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

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)

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.

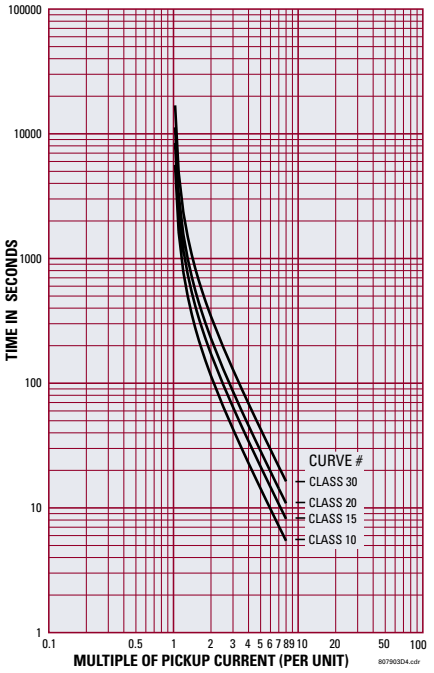
PROTECTION AND CONTROL

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^2t value and chosen overload curves. True RMS current sensing ensures correct response to the heating effect of harmonics. One of 12 different I^2t 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.

Contactor 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.

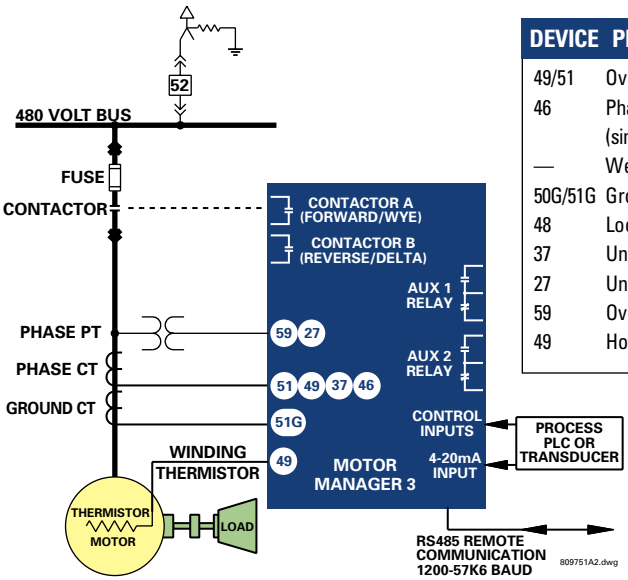
Additional Alarms

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



DEVICE	PROTECTION
49/51	Overload
46	Phase unbalance (single phase)
—	Welded/open contactor
50G/51G	Ground fault
48	Locked rotor/stalled rotor
37	Undercurrent/underpower
27	Undervoltage
59	Overvoltage
49	Hot winding (thermistor) – **option 3**

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^2t 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

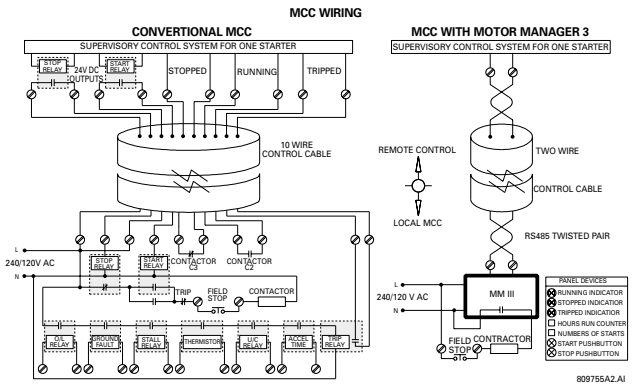
The MM3 records statistical data about relay and motor operation. The MM3 also allows the user to set the interval at which a number of routine maintenance tasks should be performed. When these times are exceeded an alarm is generated. These include:

- 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). 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.

Cost Effective MCC Wiring with MM3.



