter via the contactor B status within the setpoint during a start, a Drive Start Failed alarm is generated. If up to speed feedback resets before a stop control, an Inverter Fail alarm is generated, and the contactor B relay opened. If inverter speed feedback remains when the **Ramp Down Time** expires during a stop, a Drive Stop Fail alarm is generated. Neither results in a trip or a stop. The Drive Start Failed alarm is latched until reset. The Inverter Fail alarm is also cleared by a stop control.

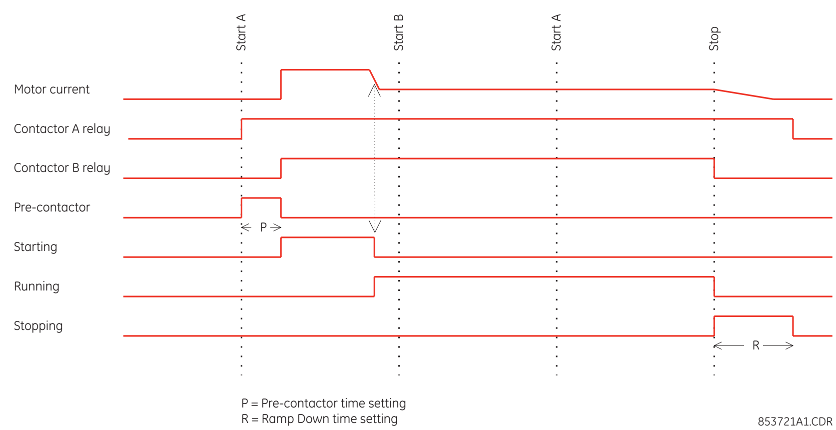
The B Open Contactor Control Circuit and B Welded Contactor alarms implemented in the start/stop control element are defeated when the inverter starter is selected.

If the inverter does not provide an up to speed feedback signal, the contactor B relay contact or an auxiliary contact of the B contactor should be connected to the contactor B status contact input to suppress spurious Drive Failed To Start alarms.

The Undervoltage Autorestart feature is disabled for the Inverter Starter.

The following figure illustrates typical starter timing beginning from the stopped state.

Figure 8: Typical starter timing for the inverter starter



The following additional setpoints are available for the inverter starter.

Pre-Contactor Time

Range: 0 to 60 seconds in steps of 1

Default: 0 seconds

This setpoint specifies the time after a start command before the motor is started. Most starters do not use this delay for forced starts such as external start. This setpoint is also used by the inverter starter and the soft start starter to set the amount of time between powering up an inverter or soft starter and sending the ramp-up command. An audible or other warning signal can be activated in this interval by connecting the signal to a contact output set to the pre-contactor function.

Ramp Up Time

Range: 0 to 125 seconds in steps of 1

Default: 1second

This setpoint specifies the time after signalling the inverter starter to ramp up that the up-to-speed feedback can be delayed without issuing a Drive Start Fail alarm.

Ramp Down Time

Range: 0 to 125 seconds in steps of 1

Default: 1second

This setpoint specifies the time after signalling the inverter starter to ramp down before the main contactor is opened, cutting power to the starter. If speed feed back is still on when this time expires, a Drive Stop Fail alarm is issued.

6.2.1.7 Soft starter

The "Soft Starter" type is used with an external soft starter that ramps the motor speed up on start and down on stop. Once the motor is ramped up, the soft starter can be bypassed.

When a start A control is received, the contactor A relay picks up and seals-in. This provides power for the soft starter to start up and to drive the motor. The pre-contactor relay (if any) is also picked up for the set **Pre-Contactor Time**. When the pre-contactor timer times out, the contactor B relay is picked up signalling the soft starter to ramp the motor up. When a stop control is received, the contactors A and B relays drop out, signalling the soft starter to ramp down.

Forced starts (for example, external start) operate in the same fashion as other starts, with the B contactor not calling for the soft starter to ramp until the pre-contactor timer times out.

If up to speed feedback is not received from the soft starter via the contactor B status within the **Ramp Up Time** setpoint during a start, a Drive Start Failed alarm is generated. If soft starter speed feedback remains when the **Ramp Down Time** expires during a stop, a Drive Stop Fail alarm is generated. Neither results in a trip or a stop. The Drive Start Failed alarm is latched until reset.

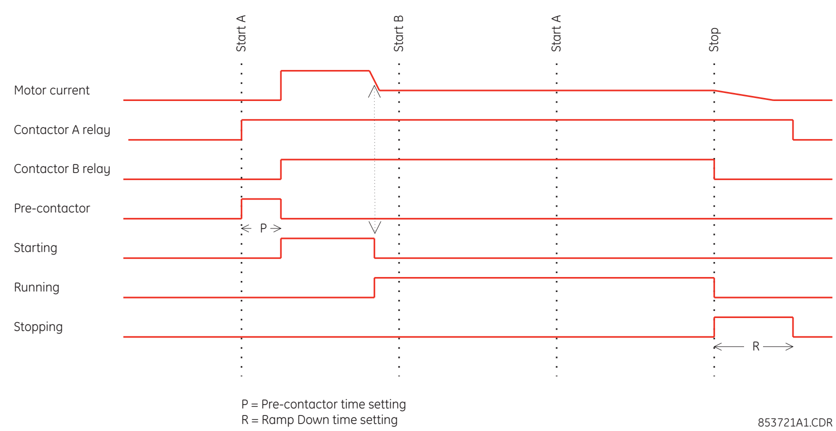
The B Open Contactor Control Circuit and B Welded Contactor alarms implemented in the start/stop control element are defeated when the soft starter is selected.

If the soft starter does not provide an up to speed feedback signal, the contactor B relay contact or an auxiliary contact of the B contactor should be connected to the up to speed feedback contact input to suppress spurious Drive Failed To Start alarms.

The Undervoltage Autorestart feature is disabled for the Soft Starter.

The following figure illustrates typical starter timing beginning from the stopped state.

Figure 9: Typical starter timing for the soft starter



The following additional setpoints are available for the soft starter.

Pre-Contactor Time

Range: 0 to 60 seconds in steps of 1

Default: 0 seconds

This setpoint specifies the time after a start command before the motor is started. Most starters do not use this delay for forced starts such as external start. This setpoint is also used by the inverter starter and the soft start starter to set the amount of time between powering up an inverter or soft starter and sending the ramp-up command. An audible or other warning signal can be activated in this interval by connecting the signal to a contact output set to the pre-contactor function.

Ramp Up Time

Range: 0 to 125 seconds in steps of 1

Default: 1 second

This setpoint specifies the time after signalling the soft starter to ramp up that the up-to-speed feedback can be delayed without issuing a Drive Start Fail alarm.

Ramp Down Time

Range: 0 to 125 seconds in steps of 1

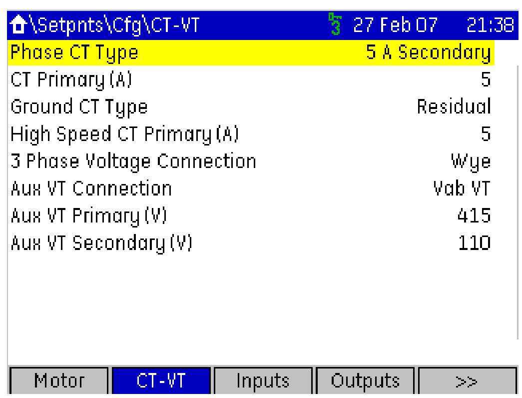
Default: 1 second

This setpoint specifies the time after signalling the soft starter to ramp down before the main contactor is opened, cutting power to the starter. If speed feedback is still on when this time expires, a Drive Stop Fail alarm is issued.

6.2.2 Current and voltage transformers

Select the **Home > Setpoints > Config > CT-VT** page to edit the current and voltage transformer setpoints.

Figure 10: Typical current and voltage transformer setpoints window



The following setpoints are available to configure the current and voltage transformers.

Phase CT Type (Mandatory Setpoint)

Range: None, 1 A Secondary, 5 A Secondary, Direct Connect

Default: Direct Connect

This setpoint specifies the phase CT connection type. The “Direct Connect” value indicates that no phase CTs are used; instead, motor phase current passes directly through the relay. The “Direct Connect” selection should never be used where full load current is greater than 5.0 amps.

NOTE

If Direct Connect is selected and the FLA is set >5 A, a "FLA too high" message will be displayed on the Status page.

CT Primary (Mandatory Setpoint)

Range: 5 to 1000 amps in steps of 1

Default: 5 amps

This setpoint specifies the phase CT primary current. It should never be less than the full load current, and preferably no greater than twice than the full load current.

NOTE

This setpoint is displayed only if the phase CT is selected to 1 A secondary or 5 A secondary.

High Speed CT Primary

Range: 5 to 1000 amps in steps of 1

Default: 5 amps

This setpoint specifies the phase CT primary current when the motor is running at high speed. It should never be less than the high speed full load current, and preferably no greater than twice than the high speed full load current.

NOTE

This setpoint is displayed only if the phase CT is selected as 1 A secondary or 5 A secondary and the motor starter type is two-speed.

Ground CT Type

Range: None, Residual, CBCT 2000:1

Default: CBCT 2000:1

This setpoint specifies the type of ground CT. Select "Residual" if the fourth CT Input on the IO_A is connected to the residual of the Phase CT. Select 2000:1 if a zero sequence CT (CBCT) is connected to the ground input on the CPU card.

CT Primary Turns

Range: 1 to 10

Default: 1

For smaller motors where the drawn current is very low, the motor leads may be wrapped through the CT Primary with several turns thereby increasing the current seen by the MM300 and as a result increasing the accuracy of the measurement. The value of this setting should equal the number of turns on the CT Primary to display the correct current value. Internally the current measurement will be divided by this setting..

Three Phase Voltage Connection

Range: Wye, Delta

Default: Wye

The method in which the IO_B voltage inputs are connected must be entered here. Note that phase reversal is disabled for single VT operation. All voltages are assumed balanced.

Auxiliary Voltage Connection (Mandatory Setpoint)

Range: VabVT, VbcVT, VcaVT, VanVT, VbnVT, VcnVT, VanDirect, VbnDirect, VcnDirect

Default: Vab VT

This setpoint specifies the control transformer connection to the motor supply voltage.

Auxiliary VT Primary

Range: 110 to 690 volts in steps of 1

Default: 415 volts

This setpoint specifies the primary voltage rating of the control transformer.

Auxiliary VT Secondary

Range: 110 to 300 volts in steps of 1

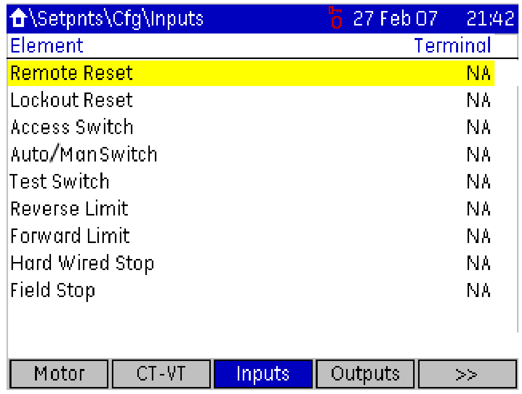
Default: 110 volts

This setpoint specifies the secondary voltage rating of the control transformer.

6.2.3 Inputs

The MM300 digital (contact) inputs are programmed in this menu. A typical input configuration page is shown below.

Figure 11: Input configuration setpoint page



NOTE

Inputs are automatically assigned based on typical wiring diagrams, shown in chapter 2, when a pre-defined starter is selected.

The following setpoints are available for each contact input:

Function

Range: Access Switch, Comms Permissive, Contactor A Status, Contactor B Status, Field Permissive, Field Start A, Field Start B, Field Stop, Forward Limit, Hard Wired Permissive, Hard Wired Start A, Hard Wired Start B, Hard Wired Stop, Interlock A, Interlock B, Interlock C, Interlock D, Interlock E, Interlock F, Interlock G, Interlock H, Interlock I, Interlock J, Lockout Reset, MCC Permissive, Remote Reset, Reverse Limit, Test Switch, U/V Restart Inhibit, Auto/Manual Switch.

Default: None

- “Access Switch”: This value represents an open contact that disables security access of selected levels.
- “Auto/Manual”: "Close" sets the auto mode. "Open" sets the manual mode.
- “Comms Permissive”: This value represents an open contact that disables communications control. Used by the auto/manual control element.
- “Contactor A Status”: This value represents the normally open auxiliary contact of contactor A. Used by the starters, the stop/start control element, and the system trouble function. Automatically assigned to the first input when a starter type is selected. Not otherwise user-programmable.
- “Contactor B Status”: This value represents the normally open auxiliary contact of contactor B. Used by the starters, the stop/start control element, and the system trouble function. Automatically assigned to the second input when a reversing or two-speed starter type is selected, and when the custom starter which uses this input is selected. Not otherwise user assignable.
- “Field Permissive”: This value represents an open contact which disables field control. Used by the auto/manual control element.
- “Field Start A”: This value represents a field-located manual switch requesting contactor A pickup. Used by the auto/manual control element.
- “Field Start B”: This value represents a field-located manual switch requesting contactor B pickup. Used by the auto/manual control element.
- “Field Stop”: This value represents a field-located manual switch where an open position requests stop. Used by the auto/manual control element.

- "Forward Limit": This value represents a contact which opens at the forward travel limit. Used by the reversing starter type.
- "Hard Wired Permissive": This value represents an open contact that disables hard-wired control. Used by the auto/manual control element.
- "Hard Wired Start A": This value represents an auto contact (typically from a PLC) requesting contactor A pickup. Used by the auto/manual control element.
- "Hard Wired Start B": This value represents an auto contact (typically from a PLC) requesting contactor B pickup. Used by the auto/manual control element.
- "Hard Wired Stop": This value represents an auto contact (typically from a PLC) where the open position requests stop. Used by the auto/manual control element.
- "Interlock A" to "Interlock J": These value represent the contact inputs used by process interlocks A through J, respectively.
- "Lockout Reset": This value represents a contact input used to reset lockout trips: mechanical jam, ground fault and thermal overload.
- "NA": This value indicates the contact Input has no assigned function, though it may still be used by the custom starter (FlexLogic™) if that starter type is selected.
- "MCC Permissive": This value represents an open contact that disables MCC control. Used by the auto/manual control element.
- "Remote Reset": This value represents a contact input used to reset non-lockout trips and alarms.
- "Reverse Limit": This value represents a contact which opens at the reverse travel limit. Used by the reversing starter type.
- "Test Switch": This value represents a contact input used to suspend collection of selected data items, override auto/manual modes, and cause interlocks to be ignored.
- "UV Restart Inhibit": This value repesents a contact that disables undervoltage restart feature when closed, and allows undervoltage restarts to take place when open.

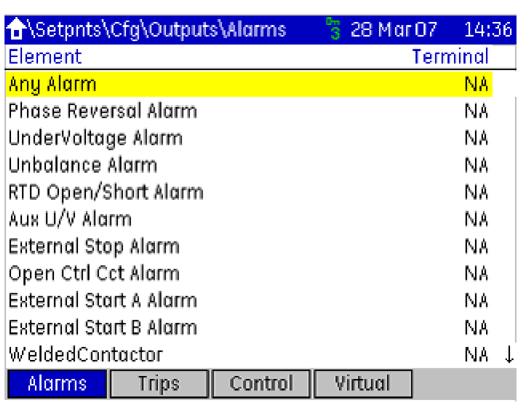
NOTE

When Lockout Reset is used to reset a Thermal Overload, the Thermal Capacity % will be reset to zero.

6.2.4 Outputs

Contact inputs are designated by their card slot letter appended with their card terminal number. Contact outputs, which have two or three terminals, use the first of their terminal numbers. This is the same scheme as is used to form the relay terminal designation. A typical contact output setpoint page is shown below.

Figure 12: Output configuration setpoint page



The terminal designation is indicated under the “Terminal” column. The values in the first column are determined from the installed option cards and cannot be edited.

When a starter type is selected, the first equipped contact output and the first equipped contact input are forced to the contactor A relay function and the contactor A status function, respectively. When the two-speed or reversing starter type is selected, the second equipped contact output and the second equipped contact input are forced to the contactor B relay function and the contactor B status function, respectively. Any prior values for these setpoints are erased, and the setpoint becomes non-editable.

For contact outputs the Function setpoint determines which internal signal turns the output on and off. A list of the setpoints options with descriptions is shown below. For more information on a particular option, see the appropriate section in this manual. Output functions may be selected more than once - different outputs can be set to the same function.

