

**Integrated process and electrical control  
with protection for low voltage motors.**



## DESCRIPTION

The Motor Manager 3 (MM3) combines control functions and comprehensive motor protection in one package. This compact device provides sophisticated control and protective relaying at significant cost savings over the discrete devices normally found in a low voltage motor control center (MCC).

One MM3 is required for every starter in the MCC. The contactors can be energized and de-energized using the MM3's direct wired inputs, or via the serial port. A total of 6 fixed and 10 programmable switch inputs are available. A wide range of starter types may be controlled by the MM3 using two contactor outputs and two auxiliary outputs. One analog input can be programmed by the user as well as one analog out. A programmable undervoltage auto restart function is available.

Motor protection features for the most common causes of failure are provided to prevent costly shut downs and rewinds. These include overload, phase unbalance, locked rotor (stall), ground fault, undercurrent and underpower. A thermistor input can also be provided to protect a hot winding. The relay checks the contactor status at start and stop commands to indicate contactor failure. Alarms are provided to warn of additional abnormal conditions.

The MM3 has two mounting configurations: chassis mount no display, and panel mount local display. Both models have a 2 wire RS485 ModBus® RTU protocol communication port operating at up to 57,600 bps. The panel mount model has a stop key and 8 status LEDs, a 2 by 20 line display, 2 additional command mode LEDs, and a keypad, which allows full local access without a computer.

# MM3

## Intelligent MCC Controller

### Applications

- Low voltage motor control centers
- Integrated process & electrical control

### Protection

- Overload
- Phase unbalance
- Contactor failure
- Locked/stalled rotor
- Ground fault
- Hot winding thermistor
- Undercurrent/underpower

### Control

- Undervoltage auto restart
- Outputs: 2 contactor, 2 programmable
- Inputs: 6 fixed, 10 programmable
- 1 analog input
- 1 analog output 4-20 mA

### Monitoring and Metering

- Display phase current, ground current, thermal capacity, analog input, power, energy, etc.
- Trip record and pre-trip values
- Maintenance information
- Self-test

### User Interfaces

- RS485 ModBus® Port, 1200 - 57,600 bps
- Display model for local interface
- Up to 10 status LEDs

### Features

- Reduces MCC and field wiring
- Replaces timers, relays, protective devices, meters, panel indicators
- Integrated primary CTs up to 250 FLC
- Local faceplate
- Standard removable rear terminals
- Remote Touchscreen graphical interface (connects up to 32 units)



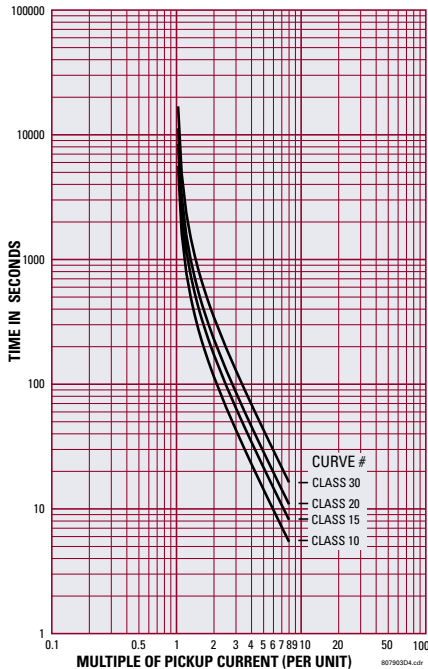
## PROTECTION AND CONTROL

The MM3 is available with different protection and control features depending on the model ordered as outlined in the Model Table (page 208).

### Overload (49/51)

An overload trip is caused when the thermal capacity value equals 100%. Thermal capacity used is calculated from accumulated I<sup>2</sup>t value and chosen overload curves. True RMS current sensing ensures correct response to the heating effect of harmonics. One of 12 different I<sup>2</sup>t time-overcurrent overload curves may be selected from 8 standard curves and 4 NEMA compatible curves.

*Of the 12 overload curves available 4 are NEMA compatible time/current overload curves.*



### Phase Unbalance (46)

The MM3 monitors the percentage unbalance in the motor phase currents. If a phase current unbalance of greater than 15% exists for more than 5 seconds an alarm is generated. If a phase current unbalance of greater than 30% exists for more than 5 seconds a trip occurs.

### Locked/Stalled Rotor (48)

Mechanical equipment such as pumps or fans can be quickly damaged if it gets jammed resulting in a locked rotor stall. The MM3 will trip when the running current exceeds the stalled rotor trip level after the programmed time delay. If stall protection is not required this feature may be set to 'OFF'. This feature is disabled during the inrush of motor starting.

### Ground fault (50G/51G)

The ground fault level is measured as a percentage of FLC. Ground overcurrent can be detected either from the residual connection of the phase CTs or from the zero sequence CT. A delay time is set to prevent nuisance alarms from momentary surges. Both a ground fault alarm and trip are provided. The alarm can be set below the trip level to get an early warning of insulation breakdown.

### Overtemperature (49)

An input from motor winding thermistors is available. The MM3 can accept both positive temperature coefficient (PTC) and negative temperature coefficient (NTC) sensors. A thermistor level can be selected for both alarm and trip.

