Digital Energy
Multilin

MM200

Motor Management System

Low voltage motor protection and control

Instruction manual

MM200 revision: 1.2x

Manual P/N: 1601-9034-A6

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GE Multilin MM200 Motor Management System instruction manual for revision 1.2x.

Part number: 1601-9034-A6 (July 2010)

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MM200 Motor Management System

Chapter 1: Introduction

Overview

The MM200 is a motor protection and control system designed specifically for low-voltage motor applications. The MM200 provides the following key benefits.

- Protection, control, and communication options to suit low-voltage motor applications.
- Small footprint designed specifically for IEC and NEMA MCC applications.
- DIN rail Mounting.
- Multiple communication protocols allows simple integration into monitoring and control systems.
- Optional basic control panel interface provides local control and access to system information.

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.

Description of the MM200 Motor Management system

The MM200 can be equipped with a basic control panel: includes pushbuttons for Stop, Start A, Start B, Auto, Manual, and Reset, and 12 LED status indicators.

The MM200 includes the following input/output capabilities:

- 2 Form A relays, 1 Form C relay
- 7 contact inputs LO power supply; 6 contact inputs HI power supply.

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

A single-line diagram for the MM200 is shown below.

Figure 2: Single line diagram

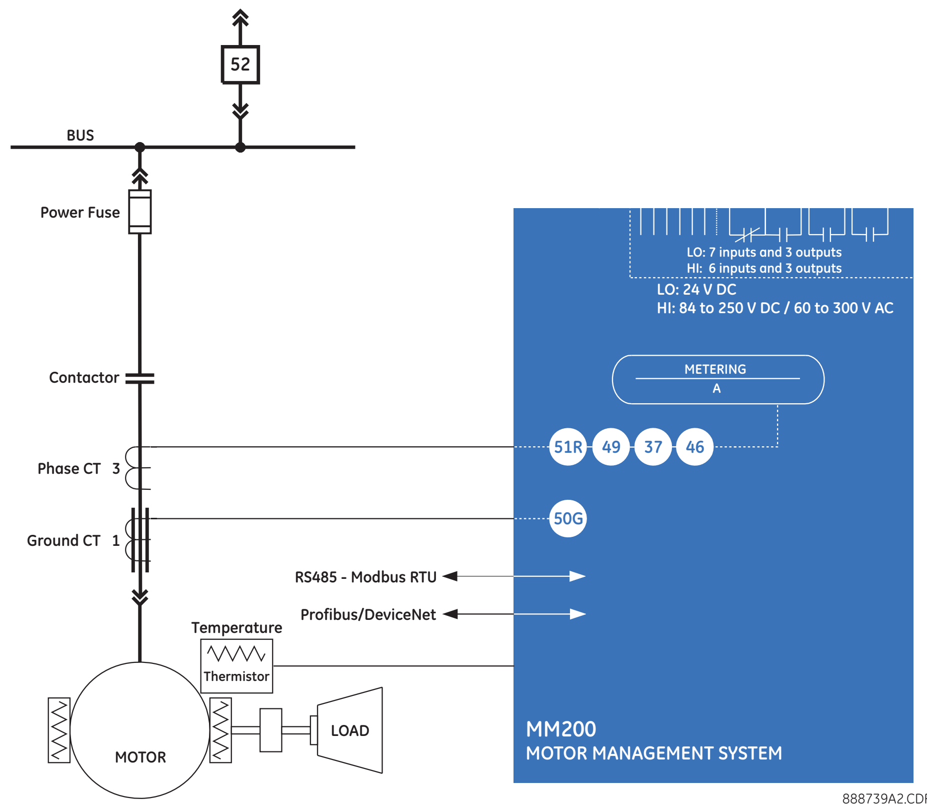
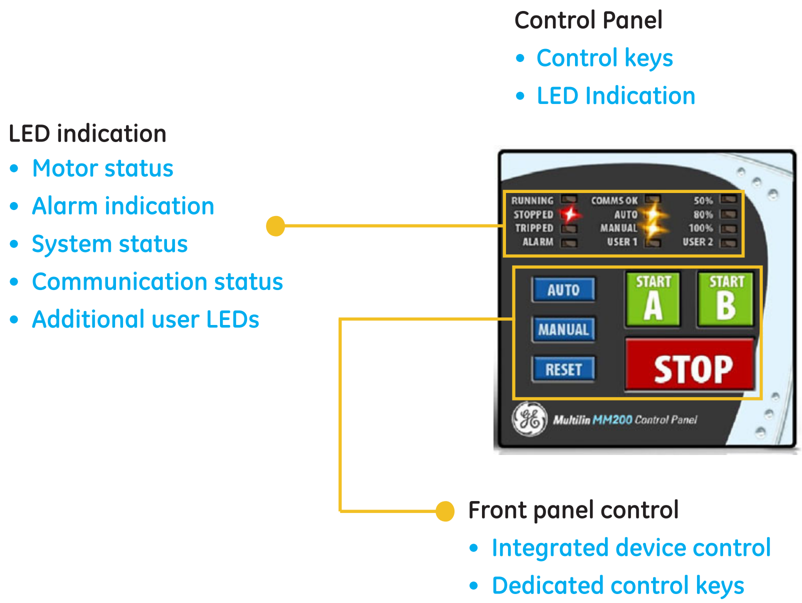


Table 1: MM200 protection functions

ANSI device	Description
37	Undercurrent
46	Current unbalance
49	Thermal overload
50G	Ground instantaneous overcurrent
51R	Locked/stalled rotor, mechanical jam

Figure 3: MM200 feature overview



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MM200 order codes

The information to specify an MM200 relay is provided in the following order code figure.

Figure 4: MM200 order codes

	Base						
	MM200	*	X	*	*	*	Description (7 inputs, 2 Form A, 1 Form C, 3 CT, CBCT, Thermistor)
	MM200	|		|	|	|	MM200 Motor Management System
Control panel		X		|	|	|	No Control Panel
		B		|	|	|	Basic Control Panel
Power supply				H	|	|	6 AC Digital inputs 65 to 300 V AC, 3 Outputs (2 form A, 1 form C), 3CT, CBCT, thermistor
				L	|	|	7 DC digital inputs 24 V DC, 3 Outputs (2 form A, 1 form C), 3CT, CBCT, thermistor
Communications					1	|	RS485 Modbus RTU plus DeviceNet Slave
					2	|	RS485 plus Profibus DP slave
					S	|	Standard Communications: RS485 Modbus RTU
Protection						S	Standard Protection and Control

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Example of an MM200 order code

MM200-BXL1S: MM200 with basic control panel, 24 V DC power supply, RS485 Modbus RTU communications, three-phase current, thermal overload, undercurrent, Devicenet communications, protection option.

Specifications

NOTE

Specifications are subject to change without notice.

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

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

GROUND FAULT (CBCT)

Pickup level: .... 0.5 to 15.0 A in steps of 0.1 A
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: .... ±100 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

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 × FLA
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:..hot/cold ratio
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

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

POWER FAILURE RESTART

Type:...Digital input
Power failure time: ....0 to 30 seconds in steps of 1
Restart time delay: ....0 to 300 seconds in steps of 1
UV detection time accuracy:.......................±100 ms or ±5%

User interface specifications

HAND HELD DISPLAY (HHD)

Size: ....width 153mm, height 102mm, depth 35mm
LCD: ....3.5-inch color, 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
Cable - GCP to Base Unit:..............................Shielded RJ45; Maximum length 6' (1.83m)

BASIC CONTROL PANEL

Size: ....BCP: width 75mm, height 75mm, depth 31mm
LED Indicators: ....12 LEDs
Pushbuttons: ....Start A, Start B, Stop, Reset, Auto, Manual
Cable - BCP to Base Unit:..............................Shielded RJ45; Maximum length 6' (1.83m)

Control specifications

POWER FAILURE RESTART

Type:...Digital input
Power failure time: ....0 to 30 seconds in steps of 1
Restart time delay: ....0 to 300 seconds in steps of 1
UV detection time accuracy:.......................±100 ms or ±5%

Inputs specifications

DIGITAL INPUTS (LO)

Fixed pickup: .... 24 V DC
Continuous current draw: .... 4 mA
Type: .... opto-isolated inputs
External switch: .... wet contact
Maximum input voltage: .... 36 V DC

DIGITAL INPUTS (HI)

Nominal voltage: .... 120 V AC to 240 V AC
Recognition time: .... 2 cycles
Continuous current draw: .... 4 mA @120 V AC; 8 mA @ 240 V AC
Type: .... opto-isolated inputs
External switch: .... wet contact
Voltage range: .... 65 V AC to 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)

PHASE CURRENT INPUTS

Range: .... 0.07 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 × rated current
1.0 s at 50 × rated current
2.0 s at 40 × rated current
continuous at 3 × rated current
maximum 100 A peak
Short Circuit: .... 5000 A @ 240 V AC direct connect
100000 A @ 600 VAC with accessory external CT

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

Outputs specifications

OUTPUT RELAYS

Configuration: .... electromechanical 2 x Form-A and 1 x Form-C
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: .... 5 A at 60°C
Make and carry for 0.2s: .... 30 A per ANSI C37.90 (**not UL rated**)

OUTPUT RELAY BREAK CAPACITY (FORM-A RELAY)

AC resistive, 120 V AC:.......................................5 A
AC resistive, 250 V AC:.......................................5 A
AC inductive, PF = 0.4:.......................................240 VA pilot duty
DC resistive, 30 V DC: ....5 A

OUTPUT RELAY BREAK CAPACITY (FORM-C RELAY)

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

Power supply specifications

POWER SUPPLY (LO RANGE)

Nominal:...24 V DC
Range: ....18 to 36 V DC
Power Consumption:..10 W typical

POWER SUPPLY (HI RANGE)

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
Power consumption: ....10 W typical
Voltage withstand: ....2 × highest nominal voltage for 10 ms

Communications specifications

DEVICENET (COPPER)

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

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

Testing and certification

CERTIFICATION

	APPROVAL	
	Applicable Council Directive	**According to**
	Low voltage directive	EN60255-5, EN60255-27
CE compliance	EMC Directive	EN60255-26 / EN50263
		UL508
North America	cULus	UL1053
		C22.2.No 14

TYPE TESTS (TEST NOT PERFORMED FOR AC PSU)

Test	Reference Standard	Test Level
Dielectric voltage withstand		2.3KV
Impulse voltage withstand	EN60255-5	5KV
Damped Oscillatory	IEC61000-4-18IEC60255-22-1	2.5KV CM, 1KV DM
Electrostatic Discharge	EN61000-4-2/IEC60255-22-2	Level 4
RF immunity	EN61000-4-3/IEC60255-22-3	Level 3
Fast Transient Disturbance	EN61000-4-4/IEC60255-22-4	Class A
Surge Immunity	EN61000-4-5/IEC60255-22-5	Level 3
Conducted RF Immunity	EN61000-4-6/IEC60255-22-6	Level 3
Power Frequency Immunity	EN61000-4-7/IEC60255-22-7	Class A
Voltage interruptionand Ripple DC	IEC60255-11	15% ripple, 200ms interupts
Radiated & Conducted Emissions	CISPR11 /CISPR22/ IEC60255-25	Class A
Sinusoidal Vibration	IEC60255-21-1	Class 1
Shock & Bump	IEC60255-21-2	Class 1
Siesmic	IEC60255-21-3	Class 2
Power magnetic Immunity	IEC61000-4-8	Level 5
Pulse Magnetic Immunity	IEC61000-4-9	Level 4
Damped Magnetic Immunity	IEC61000-4-10	Level 4
Voltage Dip & interruption	IEC61000-4-11	0, 40, 70% dips, 250/300cycle interrupts
Damped Oscillatory	IEC61000-4-12	2.5KV CM, 1KV DM
Voltage Ripple	IEC61000-4-17	15% ripple
Ingress Protection	IEC60529	IP20 (base unit) , IP54 (Control Panel)
Environmental (Cold)	IEC60068-2-1	-25C 16 hrs
Environmental (Dry heat)	IEC60068-2-2	70C 16hrs
Relative Humidity Cyclic	IEC60068-2-30	6day variant 2
	UL508	e83849 NKCR
Safety	UL C22.2-14	e83849 NKCR7
	UL1053	e83849 NKCR

Physical specifications

DIMENSIONS

Size: .... Base: 78 mm (W) × 90 mm (H) × 113 mm (D) [+ terminals 10mm]
BCP: 75 mm (W) × 75 mm (H) × 31 mm (D)

Weight (Base):.. 0.5 kg

Environmental specifications

OPERATING ENVIRONMENT

Ambient temperatures:	
Storage/shiipping:	- 40C to 90C *
Operating:	-20C to 60C *
Humidity	Operating up to 95% (non condensing) @ 55C (As per IEC60068-2-30 Variant 2, 6days)
Altitude:	2000m (max)
Pollution Degree:	II
Overvoltage Category:	II
Ingress protection:	IP20 (base unit) , IP54 (Control Panel)
Environmental rating;	60C surrounding Air ,pollution degree II,Type 1 (panel mount versions only)

* 1" around base unit

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MM200 Motor Management System