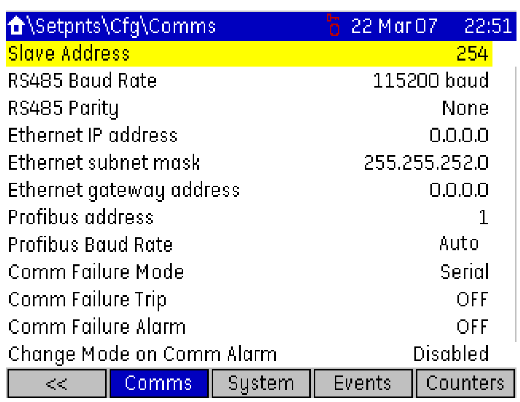
- "Contactor A Relay": This value represents an output contact that energizes contactor A. It is used by the starters, the stop/start control element, and the system trouble function, and automatically assigned to the first output when a starter type is selected. Not otherwise user assignable.
- "Contactor B Relay": This value represents an output contact that energizes contactor B. It is used by the starters, the stop/start control element, and the system trouble function, and automatically assigned to the second output when a reversing, two-speed, inverter, or soft starter type is selected, and when the custom starter is selected and uses this output. Not otherwise user assignable.
- FlexLogic™ operands: Any FlexLogic™ operand can be assigned to a contact output.

6.2.5 Communications setpoints

The MM300 has one RS485 serial communications port supporting a subset of the Modbus protocol. An additional DeviceNet, Profibus, or Ethernet port is also available as an option.

Select the **Home > Setpnts > Cfg > Comms** page to edit the communications setpoints.

Figure 13: Communications setpoints page



The following setpoints are available.

Slave Address

Range: 1 to 254 in steps of 1

Default: 254

For RS485 communications, each MM300 IED must have a unique address from 1 to 254. Address 0 is the broadcast address detected by all IEDs in the serial link. Addresses do not have to be sequential, but no two units can have the same address or errors will occur. Generally, each unit added to the link uses the next higher address starting at 1.

RS485 Baud Rate

Range: 9600, 19200, 38400, 57600, or 115200 baud
Default: 115200 baud

This setpoint selects the baud rate for the RS485 port. The data frame is fixed at 1 start, 8 data, and 1 stop bits, while parity is optional.

DeviceNet MAC ID

Range: 0 to 63 in steps of 1
Default: 63

This setpoint specifies the dedicated MAC ID as per the DeviceNet design.

DeviceNet Baud Rate

Range: 125, 250, or 500 kbps
Default: 125 kbps

This setpoint selects the DeviceNet baud rate.

Ethernet IP Address

Range: standard IP address format
Default: 0.0.0.0

This setpoint specifies the dedicated IP address provided by the network administrator.

NOTE

When changing the IP address, power to the relay must be cycled in order for the new IP address to become active.

Ethernet Subnet Mask

Range: standard IP address format
Default: 255.255.252.0

This setpoint specifies the subnet IP mask provided by the network administrator.

Ethernet Gateway Address

Range: standard IP address format
Default: 0.0.0.0

This setpoint specifies the gateway IP address provided by the network administrator.

NTP Address

This setpoint is set to the IP address of the external clock source.

Profibus Address

Range: 1 to 125
Default: 125

Specifies the Profibus Slave address for this node.

Profibus Baud Rate

*Range: 9600, 19200, 31250, 45450, 93750, 187500, 500K, 1.5M, Autodetect**
Default: Autodetect

Specifies the speed of communication for the Profibus inteface.

* Profibus communications will operate only in 1.5Mbps or Autodetect with the present implementation. Autodetect includes all listed baud rates.

Comms OK Evaluation

Range: Serial, Serial + Ethernet, Serial + Fieldbus, Ethernet, Fieldbus, Ethernet + Fieldbus, All
Default: Serial

Specifies the operands for the Comms OK flag.

Comm Failure Trip

Range: Off, 5 to 25 step 5s

Default: Off

Specifies the time without comms before a trip will be generated.

Comm Failure Alarm

Range: Off, 5 to 25 step 5s

Default: Off

Specifies the time without comms before an alarm will be generated.

NOTE

Timing delay commences **after** failure is detected.

Change Mode on Comm Alarm

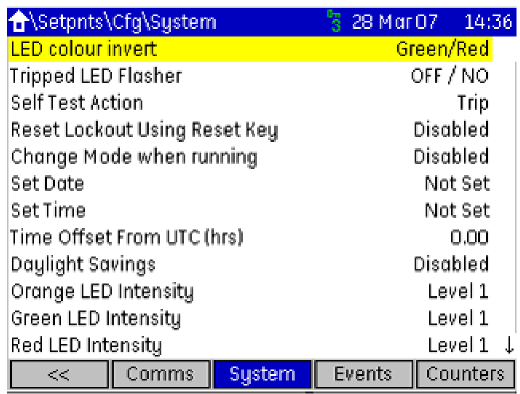
Range: Disabled, Enabled

Default: Disabled

If enabled, forces control mode to manual if comms are lost.

6.2.6 System

Figure 14: System setpoint page



The following setpoints are available.

LED Colour Invert

Range: Red/Green, Green/Red

Default: Green/Red

When set Red/Green, the colour of Running LED is red, and the colour of the Stopped LED is green. When set Green/Red the colour of the Running LED is green, and the colour of the Stopped LED is red.

Tripped LED Flasher

Range: ON/YES, OFF/NO

Default: OFF/NO

This setpoint determines whether the Tripped LED flashes or is steadily illuminated when there is a trip or lockout condition.

Self-Test Action

Range: Trip, Alarm

Default: Trip

This setpoint defines whether a self-test failure will cause a trip or an alarm.

For relay self-test, the MM300 runs a series of self-tests, including data and program memory integrity and program execution watchdogs. If any of these tests fail, a self-test trip or alarm is generated depending on the value of the setpoint.

Reset Lockout Using Reset Key

Range: Disabled/Enabled

Default: Disabled

If set to "enabled," the GCP/BCP reset key will perform a non-lockout and lockout reset.

CAUTION

When a Lockout Reset is used to reset a Thermal Overload, the Thermal Capacity % will be reset to zero.

Change Mode When Running

Range: Disabled/Enabled

Default: Enabled

If set to "enabled," the Auto/Manual mode can be changed while the motor is running.

Set Date

Set to program today's date.

Set Time

Set to program current time.

Time Offset from UTC

Range: -24 to +24 step 0.25

Default: 0.00

Enter the time in hours that your zone is off from Universal Time.

Daylight Savings

Range: Disabled/Enabled

Default: Disabled

Set to enable automatic time change based on the DS time setpoints.

Orange LED Intensity

Range: 1 to 6

Default: 1

Selects brightness level (1 to 6) for Control Panel LEDs.

Green LED Intensity

Range: 1 to 6

Default: 1

Selects brightness level (1 to 6) for Control Panel LEDs.

Red LED Intensity

Range: 1 to 6

Default: 1

Selects brightness level (1 to 6) for Control Panel LEDs.

User 1 LED Assignment, User 2 LED Assignment, User 3 LED Assignment

Range: any FlexLogic™ operand

Default: Not Set

Set to program the GCP/BCP user LEDs to follow an internal element.

USER 1 LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the USER 1 LED.

USER 2 LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the USER 2 LED.

USER 3 LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the USER 3 LED.

Screen Saver Feature

Range: Enabled, Disabled

Default: Enabled

Screen saver will become active after five (5) minutes of LCD inactivity. The LCD will switch off after this time interval. Timing is fixed.

Phasor Display

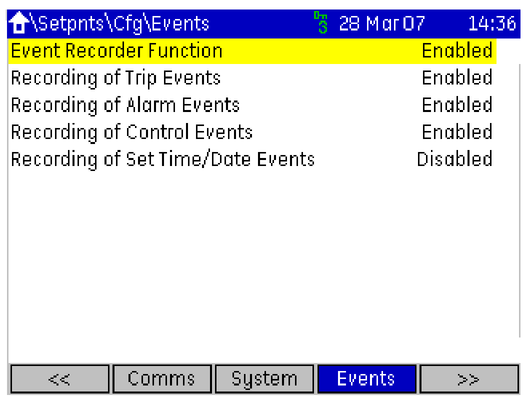
Range: Leading, Lagging

Default: Lagging

The customer has the choice to display either lagging or leading phasor quantities.

6.2.7 Events

Figure 15: Events setpoint page



The following setpoints are available.

Event Recorder Function

Range: Enabled, Disabled

Default: Enabled

Enables or disables the Event Recorder feature.

Recording of Trip Events

Range: Enabled, Disabled

Default: Enabled

Enables or disables the recording of Trip events.

Recording of Alarm Events

Range: Enabled, Disabled

Default: Enabled

Enables or disables the recording of Alarm events.

Recording of Control Events

Range: Disabled, Enabled

Default: Enabled

Enables or disables the recording of Control events.

Recording of Set Time/Date Events

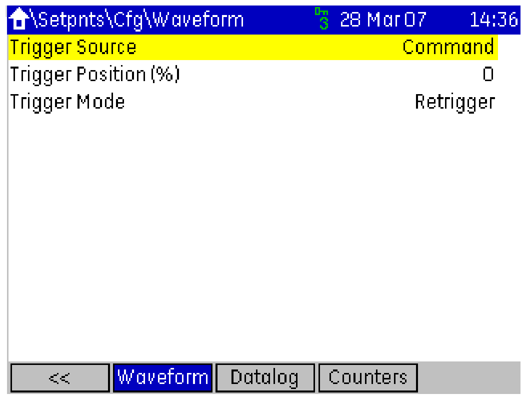
Range: Disabled, Enabled

Default: Disabled

Enables or disables the recording of Time and Date storage events.

6.2.8 Waveforms

Figure 16: Waveform setpoint page



The following setpoints are available:

Trigger Source

Range: Command, VO1 to VO32, Any Trip Pickup, Any Trip, Any Trip Dropout, Any Alarm Pickup, Any Alarm, Any Alarm Dropout, Any Stop, Start A, Start B

Default: Command

Selects a trigger source. Command is always active. Flexlogic can be used to create combinations of trigger sources.

Trigger Position

Range: 0 to 100% step 1%

Default: 0

Percentage of the sample buffer used for pretrigger samples.

Trigger Mode

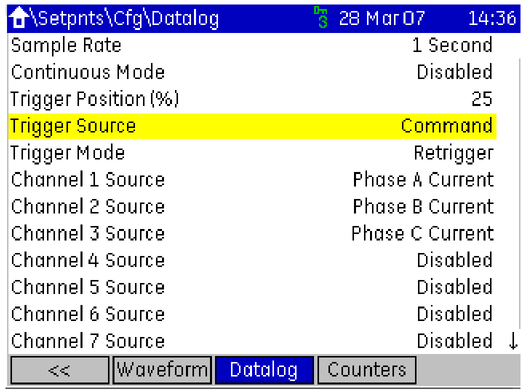
Range: Retrigger, One-shot

Default: Retrigger

Determines whether or not the trigger data is overwritten with new trigger data. Retrigger will overwrite the previous trigger data with the new trigger data. One-shot mode will keep the current trigger data until a manual Clear command is sent.

6.2.9 Datalog

Figure 17: Datalog setpoint page



The following setpoints are available:

Sample Rate

Range: 1 cycle, 1 second, 1 minute, 1 hour

Default: 1 second

Determines how often data is stored in the data log.

Continuous Mode

Range: Disabled, Enabled

Default: Disabled

Determines whether or not the trigger data is overwritten with new data. Enabled will overwrite the previous trigger data with new trigger data. When Disabled, the data log will run until filled with 256 samples. Continuous Mode should be used when the data is stored externally by a polling system. The sample rate should be chosen to match the poll rate of the external program.

Trigger Position

Range: 0 to 100% steps of 1%

Default: 25%

Percentage of the sample buffer used for pretrigger samples.

Trigger Source

Range: Command, VO1 to VO32, Any Trip Pickup, Any Trip, Any Trip Dropout, Any Alarm Pickup, Any Alarm, Any Alarm Dropout, Any Stop, Start A, Start B

Default: Command

Selects a trigger source. Command is always active. Flexlogic can be used to create combinations of trigger sources.

Channel 1 Source

Range: Disabled, Phase A Current, Phase B Current, Phase C Current, Average Phase Current, Motor Load, Current Unbalance, Ground Current, System Frequency, Vab, Vbc, Vca, Van, Vbn, Vcn, Power Factor, Real Power (kW), Reactive Power (kvar), Apparent Power (kVA), Positive Watthours, Positive Varhours, Hottest Stator RTD, Thermal Capacity Used, RTD #1, RTD #2, RTD #3, RTD #4, RTD #5, RTD #6

Default: Disabled

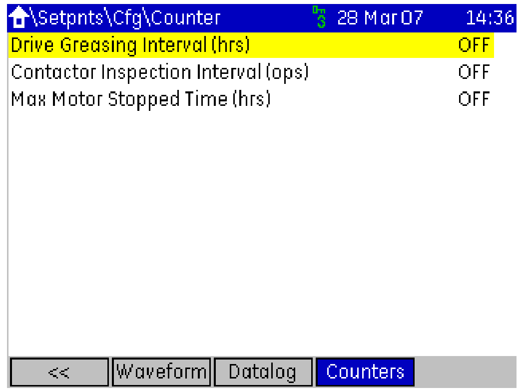
Selects the data to be stored for each sample of the data log channel.

NOTE

Sources and Defaults for Channels 2 to 10 are the same as those for Channel 1.

6.2.10 Counters

Figure 18: Counters setpoint page



The following setpoints are available:

Drive Greasing Inteval

Range: 100 to 50000 hours in steps of 100 hours, or OFF

Default: OFF

Enter the interval at which the motor bearings must be lubricated. When the motor running time exceeds this setpoint, a motor greasing interval alarm is generated. To clear the "Motor Running Hours," use the "Clear Maintenance Timers" command and start the motor. If this feature is not required, set this setpoint to OFF.

Contactor Inspection Interval

Range: 100 to 64900 operations in steps of 100 operations, or OFF

Default: OFF

Enter the interval after which the contactor contacts must be inspected for wear. When the Number of Starts counter exceeds this setpoint, a contactor inspection interval alarm is generated. To clear the "Number of Motor Starts," use the "Clear Counters" command. If this feature is not required, set this setpoint to OFF.

Max Motor Stopped Time

Range: 10 to 10000 hours in steps of 10 hours, or OFF

Default: OFF

Enter the maximum interval during which the motor can be left not running. When the Motor Stopped Time exceeeds this setpoint, a maximum motor stopped time alarm is generated. To clear the "Motor Stopped Hours," use the "Clear Maintenance Timers" command, and stop the motor. If this feature is not required, set this setpoint to OFF.

6.3 Protection elements

6.3.1 Thermal protection

The primary protective function of the MM300 is the thermal model. The MM300 integrates stator and rotor heating into a single model. The rate of motor heating is gauged by measuring the terminal currents. The present value of the accumulated motor heating is maintained in the **Thermal Capacity Used** actual value register. When the motor is in overload, the motor temperature and thermal capacity used will rise. A trip occurs when the thermal capacity used reaches 100%. When the motor is stopped and is cooling to ambient, the thermal capacity used decays to zero. If the motor is running normally, the motor temperature will eventually stabilize at some steady state temperature, and the thermal capacity used increases or decreases to some corresponding intermediate value, which accounts for the reduced amount of thermal capacity left to accommodate transient overloads.

The thermal model consists of six key elements.

- Unbalance current biasing that accounts for negative-sequence heating.
- Hot/cold biasing that accounts for normal temperature rise.
- RTD biasing that accounts for ambient variation and cooling problems
- An overload curve that accounts for the rapid heating that occurs during stall, acceleration, and overload.
- Cooling rate that accounts for heat dissipation.
- Thermal protection reset that controls recovery from thermal trips and lockouts.

Each of these categories are described in the following sub-sections.

6.3.1.1 Unbalance biasing

Unbalanced phase currents (that is, negative-sequence currents) cause rotor heating in addition to the normal heating caused by positive-sequence currents. When the motor is running, the rotor rotates in the direction of the positive-sequence MMF wave at near synchronous speed. The induced rotor currents are at a frequency determined by the difference between synchronous speed and rotor speed, typically 2 to 4 Hz. At these low frequencies the current flows equally in all parts of the rotor bars, right down to the inside portion of the bars at the bottom of the slots. On the other hand, negative-sequence stator current causes an MMF wave with a rotation opposite to rotor rotation, which induces rotor current with a frequency approximately two times the line frequency (100 Hz for a 50 Hz system or 120 Hz for a 60 Hz system.) The skin effect at this frequency restricts the rotor current to the outside portion of the bars at the top of the slots, causing a significant increase in rotor resistance and therefore significant additional rotor heating. This extra heating is not accounted for in the thermal limit curves supplied by the motor manufacturer, as these curves assume only positive-sequence currents from a perfectly balanced supply and balanced motor construction.