### Cooling Time

After an overload trip the thermal capacity value will decrease exponentially to model the cooling characteristic of the motor. An overload trip can normally be reset when the thermal capacity value decreases to 15%. A stopped motor cooling time can be set to determine how long it takes for a stopped motor to reach steady state ambient temperature from its maximum allowable temperature.

### Undercurrent/Underpower (37)

Both undercurrent and underpower alarms and trips are provided with time delays. Protection against failed

shearpin, loss of pump flow, etc., which may result in only a small change in current is provided by the under power alarm.

### Contactors Failure

The MM3 monitors the contactor while performing start and stop commands. If the contactor does not change status (open to closed or closed to open) an 'open control circuit' or 'welded contactor' alarm is triggered.

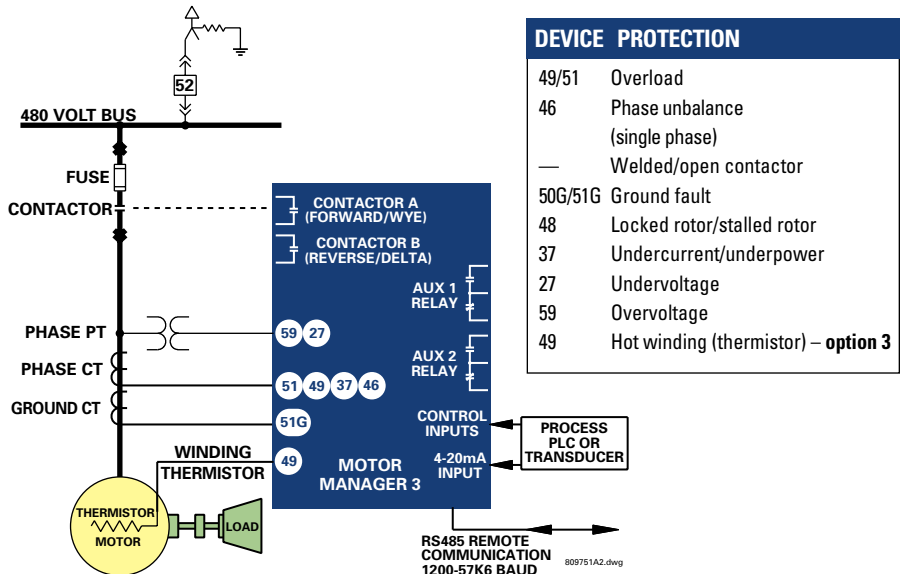
### Additional Alarms

The MM3 has programmable alarms to warn of a number of abnormal conditions. These include: acceleration time exceeded, abnormal inverter starter, incomplete start, motor greasing, contactor inspection, motor stop time, analog input, and process interlock switch open.

### Starters

The MM3 can control a variety of starter types using the contactor outputs. Contactor A is used for full voltage non-reversing starters. Contactor A and B are used for reversing, two speed, autotransformer, inverter, wye-delta open transition, slip ring, and part winding starters. Contactors A, B, and one auxiliary output are used for the reduced voltage wye-delta closed transition starter.

## FUNCTIONAL BLOCK DIAGRAM



## MONITORING AND METERING

### Undervoltage Auto Restart

It is possible to automatically restart the motor after a momentary power loss if this feature is enabled. When the control voltage drops below the dropout voltage the contactors are de-energized. The MM3 can initiate timers to restart selected drives upon the return of supply voltage. If control voltage is restored within the programmed restart time it will be restarted immediately. If the control voltage takes longer to be restored the MM3 can be programmed to attempt to restart the motor after a programmed time delay.

### Outputs

The MM3 has one or two contactors (A and B). There are also two auxiliary programmable output relays available on the MM3. These two outputs can be assigned to any one of 31 functions.

### Switched Inputs

The MM3 has up to 6 fixed control inputs. These are used for start A and B, stop, local isolator, and contactor A and B status. The MM3 also has up to 10 programmable switch inputs. Each input can have one of 33 interlock functions assigned to it. Once a function is assigned to one interlock input that function cannot be assigned to any other interlock input.

### Analog Input

The analog input can be scaled to user defined values. High and low alarm and trip setpoints are recorded with time delays.

### Metering

The MM3 meters and displays:

- RMS current of each phase
- Ground fault leakage current
- Motor load as a % of full load current
- Thermal capacity used (%) according to I<sup>2</sup>t history and chosen overload curve; hot/cold ratio is used to model heating when running below full motor current
- % unbalance
- Power (kW)
- Energy (kWh)
- Voltage
- Analog input

### Trip Record

When the MM3 issues a trip command a trip record is generated. This includes the cause of the trip and pre-trip actual values.