Chapter 2: Installation

Mechanical installation

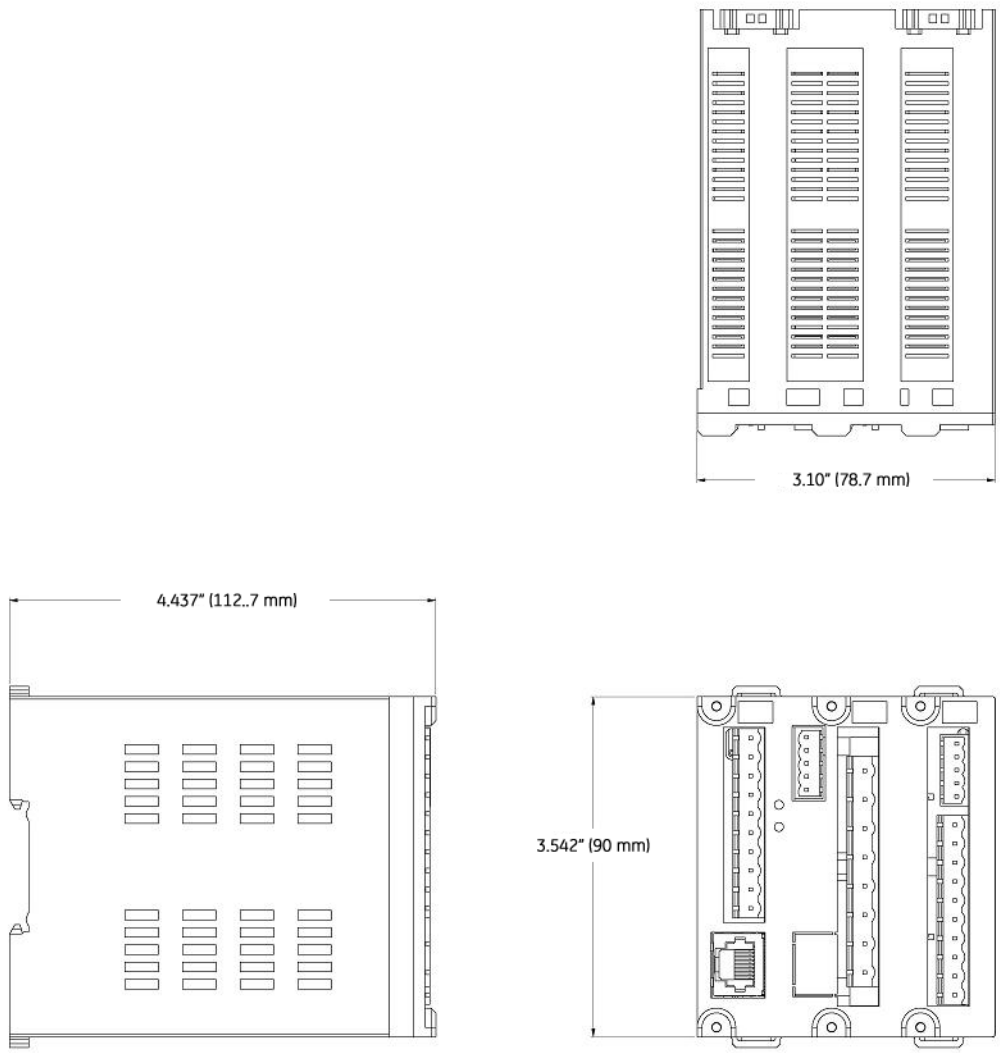
This section describes the mechanical installation of the MM200 system, including dimensions for mounting.

Dimensions

The MM200 is packaged in a fixed format divided into three specific sections.

The dimensions of the MM200 are shown below. Additional dimensions for mounting are shown in the following sections.

Figure 1: MM200 dimensions



Product identification

The product identification label is located on the side panel of the MM200. This label indicates the product model, serial number, firmware revision, and date of manufacture.

Figure 2: MM200 Identification label

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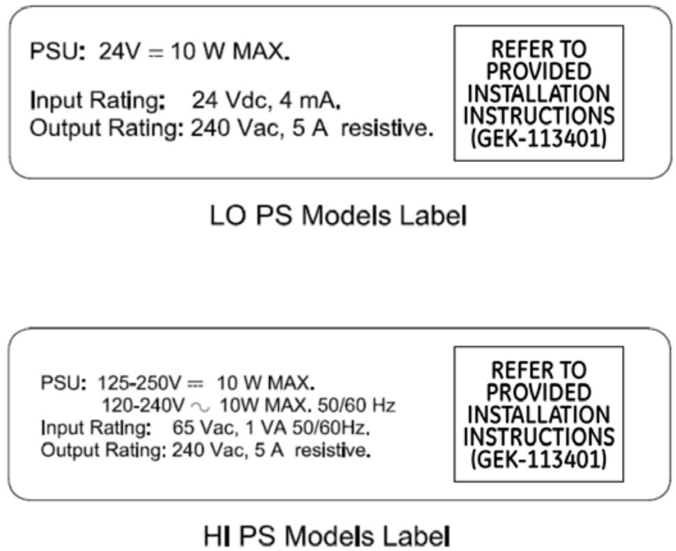
Figure 3: MM200 ratings label



Mounting

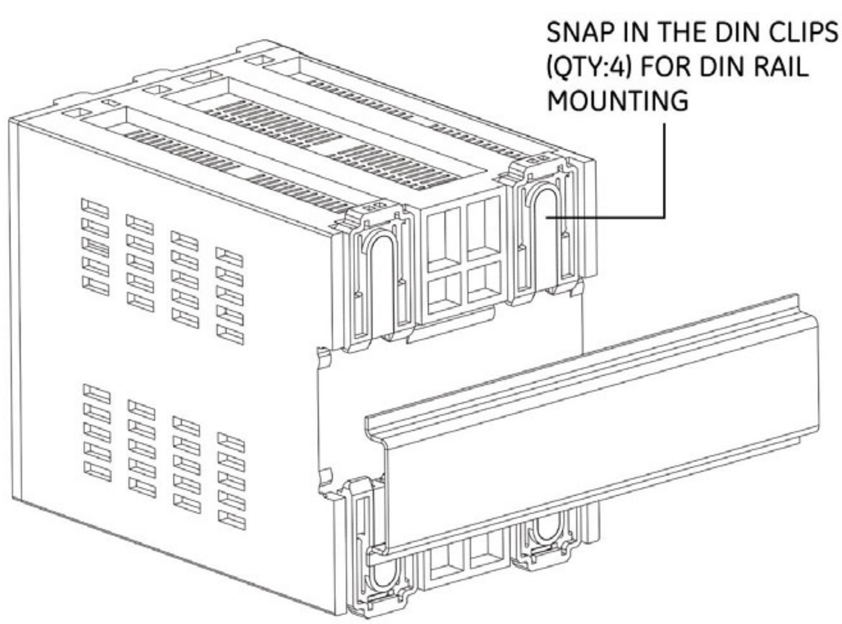
The MM200 is DIN rail mounted.

The standard 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: DIN rail mounting



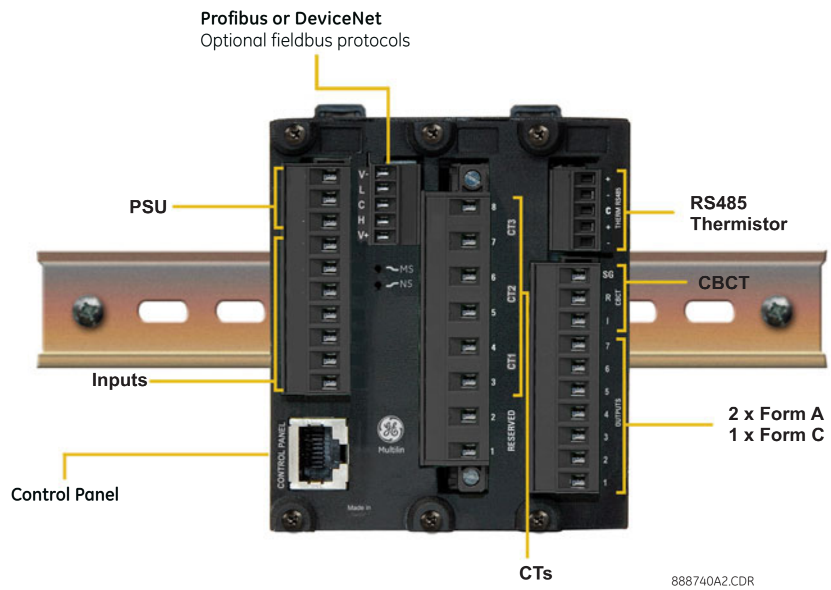
Electrical installation

This section describes the electrical installation of the MM200 system. An overview of the MM200 terminal connections is shown below.

CAUTION

MM200 is not to be used in any way other than described in this manual.

Figure 5: MM200 terminal connection overview

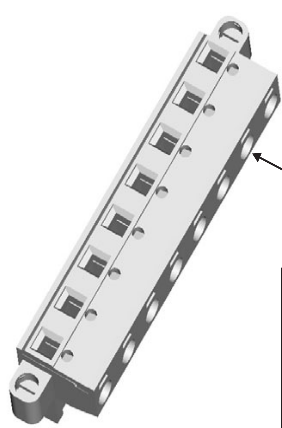


A Modbus RTU RS485 port, a thermistor input, and a 50:0.025 CBCT input are provided. Profibus and Devicenet are provided as options.

Table 1: Slot position

Slot	Type
A	PSU/Inputs/Control Panel
B	CPU/CTs
C	Outputs/CBCT/Thermistor/RS485

Figure 6: MM200 terminal connection torque rating



connector	screw torque
CT	4.5 lb-in
IPS, output	5.0 lb-in
Fieldbus, Thermistor & RS485	3.0 lb-in

CAUTION

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

Table 2: Wire Gauge Sizes

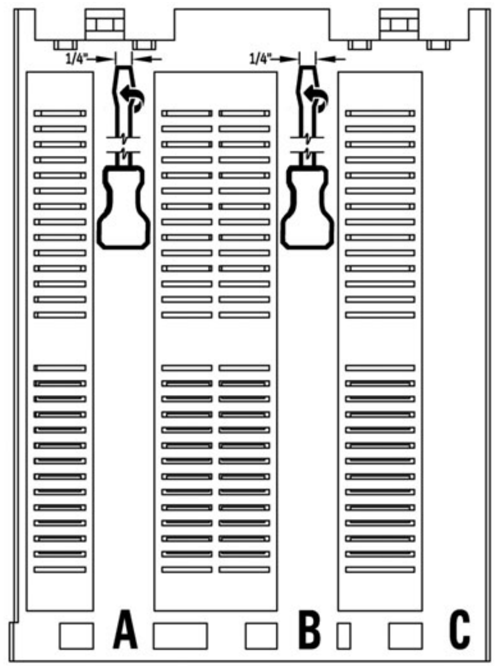
Slot A	PSU and Inputs	12 AWG (2.5 mm2) (5.00mm pitch terminals)[1]
Slot B	Fieldbus, CT Connections	16 AWG (1.5 mm2) (3.50mm pitch terminals)12 AWG (2.5 mm2) (7.62mm pitch terminals)1
Slot C	RS485 & ThermistorOutput Relays, CBCT	16 AWG (1.5 mm2) (3.50mm pitch terminals12 AWG (2.5 mm2) (5.00mm pitch terminals)1

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

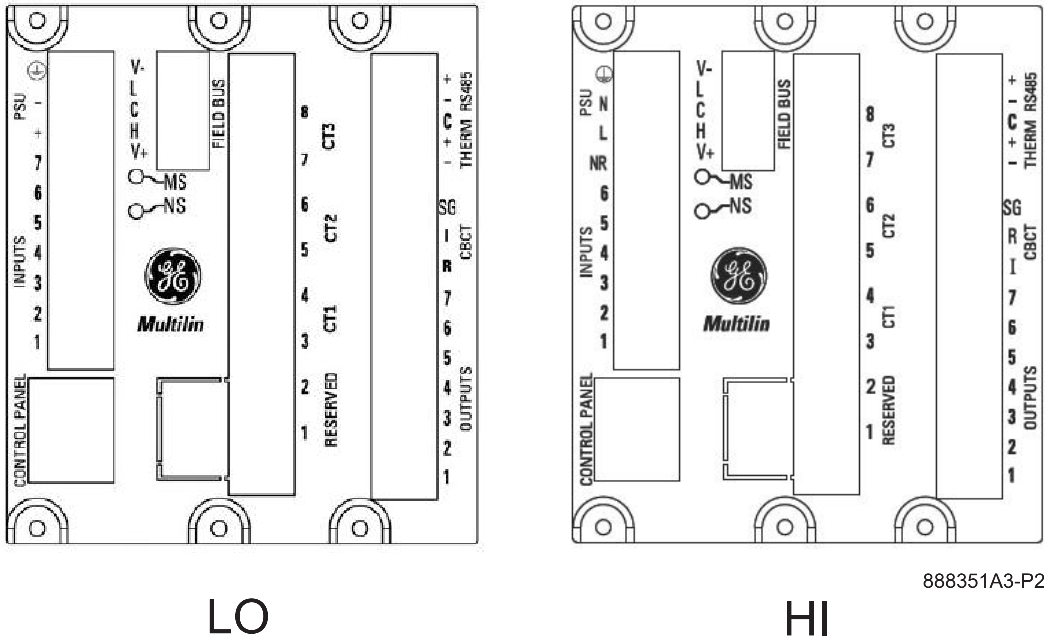
NOTE

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 7: Top and Rear panel arrangement



The MM200 I/O terminals are labeled with a two-character identifier. The first character identifies slot position and the second identifies the terminal.



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 MM200.