To account for this additional heating, the MM300 allows for the thermal model to be biased with negative-sequence current. This biasing is accomplished by using an equivalent motor heating current rather than the simple motor terminal current (I_{avg}). This equivalent current is calculated as shown in the following equation.

$$I_{eq} = I_{avg} \times \sqrt{1 + k \times \left(\frac{I_2}{I_1}\right)^2} \qquad \textbf{Eq. 1}$$

In the above equation:

- I_{eq} represents the equivalent motor heating current in per-unit values on an FLA base.
- I_{avg} represents the average RMS current at each motor terminals in per-unit values on an FLA base.
- I_2 / I_1 represents the negative-sequence to positive-sequence current ratio.
- k represents the value of the **Unbalance K Factor** setpoint, used to adjust the degree of unbalance biasing.

The value for k may be estimated as follows.

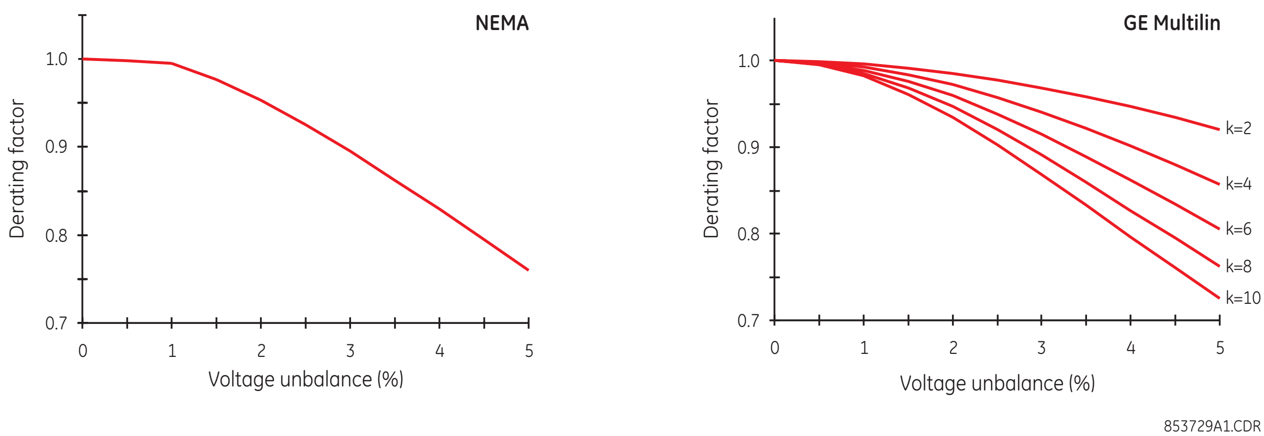
$$k = \frac{175}{I_{LR}^2} \text{ (typical estimate); } k = \frac{230}{I_{LR}^2} \text{ (conservative estimate)} \qquad \textbf{Eq. 2}$$

In the above equation, I_{LR} represents the locked rotor current in per-unit values on an FLA base.

If a k value of 0 is entered, the unbalance biasing is defeated and the overload curve will time out against the average per-unit motor current.

The following figure shows recommended motor derating as a function of voltage unbalance recommended by NEMA (the National Electrical Manufacturers Association). To illustrate the MM300 unbalance biasing, assume a typical induction motor with an inrush of 6 × FLA and a negative-sequence impedance of 0.167. With this impedance, voltage unbalances of 1, 2, 3, 4, and 5% on the motor terminals will result in current unbalances of 6, 12, 18, 24, and 30%, respectively. Based on these assumptions, the derating resulting from the MM300 unbalance biasing for different values of k is as illustrated in the GE Multilin curve below. Note that the curve for k = 8 is almost identical to the NEMA derating curve.

Figure 19: Motor derating factor due to unbalanced voltage



6.3.1.2 Hot/cold biasing

When the motor is running with a constant load below the overload level, the motor will eventually reach a steady state temperature, which corresponds to a particular steady-state thermal capacity used. As some thermal capacity is used, there is less thermal capacity left in the motor to cover transient overloads than is available when the motor is cold. Typically, the extent of this effect is calculated by taking the ratio of the motor's rated hot safe stall time to its rated cold safe stall time. The safe stall time (also known as locked rotor time) is the time taken with the rotor not turning for the motor to heat to a temperature beyond which motor damage occurs at an unacceptable rate. The term 'cold' refers to starting off with the motor at ambient temperature, while 'hot' refers to starting off with the motor at the temperature reached when running at rated load. The method the thermal model uses to account for the pre-overload state is thus known as hot/cold biasing.

The MM300 calculates the steady-state thermal capacity used according to the following equation.

$$TCU_{SS} = I_{eq} \times (100\% - HCR) \quad \textbf{Eq. 3}$$

In the above equation:

- TCU_{SS} represents the steady-state thermal capacity used expressed as a percentage.
- I_{eq} represents the equivalent motor heating current in per-unit values on an FLA base. Refer to unbalance biasing for additional details.
- HCR represents the value of the **Hot/Cold Safe Stall Ratio** setpoint expressed as a percentage.

If a **Hot/Cold Safe Stall Ratio** value of 100% is entered, the hot/cold biasing is defeated, and unless RTD biasing is deployed, the thermal model will operate as if the motor was cold prior to overload.

6.3.1.3 RTD biasing

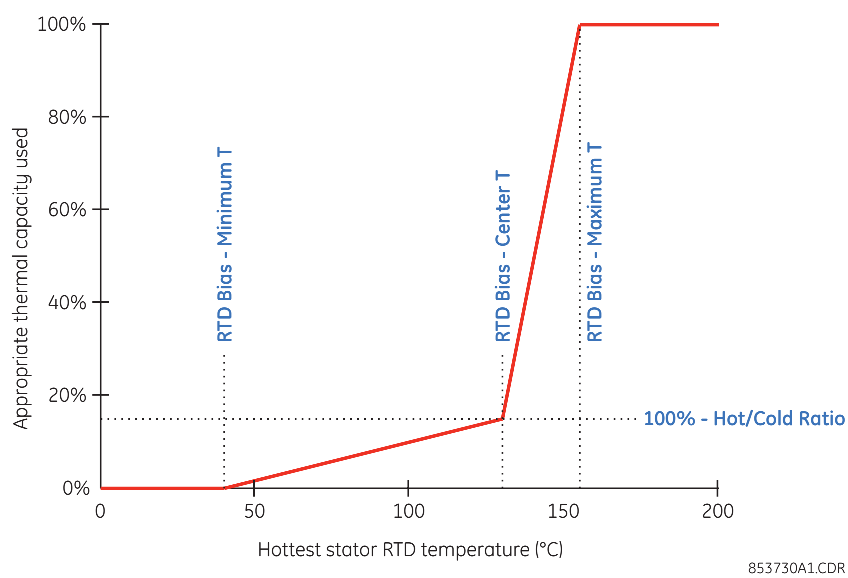
The thermal model can operate based solely on measured current and the assumption of rated ambient and normal motor cooling, as described earlier. However, if the ambient temperature is unusually high, or motor cooling is blocked, the motor will have a non-modeled temperature increase. The RTD biasing feature can correct for this by forcing the **Thermal Capacity Used** register up to the value appropriate to the temperature of the hottest stator RTD. Since RTDs are relatively slow, the rest of the thermal model is still required during starting and heavy overload conditions when motor heating is relatively fast. Thus the RTD bias feature does not prevent the thermal capacity used value from rising above the value appropriate to the RTD temperature.

The value of the **Thermal Capacity Used** register appropriate to the RTD temperature is determined by the straight line segmented curve shown in the following figure. This curve is characterized by minimum, center, and maximum temperature values, and by the hot/cold ratio value.

NOTE

The RTD bias feature alone cannot create a trip. If the RTD bias forces thermal capacity used to 100%, the motor current must be above FLA before an overload trip can occur.

Figure 20: RTD bias curve



6.3.1.4 Overload curve

The overload curve accounts for the rapid motor heating that occurs during stall, acceleration, and overload. Specifically, the overload curve controls the rate of increase of **Thermal Capacity Used** whenever the equivalent motor heating current is greater than 1.01 times the full load current setpoint. The curve is defined by the following equation and reflects that overload heating largely swamps the cooling, and this heating is primarily due to resistive losses in the stator and the rotor windings (said losses being proportional to the square of the current).

$$\text{Trip time} = \frac{\text{Curve Multiplier} \times 2.2116623}{0.02530337 \times (\text{Pickup} - 1)^2 + 0.05054758 \times (\text{Pickup} - 1)} \qquad \textbf{Eq. 4}$$

In the above equation,

- The trip time represents the time (in seconds) for the MM300 to trip, given the motor starts cold and the current is constant.
- The multiplier represents the value of the **Curve Multiplier** setpoint. This setpoint can be used to adjust the curve to match the thermal characteristics of the motor.
- I_{eq} represents the equivalent motor heating current in per-unit values on a full load current base. The value of I_{eq} is limited in this equation to 8.0 to prevent the overload from acting as an instantaneous element and responding to short circuits. Equivalent motor heating current is discussed in the *Unbalance biasing* section.

For example, a motor with a stall current (also known as locked rotor current) of 8 times its FLA, with a curve multiplier of 7, if stalled from a cold state, trips in the following amount of time.

$$\text{Trip time} = \frac{\text{Curve Multiplier} \times 2.2116623}{0.02530337 \times (\text{Pickup} - 1)^2 + 0.05054758 \times (\text{Pickup} - 1)}$$

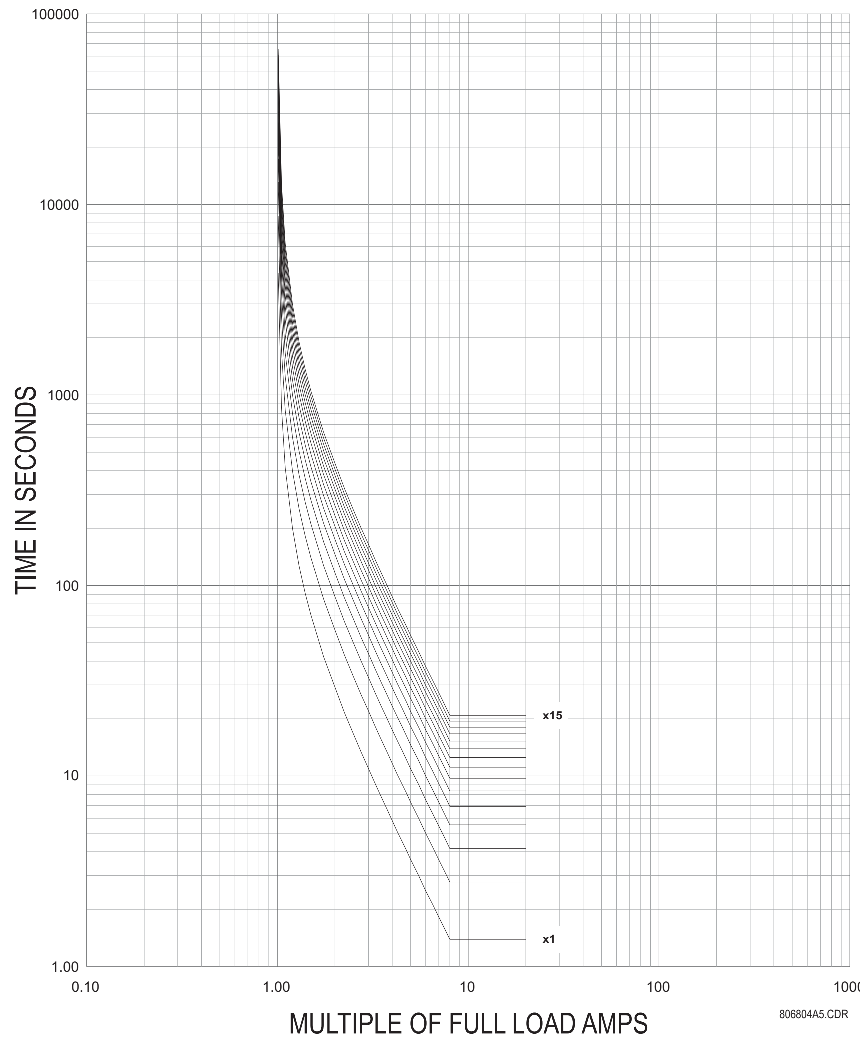
$$= \frac{7 \times 2.2116623}{0.02530337 \times (8 - 1)^2 + 0.05054758 \times (8 - 1)}$$

$$= 9.714 \text{ seconds} \qquad \textbf{Eq. 5}$$

This would respect a safe stall cold time of 10 seconds.

The standard overload curves are displayed below.

Figure 21: Standard overload curves



The trip times for the standard overload curves are tabulated below.

Table 1: Standard overload curve trip times (in seconds)

PICKUP (× FLA)	STANDARD CURVE MULTIPLIERS														
	× 1	× 2	× 3	× 4	× 5	× 6	× 7	× 8	× 9	× 10	× 11	× 12	× 13	× 14	× 15
1.01	4353.6	8707.2	13061	17414	21768	26122	30475	34829	39183	43536	47890	52243	56597	60951	65304
1.05	853.71	1707.4	2561.1	3414.9	4268.6	5122.3	5976.0	6829.7	7683.4	8537.1	9390.8	10245	11098	11952	12806
1.10	416.68	833.36	1250.0	1666.7	2083.4	2500.1	2916.8	3333.5	3750.1	4166.8	4583.5	5000.2	5416.9	5833.6	6250.2
1.20	198.86	397.72	596.58	795.44	994.30	1193.2	1392.0	1590.9	1789.7	1988.6	2187.5	2386.3	2585.2	2784.1	2982.9
1.30	126.80	253.61	380.41	507.22	634.02	760.82	887.63	1014.4	1141.2	1268.0	1394.8	1521.6	1648.5	1775.3	1902.1
1.40	91.14	182.27	273.41	364.55	455.68	546.82	637.96	729.09	820.23	911.37	1002.5	1093.6	1184.8	1275.9	1367.0
1.50	69.99	139.98	209.97	279.96	349.95	419.94	489.93	559.92	629.91	699.90	769.89	839.88	909.87	979.86	1049.9
1.75	42.41	84.83	127.24	169.66	212.07	254.49	296.90	339.32	381.73	424.15	466.56	508.98	551.39	593.81	636.22
2.00	29.16	58.32	87.47	116.63	145.79	174.95	204.11	233.26	262.42	291.58	320.74	349.90	379.05	408.21	437.37
2.25	21.53	43.06	64.59	86.12	107.65	129.18	150.72	172.25	193.78	215.31	236.84	258.37	279.90	301.43	322.96
2.50	16.66	33.32	49.98	66.64	83.30	99.96	116.62	133.28	149.94	166.60	183.26	199.92	216.58	233.24	249.90
2.75	13.33	26.65	39.98	53.31	66.64	79.96	93.29	106.62	119.95	133.27	146.60	159.93	173.25	186.58	199.91
3.00	10.93	21.86	32.80	43.73	54.66	65.59	76.52	87.46	98.39	109.32	120.25	131.19	142.12	153.05	163.98
3.25	9.15	18.29	27.44	36.58	45.73	54.87	64.02	73.16	82.31	91.46	100.60	109.75	118.89	128.04	137.18
3.50	7.77	15.55	23.32	31.09	38.87	46.64	54.41	62.19	69.96	77.73	85.51	93.28	101.05	108.83	116.60
3.75	6.69	13.39	20.08	26.78	33.47	40.17	46.86	53.56	60.25	66.95	73.64	80.34	87.03	93.73	100.42
4.00	5.83	11.66	17.49	23.32	29.15	34.98	40.81	46.64	52.47	58.30	64.13	69.96	75.79	81.62	87.45
4.25	5.12	10.25	15.37	20.50	25.62	30.75	35.87	41.00	46.12	51.25	56.37	61.50	66.62	71.75	76.87
4.50	4.54	9.08	13.63	18.17	22.71	27.25	31.80	36.34	40.88	45.42	49.97	54.51	59.05	63.59	68.14
4.75	4.06	8.11	12.17	16.22	20.28	24.33	28.39	32.44	36.50	40.55	44.61	48.66	52.72	56.77	60.83
5.00	3.64	7.29	10.93	14.57	18.22	21.86	25.50	29.15	32.79	36.43	40.08	43.72	47.36	51.01	54.65
5.50	2.99	5.98	8.97	11.96	14.95	17.94	20.93	23.91	26.90	29.89	32.88	35.87	38.86	41.85	44.84
6.00	2.50	5.00	7.49	9.99	12.49	14.99	17.49	19.99	22.48	24.98	27.48	29.98	32.48	34.97	37.47
6.50	2.12	4.24	6.36	8.48	10.60	12.72	14.84	16.96	19.08	21.20	23.32	25.44	27.55	29.67	31.79
7.00	1.82	3.64	5.46	7.29	9.11	10.93	12.75	14.57	16.39	18.21	20.04	21.86	23.68	25.50	27.32
7.50	1.58	3.16	4.75	6.33	7.91	9.49	11.08	12.66	14.24	15.82	17.41	18.99	20.57	22.15	23.74
8.00	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.10	12.49	13.88	15.27	16.65	18.04	19.43	20.82

The following tables illustrate the relation between GE Multilin MM2 and MM3 curve numbers, NEMA curves, and the MM300 curve multipliers.

