MP-3000 Motor Protection Relay

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MP-3000 Motor Protection Relay

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SECTION 1—INTRODUCTION

1.0 General

The MP-3000 is an advanced microprocessor-based motor protection relay that is easy to set up and use. It monitors, controls and protects motors against overload, thermal damage to rotor or stator, electrical faults, and excessive starting, and many process equipment failures. Advanced algorithms and thermal models give safe operation over a wide range of conditions.

The MP-3000 protects 50 or 60 Hz three-phase motors of any size or voltage level. It can protect induction or synchronous motors, with or without RTDs. It is frequently installed in motor starters or switchgear.

The MP-3000 Motor Protection relay provides the following protection, alarm, and control functions (ANSI device numbers in parentheses):

Protection

- *Intel-I-Trip* I^2t Overload Protection (49/51)
- Locked rotor protection (49S/51)
- Ultimate trip current (51)
- Negative sequence current/phase unbalance and reverse phase protection (46)
- Instantaneous overcurrent trip(50)
- Ground fault protection (50G)
- RTD trip with accessory URTD module (49/38)
- Underload trip (37)
- Starts per time limit (66)
- Jam or stall trip (51R)
- Zero-speed switch trip (14)
- I^2t Auto or manual reset (86)
- Fail-safe or non-failsafe trip modes

Alarming

- Ground fault
- I^2t Overload
- Jam / Stall
- Underload
- Phase unbalance
- RTD temperature with URTD module

Control Features

- Transition control for reduced voltage starters
- Incomplete sequence (process feedback) detection and trip
- Permits user-set number of cold starts
- Limits number of starts per time
- User sets minimum time between starts
- Antibackspin (time from stop to next start) delay
- Current-based process load shedding and restoration
- Long acceleration timing feature
- Motor stop input for synchronous motor and condenser applications
- Remote trip input
- Differential trip input
- Emergency override clears blocks to motor restarting (if enabled)
- Program settings while motor runs, with controlled changeover (if enabled)
- Disarmed mode for commissioning and checking in a running process.

1.1 Replacing the IQ1000 II with MP-3000

The MP-3000 Motor Protection Relay has been designed to serve as a direct replacement for the prior-generation Westinghouse or Cutler-Hammer IQ 1000 II. The cutout and mounting are compatible. The relay terminal configuration and wiring connections are similar *except* for the wiring of the two discrete inputs.

⚠ CAUTION

TERMINAL 6 (SEE FIGURE 6.3) WAS REMOTE COMMON IN THE IQ1000II. THIS TERMINAL PROVIDED A CONNECTION TO NEUTRAL IF 120 VAC CONTROL POWER WAS USED, AND A 120 VAC SOURCE IF 240 VAC CONTROL POWER WAS USED. THE IQ1000 II HAD A FACTORY INSTALLED JUMPER BETWEEN TERMINAL 6 AND TERMINAL 9—THE COMMON RETURN OF THE DISCRETE INPUT CHANNELS. *DO NOT INSTALL THIS JUMPER ON THE MP-3000.* THE MP-3000 USES TERMINAL 6 FOR DISCRETE SOURCE AND IT IS A CONNECTION TO 120VAC IN BOTH CASES OF 120VAC AND 240VAC CONTROL POWER USE. REFER TO SECTION 6, *INSTALLATION AND WIRING* FOR PROPER WIRING OF THE DISCRETE INPUTS.

The IQ 1000 II had a dedicated output assigned for the transition function and a discrete input assigned for incomplete sequence on transition. The MP-3000's inputs and outputs are user configurable for a variety of functions. If the Transition and Incomplete Sequence functions are enabled, then the input and output corresponding to the IQ 1000 II configuration is assigned to these functions exclusively. These settings will keep the same wiring connections when replacing the IQ1000II with an MP-3000. If the IQ 1000 II communicated with a host computer, see section 10 for guidance on keeping IQ 1000 II data communications.

1.2 MP-3000 Enhancements

The MP-3000 Motor Protection Relay incorporates the field proven motor thermal models and sequence component measurement techniques that were pioneered in the IQ 1000 and IQ 1000 II relay thermal models. However, the MP-3000 adds over 50 enhancements and new features. In addition, the new relay has new hardware with more computational power, more data storage capability, and greater immunity to electrical noise, voltage surges, and supply dips or interruptions. Other significant enhancements and new features include:

1. The MP-3000 Motor Protection Relay is now recognized to UL 1053 Standards for Ground Fault Protection Devices.
2. New power supply that can operate continuously at 55% of nominal supply voltage, and can ride through a voltage sag or loss for 30 cycles without dropping out and taking the motor off line.
3. Optional Quick Release Drawout Case that makes removal and replacement fast and easy.

4. New Armed/Disarmed feature for trip free installation with Quick Release Drawout Case.

5. User selectable trip or alarm only on relay internal failure detection.

6. Real time clock for date and time stamping of trips, alarms and events (Y2K compliant).

7. Expanded memory for extensive recording and logging of events, trips, alarms, history, and motor starting current profiles.

8. New motor starting profile plot versus protection limits.

9. New easy-to-use faceplate and user interface. Settings and data are organized into pages under 6 main modes. The modes are Default (motor state), Monitor, View Settings, History, Logs, and Program (change settings).

10. ***Intel-I-Trip*** Intelligent Overload Protection with adaptive trip characteristics based on RTD readings and motor operating history.

11. RTD diagnostics and communications error checking for additional security against operation from RTD failures.

12. Mechanical Process Load Shedding feature provides overload indication to control upstream processes, averting unnecessary motor overload shutdown or jam trips, and maintaining process continuity.

13. Download settings or retrieve metered and historical values via the communications port.

14. Flexible user-configurable inputs and outputs for broader application.

15. New options for transition function control and monitoring on time and/or current.

16. Emergency override function resets jogging limit functions and clears thermal-model bucket to permit restart with a time-tagged event log. Uses secured button, and function can be disabled.

17. Relay can be programmed while the motor runs, and the new settings are all put into effect at once in a controlled fashion. Or, user can set so programming is allowed only after stop.

1.3 Use of Manual

This manual contains the following sections:

- **Section 1—Introduction–**Describes the upgrade changes from the existing IQ-1000II to the MP-3000. Retrofit and new features list.
- **Section 2—Product Overview–**Benefits, feature list, use of manual, and list of options.
- **Section 3—Specifications–**Hardware specifics
- **Section 4—Operator Panel–**Describes the pushbuttons, LEDs, display window and security door on the MP-3000's faceplate plus the different modes of operation and detailed mode description tables.
- **Section 5—Programming the MP-3000–**Gives specific guidance for selecting setting values.
- **Section 6—Installation and Wiring–**Outlines procedures for the plant electrician to follow when installing and wiring the MP-3000.
- **Section 7—Start-Up–**Lists step-by-step procedures for energizing the MP-3000 for the first time after installation.
- **Section 8—Motor Thermal Protection Basics–**Gives an overview of how the hardware and software function together to control, monitor, and protect the motor.
- **Section 9—Application and Settings–**Intended as an aid to the application engineer considering how and when to apply the various features of the MP-3000.
- **Section 10—Data Communications–**Describes what is needed for the MP-3000 to communicate with host computer systems.
- **Section 11—Testing–**Describes how to use the MP-3000 test functions and recommended maintenance.
- **Section 12—Troubleshooting–**Provides information on how to use the Operator Panel to recognize malfunctions. Also, gives specific troubleshooting procedures.
- **Section 13—Drawout Case Option–**Describes installing and using MP-3000 drawout case models.

Once the user is familiar with the basics of operating the MP-3000, Tables 4.1 through 4.5 serve as guides to program and monitor the MP-3000.

The following accessories and options are covered in other instruction manuals:

• URTD module for connecting RTDs to MP-3000 (1)	I.L. 17367
• IQ DC Power Supply, 40-250 Vdc	I.L. 17286
• INCOM PONI (IPONI)	I.L. 17547
• Ethernet PONI (EPONI)	I.L. 17560
• RS-232 PONI	I.L. 17202
• Other PONI Types	Consult C-H distributor or web site

(1) This MP-3000 I.L. gives all basic information on installing the URTD module.

Table 1.1 MP-3000 Motor Protection Relay Ordering Information

Catalog Number	*Style Number*	*Description*
MP3000	66D2032G01	Motor relay with 5 A nominal input, fixed case
MP3100	66D2032G02	Motor relay with 1 A nominal input, fixed case
MP3000VPI	66D2036G01	Value Pack includes MP-3000 with 5 A nominal input, URTD, IPONI & Fiber Optic Cable
MP3100VPI	66D2036G02	Value Pack includes MP-3000 with 1 A nominal input, URTD, IPONI & Fiber Optic Cable
MP3000VPR	66D2036G03	Value Pack includes MP-3000 with 5 A nominal input, URTD, RS232 PONI & Fiber Optic Cable
MP3100VPR	66D2036G04	Value Pack includes MP-3000 with 1 A nominal input, URTD, RS232 PONI & Fiber Optic Cable
MP3000-INCOM	66D2032G11	MP-3000 with 5 A nominal input & IPONI
MP3100-INCOM	66D2032G12	MP-3000 with 1 A nominal input & IPONI
MP3000-RS232	66D2032G21	MP-3000 with 5 A nominal input, & RS232 PONI
MP3100-RS232	66D2032G12	MP-3000 with 1 A nominal input & RS232 PONI
MP3001	66D2033G01	Motor relay with 5 A nominal input, drawout case
MP3101	66D2033G03	Motor relay with 1 A nominal input, drawout case
MP3002	66D2033G02	Motor relay with 5 A nominal input, drawout case with IPONI
MP3102	66D2033G04	Motor relay with 1 A nominal input, drawout case with IPONI

Table 1.2 MP-3000 Motor Protection Relay Accessories

Catalog Number	*Style Number*	*Description*
URTD Module	2D78559G01	Universal RTD Module
IQDCPS	2D78542G01	IQ DC dc to ac power supply converter, 40 to 250 Vdc
MPFO-1 MPFO-5 MPFO-10	66D2037G01 66D2037G02 66D2037G03	1, 5, or 10, meter precut optical fiber link for URTD with connectors
MP3BRACKET	66D2053G01	MP3000 PONI Mounting Bracket
MPML	66D2044G01	Relay mounting plate adapter with ½" stud – fits GE Multilin ® 269 cut out.
MPML-L	66D2044G02	Relay mounting plate adapter with 1" stud – fits GE Multilin ® 269 cut out.
EPONI	66D2028G01	Ethernet communication module
EPONIF	66D2028G02	Ethernet optical fiber communication module
IPONI	8793C36G01	INCOM communication module
RS232PONI	5299C57G02	RS-232 communication module

Table 1.3 MP-3000 Renewal Parts

Catalog Number	*Style Number*	*Description*
MP3001-IC	66D2029G01	MP3001 relay inner drawout chassis, 5A Cts, no communications
MP3101-IC	66D2029G03	MP3001 relay inner drawout chassis, 1A Cts, no communications
MP3002-IC	66D2029G02	MP3002 relay inner drawout chassis, 5A Cts, IPONI
MP3102-IC	66D2029G04	MP3002 relay inner drawout chassis, 1A Cts, IPONI
MP3-OC	66D2035G01	Outer case for MP3001 or MP3002 drawout chassis

SECTION 2—PRODUCT OVERVIEW

2.0 General Overview

The MP-3000 Motor Protection Relay is available in either a fixed mount, semi-flush case or in a semi-flush Quick Release drawout case. Both housings are compact and fit a standard IQ cutout.

The optional Quick Release drawout case features 2-stage contact disconnects and self-shorting Ct circuit terminal blocks. A spare self-shorting terminal pair is available for use as relay removal alarm, or to keep the contactor energized for continuous motor operation on relay removal. The optional communication module (PONI) is externally mounted on the fixed mount case and internally mounted in the drawout case.

The MP-3000 has three phase current inputs and one ground current input. Both 5 A and 1 A versions are available. The ground protection and metering functions are best used with a zero-sequence ground Ct, rather than from the residual connection of the phase Cts - the zero sequence ground Ct provides greater ground fault sensitivity. The unit is user programmable for 60 Hz or 50 Hz operation.

The MP-3000 has 2 discrete inputs, 4 form c (1 N.O. and 1 N.C.) output contacts, and one 4 to 20 ma analog output. The relay lets the user program the operation of all the I/O points except for the trip output. In addition, the relay has 10 LED's for the indication of protection on, program mode, monitor mode, view setting mode, history mode, log mode, trip, alarm, Aux 1 and Aux 2 output relay operation. A test page in the program mode provides display indication of the discrete input states and testing of the output relays, target LED's and analog output circuit.

A user-friendly operator interface provides quick access to the settings, monitored values, motor history and operational logs. A large LED alphanumeric display provides easy viewing from any angle. Simple keypad operations provide quick and easy navigation through all settings and stored data. The program mode and emergency override buttons are access restricted via a seal and latched cover. An integrated context-sensitive help button provides an online descriptive display of functions, abbreviations and operations.

2.1 Optimum Motor Protection

The MP-3000 Motor Protection Relay has been designed for maximum motor utilization and protection. It is desirable to run the motor as close as possible to its design limits, while protecting it against excessive heating and damaging overload conditions. The MP-3000 has field proven protection algorithms developed from basic motor design principles and operating parameters

The MP-3000 protects against rotor and stator overheating, short circuits or insulation faults, excessive starting duty, and abnormal operating conditions.

2.1.1 Intel-I-Trip (Adaptive I^2t Motor Overload Protection)

Motor operation is typically limited by the rotor thermal capabilities, but the measuring quantities are stator currents. This requires accurate measurements and good motor thermal models to provide maximum utilization and reliable protection.

The MP-3000 uses the field-proven Intel-I-Trip overload measurement and motor thermal protection model that uses the manufacturer's nameplate data to develop an overload protection curve specifically for the motor being protected. When RTDs are used, the Intel-I-Trip overload protection curve becomes adaptive. The overload trip times will change based on the modeling impact of the motor's internal temperature data. It also trips directly for high stator temperature.

The relay samples the current waveforms 36 times per cycle providing accurate measurements of the positive and negative sequence currents, as well as harmonic components which add to rotor and stator heating. The negative sequence component of current causes far greater heating effect on the rotor and has a greater impact on the thermal model in the relay, as compared to the balanced or positive-sequence component.

2.1.2 Instantaneous Overcurrent Protection

The MP-3000 has instantaneous phase overcurrent function to trip the motor for fault currents, sometimes saving the fuses for medium-current faults. This function can be disabled and has an adjustable time delay on starting to avoid nuisance tripping on inrush.

2.1.3 Phase Unbalance Protection

Motor supply circuits are often fed through fuses and may be energized with one fuse blown, causing single phasing the motor. The MP-3000 measures the current unbalance and can be used to alarm or trip the motor before heating and a thermal-model trip. Pickup, start and run timers, and separate alarm settings, are provided.

2.1.4 Ground Fault Protection

A separate measuring circuit is used to measure ground current. A ground Ct is recommended for more sensitive protection against winding insulation failure to ground. The relay ground Ct input can be connected residually from the three phase Cts, but with much inferior protection sensitivity. The ground fault protection has adjustable pickup and time delay set points or can be disabled.

2.1.5 Jam Protection

The user-selectable Jam function protects motors that are running against a sudden mechanical jam or stall condition. The common application is on motors used on crushers, chippers or conveyors. It detects an increase of motor current to a level above full load. Pickup, start and run timers and a separate alarm setting are provided.

2.1.6 Underload Protection

The user selectable under-load function is used to detect the loss of load on the motor. Coupling failure is a common cause for loss of load. Pickup, start and run timers and a separate alarm setting are provided.

2.1.7 Remote and Differential Trip

One of the discrete inputs can be programmed to accept a contact input from a separate differential relay or other device to trip the motor. This provides local and remote target (logging) information, and utilizes the trip contacts of the MP-3000. It will also record and log the motor information at the time of the trip.

2.1.8 Zero-Speed Switch Trip

One of the discrete inputs can be programmed to accept a contact input from a zero-speed switch connected to the motor shaft. This provides faster tripping for a motor which remains completely stalled when energized for a start. It provides backup protection for motors with long acceleration timing.

2.2 Motor Starting and Control Functions

The MP-3000 Motor Protection relay includes logic to control the number of starts that can occur on the motor in a given time period for cold and hot motor conditions. Settable timers are provided to control the time between starts and to restart a motor after a stop. Additional logic is included for transition control of reduced-voltage starters.

2.2.1 Start Control Timers

Motors typically have limits to the number of cold starts, starts per time period and time between starts that are permitted without damage. The MP-3000 incorporates these checks to prevent excessive starting the motor.

2.2.2 Reduced Voltage Starting

The MP-3000 provides a transition and incomplete sequence detection function for reduced voltage starting. The user can select to transition based on four logical combinations of starting current and time sequence. The incomplete sequence function can be used independently for feedback indication from the process, to trip the motor if expected action doesn't occur.

2.2.3 Antibackspin Timing

For certain applications, such as pumping a fluid up a pipe, the motor may be driven backward for a period of time after it stops. The MP-3000 provides an antibackspin timer (minimum time between stop and restart) to prevent starting the motor while it is spinning in the reverse direction. The relay displays the timer countdown from the moment a stop is declared by the relay.

2.2.4 Load Shedding

The MP-3000 provides a mechanical load shedding feature that can be used to control the driven process. The load shedding function closes a contact on an overload condition to stop addition of load until the overload condition subsides by a set amount. Then the load shedding contact opens and the load is restored.

2.2.5 Emergency Override

The MP-3000 has a user programmable feature that lets the operator reset certain trip conditions including the jogging timers and thermal-model overload bucket. This function is for use in emergency conditions only and may result in motor damage or failure. The override action is logged with time-tag. The button is located behind a security door. The function can be disabled.

2.2.6 Long Acceleration Motors

Large motors with high inertia loads, such as centrifuges and large fans, may experience starting currents that greatly exceed the full load current for greater than the locked rotor time. The MP-3000 has a timing feature which holds off thermal tripping during the long acceleration. Use this with a zero-speed switch input.

2.2.7 Motor Starting Profile

The MP-3000 records the average current versus time for the last four starting cycles. This information is available via the communications port. PowerNet host plots the motor current versus the motor cold-start protection curve as in Figure 2.1.

2.3 User Interface

The MP-3000 Motor Protection Relay has a user-friendly interface that makes it easy to retrieve important information or to make setting changes. LED's provide visual indication of display mode. The push button access scheme is easy to learn, and quickly accesses the large volumes of setting, monitoring, log, and historical information.