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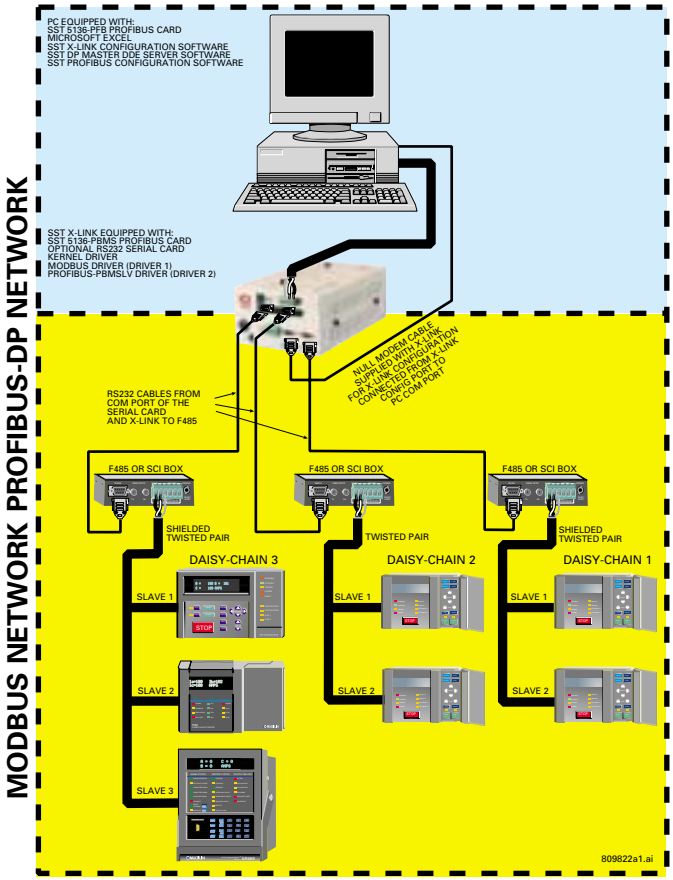


USER INTERFACES MODELS

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
Protection	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)
Inputs	4 control 2 programmable	6 control 10 programmable Thermistor input Analog in input Analog output
Relays	Contactor A Aux 1 Aux 2 or ESD relay	Contactor A Contactor B Aux 1 Aux 2 or ESD relay

FEATURES

Front View

DISPLAY:
2 line, 40 character illuminated display communicates all messages in simple English for easy interpretation by users unfamiliar with unit.

RELAY INDICATORS:
RELAY A: Contactor A energized.
RELAY B: Contactor B energized.
AUX 1: User programmable relay 1 energized.
AUX 2: User programmable relay 2 energized.

PROGRAM KEYS:
ACTUAL VALUES: Press to enter actual values mode to display actual motor values such as current, ground leakage, thermal capacity.
SETPOINTS: Press to enter setpoint mode to alter or examine setpoints.
STORE: Save a newly entered setpoint.
RESET: Reset the MM3 after a trip.
MESSAGE: Move to the desired setpoint or actual value message.
VALUE: Increment or decrement currently displayed setpoint value.

STATUS INDICATORS:
RUNNING: Contactor is energized and motor is running.
STOPPED: Contactor is not energized and motor is not running.
TRIPPED: Contactor is not energized. Motor is not running. The MM3 has tripped the motor due to a fault. Normally a cause of trip message will be displayed.
ALARM: One or more alarm conditions are present. Normally a cause of alarm message will be displayed.

CONTROL KEYS:
AUTO: Selects operation of start via communication port.
MANUAL: Selects manual operation of motor using start key.
START A: Energize contactor A.
START B: Energize contactor B.
STOP: De-energize contactors.

Rear View

SWITCH INPUTS
Opto-isolated 120/240 VAC live inputs for various interlock functions. The interlock inputs are fully programmable and can be assigned to such functions as setpoint access, plant interlock, test, and various others.

THERMISTOR
NTC or PTC thermistor input for hot winding detection.

GROUND CT INPUT
50:0.025 ground fault input.

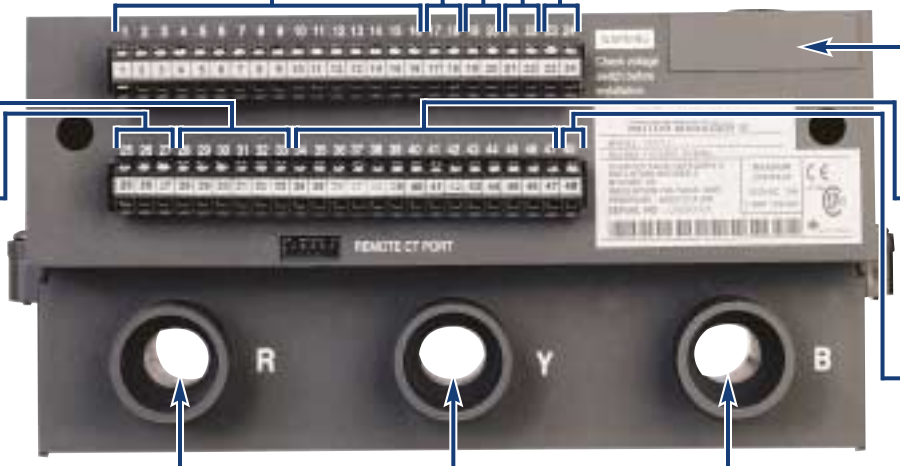
Ground safety and surge

SUPPLY VOLTAGE
required to power the MM3

VOLTAGE INPUT
Phase A voltage input for voltage and power monitoring.