Table 2: MM2 and MM3 curve numbers and MM300 curve multipliers

MM2 and MM3 curve number	1	2	3	4	5	6	7	8
MM300 curve multiplier	1	2	3	4	7	9	12	15

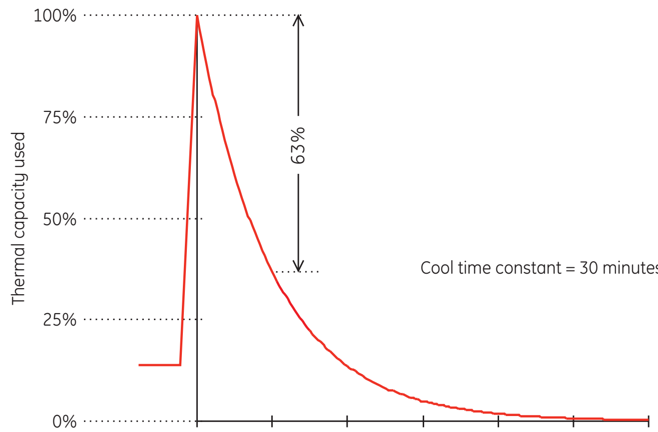
Table 3: NEMA curves and MM300 curve multipliers

NEMA curve	Class 10	Class 15	Class 20	Class 30
MM300 curve multiplier	4	6	8	12

6.3.1.5 Cooling rate

The model causes the thermal capacity used to decrease exponentially when the steady-state thermal capacity used value is less than the actual thermal capacity used. This simulates motor cooling. As a stopped motor normally cools significantly slower than a running motor, the relay has two cooling time constant setpoints, one used when the motor is off (stopped, tripped, locked out, pre-contactor, etc.), the other used when the motor is on (starting, running, stopping). In each case, the time constant is time in minutes for the motor temperature to cool by 63% of the difference between the initial temperature and ambient temperature.

Figure 22: Thermal model cooling following a trip at *t* = 0



6.3.1.6 Thermal protection reset

Operating at the thermal model protection limit is a serious event, and results in a lockout that can not be reset until the motor has cooled, except with a level 2 or level 3 security login. A setpoint is available (Minimize Reset Time - see *section 6.3.1*) that controls whether a lockout persists until the motor has cooled up to the point at which the thermal capacity used reaches 15% (approximately twice the cool time stopped setpoint), or until the relay itself estimates - based on learned thermal capacity used on start - that the motor has cooled sufficiently for a successful restart. For the latter situation, a 2% safety margin is included. While in lockout, the motor can not be started via the MM300. Refer to *6.4.2 - Thermal Start Inhibit* for details.

If the motor is re-started it may re-trip quickly. Should process interruption concerns outweigh the probable damage to the motor that early starting would incur, an external circuit should be added that bypasses the relay to directly close the motor contactor.

A second setpoint controls whether once the motor has cooled as described above, the lockout is replaced with a trip that can be manually reset without security login, or alternatively the condition is fully reset allowing immediate restart.

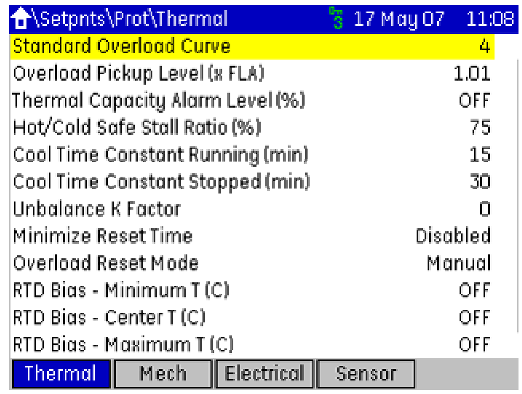
CAUTION

When the "Reset Lockout Using Reset Key" set point is set to "Enabled," pressing the Reset key will reset all Lockout and Non-Lockout trips. When this Lockout Reset is used to reset a Thermal Overload, the Thermal Capacity % will be reset to zero.

6.3.1.7 Thermal protection setpoints

Select the **Home > Setpoints > Protection > Thermal** page to edit the thermal protection setpoints.

Figure 23: Thermal protection configuration setpoints



The following setpoints are available for thermal protection.

Standard Overload Curve

Range: 1 to 15 in steps of 1

Default: 4

This setpoint specifies the standard overload curve to the thermal characteristics of the protected motor.

Unbalance K Factor

Range: 0 to 19 in steps of 1

Default: 0

This setpoint specifies the degree of unbalance biasing used by the thermal model. A value of "0" disables the unbalance bias feature.

Hot/Cold Safe Stall Ratio

Range: 1 to 100% in steps of 1

Default: 75%

This setpoint is used to control the hot/cold bias and RTD bias features. It specifies the ratio of the rated hot safe stall time to the rated cold safe stall time as a percentage. A value of "100%" disables the hot/cold bias feature.

Cool Time Constant Stopped

Range: 1 to 1000 minutes in steps of 1

Default: 30 minutes

This setpoint specifies the cooling time constant used by the thermal model when the motor is stopped. Enter the time in minutes for the temperature to cool by 63% of the difference between the initial value and ambient when the motor is stationary.

Cool Time Constant Running

Range: 1 to 1000 minutes in steps of 1

Default: 15 minutes

This setpoint specifies the cooling time constant used by the thermal model when the motor is running. Enter the time in minutes for the temperature to cool by 63% of the difference between the initial value and ambient when the motor is at speed.

RTD Bias - Minimum T

Range: 0 to 250°C in steps of 1 or OFF

Default: OFF

This setpoint specifies the stator RTD temperature appropriate for a thermal capacity used value of zero. If RTD bias is to be deployed, enter the rated ambient temperature. A value of "0" or a value greater than the **RTD Bias – Center T** setpoint disables the RTD bias feature.

RTD Bias - Center T

Range: 0 to 250°C in steps of 1 or OFF

Default: OFF

This setpoint specifies the stator RTD temperature appropriate for a thermal capacity used value of 100% – **Hot/Cold Ratio**. If RTD bias is to be deployed, enter the rated full load motor running temperature. A value of "0" or a value greater than the **RTD Bias – Maximum T** setpoint disables the RTD bias feature.

RTD Bias - Maximum T

Range: 0 to 250°C in steps of 1 or OFF

Default: OFF

This setpoint specifies the stator RTD temperature appropriate for a thermal capacity used value of 100%. If RTD bias is to be deployed, enter the stator insulation temperature rating. A value of "0" or a value greater than the **RTD Bias – Center T** setpoint disables the RTD bias feature.

Minimize Reset Time

Range: Enabled, Disabled

Default: Disabled

When set to "Disabled", the lockout condition following a thermal protection operation will persist until the thermal capacity used has dropped to 15%. When set to "Enabled", the lockout persists until the thermal capacity used has dropped to 2% below the learned thermal capacity used at start (refer to *6.4.2 - Thermal Start Inhibit* for details).

Overload Reset Mode

Range: Manual, Auto

Default: Manual

If this setpoint value is "Auto", an automatic reset of overload lockouts occurs after the motor has cooled as described above. When set to "Manual", the lockouts are replaced with trips when the motor cools, the trips must be reset by the control panel, by remote contact or by communications before the motor can be restarted.

Thermal Capacity Alarm Level

Range: 10 to 100% in steps of 1 or OFF

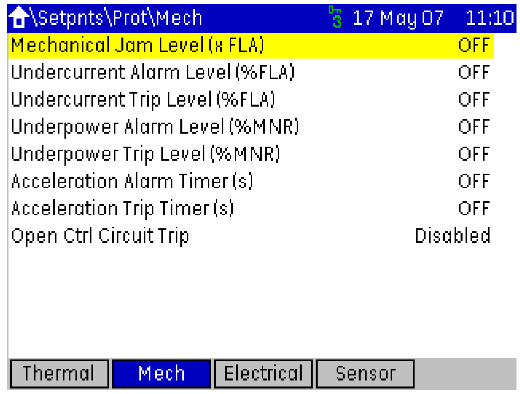
Default: OFF

This setpoint specifies the amount of thermal capacity used, equal to or above that at which the thermal level alarm is issued.

6.3.2 Mechanical protection

Select the **Home > Setpoints > Protection > Mech** page to edit the mechanical protection setpoints.

Figure 24: Mechanical protection configuration setpoints



The mechanical protection setpoints are divided into the following categories.

- Mechanical jam
- Undercurrent protection
- Underpower protection
- Acceleration protection
- Open control circuit trip.

The setpoints applicable to each of these categories are described in the following sections.

6.3.2.1 Mechanical jam

After the motor has started and reached a running state, the mechanical jam element (if enabled) produces a trip when the magnitude of Ia, Ib, or Ic reaches or exceeds the pickup level for the time specified by the **Mechanical Jam Delay** setpoint. This feature may be used to indicate a stall condition when running. Not only does it protect the motor by taking it off-line faster than the thermal model (overload curve), it may also prevent or limit damage to the driven equipment if motor starting torque persists on jammed or broken equipment.

The **Mechanical Jam Level** should be set higher than motor loading during normal operation, but lower than the motor stall level. Normally the delay is set to the minimum time delay or to avoid nuisance trips due to momentary load fluctuations.

The following setpoints are available for the mechanical jam element.

Mechanical Jam Level

Range: 1.01 to 4.50 × FLA in steps of 0.01 or OFF

Default: OFF

This setpoint specifies the current pickup level. Set this value to “OFF” to disable mechanical jam protection.

Mechanical Jam Delay

Range: 0.1 to 30.0 seconds in steps of 0.1

Default: 0.1 seconds

This setpoint specifies the time that the motor current must reach or exceed pickup to generate a mechanical jam trip.

6.3.2.2 Undercurrent protection

When the motor is in the running state, a trip or alarm will occur should the magnitude Ia, Ib, or Ic fall below the pickup level for the time specified by the **Undercurrent Alarm Delay**. The pickup levels should be set lower than the lowest motor loading during normal operations.

The following setpoints are available for the undercurrent protection element.

Undercurrent Trip Level

Range: 1 to 100% of FLA or OFF

Default: OFF

This setpoint specifies the undercurrent trip pickup level. A value of “OFF” disables the undercurrent trip function.

Undercurrent Trip Delay

Range: 1 to 60 seconds in steps of 1

Default: 1 second

This setpoint specifies the time that the motor current must exceed pickup to generate a trip.

Undercurrent Alarm Level

Range: 1 to 100% of FLA or OFF

Default: OFF

This setpoint specifies the undercurrent alarm pickup level. A value of “OFF” disables the undercurrent alarm function.

Undercurrent Alarm Delay

Range: 1 to 60 seconds in steps of 1

Default: 1 seconds

This setpoint represents the time that the motor current must exceed pickup to generate an alarm.

For example, if a pump is cooled by the liquid it pumps, loss-of-load may mean that the pump overheats. In this case, the undercurrent feature is enabled. To prevent motor loading from falling below 0.75 × FLA, even for short durations, the **Undercurrent Trip Level** could be set to “70%” and the **Undercurrent Alarm Level** to “75%”. The **Undercurrent Trip Delay** and **Undercurrent Alarm Delay** setpoints are typically set as quick as possible (that is, 1 second).

6.3.2.3 Underpower protection

Underpower protection is available whether or not a type I0_B module (3 x VT) is included in the order code. When this option is included, the power is calculated using the voltages connected to this card. When this option is not included, the power is calculated using the auxiliary voltage and assumes that the missing voltages are balanced.

When the motor is in the running state, a trip or alarm will occur if the magnitude of the real power falls below the pickup level for the time specified by the **Underpower Alarm Delay** setpoint. The pickup levels should be less than the lowest motor loading during normal operations.

Setpoint levels are a percentage of MNR, where MNR is the "Motor Rating Setpoint."

The following setpoints are available for the underpower protection feature.

Underpower Trip Level

Range: 1 to 100% MNR in steps of 1 or OFF

Default: OFF

This setpoint specifies the underpower trip pickup level. A value of “OFF” disables the underpower trip function.

Underpower Trip Delay

Range: 1 to 60 seconds in steps of 1

Default: 1 second

The setpoint specifies the amount of time the motor power must meet or exceed the trip pickup level to generate a trip.

Underpower Alarm Level

Range: 1 to 100% MNR in steps of 1 or OFF

Default: OFF

This setpoint specifies the underpower alarm pickup level. A value of “OFF” disables the underpower alarm function.

Underpower Alarm Delay

Range: 1 to 60 seconds in steps of 1

Default: 1 second

The setpoint specifies the amount of time the motor current must exceed the alarm pickup level to generate an alarm.

For example, underpower may be used to detect loss-of-load conditions. A loss-of-load condition will not always cause a significant loss of current. Power is a more accurate representation of loading and may be used for more sensitive detection of load loss or pump cavitation. This may be especially useful for detecting process related problems.

6.3.2.4 Acceleration protection

The thermal model protects the motor under both starting and overload conditions. The acceleration timer trip may be used to complement this protection. For example, if the motor always starts in 2 seconds, but the safe stall time is 8 seconds, there is no point letting the motor remain in a stall condition for the 7 or 8 seconds it would take for the thermal model to operate. Furthermore, the starting torque applied to the driven equipment for that period of time could cause severe damage.

If enabled, the acceleration protection will trip if the motor stays in the starting state and does not reach the running state by the set acceleration time.

The acceleration protection setpoints and logic are described below.

Acceleration Alarm Timer(s)

Range: 0.5 to 250.0 seconds in steps of 0.1 or OFF

Default: OFF

This setpoint specifies the maximum acceleration time before alarming. A value of “OFF” disables the acceleration protection alarm.

Acceleration Trip Timer(s)

Range: 0.5 to 250.0 seconds in steps of 0.1 or OFF

Default: OFF

This setpoint specifies the maximum acceleration time before tripping. A value of “OFF” disables acceleration protection tripping.

Open Control Circuit Trip

Range: Enable, Disable

Set to Enable if the MM300 should trip when an open control circuit is detected.

6.3.3 Electrical protection

6.3.3.1 Current unbalance protection

When an unbalance or phase current exceeds the setpoints, an alarm or trip condition is generated.

The calculation method is as follows:

$$\text{If } I_{AV} \geq I_{FLA}: \quad UB\% = \frac{|I_M - I_{AV}|}{I_{AV}} \times 100\%$$

$$\text{If } I_{AV} \leq I_{FLA}: \quad UB\% = \frac{|I_M - I_{AV}|}{I_{FLA}} \times 100\%$$

Where:
I_{AV} = average phase current
I_M = current in a phase with maximum deviation from I_{AV}
I_{FLA} = MOTOR FULL LOAD CURRENT setpoint

Current Unbalance Trip Level

Range: 4 to 40%, in steps of 1, or OFF

Default: 30%

This setpoint specifies the current unbalance trip pickup level. A value of “OFF” disables the current unbalance trip function.

Current Unbalance Trip Delay

Range: 1 to 60 seconds in steps of 1

Default: 1 second

This setpoint specifies the time the motor unbalance current must meet or exceed pickup to generate a trip.

Current Unbalance Alarm Level

Range: 4 to 40%, in steps of 1, or OFF

Default: 15%

This setpoint specifies the current unbalance alarm pickup level. A value of “OFF” disables the current unbalance alarm function.

Current Unbalance Alarm Delay

Range: 1 to 60 seconds in steps of 1

Default: 1 second

This setpoint specifies the time the motor unbalance current must meet or exceed pickup to generate an alarm.

6.3.3.2 Ground fault protection

When motor stator windings become wet or otherwise suffer insulation deterioration, low magnitude leakage currents often precede complete failure and resultant destructive fault currents. Ground fault protection provides early detection of such leakage current, allowing the motor to be taken offline in time to limit motor damage. However, if a high magnitude ground fault occurs that is beyond the capability of the contactor to interrupt, it is desirable to wait for the fuses or an upstream device to provide the interruption.

The ground fault protection will alarm or trip when the ground current magnitude meets or exceeds the pickup for the specified time, provided that the maximum phase current is less than 8 × FLA. When used with a core-balance CT, this protection becomes a sensitive ground fault protection.