### Statistics and Maintenance

The MM3 records statistical data about relay and motor operation. The MM3 also allows the user to set the interval

at which a number of routine maintenance tasks should be performed. When these times are exceeded an alarm is generated. These include:

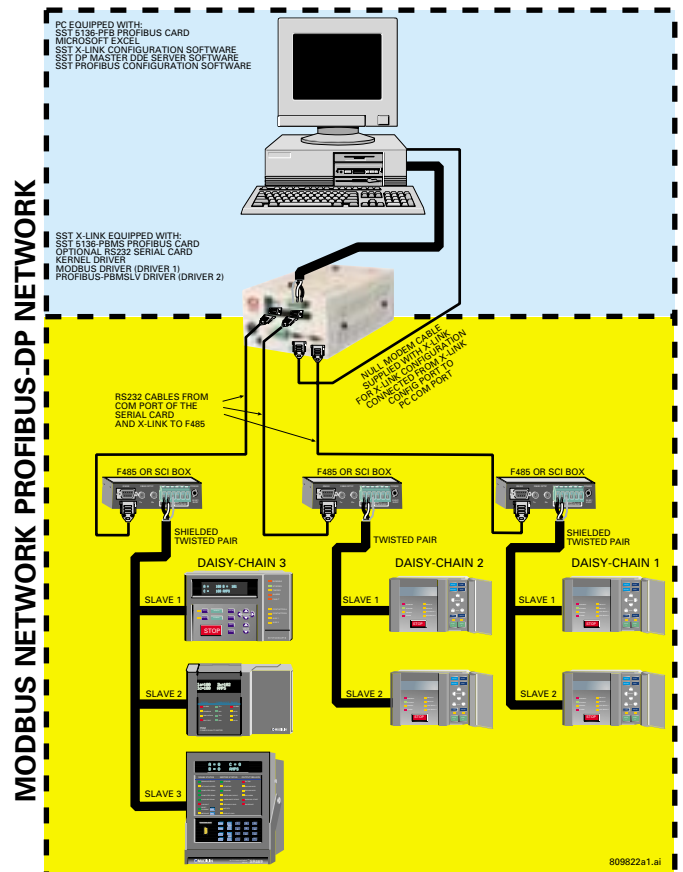
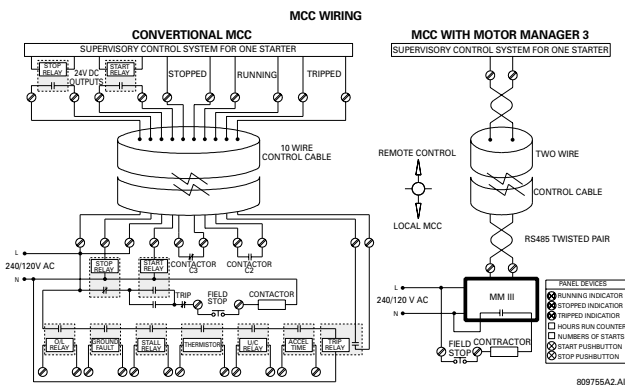
- Motor greasing interval: number of hours after which motor bearings must be lubricated
- Contactor inspection: number of starts after which contactor contacts must be inspected for wear
- Maximum motor stopped time: The maximum number of hours that the motor can be left not running

### Networking

Gateway solutions exist to connect the MM3 to installed protocols in a given system. The X-Link is a gateway product from SST ([www.sstech.on.ca](http://www.sstech.on.ca)). This product makes it possible to transfer data between two communications networks. Networks such as ModBus, ModBus Plus, ProfiBus, DeviceNet, Data Highway Plus, GE Fanuc, ControlNet and DNP are supported.

X-Link makes it possible to transfer data between two communications networks.

Cost Effective MCC Wiring with MM3.



## USER INTERFACES MODELS

### Communication

The MM3 uses a ModBus® RTU RS485 connection for communication. Up to 32 MM3s can be daisy chained together on a single communication channel. The MM3 supports operation at 1200 to 57600 bps. A RS232/485 converter module may be used to connect a personal computer to the MM3.

### Software

The MM3 is provided with a free communications program called MM3PC. It runs on a personal computer under Windows®. It allows access to all the features of the MM3 with easy to use pull down menus. Using this program it is possible to:

- Program or modify setpoints
- Load or save setpoints from or to a disk
- Read actual values from the MM3
- Monitor status
- Read pre-trip data and trip record
- Display dynamic trending of actual values
- Get help on any topic
- Print the instruction manual from disk
- Simulate and test features

Windows® based software is supplied with the MM3.



### Mounting Configurations

The MM3 can be ordered in two mounting configurations; the chassis mount and the panel mount with local display.

The chassis mount model is the "black box" version of the MM3. It is mounted inside the motor control center (MCC).



The chassis mount version has the added flexibility of using the display port as a second communications port. The advantage is that slower metering functions can be assigned to one communications port while the other port could be used for high speed command operations such as Start/Stop or quick status updates such as tripped, running, etc. Using the second port provides a means for redundant communication channels guaranteeing control and status information even if one channel is interrupted.

Alternatively up to 32 MM3's could be daisy chained and connected to a Touch-screen Graphical Interface (TGI) module for remote status/command operations.



The panel mount with display model is the "Top of the Line" MM3.