CAUTION

Figure 8: CBCT ground CT connection

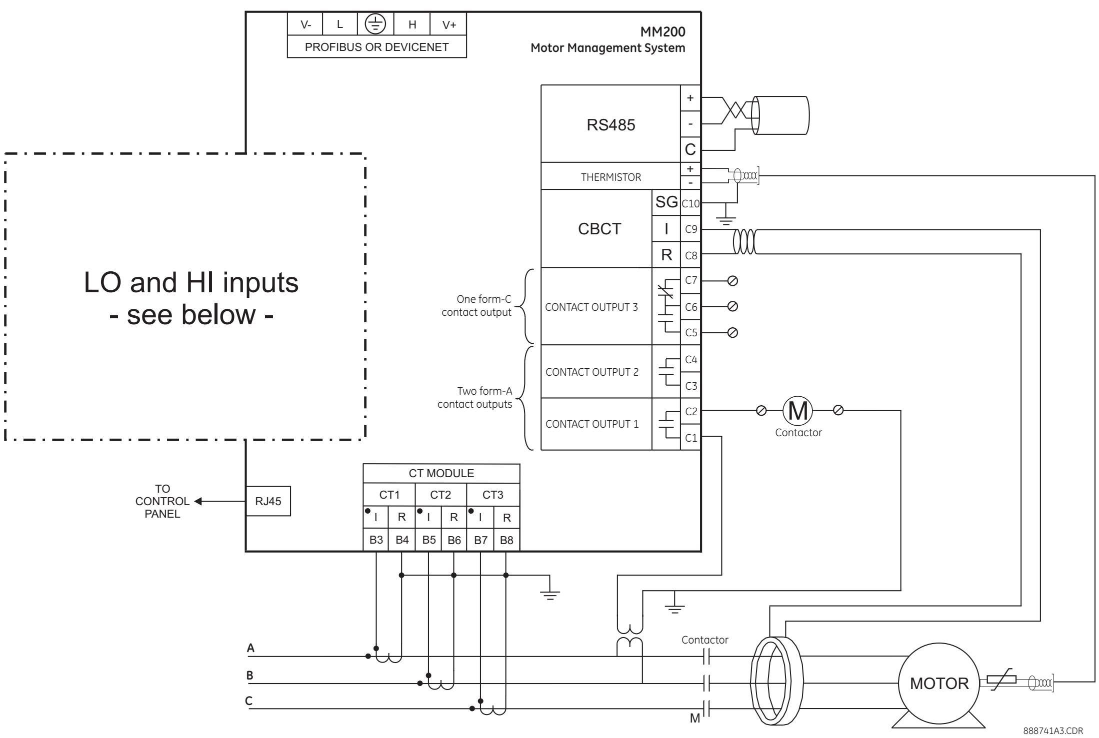
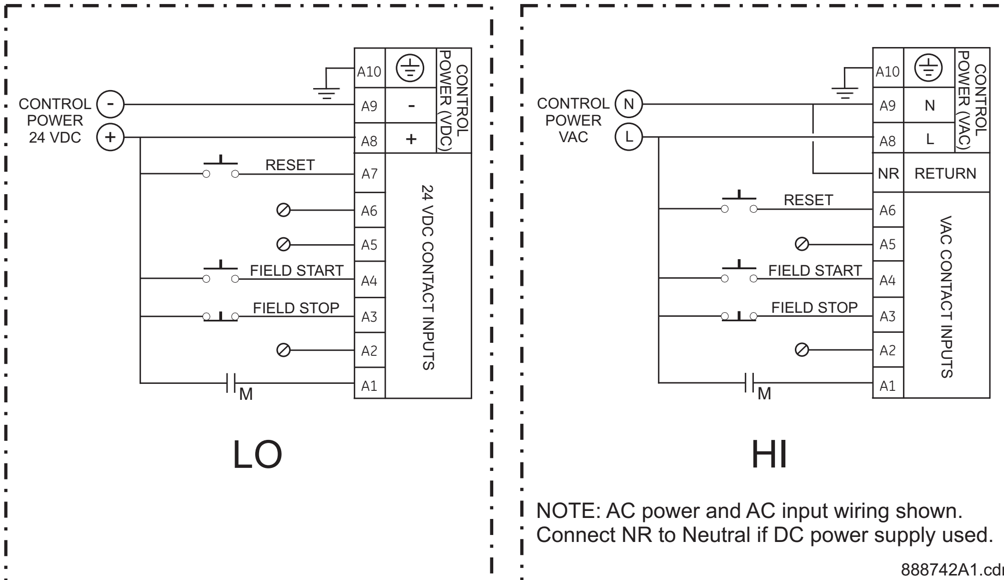


Figure 9: CBCT ground CT connection - LO and HI inputs



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 10: Core balance ground CT installation, shielded cable

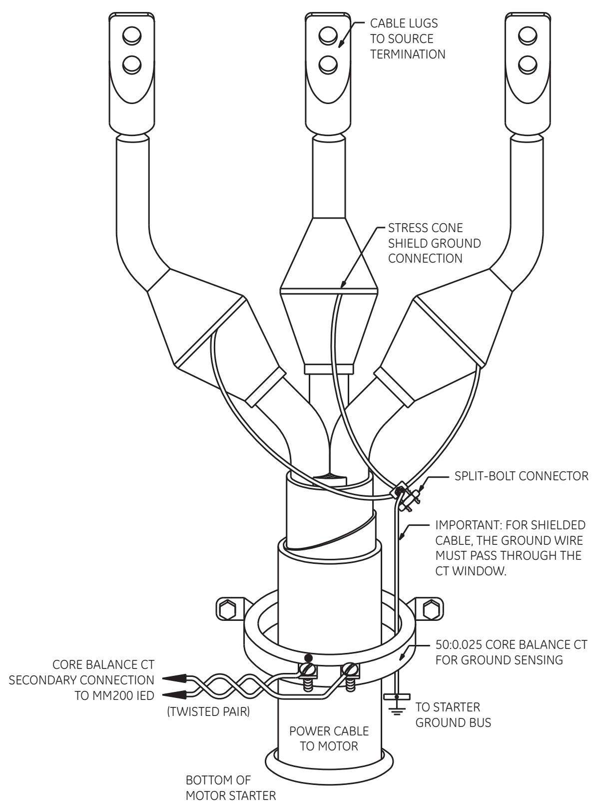
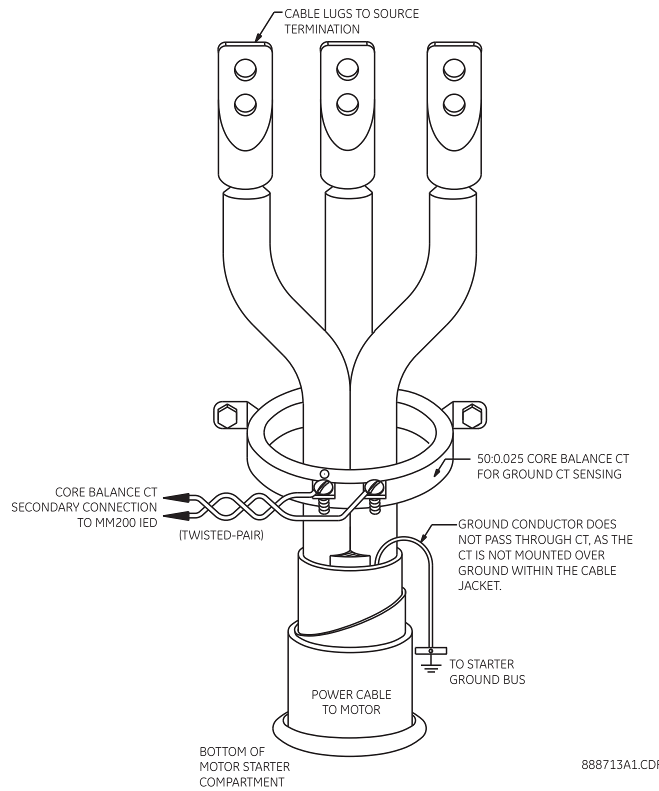


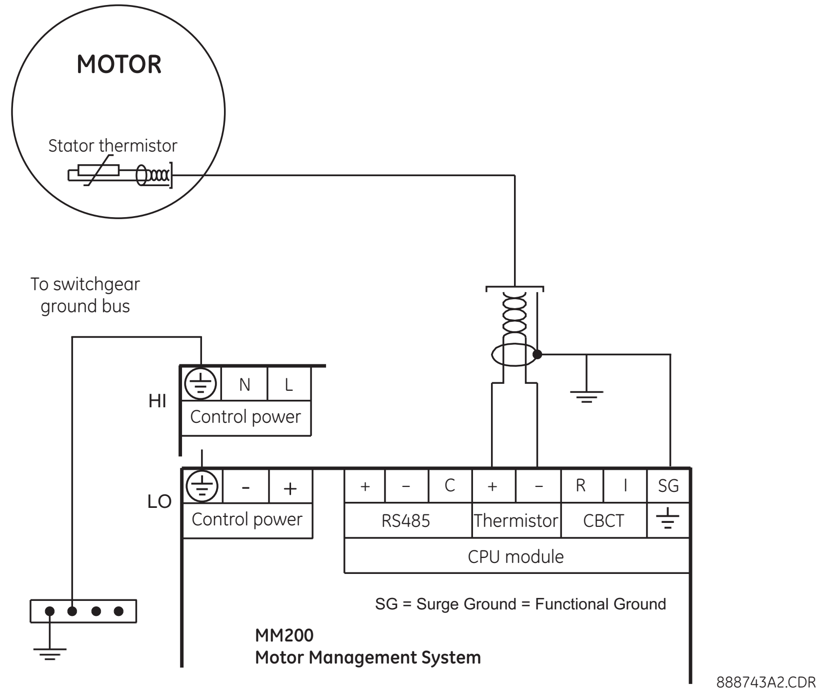
Figure 11: Core balance ground CT installation, unshielded cable



Thermistor connections

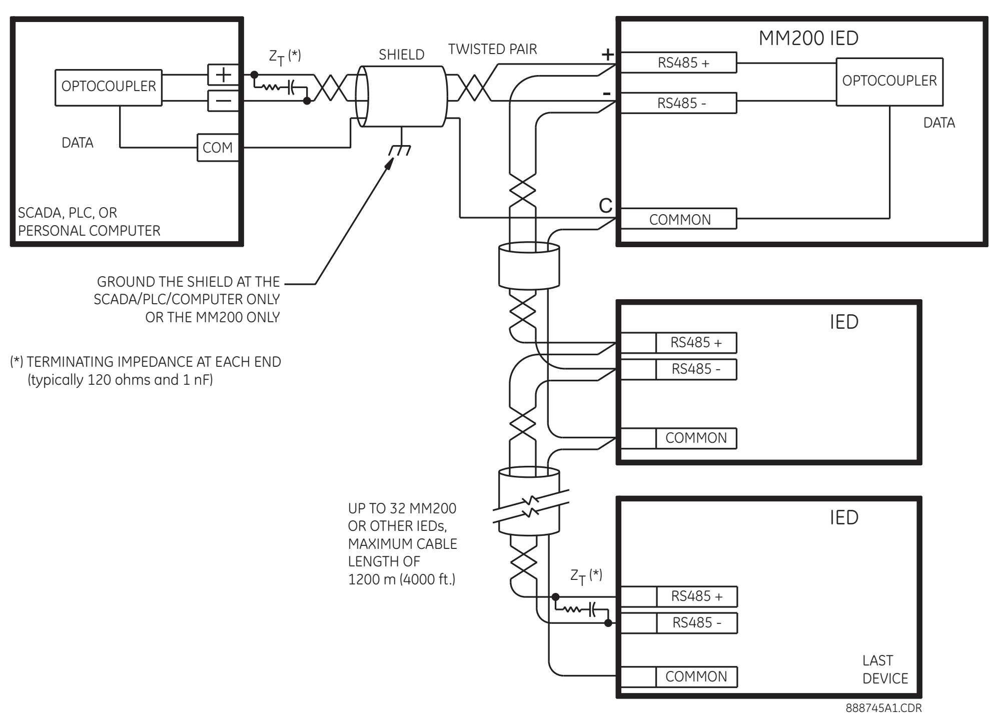
Either a positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor may be directly connected to the thermistor + and - terminals in slot C. By specifying the hot and cold thermistor resistance, the MM200 automatically determines the thermistor type as NTC or PTC. Use 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 12: Typical thermistor connection



RS485 connections

Figure 13: Typical RS485 connection



One two-wire RS485 port is provided. Up to 32 MM200 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 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 MM200. Failure to do so may result in intermittent or failed communications.

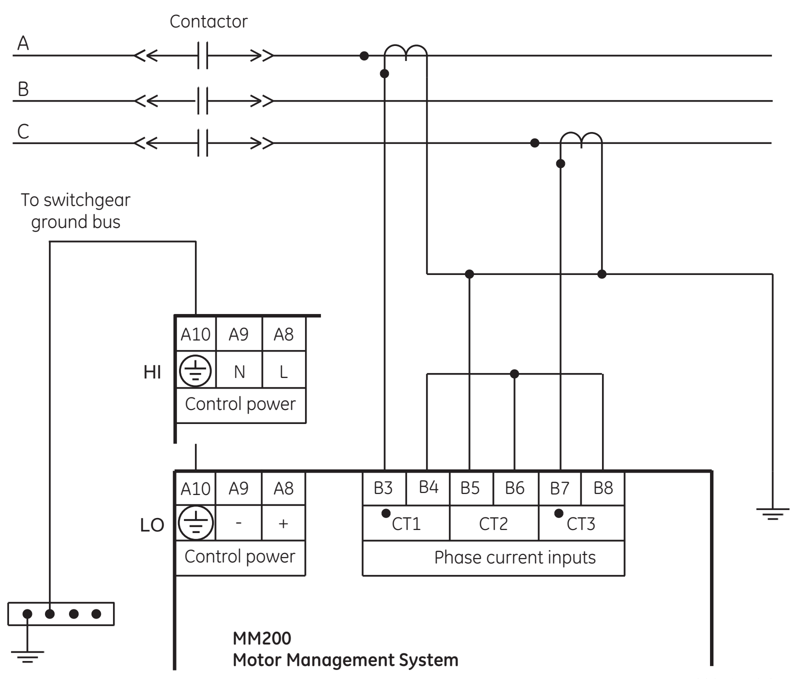
The source computer/PLC/SCADA system should have similar transient protection devices installed, either internally or externally. Ground the shield at one point only, as shown in the figure above, to avoid ground loops.

Correct polarity is also essential. The MM200 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.

Protection

Phase current inputs

Figure 14: Typical phase current input connections



The MM200 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.