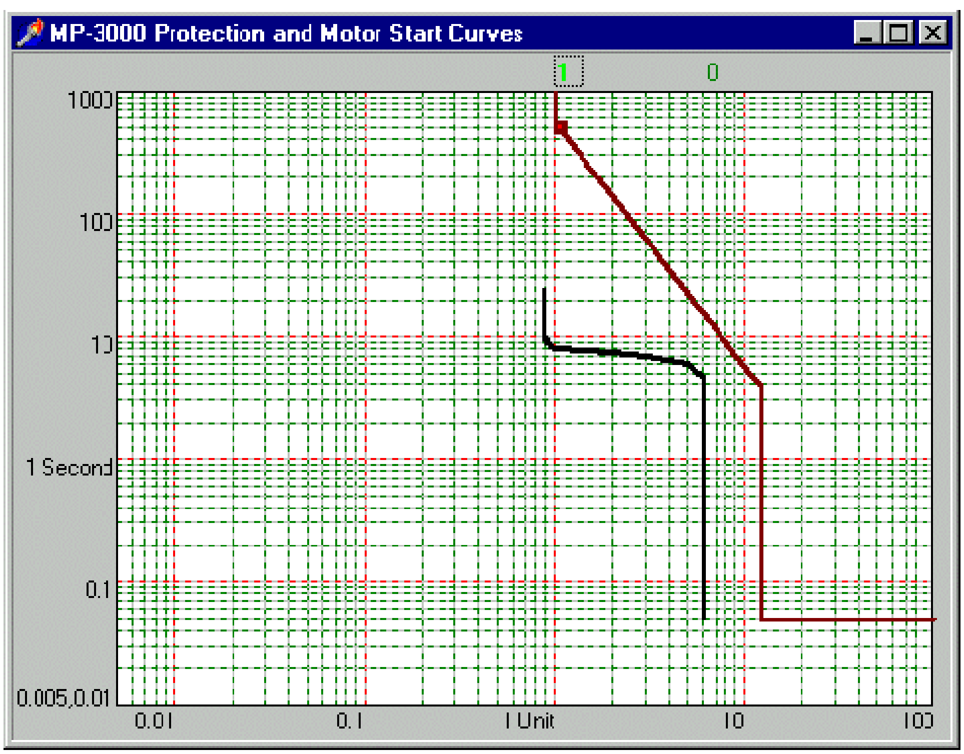

Fig. 2.1 Motor Starting Profile

SECTION 3—MP3000 TECHNICAL SPECIFICATIONS

Control Power

Nominal voltage:	120 Vac or 240 Vac (+10%, -25%)
Operating Range:	120 Vac: 90 – 132 Vac
	240 Vac: 180 – 264 Vac
Interruption ride through time:	30 cycle interruption of nominal ac supply.
Frequency:	60 Hz nominal, 57-63 Hz
	50 Hz nominal, 47-53 Hz
Power consumption:	20 VA max
	URTD: 6 VA max
	IPONI: 1 VA max

Current Inputs

Nominal (I_n):	1 A or 5 A
Ct Rating:	2 x I_n continuous
	50 x I_n for 1 second
CT Burdens:	< 0.25VA @5A (nominal)
	< 0.05VA @1A (nominal)

Metering Accuracy

Phase Current:	± 2% of I_n (5% -100% of I_n)
Ground Current:	± 2.2% of I_n (5% - 55% of I_n)

Discrete Inputs

Number of inputs:	2 programmable
Rating:	1.2 VA @ 120 Vac
	Max. off = 36 Vac
	Min. on = 86 Vac

Output Contacts

Number of outputs:	4 form c, programmable
Momentary:	Make 30A ac/dc for 0.25 s.
	Break 0.25A @ 250 Vdc (resistive)
	Break 5A @ 120/240 Vac
Continuous:	5A @ 120/240 Vac
	5A @ 30 Vdc

Analog Output

Rating:	± 4 to 20 ma, programmable
Max load:	1 k Ohm
Accuracy:	1 %

Motor Overload Protection (I^2t)

Full Load Amps:	10 to 3000 A
Locked Rotor Current:	300 to 1200% FLA
Locked Rotor Time:	1 to 120 sec.
Ultimate Trip Current:	85 to 150 % FLA
Phase CT ratio:	10 to 4000: I_n
Ground CT ratio:	10 to 4000: I_n
Timing Accuracy:	± 8.5% or ± 100 ms for I > 1.1X UTC

Trip setting ranges

Ground fault (GF):	Off, 2% to 55% of Ct ratio primary
GF start delay:	2 to 60 cycles
GF run delay:	0 to 60 cycles
Timer accuracy:	± 20 ms
Instantaneous overcurrent:	off, 300 to 1600% FLA
IOC start time delay:	2 to 60 cycles
Timer accuracy:	± 20 ms
Jam Trip:	off, 100 to 1200% FLA
Underload Trip:	off, 6 to 90 % FLA
Phase Unbalance Trip:	off, I_2/I_1 = 4 to 40%
Start Delay Timers:	0 to 120 sec. – underload and phase unbalance
	0 to 1200 s - jam
Run Delay Timers:	0 to 240 sec.
Timer accuracy:	± .5% + 100 ms
	For phase unbalance, add 100 ms for zero setting
	For underload, add 350 ms for zero setting

Alarm setting range

Ground Fault:	off, 2% to 55% ct Ratio
Overload I^2t:	off, 60 to 99% I^2t
Jam:	off, 100 to 1200 %FLA
Underload:	off, 6 to 90%FLA
Phase Unbalance:	off, 4 to 40% I_2/I_1
Run Delay Timers:	0 to 240 s

Start Control Functions

Starts per time:	1 to 10 starts
Time for starts per time:	off, 1 to 240 minutes
Time between starts:	off, 1 to 240 minutes
Number of Cold Starts:	1 to 5 starts
Motor transition current:	10 to 300% FLA
Time for transition:	0 to 1200 s
Incomplete sequence timer:	off, 1 to 240 s
Long acceleration timer:	off, 1 to 1200 s
Antibackspin timer:	off, 1 to 3600 sec

RTD Inputs (Requires URTD module)

Sensor Types:	10 ohm copper
	100 ohm nickel
	120 ohm nickel
	100 ohm platinum

URTD Module Communications

Interface:	Plastic optical fiber (preferred)
	Electrical (3 wire)
Fiber Optic Cable:	Type HFBR-ELS(length) - precut low-loss with connectors
	Type HBFR-EUS(length) - bulk low-loss without connectors
	Type HBFR-RLS(length) - standard-loss, acceptable for <10m

Clock

Accuracy:	Freerunning ± 1 minute/month @ 25°C. Automatically updated by PowerNet host.

IPONI Communications

Type:	2 wire, 115.2 kHz carrier
Baud Rate:	1200 ASK or 9600 FSK
Max. distance:	10,000 feet
Protocol:	INCOM
Functions:	Read/write set points
	Read metered values
	Read trip/alarms
	Read events
	Read history
	Reset history
	Reset functions
	Emergency override
	Trip
	View Starting Profile

Logging

Log Book:	100 Events
Log Event:	20 Trips & Alarms
Log Start:	Last 4 starts
Start Profile:	Last 4 starts (Communications port only)
History Records:	Motor, trips, alarms & totals records

Environmental Ratings

Operating Temp:	-20° to + 60°C
Storage Temp:	-45° to + 85°C
Humidity:	0 to 95% non-condensing

Dimensions (fixed mount case only)

Height:	10.25 in. (26.04 cm)
Width:	6.72 in. (17.0 cm)
Depth:	3.70 in. (9.40 cm)
Weight:	7 lbs. (15.4 kg)

Standards

UL Recognized:	File #E154862
UL Standard:	1053, Ground Fault Protective Device
ANSI:	C37.90, C37.90.1

SECTION 4—OPERATOR PANEL

4.0 General Description

The faceplate of the MP-3000 contains the display, indicators, and pushbuttons that make up the Operator Panel (Figures 4.1 and 4.2).

The Operator Panel is used to:

- Monitor the metered values on the Display Window
- Enter or modify settings
- View motor history or statistics
- View a log of recent events
- Determine that a trip or alarm condition exists by means of two distinct LEDs and the cause of the trip by means of the Display Window
- Reset the unit after a trip condition has occurred by means of a Reset pushbutton
- Get help on any display
- Override start lockouts during emergencies

4.0.1 Display Window

All available displays are discussed in Sections 4.1 through 4.5.

4.0.2 Protected Pushbuttons

A security door located on the bottom left corner of the operator panel covers two pushbuttons: the program pushbutton and the emergency override pushbutton. This door will accept a lead seal to prevent unauthorized setting changes and the overriding of start lockout functions.

4.0.3 Mode Pushbuttons

The four mode pushbuttons near the middle of the operator panel provide access to the four different modes used by the MP-3000. The Monitor, View Settings, History, and Log modes are detailed in Sections 4.2 through 4.5.

4.0.4 Navigation Pushbuttons

The six buttons with up and down arrows, located beneath the mode buttons, are used to navigate through the modes by page, line, and value. The up arrow buttons are used to advance through the displays, and the down arrow buttons are used to return to the previous display. Refer to the mode examples in Sections 4.2 through 4.5 for an explanation on the proper use of the navigation buttons.

4.0.5 Help Pushbutton

The Help pushbutton provides a scrolling explanation of the displayed message, including units of measure, for any of the messages from the MP-3000. The complete list of help messages for each function mode is included in Tables 4.1 through 4.5. The help message may be terminated by pressing the Reset or Help pushbutton.

4.0.6 Reset Pushbutton

The Reset pushbutton is primarily used to reset the MP-3000 after a trip condition. If the cause of the trip has been corrected, the displayed trip condition will be cleared. If a trip condition is not present, pressing the Reset pushbutton to step out of Line, Page, or Mode will bring up the Default mode displaying the status of the motor.

In the Program mode, pressing the Reset pushbutton will allow the user to exit out of the Program mode without saving any entered settings.

4.0.7 Operator Panel LEDs

There are 10 LEDs on the operator panel.

The *Protection* LED is lit when the MP-3000 is in the Protection mode. The MP-3000 provides protection with the relay while in the Program mode; therefore, the only time the Protection LED is extinguished is when the "DISARMED" feature is used and also for the brief time it takes to calculate all settings when leaving the Program mode.

The *Program* LED is lit when the MP-3000 is in the Program mode.

The *Trip* LED is lit when a trip condition has occurred.

The *Alarm*, *Aux 1* and *Aux 2* LEDs are lit when these auxiliary relays are activated. (The Program mode is used to specify what will cause these relays to activate.)

The remaining LEDs are on the mode select buttons and indicate the mode of the MP-3000 display - Monitor, View Setting, History, and Log. If none of these four LEDs is lit and the relay is not in Program Mode, then the display is in the Motor State (Default) Mode.

4.1 Default Mode

In the Motor State or Default mode, basic messages concerning the state of the motor and relay are displayed. The following events reset the system to Default mode:

- Cycling power
- Pressing any mode button a second time
- Pressing the Reset pushbutton the required number of times to step out of Line, Page, or Mode
- A change in the state of the motor, except when in the Monitor mode
- An alarm or trip

When in the Motor State mode, The display normally shows READY—3 (stopped), START, or RUN. If the relay is disarmed, the DISARMED display will alternate with the motor state See Table 4.1. Self-diagnostics and trip or alarm data are also displayed. If more than one event has occurred, the messages will alternate.

An alarm or trip will always return the display to the Default mode. As soon as any mode button is pushed, the flashing stops and the Modes, Page, and Line displays are available. Returning to the default display will again show the alarm and/or trip condition until the condition is cleared and is acknowledged with the Reset pushbutton. If the relay is in Monitor mode when a change of motor state occurs, the new state will flash on the display for 5 seconds and then the display will return to the value being monitored.

4.2 Monitor Mode

The Monitor mode displays real-time data as shown in Table 4.2.

For example, to view the motor bearing temperatures:

- Press the Monitor pushbutton; the display will show MONITOR as shown at the top of Table 4.2.
- Press the Page up button once to advance to MONT I.
- Press the Page up button a second time to advance to MONT RTD. As the table shows, the motor bearing temperatures are part of the MONT RTD page.
- Press the Line up button to advance to winding temperature 1.

- Press the Line up button six more times to advance to motor bearing temperature 1. The display shows motor bearing temperature 1 as MT1 XXXX, where XXXX is the actual temperature.
- Press the Line up button again to advance to motor bearing temperature 2.

NOTE: Pressing the Line down button returns to the previous Line display and pressing the Page down button returns to the previous Page. The Value pushbuttons are not used in the Monitor Mode.

4.3 View Settings and Program Mode

These modes display the same information, but the settings cannot be changed in the View Settings mode.

4.3.1 View Settings Mode

Pressing the View Settings pushbutton only displays the programmed settings listed in Table 4.3. The displays and help messages are the same as in the Program mode.

4.3.2 Program Mode

The Program mode permits the user to change the settings. Table 4.3 is a guide for programming and is a setting record sheet. Chapter 5 contains a description of the Program mode.

4.4 History Mode

Pressing the History mode displays the past history of the motor as shown in Table 4.4.

For example, to view the number of under load trips and phase unbalance trips:

- Press the History mode pushbutton; the display will show HISTORY as shown at the top of Table 4.4.
- Press the Page up button twice to advance to HIST TRP.
- Press the Line up button five times to advance to UL T XX, where XX is the underload trip count since the last reset.
- Press the Value up button once to view the date of the last reset and a second time to view the time of the last reset. Pressing the Value up button one more time returns the display back to the underload trip count.
- Press the Line up button once to advance to UB T XX, where XX is the number of phase unbalance trips since the last reset.
- Repeatedly press the Value up button to cycle through the date of reset, the time of reset, and the number of phase unbalance trips.

4.5 Log Mode

The Log mode displays a record of detected events that have happened to the motor. The following are considered events: start, stop, entering into Program mode, using the emergency override button, alarm condition, and trip condition. Unlike the other modes, the Line column function order varies with the number of events, since the actual event information is stored as it happens. Table 4.5 lists examples of event information as a guide to retrieving log information. Refer to the examples given for the History mode in Section 4.4 on the use of the navigation buttons.

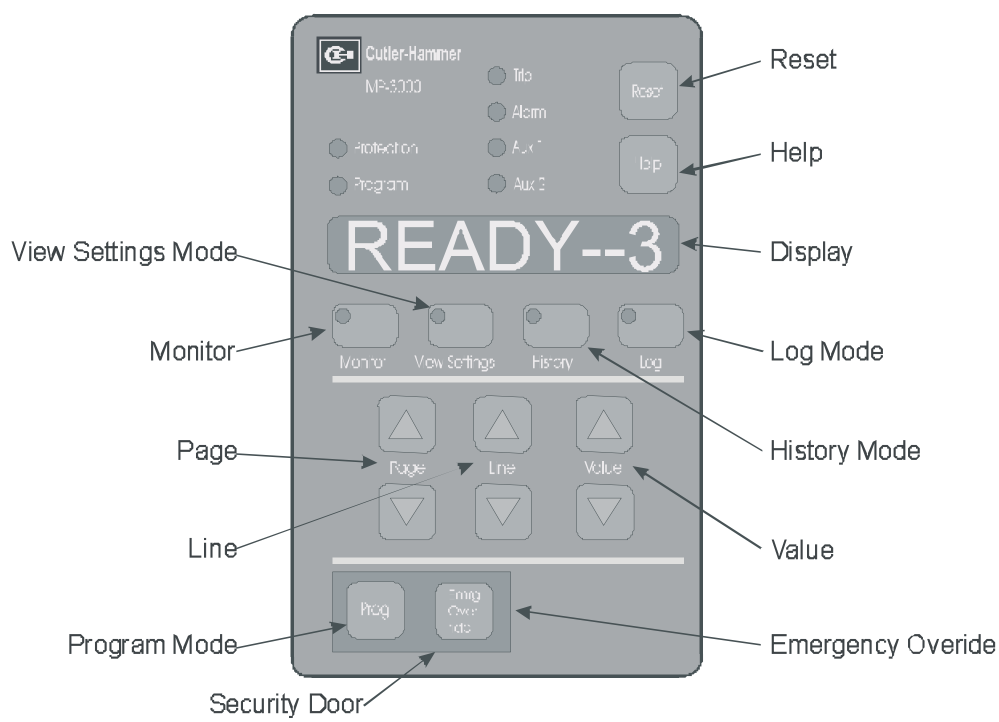

Fig. 4.1 MP-3000 Pushbuttons

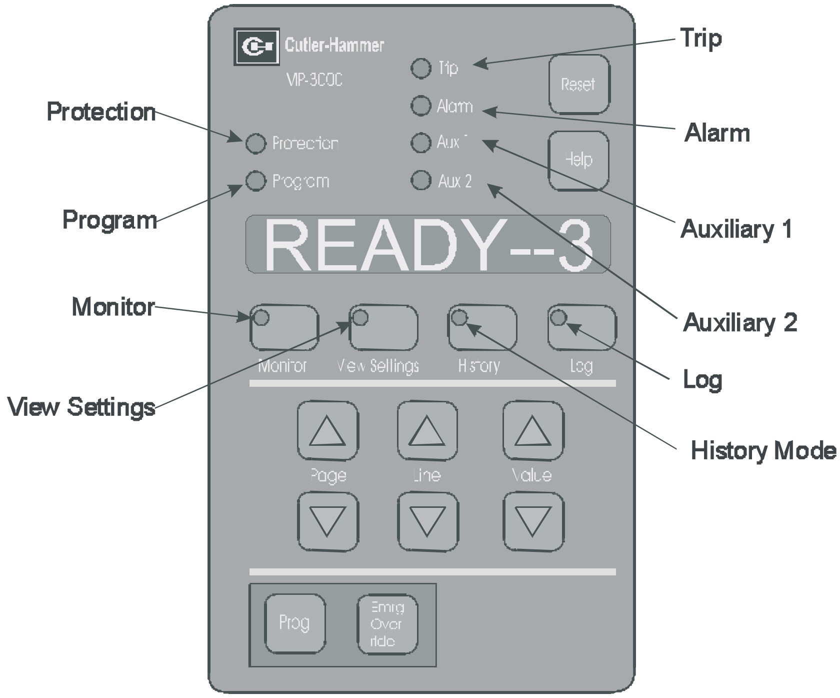

Fig. 4.2 MP-3000 LED Indicators

Table 4.1 Motor State (Default Mode) Display

Display	*Complete Help Message*	*Description*
READY—1	READY TO START MOTOR, SINGLE PHASE TEST MODE	**WARNING** MP-3000 has been set to 1 PHASE for bench testing only. Will not protect a 3-phase motor. Change setting P13L1 to 3 PHASE for normal motor protection.
READY—3	READY TO START MOTOR, THREE PHASE MODE	Motor is stopped and MP-3000 is ready for a start, 3-phase mode.
RUN	MOTOR IS RUNNING	Motor is running, as indicated by phase currents.
START	ATTEMPTING TO START MOTOR	Motor is starting, and has not yet reached transition to RUN as defined by user settings
DISARMED	WARNING RELAY IS DISARMED AND CAN NOT TRIP	**WARNING** Protection functions have been blocked from operating the trip relay by user setting P12L18. MOTOR IS UNPROTECTED. This mode of operation is for commissioning in a critical process only. See Section 5.12.18.
ABKSP XX	ANTI-BACKSPIN ACTIVE, REMAIN-ING MINUTES ACTIVE SHOWN	The motor is stopped, and the trip contact has been opened to prevent restarting until the antibackspin time delay has expired. XX is the remaining minutes before restarting is allowed.
ILLEGAL	AN ILLEGAL REQUEST WAS MADE	Response to request for an action which the relay cannot perform.