A ground fault trip is a serious event, and therefore results in a lockout that can not be reset until the motor has cooled except with a level 2 or level 3 security login.

NOTE

The ground fault protection pickup setpoints are entered in %FLA if the **Ground CT** setpoint is selected as "Residual," or in units of primary amps if a 50:0.025 core balance CT is used and the ground CT is selected as “CBCT 2000:1”.

Various situations (for example, contactor bounce) may cause transient ground currents during motor starting that exceed the ground fault pickup levels for a very short period of time. The delay can be fine-tuned to an application so it still responds very quickly, but rides through normal operational disturbances. Normally, the ground fault time delays are set as short as possible, that is, 0 ms. Time may have to be increased if nuisance tripping occurs.

Special care must be taken when the ground input is wired to the phase CTs in a residual connection. When a motor starts, the starting current (typically 6 × FLA for an induction motor) has an asymmetrical or DC component. This momentary DC component will cause each of the phase CTs to react differently, and cause a net current into the ground input of the relay.

The following setpoints are available for the ground fault protection element.

[Path: Home > Setpoints > Protection > Electrical]

Ground Trip Level

Range: 10 to 100% FLA in steps of 1%, or OFF, when Ground CT type is set to "Residual"
Range: 0.5 to 15.0 A in steps of 0.1 A, when Ground CT type is set to "CBCT 2000:1"
Default: OFF

This setpoint specifies the ground fault trip pickup level. A value of “OFF” disables the ground fault trip function.

Ground Trip Delay on Start

Range: 0.0 to 10.0 s in steps of 0.1 s
Default: 0.0 s

This setpoint specifies the time that the motor ground fault current must meet or exceed pickup to generate a ground fault trip when the motor is in a starting condition.

Ground Trip Delay on Run

Range: 0.0 to 5.0 s in steps of 0.1 s
Default: 0.0 s

This setpoint specifies the time that the motor ground fault current must meet or exceed pickup to generate a ground fault trip when the motor is in a running condition.

Ground Alarm Level

Range: 10 to 100% FLA in steps of 1%, or OFF, when Ground CT type is set to "Residual"
Range: 0.5 to 15.0 A in steps of 0.1 A, when Ground CT type is set to "CBCT 2000:1"
Default: OFF

The setpoint specifies the ground fault alarm pickup level. A value of “OFF” disables the ground fault alarm function.

Ground Alarm Delay on Start

Range: 0 to 60 s in steps of 1 s
Default: 10 s

This setpoint specifies the time that the motor ground fault current must meet or exceed pickup to generate a ground fault alarm.

Ground Alarm Delay on Run

Range: 0 to 60 s in steps of 1 s
Default: 10 s

This setpoint specifies the time that the motor ground fault current must meet or exceed pickup to generate a ground fault alarm.

6.3.3.3 Load increase alarm

The load increase alarm is used to alarm abnormal load increases that may indicate problems with the process. An alarm is enabled only after the acceleration phase is complete and the motor has entered the running phase, and then only if the current has fallen below the set pickup or one minute has elapsed. Once enabled, the alarm is generated when the current exceeds the set pickup, and automatically resets when the current has subsided.

The following setpoints are available.

[Path: Home > Setpoints > Protection > Electrical]

Load Increase Alarm Level

Range: 50 to 150% of FLA in steps of 1, or OFF
Default: OFF

This setpoint specifies the load increase alarm pickup level. A value of "OFF" disables the load increase alarm.

6.3.3.4 Phase undervoltage

An undervoltage on a running motor with a constant load results in increased current. The relay thermal model typically picks up this condition and provides adequate protection. However, the phase undervoltage element may be used to provide for an advance warning alarm and/or for tripping before the motor has heated.

In some motor manager relays, the undervoltage feature is used for additional conditions. Instead, the MM300 uses the undervoltage restart element to handle loss of supply, and the fuse fail element to cover main and VT fuse failure.

The element generates alarms or trips when any of the three phase-to-phase voltages meets or falls below the pickup level.

NOTE

Phase undervoltage protection is available only when a type B option card (3 × VT) is included in the order code.

The following setpoints are available.

[Path: Home > Setpoints > Protection > Electrical]

Undervoltage Alarm Level

Range: 60 to 99% of MNV in steps of 1, or OFF
Default: OFF

This setpoint specifies the phase undervoltage alarm pickup level as a percentage of the rated voltage.

Undervoltage Alarm Delay

Range: 1 to 60 seconds in steps of 1second
Default: 30 seconds

This setpoint specifies the time that the voltage must be less than or equal to, the undervoltage alarm pickup level to generate an alarm.

Undervoltage Trip Level

Range: 60 to 99% of MNV in steps of 1, or OFF
Default: OFF

This setpoint specifies the phase undervoltage trip pickup level as a percentage of the rated voltage.

Undervoltage Trip Delay

Range: 1 to 60 seconds in steps of 1 second

Default: 30 seconds

This setpoint specifies the time that the voltage must be less than or equal to, the undervoltage trip level to generate a trip.

6.3.3.5 Auxiliary undervoltage

Undervoltage on the motor supply can present problems for both starting and running the motor. The phase undervoltage element may be used to protect against these problems, however it requires the 3 × VT input option B card to be installed. The auxiliary undervoltage element may be used if there is no installed option B card, the relay auxiliary VT input is derived from the motor supply, and where errors introduced by the control power transformer can be tolerated.

The following setpoints are available for the auxiliary undervoltage protection element.

[Path: Home > Setpoints > Protection > Electrical]

Aux Undervoltage Alarm

Range: 60 to 90% of NCV in steps of 1, or OFF

Default: OFF

This setpoint specifies the auxiliary undervoltage alarm level.

Aux Undervoltage Alarm Delay

Range: 1 to 60 seconds in steps of 1

Default: 5 seconds

This setpoint specifies the auxiliary undervoltage alarm delay.

Aux Undervoltage Trip

Range: 60 to 90% of NCV in steps of 1, or OFF

Default: OFF

This setpoint specifies the auxiliary undervoltage trip level.

Aux Undervoltage Trip Delay

Range: 1 to 60 seconds in steps of 1

Default: 5 seconds

This setpoint specifies the auxiliary undervoltage trip delay.

For additional information, refer to:

Phase undervoltage

6.3.3.6 Phase overvoltage

An overvoltage on a running motor with a constant load results in decreased current. However, iron losses increase, causing an increase in motor temperature. The current overload element will not pickup this condition and provide adequate protection. Therefore, the overvoltage element may be useful for protecting the motor in the event of a sustained overvoltage condition.

If this element is enabled, a trip or alarm will occur once the magnitude of either V_{ab}, V_{bc}, or V_{ca} meets or rises above the pickup level for a user-specified period of time.

NOTE

Phase overvoltage protection is available only when a type IO_B option card (3 × VT) is specified in the order code.

The following setpoints are available for the phase overvoltage element.

[Path: Home > Setpoints > Protection > Electrical]

Overvoltage Alarm Level

Range: 101 to 120% of MNV in steps of 1, or OFF

Default: OFF

This setpoint specifies the overvoltage alarm pickup level as a percentage of the rated voltage.

Overvoltage Alarm Delay

Range: 1 to 60 seconds in steps of 1 s

Default: 30 seconds

This setpoint specifies the time that the voltage must meet or exceed the overvoltage alarm pickup level to generate an alarm.

Overvoltage Trip Level

Range: 101 to 120% of MNV in steps of 1, or OFF

Default: OFF

This setpoint specifies the overvoltage trip pickup level as a percentage of the rated voltage.

Overvoltage Trip Delay

Range: 1 to 60 seconds in steps of 1 s

Default: 30 seconds

This setpoint specifies the time that the voltage must meet or exceed the overvoltage trip pickup level to generate a trip.

6.3.3.7 Phase reversal

The MM300 can detect the phase rotation of the three phase voltages.

NOTE

Phase reversal protection is available only when a type IO_B option card (3 × VT) is specified in the order code. This element assumes A-B-C connection.

The following setpoints are available.

[Path: Home > Setpoints > Protection > Electrical]

Voltage Phase Reversal

Range: Disabled, Alarm, Trip

Default: Trip

This setpoint selects the phase reversal action.

6.3.3.8 Fuse failure

If one or two of the three phase voltages drops to less than 70% of nominal, and at the same time any of the three voltages is greater than 85%, either an alarm or a trip and block start will occur after a one second delay. The 70% threshold allows for the possibility that the voltage downstream from a blown fuse is pulled up above zero by devices connected between the open fuse and another phase.

NOTE

Fuse failure protection is available only when a type IO_B option card (3 × VT) is specified in the order code.

The following setpoints are available.

[Path: Home > Setpoints > Protection > Electrical]

VT Fuse Fail

Range: Disabled, Alarm, Trip

Default: Trip

This setpoint selects the fuse failure action.

6.3.4 Sensor protection

6.3.4.1 RTD protection

The MM300 can support up to six 100-R RTDs, each of which may be configured to have a trip temperature and an alarm temperature. The alarm temperature is normally set slightly greater than normal running temperature, and the trip temperature is normally set at the insulation rating. Trip voting has been added for extra security in the event of RTD malfunction. If enabled, a second RTD must also exceed the trip temperature of the RTD being checked before a trip will be issued. If the RTD is chosen to vote with itself, or OFF, the voting feature is disabled.

The following table shows the RTD resistance versus temperature. RTDs configured as stator types are also used by the thermal model for determining the RTD bias.

Table 4: RTD temperature vs. resistance

Temperature		Resistance (in ohms)
°C	°F	100 Pt
–50	–58	80.31
–40	–40	84.27
–30	–22	88.22
–20	–4	92.16
–10	14	96.09
0	32	100.00
10	50	103.90
20	68	107.79
30	86	111.67
40	104	115.54
50	122	119.39
60	140	123.24
70	158	127.07
80	176	130.89
90	194	134.70
100	212	138.50
110	230	142.29
120	248	146.06
130	266	149.82
140	284	153.58
150	302	157.32
160	320	161.04
170	338	164.76
180	356	168.47
190	374	172.46
200	392	175.84
210	410	179.51
220	428	183.17
230	446	186.82
240	464	190.45
250	482	194.08

All RTDs programmed with an alarm or a trip are monitored for sensor failure. When the measured temperature is greater than 250°C, the RTD is declared failed and a common RTD open circuit alarm is issued. When the measured temperature is less than -50°C, a common RTD short circuit/low temperature alarm is issued.

The following setpoints are available for RTD protection.

[Path: Home > Setpoints > Protection > Sensor]

RTD Open Circuit Alarm

Range: Enabled, Disabled
Default: Disabled

Enable to generate an alarm if RTD is open circuit.

RTD Open/Short Circuit Alarm

Range: Enabled, Disabled
Default: Disabled

Enable to generate an alarm if RTD is shorted/opened.

RTD #1 Application to RTD #3 Application

Range: None, Stator, Bearing, Ambient, Other
Default: None

These setpoints select the application type for RTDs #1 through 6, respectively.

RTD #1 Alarm Temp to RTD #6 Alarm Temp

Range: 1 to 250°C in steps of 1 or OFF
Default: OFF

These setpoints specify the alarm temperature for RTDs #1 through 6, respectively.

RTD #1 Trip Temp to RTD #6 Trip Temp

Range: 1 to 250°C in steps of 1 or OFF
Default: OFF

These setpoints specify the trip temperature for RTDs #1 through 6, respectively.

RTD #1 Trip Voting to RTD #6 Trip Voting

Range: RTD #1, RTD #2, RTD #3, RTD #4, RTD #5, RTD #6, OFF
Default: OFF

These setpoints select the redundant RTD that must also exceed the trip temperature for RTDs #1 through 6, respectively, for a trip to occur.

6.3.4.2 Thermistor protection

Either a Positive Temperature Coefficient (PTC) or Negative Temperature Coefficient (NTC) thermistor may be directly connected to the MM300. By specifying the hot and cold thermistor resistance, the MM300 automatically determines the thermistor type as NTC or PTC. Use thermistors with hot and cold resistance values in the range 100 to 30000 OHMS. If no thermistor is connected, the thermistor alarm and trip detection must be set to DISABLE.

Cold Resistance

Range: 0.1 to 30.0 kOHMS in steps of 0.1
Default: 0.1 kOHMS

For a PTC thermistor, enter the resistance that the thermistor must drop below before a Thermistor Trip or Alarm can be cleared. For an NTC thermistor, enter the resistance that the thermistor must rise above before a Thermistor Trip or Alarm can be cleared.

Hot Resistance

Range: 0.1 to 30.0 kOHMS in steps of 0.1

Default: 5.0 kOHMS

For a PTC thermistor, enter the resistance that the thermistor must rise above before a Thermistor Trip or Alarm can be cleared. For an NTC thermistor, enter the resistance that the thermistor must drop below before a Thermistor Trip or Alarm can be cleared.

Thermistor Trip

Range: ENABLE, DISABLE

Default: DISABLE

When a thermistor is used, it can be selected for an Alarm or Trip or both. Choose ENABLE to allow Thermistor Trips to occur.

Thermistor Alarm

Range: ENABLE, DISABLE

Default: DISABLE

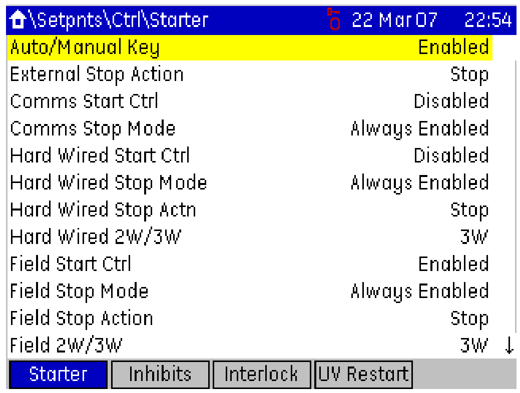
When a thermistor is used, it can be selected for an Alarm or Trip or both. Choose ENABLE to allow Thermistor Alarms to occur.

6.4 Control elements

6.4.1 Starter setpoints

Select the **Home > Setpoints > Control > Starter** page to edit the starter setpoints.

Figure 25: Starter configuration setpoints



6.4.1.1 Auto/manual control

The auto/manual control element manages the auto/manual control mode, consolidates the start A, start B and stop controls from their various sources, and applies auto/manual, test switch and permissive supervision.

The MM300 has four possible sources of start A, start B and stop controls:

- Communications: Controls received over a serial data link - Modbus, DeviceNet, Profibus and/or Modbus TCP. Communications controls are not differentiated based on port or protocol.
- Hard-wired: Controls received typically via contact inputs from a PLC or DCS.
- Field: Controls received typically via contact inputs from pushbuttons or switches located adjacent to the controlled equipment.
- MCC: controls received from the control panel of the MM300.

Communications and hard-wired controls are considered to be auto controls, and are inhibited unless auto mode is on. Likewise, field and MCC controls are considered to be manual controls, and are inhibited unless manual mode is on. Each source may also have a contact input assigned to permissive supervision, which enables that source when on.

Table 5: Auto/manual control sources

Control source	Supervision	
Communications	Auto	Comms permissive
Hard-wired	Auto	Hard-wired permissive
Field	Manual	Field permissive
MCC	Manual	MCC permissive

The MM300 may also be set to always honor stop controls, regardless of auto/manual mode and permissive supervision (default).

The auto/manual control element also drives a control source active indicator for each source on the front panel display (if equipped) that shows the user exactly which control sources have both the correct auto/manual mode on and have their permissive configured and on.

The auto/manual control element includes non-volatile latches that hold the auto and manual mode states. Besides supervising controls from the sources, the latches drive auto and manual indicators on the MM300 control panel. The latches can be controlled either by an external auto switch contact or by the control panel.

- When configured for Auto/Man switch contact, auto is on when the contact is closed energizing the input, and manual is on when the contact is open.
- When a switch contact is configured for auto/manual, the front panel auto/manual pushbuttons are inoperative. When no switch contacts are configured, but the **MCC Auto/Manual Key** setpoint is "Enabled", the control panel auto and manual keys will switch the mode between auto and manual.
- When no input is configured for auto or manual, and the **MCC Auto/Manual Key** setpoint is "Disabled", both auto and manual modes are set off.

The Auto and Manual modes are temporarily forced to settable states when the test switch is on.

The following setpoints are available for the auto/manual control element.

[Path: Home > Setpoints > Control > Starter]

Comms Start Ctrl

Range: Enabled, Disabled

Default: Disabled

Sets whether start commands are accepted via communications.

Comms Stop Mode

Range: Always Enabled, Follow Ctrl Mode

Default: Always Enabled

If set to "Always Enabled", communication stops will always be honoured, irrespective of the **Comms Start Ctrl** setpoint and auto/manual mode. If set to "Follow Ctrl Mode", communication stops will be supervised by auto/manual and by communication permissive in the same manner as the starts.