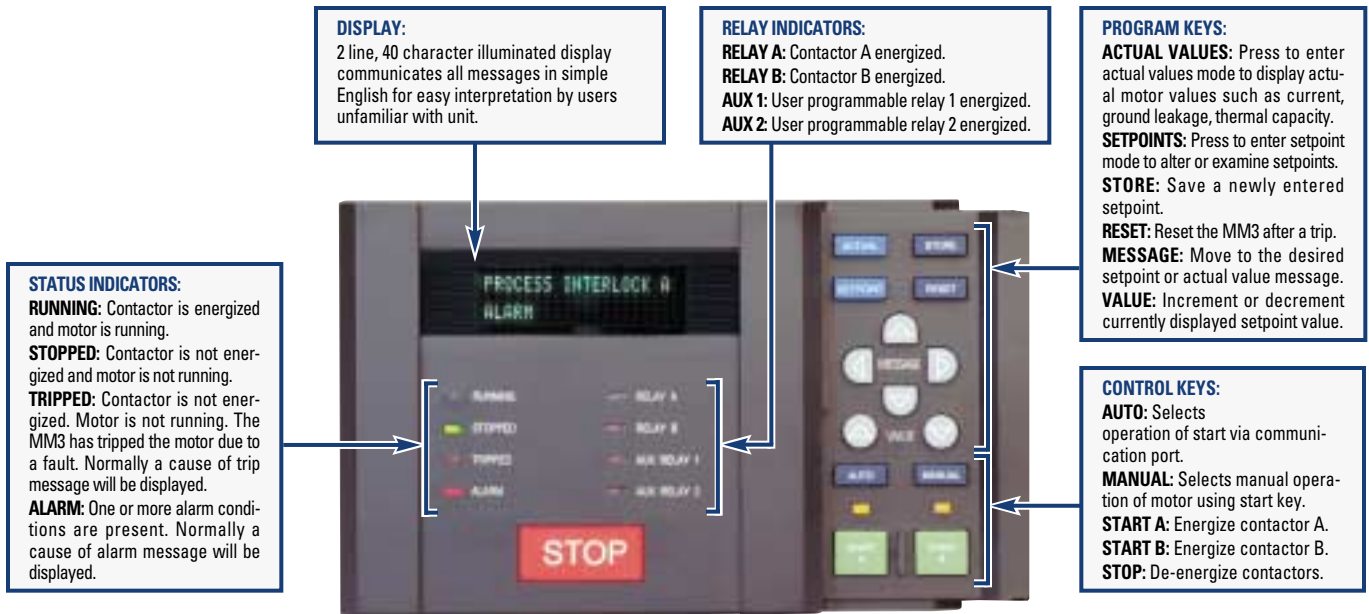
The panel mount with local display model is mounted on the front panel of the MCC with its 2 by 20 alphanumeric display, full keypad, and 10 status LEDs exposed to the operator for complete local viewing and setpoint programming. The setpoints can also be loaded into the relay through the RS485 communications port.

Model Table: The MM3 is available in chassis mount or panel mount models.

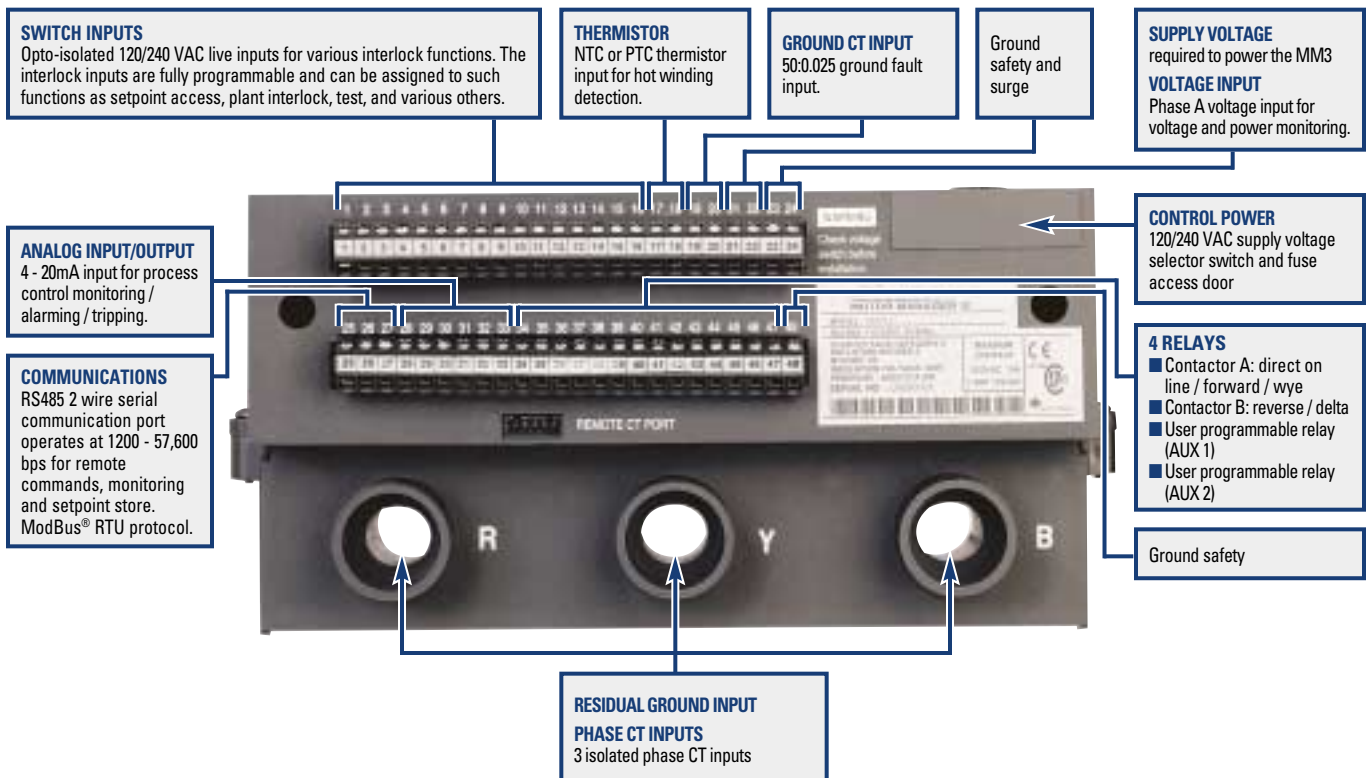
	OPTION 1 (Standard)	OPTION 2
<b>Protection</b>	3 phase overload protection (49/51) Phase unbalance (46) Welded/open contactor Ground fault trips (50G/51G) Stalled rotor protection (48) Display kw and kWh Undercurrent/underpower (37) Overvoltage (59) Undervoltage (27)	3 phase overload protection (49/51) Phase unbalance (46) Welded/open contactor Ground fault trips (50G/51G) Stalled rotor protection (48) Display kw and kWh Undercurrent/underpower (37) Overvoltage (59) Undervoltage (27)
<b>Inputs</b>	4 control 2 programmable	6 control 10 programmable Thermistor input Analog in input Analog output
<b>Relays</b>	Contactor A  Aux 1 Aux 2 or ESD relay	Contactor A Contactor B Aux 1 Aux 2 or ESD relay