Table 4.2 Monitor Mode Display

Page	*Line*	*Complete Help Message*	*Description*
MONITOR		MONITOR OF REAL TIME VALUES	Monitor mode
MONT I		REAL TIME DATA FROM CURRENT MEASUREMENTS	Current monitoring data follows
	IAVG XXX	AVERAGE OF THREE PHASE CURRENT	Average rms current of 3-phase currents in amps
	IA XXX	PHASE A CURRENT IN AMPS	Actual ac line motor rms current
	IB XXX	PHASE B CURRENT IN AMPS	
	IC XXX	PHASE C CURRENT IN AMPS	
	IG XXX	GROUND FAULT CURRENT IN AMPS	Actual ground current
	%IA XXX	PHASE A CURRENT AS A PERCENT OF FULL LOAD AMPS	The percents of the actual
	%IB XXX	PHASE B CURRENT AS A PERCENT OF FULL LOAD AMPS	monitored current in amps
	%IC XXX	PHASE C CURRENT AS A PERCENT OF FULL LOAD AMPS	
	%UB XXX	PHASE UNBALANCE – IF POSITIVE THE RATIO OF NEGATIVE TO POSITIVE SEQUENCE CURRENT – IF NEGATIVE THE INVERSE	Ratio of negative sequence current to positive sequence current in percent. If a phase reversal exists, then the ratio is inverted and a negative sign is displayed.
MONT RTD		REAL TIME DATA FROM RTD MODULE	RTD monitoring data follows. Page is only visible when an URTD is communicating with the MP-3000
	WT1 XXXX	WINDING TEMP 1 IN DEGREES F (or) C	RTD reading – terminals 1,2,3
	WT2 XXXX	WINDING TEMP 2 IN DEGREES F (or) C	RTD reading – terminals 4,5,6
	WT3 XXXX	WINDING TEMP 3 IN DEGREES F (or) C	RTD reading – terminals 7,8,9
	WT4 XXXX	WINDING TEMP 4 IN DEGREES F (or) C	RTD reading – terminals 10,11,12
	WT5 XXXX	WINDING TEMP 5 IN DEGREES F (or) C	RTD reading – terminals 13,14,15
	WT6 XXXX	WINDING TEMP 6 IN DEGREES F (or) C	RTD reading – terminals 17,18,19
	MT1 XXXX	MOTOR BEARING TEMP 1 IN DEGREES F (or) C	RTD reading – terminals 20,21,22
	MT2 XXXX	MOTOR BEARING TEMP 2 IN DEGREES F (or) C	RTD reading – terminals 23,24,25
	LT1 XXXX	LOAD BEARING TEMP 1 IN DEGREES F (or) C	RTD reading – terminals 26,27,28
	LT2 XXXX	LOAD BEARING TEMP 2 IN DEGREES F (or) C	RTD reading – terminals 29,30,31
	AXT XXXX	AUXILIARY TEMP IN DEGREES F (or) C	RTD reading – terminals 33,34,35
MONT MTR		REAL TIME MOTOR DATA	Motor monitoring data follows
	VER XXXX	SOFTWARE VERSION NUMBER	MP-3000 software version in use
	%I2T XXX	PERCENT OF I2T TRIP LEVEL	Percent of thermal bucket used
	TUS XXX	TIME IN MINUTES UNTIL NEXT START CAN OCCUR	Displays largest amount of time in minutes among three functions: anti-backspin, starts per unit time, and time between starts.
	RMST XX	REMAINING STARTS	Number of starts remaining if starts per time is programmed.

Page	Line	Complete Help Message	Description
	OST XXX	TIME LEFT ON OLDEST START IN MINUTES	Remaining time allowed on oldest start for starts per time if programmed. If motor start/time is exceeded, this is time in minutes before restart is permitted.
	ICM XXXX	ADDRESS ON THE IMPACC NETWORK IN HEXADECIMAL	Address of device if on INCOM communications network, only visible if on the network.
MONT TIM		DATE AND TIME	Current date and time with display format as programmed.
	HH.MM XM or HH.MM	CURRENT TIME	12-hour format or 24-hour format
	MM/DD/YY or DD/MM/YY	CURRENT DATE	Common format or European / military format

Table 4.3 View Settings Mode/Program Worksheet

Program Date ____________ Control Schematic ____________

Unit ID/Starter Type ____________ Work Order # ____________

Motor HP ____________ Mfgr. ____________ Serial# ____________ Volts ____________

FLA ____________ LRC ____________ Stall Time/LRT ____________ Accel Time ____________

SF ____________ RTD Type ____________ Other ____________

Line No.	*Display*	*Help Message*	*Setting Range/ Value Selection*	*Value as shipped*	*Section Reference*	*Selected Value*
Page 1	**SP MOTOR**	**SP MOTOR SETTINGS FOR MOTOR CONSTANTS**				
1	FLA XXXX	FULL LOAD AMPS	10-3000 amps (1 amp. increments)	10	5.1.1	
2	LRC XXXX	LOCKED ROTOR CURRENT % OF FLA	300-1200 % (1 % increments)	300	5.1.2	
3	LRT XXX	MAXIMUM ALLOWABLE STALL TIME IN SECONDS	1-120 sec. (1 sec. increments)	1	5.1.3	
4	UTC XXX	ULTIMATE TRIP CURRENT IN % FLA	85-150% (1% increments)	85	5.1.4	
5	PCT XXXX	PHASE CT RATIO NUMERATOR IN PRIMARY AMP	10-4000 A (incre-ments of 1)	10	5.1.5	
6	GCT XXXX	GROUND CT RATIO NUMERATOR IN PRIMARY AMP	10-4000 A (incre-ments of 1)	50	5.1.6	
7	FREQ 50 or FREQ 60	50 OR 60 HERTZ LINE FREQUENCY	Toggles between FREQ 50 and FREQ 60	FREQ 60	5.1.7	
8	REV or NON REV	REVERSING OR NONREVERSING STARTER	Toggles between REV and NONREV	NONREV	5.1.8	
Page 2	**SP RTD**	**SETTINGS FOR RTD INPUTS**				
1	RTD IN C or RTD IN F	DISPLAYED IN DEGREES C OR F	Toggles between RTD IN C and RTD IN F	RTD IN C	5.2.1	
2	WD T XXX	WINDING TEMP TRIP	0-199°C, OFF / 32-390°F, OFF (1°increments)	100	5.2.2	
3	WD A XXX	WINDING TEMP ALARM	0-199°C, OFF / 32-390°F, OFF (1°increments)	80	5.2.3	
4	MB T XXX	MOTOR BEARING TRIP	0-199°C, OFF / 32-390°F, OFF (1°increments)	100	5.2.4	
5	MB A XXX	MOTOR BEARING ALARM	0-199°C, OFF / 32-390°F, OFF (1°increments)	80	5.2.5	
6	LB T XXX	LOAD BEARING TRIP	0-199°C, OFF / 32-390°F, OFF (1°increments)	100	5.2.6	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
7	LB A XXX	LOAD BEARING ALARM	0-199°C, OFF / 32-390°F, OFF (1°increments)	80	5.2.7	
8	AX T XXX	AUXILIARY TRIP	0-199°C, OFF / 32-390°F, OFF (1°increments)	100	5.2.8	
9	AX A XXX	AUXILIARY ALARM	0-199°C, OFF / 32-390°F, OFF (1°increments)	80	5.2.9	
10	DIAG ON or DIAG OFF	ALARM ON RTD FAILURE DIAGNOSTIC	Toggles between DIAG ON and DIAG OFF	DIAG ON	5.2.10	
Page 3	**SP TRIP**	**SETTINGS FOR TRIP EVENTS**				
1	GFT XXX	GROUND FAULT TRIP LEVEL IN % OF GROUND CT RATIO NUMERATOR	2-55% of Ground Ct ratio numerator, OFF (1% increments)	24%	5.3.1	
2	GFSD XX	GROUND FAULT START DELAY IN CYCLES	2-60 ac cycles (1 cycle increments)	5	5.3.2	
3	GFRD XX	GROUND FAULT RUN DELAY IN CYCLES	0-60 ac cycles (1 cycle increments)	2	5.3.3	
4	IOC XXXX	INSTANTANEOUS OVERCURRENT IN % FLA	300-1600%, OFF (1% increments)	OFF	5.3.4	
5	IOCSD XX	INSTANTANEOUS OVERCURRENT START DELAY IN CYCLES	2-60 ac cycles (1 cycle increments)	3	5.3.5	
6	JMT XXXX	JAM TRIP LEVEL IN % FLA	100-1200%, OFF (1% increments)	1000%	5.3.6	
7	JMSD XXX	JAM TRIP AND ALARM START DELAY IN SECONDS	0-1200 sec. (1 sec. increments)	60	5.3.7	
8	JMTR XXX	JAM TRIP RUN DELAY IN SECONDS	0-240 sec. (1 sec. increments)	2	5.3.8	
9	ULT XXX	UNDERLOAD TRIP LEVEL IN % FLA	6-90%, OFF (1% increments)	OFF	5.3.9	
10	ULSD XXX	UNDERLOAD TRIP AND ALARM START DELAY IN SECONDS	0-120 sec. (1 sec. increments)	60	5.3.10	
11	ULTR XXX	UNDERLOAD TRIP RUN DELAY IN SECONDS	0-240 sec. (1 sec. increments)	10	5.3.11	
12	UBT XXX	PHASE UNBALANCE TRIP LEVEL	4-40%, OFF (1% increments)	OFF	5.3.12	
13	UBSD XXX	PHASE UNBALANCE TRIP AND ALARM START DELAY IN SECONDS	0-120 sec. (1 sec. increments)	10	5.3.13	
14	UBTR XXX	PHASE UNBALANCE TRIP RUN DELAY IN SECONDS	0-240 sec. (1 sec. increments)	2	5.3.14	
Page 4	**SP ALARM**	**SETTINGS FOR ALARM EVENTS**				
1	GFA XXX	GROUND FAULT ALARM LEVEL IN % OF GROUND CT RATIO NUMERATOR	2-55% of Ground Ct ratio numerator, OFF (1% increments)	OFF	5.4.1	

Line No.	*Display*	*Help Message*	*Setting Range/ Value Selection*	*Value as shipped*	*Section Reference*	*Selected Value*
2	I2TA XXX	I2T ALARM LEVEL IN % FULL OF I2T TRIP CAPACITY	6-99%, OFF (1% increments)	80	5.4.2	
3	JMA XXXX	JAM ALARM LEVEL IN % FLA	100-1200%, OFF (1% increments)	1000%	5.4.3	
4	JMAR XXX	JAM ALARM RUN DELAY IN SECONDS	0-240 sec. (1 sec. increments)	2	5.4.4	
5	ULA XXX	UNDERLOAD ALARM LEVEL IN % FLA	6-90%, OFF (1% increments)	OFF	5.4.5	
6	ULAR XXX	UNDERLOAD ALARM RUN DELAY IN SECONDS	0-240 sec. (1 sec. increments)	10	5.4.6	
7	UBA XXX	PHASE UNBALANCE ALARM LEVEL	4-40%, OFF (1% increments)	10	5.4.7	
8	UBAR XXX	PHASE UNBALANCE ALARM RUN DELAY IN SECONDS	0-240 sec. (1 sec. increments)	10	5.4.8	
Page 5	**SP START**	**SETTINGS FOR START EVENTS**				
1	ST/T XXX	STARTS PER TIME ALLOWED	1-10 starts/time (increments of 1)	1	5.5.1	
2	T/ST XXX	TIME ALLOWED FOR STARTS COUNT IN MINUTES	1-240 minutes, OFF (1 minute increments)	OFF	5.5.2	
3	TBS XXX	TIME BETWEEN STARTS IN MINUTES	1-240 minutes, OFF (1 minute increments)	OFF	5.5.3	
4	NOCS X	NUMBER OF COLD STARTS ALLOWED	1-5 starts (increments of 1)	1	5.5.4	
5	TRNC XXX	MOTOR START TRANSITION CURRENT LEVEL IN % FLA	10-300% (1% increments)	130	5.5.5	
6	TRNT XXX	MOTOR START TRANSITION TIME IN SECONDS	0-1200 sec. (1 sec. Increments)	10	5.5.6	
7	Choose: TRN TIME TRN I TRN T+C TRN T/C	TRANSITION ON EVENT TRN TIME – ON TIME ONLY, TRN I – ON CURRENT ONLY, TRN T+C – ON TIME OR CURRENT, TRN T/C – ON TIME AND CURRENT	Choose one of the four conditions that determine a start-to-run transition: TRN TIME, TRN I, TRN T+C, or TRN T/C. Refer to settings P5L5 and P5L6.	TRN I	5.5.7	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
8	INSQ XXX	INCOMPLETE SEQUENCE REPORT BACK TIME IN SECONDS ON DISCRETE INPUT 2	1-240 sec., OFF (1 sec. increments) **Note:** Choosing a time value here (not OFF) also locks P7L1 to INC SEQ and no other choices are available there. Also, if this is set to OFF, later setting of P7L1 to INC SEQ will force a setting of 1 second here.	1	5.5.8	
9	INSQ TRN or INSQ ST	INCOMPLETE SEQUENCE START TIMER EVENT INSQ TRN – START TO RUN TRANSITION INSQ ST – STOP TO START TRANSITION	Toggles between INSQ TRN and INSQ ST	INSQ ST	5.5.9	
10	LAT XXX	LONG ACCELERATION TIME IN SEC-ONDS	1-1200 sec., OFF (1 sec. increments) **Danger** - set to OFF unless absolutely needed. If used, connect zero-speed switch - see P5L11 and P6L1.	OFF	5.5.10	
11	ZSW ON or ZSW OFF	ZERO SPEED SWITCH ON DISCRETE INPUT 1 ON OR OFF	Toggles between ZSW ON and ZSW OFF. **Note:** Choosing ZSW ON here also locks P6L1 to ZERO SW and no other choices are available there. Also, setting P6L1 to ZERO SW will force ZSW ON here.	ZSW OFF	5.5.1.1	
12	ABK XXXX	ANTI-BACKSPIN DELAY TIME IN SEC-ONDS	1-3600 seconds, OFF (1 second increments)	OFF	5.5.1.2	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
Page 6	**SP DI 1**	**SETTING FOR DISCRETE INPUT NUMBER 1**				
1	Choose: REM RST REM TRIP DIF TRIP MTR STOP RST DBL EMG OVR ZERO SW	CONFIGURE DISCRETE INPUT 1 - - REM RST – REMOTE RESET REM TRIP – REMOTE TRIP DIF TRIP – DIFFERENTIAL TRIP MTR STOP – MOTOR STOP DETECTION RST DBL – RESET DISABLE EMG OVR – EMERGENCY OVERRIDE ZERO SW – ZERO SPEED SWITCH CONFIGURE DISCRETE INPUT 1 – ZERO SW – ZERO SPEED SWITCH TO GET ANY OTHER FUNCTION SET ZERO SPEED SWITCH SETTING TO OFF	Choose from the seven selections for the function of Discrete Input 1. If ZERO SW is selected here, P5L11 will be forced to ZSW ON. If P5L11 was already set to ZSW ON, then this setting is automatically set to ZERO SW and no other selections are visible.	REM RST	5.6.1	
Page 7	**SP DI 2**	**SETTING FOR DISCRETE INPUT NUMBER 2**				
1	Choose: REM RST REM TRIP DIF TRIP MTR STOP RST DBL EMG OVR INC SEQ	CONFIGURE DISCRETE INPUT 2 - - REM RST – REMOTE RESET REM TRIP – REMOTE TRIP DIF TRIP – DIFFERENTIAL TRIP MTR STOP – MOTOR STOP DETECTION RST DBL – RESET DISABLE EMG OVR – EMERGENCY OVERRIDE INC SEQ – INCOMPLETE SEQUENCE CONFIGURE DISCRETE INPUT 2 – INC SEQ – INCOMPLETE SEQUENCE TO GET ANY OTHER FUNCTION SET INCOMPLETE SEQUENCE TIME SETTING TO OFF	Choose from the seven selections for the function of Discrete Input 2. If INC SEQ is selected here, P5L8 will be turned on and set to 1 second. If P5L8 was already set to a time value (not OFF), then this setting is automatically set to INC SEQ and no other selections are visible.	INC SEQ	5.7.1	
Page 8	**SP AREL**	**SETTING FOR ALARM RELAY OUTPUT CONFIGURATION**				
1	Choose: GF A ON GF T ON or GF OFF	ENABLE GROUND FAULT ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between GF A ON, GF T ON, and GF OFF	GF A ON	5.8	
2	Choose: I2T A ON I2T T ON or I2T OFF	ENABLE I2T ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between I2T A ON, I2T T ON, and I2T OFF	I2T A ON	5.8	
3	Choose: JAM A ON JAM T ON or JAM OFF	ENABLE JAM ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between JAM A ON, JAM T ON, and JAM OFF	JAM A ON	5.8	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
4	Choose: UL A ON UL T ON or UL OFF	ENABLE UNDERLOAD ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between UL A ON, UL T ON, and UL OFF	UL A ON	5.8	
5	Choose: UB A ON UB T ON or UB OFF	ENABLE PHASE UNBALANCE ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between UB A ON, UB T ON, and UB OFF	UB A ON	5.8	
6	Choose: WD A ON WD T ON or WD OFF	ENABLE WINDING TEMP ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between WD A ON, WD T ON, and WD OFF	WD A ON	5.8	
7	Choose: MB A ON MB T ON or MB OFF	ENABLE MOTOR BEARING ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between MB A ON, MB T ON, and MB OFF	MB A ON	5.8	
8	Choose: LB A ON LB T ON or LB OFF	ENABLE LOAD BEARING ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between LB A ON, LB T ON, and LB OFF	LB A ON	5.8	
9	Choose: AX A ON AX T ON or AX OFF	ENABLE AUXILIARY RTD TEMP ALARM OR TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between AX A ON, AX T ON, and AX OFF	AX A ON	5.8	
10	Choose: SX A ON SX T ON or SX OFF	ENABLE STARTS PER TIME TRIP OR ALARM TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between SX A ON, SX T ON, and SX OFF	SX A	5.8	
11	Choose: TBS T ON or TBS OFF	ENABLE TIME BETWEEN STARTS TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between TBS T ON and TBS OFF	TBS OFF	5.8	
12	RTDF ON or RTDF OFF	ENABLE INDIVIDUAL RTD CHANNEL FAILURE TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between RTDF ON and RTDF OFF	RTDF ON	5.8	
13	RCOM ON or RCOM OFF	ENABLE RTD MODULE COMMUNICA-TION FAILURE TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between RCOM ON and RCOM OFF	RCOM ON	5.8	
14	IOCT ON or IOCT OFF	ENABLE INSTANTANEOUS TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between IOCT ON and IOCT OFF	IOCT OFF	5.8	
15	PH R ON or PH R OFF	ENABLE PHASE REVERSAL TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between PH R ON and PH R OFF	PH R OFF	5.8	
16	INSQ ON or INSQ OFF	ENABLE INCOMPLETE SEQUENCE TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between INSQ ON and INSQ OFF	INSQ OFF	5.8	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
17	REMT ON or REMT OFF	ENABLE REMOTE TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between REMT ON and REMT OFF	REMT OFF	5.8	
18	DIFT ON or DIFT OFF	ENABLE DIFFERENTIAL TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between DIFT ON and DIFT OFF	DIFT OFF	5.8	
19	INCT ON or INCT OFF	ENABLE INCOM TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between INCT ON and INCT OFF	INCT OFF	5.8	
20	TRNT ON or TRNT OFF	ENABLE TRANSITION TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between TRNT ON and TRNT OFF	TRNT OFF	5.8	
21	ZSWT ON or ZSWT OFF	ENABLE ZERO SPEED SWITCH TRIP TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between ZSWT ON and ZSWT OFF	ZSWT OFF	5.8	
22	TBYP ON or TBYP OFF	ENABLE TRIP BYPASS TO ACTIVATE ALARM RELAY OUTPUT OR DISABLE	Toggles between TBYP ON and TBYP OFF	TBYP OFF	5.8	
Page 9	**SP AUX1**	**SETTINGS FOR AUX2 RELAY OUTPUT CONFIGURATION**				
1	LSPU XXX	LOAD SHED PICK-UP CURRENT AS % OF FLA	50-150%, OFF (1% increments) **Note**: P9L1 and P9L2 are forced to be coherent. See Section 5 explanation.	OFF	5.9.1	
2	LSDO XXX	LOAD SHED DROP-OUT CURRENT AS % OF FLA	50-LSPU Value %, OFF (1% increments) **Note**: P9L1 and P9L2 are forced to be coherent. See Section 5 explanation.	OFF	5.9.2	
3	LSDL XX	LOAD SHED DELAY IN SECONDS	0-5 sec. (0.1 sec. increments) If LSPU and LSDO are both set to OFF then the SP AUX1 functions below are available and visible:	1	5.9.3	
4	Choose: GF A ON GF T ON or GF OFF	ENABLE GROUND FAULT ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between GF A ON, GF T ON, and GF OFF	GF OFF	5.9.4	
5	Choose: I2T A ON I2T T ON or I2T OFF	ENABLE I2T ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between I2T A ON, I2T T ON, and I2T OFF	I2T T ON	5.9.4	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
6	Choose: JAM A ON JAM T ON or JAM OFF	ENABLE JAM ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between JAM A ON, JAM T ON, and JAM OFF	JAM OFF	5.9.4	
7	Choose: UL A ON UL T ON or UL OFF	ENABLE UNDERLOAD ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between UL A ON, UL T ON, and UL OFF	UL OFF	5.9.4	
8	Choose: UB A ON UB T ON or UB OFF	ENABLE PHASE UNBALANCE ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between UB A ON, UB T ON, and UB OFF	UB OFF	5.9.4	
9	Choose: WD A ON WD T ON or WD OFF	ENABLE WINDING TEMP ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between WD A ON, WD T ON, and WD OFF	WD OFF	5.9.4	
10	Choose: MB A ON MB T ON or MB OFF	ENABLE MOTOR BEARING TEMP ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between MB A ON, MB T ON, and MB OFF	MB OFF	5.9.4	
11	Choose: LB A ON LB T ON or LB OFF	ENABLE LOAD BEARING TEMP ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between LB A ON, LB T ON, and LB OFF	LB OFF	5.9.4	
12	Choose: AX A ON AX T ON or AX OFF	ENABLE AUXILIARY RTD TEMP ALARM OR TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between AX A ON, AX T ON, and AX OFF	AX OFF	5.9.4	
13	Choose: SX A ON SX T ON or SX OFF	ENABLE STARTS PER TIME TRIP OR ALARM TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between SX A ON, SX T ON, and SX OFF	SX OFF	5.9.4	
14	Choose: TBS T ON or TBS OFF	ENABLE TIME BETWEEN STARTS TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between TBS T ON, and TBS OFF	TBS OFF	5.9.4	
15	RTDF ON or RTDF OFF	ENABLE RTD FAILURE DIAGNOSTIC TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between RTDF ON and RTDF OFF	RTDF OFF	5.9.4	
16	RCOM ON or RCOM OFF	ENABLE RTD MODULE COMMUNICATION FAILURE TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between RCOM ON and RCOM OFF	RCOM OFF	5.9.4	
17	IOCT ON or IOCT OFF	ENABLE INSTANTANEOUS OVERCURRENT TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between IOCT ON and IOCT OFF	IOCT OFF	5.9.4	