Hard Wired Start Ctrl

Range: Enabled, Disabled

Default: Disabled

Sets whether start commands are accepted from hard wired start contact inputs.

Hard Wired Stop Mode

Range: Always Enabled, Follow Ctrl Mode

Default: Always Enabled

If set to "Always Enabled", hard-wired stops will always be honoured, irrespective of the **Hard Wired Start Ctrl** setpoint, auto/manual mode and permissive. If set to "Follow Ctrl Mode", hard-wired stops will be supervised by auto/manual and by hard-wired permissive in the same manner as the starts.

Hard Wired Stop Actn

Range: Stop, Trip

Default: Stop

Defines whether hard wired stop control trips (reset required to clear) or stops (no reset required).

Hard Wired 2W/3W

Range: 2W, 3W

Default: 3W

The setpoint is for two-wire or three-wire control selection. If in the two-wire mode, all hard-wired start contact inputs being open will be treated as a hard-wired stop control. For reversing and two-speed starter configurations, both start inputs open is treated as a hard-wired stop control.

Field Start Ctrl

Range: Enabled, Disabled

Default: Disabled

Sets whether start commands are accepted from field start contact inputs.

Field Stop Mode

Range: Always Enabled, Follow Ctrl Mode

Default: Always Enabled

If set to "Always Enabled", field stops will always be honoured, irrespective of the **Field Start Ctrl** setpoint, auto/manual mode, and permissive. If set to "Follow Ctrl Mode", field stops will be supervised by auto/manual and by field permissive in the same manner as the starts.

Field Stop Action

Range: Stop, Trip

Default: Stop

Defines whether field control trips (reset required to clear) or stops (no reset required).

Field 2W/3W

Range: 2W, 3W

Default: 3W

Two-wire or three-wire controls selection. If in the two-wire mode, all field start contact inputs being open will be treated as a field stop control. For reversing and two-speed starter configurations, both start inputs open is treated as a field stop control.

MCC Start Ctrl

Range: Enabled, Disabled

Default: Enabled

Sets whether start commands are accepted from the control panel.

MCC Stop Mode

Range: Always Enabled, Follow Ctrl Mode

Default: Always Enabled

If set to "Always Enabled", control panel stops will always be honoured, irrespective of the **MCC Start Ctrl** setpoint, auto/manual mode, and permissive. If set to "Follow Ctrl Mode", control panel stops will be supervised by auto/manual and by MCC permissive in the same manner as the starts.

MCC Stop Action

Range: Stop, Trip

Default: Stop

Defines whether MCC control trips (reset required to clear) or stops (no reset required).

Test Auto Mode

Range: On, Off, Unaffected

Default: Off

Sets whether, when the test switch is on, the auto mode is forced on, forced off, or is unaffected.

Test Manual Mode

Range: On, Off, Unaffected
Default: On

When the test switch is on, this setpoint determines if the manual mode is forced on, forced off, or is unaffected.

6.4.1.2 Stop/start control element

An external stop sequence has occurred if the relay detects that either contactor A or contactor B has dropped out without receiving a stop command. If the **External Stop Action** setpoint is programmed as "Stop", the relay will accept this as a stop control and display the **External Stop** message. If this setpoint is set to "Trip", the relay will treat this as an emergency stop trip. This trip condition must be reset before the motor can be restarted.

Most protection and control elements in this relay are sensitive to whether the motor is stopped, starting, or running. These include the jam, acceleration, undercurrent, underpower, overvoltage, and undervoltage protection, the process interlocks, and the thermal start inhibit and undervoltage restart elements.

Traditionally, the motor is deemed to have entered the starting state when the motor current changes from zero to some measurable value, and to have entered the running state when the current having increased above FLA then subsides below FLA. This algorithm is satisfactory for most applications. The current profile of full voltage across-the-line starters for instance typically goes from zero to 6 × FLA within a cycle of the contactor closing, and then decays exponentially until it reaches 1 × FLA just before reaching normal operating speed.

However, some starter types implemented in the MM300 have significantly different current profiles. For instance, with an inverter starter, the inverter may ramp the motor speed up so slowly that the current never exceeds FLA. Alternatively, the current may initially exceed 1 × FLA, but subside well before reaching normal operating speed. The traditional algorithm could either not declare the motor reaching the running state, or declare it much too soon.

Another problem can develop when there is a brief supply interruption for which the immediate undervoltage restart feature recloses the contactor so quickly that there is little or no inrush current.

The traditional algorithm would detect the start (if it is fast enough), but may or may not detect the running state that follows. Even if it does detect the running state, as it is an atypical start, the learned values such as learned acceleration time would be corrupted.

The MM300 employs an improved starting and running state detection algorithm. Normally, it declares starting when either contactor A or contactor B closes. Running is declared when either contactor has been closed for one second, and then current is found to be below 1 × FLA. This provides equivalent functionality to the traditional algorithm. However, the advanced algorithm also accepts Starting Status Block and Running Status Block signals. Most starter types leave these signals in their default off state, where they have no effect on the starting and running declarations. Where required however, the starters can manipulate these signals to correct the above described problems with the traditional algorithm. The inverter starter for instance asserts the Starting Status Block signal when it powers up the inverter, and then allows the starting state to be declared by turning it off only when the ramp up command is issued. The inverter starter also asserts the Running Status Block signal and then allows the running state to be declared by turning it off only when the inverter signals up-to-speed.

In addition, the advanced algorithm accepts a UVR Short Dip signal from the undervoltage restart element. This signal will carry the running status through short dips followed by immediate reclose.

If an A or B motor contactor is externally energized, the relay will treat this as a start A or B control, and display an **External Start A Alarm** or an **External Start B Alarm** message.

The stop/start control element also consolidates the various start and stop signals for the convenience of other elements.

The following setpoint is available:

[Path: Home > Setpoints > Control > Starter]

External Stop Action

Range: Stop, Trip

Default: Stop

This setpoints selects whether an external stop is considered to be an emergency stop (reset required to clear) or a stop control (no reset required).

6.4.2 Starting duty inhibits

The MM300 provides four elements that guard against excessive starting duty:

- Thermal start inhibit
- Starts per hour inhibit
- Time between starts inhibit
- Restart inhibit

The thermal start inhibit function inhibits starting of a motor if there is insufficient thermal capacity available for a successful start. The motor start inhibit logic algorithm is defined by the Start Inhibit Margin setpoint. If this value is "0", starts are inhibited until thermal capacity used decays to a level of 15%. If this setpoint is greater than zero, starts are inhibited while the available thermal capacity is greater than the learned thermal capacity used at start.

NOTE

The margin should be set to zero if the load varies for different starts.

The learned thermal capacity used at start is the largest value of thermal capacity used calculated by the thermal model from the last five successful starts, plus a user-defined margin. The margin is a percentage of this largest of five. A successful motor start is one in which the motor reaches the running state. See the Start/Stop section of this manual for a description of running state logic. If the relay does not contain records of five successful starts, a value of 85% is used for the learned thermal capacity used, which requires the thermal capacity used to decay to the same 15% level required when the margin setpoint is zero.

In addition, since a 2% safety margin is included for the relay to determine if Thermal Capacity Used has decreased enough (ie - the motor has cooled enough) to allow another restart, in the case where the Start Inhibit margin is set to 0%, Thermal Capacity must actually reduce to 15% - 2% = 13%.

For example, if the thermal capacity used for the last five starts is 24, 23, 30, 22, and 21% respectively, and the set margin is 10%, the learned starting capacity used at start is:

Maximum[24%, 23%, 30%, 22%, 21%] /5 x (1 + 10%/100%) = 33%.

If the motor stops with a thermal capacity used of 90%, a start inhibit will be issued until the motor cools to 100% – 33% - 2% = 65%. If the stopped cool time constant is set to 30 minutes, the inhibit time will be:

30 x ln (90% / 65%) = 9.8 minutes

If the margin is set to zero instead, the inhibit time will be:

30 x ln (90% / (15% - 2%)) = 58 minutes

The starts per hour element defines the number of start attempts allowed in any 60 minute interval. Once the set number of starts has occurred in the last 60 minutes, start controls are inhibited until the oldest start contributing to the inhibit is more than 60 minutes old.

NOTE

The starts per hour element assumes a motor start is occurring when the relay measures the transition of no motor current to some value of motor current.

The time between starts element enforces a programmable minimum time duration between two successive starts attempts. A time delay is initiated with every start and a restart is not allowed until the specified interval has elapsed. This timer feature may be useful in enforcing the duty limits of starting resistors or starting autotransformers. It may also be used to restrict jogging.

NOTE

This time between starts element assumes a motor start is occurring when the relay measures the transition of no motor current to some value of motor current.

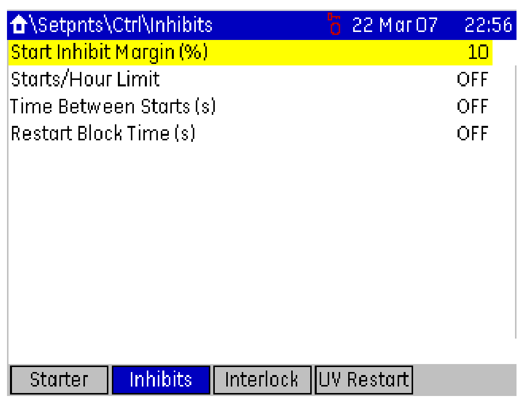
The restart inhibit element may be used to ensure that a certain amount of time passes between the time a motor is stopped and the restarting of that motor. This timer is useful for many process applications and motor considerations. If a motor is on a down-hole pump, the liquid may fall back down the pipe and spin the rotor backwards after the motor stops. It would be very undesirable to start the motor at this time. This feature is bypassed by undervoltage immediate restart and by external start.

NOTE

This element assumes a motor stop is occurring when the relay measures the transition of some value of motor current to no motor current

For each of these features, non-volatile memory is used to make them behave as if they continue to operate while control power is lost.

Figure 26: Starting duty inhibit setpoints



The following setpoints are available.

[Path: Home > Setpoints > Control > Inhibits]

Start Inhibit Margin

Range: 0 to 10% in steps of 1 or Off

Default: OFF

This setpoint specifies the start inhibit margin. A value of “OFF” disables start inhibits. A value of 0% causes starts to be inhibited until the thermal capacity used value calculated by the thermal model drops to 15% or less. Setpoint values in the range of 1 to 10% specify the margin to be included in the calculation of the learned thermal capacity used at start value, and cause starts to be inhibited until the present thermal capacity used value drops to the learned thermal capacity used at start value or less.

Starts/Hour Limit

Range: 1 to 5 in steps of 1 or OFF

Default: OFF

This setpoint specifies the number of starts in the last 60 minutes at which count start control is inhibited. A value of “OFF” defeats this feature.

Time Between Starts

Range: 1 to 3600 seconds in steps of 1 second, or OFF

Default: OFF

This setpoint specifies the time following a start before a start control is permitted to prevent restart attempts in quick succession (jogging). A value of “OFF” defeats this feature.

Restart Block Time

Range: 1 to 50000 seconds in steps of 1 second, or OFF

Default: OFF

This setpoint specifies the time following stop before a start control is permitted. A value of “OFF” defeats this feature.

6.4.3 Process interlocks

Ten independent process interlocks A through J (abbreviated as **IL A...J** on the display) are used to provide trip, stop or alarm actions based on a contact input.

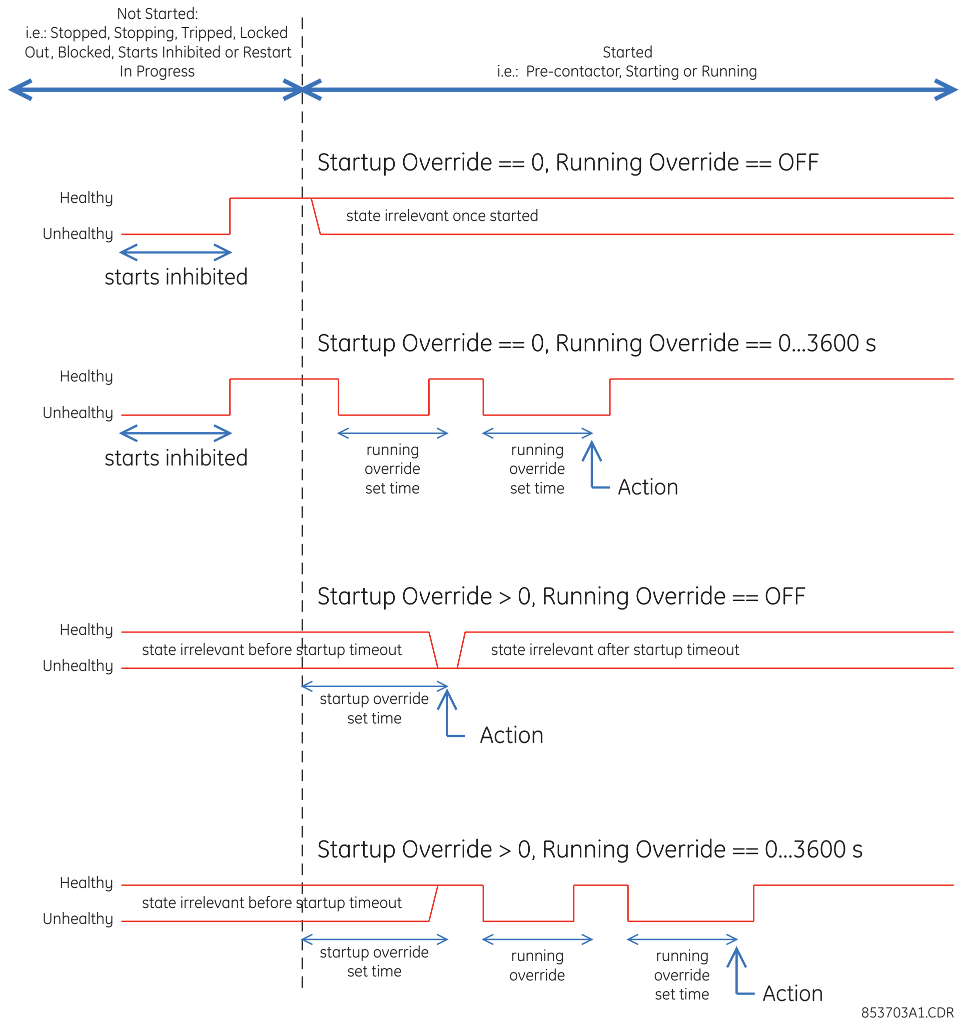
The contact input for utilized process interlocks is assigned in the contact inputs setpoints page. The healthy state of the contact driving the input, the state wherein there is no trip, stop or alarm action taken by the interlock, may be set to either open or closed.

Each process interlock has a startup override timer that sets the time given for the process interlock switch to reach the healthy state (measured from the moment a start control is received). If the input is unhealthy at the moment this timer expires, the interlock function performs its configured action. If the startup override delay setpoint is set to zero, the switch must be healthy for the motor to start.

Each process interlock also has a running override timer that sets the time the switch can remain unhealthy during normal running. If the startup override timer has expired and the switch then goes unhealthy for longer than the **IL A(J) Running Override** delay setpoint, the interlock performs its configured action. If the **IL A(J) Running Override** is “OFF” and the switch goes unhealthy after the startup override has expired, no action will occur.

The process interlocks may also be set such that no action is performed when the test switch is closed. This allows the control circuit to be tested.

Figure 27: Process interlock timing



The following setpoints are available. The setpoints and logic for interlock A shown below applies to all interlocks A through J.

[Path: Home > Setpoints > Control > Interlock]

IL A Function

Range: Disabled, Trip, Stop, Alarm

Default: Disabled

This setpoint selects whether the process interlock causes a trip (reset required to restart the motor), a stop (no reset required), or alarms only. The "Disabled" selection disables all interlock functions, including the instantaneous alarm.

IL A Healthy State

Range: Open, Closed

Default: Closed

This setpoint allows the user to configure the process interlock contact input as either healthy open or healthy closed. The switch state is healthy when no action is taken by this interlock.

IL A Startup Override

Range: 0 to 3600 seconds in steps of 1

Default: 0 seconds

This setpoint specifies the time provided for the process interlock switch to reach the healthy state, measured from the moment a start control is received. This includes any pre-contactor time. A value of “0” inhibits starts if the switch state is unhealthy.

IL A Running Override

Range: 0 to 3600 seconds in steps of 1 or OFF

Default: 0 seconds

This setpoint specifies the time the switch can remain unhealthy during normal running. A value of “OFF” indicates the interlock is inoperative during normal running.

IL A Inst Alarm

Range: Enabled, Disabled

Default: Disabled

When this setpoint is “Enabled”, a process interlock alarm is issued without delay. This is in addition to the trip, stop, or alarm selected by the **IL Function A** setpoint.