ANALOG INPUT/OUTPUT
4 - 20mA input for process control monitoring / alarming / tripping.

COMMUNICATIONS
RS485 2 wire serial communication port operates at 1200 - 57,600 bps for remote commands, monitoring and setpoint store. ModBus® RTU protocol.



CONTROL POWER
120/240 VAC supply voltage selector switch and fuse access door

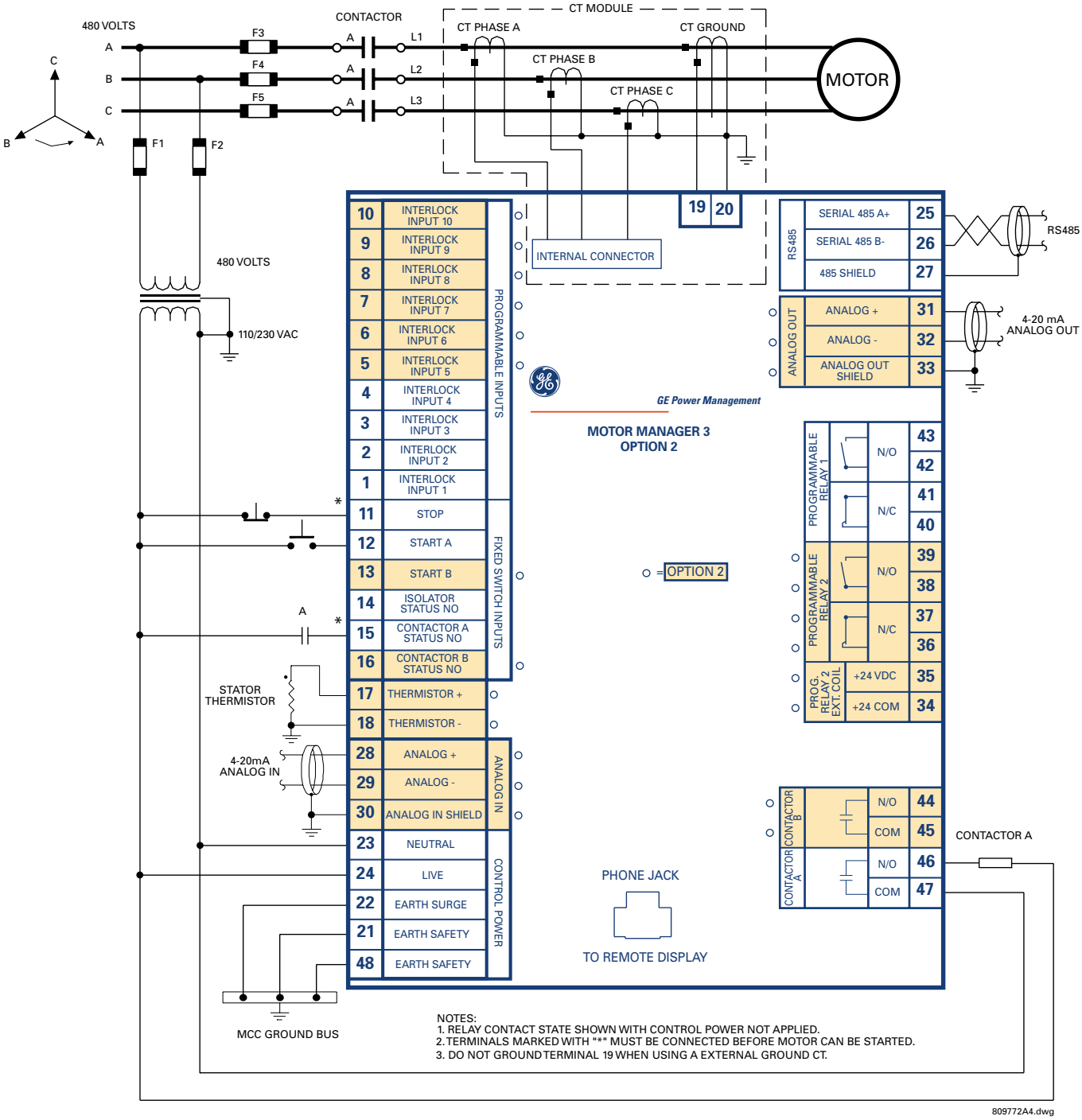
4 RELAYS
- Contactor A: direct on line / forward / wye
- Contactor B: reverse / delta
- User programmable relay (AUX 1)
- User programmable relay (AUX 2)