Line No.	*Display*	*Help Message*	*Setting Range/ Value Selection*	*Value as shipped*	*Section Reference*	*Selected Value*
18	PH R ON or PH R OFF	ENABLE PHASE REVERSAL TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between PH R ON and PH R OFF	PH R OFF	5.9.4	
19	INSQ ON or INSQ OFF	ENABLE INCOMPLETE SEQUENCE TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between INSQ ON and INSQ OFF	INSQ OFF	5.9.4	
20	REMT ON or REMT OFF	ENABLE REMOTE TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between REMT ON and REMT OFF	REMT OFF	5.9.4	
21	DIFT ON or DIFT OFF	ENABLE DIFFERENTIAL TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between DIFT ON and DIFT OFF	DIFT OFF	5.9.4	
22	INCT ON or INCT OFF	ENABLE INCOM TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between INCT ON and INCT OFF	INCT OFF	5.9.4	
23	TRNT ON or TRNT OFF	ENABLE TRANSITION TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between TRNT ON and TRNT OFF	TRNT OFF	5.9.4	
24	ZSWT ON or ZSWT OFF	ENABLE ZERO SPEED SWITCH TRIP TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between ZSWT ON and ZSWT OFF	ZSWT OFF	5.9.4	
25	TBYP ON or TBYP OFF	ENABLE TRIP BYPASS TO ACTIVATE AUX1 RELAY OUTPUT OR DISABLE	Toggles between TBYP ON and TBYP OFF	TBYP OFF	5.9.4	
Page 10 SP AUX2		**SETTINGS FOR AUX 2 RELAY OUTPUT CONFIGURATION**				
1	TRN ON or TRN OFF	ENABLE TRANSITION OUTPUT IF ENABLED ALL OTHER FUNCTIONS FOR AUX 2 ARE DISABLED	Toggles between TRN ON and TRN OFF. If TRN is set to OFF then the SP AUX2 functions below are available and visible.	TRN ON	5.10.1	
2	Choose: GF A ON GF T ON Or GF OFF	ENABLE GROUND FAULT ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between GF A ON, GF T ON, and GF OFF	GF OFF	5.10.2	
3	Choose: I2T A ON I2T T ON Or I2T OFF	ENABLE I2T ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between I2T A ON, I2T T ON, and I2T OFF	I2T OFF	5.10.2	
4	Choose: JAM A ON JAM T ON or JAM OFF	ENABLE JAM ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between JAM A ON, JAM T ON, and JAM OFF	JAM OFF	5.10.2	
5	Choose: UL A ON UL T ON or UL OFF	ENABLE UNDERLOAD ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between UL A ON, UL T ON, and UL OFF	UL OFF	5.10.2	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
6	Choose: UB A ON UB T ON or UB OFF	ENABLE PHASE UNBALANCE ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between UB A ON, UB T ON, and UB OFF	UB OFF	5.10.2	
7	Choose: WD A ON WD T ON or WD OFF	ENABLE WINDING TEMP ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between WD A ON, WD T ON, and WD OFF	WD OFF	5.10.2	
8	Choose: MB A ON MB T ON or MB OFF	ENABLE MOTOR BEARING TEMP ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between MB A ON, MB T ON, and MB OFF	MB OFF	5.10.2	
9	Choose: LB A ON LB T ON or LB OFF	ENABLE LOAD BEARING TEMP ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between LB A ON, LB T ON, and LB OFF	LB OFF	5.10.2	
10	Choose: AX A ON AX T ON or AX OFF	ENABLE AUXILIARY RTD TEMP ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between AX A ON, AX T ON, and AX OFF	AX OFF	5.10.2	
11	Choose: SX A ON SX T ON or SX OFF	ENABLE STARTS PER TIME TRIP OR ALARM TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between SX A ON, SX T ON, and SX OFF	SX OFF	5.10.2	
12	Choose: TBS T ON or TBS OFF	ENABLE TIME BETWEEN STARTS TRIP OR TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between TBS T ON, and TBS OFF	TBS OFF	5.10.2	
13	RTDF ON or RTDF OFF	ENABLE RTD FAILURE DIAGNOSTIC TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between RTDF ON and RTDF OFF	RTDF OFF	5.10.2	
14	RCOM ON or RCOM OFF	ENABLE RTD MODULE COMMUNICA-TION FAILURE TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between RCOM ON and RCOM OFF	RCOM OFF	5.10.2	
15	IOC A ON IOC T ON or IOC OFF	ENABLE INSTANTANEOUS OVERCURRENT ALARM OR TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between IOCT ON and IOCT OFF	IOCT OFF	5.10.2	
16	PH R ON or PH R OFF	ENABLE PHASE REVERSAL TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between PH R ON and PH R OFF	PH R OFF	5.10.2	
17	INSQ ON or INSQ OFF	ENABLE INCOMPLETE SEQUENCE TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between INSQ ON and INSQ OFF	INSQ OFF	5.10.2	
18	REMT ON or REMT OFF	ENABLE REMOTE TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between REMT ON and REMT OFF	REMT OFF	5.10.2	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
19	DIFT OFF or DIFT OFF	ENABLE DIFFERENTIAL TRIP TO ACTI-VATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between DIFT ON and DIFT OFF	DIFT OFF	5.10.2	
20	INCT ON or INCT OFF	ENABLE INCOM TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between INCT ON and INCT OFF	INCT OFF	5.10.2	
21	TRNT ON or TRNT OFF	ENABLE TRANSITION TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between TRNT ON and TRNT OFF	TRNT OFF	5.10.2	
22	ZSWT ON or ZSWT OFF	ENABLE ZERO SPEED SWITCH TRIP TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between ZSWT ON and ZSWT OFF	ZSWT OFF	5.10.2	
23	TBYP ON or TBYP OFF	ENABLE TRIP BYPASS TO ACTIVATE AUX2 RELAY OUTPUT OR DISABLE	Toggles between TBYP ON and TBYP OFF	TBYP OFF	5.10.2	
Page 11	**SP A OUT**	**SETTING FOR ANALOG OUTPUT CONFIGURATION**				
1	MAX 100 MAX 125 MAX WRTD MAX %12T	4-20 MA OUTPUT MAX 100 – 20 MA FOR 100% FLA MAX 125 – 20 MA FOR 125% FLA MAX WRTD – 20 MA FOR TRIP LEVEL MAX %I2T – 20 MA FOR 100% I2T	Select one of MAX 100, MAX 125, MAX WRTD, or MAX %I2T	MAX 125	5.11.1	
Page 12	**SP SYS**	**SETTINGS FOR SYSTEM CONFIGURATION**				
1	TP MODE X	CONFIGURE TRIP RELAY OUTPUT TO BE MODE 1 – TRIP RELAY ENERGIZES ON TRIP EVENT OR MODE 2 – TRIP RELAY ENERGIZES ON POWER UP AND DE-ENERGIZES ON TRIP EVENT	Toggles between TP MODE1 and TP MODE2	TP MODE2	5.12.1	
2	AL MODE X	CONFIGURE ALARM RELAY OUTPUT TO BE MODE 1 – ALARM RELAY ENERGIZES ON ALARM EVENT OR MODE 2 – ALARM RELAY ENERGIZES ON POWER UP AND DE-ENERGIZES ON ALARM EVENT	Toggles between AL MODE1 and AL MODE2	AL MODE2	5.12.2	
3	AX1 MOD X	CONFIGURE AUX1 RELAY OUTPUT TO BE MODE 1 – AUX1 RELAY ENERGIZES ON AUX1 EVENT OR MODE 2 – AUX1 RELAY ENERGIZES ON POWER UP AND DE-ENERGIZES ON AUX1 EVENT	Toggles between AX1 MOD1 and AX1 MOD2	AX1 MOD1	5.12.3	
4	AX2 MOD X	CONFIGURE AUX2 RELAY OUTPUT TO BE MODE 1 – AUX2 RELAY ENERGIZES ON AUX2 EVENT OR MODE 2 – AUX2 RELAY ENERGIZES ON POWER UP AND DE-ENERGIZES ON AUX2 EVENT	Toggles between AX2 MOD1 and AX2 MOD2	AX2 MOD1	5.12.4	
5	MAN I2T or AUTO I2T	AUTO OR MANUAL I2T RESET	Toggles between MAN I2T and AUTO I2T	AUTO I2T	5.12.5	
6	RUN PGM or STOP PGM	ENABLES UNIT TO BE PROGRAMMED WHILE MOTOR IS RUNNING	Toggles between RUN PGM and STOP PGM	STOP	5.12.6	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
7	EMRG EN or EMRG DIS	EMERGENCY OVERRIDE ENABLE EMRG EN – ENABLE EMERGENCY OVERRIDE EMRG DIS – DISABLE EMERGENCY OVERRIDE	Toggles between EMRG EN and EMRG DIS	EMRG DIS	5.12.7	
8	12 HOUR or 24 HOUR	SET REAL TIME CLOCK DISPLAY 12 HOUR – AM/PM TIME DISPLAYED 13 24 HOUR – 24 HOUR TIME DISPLAYED	Toggles between 12 HOUR and 24 HOUR	12 HOUR	5.12.8	
9	MONTH XX	SET REAL TIME CLOCK MONTH	Month 1-12 (1 month increments)	—	5.12.9	
10	DAY XX	SET REAL TIME CLOCK DAY	Day 1-31 (1 day increments)	—	5.12.10	
11	YEAR XX	SET REAL TIME CLOCK YEAR	Year 0-99 (1 year increments)	—	5.12.11	
12	HOUR XX	SET REAL TIME CLOCK HOUR	Hour 0-23 (1 hour increments)	—	5.12.12	
13	MIN XX	SET REAL TIME CLOCK MINUTE	Minute 0-59 (1 minute increments)	—	5.12.13	
14	M D Y or D M Y	SET REAL TIME DATE DISPLAY MONTH DAY YEAR OR DAY MONTH YEAR	Toggles between M D Y and D M Y	M D Y	5.12.14	
15	IQ2 EN or IQ2 DIS	IMPACC COMMUNICATIONS MODE IQ2 EN – IQ1000II EMULATION IQ2 DIS – MP-3000 COMMUNICATION	Toggles between IQ2 EN and IQ2 DIS	IQ2 EN	5.12.15	
16	RLYF TRP RLYF ALM or RLYF T+A	INTERNAL DIAGNOSTIC FAILURE ACTIVATES TRIP AND OR ALARM RELAY	Toggles between RLYF TRP, RLYF ALM and RLYF T+A	RLYF T+A	5.12.16	
17	INCT DIS or INCT EN	INCOM TRIP DISABLED OR ENABLED	Toggles between INCT DIS and INCT EN	INCT EN	5.12.17	
18	DISARMED or ARMED	ARM OR DISARM TRIP RELAY WARNING DISARM WILL NOT ALLOW TRIP RELAY TO FUNCTION TRIP WARNING MP-3000 WILL BE DISARMED UPON EXIT OF PROGRAM MODE AND WILL NOT PROTECT THE MOTOR-ENTER ARMED INTO SETTING TO PROTECT THE MOTOR	Toggles between ARMED and DISARMED	ARMED	5.12.18	
Page 13 SP TEST		**SETTINGS FOR TESTING INPUTS AND OUTPUTS**				
1	3 PHASE or 1 PHASE	SINGLE PHASE TEST MODE OR THREE PHASE PROTECTION MODE	Toggles between 3-PHASE and 1-PHASE **Note**: 1-PHASE is for bench testing ONLY.	3-PHASE	5.13.1	3-Phase

Line No.	*Display*	*Help Message*	*Setting Range/ Value Selection*	*Value as shipped*	*Section Reference*	*Selected Value*
2	TRP ENER or TRP DENR	TRP ENER – ENERGIZE TRIP RELAY TRP DENR – DE-ENERGIZE TRIP RELAY	Toggles between TRP ENER and TRP DENR Press and hold **Reset** button to perform selected test	—	5.13.2	
3	ALM ENER or ALM DENR	ALM ENER – ENERGIZE ALARM RELAY ALM DENR – DE-ENERGIZE ALARM RELAY	Toggles between ALM ENER and ALM DENR Press and hold **Reset** button to perform selected test	—	5.13.3	
4	AX1 ENER or AX1 DENR	AX1 ENER – ENERGIZE AUXILIARY RELAY 1 AX1 DENR – DE-ENERGIZE AUXILIARY RELAY 1	Toggle between AX1 ENER and AX1 DENR Press and hold **Reset** button to perform selected test	—	5.13.4	
5	AX2 ENER or AX2 DENR	AX2 ENER – ENERGIZE AUXILIARY RELAY 2 AX2 DENR – DE-ENERGIZE AUXILIARY RELAY 2	Toggle between AX2 ENER and AX2 DENR Press and hold **Reset** button to perform selected test	—	5.13.5	
6	Choose: AOUT 4 AOUT 12 or AOUT 20	FORCE ANALOG OUTPUT 4 – FORCE A 4 MA OUTPUT 12 – FORCE A 12 MA OUTPUT 20 – FORCE A 20 MA OUTPUT	Toggle between AOUT 4, AOUT 12, AND AOUT 20 Press and hold **Reset** button to output forced value	—	5.13.6	
7	DI 1OFF or DI 1 ON	STATE OF DISCRETE INPUT 1	Read only	—	5.13.7	
8	DI 2 OFF or DI 2 ON	STATE OF DISCRETE INPUT 2	Read only	—	5.13.8	
Page 14 SP RESET		**RESETTING HISTORY MODE PAGES**				
1	MTR RST or PUSH RST	MTR RST – PUSH RAISE TO ENABLE MOTOR HISTORY RESET PUSH RST – PUSH RESET TO EXECUTE RESET OF MOTOR HISTORY OR PUSH RAISE TO NOT RESET	Change to PUSH RST and press Reset button, or return to MTR RST	—	5.14.1	
2	TRIP RST or PUSH RST	TRIP RST – PUSH RAISE TO ENABLE TRIP HISTORY RESET PUSH RST – PUSH RESET TO EXECUTE RESET OF TRIP HISTORY OR PUSH RAISE TO NOT RESET	Change to PUSH RST and press Reset button, or return to TRIP RST	—	5.14.2	

Line No.	Display	Help Message	Setting Range/ Value Selection	Value as shipped	Section Reference	Selected Value
3	ALRM RST or PUSH RST	ALRM RST – PUSH RAISE TO ENABLE ALARM HISTORY RESET PUSH RST – PUSH RESET TO EXECUTE RESET OF ALARM HISTORY OR PUSH RAISE TO NOT RESET	Change to PUSH RST and press Reset button, or return to ALRM RST	—	5.14.3	
4	TOT RST or PUSH RST	TOT RST - PUSH RAISE TO ENABLE TOTAL HISTORY RESET PUSH RST - PUSH RESET TO EXECUTE RESET OF ALARM HISTORY OR PUSH RAISE TO NOT RESET	Change to PUSH RST and press Reset button, or return to TOT RST	—	5.14.4	

Table 4.4 History Mode Display

Note: For any of the Line functions, the Value buttons are used to view the multiple displays.