# FEATURES

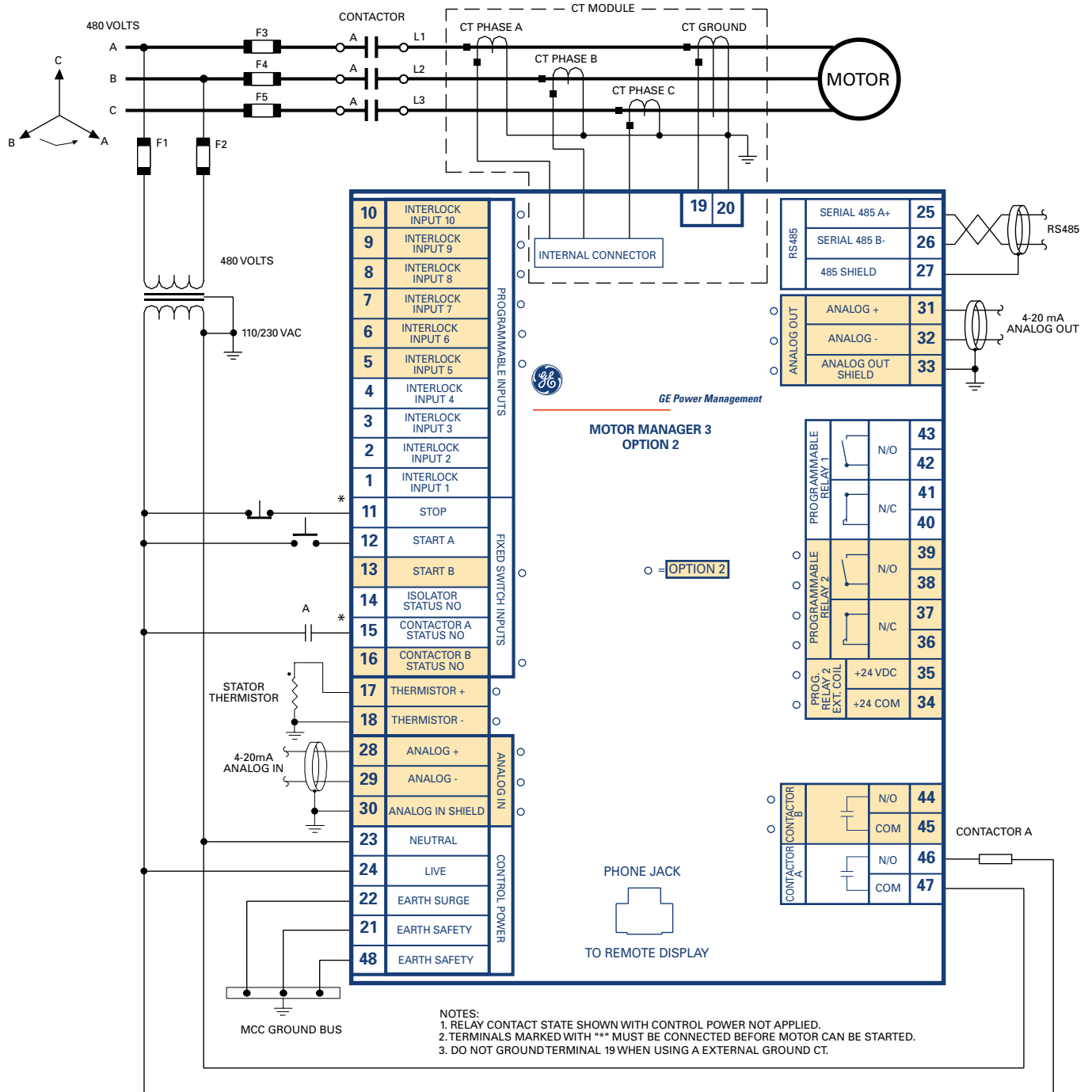
## Front View



## Rear View



# TYPICAL WIRING



809772A4.dwg

9

MM3 TECHNICAL SPECIFICATIONS

PROTECTION	
OVERLOAD CURVES	
<b>Trip Time:</b>	±200 ms up to 10 sec
<b>Accuracy:</b>	± 2% of trip time over 10 sec
<b>Detection Level:</b>	± 1% of primary CT amps
GROUND FAULT TRIP TIME	
<b>Accuracy:</b>	- 0 ms, + 50 ms, 0.0 = less than 50 ms
SINGLE PHASE (PHASE UNBALANCE)	
<b>Range:</b>	Greater than 30% U/B
<b>Accuracy:</b>	± 2 percentage points
<b>Trip Delay:</b>	5 sec, ± 1 sec
<b>Calculation Method:</b>	If $I_{AV} \geq I_{FLC}$ : $UB = \frac{ I_M - I_{AV} }{I_{AV}} \times 100$
	If $I_{AV} < I_{FLC}$ : $UB = \frac{ I_M - I_{AV} }{I_{FLC}} \times 100$
	Where: $I_{AV}$ = average phase currents
	$I_M$ = current in a phase with maximum deviation from $I_{AV}$
	$I_{FLC}$ = motor full load current setting
UNDERCURRENT	
<b>Range:</b>	10-100% of motor FLC, or OFF
<b>Delay Range:</b>	1 to 60 sec
<b>Accuracy:</b>	± 1 sec
UNDERVOLTAGE – SUPPLY VOLTAGE	
<b>Undervoltage:</b>	65 % of nominal (120 VAC or 240 VAC) immediate restart for maximum dip time of 0.1-0.5 sec or OFF delayed restart for maximum dip time of 0.1-10.0 sec/unlimited time
<b>Delay Restart Range:</b>	0.2-300 sec
<b>Delay Restart Accuracy:</b>	± 0.2 sec

MONITORING	
VOLTAGE INPUT/POWER READING	
<b>Conversion:</b>	True RMS, sample time 1.67 ms
<b>Voltage Full Scale:</b>	1.5 x VT Primary
<b>Voltage Accuracy:</b>	± 2% of VT Primary or ± 2% of reading, whichever is greater
<b>Power Accuracy:</b>	± 5% of nominal or ± 5% of reading, whichever is greater