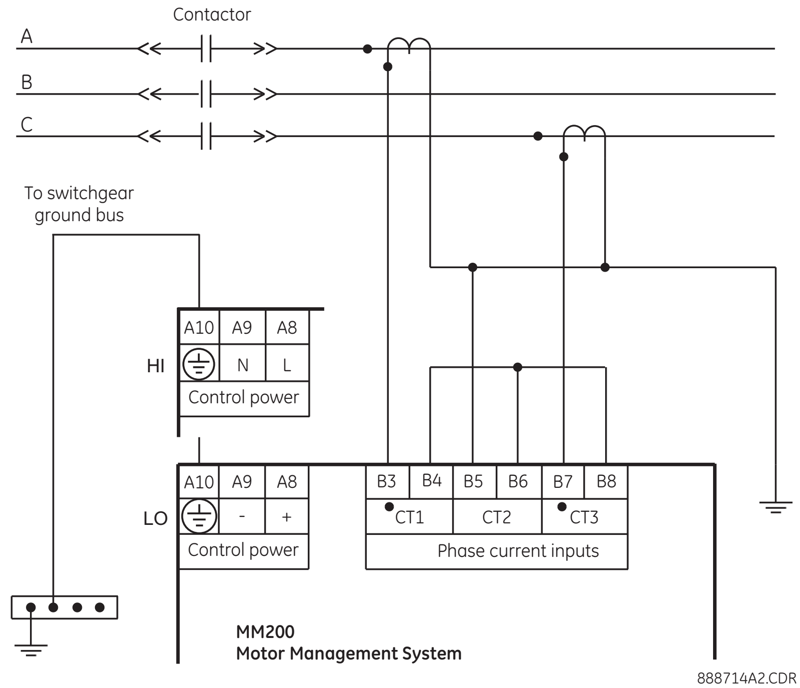
The MM200 measures up to 8 times the phase current nominal rating. CTs with 1 A or 5 A secondaries must be used if the FLA is greater than 5 A. The chosen CTs must be capable of driving the MM200 phase CT burden.

CAUTION

Polarity of the phase CTs is critical for unbalance calculation.

Two CT configuration

Figure 15: Two CT connection



The proper configuration for the use of two CTs rather than three to detect phase current is shown. 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.

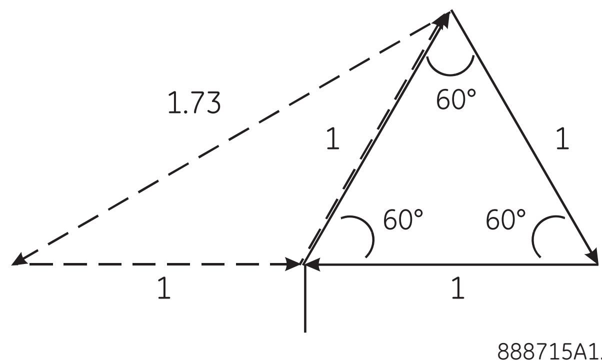
Only one ground connection should be made as shown. If two ground connections are made, a parallel path for current has been created.

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

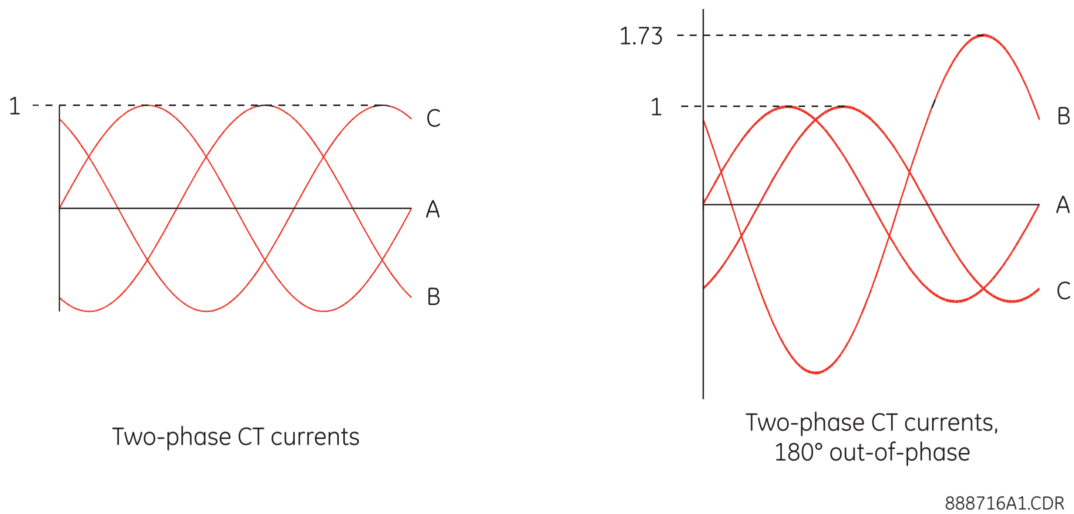
Change CT wiring only if the system is de-energized!

Figure 16: 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 17: 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.

Input/output

Type IO_C connections

Figure 18: Typical wiring for IO connectors

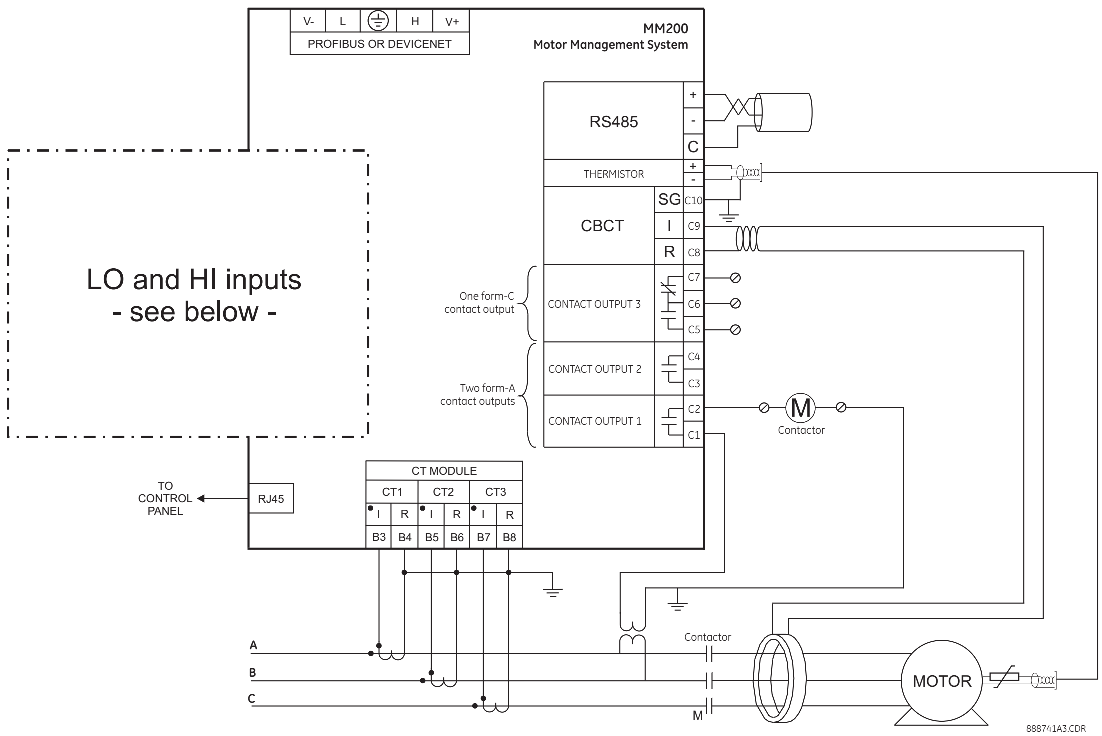
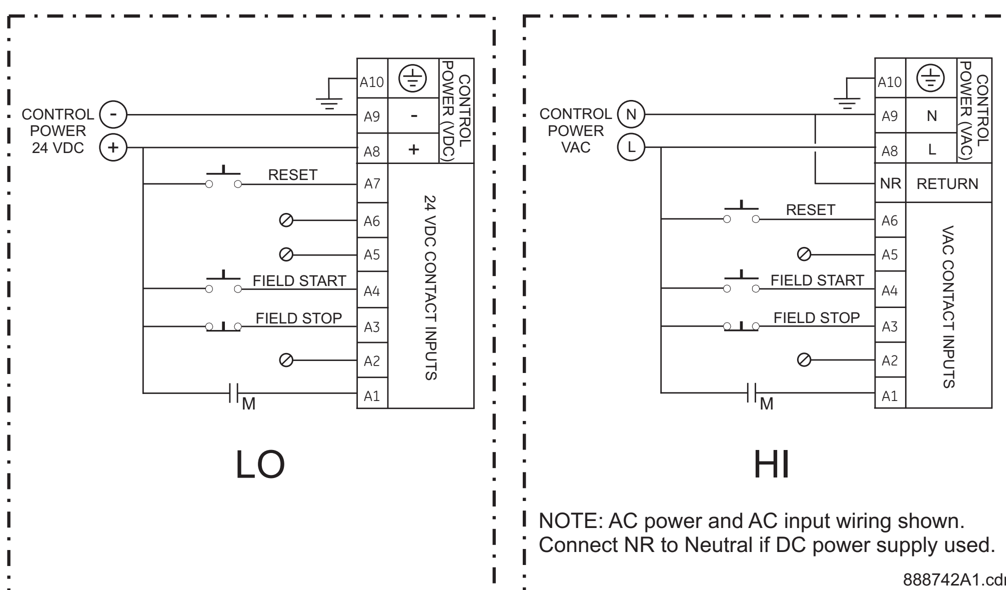


Figure 19: LO and HI input connections



The MM200 contains two Form-A contact output relays, one Form-C contact output relay, and seven digital inputs.

Contact inputs can be programmed to any of the input functions, such as field stop. 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.

The three contact outputs can be programmed to follow any one of the digital signals developed by the MM200, 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).

Dielectric strength testing

Figure 20: Testing for dielectric strength

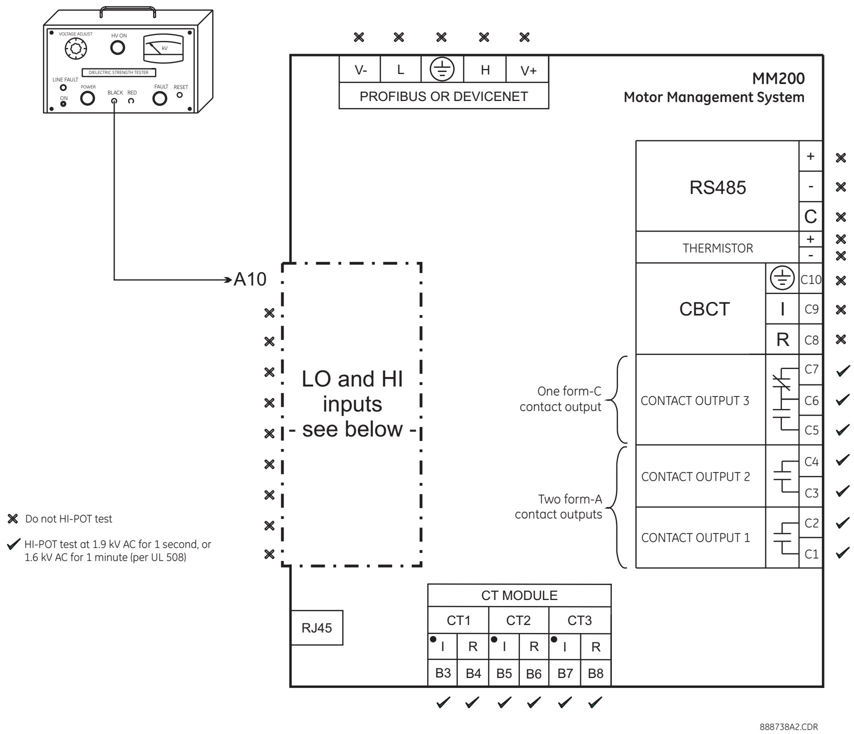
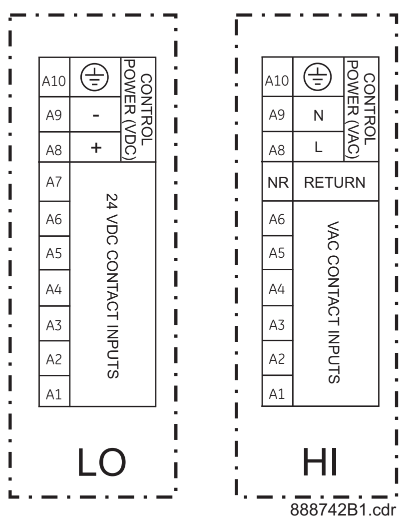


Figure 21: LO and HI inputs



It may be required to test a complete motor starter for dielectric strength (“flash” or “HI-POT”) with the MM200 installed. The MM200 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 MM200 during these tests.

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).