Page	Line	Display	Complete Help Message	Description
HISTORY			HISTORY MODE	Recalls stored motor data
HIST MTR			HISTORY OF MOTOR STATISTICS	This page contains historical information of motor since reset
	OCNT XX	OCNT XX MM/DD/YY HH:MM:SS	OPERATION COUNT SINCE LAST RESET DATE OF RESET TIME OF RESET	The number of motor starts logged since last reset The date when OCNT was reset The time when OCNT was reset
	RT XXXX	RT XXXX MM/DD/YY HH:MM:SS	RUN TIME HOURS SINCE LAST RESET DATE OF RESET TIME OF RESET	Total motor run time accumulated since last reset The date when RT was reset The time when RT was reset
	IMS XXXX	IMS XXXX MM/DD/YY HH:MM:SS	HIGHEST STARTING PHASE CURRENT DATE OF EVENT TIME OF EVENT	Highest starting phase current monitored since last reset The date of highest IMS The time of highest IMS
	IMR XXXX	IMR XXXX MM/DD/YY HH:MM:SS	HIGHEST RUNNING PHASE CURRENT DATE OF EVENT TIME OF EVENT	Highest running phase current monitored since last reset The date of highest IMR The time of highest IMR
	UBM XXX	UBM XXX MM/DD/YY HH:MM:SS	HIGHEST PHASE UNBALANCE DATE OF EVENT TIME OF EVENT	Maximum phase unbalance monitored since last reset Date of highest phase unbalance Time of highest phase unbalance
	WMX XXXX	WMX XXXX MM/DD/YY HH:MM:SS	HIGHEST MOTOR WINDING TEMPERATURE IN DEGREES C(F) DATE OF EVENT TIME OF EVENT	Maximum motor winding temperature monitored since reset The date of highest WMX The time of highest WMX
	MBX XXXX	MBX XXXX MM/DD/YY HH:MM:SS	HIGHEST MOTOR BEARING TEMPERATURE IN DEGREES C(F) DATE OF EVENT TIME OF EVENT	Maximum motor bearing temperature monitored since reset The date of highest MBX The time of highest MBX
	LMX XXXX	LMX XXXX MM/DD/YY HH:MM:SS	HIGHEST LOAD BEARING TEMPERATURE IN DEGREES C(F) DATE OF EVENT TIME OF EVENT	Maximum load bearing temperature monitored since reset The date of highest LMX The time of highest LMX

Page	Line	Display	Complete Help Message	Description
	EMOR XXX	EMOR XXX MM/DD/YY HH:MM:SS	NUMBER OF EMERGENCY OVERRIDES SINCE LAST RESET DATE OF RESET TIME OF RESET	Total number of emergency overrides performed since reset The date when EMOR was reset The time when EMOR was reset
HIST TRP			HISTORY OF TRIP EVENTS	This page contains historical information on trips that have occurred since reset
	GF T XX	GF T XX MM/DD/YY HH:MM:SS	NUMBER OF GROUND FAULT TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	Total number of respective trips that occurred since reset The date when respective trip function was reset The time when respective trip function was reset
	I2TT XX	I2TT XX MM/DD/YY HH:MM:SS	NUMBER OF I2T TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	IOCT XX	IOCT XX MM/DD/YY HH:MM:SS	NUMBER OF INSTANTANEOUS OVER CURRENT TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	JAMT XX	JAMT XX MM/DD/YY HH:MM:SS	NUMBER OF JAM TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	UL T XX	UL T XX MM/DD/YY HH:MM:SS	NUMBER OF UNDERLOAD TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	UB T XX	UB T XX MM/DD/YY HH:MM:SS	NUMBER OF PHASE UNBALANCE TRIPS SINCE LAST RESET| DATE OF RESET TIME OF RESET	
	WD T XX	WD T XX MM/DD/YY HH:MM:SS	NUMBER OF WINDING TEMPERATURE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	MB T XX	MB T XX MM/DD/YY HH:MM:SS	NUMBER OF MOTOR BEARING TEMPERATURE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	LB T XX	LB T XX MM/DD/YY HH:MM:SS	NUMBER OF LOAD BEARING TEMPERATURE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	AX T XX	AX T XX MM/DD/YY HH:MM:SS	NUMBER OF AUXILIARY TEMPERATURE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	

Page	Line	Display	Complete Help Message	Description
	PHRT XX	PHRT XX MM/DD/YY HH:MM:SS	NUMBER OF PHASE REVERSAL TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	ISQT XX	ISQT XX MM/DD/YY HH:MM:SS	NUMBER OF INCOMPLETE SEQUENCE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	REMT XX	REMT XX MM/DD/YY HH:MM:SS	NUMBER OF REMOTE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	DIFT XX	DIFT XX MM/DD/YY HH:MM:SS	NUMBER OF DIFFERENTIAL TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	INCT XX	INCT XX MM/DD/YY HH:MM:SS	NUMBER OF INCOM REMOTE TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	STXT XX	STXT XX MM/DD/YY HH:MM:SS	NUMBER OF STARTS PER TIME TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	TBST XX	TBST XX MM/DD/YY HH:MM:SS	NUMBER OF TIME BETWEEN STARTS TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	TRNT XX	TRNT XX MM/DD/YY HH:MM:SS	NUMBER OF TRANSITION TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	TBYT XX	TBYT XX MM/DD/YY HH:MM:SS	NUMBER OF TRIP BYPASS TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	ZSWT XX	ZSWT XX MM/DD/YY HH:MM:SS	NUMBER OF ZERO SPEED SWITCH TRIPS SINCE LAST RESET DATE OF RESET TIME OF RESET	
HIST ALM			**HISTORY OF ALARM EVENTS**	
	GF A XX	GF A XX MM/DD/YY HH:MM:SS	NUMBER OF GROUND FAULT ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	Number of respective alarms since last reset The date when respective alarm function was reset The time when respective alarm function was reset
	I2TA XX	I2TA XX MM/DD/YY HH:MM:SS	NUMBER OF I2T ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	

Page	Line	Display	Complete Help Message	Description
	JAMA XX	JAMA XX MM/DD/YY HH:MM:SS	NUMBER OF JAM ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	UL A XX	UL A XX MM/DD/YY HH:MM:SS	NUMBER OF UNDERLOAD ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	UB A XX	UB A XX MM/DD/YY HH:MM:SS	NUMBER OF PHASE UNBALANCE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	WD A XX	WD A XX MM/DD/YY HH:MM:SS	NUMBER OF WINDING TEMPERATURE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	MB A XX	MB A XX MM/DD/YY HH:MM:SS	NUMBER OF MOTOR BEARING TEMPERATURE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	LB A XX	LB A XX MM/DD/YY HH:MM	NUMBER OF LOAD BEARING TEM-PERATURE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	AX A XX	AX A XX MM/DD/YY HH:MM:SS	NUMBER OF AUXILIARY TEMPERA-TURE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	STXA XX	STXA XX MM/DD/YY HH:MM:SS	NUMBER OF STARTS PER TIME ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	RTDF XX	RTDF XX MM/DD/YY HH:MM:SS	NUMBER OF RTD CHANNEL FAILURE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
	URTD XX	URTD XX MM/DD/YY HH:MM:SS	NUMBER OF URTD COMMUNICATION FAILURE ALARMS SINCE LAST RESET DATE OF RESET TIME OF RESET	
HIST TRP			HISTORY OF TRIP EVENTS	
	TRPS	 MM/DD/YY HH:MM:SS	TOTAL NUMBER OF TRIPS SINCE RESET DATE OF RESET TIME OF RESET	
	TRT XXXX	 MM/DD/YY HH:MM:SS	TOTAL RUN TIME SINCE RESET DATE OF RESET TIME OF RESET	

Page	Line	Display	Complete Help Message	Description
	TOCS XXX	 MM/DD/YY HH:MM:SS	TOTAL OPERATION COUNT SINCE RESET DATE OF RESET TIME OF RESET	

Table 4.5 Log Mode Display

Page	Line	Display	Complete Help Message	Description
LOG			LOG OF EVENTS MODE	Recalls stored motor events as observed by the relay
LOG BOOK			LOG BOOK OF THE LAST 100 EVENTS	This page contains a chronological list of motor events
	START	MM/DD/YY HH.MM	START EVENT – A STOP TO START TRANSITION WAS MADE DATE OF EVENT TIME OF EVENT	First event recorded – this is just an example, the event could be any of the following six types: start, stop, entering in program mode, emergency override, alarm condition, or trip condition. The events listed in the Line column are used to show all of the different types of events, but a true LOG BOOK page will have any number of different events in the order that they occur. From the LOG BOOK display, push line up to see the latest event. Push again for the next most recent event and so on. From the LOG BOOK display, push line down to see the oldest logged event. Push again to see the next oldest and so on.The date that the event occurred The time that the event occurred
	STOP	MM/DD/YY HH.MM	STOP EVENT - A TRANSITION TO THE STOP STATE WAS MADE DATE OF EVENT TIME OF EVENT	The date that the event occurredThe time that the event occurred
	EMRG OVR	MM/DD/YY HH.MM	EMERGENCY OVERRIDE EVENT – AN EMERGENCY OVERRIDE WAS PERFORMED DATE OF EVENT TIME OF EVENT	Emergency override can be activated from the front face plate, from a programmed discrete input, or over the communications network The date that the event occurred The time that the event occurred
	SET CHNG	MM/DD/YY HH.MM	PROGRAM MODE ENTERED – POSSIBLE SET POINT CHANGES DATE OF EVENT TIME OF EVENT	Recorded every time the program mode is normally exited. This can occur with the second push of the “Prog” push button or over the communication network. The date that the event occurred The time that the event occurred
	RESET	MM/DD/YY HH.MM	RESET EVENT – A RESET EVENT CLEARED A TRIP OR ALARM DATE OF EVENT TIME OF EVENT	Logged only when a trip or alarm event was cleared. This can be done through the front face panel “Reset” button, by a programmed discrete input activation, or over the communication network.

Page	Line	Display	Complete Help Message	Description
	TRIP		(Description of trip event)	For a complete list of trips with help messages see the trip conditions table 12.2, and internal diagnostics failure messages table 12.4
		MM/DD/YY	DATE OF EVENT	The date that the event occurred
		HH.MM	TIME OF EVENT	The time that the event occurred
	ALARM		(Description of alarm event)	For a complete list of alarms with help messages see the alarm conditions table 12 .2, and internal diagnostics failure messages table 12.4
		MM/DD/YY	DATE OF EVENT	The date that the event occurred
		HH.MM	TIME OF EVENT	The time that the event occurred
LOG EVNT			DETAILED LOG OF THE LAST 20 ABNORMAL EVENTS	This page contains detailed trouble shooting information for all trip and alarm events. The events are logged chronologically. From this display press line up to get the most recent event. Push again for the next most recent event and so on. From this display press line down to get the oldest event. Push again for the next oldest event.
	TRIP *Or* ALARM		(Description of trip or alarm event)	A trip or alarm event was logged. For a complete list see the trip conditions table 12.2, and internal diagnostics failure messages table 12.4
		MM/DD/YY	DATE OF EVENT	The date that the trip occurred
		HH.MM	TIME OF EVENT	The time that the trip occurred
		IA XXX	PHASE A CURRENT IN AMPS AT TIME OF EVENT	The phase current in amps at time of trip
		IB XXX	PHASE B CURRENT IN AMPS AT TIME OF EVENT	
		IC XXX	PHASE C CURRENT IN AMPS AT TIME OF EVENT	
		IG XXX	GROUND FAULT CURRENT IN AMPS AT TIME OF EVENT	The ground fault current in amps at time of trip
		%I2T XXX	PERCENT OF I2T TRIP LEVEL AT TIME OF EVENT	The percent of thermal bucket used at time of trip
		%UB XXX	PHASE UNBALANCE AT TIME OF THE EVENT - IF POSITIVE THE RATIO OF NEGATIVE TO POSITIVE SEQUENCE CURRENT – IF NEGATIVE THE INVERSE	The percent sequence current unbalance at time of trip
		WT1 XXX	WINDING TEMP 1 IN DEGREES (F OR C) AT TIME OF EVENT”	RTD temperatures at time of trip
		WT2 XXX	WINDING TEMP 2 IN DEGREES (F OR C) AT TIME OF EVENT” WINDING	
		WT3 XXX	TEMP 3 IN DEGREES (F OR C) AT TIME OF EVENT”	
		WT4 XXX	WINDING TEMP 4 IN DEGREES (F OR C) AT TIME OF EVENT”	
		WT5 XXX	WINDING TEMP 5 IN DEGREES (F OR C) AT TIME OF EVENT”	
		WT6 XXX	WINDING TEMP 6 IN DEGREES (F OR C) AT TIME OF EVENT”	
		MT1 XXX	MOTOR BEARING TEMP 1 IN DEGREES (F OR C) AT TIME OF EVENT	

Page	Line	Display	Complete Help Message	Description
		MT2 XXX	MOTOR BEARING TEMP 2 IN DEGREES (F OR C) AT TIME OF EVENT	
		LT1 XXX	LOAD BEARING TEMP 1 IN DEGREES (F OR C) AT TIME OF EVENT	
		LT2 XXX	LOAD BEARING TEMP 2 IN DEGREES (F OR C) AT TIME OF EVENT	
		AXT XXX	AUXILIARY TEMP IN DEGREES (F OR C) AT TIME OF EVENT	
LOG STRT			DETAILED LOG OF THE LAST 4 STARTS	This page contains detailed information about the last four motor starts.
	START X		START NUMBER MOST RECENT START EQUAL 1	Each of the last 4 starts are numbered 1 being the most recent and 4 being the oldest. Press line up to get the latest start line down to get the oldest start.
		MM/DD/YY	DATE OF EVENT	The date of start
		HH.MM	TIME OF EVENT	The time of start
		IA XXX	MAXIMUM PHASE A CURRENT DURING START	Highest of each phase current in amps during start
		IB XXX	MAXIMUM PHASE B CURRENT DURING START	
		IC XXX	MAXIMUM PHASE C CURRENT DURING START	
		IG XXX	MAXIMUM GROUND FAULT CURRENT DURING START	The highest ground fault current in amps during start
		UB XXX	MAXIMUM PHASE UNBALANCE DURING START	The highest percent sequence current unbalance during start
		ITR XXX	AVERAGE CURRENT AT TIME OF TRANSITION IN AMPS	The average current of all three phases in amps at start transition
		TSTI XXX	TIME FROM START TO CURRENT TRANSITION IN SECONDS	The elapsed time from start to current below the transition current set point level
		TSTR XXX	TIME FROM START TO RUN OR TRIP IN SECONDS	

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SECTION 5—PROGRAMMING THE MP-3000

5.0 General

The Program mode is used to change MP-3000 settings.

The user should read this section and also **Section 9, Application and Settings**, for a full understanding of the settings and the relay functions they control. This Section summarizes the functions of all of the settings. Section 9 provides more detailed engineering explanation for selected settings that require it.

Open the security door and press the **Prog** button to put the relay into Program mode (Figure 4.1). Use Table 4.3 as a guide and as a worksheet for programming. Use the Page and Line pushbuttons to navigate through the Program mode, and the Value pushbuttons to change the setting values.

A relay protecting a running motor can be reprogrammed only if the setting number 6 (RUN PGM or STOP PGM) on the SP SYSTEM Page (Page 12 of the settings) was previously set to RUN PGM. See Section 5.12.6 below.

The relay continues to protect the motor with its prior settings as you manipulate the values in Program mode. Changes to the settings will not take effect until the program button is pressed a second time to exit the Program mode.

Make sure the motor is in a stable state before programming. If the operating state of the motor changes during a programming operation, the MP-3000 exits the program mode without actually making any of the changes entered to that time. State changes include any transition to start, run, stop, alarm, or trip.

In the following, the notation **PnLm** designates the setting on page n, line m.

5.0.1 Conditional Setting Ranges

Program settings have individual ranges and setting increments, or selections, listed in Table 4.3. However, note that four of the settings have linked ranges. Because of this, it may be possible to set unacceptable combinations of values during the programming operation. If this error is made, the user will not be able to exit the programming mode by pushing **Prog**. Instead, the display indicates which setting is out of range and the Help message indicates the fix. Also, see individual descriptions for each of these linked settings:

- The ratio of Motor Full Load Amperes nameplate value (**FLA**; P1L1) to Phase Ct-ratio numerator (**PCT**, P1L5) must be between 0.5 and 1.5. These values are both dictated by the design of the protected equipment, and the error can be corrected only by installing an appropriate current transformer set for this motor. See FLA CT L and FLA CT H in Table 5-1, also see Section 5.1.5 for guidance on Ct ratio selection.

- The instantaneous overcurrent trip setting (**IOC**, P3L4) must be below (1020 * **PCT**/ **FLA**)% or 1600%, whichever is less. See IOC OUT in Table 5-1.

- The jam trip and alarm current levels (**JMT**, P3L6 and JMA, P4L3) must be below (1020 * **PCT**/ **FLA**)% or 1200%, whichever is less. See JAMT OUT and JAMA OUT in Table 5-1.

CAUTION

FLA IS A FIXED PROPERTY OF THE MOTOR. SELECT A CT WHOSE RATIO IS SUITABLE FOR THIS MOTOR.

5.0.2 Viewing Settings

Most of the following settings can be viewed by users without access to the **Program** button behind the front-panel security door. Use the **View Settings** display mode button.

Note that certain settings without logical display values are not visible in the View Setting mode. These are on setting pages 12, 13, and 14, and are indicated by dashes in the Factory Default column of Table 4.3. They include testing settings and time values. Check the setting of the calendar/clock using the **Monitor Time** page of the **Monitor Mode.**

5.1 Page 1, SP MOTOR, Settings P1L1 to P1L8

Settings for motor constants. These settings are usually obtained from the motor nameplate or manufacturer-supplied data. They must be correct for the MP-3000 to protect the motor.

5.1.1 Setting P1L1, Full-Load Amperes (FLA)

Set to maximum stator continuous rms current in primary (actual motor winding) amperes in each phase. Use motor nameplate or manufacturer's data.

Table 5.1 Inconsistent Settings Messages

Display	*Complete Help Message*
FLA CT L	THE RATIO OF FLA TO CT RATIO IS BELOW .5—INCREASE FLA OR DECREASE CT RATIO—PRESS PROGRAM TO CONTINUE
FLA CT H	THE RATIO OF FLA TO CT RATIO IS ABOVE 1.5—DECREASE FLA OR INCREASE CT RATIO—PRESS PROGRAM TO CONTINUE
IOC OUT	IOC SETTING IS OUT OF RANGE—DECREASE IOC OR DECREASE FLA OR INCREASE CT RATIO—PRESS PROGRAM TO CONTINUE'
JAMT OUT	JAM TRIP SETTING IS OUT OF RANGE—DECREASE JAM TRIP OR DECREASE FLA OR INCREASE CT RATIO—PRESS PROGRAM TO CONTINUE
JAMA OUT	JAM ALARM SETTING IS OUT OF RANGE—DECREASE JAM ALARM OR DECREASE FLA OR INCREASE CT RATIO—PRESS PROGRAM TO CONTINUE

NOTE: Do not vary the FLA setting from motor nameplate value even if the motor has a service factor different from 1.0. See UTC, P1L4 below for consideration of service factor.

CAUTION

MANY OF THE PROTECTION FUNCTIONS OF THE MP-3000, INCLUDING THE MOTOR THERMAL PROTECTION ALGORITHM, USE THE FLA SETTING VALUE TO CALCULATE TRIP POINTS. IF THE USER ENTERS AN INCORRECT SETTING, MANY PROTECTION FUNCTIONS MAY NOT OPERATE AS DESIGNED AND THE MOTOR MAY BE DAMAGED.

5.1.2 Setting P1L2, Locked-Rotor Current (LRC)

Set to the locked-rotor current (the current the motor draws when stalled), in percent of **FLA** (see P1L1). Use motor nameplate or manufacturer's data.

5.1.3 Setting P1L3, Maximum Allowable Stall or Locked-Rotor Time (LRT)

Specifies how long a locked-rotor or stall condition can be maintained before the motor is damaged, in seconds, for a cold start. Use motor nameplate or manufacturer's data.

LRC and **LRT** combine to specify a point on the motor damage curve (Figure 9.4) which, when reached during a start, causes a locked-rotor trip. Refer to subsection 9.1.3 for a detailed explanation.

CAUTION

INCORRECT SETTING VALUES FOR THESE FUNCTIONS CAN RESULT IN EXCESSIVE ROTOR TEMPERATURES AND MOTOR DAMAGE.

5.1.4 Setting P1L4, Ultimate Trip Current (UTC)

Sets the current level above which a trip will eventually occur when no RTD stator temperature data is available, in percent of FLA. This value represents the limit line on the running (upper) portion of the non-RTD motor damage curve of Figure 9.4.

NOTE: This UTC setting is where the user considers the service factor rating of the motor. *Never* adjust the **FLA** setting P1L1 according to the service factor (see subsection 9.1.3.3).

For normal use, set UTC to *service factor* times 100%. The available range is 85% to 150%. The service factor is found on the motor nameplate or in manufacturer's data.

Note that the relay will not trip at the moment the current goes above UTC during motor running. Instead, it models the gradual stator heating for currents above UTC, and will trip only after some time has passed. The trip time depends on a variety of setting and operating factors, including motor nameplate data contained in other setting values.

Use a conservative, or lower, value of UTC than that dictated by the service factor if motor ambient temperatures may rise above 40ºC and the optional URTD Module is not used (see Subsection 9.1.1). Also, consider lowering the UTC if the motor is suitably rated, yet additional safety is critical for the application.

CAUTION

IF UTC IS SET ABOVE 100 PERCENT TIMES THE SERVICE FACTOR, MOTOR DAMAGE COULD RESULT.

5.1.5 Setting P1L5, Phase Current Transformer Ratio (PCT)

Specifies the numerator of the turns ratio of the main phase current transformers. Obtain from the Ct nameplate or from the installation drawings, watching for the use of ratio taps on Cts which have tapped windings.

Explanation of Ct Ratio Presentation

The MP-3000 motor relay is available in multiple styles designed for use with current transformers (Cts) having a nominal or rated secondary current of either 5 amperes or 1 ampere. Check the relay labeling or the catalog number, and the Ct secondary rating, to confirm a match.

All displayed information is the same for either of the two types of MP-3000 relays. When Ct ratios are to be set, the value entered is the *numerator* of the main Ct ratio. The denominator is assumed to be either 5 or 1, depending on the rating of the cts and relay in use.