<b>Input Voltage:</b>	Nominal: 120 VAC or 240 VAC Max: 250 VAC
<b>VT Burden:</b>	0.01 VA
ACCELERATION TIME	
<b>Range:</b>	0.5 to 125 sec, or OFF
<b>Accuracy:</b>	± 0.5 sec
THERMAL COOLING TIMES	
<b>Range:</b>	5-1080 min when motor stopped 50% of motor stopped value when motor running
<b>Accuracy:</b>	± 1 min
STALLED ROTOR	
<b>Range:</b>	1.15 to 4.50 x FLC, or OFF
<b>Delay Range:</b>	0.5 to 5 sec
<b>Accuracy:</b>	± 0.5 sec

METERING	
PHASE CURRENT INPUTS	
<b>Conversion:</b>	True RMS, sample time 1.67 ms
<b>Range:</b>	0.1 to 8 x phase CT primary amps setpoint when external CTs are used .2 to 250 A, FLC < 32 A
<b>Accuracy:</b>	± (2% + 1)*
GROUND FAULT CURRENT INPUT	
<b>Conversion:</b>	True RMS, sample time 1.67 ms
<b>Range:</b>	0.1 to 1.0 x FLC amps setpoint (residual connection) 0.5 to 15.0 A (50:0.025 CT)
<b>Full Scale:</b>	1.5 x FLC amps setpoint (residual connection) 15 A (50:0.025 CT)
<b>Accuracy:</b>	± (2% + 2)* (residual connection) FLC < 32 A ± (2% + 6)* (residual connection) FLC < 32 A 50:0.025 CT: ± 0.3 A
*Accuracy is given as ± ((% of reading) + [number of least significant digits])	

OUTPUTS			
RELAY CONTACTS			
MM3 CONTACTOR A & B OUTPUT RELAYS			
VOLTAGE	MAKE/CARRY CONTINUOUS	MAX. OPERATING CURRENT	MAX. SWITCH. CAPACITY
RESISTIVE	30 VDC	8 A	2500 VA 300 W
	250 VDC	8 A	2500 VA 300 W
INDUCTIVE (PF=0.4)	30 VDC	3.5 A	1250 VA 220 W
	250 VDC	3.5 A	1250 VA 220 W
<b>CONFIGURATION</b> SPST-NO – Contactor A & B – Form A			
<b>CONTACT MATERIAL</b> Silver Alloy (AgCdO)			
<b>MAX OPERATING VOLTAGE</b> 380 VAC, 125 VDC			
<b>MIN PERMISSIBLE LOAD</b> 5 VDC, 100 mA			