Starter types

Full-voltage non-reversing starter

Figure 22: Full-voltage non-reversing starter wiring

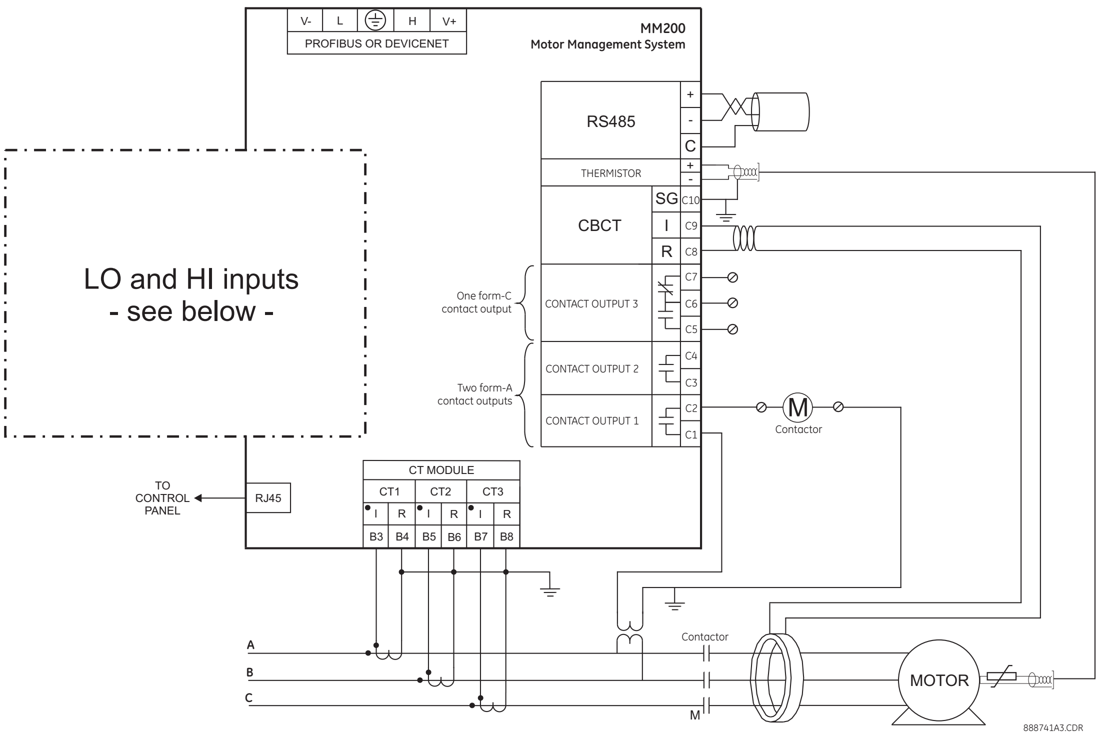
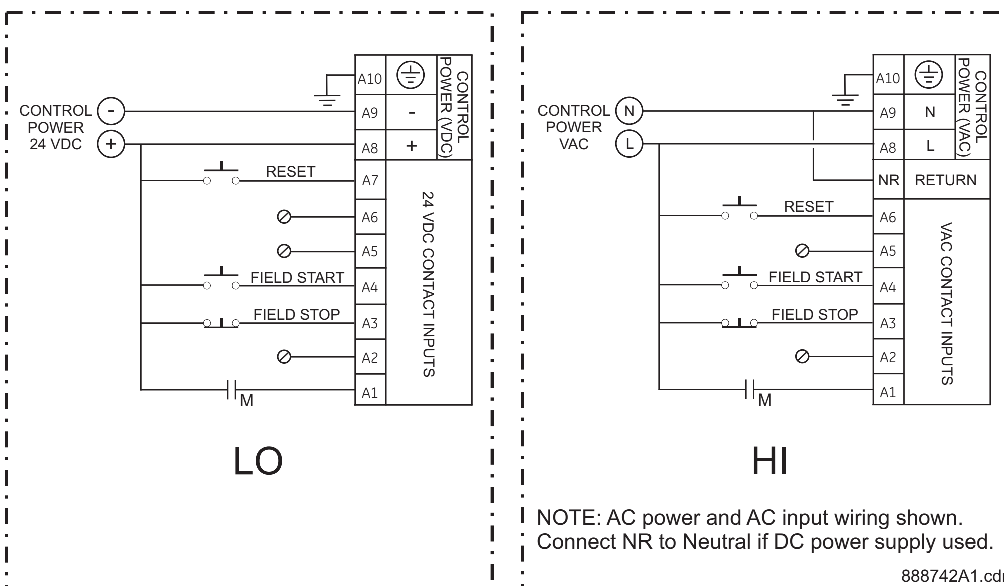


Figure 23: LO and HI inputs



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, relay contact output 1 closes and seals-in, picking up contactor M, which starts the motor. When a stop control is received, relay contact output 1 drops out, contactor M drops out, and the motor stops. The pre-contactor is omitted on forced starts (for example, External Start).

Full-voltage reversing starter

Figure 24: Full-voltage reversing starter wiring

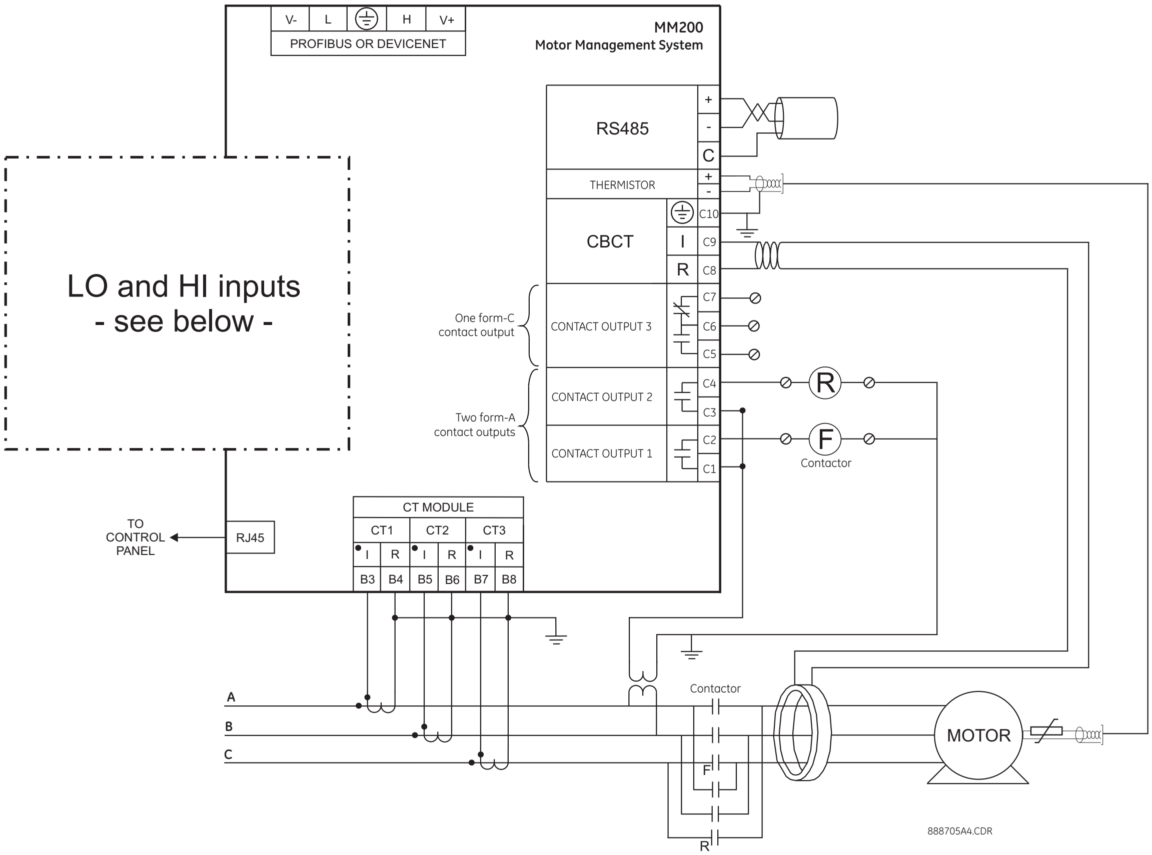
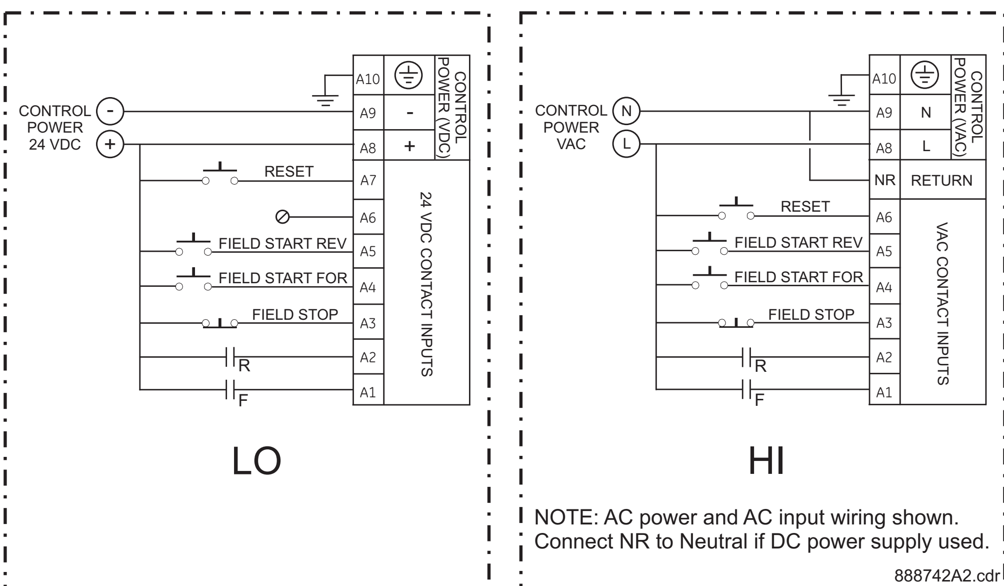


Figure 25: LO and HI inputs



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, relay1 drops 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, External Start). Forced starts are not supervised by this starter transfer timer – any external starting circuit must itself respect fast direction change restrictions.

Two-speed starter

Figure 26: Two-speed starter typical wiring

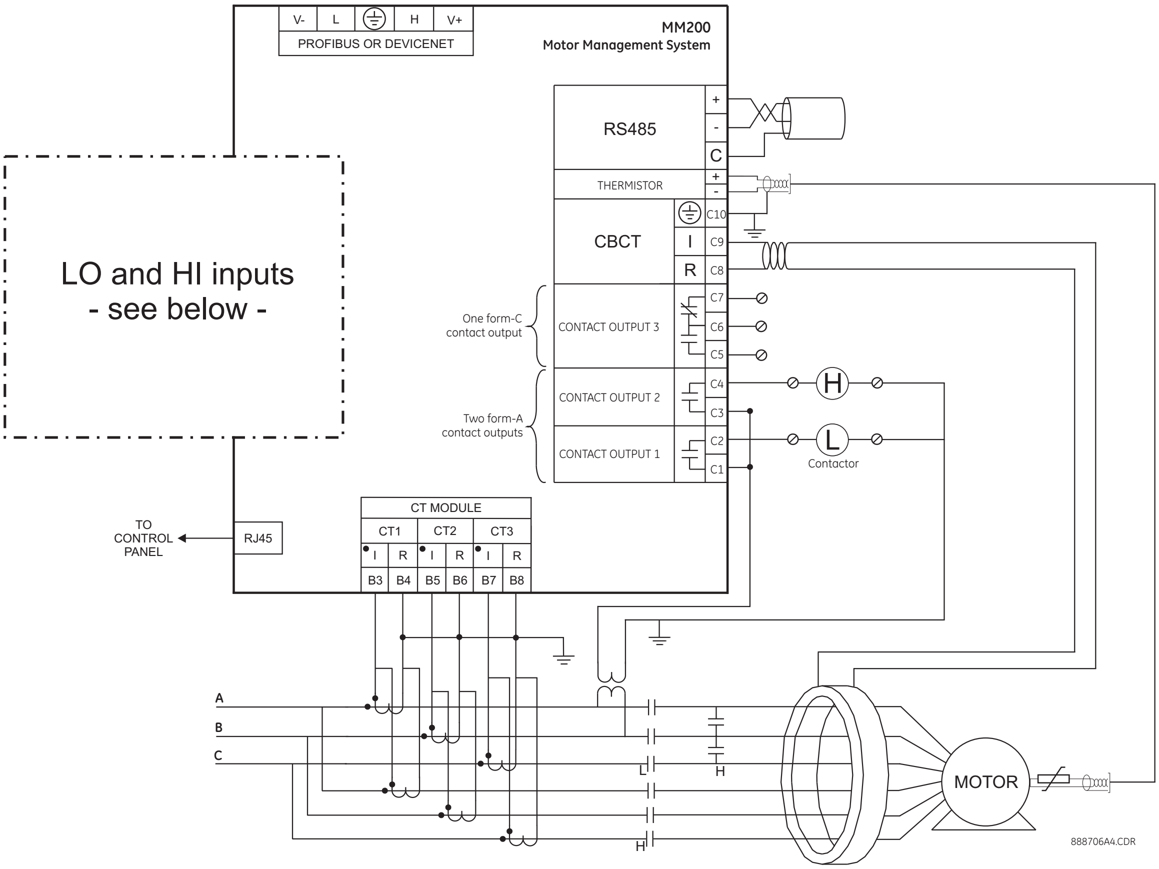
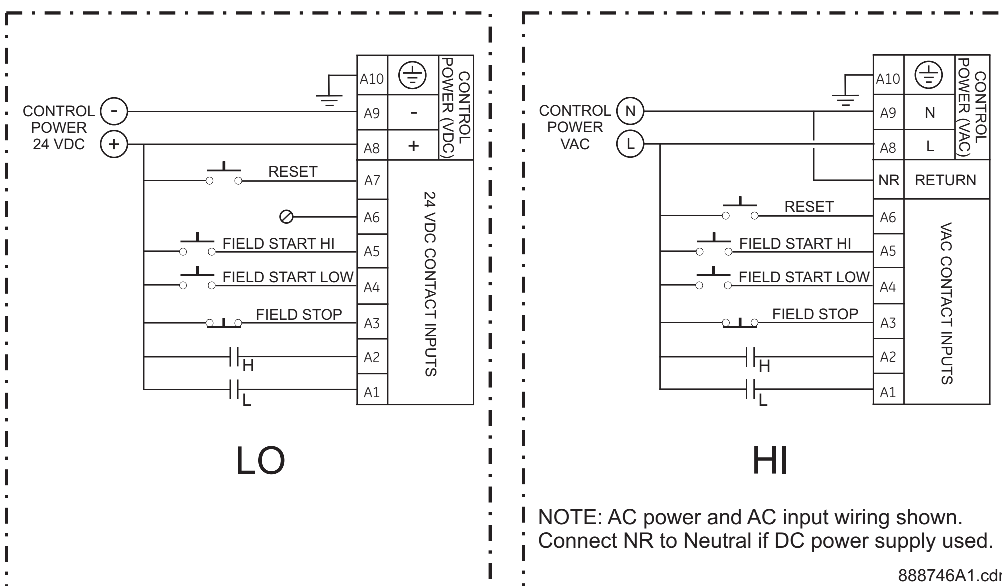


Figure 27: LO and HI inputs



This 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, relay1 picks up and seals-in, picking up contactor L, which starts the motor in low speed. When a start B (high speed) control is received, the relay1 drops out, and contactor L drops out. When contactor L Off status is received, the relay2 picks up and seals-in, picking up contactor H, which starts the motor in high speed. Should a start A (low speed) control be received when relay2 is picked up, relay2 is drops out, and contactor H drops out. When contactor H Off status is received, the starter waits for the set transfer time to allow the motor to slow. When the transfer time timer times out, the relay1 picks up and seals-in, picking up contactor L, which starts the motor in low speed. When a stop control is received, the relays 1 and 2 drop out, contactors L and H drop out, and the motor stops. If the **HIGH SPEED START BLOCK** setting is "Enabled", this starter will not allow a start B (high speed) control unless already running at low speed.