For example, a set of three 400:5 phase Cts might be used with an MP-3000 specified for 5 A Cts. The phase Ct ratio is then set to 400. Alternatively, a set of three 400:1 Cts could be used with an MP-3000 rated for 1 A cts. Use a setting of 400 in this case as well.

Ct Ratio Selection

Check the following criteria to insure a suitable current transformer ratio.

For a 5 ampere Ct set:

For optimum metering accuracy at low loads, the Ct should deliver between 3.5 and 4 amperes at 100 percent FLA. Attempt to achieve 3.75 A.

For reliable motor protection, the Ct must deliver between 2.5 and 4 amperes at 100 percent FLA.

For example, if the motor has an FLA value of 300A, a 400:5 Ct will supply:

$300 \times 5/400 = 3.75$ amperes, an ideal value.

For a 1 ampere Ct set:

For optimum metering accuracy at low loads, the Ct should deliver between 0.7 and 0.8 amperes at 100 percent FLA. Attempt to achieve 0.75 A.

For reliable motor protection, the Ct should deliver between 0.5 and 0.8 amperes at 100 percent FLA.

For example, if the motor has an FLA of 300A, a 400:1 Ct will supply:

$300 \times 1/400 = 0.75$ amperes, an ideal value.

Note that **FLA/PCT** must lie between 0.5 and 1.5 for successful programming - you will not be able to exit Program Mode until one or the other value is adjusted. See Section 5.0.1

⚠ CAUTION

BE CAREFUL WHEN DETERMINING CT TURNS RATIO. AN IMPROPER VALUE CAN CAUSE THE MP-3000 TO RECEIVE INCORRECT MOTOR CURRENT DATA. MOTOR DAMAGE COULD RESULT.

5.1.6 Setting P1L6, Ground Fault Ct Ratio (GCT)

Specifies the numerator of the turns ratio of the single ground current transformer used only for ground fault protection and ground current metering. Obtain from the Ct nameplate or from the installation drawings, watching for the use of taps on cts which have tapped windings.

Typically, the three phase power conductors pass through the single window of a ground fault Ct, whose ratio is usually much lower than that of the phase Cts for good ground fault sensitivity. A very common type of ground fault Ct has a ratio of 50:5 or 50:1, but check the Ct in use.

Ground fault protection by residual connection of phase Cts is possible, but doesn't give high sensitivity. See Section 9.1.10.

5.1.7 Setting P1L7, Frequency (FREQ)

Sets the MP-3000 for either a 60 Hz or 50 Hz ac supply frequency. No hardware settings are necessary. The MP-3000 can protect the motor during the limited frequency excursions of a power system in emergency conditions, but is not intended for use with variable-frequency motor drives.

5.1.8 Setting P1L8, Reversing or Non-reversing Starter (REV/NONREV)

Specifies whether or not the starter for this motor is designed to reverse phase sequence and make the motor run in either direction.

Setting to REV indicates that starting with a reversed phase sequence is an acceptable operating condition. The relay will accept either sequence at the time of a start, and will assign the role of positive sequence to the larger of the two sequence components.

When the motor runs in reverse, any phase current unbalance is displayed with a negative sign. This is not a negative number - view it as a notation that the unbalance is measured on the motor running in reverse.

If set to NONREV, the relay will check the phase sequence at the beginning of the START cycle only and accept only a positive phase sequence (ABC). It trips the motor for a reversed sequence of ACB with the message "PH REVRS" on the display.

5.2 Page 2, SP RTD, Settings P2L1 to P2L10

This page contains all of the settings needed to use the RTD temperature inputs from the optional URTD accessory module.

NOTE: For direct temperature tripping, alarming, and displays to function, a URTD module must be connected and communicating with the relay. However, the settings for temperature can be viewed or adjusted with or without a URTD module connected.

Pay attention to the specific labeled assignments of the eleven URTD input channels. The first six are specifically intended for up to six RTDs embedded in the motor stator winding. Inputs 7 and 8 are specifically for motor bearing RTDs. Inputs 9 and 10 are specifically for load bearings. Input 11 is an auxiliary general-use input.

All RTD inputs have alarm and trip values set below. But, note that only the maximum of the values read via stator RTD channels 1 through 6 is used by the MP-3000 motor thermal modeling algorithm.

5.2.1 Setting P2L1, RTD Display Information (RTD IN C or RTD IN F)

Specifies the temperature displays in degrees Celsius or degrees Fahrenheit.

5.2.2 Setting P2L2, Winding Temp Trip (WD T)

Specifies the motor stator winding temperature limit above which the hottest winding RTD will cause the relay to trip the motor. This trip can also be set to OFF. Trip temperature values are in degrees C or F depending on Setting P2L1 above. There are six specifically-labeled stator RTD inputs on the URTD module whose readings can trigger this particular type of trip. See 9.1.8 for setting advice.

⚠ CAUTION

IF WD T IS SET TO OFF, THE THERMAL-MODEL PROTECTION REVERTS TO THE NON-RTD ALGORITHM EVEN IF A URTD IS CONNECTED.

5.2.3 Setting P2L3, Winding Temp Alarm (WD A)

Specifies the motor stator winding temperature limit above which any winding RTD will produce an alarm output from the relay. This alarm can also be set to OFF. Alarm temperature values are in degrees C or F depending on Setting P2L1 above. There are six specifically-labeled stator RTD inputs on the URTD module whose readings can trigger this particular type of alarm.

5.2.4 Setting P2L4, Motor Bearing Trip (MB T)

Specifies the motor bearing temperature limit above which either of the two motor bearing RTDs will cause the relay to trip the motor. This trip can also be set to OFF. Trip temperature values are in degrees C or F depending on Setting P2L1 above. There are two specifically-labeled motor bearing RTD inputs on the URTD module whose readings can trigger this particular type of trip.

5.2.5 Setting P2L5, Motor Bearing Alarm (MB A)

Specifies the motor bearing temperature limit above which either of the two motor bearing RTDs will produce an alarm output from the relay. This alarm can also be set to OFF. Alarm temperature values are in degrees C or F depending on Setting P2L1 above. There are two specifically-labeled motor bearing RTD inputs on the URTD module whose readings can trigger this particular type of alarm.

5.2.6 Setting P2L6, Load Bearing Trip (LB T)

Specifies the load bearing temperature limit above which either of the two load bearing RTDs will cause the relay to trip the motor. This trip can also be set to OFF. Trip temperature values are in degrees C or F depending on Setting P2L1 above. There are two specifically-labeled load bearing RTD inputs on the URTD module whose readings can trigger this particular type of trip.

5.2.7 Setting P2L7, Load Bearing Alarm (LB A)

Specifies the load bearing temperature limit above which either of the two load bearing RTDs will produce an alarm output from the relay. This alarm can also be set to OFF. Alarm temperature values are in degrees C or F depending on Setting P2L1 above. There are two specifically-labeled load bearing RTD inputs on the URTD module whose readings can trigger this particular type of alarm.

5.2.8 Setting P2L8, Auxiliary RTD Temp Trip (AX T)

Specifies the auxiliary RTD temperature limit above which the relay will trip the motor. This trip can also be set to OFF. Trip temperature values are in degrees C or F depending on Setting P2L1 above. There is one specifically-labeled auxiliary RTD input on the URTD module whose readings can trigger this particular type of trip.

5.2.9 Setting P2L9, Auxiliary RTD Temp Alarm (AX A)

Specifies the auxiliary RTD temperature limit above which the relay will produce an alarm output. This alarm can also be set to OFF. Alarm temperature values are in degrees C or F depending on Setting P2L1 above. There is one specifically-labeled auxiliary RTD input on the URTD module whose readings can trigger this particular type of alarm.

5.2.10 Setting P2L10, RTD Diagnostic (DIAG ON or DIAG OFF)

Sets the RTD diagnostic alarm ON or OFF. If set to ON, the relay will alarm on any RTD failure or URTD communications failure.

5.3 Page 3, SP TRIP, Settings P3L1 to P3L14

This page contains the settings that configure the trip functions. Any trip function can be turned off as shown in Table 4.3. Start and run delays are used to block these tripping functions for the set time to avoid nuisance tripping:

- Start delays—begin when the MP-3000 first sees motor current and declares a START. The start delay completely inhibits operation of the governed function for the set time after the start. A single setting serves for both tripping and alarming functions.
- Run delays—also known as pickup delays. These delays prevent momentary disturbances in the system from causing nuisance trips.
- When the motor starts, all of the start delays begin timing. As each start delay expires, the supervised measurement element is enabled.
- The pickup of a measurement element will begin the timing of its run delay, which must expire before the relay can actually trip or alarm. Once the run delay timing has begun, the driving condition must remain for the full run delay time. If the condition goes away and then returns during run delay timing, the run delay timer resets and begins timing over again.
- Note that the transition of the motor or the MP-3000 relay from START to RUN state has no bearing on any of these time delays.

Timing Example:

Say the MP-3000 jam trip function (see below) is set for a start delay of 15 seconds and a run delay of 5 seconds. This motor typically might start and enter the RUN mode in about 5 seconds, but the jam trip start delay setting inhibits any jam detection for 15 seconds regardless of this. If a jam occurs (causing the current to rise markedly) 12 seconds after the start, the jam trip function will still be blocked until the 15 second start delay is expired. Then, the jam measurement element is enabled. It responds at once, but the 5 second jam run delay must ALSO expire before the relay trips the motor. In this example, if the jam appears, temporarily clears, and then returns all during the 15-second start delay, there is no effect on tripping. But if it temporarily clears and returns while the run delay is timing, the run delay resets. The jam must return for a sustained 5 seconds before a jam trip occurs.

5.3.1 Setting P3L1, Ground Fault Trip Level (GFT)

Sets the ground fault trip current pickup in percent of ground Ct ratio numerator (Ct rated primary current). For example, with a 50:5 ground fault Ct and a setting of 24%, the GFT function will pick up at 24% of 50 A, or 12 A actual ground fault current in the motor. The start and/or run delays must expire before the trip occurs.

NOTE

THIS IS THE ONLY PROTECTIVE CURRENT SETTING THAT DOES NOT USE FLA AS THE BASIS FOR THE SETTING.

5.3.2 Setting P3L2, Ground Fault Start Delay (GFSD)

Sets the time from a motor start until the ground fault trip and alarm functions are enabled, in power cycles. Use this to block GFT operation until the ground current of power factor correction capacitors decays after a start.

5.3.3 Setting P3L3, Ground Fault Run Delay (GFRD)

Sets the number of power cycles that a ground fault trip or alarm operation must be maintained before the relay produces an output.

5.3.4 Setting P3L4, Instantaneous Overcurrent Trip Level (IOC)

Sets the instantaneous overcurrent trip limit in percent of FLA above which the relay will trip. This trip type can be set to OFF. For currents clearly above the setting, the IOC function picks up in two power cycles or less. IOC operates only for high-current faults, and no run delay is needed. Use with IOC Start Delay. Normally, set IOC above 1.5 times LRC. See Section 9.1.3.1.

The **IOC** setting must be below (1020 * **PCT**/ **FLA**) or 1600%, whichever is less. **PCT** is Setting P1L5; **FLA** is Setting P1L1. If this constraint is exceeded, you will not be able to exit program mode, but will get a specific warning message instead.

5.3.5 Setting P3L5, Instantaneous Overcurrent Start Delay (IOCSD)

Sets the number of power cycles after a start is recognized until the instantaneous overcurrent trip and alarm functions are enabled. Use this delay to inhibit IOC tripping on a current peak caused by magnetic inrush when the motor is first energized—usually one to three cycles.

5.3.6 Setting P3L6, Jam Trip Level (JMT)

Sets the motor jam current trip limit in percent of FLA. This element can be set to OFF. Use with the jam start and run delays.

The jam trip function operates if the current rises well above FLA during running, perhaps due to a mechanical jam in the load or a sudden larger-than-intended load. For example, see the jam trip limits set at 180% of FLA in the upper RUN portions of protection curves of Figures 9.4 or 9.5.

The **JMT** setting must be below (1020 * **PCT**/ **FLA**) or 1200%, whichever is less. **PCT** is Setting P1L5; **FLA** is Setting P1L1. If this constraint is exceeded, you will not be able to exit program mode, but will get a specific warning message instead.

5.3.7 Setting P3L7, Jam Start Delay (JMSD)

Sets the number of seconds after a start is recognized until the jam trip and alarm functions are enabled.

Use JMSD to block jam trips during starting. Use even longer values in high-inertia load situations where the acceleration time is longer than the start time. In these cases, the motor current may remain above FLA or JMT for some time after the transition from start to run.

5.3.8 Setting P3L8, Jam Trip Run Delay (JMTR)

Sets the number of seconds that a jam trip current level must be maintained before the trip output occurs.

Use JMTR to block undesired jam trips for temporary large loads which are normal for the process - for example, a heavy load suddenly being placed on the conveyor belt which the motor must accelerate.

5.3.9 Setting P3L9, Underload Trip Level (ULT)

Sets the current level in percent of FLA *below* which the MP-3000 determines that the motor has lost its load and trips the motor. This element can be set to OFF. Use with the underload start and run delays.

5.3.10 Setting P3L10, Underload Start Delay (ULSD)

Sets the number of seconds after a start until the underload trip and alarm functions are enabled.

5.3.11 Setting P3L11, Underload Trip Run Delay (ULTR)

Sets the number of seconds that current below the underload trip setting must be maintained before a trip output.

5.3.12 Setting P3L12, Phase Unbalance Trip Level (UBT)

Sets the percent of phase unbalance above which the relay will trip. This element can be set to OFF. The percent unbalance is calculated from the ratio of negative sequence current to positive sequence current. Use with the phase unbalance trip start and run delays.

For reversing starter applications (see P1L8), the MP-3000 assumes that the larger sequence current is the positive sequence current, and can trip for unbalance with the motor turning in either direction.

5.3.13 Setting P3L13, Phase Unbalance Start Delay (UBSD)

Sets the number of seconds after a start until the phase unbalance trip and alarm elements are enabled.

5.3.14 Setting P3L14, Phase Unbalance Trip Run Delay (UBTR)

Sets the number of seconds that a high phase unbalance must be sustained before a trip output.

5.4 Page 4, SP ALARM, Settings P4L1 to P4L8

This page contains the settings needed to configure the alarm functions. Each alarm function can be disabled.

NOTE

EVEN IF AN ALARM FUNCTION IS ENABLED ON THIS PAGE, IT MUST ALSO BE DIRECTED TO AN OUTPUT RELAY TO PRODUCE CONTACT OPERATION FOR REMOTE OR ANNUNCIATOR ALARMING. NORMALLY (AND BY FACTORY DEFAULT SETTINGS), THE CONDITIONS SHOULD ALL BE DIRECTED TO THE ALARM RELAY BY THE 22 SETTINGS ON PROGRAM MODE PAGE 8. THEY MAY ALSO BE SELECTIVELY DIRECTED TO THE AUX 1 AND/OR AUX 2 OUTPUT RELAYS USING THE SETTINGS ON PROGRAM MODE PAGES 9 AND 10 RESPECTIVELY.

If you configure an alarm here, but don't set it to activate any output relay on Pages 8 to 10, alarm conditions will still appear in all displays and logs, and in communications information sent to a PowerNet host.

5.4.1 Setting P4L1, Ground Fault Alarm Level (GFA)

Sets the ground fault alarm current pickup level in percent of ground Ct ratio numerator. For example, with a 50:5 ground fault Ct and a setting of 10%, the GFA function will pick up at 10% of 50A, or 5A actual ground fault current in the motor. The start and/or run delays must expire before the alarm output occurs.

5.4.2 Setting P4L2, I^2T Alarm Level (I2TA)

Sets the I^2T model thermal accumulator or bucket level at which the relay will alarm, in percent of I^2T bucket trip value. This important alarm indicates that the MP-3000 thermal model is progressing toward a thermal protective trip (thermal capacity bucket is filling), so that the user can act to reduce loading or protect the process.

This setting also determines when the I^2T trip condition can reset. After a trip, the I^2T bucket or thermal accumulator must cool below the I^2T alarm level before the thermal trip can reset. See setting P12L5 for more on resetting of thermal trip.

5.4.3 Setting P4L3, Jam Alarm Level (JMA)

Sets the current limit in percent of FLA at which the jam alarm picks up. This alarm can be set to OFF. Set to a lower level than the jam trip level P3L6. The start delay is the same as for the jam trip function; see P3L7. Use with run delay, next.

5.4.4 Setting P4L4, Jam Alarm Run Delay (JMAR)

Sets the number of seconds that the jam alarm level must be maintained before the alarm occurs.

5.4.5 Setting P4L5, Underload Alarm Level (ULA)

Specifies the current level in percent of FLA below which the MP-3000 alarms. The start delay is the same as for underload trip; see P3L10. Use with the underload run delay, next. Note: ULA must be set to a higher current value than the underload trip level P3L9.

5.4.6 Setting P4L6, Underload Alarm Run Delay (ULAR)

Sets the number of seconds that the current must remain below the underload alarm limit before the alarm occurs.

5.4.7 Setting P4L7, Phase Unbalance Alarm Level (UBA)

Sets the percent of phase current unbalance above which the MP-3000 alarms. This alarm can be set to OFF. The start delay is the same as for the phase unbalance trip; see P3L13. Use with unbalance alarm run delay, next. See P3L12 above, unbalance trip level, for more information.

5.4.8 Setting P4L8, Phase Unbalance Alarm Run Delay (UBAR)

Sets the number of seconds that a phase unbalance alarm must be maintained before the alarm occurs.

5.5 Page 5, SP START, Settings P5L1 to P5L12

This page contains settings that control motor starting and jogging functions.

5.5.1 Setting P5L1, Starts Per Time Allowed (ST/T)

Sets the maximum number of motor starts permitted within the time set in P5L2, next. To disable this function, set P5L2 to OFF.

The record of recent start times is kept in a memory stack; the oldest starts in the memory are deleted as they age beyond the time limit set below in P5L2. If the maximum number of starts is reached within the set time window, the relay raises an alarm with STEX A on the display. To observe the per time limiting values, check the **remaining starts RMST** and **time until start TUS** displays on the **monitor** page.

After the motor stops, the relay trips with the message STEX XXX where XXX is the number of minutes before the oldest start is deleted from the memory stack, allowing the motor to start. XXX can be observed to count down as the motor sits idle.

5.5.2 Setting P5L2, Time Allowed For Starts Count (T/ST)

Sets the number of minutes within which the maximum number of starts cannot be exceeded. This function can be set to OFF.

5.5.3 Setting P5L3, Time Between Starts (TBS)

Sets the time in minutes that must expire from one start until the next is permitted. This function can be set to OFF.

5.5.4 Setting P5L4, Number of Cold Starts Allowed (NOCS)

Sets the number of cold starts allowed from 1 to 5. Most motors can tolerate some number of consecutive cold starts before the time between starts is enforced. The MP-3000 treats a start as the first in a sequence of cold starts if the motor has been stopped for at least the time period which is the **greatest** of:

- Setting P5L2, Time Allowed For Starts Count (T/ST).
- Setting P5L3, Time Between Starts (TBS)
- One hour.

Subsequent starts are treated as additional cold starts in the same sequence only if they follow the previous start by ten minutes or less, until the set number of cold starts is reached. Starts after this are subject to time and count limits imposed by settings P5L1 through P5L3 above.

5.5.5 Setting P5L5, Motor Start Transition Current Level (TRNC)

Sets the current level defining the transition from the START to the RUN state. This setting, along with settings P5L6 and P5L7, determine when the MP-3000 declares a transition from START to RUN..

5.5.6 Setting P5L6, Motor Start Transition Timeout (TRNT)

Sets the maximum duration of the START state of the motor before transition to RUN. See P5L7 for further explanation.

5.5.7 Setting P5L7, Transition on Event (TRN TIME, TRN I, TRN T+C, or TRN T/C)

This setting is used with P5L5 and P5L6 to determine what events must happen for the MP-3000 to declare a transition from START to RUN. Select one of four choices:

TRN TIME—Transition to RUN after time setting (P5L6) only. Ignore current.