OUTPUTS			
MM3 CONTACTOR AUX 1 & AUX 2 OUTPUT RELAYS			
VOLTAGE	MAKE/CARRY CONTINUOUS	MAX. OPERATING CURRENT	MAX. SWITCH. CAPACITY
RESISTIVE	30 VDC	8 A	2400 VA 240 W
	250 VAC	8 A	2000 VA 240 W
INDUCTIVE (PF = 0.4)	30 VDC	3.5 A	875 VA 170 W
	250 VAC	3.5 A	875 VA 170 W
<b>CONFIGURATION</b> SPST-NO + SPST-NC – AUX 1 & 2 – Form A			
<b>CONTACT MATERIAL</b> Silver Alloy (AgCdO)			
<b>MAX OPERATING VOLTAGE</b> 380 VAC, 125 VDC			
<b>MIN PERMISSIBLE LOAD</b> 5 VDC, 10 mA			
ANALOG OUTPUTS			
<b>Output:</b>	4-20 mA		
<b>Max Load:</b>	600 Ω		
<b>Max Output:</b>	21 mA		
<b>Accuracy:</b>	±2% of full scale reading		
<b>Isolation:</b>	36 V isolated, active source		

INPUTS	
THERMISTOR INPUTS	
<b>Sensor Types:</b>	positive temperature coefficient PTC $R_{HOT}=100-30,000 \Omega$ negative temperature coefficient NTC $R_{HOT}=100-30,000 \Omega$
<b>Delay:</b>	1 sec
<b>Accuracy:</b>	± 5% or 100 Ω (whichever is greater)
ANALOG INPUT	
<b>Range:</b>	4-20 mA
<b>Accuracy:</b>	± 1% of full scale
<b>Alarm:</b>	Programmable 4-20 mA
<b>Trip:</b>	Programmable 4-20 mA
<b>Accuracy:</b>	± 2% of full scale reading
<b>Isolation:</b>	15 V isolated, active source

COMMUNICATIONS	
<b>Type:</b>	RS485 2 wire, half duplex
<b>Baud Rate:</b>	1,200-57,600 bps
<b>Protocol:</b>	ModBus® RTU
<b>Functions:</b>	Read/write setpoints, read actual values, execute commands, read coil status, read device status, loopback test

POWER SUPPLY	
SUPPLY VOLTAGE	
<b>AC Nominal:</b>	120 VAC, range 80-135 VAC 240 VAC, range 150-250 VAC
<b>Frequency:</b>	50/60 Hz
<b>Power Consumption:</b>	25 VA (Maximum) 7 VA (Nominal)

ENVIRONMENTAL	
<b>Pollution Degree:</b>	2
<b>Overvoltage Category:</b>	2
<b>Insulation Voltage</b>	300 V
<b>Continuous Operating Temperature:</b>	0°C to 60°C
<b>Peak Operating Temperature:</b>	85°C, 16Hrs (IEC60068-2-2)
<b>IP Class:</b>	IEC 529 IPX0

TYPE TESTS	
<b>Transients:</b>	ANSI/IEEE C37.90.1 Oscillatory/ Fast Risettime Transients IEC 801-4 Electrical Fast Transient/ Burst Requirements
<b>Impulse:</b>	IEC 255-5 5 kV Impulse Voltage Test
<b>RFI:</b>	150 MHz, 450 MHz 5 W Handheld Transmitter @ 25 cm
<b>Static:</b>	IEC 801-2 Electrostatic Discharge
<b>Hipot:</b>	1500 V, 1 min all input > 30 V

FUSE TYPE/RATING	
	0.5 A 250 V Fast blow, high breaking capacity

INSTALLATION	
<b>WARNING:</b>	HAZARD may result if the product is not used for its intended purpose.

PACKAGING	
<b>Max. Weight:</b>	6 lbs 12 oz (3.1 kg)
<b>Shipping Dimensions:</b>	12' x 9' x 7.5' (350 mm x 229 mm x 190 mm)

APPROVALS	
<b>CE:</b>	IEC 947-1, IEC 1010-1
<b>Quality Assurance System (registered by QMI):</b>	UL Listed for USA and Canada
<b>ISO:</b>	9001 - 1994

\*Specifications subject to change without notice.

**NOTE:** It is recommended that all MM3 relays are powered up at least once per year to avoid deterioration of electrolytic capacitors in the power supply.

GUIDEFORM SPECIFICATIONS

Motor protection and control shall be provided by an intelligent control device capable of manual or automatic control.

Protection features available shall include trip and alarms for:

- Overload with 12 overload curves
- Phase unbalance
- Welded/open contactor
- Ground fault
- Locked/stalled rotor
- Thermistor for hot winding
- Undercurrent and underpower
- Additional alarms for abnormal conditions

Control features available shall include:

- 6 fixed control inputs for start A & B, stop, local isolator, contactor A & B status
- 10 programmable inputs, each of which can be assigned to any one of 33 functions

- 2 contactors (A & B)
- 2 auxiliary relays, each of which can be assigned to any one of 31 functions
- One analog input with high and low alarm and trip setpoints
- Undervoltage auto restart

Motor current sensing shall be from internal primary CTs up to 250 FLC. Ground sensing shall be from an external core balance CT or residually.