The pre-contactor is omitted on forced starts (for example, 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.

MM200 Motor Management System

Chapter 3: Control panel

This section provides an overview of the interfacing methods available with the MM200. For additional details on interface parameters (for example, settings, actual values, etc.), refer to the individual chapters.

There are two methods of interfacing with the MM200 Motor Management System.

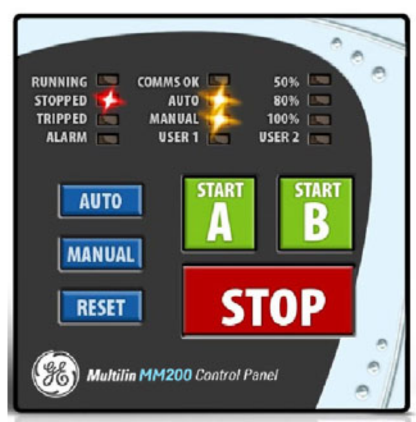
- Via the basic control panel.
- Via the EnerVista MM200 Setup software.

NOTE: For full details on handling the EnerVista MM200 Setup software, please use the EnerVista MM200 Setup Software Guide which accompanies this manual.

Basic control panel

The MM200 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 1: Basic control panel



888750A1.CDR

The following LEDs are provided:

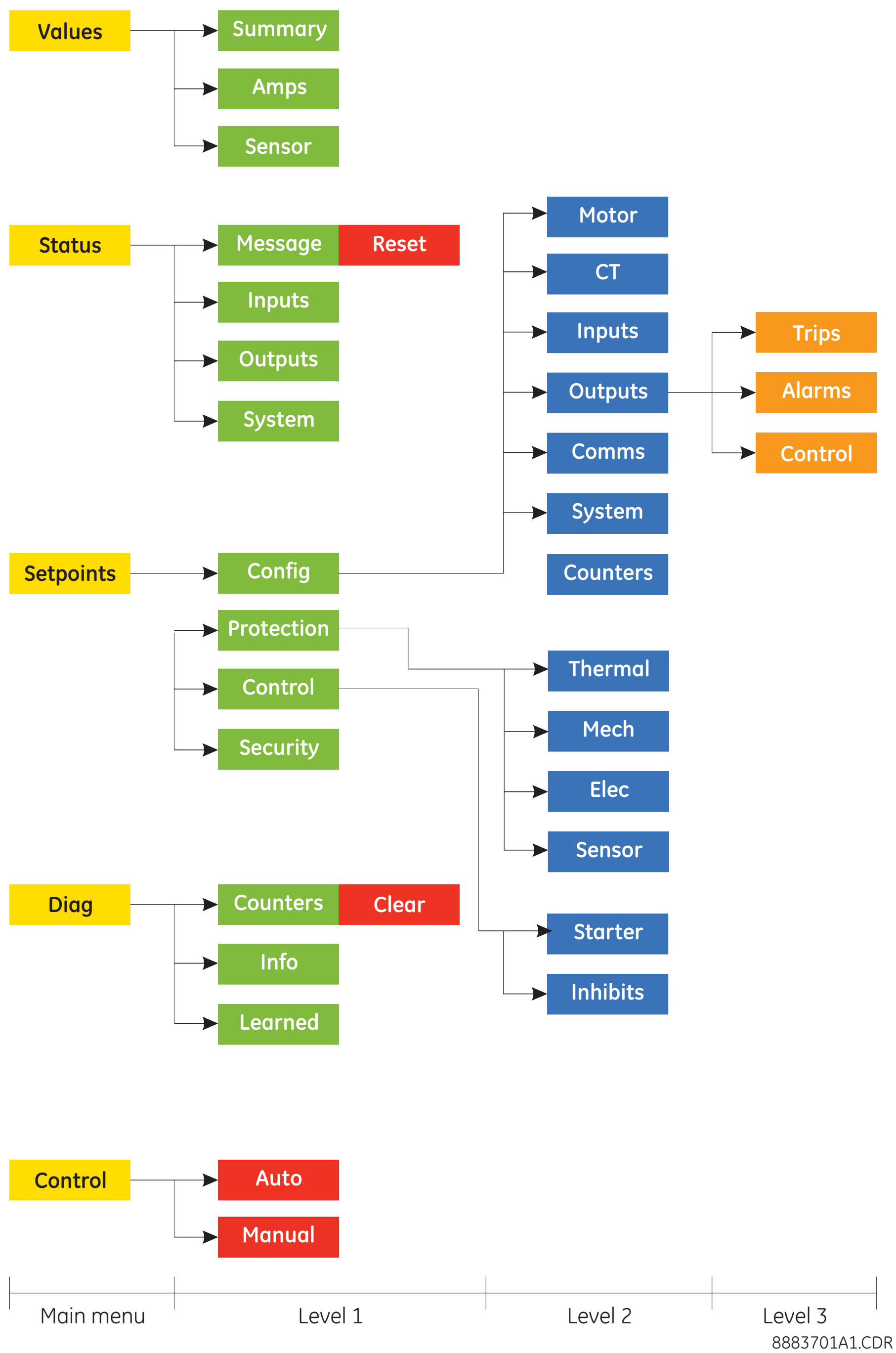
- Two USER LEDs (USER 1 and USER 2). the user can select parameters from a list

- 50%/80%/100% - showing motor load
- RUNNING, STOPPED, TRIPPED, and ALARM
- COMMS OK
- AUTO and MANUAL

MM200 graphical display page hierarchy

A summary of the MM200 page hierarchy is shown below:

Figure 2: MM200 display page hierarchy



EnerVista MM200 Setup Software

The EnerVista MM200 Setup software is available from GE Multilin to make setup as convenient as possible. With EnerVista MM200 Setup running, it is possible to:

- Program and modify settings
- Load and save settings files to and from a disk
- Read actual values
- Monitor status
- Read pre-trip data
- Get help on any topic
- Upgrade the MM200 firmware

NOTE

Before performing a firmware upgrade, ensure that you create a back-up of your existing settings files.

Once the firmware upgrade has been completed on the PC, the firmware on the MM200 must be immediately upgraded from the PC.

Check the firmware level on the MM200 once the above operations have been completed.

The EnerVista MM200 Setup software allows immediate access to all MM200 features with easy to use pull down menus in the familiar Windows environment. This section provides the necessary information to install EnerVista MM200 Setup, upgrade the relay firmware, and write and edit setting files.

The EnerVista MM200 Setup software can run without a MM200 connected to the computer. In this case, settings may be saved to a file for future use. If an MM200 is connected to a PC and communications are enabled, the MM200 can be programmed from the setting screens. In addition, measured values, status and trip messages can be displayed with the actual value screens.

Software requirements

The following requirements must be met for the EnerVista MM200 Setup software.

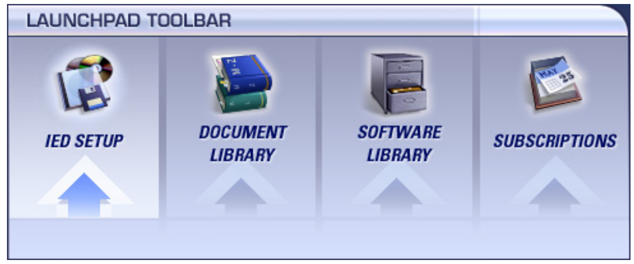
- Microsoft Windows™ XP / 2000 is installed and running properly.
- At least 20 MB of hard disk space is available.
- At least 128 MB of RAM is installed.

The EnerVista MM200 Setup software can be installed from either the GE EnerVista CD or the GE Multilin website at http://www.GEmultilin.com.

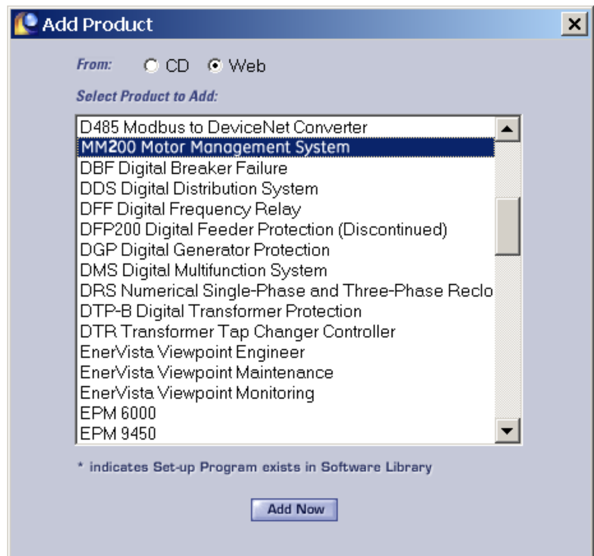
Installing the EnerVista MM200 Setup software

After ensuring the minimum requirements indicated earlier, use the following procedure to install the EnerVista MM200 Setup software from the enclosed GE EnerVista CD.

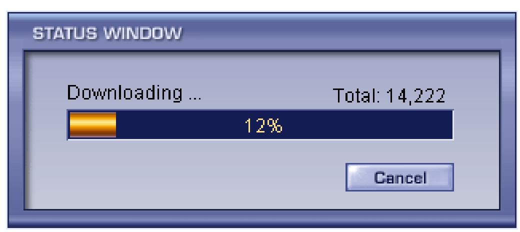
1. Insert the GE EnerVista CD into your CD-ROM drive.
2. Click the Install Now button and follow the installation instructions to install the no-charge EnerVista software on the local PC.
3. When installation is complete, start the EnerVista Launchpad application.
4. Click the IED Setup section of the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



5. In the EnerVista Launchpad window, click the **Add Product** button and select the MM200 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 MM200.



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 MM200 Setup software will be installed.
8. Click on **Next** to begin the installation. The files will be installed in the directory indicated and the installation program will automatically create icons and add EnerVista MM200 Setup software to the Windows start menu. The following screen will appear:
9. The MM200 device will be added to the list of installed IEDs in the EnerVista Launchpad window, as shown below.

Uploading the MM200 Firmware

Use the following steps to upload the MM200 firmware to the MM200 device:

1. Remove the Basic Front Panel (if connected) from the BCP (RJ45) port of the CPU.
2. Connect the special RJ45 to D89 cable through this RJ45 port to the computer's serial port. **Please contact GE Mutlin to place an order for this cable (Part Number: B3427G5).**
3. Launch the EnerVista MM200 Setup software application.
4. Open **Device Setup** and add a site and a device.
5. Select **Serial** as the interface. Baud Rate = **115200**, Slave Address = **254**, Parity = **None**, Bits = **8**, Stop Bits = **1**.
6. Select the COM Port number of the PC, to which the DB9 is connected (normally 1 or 2), and press the **Read Order Code** button.
7. Once the Order Code and Version are read from the device, press **OK**.
8. In **Setup Software**, go to the Online window and expand the tree for this newly-added device.
9. Go to **Maintenance > Firmware Upload**, select the firmware file to be uploaded to the device, and press **Proceed**. A popup message will appear, showing the type of cable connection required to perform the firmware upload process (RJ45 to RS232 cable). When uploading firmware, remove the RS485 connector from the device. When the warning message appears, press **OK** and the firmware will start to upload.
10. Once the Setup Software message appears, indicating that the Firmware Upload was successful, you must reboot the device.

You have successfully uploaded the new firmware to the device, and the device is now ready to be used.

Digital Energy
Multilin

MM200 Motor Management System

Chapter 4: Setpoints

Understanding setpoints

Setpoints can be modified via RS485, using the EnerVista MM200 Setup program.

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.

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
- VT: voltage transformer

- %UB: percent unbalance
- Ctrl: control
- Hr & hr: hour
- O/L: overload
- ops: operations
- mcc: motor control center

Configuration setpoints

The configuration setpoints contains data on motor configuration as well as system setup, inputs, outputs, communications, and CTs.

- Motor (setpoints related to motor configuration).
- CT (setpoints related to CT 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 MM200 system configuration, such as the faceplate LEDs)
- Counters (setpoints related to the digital counters)

Motor setpoints

The MM200 starter function is responsible for executing the motor startup sequence, including the pre-contactor start warning. The MM200 provides three pre-defined starters.

- Full-voltage non-reversing
- Full-voltage reversing
- Two-speed

NOTE

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

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.

Starter Type (Mandatory setpoint)

Range: None, FV Non-Reversing, FV Reversing, Two Speed

Default: FV Non-Reversing

This setpoint selects the starter type. The relay is essentially disabled when the value is set to “None”. Figure 1 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.