TRN I—Transition when starting current drops below setting (P5L5) only. If the time set in TRNT P5L6 expires before the current transition, trip the motor.

TRN T+C—Transition on time or current, whichever comes first.

TRN T/C—Transition on time and current. Both must occur, and the current must drop below the setting before the time delay expires. If the timer expires before the current falls below the set transition level, trip the motor.

In addition, the MP-3000 provides a transition control signal to a reduced-voltage starter, allowing it to raise the voltage to the running value. To do this, the transition function activates the contact output AUX2 (unless the function of AUX2 has been redefined by setting changes in the AUX2 configuration settings page, Page 10).

NOTE

EVEN IF THE TRANSITION CONTROL OUTPUT IS NOT USED, SET THE TRANSITION FUNCTION TO PROVIDE CLEAR INDICATIONS OF THE ACTUAL STATE OF THE MOTOR (START; RUN) ON THE FRONT-PANEL DISPLAY AND VIA DATA COMMUNICATIONS. A GOOD WAY TO DO THIS IS TO USE THE SETTINGS OF P5L7 = TRN T+C AND P5L5 = 130% OF FLA. MODIFY THE LATTER, IF NEEDED, TO LIE AT A TRANSITION VALUE BETWEEN THE STARTING CURRENT AND POST-START MAXIMUM LOAD CURRENT.

5.5.8 Setting P5L8, Incomplete Sequence Report Back Time (INSQ)

Sets the required process report-back time in seconds. This function can be set to OFF.

The incomplete-sequence function requires a report-back contact from the process which the motor runs—any indication that the process has proceeded to operate as expected some time after the motor start. If the process doesn't start up correctly, the contact doesn't close within the expected time. If a problem develops later on, the report-back contact opens. In either case, the open contact state indicates that the motor should be tripped.

To use this function, set a time limit for report-back here. Set P5L9, next, to define the start of report-back timing. Connect the report-back contact to MP-3000 Discrete Input 2. This input must then be energized before the set time expires, or the relay trips for incomplete sequence.

Note that the input must be energized *continuously* after the time delay has expired to hold off this trip.

Note that Discrete Input 2 setting P7L1 below is *automatically* assigned to the function INC SEQ if a time delay is set here. All other alternate uses for Discrete Input 2 (P7L1) are suppressed and not visible until INSQ is set to OFF.

5.5.9 Setting P5L9, Incomplete Sequence Start Timer Event (INSQ TRN or INSQ ST)

Choose either to start the incomplete-sequence timer when the motor start is declared (INSQ ST), or when the transition from start to run is declared (INSQ TRN).

5.5.10 Setting P5L10, Long Acceleration Time (LAT)

Sets a time interval during which the motor is permitted to accelerate a high-inertia load, which is longer than the locked-rotor time. This function can be set to OFF, and usually should be. If the thermal-model accumulator bucket fills to 100% during the long acceleration time, it is limited to that value and the thermal trip is held off until the LAT delay expires. By then, the thermal bucket level must have decreased (thermal model cooled) below 100% or the motor trips.

The LAT function should be used only on motors with a zero-speed switch (normally-closed contact which opens when the motor actually begins to spin). Connect the zero-speed switch contact to MP-3000 Discrete Input 1. The Zero-Speed Switch function must be enabled (ZSW ON)- see setting P5L11 below. The MP-3000 then requires the zero-speed switch to open within LRT/2 (half of locked-rotor time setting P1L3) after a start, or the motor is tripped by the ZSW function. This protects a completely stalled motor from being damaged when the LAT timer blocks the locked-rotor thermal trip.

CAUTION

THE LONG ACCELERATION TIME (LAT) FUNCTION IS CAPABLE OF BLOCKING THE CRITICAL LRC-LRT ROTOR THERMAL PROTECTION DURING A START AND DESTROYING THE MOTOR. TURN LAT OFF UNLESS ABSOLUTELY NEEDED, AND MOTOR SUITABILITY FOR THIS STARTING DUTY HAS BEEN CONFIRMED. USE ONLY WITH ZERO-SPEED SWITCH FUNCTION ZSW ON AND SWITCH INPUT CONNECTED, TO PROTECT A STALLED MOTOR.

5.5.11 Setting P5L11, Zero Speed Switch On or Off (ZSW ON or ZSW OFF)

Enables the function which checks to see if the motor begins to physically spin after a start. Requires a zero-speed switch on the motor which is closed at rest, and opens as the rotor begins to turn. Connect the zero-speed switch contact to MP-3000 Discrete Input 1. If the contact fails to open within LRT/2 (one half of locked-rotor time setting P1L3) after a start, the relay trips with a zero-speed switch trip message.

This protection is *always* useful, but is essential if the Long Acceleration Time (LAT) function set by P5L10 is used.

Note that if the ZSW function is set to ON, then Discrete Input 1 is *automatically* configured to be the zero speed switch input. All other alternate function settings for Discrete Input 1 (P6L1) are suppressed and not visible until ZSW is set to OFF.

With ZSW ON, the MP-3000 checks Discrete Input 1 for voltage at the very moment it sees a start—it wants to see the initially closed zero-speed switch, which opens shortly thereafter as the motor spins. If it fails to find the closed contact, it trips immediately with a zero-speed switch trip message. Check the wiring and contact for problems.

5.5.12 Setting P5L12, Anti-Backspin Delay Time (ABK)

Sets the time in seconds before a motor restart is permitted after a trip or stop condition. This function can be set to OFF.

This function is used with a motor driving a pump working into a head, or any other load which tends to spin in a reverse direction (backspin) when the motor is de-energized. It blocks starting during the time when the motor might be rotating in reverse following a trip. Also, this function may be used simply to set idle time (time between stop and start) before a restart is permitted.

5.6 Page 6, SP DI 1

This page contains the single setting which configures Discrete Input 1 (DI 1). The input must be a 120 Vac signal. A 120 Vac source for wetting dry contacts is provided on the MP-3000 terminal block for convenience. Refer to wiring diagrams in Section 6.

5.6.1 Setting P6L1 (REM RST, REM TRIP, DIF TRIP, MTR STOP, RST DBL, EMG OVR, or ZERO SW)

If the zero speed switch (ZSW) function is ON in the SP START page (P5L11), then this DI 1 input is *automatically* configured to be zero speed switch contact input, ZERO SW, and no other setting option is visible.

If ZSW is set to OFF, then the available choices for Discrete Input 1 are:

REM RST–Remote Reset—When voltage is applied, the MP-3000 resets its active functions and displays, just as if the reset pushbutton on the faceplate were pressed.

REM TRIP–Remote Trip—When voltage is applied, the MP-3000 trips the motor and displays the message “REMOTE”. The trip will reset only if the input voltage is removed.

DIF TRIP–Differential Trip—When voltage is applied, the MP-3000 trips the motor and displays the message “DIF TRIP”. This is used with an external motor differential relay whose trip contact is normally open, but closes when it detects a fault. The trip can be reset only after the voltage is removed. Can be used for tripping by any auxiliary function with a normally open contact.

MTR STOP–Motor Stop Detection Blocking—With this setting, a voltage input to DI 1 will keep the MP-3000 in the RUN mode even when the motor current drops below 100 mA secondary. This feature is used mainly with a synchronous motor operating as synchronous condenser, for power factor correction. The current may approach zero during normal sustained operation.

RST DBL–Reset Disable—With this setting, the MP-3000 front-panel Reset pushbutton is disabled following a trip or alarm condition. The only way to reset the unit is by applying voltage to DI 1. This feature prevents unauthorized personnel from resetting the relay or restarting the motor after a trip. Use a secure reset contact to apply voltage to DI 1.

EMG OVR–Emergency Override—On DI 1 voltage input, the MP-3000 will perform as if the emergency override pushbutton were pressed.

5.7 Page 7, SP DI 2

This page contains the single setting which configures Discrete Input 2 (DI 2). The input must be a 120 Vac signal. A 120 Vac source for wetting dry contacts is provided on the MP-3000 terminal block. Refer to wiring diagrams in Section 6.

5.7.1 Setting P7L1 (INC SEQ, REM RST, REM TRIP, DIF TRIP, MTR STOP, RST DBL, or EMG OVR)

If the incomplete sequence function INSQ is on and set for some time delay (P5L8), then DI 2 is *automatically* configured to control incomplete sequence timing, INC SEQ, and no other setting is possible.

If INSQ is turned OFF, the other choices for DI 2 are available. These are the same choices as for Discrete Input 1, P6L1, Section 5.6.1 just above.

5.8 Page 8, SP AREL, Settings P8L1 to P8L22

Use this page to configure which events activate the alarm relay.

The factory default setting is for every alarm event to activate the alarm relay; and for the alarms to reset automatically when the condition disappears. Trip events do not activate the alarm relay; nor does Time Between Starts blocking, which frequently goes true during normal operating cycles. Check the settings to be sure they agree with factory defined values (see column in Table 4.3) or change as needed.

NOTE

EVEN THOUGH A PARTICULAR ALARM CONDITION IS DIRECTED TO THE ALARM RELAY ON *THIS* PAGE, IT CAN FUNCTION *ONLY IF IT IS TURNED ON* IN THE SP ALARM PAGE 4.

Settings control the following 22 alarm assignments. Any or all can be turned OFF:

- Ground fault alarm, or trip
- I^2T alarm, or trip
- Jam alarm, or trip

- Underload alarm, or trip
- Phase unbalance alarm, or trip
- Winding temperature alarm, or trip (with URTD)
- Motor bearing temperature alarm, or trip (with URTD)
- Load bearing temperature alarm, or trip (with URTD)
- Auxiliary temperature alarm, or trip (with URTD)
- Starts per time alarm, or trip
- Time between starts trip
- Individual RTD channel failure alarm
- URTD overall communications failure alarm
- IOC trip
- Phase reversal trip
- Incomplete sequence trip
- Remote trip (via discrete input)
- Differential trip
- INCOM (data communications) trip
- Transition trip
- Zero speed switch trip
- Trip bypass (contactor fails to interrupt current after trip)

5.9 Page 9, SP AUX1, Settings P9L1 to P9L25

Use this page to configure which events activate the AUX1 output relay. It also includes the three settings to configure the load shedding function.

The factory default setting is for a thermal trip (I2T trip) only to pick up this relay. Many users will choose to change this. If the load shed function is turned on, using settings P9L1 to P9L3 as explained next, the relay AUX1 is dedicated to this function and other uses are not available or visible.

The load shed function provides a contact output signal that the user connects to the process equipment, to reduce loading on the motor if it becomes too large. For example, the contact might be used to temporarily stop the flow of heavy materials onto a conveyor driven by the protected motor. In this way, the MP-3000 tries to alleviate an overload before it reaches an outright thermal protective trip. When the load is reduced, the contact returns to the normal state and the process can resume loading of the motor.

The load shed function, which is active only during the RUN state of the motor, is configured with the following three settings:

5.9.1 Setting P9L1, Load Shed Pickup Current (LSPU)

Sets current level above which the load shed output is activated.

5.9.2 Setting P9L2, Load Shed Dropout Current (LSDO)

Sets current level below which the load shed output is deactivated.

5.9.3 Setting P9L3, Load Shed Delay (LSDL)

Sets both the pickup and dropout delays in seconds for the load shed output. In other words, it sets the time for which the current must be above LSPU before the output is activated; and also sets the time for which the current must be below LSDO before the output is deactivated.

The LSPU and LSDO settings are forced to be coherent:

- If the user sets either to OFF, the other is automatically set to OFF as well.
- If LSPU is set to any pickup value with LSDO OFF then LSDO is set to its minimum on-setting, 50 percent of FLA. User can then set it to a different value if desired.
- If LSDO is set to any dropout value with LSPU OFF then the LSPU is set to its maximum value, 150 percent of FLA. User can then set it to a different value if desired.
- LSPU must be greater than LSDO. Setting range of either may be limited to enforce this.

5.9.4 Settings P9L4 through P9L25, Alarm and Trip assignments to AUX1

If LSPU and LSDO are both set to OFF, all other available functions for AUX1 become visible and can be individually turned on or off. AUX1 is activated if any of the designated functions picks up, with an OR logic function. Other than the three load shed function settings, the remaining settings are the same as the 22 listed for SP AREL page in Section 5.8. The AUX1 output operates if any of the selected functions become true.

5.10 Page 10, SP AUX2, Settings P10L1 to P10L23

This page determines which events activate the output relay AUX2. It also includes the setting to enable the transition function. The factory settings configure AUX2 to pick up for the transition function.

NOTE

THE OPERATING SPECIFICS OF THE TRANSITION FUNCTION MUST BE CONFIGURED ON THE SP START PAGE 5, SETTINGS P5L5 TO P5L9, IF THE TRANSITION FUNCTION IS SET ON HERE WITH P10L1.

5.10.1 Setting P10L1, Enable transition control output (TRN ON or TRN OFF)

Enables the transition function through output relay AUX2. If ON, the AUX2 relay is activated when the motor transitions from the START state to the RUN state, and deactivated when the next motor STOP is declared. Consider MODE 1 versus MODE 2 activation as set by P12L4 below.

5.10.2 Settings P10L2 through P10L23, Alarm and Trip assignments to AUX2

If the transition function is OFF, then all the other functions for AUX2 are visible. The settings are the same 22 selections as those in the SP AREL page—see Section 5.8. The AUX2 output operates if any of the selected functions become true.

5.11 Page 11, SP A OUT

Configures the operation of the 4-20 mA analog output.

5.11.1 Setting P11L1, Analog Output Function (MAX XXXX)

Selects the internal MP-3000 parameter represented by the 4-20 mA analog output. Select one of four choices:

MAX 100–100 percent of FLA—proportional to the average of the three-phase current values, with 100 percent of FLA = 20 mA and zero percent = 4 mA.

MAX 125–125 percent of FLA—proportional to the average of the three-phase current values, with 125 percent of FLA = 20 mA and zero percent = 4 mA.

MAX %I2T–Percent of I^2T Trip Level—proportional to the percent I^2T trip level (thermal-model accumulator bucket), with 100 percent of the I^2T Trip Level = 20 mA and zero percent = 4 mA.

MAX WRTD—Winding temperature—proportional to the maximum winding RTD temperature from the URTD module. The winding RTD trip level (setting P2L2) = 20 mA and zero degrees C or 32 degrees F = 4 mA.

5.12 Page 12, SP SYS, Settings P12L1 to P12L18

This page configures overall operation of the MP-3000.

5.12.1 Setting P12L1, Configure Trip Relay Output (TP MODE1 or TP MODE2)

Selects:

MODE 1—trip relay is normally de-energized. Energize the trip relay on a trip event.

MODE 2—energize the trip relay on power up and de-energize the trip relay on a trip event. Also called fail-safe mode. This is the factory-set mode.

Keep in mind that each of the output relays has a form c (SPDT) contact set, so that combining output modes and contact choices gives four logical combinations. Note the key difference in using Mode 2 with the normally-open contact versus using Mode 1 with the normally-closed contact. With Mode 2 and a normally-open contact, the external circuit is closed during normal non-trip operation, and opens for a trip, if the MP-3000 power supply is de-energized, or the product fails. With Mode 1 and a normally-closed contact, the external circuit opens only for an overt trip decision, and is maintained when the MP-3000 is de-energized.

The MP-3000 is normally set for Mode 2 operation of the TRIP and ALARM relays.

5.12.2 Setting P12L2, Configure Alarm Relay Output (AL MODE1 or AL MODE2)

Select Mode 1 or Mode 2 operation of the alarm relay - see 5.12.1 above. The factory default is the fail-safe MODE 2.

5.12.3 Setting P12L3, Configure AUX1 Relay Output (AX1 MOD1 or AX1 MOD2)

Select Mode 1 or Mode 2 operation of the AUX1 relay - see 5.12.1 above. The factory default is MODE 1.

5.12.4 Setting P12L4, Configure AUX2 Relay Output (AX2 MOD1 or AX2 MOD2)

Select Mode 1 or Mode 2 operation of the AUX2 relay - see 5.12.1 above. The factory default is MODE 1.

5.12.5 Setting P12L5, Auto or Manual I^2T Reset (MAN I2T or AUTO I2T)

Select AUTO I2T to set this particular alarm function to automatically reset when the thermal-model bucket level drops below the alarm setting P4L2 (I2TA XX). Select MAN I^2T to reset only after the thermal-model bucket level drops below the alarm setting P4L2 (I2TA XX) *and* a manual reset command is given. The RESET command can come from the front-panel Reset button, from the PowerNet communications host, or from a remote contact . A remote reset contact, if used, is connected to one of the digital input channels; and that channel must be programmed for REM RST (remote reset) or RST DBL (reset disable).

5.12.6 Setting P12L6, Enable Programming with a Running Motor (RUN PGM or STOP PGM)

If RUN PGM is selected, the motor may be started and/or run during programming of the MP-3000 settings. If STOP PGM is selected, the motor must be stopped in order to enter the PROGRAM mode, and starting is blocked.

NOTE

IF YOU WANT TO TAKE FULL ADVANTAGE OF THE ARMED/ DISARMED CAPABILITY OF THE MP-3000 AS DESCRIBED IN P12L18 BELOW, BE SURE TO SET P12L6 TO RUN PGM.

With RUN PGM, if the user reprograms the MP-3000 while the motor runs, the relay continues to protect with the all the *old* settings. All setting changes are stored in a scratchpad area and not immediately used. Finally, when the reprogramming is finished, the user exits the PROGRAM mode by pushing the **Program** button again—see Section 4. Only at this moment does the MP-3000 recalculate its internal values and put the new settings into effect. Note what happens when it does so:

- Thermal-model accumulator bucket is dumped and resets to 40 degrees C.
- Any active run delay timers are reset and must start timing again.
- All jogging functions are reset—time between starts, cold starts, and starts per time limits are all cleared.
- The MP-3000 remembers that it was in the RUN state when the program mode was exited, and continues that state. The transition function will not reset, or trigger a reduced-voltage starter to switch to reduced voltage.

5.12.7 Setting P12L7, Emergency Override Enable (EMRG EN or EMRG DIS)

Select if the emergency override button is enabled or disabled. If enabled, an emergency override can be executed by pushing the **Emrg Override** button behind the front-panel security door. In any case, an emergency override can be performed by a remote contact connected to either of the discrete inputs DI1 or DI2 programmed as EMG OVR; or via data communications from a PowerNet host. The as-shipped setting is disabled.

Emergency Override allows a panic restart of a tripped motor without completely disabling protection. When the override request is received, the thermal-model accumulator bucket is drained to its initial level of 40 degrees C. Jogging limit counters and timing, including antibackspin timing, are reset. Cold starts are fully restored.

The motor protection is now in the state it would be in if the motor had been standing for a long time prior to the moment of the override. This will allow an immediate restart of the motor. The override can also delay an impending thermal trip of a running motor. The emergency override action is counted in the history record, and noted with its time tag in the logbook record.

⚠ CAUTION

THE EMERGENCY OVERRIDE FUNCTION CLEARS AND RESTARTS ALL PROTECTIVE FUNCTIONS OF THE MP-3000. YOU CAN DAMAGE THE MOTOR. USE ONLY FOR TRUE EMERGENCIES, WHEN YOU ARE AWARE OF WHAT CAUSED THE TRIP. OVER-RIDE LETS YOU RISK MOTOR DAMAGE TO AVOID AN EVEN MORE DANGEROUS PROCESS SITUATION CAUSED BY THE TRIPPING OF THE MOTOR.

5.12.8 Setting P12L8, Set Real Time Clock Display (12 HOUR or 24 HOUR)

Select the time display to be the 12 hour format (with AM or PM) or the 24 hour (military time or international time) format.

5.12.9 Setting P12L9, Month (MONTH)

Set the real-time clock month, 1 to 12.