Ground safety

RESIDUAL GROUND INPUT

PHASE CT INPUTS
3 isolated phase CT inputs

TYPICAL WIRING



MM3 TECHNICAL SPECIFICATIONS

PROTECTION

OVERLOAD CURVES
Trip Time: ±200 ms up to 10 sec
Accuracy: ± 2% of trip time over 10 sec
Detection Level: ± 1% of primary CT amps

GROUND FAULT TRIP TIME
Accuracy: - 0 ms, + 50 ms, 0.0 = less than 50 ms

SINGLE PHASE (PHASE UNBALANCE)
Range: Greater than 30% U/B
Accuracy: ± 2 percentage points
Trip Delay: 5 sec, ± 1 sec
Calculation Method: 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
Range: 10-100% of motor FLC, or OFF
Delay Range: 1 to 60 sec
Accuracy: ± 1 sec

UNDERVOLTAGE – SUPPLY VOLTAGE
Undervoltage: 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
Delay Restart Range: 0.2-300 sec
Delay Restart Accuracy: ± 0.2 sec

MONITORING

VOLTAGE INPUT/POWER READING
Conversion: True RMS, sample time 1.67 ms
Voltage Full Scale: 1.5 x VT Primary
Voltage Accuracy: ± 2% of VT Primary or ± 2% of reading, whichever is greater
Power Accuracy: ± 5% of nominal or ± 5% of reading, whichever is greater
Input Voltage: Nominal: 120 VAC or 240 VAC Max: 250 VAC
VT Burden: 0.01 VA

ACCELERATION TIME
Range: 0.5 to 125 sec, or OFF
Accuracy: ± 0.5 sec

THERMAL COOLING TIMES
Range: 5-1080 min when motor stopped 50% of motor stopped value when motor running
Accuracy: ± 1 min

STALLED ROTOR
Range: 1.15 to 4.50 x FLC, or OFF
Delay Range: 0.5 to 5 sec
Accuracy: ± 0.5 sec

METERING

PHASE CURRENT INPUTS
Conversion: True RMS, sample time 1.67 ms
Range: 0.1 to 8 x phase CT primary amps setpoint when external CTs are used .2 to 250 A, FLC < 32 A
Accuracy: ± (2% + 1)*

GROUND FAULT CURRENT INPUT
Conversion: True RMS, sample time 1.67 ms
Range: 0.1 to 1.0 x FLC amps setpoint (residual connection) 0.5 to 15.0 A (50:0.025 CT)
Full Scale: 1.5 x FLC amps setpoint (residual connection) 15 A (50:0.025 CT)
Accuracy: ± (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	8 A	2500 VA 300 W
	250 VDC	8 A	8 A	2500 VA 300 W
INDUCTIVE	30 VDC	3.5 A	8 A	1250 VA 220 W
(PF=0.4)	250 VDC	3.5 A	8 A	1250 VA 220 W
CONFIGURATION		SPST-NO – Contactor A & B – Form A		
CONTACT MATERIAL		Silver Alloy (AgCdO)		
MAX OPERATING VOLTAGE		380 VAC, 125 VDC		
MIN PERMISSIBLE LOAD		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	8 A	2400 VA 240 W
	250 VAC	8 A	8 A	2000 VA 240 W
INDUCTIVE (PF = 0.4)	30 VDC	3.5 A	8 A	875 VA 170 W
	250 VAC	3.5 A	8 A	875 A 170 W
CONFIGURATION		SPST-NO + SPST-NC – AUX 1 & 2 – Form A		
CONTACT MATERIAL		Silver Alloy (AgCdO)		
MAX OPERATING VOLTAGE		380 VAC, 125 VDC		
MIN PERMISSIBLE LOAD		5 VDC, 10 mA		

ANALOG OUTPUTS
Output: 4-20 mA
Max Load: 600 Ω
Max Output: 21 mA
Accuracy: ±2% of full scale reading
Isolation: 36 V isolated, active source

INPUTS

THERMISTOR INPUTS
Sensor Types: positive temperature coefficient PTC R_{HOT}=100-30,000 Ω
negative temperature coefficient NTC R_{HOT}=100-30,000 Ω
Delay: 1 sec
Accuracy: ± 5% or 100 Ω (whichever is greater)