Supply Frequency (Mandatory setpoint)

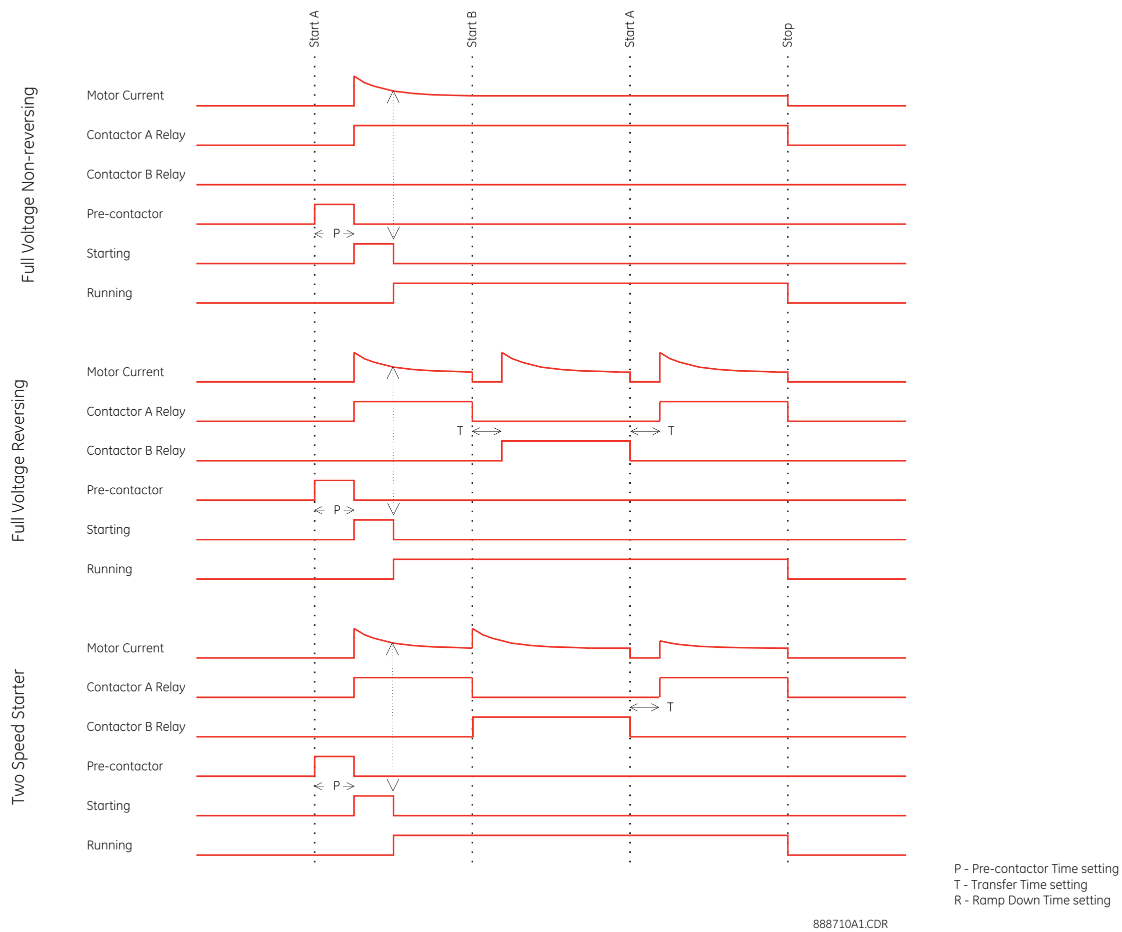
Range: 50 Hz, 60 Hz

Default: 60 Hz

This setpoint specifies the nominal system frequency.

The following sections provide additional information for each starter type.

Figure 1: Typical starter timing

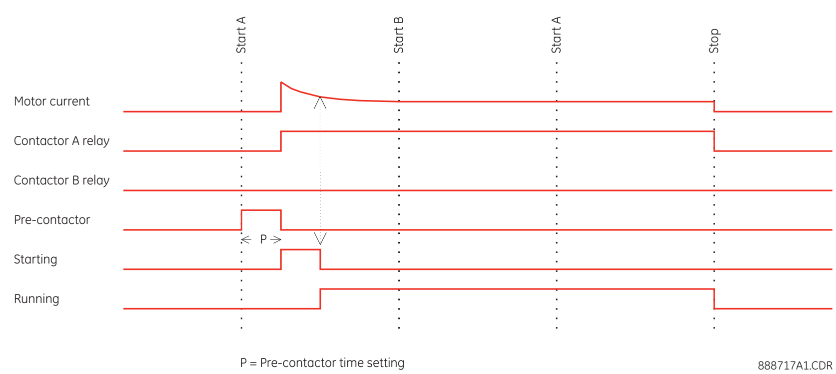


Full-voltage non-reversing starter

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 contact output picks up and seals-in, starting the motor. When a stop control is received, contactor A relay contact output is dropped out and the motor stops.

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

Figure 2: 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. 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.

Full-voltage reversing starter

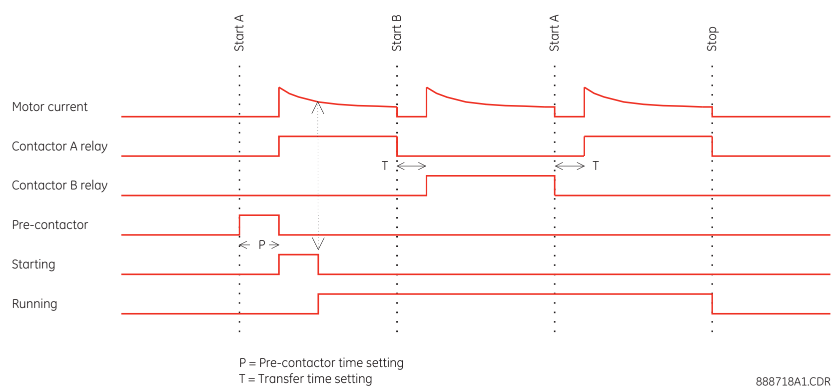
The full-voltage reversing starter type is a full-voltage or across-the-line reversing starter.

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

Figure 3: 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. 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.

Two-speed starter

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

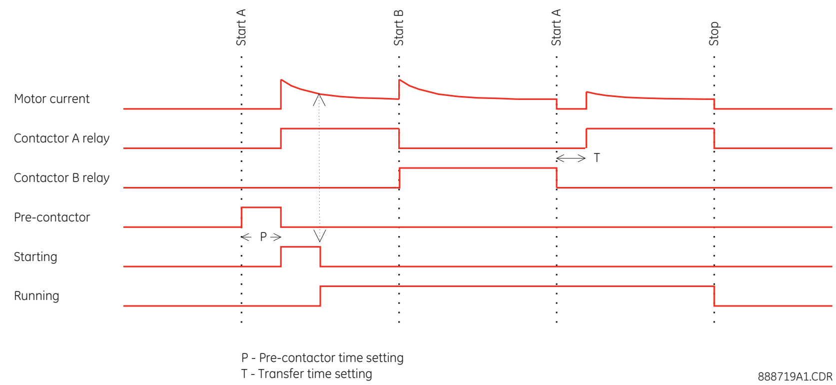
When a start A (low speed) control is received, the pre-contactor relay (if any) is picked up for the set **Pre-Contactor Time**. When the pre-contactor timer times out, the contactor A relay picks up and seals-in, starting the motor in low speed. When a start B (high speed) control is received, the 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).

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 4: 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.

Pre-Contactor Time

Range: 0 to 60 seconds in steps of 1

Default: 0 seconds

This setpoint represents the time between a start command and the starting of the motor. An audible or other warning signal can be activated during this interval, by connecting the signal to a contact output set to the pre-contactor function.

High Speed Start Block

Range: Enabled, Disabled

Default: Enabled

This setpoint specifies the high-speed motor rating for two-speed starters, in kW on the line. This setpoint is for reference only, and does not affect operation of the MM200.

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.

Current transformers

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 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 MM200 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.

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.

Inputs

The MM200 digital (contact) inputs are programmed in this menu.

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, Lockout Reset, MCC Permissive, Remote Reset, Reverse Limit, Test Switch, Auto/Manual Switch.
Default: None

- "Access Switch": This value represents an open contact that disables security access of selected levels. When closed, sets the access level to the value configured in Security > Access Switch Level.
- "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. 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.
- "Lockout Reset": This value represents a contact input used to reset lockouts, trips, and alarms.
- "NA": This value indicates the contact Input has no assigned function.
- "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 resets 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 repesents a contat input used to supend collection of selected data items, override auto/manual modes, and cause interlocks to be ignored.

NOTE

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

Outputs

Contact outputs 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 on the GCP. This is the same scheme as is used to form the relay terminal designation.

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.

Communications setpoints

The MM200 has one RS485 serial communications port supporting a subset of the Modbus protocol. An additional DeviceNet or Profibus port is also available as an option.

The following setpoints are available.

Slave Address

Range: 1 to 254 in steps of 1

Default: 254

For RS485 communications, each MM200 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.

Profibus Address

Range: 1 to 125

Default: 1

This setpoint allows the user to select the appropriate Profibus address.

Profibus Baud Rate

Range: 9600 to 1.5 M

Default: 1.5 M

This setpoint selects the Profibus baud rate.

System

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.

Passcodes are automatically canceled after five minutes of inactivity. Communications passcode access can be cancelled by writing zero to the passcode register.

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.

System trouble

For relay self-test, the MM200 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 Self Test Action setpoint.

The following setpoints are available for the system trouble element.

Self-Test Action

Range: Trip, Alarm

Default: Trip

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

LED indicators

These setpoints allow the user to control the display characteristics of the front panel LEDs.

The following setpoints are available.

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

Range: Any alarm trip control I/O operand

Default: Not Set

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

USER 1 LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the USER LEDs.

USER 2 LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the USER LEDs.

Reset Lockout using Reset Key

Range: Disabled, Enabled

Default: Disabled

When this setpoint is programmed as "Disabled," the relay does not allow performing of the Reset Lockout using the Reset key. When programmed as "Enabled," the Reset Lockout can be performed using the Reset key.

Change Mode when Running

Range: Disabled, Enabled

Default: Disabled

When this setpoint is programmed as "Disabled," the relay does not allow changing of the Auto/Manual mode. When programmed as "Enabled," the relay does allow changing of the Auto/Manual mode.

Running LED Color

Range: None, Red, Green, Orange

Default: Green

Selects the color of the Running LED.

Stopped LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the Stopped LED.

Alarm LED Color

Range: None, Red, Green, Orange

Default: Orange

Selects the color of the Alarm LED.

Tripped LED Color

Range: None, Red, Green, Orange

Default: Red

Selects the color of the Tripped LED.

Comms OK LED Color

Range: None, Red, Green, Orange

Default: Green

Selects the color of the Comms OK LED.

Auto LED Color

Range: None, Red, Green, Orange

Default: Orange

Selects the color of the Auto LED.

Manual LED Color

Range: None, Red, Green, Orange

Default: Orange

Selects the color of the Manual LED.

50% LED Color

Range: None, Red, Green, Orange

Default: Orange

Selects the LED color at 50% of the motor load.

80% LED Color

Range: None, Red, Green, Orange

Default: Orange

Selects the LED color at 80% of the motor load.

100% LED Color

Range: None, Red, Green, Orange

Default: Orange

Selects the LED color at 100% of the motor load.

Counters Settings

Drive Greasing Interval

Range: 100 to 50000 hours in steps of 100 hours

Default: OFF

This setpoint allows the user to set the alarm level for the greasing interval

Contactor Inspection Interval

Range: 0 to 64000 hours in steps of 100 hours

Default: OFF

This setpoint allows the user to set the alarm level for the contactor inspection interval.

Maximum Motor Stopped Time

Range: 10 to 10000 hours in steps of 10 hours

Default: OFF

This setpoint allow the user to set the alarm level for the maximum allowable motor stopped hours.

Protection elements

Thermal protection

The primary protective function of the MM200 is the thermal model. The MM200 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 four key elements.

- Hot/cold biasing that accounts for normal temperature rise.
- 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.

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.

$$TCU_{SS} = I_{eq}^2 \times (100\% - HCR) \qquad \textbf{Eq. 1}$$

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.

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).

$$\text{Pickup} = \frac{I_{AV}}{\text{FLA}} \quad \textbf{Eq. 2}$$

$$\text{Trip time} = \frac{\text{Curve Multiplier} \times 2.2116623}{0.02530337 \times (\text{Pickup} - 1)^2 + 0.05054758 \times (\text{Pickup} - 1)} \quad \textbf{Eq. 3}$$

In the above equation,

- The trip time represents the time (in seconds) for the MM200 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.
- *Iav* represents the equivalent motor heating current in per-unit values on a full load current base. The value of I_{AV} is limited in this equation to 8.0 to prevent the overload from acting as an instantaneous element and responding to short circuits.

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.

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

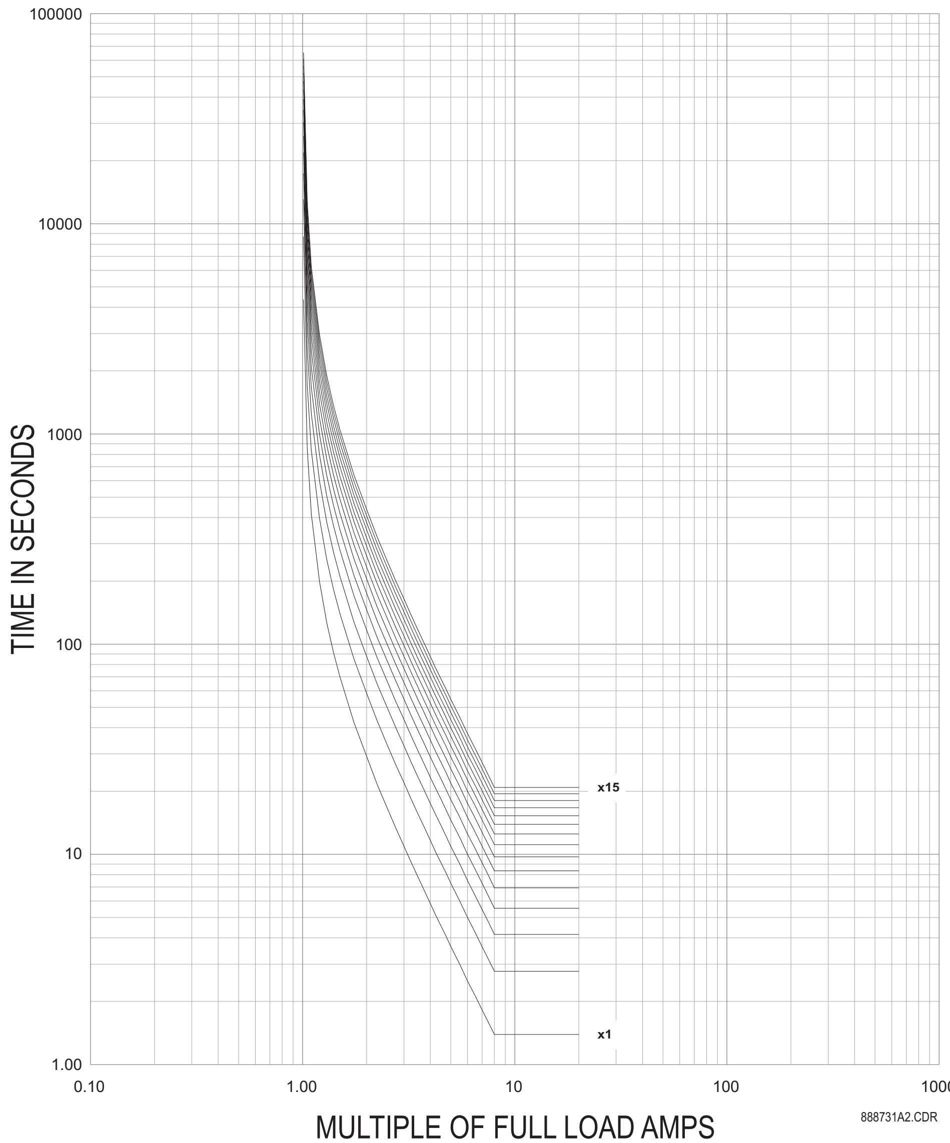
$$= \frac{7 \times 2.2116623}{0.02530337 \times (8 - 1)^2 + 0.05054758 \times (8 - 1)}$$

$$= 9.714 \text{ seconds} \quad \textbf{Eq. 4}$$

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

The standard overload curves are displayed below.