IL Ignore in Test

Range: Enabled, Disabled

Default: Disabled

When this setpoint is “Enabled”, all process interlocks are ignored when the test switch is on.

IL A Name

Range: 20 alphanumeric characters

Default: Process Interlock A

This setpoint represents the interlock description that appears in the event record and on the status message page.

6.4.4 Undervoltage autorestart

The undervoltage restart element (UVR) provides for relay initiated undervoltage motor restart after a momentary power loss (dip). In addition, this element provides for controlling the timing of both controlled starts and undervoltage restarts following interruptions.

When the auxiliary voltage supply drops below the dropout voltage level, the motor contactor(s) are de-energized until the dip is over as indicated by supply recovery to the pickup level. The duration of the dip is classified as short, medium, or long, based on settable time thresholds.

- Short dips are intended to cover situations where it is appropriate to immediately close the contactors back in on voltage recovery.
- Medium dips are for where it is appropriate to restart the motor with any staged startup sequence the starter type might provide.
- Long dips (interruptions actually) are intended to cover cases where restoration is from backup power, and there must be substantial intervals between starting different motors to maintain stability, and/or only critical motors can be started.

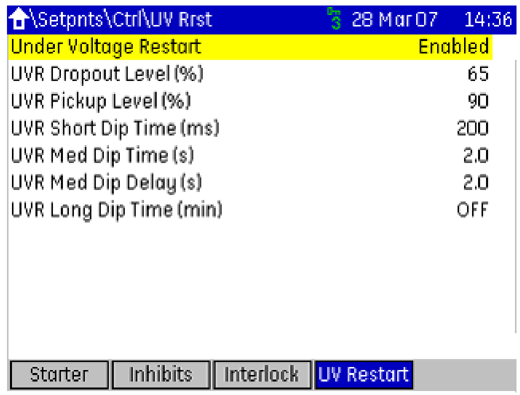
If the motor was running at the time a short dip occurred, a forced restart will occur as soon as the relay detects healthy auxiliary voltage. An immediate restart bypasses any pre-contactor and staged startup sequence the starter type might otherwise provide.

If the motor was running at the time a medium or long dip occurred, after a settable medium or long delay, a normal start will be performed.

If the motor was not running at the start of the dip, no restart sequence will be initiated. Start controls are ignored while the UVR delay is timing out. While the UVR timer is counting down, the status will change to "UVR Pending". During UVR Pending, any stop or trip will immediately cancel the restart sequence.

With control voltage derived from the incoming motor supply, the MM300 will experience the same interruption as the motor. The MM300 is designed to ride through power outages of up to 500 ms, so that the undervoltage restart function is accurate. For longer outages the relay saves critical data to non-volatile memory just before shutting down. While the relay is shut down, a backup timer continues to keep time without external power by using stored energy.

Figure 28: Undervoltage autorestart screen



The following setpoints are available:

[Path: Home > Setpoints > Control > UV restart]

Under Voltage Restart

Range: Enabled, Disabled

Default: Disabled

This setpoint enables the undervoltage autorestart function.

UVR Dropout Level

Range: 60 to 100% of NCV in steps of 1

Default: 65%

When the magnitude of the control voltage drops below the UVR Dropout Level, the motor contactor(s) are de-energized. The UVR Dropout Level is set as a percentage of the nominal control voltage. This value programmed must be set lower than the UVR Pickup Level setpoint.

UVR Pickup Level

Range: 60 to 100% of NCV in steps of 1

Default: 90%

When the magnitude of the control voltage recovers to the UVR Pickup Level, the undervoltage restart element is triggered. The UVR Pickup Level is set as a percentage of the nominal control voltage. This value programmed must be set higher than the UVR Dropout Level setpoint.

UVR Short Dip Time

Range: 100 to 500 ms in steps of 10 ms, or OFF

Default: 200 ms

This setpoint represents the maximum duration of short dips, which result in immediate restarts. A value of Off disables immediate restarts.

UVR Med Dip Time

Range: 0.1 to 10.0 s in steps of 0.1 seconds

Default: 2.0 s

This setpoint represents the maximum duration of medium dips.

UVR Long Dip Time

Range: 0.5 to 60 min. in steps of 0.5 min., or OFF

Default: OFF

This setpoint represents the maximum duration of long dips. A value of Off disables restarts after long dips.

UVR Med Dip Delay

Range: 0.2 to 60.0 seconds in steps of 0.2 seconds

Default: 2.0 s

This setpoint represents the UV restart medium delay.

UVR Long Dip Delay

Range: 1.0 to 1200.0 s in steps of 1.0 seconds

Default: 10.0 s

This setpoint represents the UV restart long delay.

NOTE

If Aux VT is set for Direct: **NCV = MNV / root3**

If Aux VT is set for VabVT, VbcVT, VcaVT, VanVT, VbnVT, VcnVT: **NCV = Aux VT secondary**

NOTE

When the UV Restart feature is used, ensure that the IO_C VT and MM300 PSU are connected to the same AC source.

NOTE

When using medium and long dip, ensure that the delay setting is greater than the Restart Inhibit time (if used).

NOTE

The UV Autorestart feature requires a minimum of 2.5 s between successive dips, to ensure correct operation.

6.5 System security

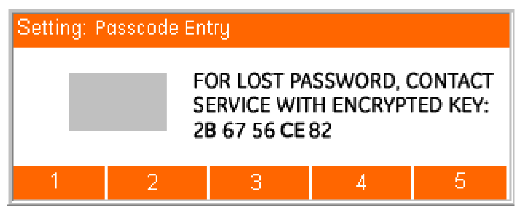
Hardware and passcode security features are designed to restrict user access. This can deter inappropriate employee action and curtail errors. Security against hackers or others with malicious intent should be provided by other means. Security for the external hard-wired and field controls should also be externally provided as required.

Three security levels above the default level are recognized. Each security level can also be set for passcode access. The passcode is programmed as a five-digit number, using only digits 1 through 5. The security access levels are:

- Default - start/stop control, auto/manual selection, and reset trips
- Level 1 - default privileges plus setpoint access
- Level 2 - level 1 privileges plus lockout reset and reset counters
- Level 3 - level 2 privileges plus factory page.

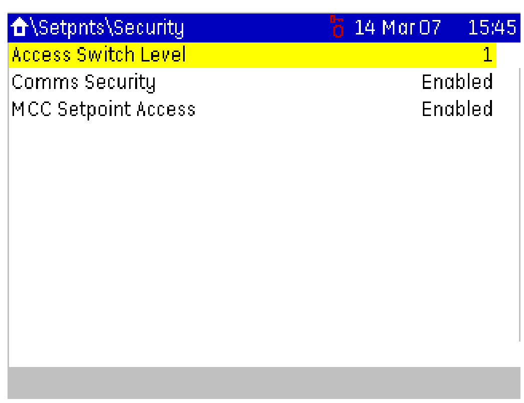
The MCC passcode can be entered at any time by a sustained press on the ENTER key. displays a dialog box prompting for a new passcode. Alternatively, the MCC passcode can be entered by pressing a currently unauthorized (grayed-out) control/selection key. This will display an error message detailing the required security levels and whether access switch or passcode entry is required. If only a passcode is required to complete the control/selection, the error message displays a passcode entry dialog box.

Figure 29: Passcode entry dialog box



Passcodes are automatically canceled after five minutes of inactivity. The MCC passcode access can also be canceled by a sustained press on the ESC key, which clears any previously entered passcode. Communications passcode access can be cancelled by writing zero to the passcode register.

Figure 30: Security page



The following system security setpoints are programmed in the security page.

Passcode Level 1, Passcode Level 2, Passcode Level 3

Range: any five-digit number using digits 1 through 5 only or Disabled

Default value: 11111 (level 1), 22222 (level 2)

Access is granted if a passcode has been correctly entered matching the value of this setpoint.

Access Switch Level

Range: 1, 2, 3

Default value: 1

Sets the access level provided by the access switch being closed. The contact input for the access switch is configured on the contact inputs page.

Comms security

Range: Enabled, Disabled

Default: Disabled

Sets whether the security feature applies to the communications ports.

MCC setpoint access

Range: Enabled, Disabled

Default: Enabled

Sets whether the setpoint access is allowed from the control panel display.

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Chapter 7: Diagnostics

The diagnostics pages display typical diagnostic information, including the event recorder, learned data, phasors, system counters, and system information. In the event of a trip or alarm, the diagnostic pages are often very helpful in diagnosing the cause of the condition.

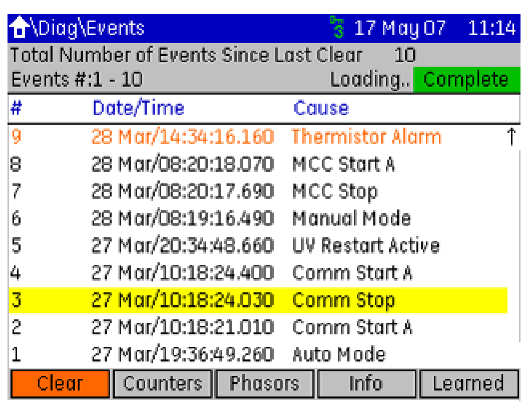
7.1 Events

The **Home > Diag > Events** page displays up to 256 events.

When this page is selected, the MM300 will load and format an event list from the event recorder. After a short length of time (depending on the number of recorded events), the green **Loading...Complete** indicator will become active, and the most recent event placed at the top of the list, with the oldest event at the bottom. The MM300 loads the event list with the most recent event automatically selected.

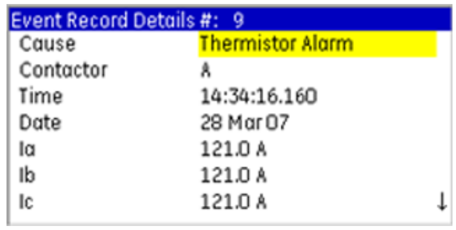
If a new event occurs while viewing the event page, the event list will automatically reorganize itself and place the newest event first. The addition of new events while the event list is being viewed will not reset the event screen to the top of the page unless the newest event is being viewed. If there are no events in the event recorder, then this page will be empty.

Figure 1: Typical event recorder view



Individual events are selected by using the UP and DOWN keys to highlight the event then pressing the ENTER key. This will display a pop-up window with the event details.

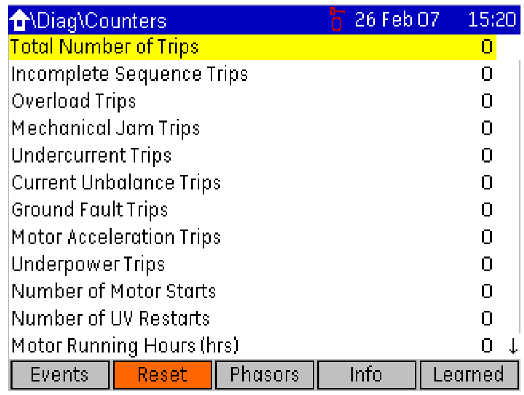
Figure 2: Typical event details view



7.2 Digital counters

The **Home > Diag > Counters** page displays the values of the various MM300 digital counters.

Figure 3: Counters page



The total number of trips by type are displayed in this screen. Trip counters are typically used for scheduling inspections on equipment, for performing qualitative analysis of system problems, and for spotting trends. Several general counters are also available.

Total Number of Trips, Incomplete Sequence Trips, Overload Trips, Mechanical Jam Trips, Undercurrent Trips, Current Unbalance Trips, Ground Fault Trips, Motor Acceleration Trips, Underpower Trips

Range: 0 to 65535 trips in steps of 1

These values display a breakdown of number of trips by type. When the total number of trips for any counter exceeds 65535, that counter is reset to 0. To clear this value, use the **Clear Counters** command.

Number of Motor Starts

Range: 0 to 65535 starts in steps of 1

This value displays the number of accumulated motor starts or start attempts. This value may be useful information when troubleshooting a motor failure. When this counter exceeds 65535 starts, it will reset to 0. To clear this value, use the **Clear Maintenance Timers** command.

Number of UV Restarts

Range: 0 to 65535 restarts in steps of 1

This value displays the number of accumulated undervoltage restarts. This value may be useful information when troubleshooting a motor failure. When this counter exceeds 65535 restarts, it will reset to 0. To clear this value, use the **Clear Counters** command.

Motor Running Hours

Range: 0 to 100000 hours in steps of 1

The motor running hours timer accumulates the total running time for the motor. This value may be useful for scheduling routine maintenance. Counter will roll over to zero after range is exceeded. To clear this value, use the **Clear Maintenance Timers** command and stop the motor.

Motor Stopped Hours

Range: 0 to 100000 hours in steps of 1

The motor stopped hours timer accumulates the total stopped time for the motor. This value may be useful for scheduling routine maintenance. To clear this value, use the **Clear Maintenance Timers** command and stop the motor.

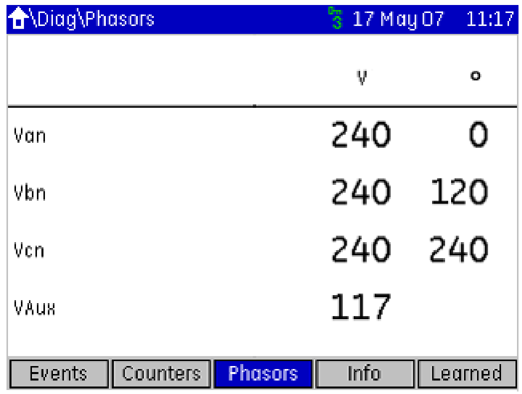
NOTE

The above **clear** commands can also be sent directly from the Graphical Control Panel, by highlighting the value then pressing "clear." Setpoint access level 2 is required.

7.3 Phasors

The **Home > Diag > Phasors** page displays phase voltage and angle, and auxiliary voltage. A typical phasor display page is shown below.

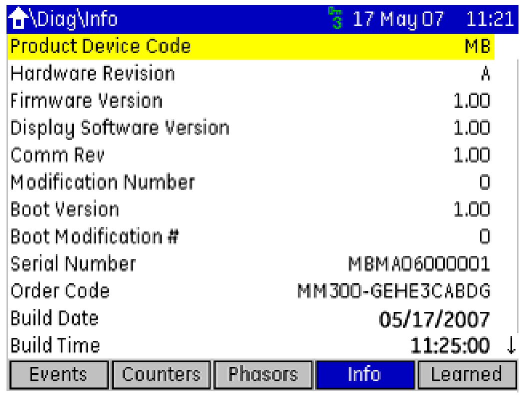
Figure 4: Typical phasors display



7.4 Product information

The **Home > Diag > Info** page displays fixed system information, including the order code, serial number, hardware revision, software revision, modification number, boot revision, boot modification, original calibration date, and last calibration date.

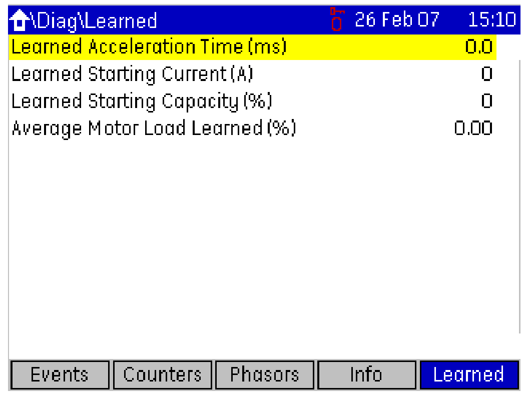
Figure 5: Product information page



7.5 Learned data

The **Home > Diag > Learned** page displays the MM300 learned data parameters. A typical learned data page is shown below.

Figure 6: Learned data values



The MM300 learns the acceleration time, the starting current, the starting capacity, and the average motor load during motor starts. This data is accumulated based on the last five successful starts.

Learned Acceleration Time

Range: 0.0 to 200.0 ms in steps of 0.1 s

If motor load during starting is relatively consistent, the learned acceleration time may be used to fine tune the acceleration protection. Learned acceleration time will be the greatest time of the last five successful starts. The time is measured from the transition of motor current from zero to greater than overload pickup, until line current falls below the overload pickup level.

Learned Starting Current

Range: 0.0 to 10000.0 A in steps of 0.1 A

The learned starting current is measured 200 ms after the transition of motor current from zero to greater than overload pickup. This should ensure that the measured current is symmetrical. The value displayed is the average of the last five successful starts. If there are less than five starts, a value of 0 seconds will be averaged in for the full five starts.

Learned Starting Capacity

Range: 0 to 100% in steps of 1

The learned starting capacity is used to determine if there is enough thermal capacity to permit a start. If there is not enough thermal capacity available for a start, a start inhibit will be issued. Starting will be blocked until there is sufficient thermal capacity available.