ANALOG INPUT
Range: 4-20 mA
Accuracy: ± 1% of full scale
Alarm: Programmable 4-20 mA
Trip: Programmable 4-20 mA
Accuracy: ± 2% of full scale reading
Isolation: 15 V isolated, active source

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

POWER SUPPLY

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

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

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

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

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

PACKAGING
Max. Weight: 6 lbs 12 oz (3.1 kg)
Shipping Dimensions: 12" x 9" x 7.5" (350 mm x 229 mm x 190 mm)

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

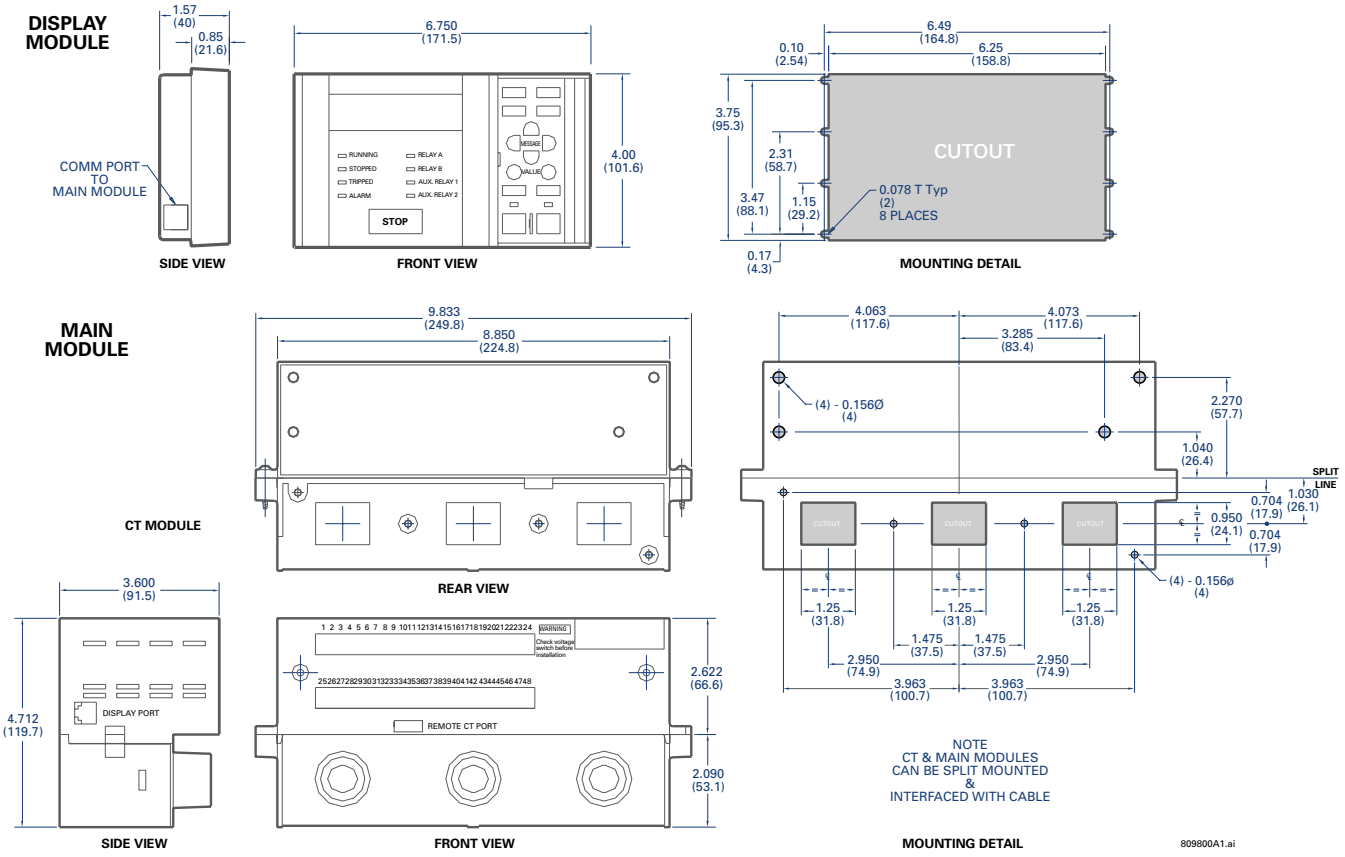
The motor manager shall generate a trip report each time a trip command is issued. It shall include the cause of the trip and the pre-trip metering values.

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