Metering values shall include:

- RMS current of each phase
- RMS ground fault leakage current
- Thermal capacity
- Analog input
- Motor load
- Thermal capacity used
- Unbalance
- Power (kW)
- Energy (kWh)
- RMS voltage

## GUIDEFORM SPECIFICATIONS *continued*

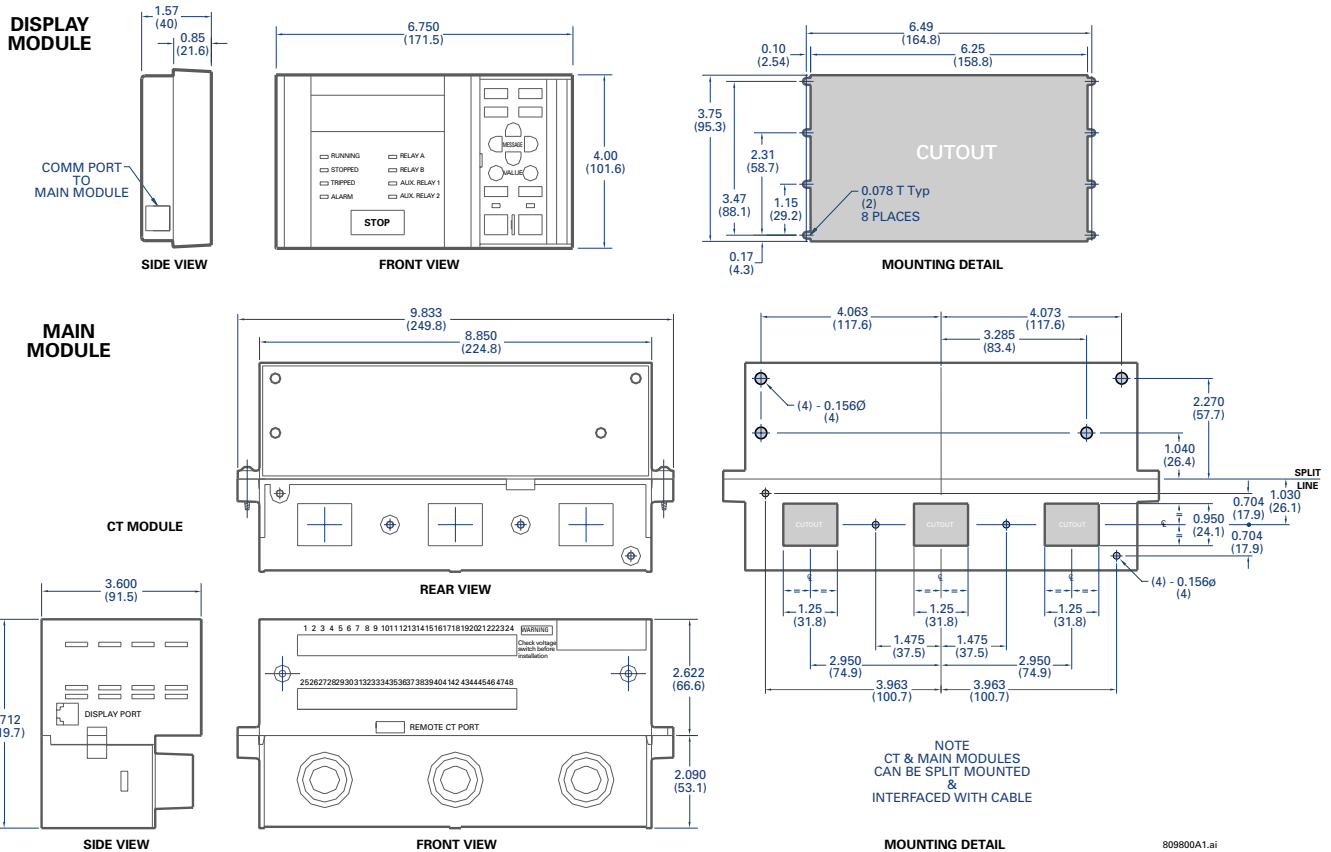
The motor manager shall generate a trip report each time a trip command is issued. It shall include the cause of the trip and the pre-trip metering values.

Statistical data and routine maintenance alarms shall be included features of the motor manager.

A RS485 ModBus® RTU connection shall be used for communication. It shall support operation at 1200 to 57,600 bps. A RS232/485 converter module can be used to connect a personal computer to the motor manager. Software shall be provided to allow easy access to all features.

A remote panel mount model shall be available with a 2 by 20 character display, control keys, and 10 LEDs to provide local access without a computer.

## DIMENSIONS



## ORDERING

To order select the basic model and the desired features from the Selection Guide below.

MM3	*	*	*	*	
MM3					Product family
1					Option 1 basic unit
2					Option 2 full unit
E					ESD relay
A					Aux 2 relay
N					No display (chassis unit)
W					With local display
				120	120 VAC control voltage
				240	240 VAC control voltage

### Accessories

- MM3PC software package supplied free
- RS232 TO RS485 CONVERTER box designed for harsh industrial environments
- 5A PHASE CT: 300, 350, 400, 500, 600, 750, 1000
- 50:0.025 Ground CT for sensitive ground detection on high resistance grounded systems
- Control key cover hides auto, manual and start buttons