Average Motor Load Learned

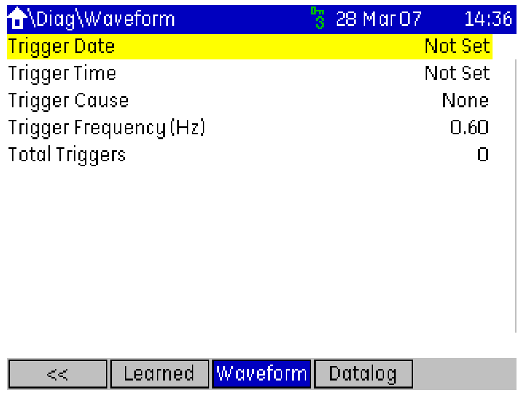
Range: 0.00 to 20.00 x FLA in steps of 0.01

The MM300 can learn the average motor load over a period of time (fixed at 15 minutes). The calculation is a sliding window and is ignored during motor starting.

7.6 Waveform

The **Home > Diag > Waveform** page displays the MM300 waveform parameters. A typical waveform page is shown below.

Figure 7: Waveform values



Trigger Date

Date of the current trigger.

Trigger Time

Time of the current trigger.

Trigger Cause

Range: None, Command, VO1 to VO32, Any Trip Pickup, Any Trip, Any Trip Dropout, Any Alarm Pickup, Any Alarm, Any Alarm Dropout, Any Stop, Start A, Start B

Indicates the cause of the waveform trigger.

Trigger Frequency (Hz)

Measured system frequency at the time of the trigger event.

Total Triggers

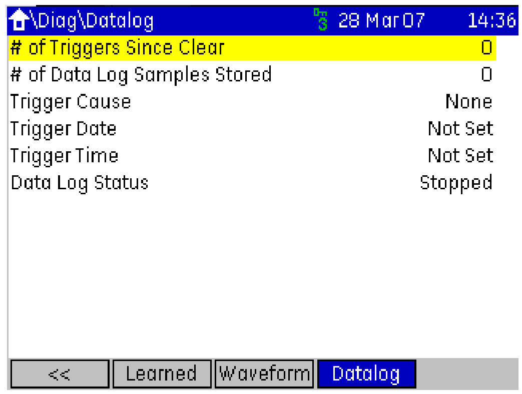
Range: 0 to 65535

A count of waveform triggers since the Clear Waveform command was sent.

7.7 Datalog

The **Home > Diag > Datalog** page displays the MM300 datalog parameters. A typical datalog page is shown below.

Figure 8: Datalog values



of Triggers Since Clear

Range: 0 to 65535

Count of data log triggers since the Clear Data Logger command was sent.

of Datalog Samples Stored

Range: 0 to 256

Count of the number of samples stored in the data log for the current trigger cause.

Trigger Cause

Range: None, Command, VO1 to VO32, Any Trip Pickup, Any Trip, Any Trip Dropout, Any Alarm Pickup, Any Alarm, Any Alarm Dropout, Any Stop, Start A, Start B

Indicates the cause of the datalog trigger.

Trigger Date

Date of the current trigger.

Trigger Time

Time of the current trigger.

Datalog Status

Range: Stopped, Started, Triggered, Pretrigger, Posttrigger

Indicates the present status of the data log feature. Stopped and Started are used only in Continuous mode. Triggered, Pretrigger, and Posttrigger are used only in Trigger Mode.

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Chapter 8: FlexLogic™

8.1 FlexLogic™ overview

8.1.1 Introduction to FlexLogic™

This topic describes the MM300 FlexLogic™ system, defines its operators, and lists its operands. In essence, all the information necessary to implement a custom starter.

All MM300 digital signal states are represented by FlexLogic™ operands. Each operand is in one of two states: on (asserted, logic 1, or set), or off (de-asserted, logic 0, or reset). There is a FlexLogic™ operand for each contact input, contact output, communications command, control panel command, element trip, and element alarm, as well as many others.

A list of FlexLogic™ operands and operators are sequentially processed once every 50 ms. When list processing encounters an operand, the value of that operand is placed in a first-in-first out stack. When list processing encounters a calculation operator, the number of values required for the calculation are removed from the stack, and the result of the operation is placed back on the stack. The operators are logic gates (for example, AND, OR, NOT), timers, latches, one-shots, and assignments. Assignment operators assign the value calculated by the preceding operators to a special class of operands called virtual outputs. Like any other operand, a virtual output can be used as an input to any operator – feedback to achieve seal-in is allowed. When list processing encounters an end operator, processing is stopped until the next processing cycle, at which time it restarts at the top of the list.

Each contact output has a setpoint to specify the operand that drives the output. Any operand may be selected – selection of a virtual output is the means by which FlexLogic™ directly controls external equipment such as the motor contactors.

The operators used in FlexLogic™ conform to the following rules.

- A virtual output may only be assigned once within any given starter. An unassigned virtual output will have a value of off.
- A maximum of thirty (30) general purpose timers (timers 1 through 30) are allowed, in addition to the special purpose timers (pre-contactor timer, transfer timer, ramp up timer, and ramp down timer).

- Each timer may only be used once within any given starter.
- A maximum of thirty (30) one-shots are allowed.
- 512 lines are executed during every 50 ms.

The operators available in FlexLogic™ are shown below.

Table 1: FlexLogic™ operators

Operator	Inputs	Description
<operand>	none	The output value is the value of the named <operand>.
NOT	1	The output value is “on” if and only if the intput value is “off”.
OR	2 to 16	The output value is “on” if and only if any of the input values are “on”.
AND	2 to 16	The output value is “on” if and only if all of the input values are “on”.
NOR	2 to 16	The output value is “on” if and only if all of the input values are “off”.
NAND	2 to 16	The output value is “on” if and only if any of the inputs values are “off”.
XOR	2	The output value is “on” if and only if one input value is “on” and the other input value is “off”.
TIMER	1	The output value is “on” if the input value has been “on” for the set pickup time. Once the output value is “on”, it remains “on” until the input value has been “off” for the set dropout time.
LATCH	2	The output value is the state of a reset-dominant volatile bi-stable latch, where the first input value is the set input, and the second input value is the reset input.
Positive one-shot	1	The output value is “on” for one processing cycle following an off-to-on transition of the input value.
Negative one-shot	1	The output value is “on” for one processing cycle following an on-to-off transition of the input value.
Dual one-shot	1	The output value is “on” for one processing cycle following either an on-to-off or off-to-on transition of the input value.
ASSIGN <operand>	1	The input value is assigned to the named operand. There is otherwise no output value.
END	none	The first END encountered terminates the current processing cycle.

The FlexLogic™ operands available in the MM300 are listed below.

Control operands: auto/manual

Auto..Asserted when auto mode is enabled.

Comms Ctrl Actv ....Asserted when the communication start controls have all required supervision enabled.

Field Ctrl Actv...........................Asserted when the field start controls have all required supervision enabled.

Field Trip....................................Asserted when a trip resulting from a field control contact input has yet to be reset.

Hard Wired Ctrl Actv.............Asserted when the hard-wired start controls have all required supervision enabled.

Hard Wired Trip ....Asserted when a trip resulting from a hard-wired control contact input has yet to be reset.

Manual..Asserted when manual mode is enabled.

MCC Ctrl Actv ....Asserted when motor control center (MCC) start controls have all required supervision enabled.

MCC Trip.....................................Asserted when a trip resulting from a motor control center (MCC) stop has yet to be reset.

Control operands: restart inhibit timer

Restart Inhibit .... Asserted when the minimum restart time has not expired since the last motor start.

Control operands: process interlocks

IL A Alarm.................................. Asserted upon a process interlock A alarm command.

IL A Stop..................................... Asserted upon a process interlock A stop command.

IL A Trip .... Asserted upon a process interlock A trip command.

IL B... to IL J.............................. The operands shown above are identical for interlocks B through J.

Control operands: starts per hour

Starts/Hour Inhibit................ Asserted when the number of starts in the last 60 minutes has reached the set maximum.

Control operands: stop/start control

Start A... Asserted when any start A is present.

Start B... Asserted when any start B is present.

Stop... Asserted when any lockout, trip, or stop is on.

Comms Start A .... Asserted when a start A control is received via communications.

Comms Start B .... Asserted when a start B control is received via communications

Comms Stop............................ Asserted when a stop control is received via communications.

Emergency Stop .... Asserted when an external stop set to trip is detected.

External Start A...................... Pulsed on when external start A is detected.

External Start B...................... Pulsed on when external start B is detected.

External Stop........................... Pulsed on when external stop set to stop only is detected.

HW Stop..................................... Asserted when a hard-wired control contact input is holding the motor stopped.

Field Stop .... Asserted when a field control contact input is holding the motor stopped.

Start A Ctrl .... Asserted when a start A command is received from any control source with all required supervision enabled.

Start B Ctrl .... Asserted when a start B command is received from any control source with all required supervision enabled.

MCC Start A.............................. Asserted when the control panel START A button has been pressed.

MCC Start B.............................. Asserted when the control panel START B button has been pressed.

MCC Stop.................................. Asserted when the control panel STOP button has been pressed.

Control operands: undervoltage restart

UVR .... Asserted when a UV Restart active condition exists.

Fixed operands

Off.. The operand is always off (not asserted). This may be used as a placeholder or test value.

On .... The operand is always on (asserted). This may be used as a placeholder or test value.

Input/output operands: virtual outputs

Contactor A Relay................. Expected by several control elements to be asserted to close contactor A.

Contactor B Relay.................Expected by several control elements to be asserted to close contactor B.

Starter

Forward.....................................Asserted when is appended to the displayed basic status.

Pre-Contactor..........................Asserted during a pre-contactor warning.

Reverse......................................Asserted when “Reverse” is appended to the displayed basic status.

Input/Output Operands

VO1..Asserted when virtual output 1 is on.

VO2 to VO32............................As above; asserted when virtual outputs 2 through 20 are on, respectively.

Protection operands: acceleration protection

Acceleration Alarm ....Asserted when an acceleration alarm condition exists.

Acceleration Trip....................Asserted when an acceleration trip condition exists.

Protection operands: auxiliary undervoltage

Aux U/V Alarm.........................Asserted when an auxiliary undervoltage alarm condition exists.

Low Aux Voltage Inhibit.......Asserted when an auxiliary undervoltage condition inhibits starting.

Aux U/V Trip.............................Asserted when an auxiliary undervoltage trip condition exists.

Protection operands: current unbalance

Unbalance Alarm...................Asserted when a current unbalance alarm condition exists.

Unbalance Trip........................Asserted when a current unbalance trip condition exists.

Protection operands: fuse failure

Fuse Fail ....Asserted when a fuse fail condition inhibits starting.

Fuse Fail Alarm ....Asserted when a fuse failure alarm condition exists.

Fuse Fail Trip ....Asserted when a fuse failure trip condition exists.

Protection operands: ground fault

Ground Fault Alarm ....Asserted when a ground fault alarm condition exists.

Ground Fault Trip...................Asserted when a ground fault trip condition exists.

Protection operands: load increase

Load Increase Alarm............Asserted when a load increase alarm condition exists.

Protection operands: mechanical jam

Mechanical Jam Trip............Asserted when a mechanical jam trip condition exists.

Protection operands: overvoltage

Overvoltage Alarm................Asserted when an overvoltage alarm condition exists.

Overvoltage Trip.....................Asserted when an overvoltage trip condition exists.

Protection operands: phase reversal

Phase Reversal Alarm...........Asserted when a phase reversal alarm condition exists.

Phase Reversal Inhibit..........Asserted when a phase reversal condition inhibits starting.

Phase Reversal Trip ....Asserted when a phase reversal trip condition exists.

Protection operands: RTD protection

RTD #1 Alarm...........................Asserted when an RTD #1 alarm condition exists.

RTD #1 Trip ....Asserted when an RTD #1 trip condition exists.

RTD #2 to RTD #6...................The same set of operands shown above are available for RTDs 2 through 6.

RTD Open/Short Alarm........ Asserted when any configured RTD channel is found to be an open circuit when any configured RTD channel is found to be shorted or showing less than –50°C..

Protection operands: starting duty inhibits

Thermal Inhibit........................ Asserted when the motor is too hot to be started.

Time Between Inhibit........... Asserted when the minimum time between starts has not expired since the last motor start.

Protection operands: thermal model

Thermal Level Alarm............. Asserted when the thermal capacity used alarm condition exists.

Thermal O/L Trip..................... Asserted when the thermal model has operated and the motor has cooled, but the trip has not yet been reset.

Protection operands: thermistor protection

Thermistor Alarm................... Asserted when a thermistor alarm condition exists.

Thermistor Trip........................ Asserted when a thermistor trip condition exists.

Protection operands: undercurrent

Undercurrent Alarm.............. Asserted when an undercurrent alarm condition exists.

Undercurrent Trip................... Asserted when an undercurrent trip condition exists.

Protection operands: underpower

Underpower Alarm................ Asserted when an underpower alarm condition exists.

Underpower Trip..................... Asserted when an underpower trip condition exists.

Protection operands: undervoltage

Undervoltage Alarm............. Asserted when an undervoltage alarm condition exists.

Undervoltage Trip.................. Asserted when an undervoltage trip condition exists.

System trouble operands

Open Control Circuit............. Asserted when an open control circuit is detected.

Self-Test Alarm........................ Asserted when the self-test has failed and is set for alarm.

Self-Test Trip............................ Asserted when the self-test has failed and is set for trip.

Welded Contactor Alarm.... Asserted when a welded contactor is detected.

Communication trouble operands

Comm Fail Trip........................ Asserted when a loss of communication is detected.

Comm Fail Alarm.................... Asserted when a loss of communication is detected.

Maintenance

Drive Greasing Alarm........... Asserted when the running hours exceed the alarm level.

Contactor Inspect Alarm.... Asserted when the number of starts exceeds the alarm level.

Max Stopped Alarm.............. Asserted when the stopped hours exceed the alarm level.

Configuration

Relay Not Configured........... Asserted when critical settings are not stored.

Reset

Remote Reset Closed........... Asserted when the Remote Reset input is closed.

Lockout Reset Closed........... Asserted when the Lockout Reset input is closed.

Test Switch

Test Switch Closed................. Asserted when the Test Switch is closed .

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Chapter 9: Communications

9.1 Communications interfaces

The MM300 has three communications interfaces. These can be used simultaneously:

- RS485
- 10/100Base-T Ethernet
- Fieldbus

NOTE

Setpoint changes related to DeviceNet, Profibus, and Ethernet, require a power cycle to be activated.

NOTE

External power must be present on the Fieldbus port at power-up, in order to correctly initialize and operate.

NOTE

For full details, please refer to the MM300 Communications Guide, to be found on the GE Multilin web site.

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Appendix

A.1 Change notes

A.1.1 Revision history

Table A–1: Revision History

MANUAL P/N	RELEASE DATE	ECO
1601-9023-A1	21 June 2007	300-002
1601-9023-A2	8 November 2007	300-005
1601-9023-A3	6 February 2008	
1601-9023-A4	13 May 2008	

Table A–2: Major Updates for MM300-A4

Section Number	CHANGES
	Manual revision number from A3 to A4
Chapter 9	Removed Communications details ---> Comm Guide
General	Minor Corrections

Table A–3: Major Updates for MM300-A3

Section Number	CHANGES
	Manual revision number from A2 to A3
Ch6 - Setpoints - System	Screen Saver Feature added
Ch6 - Setpoints - System	Phasor Display added

Table A–3: Major Updates for MM300-A3

Section Number	CHANGES
Ch6 - Setpoints - Current and Voltage Transformers	CT Primary Turns added
Ch6 - Setpoints - Soft Starter	Bypass information deleted
Ch6 - Setpoints	Waveform section added to Config section
Ch6 - Setpoints	Datalog section added to Config section
Ch6 - Setpoints	Events section added
Ch6 - Setpoints	Counters section added
Ch7 - Diagnostics	Waveform section added
Ch7 - Diagnostics	Datalog section added

Table A–4: Major Updates for MM300-A2

Section Number	CHANGES
	Manual revision number from A1 to A2
Ch1 - MM300 Order Codes	Change to Protection section of Order Table
Ch2 - Mounting	Control Panel mounting drawing added
Ch4 - Status	Description of use of <enter> symbol added
Ch5 - Comm Setpoints	Profibus Address details added
Ch5 - Status	Misc. Setpoints added
Ch5 - UV Autorestart	Two NOTES added - end of setpoint section
Ch5 - Wye-Delta Open...	Section updated
Ch5 - Soft Starter	Section updated
Ch5 - System Security	Section relocated after Control Elements section
Ch5 - System	Section updated
General	Miscellaneous text updates and revisions

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