Figure 5: 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 MM200 curve multipliers.

Table 2: MM2 and MM3 curve numbers and MM200 curve multipliers

MM2 and MM3 curve number	1	2	3	4	5	6	7	8
MM200 curve multiplier	1	2	3	4	7	9	12	15

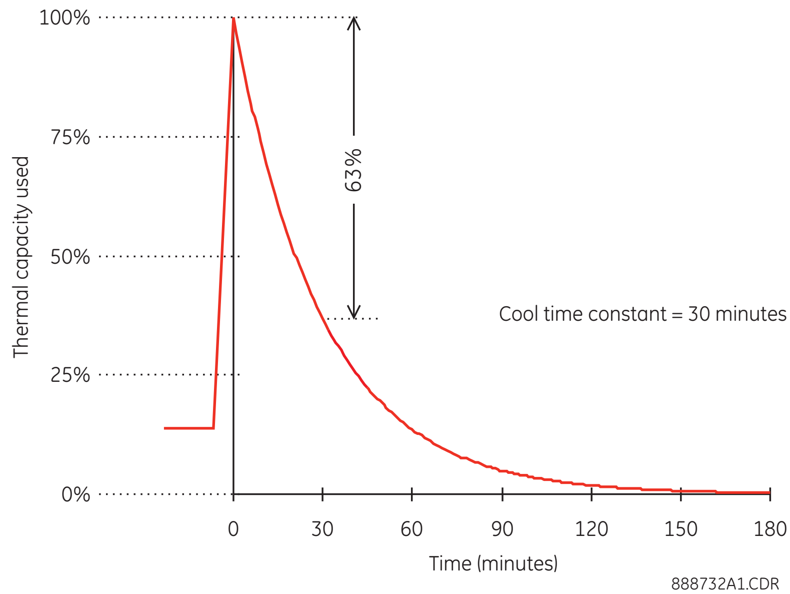
Table 3: NEMA curves and MM200 curve multipliers

NEMA curve	Class 10	Class 15	Class 20	Class 30
MM200 curve multiplier	4	6	8	12

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



Thermal protection reset

Thermal model operation 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. A setpoint is available that controls whether lockout persists until the motor has cooled until the thermal capacity used reaches 15% (approximately twice the cool time stopped setpoint), or until the relay estimates based on learned thermal capacity used on start that the motor has cooled sufficiently for a successful restart. For the latter, a 2% safety margin is included. While in lockout, the motor can not be started via the MM200.

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.

Thermal protection 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.

Overload Pickup Level

Range: 1.01 to 1.25 X FLA

Default: 4

This setpoint specifies the Overload Pickup Level for the unit to start.

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.

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 the 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.

Mechanical protection

The mechanical protection setpoints are divided into the following categories.

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

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

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.

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 or Trip 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 be below 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 be below 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).

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 MM200 should trip when an open control circuit is detected.

Electrical protection

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.

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.

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.

Ground Trip Level

Range: 0.5 to 15.0 A in steps of 0.1 A
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: 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.

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 average current has fallen below the set pickup. 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.

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.

Control elements

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 MM200 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 MM200.

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 4: 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 MM200 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 MM200 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 on.

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.

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.

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, and acceleration protection, and the thermal start inhibit 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.

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 MM200 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..

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:

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).

Power failure restart

The Power Failure Restart element (PFR) provides a relay-initiated undervoltage motor restart after a momentary power loss (dip).

The undervoltage is detected by a digital input associated with an External Voltage Relay.

When the auxiliary voltage supply drops below the pre-set low voltage level, the motor contactor(s) are de-energized until the dip is ended as indicated by supply recovery to the pre-set high voltage level.

- The motor will be switched back to its previous status if the voltage returns within the “Power Failure Time”. This can either take place immediately or be further delayed (Power Failure Restart Time).

If the motor was running at the time the dip occurred, a forced restart will occur as soon as the relay detects healthy auxiliary voltage and the restart time delay has expired.

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

With MM200 power supply voltage derived from the incoming motor supply, the MM200 will experience the same interruption as the motor. The MM200 has not been designed to ride through power outages of up to 200ms and the power failure restart is affected by this condition, so with an outage higher than 200 ms the relay will be powered off. When the control supply recovers, the relay will not initiate any motor start.

PFM Function

Range: Enabled, Disabled

Default: Disabled

Enables the Power Failure Restart function.

Power Failure Time

Range: 0 to 30 s in steps of 1 s

Default: 0.0 s

Sets the maximum measured duration of power failure time. If the mains voltage returns within the Power Failure Time, the motors that were energized before the power failure are automatically reconnected.

If the mains voltage does not return within this period of time, the above motors remain disconnected and a “Trip – Power Failure” fault is generated. Once the mains voltage has returned, the trip will be maintained until a reset command is received.

Restart Time Delay

Range: 0 to 300 s in steps of 1 s

Default: 0.0 s

After the mains voltage returns, this setting defines the time delay before the motor is restarted.

NOTE

This function restarts the motor based on the stages of the startup sequence provided by the starter type selected.

Figure 7: Power failure restart logic diagram

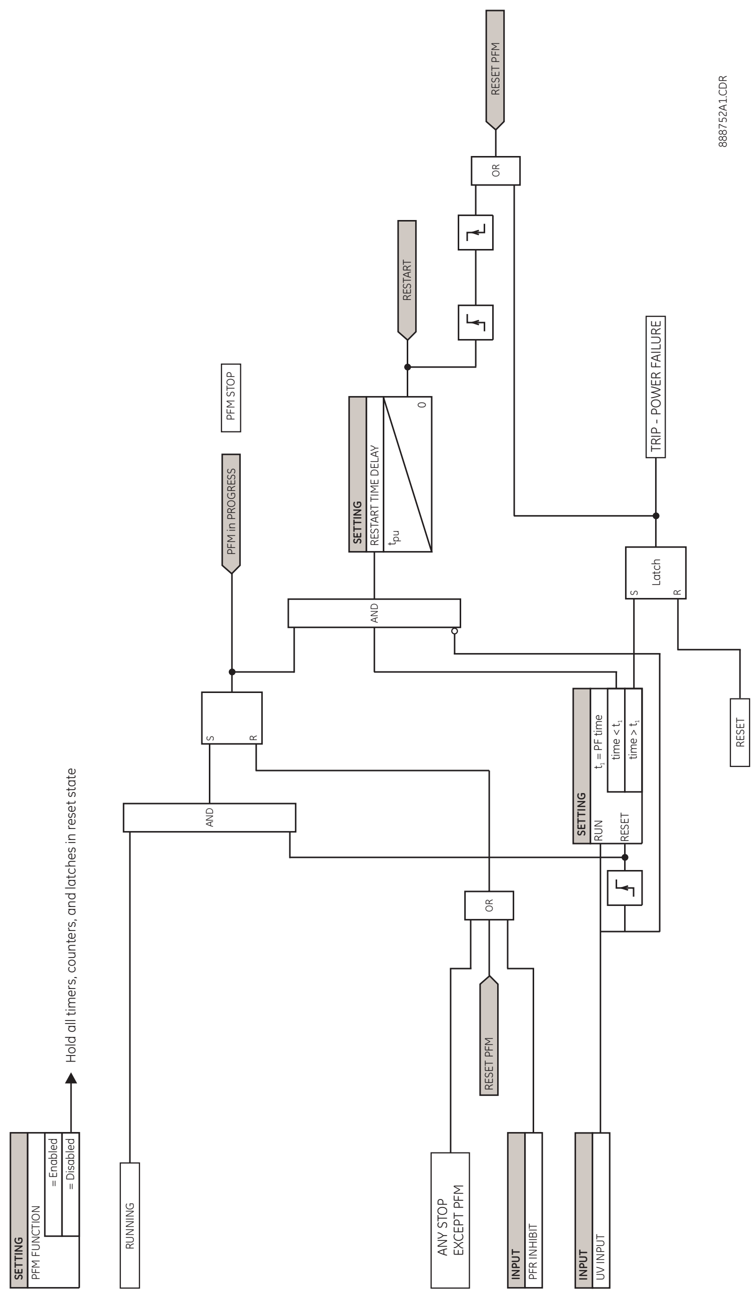
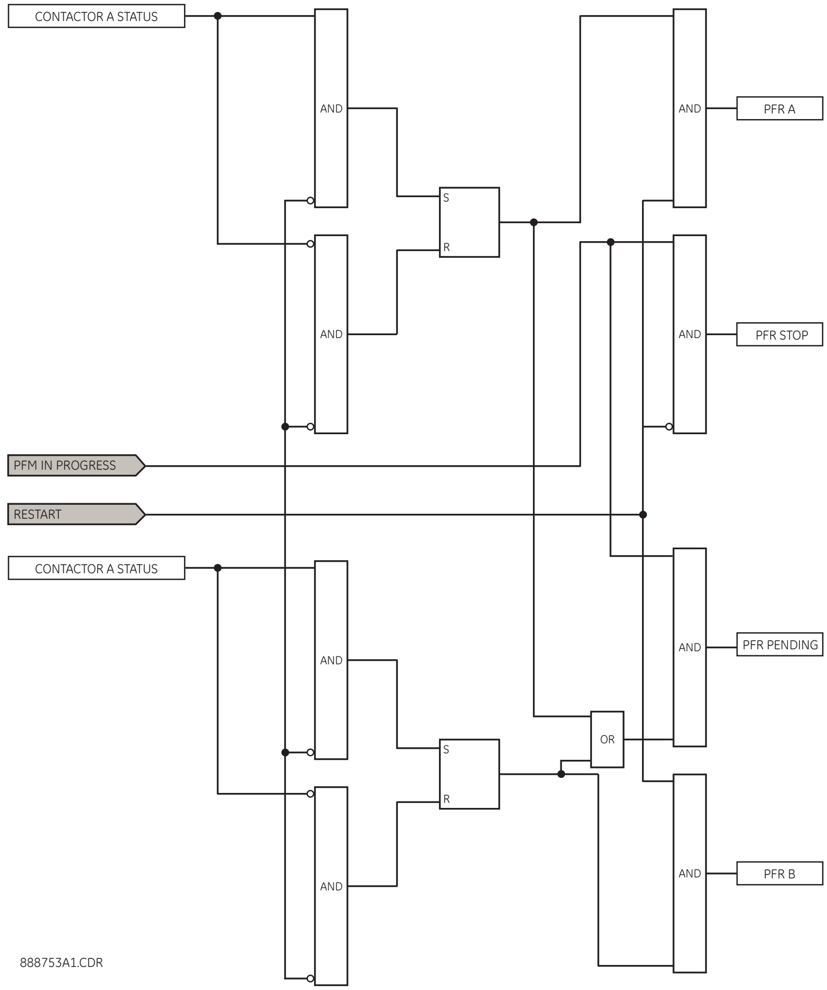


Figure 8: Undervoltage restart control logic diagram



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Chapter 5: Diagnostics

The diagnostics pages display typical diagnostic information, including 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.

Digital counters

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.

NOTE

When the relay is powered off, the counter values are stored in non-volatile memory.

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

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.

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.

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.

Learned data

The MM200 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.

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Chapter 6: Communications

Communications interfaces

The MM200 has two communications interfaces:

- RS485
- Fieldbus

NOTE

Setpoint changes related to RS485, DeviceNet, and Profibus, 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.

NOTE

For full details, please refer to the MM200 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
1601-9034-A1	21 December 2007
1601-9034-A2	05 February 2008
1601-9034-A3	27 July 2008
1601-9034-A5	31 August 2009
1601-9034-A6	23 July 2010

Table A–2: Major Updates for MM200-A6

Section/Page Number	CHANGES
	Manual revision number from A5 to A6
Ch 1	New Specifications section - User Interface

Table A–3: Major Updates for MM200-A5

Section/Page Number	CHANGES
	Manual revision number from A4 to A5
3.2	New section - Graphical Display Page Hierarchy
4.4.3	New section - Power Failure Restart

Table A–4: Major Updates for MM200-A3

Section/Page Number	CHANGES
	Manual revision number from A2 to A3
Ch1 - MM200 Order Codes	Add HI power supply option
All relevant figures	Add HI input connections
p1-2	Change line diagram
p1-5, 1-6	Add HI power supply info to Input and Power Supply Specifications
p1-7	Change Environmental Specifications in accordance with UL requirements
p2-10	Add power supply labeling

Table A–5: Major Updates for MM200-A2

Section Number	CHANGES
	Manual revision number from A1 to A2
Ch1 - MM200 Order Codes	Change Layout of Order Table
Ch1 - Type Tests	Corrections: RH Cyclic, Comp. Temperature/Humidity