5.12.10 Setting P12L10, Day (DAY)

Set the real-time clock day of the month. The MP-3000 tracks leap years to the year 2100.

5.12.11 Setting P12L11, Year (YEAR)

Set the real-time clock year.

NOTE

MP-3000 TIMEKEEPING IS Y2K COMPLIANT. WHEN *SETTING* ONLY, THE YEAR VALUES FOR THE FIRST DECADE ARE ENTERED AS SINGLE DIGITS. WHEN LATER DISPLAYING ANY DATE, THE YEAR IS ALWAYS PRESENTED AS TWO DIGITS. EXAMPLES:

- 1999: Setting and all displays of date are 99.
- 2000: Setting is 0; all displays of date are then 00.
- 2004: Setting is 4; all displays of date are then 04.
- 2019: Setting and displays are all 19.

5.12.12 Setting P12L12 , Hour (HOUR)

Set the real-time clock hour (0 to 23) Use 13 to 23 for setting even if the 12-hour AM/PM mode was selected above for display.

5.12.13 Setting P12L13, Minute (MIN)

Set the real-time clock minute. The minute does not update on its own while the relay is in program mode, so make this the last setting to adjust before exiting.

NOTE

THERE IS NO SETTING FOR SECONDS. THE CLOCK SECONDS ARE SET TO ZERO WHEN THE USER EXITS THE PROGRAM MODE. TO SYNCHRONIZE THE SECONDS, SET THE MINUTE VALUE AHEAD, AND EXIT (HIT THE *PROGRAM* BUTTON) AS THE NEXT MINUTE BEGINS.

5.12.14 Setting P12L14, Date Display Format (M D Y or D M Y)

Select a display of either MONTH DAY YEAR or DAY MONTH YEAR.

5.12.15 Setting P12L15, IMPACC Communications Mode (IQ2 EN or IQ2 DIS)

To configure the MP-3000 to communicate in a manner limited to that of the preceding IQ 1000 II product, choose IQ2 EN. This is the factory default setting - it is needed for operation with older IMPACC host systems. To take full advantage of MP-3000 capabilities with a newer PowerNet host, choose IQ2 DIS. See Section 10, Data Communications, for more details. This setting has no influence on performance or protection behavior of the protective relay itself.

NOTE

FOR THE MP-3000 TO COMMUNICATE WITH AN OLDER IMPACC SYSTEM, THERE IS A SUBSET OF ITS SETTINGS WHICH MUST BE SET TO WITHIN LIMITED RANGES OR SELECTIONS WHICH THAT HOST SYSTEM RECOGNIZED. SEE SECTION 10 FOR INFORMATION.

5.12.16 Setting P12L16, Internal Diagnostic Failure Action (RLYF TRP, RLYF ALM. RLYF T+A)

Selects the action to take if any of the MP-3000 internal background self-monitoring programs detect a problem with the relay. The factory setting is to trip and alarm. However, users with critical processes may prefer to set for alarm only so that the motor can continue to run while maintenance personnel attend to the relay.

⚠ CAUTION

IF THE RLYF ALM SETTING IS CHOSEN, BE SURE TO CONNECT AN EFFECTIVE ALARM TO THE ALARM RELAY OUTPUT, AND TEST IT PERIODICALLY. OTHERWISE, THE MOTOR RUNS WITHOUT PROTECTION IF THE RELAY SUFFERS A HARDWARE FAILURE.

5.12.17 Setting P12L17, INCOM Trip Enabled or Disabled (INCT EN or INCT DIS)

Selects whether or not the MP-3000 will accept and execute a motor trip command from a remote PowerNet or IMPACC operator via data communications. This is dictated by security concerns and operating procedures of users who connect the MP-3000 to a facility control system.

5.12.18 Setting P12L18, Arm or Disarm Trip Relay (ARMED or DISARMED)

This maintenance function blocks the MP-3000 trip output, while all the tripping functions continue to operate internally. If DISARMED is selected, the relay will still display all alarms and trips but the trip output relay contact will remain in its non-trip state.

For safety purposes, when the unit is DISARMED, the MP-3000 scrolls a warning message "WARNING MP-3000 WILL BE DISARMED UPON EXIT OF PROGRAM MODE AND WILL NOT PROTECT THE MOTOR - ENTER ARMED INTO SETTING TO PROTECT THE MOTOR". The default display says DISARMED, and the Protection LED turns off. Any alarm or trip messages on the display alternate with the word DISARMED.

In the ARMED mode, the MP-3000 works normally.

The DISARMED mode is useful for commissioning a new relay or new settings on a running motor, when a false trip output would disrupt the process. The user can commission the MP-3000 in the DISARMED mode and observe its behavior, noting any trip operations or filling of the I^2t thermal bucket without suffering the consequence of an undesired trip. Once the user confirms that the settings are suitable, set the MP-3000 to ARMED and true protection is enabled.

NOTE

THE ALARM, AUX1, AND AUX2 OUTPUT CONTACTS ALL FUNCTION NORMALLY EVEN WHEN THE MP-3000 IS DISARMED.

NOTE

TO GET THE FULL USE OF THE DISARMED/ARMED CAPABILITY OF THE MP-3000, BE SURE TO SET P12L6 TO RUN PGM **(ALLOW MP-3000 TO BE PROGRAMMED WHILE THE MOTOR RUNS), SO THAT THE RELAY CAN BE ARMED WITHOUT STOPPING THE MOTOR.**

⚠ CAUTION

WHEN DISARMED FOR MAINTENANCE REASONS, THE MP-3000 IS NOT PROTECTING THE MOTOR. AFTER PROPER OPERATION IS CONFIRMED, BE SURE TO SET TO ARMED. BE WATCHFUL AT ALL TIMES FOR THE DISARMED MESSAGE ON THE DISPLAY.

5.13 Page 13, SP TEST, Settings P13L1 to P13L8

This page is used to test the MP-3000.

5.13.1 Setting P13L1, Operating Mode (3 PHASE or 1 PHASE)

This function allows the MP-3000 to be bench-tested using a single-phase current source (1 PHASE) if a three-phase source is unavailable at the test bench. The phase unbalance functions cannot be tested in 1 PHASE mode, but unbalance functions are not necessary just to determine if a particular MP-3000 sample is functioning correctly. For three-phase testing and all normal operation, select the three-phase mode (3 PHASE).

⚠ CAUTION

IN SERVICE, THE MP-3000 DISPLAYS READY—3 WHEN READY TO START IN 3 PHASE MODE. IF IT DISPLAYS READY—1, THE USER IS WARNED THAT THE RELAY IS IN THE 1 PHASE TEST MODE, WHICH IS *NOT SUITABLE FOR PROTECTION* OF A REAL THREE-PHASE MOTOR.

5.13.2 Setting P13L2, Trip Relay Test (TRP ENER or TRP DENR)

Lets the user directly energize or de-energize the trip relay for testing purposes. To use this function:

- Stop the motor first. The test is blocked if the motor is running.
- Determine whether the MP-3000 trip relay is configured for MODE 1 or MODE 2 operation - see SYSTEM Page Setting P12L1.
- If MODE1, the trip relay is normally de-energized. Set up for the test by selecting TRP ENER here.
- If MODE 2, the trip relay is normally energized. Set up for the test by selecting TRP DENR here.
- Push the **Reset** button to test the relay. The **Trip** LED also lights. Release the button to revert to the prior output state.

5.13.3 Setting P13L3, Alarm Relay Test (ALM ENER or ALM DENR)

Lets the user directly energize or de-energize the alarm relay for testing purposes. Use it in the same way as the trip relay test. Check the Alarm relay MODE Setting P12L2. Unlike the trip output, this output can be tested with the motor running.

5.13.4 Setting P13L4, AUX1 Relay Test (AX1 ENER or AX1 DENR)

Lets the user directly energize or de-energize the AUX1 relay for testing purposes. Use it in the same way as the trip relay test. Check the AUX1 relay MODE Setting P12L3. Unlike the trip output, this output can be tested with the motor running.

5.13.5 Setting P13L5, AUX2 Relay Test (AX2 ENER or AX2 DENR)

Lets the user directly energize or de-energize the AUX2 relay for testing purposes. Use it in the same way as the trip relay test. Check the AUX2 relay MODE Setting P12L4. Unlike the trip output, this output can be tested with the motor running.

5.13.6 Setting P13L6, Force Analog Output Current Value (AOUT 4, AOUT 12, or AOUT 20)

To test the analog output, first select the value to force—either 4, 12, or 20 mA.. When ready to test, push and hold the **Reset** button to observe the forced output value. When the **Reset** button is released, the analog output returns to normal operation.

5.13.7 Setting P13L7, State of Discrete Input 1 (DI1 ON (or OFF))

Read-only—not a setting. Use to read if Discrete Input 1 is ON (energized) or OFF.

5.13.8 Setting P13L8, State of Discrete Input 2 (DI2 ON (or OFF))

Read-only—not a setting. Use to read if Discrete Input 2 is ON (energized) or OFF.

5.14 Page 14, SP RESET, Settings P14L1 to P14L4

This page is used to reset or clear the accumulated history mode statistics on each of the four History pages:

- Select the History page to clear using the **Line** pushbuttons.
- Push either **Value** button to get the PUSH RST display.
- Press the **Reset** pushbutton to clear the History page.
- To escape without clearing, don't push **Reset**. Use a Value button to change from PUSH RST back to [*History Page Name*] RST, then navigate elsewhere or exit the Program Mode.

The four History pages are:

- 5.14.1 Setting P14L1, Motor History Reset (MTR RST)
- 5.14.2 Setting P14L2, Trip History Reset (TRIP RST)
- 5.14.3 Setting P14L3, Alarm History Reset (ALRM RST)
- 5.14.4 Setting P14L4, History Totals Reset (TOT RST)

See Section 4 for more information on the History Mode displays that can be cleared.

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SECTION 6—INSTALLATION AND WIRING

6.1 Mounting

The following subparagraphs describe the mounting of the MP-3000 relay, as well as its optional URTD module and PONI Communications module.

6.1.1 Mounting the MP-3000

Mount the unit vertically on a flat panel. The location should be as free as possible of water, chemicals, dust, and excessive heat and vibration. The panel should protect the user from accidental contact with live terminals on the back of the MP-3000. A 1/8 inch steel panel or door, solidly grounded, is recommended.

Before actually cutting the panel, check the required three-dimensional clearances for the MP-3000 case, particularly behind the panel. See dimensions in Figures 6.2 and 6.3. If mounting on a swinging door, check the swinging clearance of rear projections and wired connections.

Figure 6.1 shows dimensions for the panel cutout and mounting holes. Cutout tolerances and mounting screw hole placement are critical. In particular, the tolerance of the horizontal dimension between the center of the mounting holes and the vertical edge of the cutout must be between 0 and +0.050 in. (0.13 cm).

NOTE: The cutout is the same as for the previous-generation IQ 1000 II motor relay, and other Cutler-Hammer IQ products of this case size. The six mounting holes which secure these older products are still correctly located for the MP-3000, but the four additional new holes should be added.

Secure the MP-3000 to the panel with the special self-tapping plastic screws. Use moderate torque - 8 inch pounds. Use the 0.375-inch-long (0.75 cm) screws supplied with the relay to mount the unit on a 1/8 inch panel. Do not attempt to tap the holes. Do not use machine screws.

6.1.2 Mounting the URTD Module

The optional URTD module provides temperature data to the MP-3000 from up to 11 RTDs embedded in the motor and driven equipment. See URTD I.L. 17367.

The URTD module may be mounted either on the back of the MP-3000 by using the URTD mounting bracket and machine screws (supplied with the URTD module), or mounted remotely from the MP-3000. If mounting the URTD module on the back of the MP-3000, see Figure 6.3 for overall depth dimensions. See Figure 6.4 for URTD stand-alone mounting dimensions.

Consider the benefit of mounting the URTD module away from the MP-3000, as close as possible to the motor. The big bundle of RTD wires becomes much shorter. The URTD conveys multiplexed temperature data back to the relay via a single optical fiber (recommended) or by a 3-wire communications conductor. The URTD may be placed up to 400 feet from the MP-3000 with the optical fiber connection (recommended), or up to 500 feet away with a wired communications connection. Note that the URTD will require 120 Vac power (6 VA) at its remote location. It may be mounted in any orientation.

6.1.3 Mounting the PONI Communications Module

See Section 10 for a description of the various types of optional PONI communications modules which can be used with the MP-3000. Check the I.L. for the selected PONI to confirm dimensions and communications network connection requirements.

Figure 6.3 shows clearance dimensions to the rear for an I-PONI, B-PONI, or D-PONI. An RS-232 PONI is 0.1 inch deeper. An E-PONI is 0.5 inch deeper.

The PONI, if used, is always mounted on the back of the MP-3000. If no URTD is mounted there, use the mounting bracket supplied with the MP-3000 as shown in Figure 6.3. The bracket gives a convenient space to run ct wires underneath the PONI to the adjacent Ct terminal block.

If a URTD is mounted on the back of the MP-3000, the PONI piggy-backs directly to the URTD module as shown. Use the machine screws supplied with the PONI in the molded plastic mounting holes of the URTD.

6.2 Wiring—General

When routing wires between the starter and the associated machine or process equipment, follow these guidelines:

- Do not route the control or RTD wiring through the high-voltage compartment of the motor starter. However, the starter manufacturer may be able to recommend or provide specific measures for doing this if really necessary.
- Separate the lower voltage (120 Vac) from the higher voltage (440 Vac or higher) conductors as much as possible. In general, maintain a minimum distance of 1.5 feet (45 cm) between the two types.
- Any low-voltage control wiring routed out of the motor starter cabinet should be at least #14 AWG stranded copper wire.
- Communications circuits may use thinner conductors, as recommended in installation literature for those circuits.

⚠ WARNING

BEFORE WORKING WITH THE WIRING, MAKE SURE POWER IS DISCONNECTED FROM THE MOTOR STARTER, MP-3000, AND ALL REMOTE CONNECTIONS INCLUDING CONTACT OUTPUT CONTROL CIRCUITS AND REMOTE INPUT CONTACTS. OTHERWISE, HAZARDOUS VOLTAGES COULD CAUSE INJURY OR DEATH. ALSO, UNEXPECTED MOTOR CONTROL ACTION COULD INJURE PERSONNEL OR DESTROY EQUIPMENT.

Figure 6.5 shows MP-3000 rear terminal connections.

Connect terminal 5 to the closest solid electrical-safety grounding point with a heavy wire or braid (#14 AWG or larger). Do not use a current-carrying or neutral conductor for this grounding.
Do not tie terminal 5 to neutral terminal 7 at the relay. Note that terminal 5 is internally connected to the outer case and to the conductive faceplate of the relay.

6.2.1 Ct Wiring

Carefully read the advice in Section 5.1.5 on choice of Ct ratios for a particular motor application. An inappropriate Ct ratio will result in poor measurement accuracy and limited protection. More serious errors in ratio choice will make it impossible to set the relay properly.

Connect the phase and optional ground cts as shown in Figure 6.6. Pay attention to the phase identification and sequence, and check for consistent polarity among the three phases. The MP-3000 may not allow the motor to run, and cannot protect properly, if two phases are swapped, or if the polarity of any ct is reversed with respect to the other two.

Pass the motor phase conductors through the window of the flux-canceling ground Ct. The ground ct need not have any particular polarity relationship to the phase cts.

To minimize problems with Ct saturation during faults, keep the Ct wiring as short as possible and use very heavy wire. The total resistance of the connecting wire should not be much larger than the secondary resistance of the Ct itself. The MP-3000 presents very low burden.

Every phase and ground ct circuit must have one and only one grounding point. Figure 6.6 shows the common neutral connection of the three phase Cts, and the ground fault Ct, connected at one point to a non-current-carrying ground. Do not use a neutral or current-carrying conductor for this grounding - the noise will disrupt MP-3000 measurements.

Residual connection of the phase Ct secondaries to form a ground current signal will not give sensitivity approaching that of the flux-canceling ground Ct. See Section 9.1.10.

6.2.2 Output Contact Wiring

See Specifications for ratings of output contacts, and check against controlled loads.

Figure 6.6 shows a typical connection of MP-3000 output relay contacts in the motor control circuits. However, the outputs other than the trip relay are completely programmable, so there can be nearly infinite choice in the connection and use of these outputs for tripping, alarming, and auxiliary control.

The installation design engineer must study Sections 5 and 9 to understand the available output functions and programming options. This engineer must record and confirm the settings, and also design a consistent connection of the form c contacts of the four output relays to the motor control system.

Pay attention to these features of the programming and contact use:

- Each relay can be set as Mode 1 (normally de-energized; energized to activate) or Mode 2 (normally energized; de-energize to activate). Weigh this against the use of NO versus NC contacts in the control scheme. See Section 5.12.1.
- All trips are steered to the trip relay (terminals 11-12-13) without choice - connect this to the contactor or trip coil. For all other relays and functions, the user chooses what function activates which relay.
- It is recommended to use the alarm relay in Mode 2, and to direct all alarm conditions to it. Connect the annunciator to terminals 17 and 18. With this connection, an alarm will be given if the relay or its power supply fails; as well as for all other problems the MP-3000 can actively report. However, if the MP-3000 is de-energized routinely in service, use the alarm relay in Mode 1 and connect the annunciator to terminals 18 and 19 to avoid nuisance alarms.
- If the relay AUX 1 is set for the process load shedding function, it can't be used for anything else.
- If the relay AUX 2 is set for transition control of a reduced-voltage starter, it can't be used for anything else.

6.2.3 AC supply wiring

Refer to Figure 6.7. Connect terminals 4 and 7 to a source of control power rated at either 120 Vac or 240 Vac. The MP-3000 automatically configures its power supply to work with one or the other value. *Nominal* values other than 120 Vac or 240 Vac are not recommended. However, the MP-3000 is well able to handle depressions, dips, and limited sustained variations in the normal course of service. See Specifications.

The optional URTD module can operate *only* from 120 Vac. For a 240 Vac source, use a step-down transformer suitable for a load of 6 VA. Do not attempt to power the URTD from the MP-3000 120 Vac discrete source—that source is for contact reading only and cannot handle the URTD burden.

If the supply is a dc battery system, use the optional IQ DC power supply. The IQ DC supply is able to power the MP-3000, the URTD if used, and the discrete input circuits of the MP-3000. The total burden capability of the IQ DC module is 30 VA, and it can operate from nominal voltages of 40 Vdc to 250 Vdc. See IQ DC Power Supply Module I.L. 17286.

6.2.4 Discrete input contact wiring

Refer to Figures 6.7 and 6.8. The particular contacts to be connected depend on the settings programmed in the MP-3000 - there is a long list of functions which can be assigned to each of these inputs.

The engineer designing the installation should study Sections 5 and 9 to understand and designate the use, if any, of the discrete contact-sensing inputs. Note that only one use can be assigned to each input.

CAUTION

THE DISCRETE INPUTS SHOULD BE ENERGIZED *ONLY* FROM 120 VAC. THE MP-3000 TERMINAL 6 IS ALWAYS A SOURCE OF 120 VAC, WHICH CAN BE USED TO WET REMOTE CONTACTS, EVEN WHEN THE MP-3000 IS POWERED FROM 240 VAC.

The discrete input circuits are totally isolated from the other circuits in the MP-3000, and have their own common connection, terminal 9. If the 120 Vac discrete contact-wetting source from terminal 6 is used, tie the discrete input common terminal 9 to the ac supply neutral terminal 7, as shown in Figure 6.7.

Figure 6.8, lower portion, shows an alternate scheme for using a remote contact wetting source. The source must be 120 Vac. The contact signal(s) *and the remote neutral* must be brought to the MP-3000 discrete inputs. For noise immunity and safety, do not connect the discrete common terminal 9 to terminal 7 or any other nearby neutral if a remote wetting source is in use.

CAUTION

BEWARE OF LARGE SHUNT CAPACITANCE ACROSS CONTACTS OR IN SOLID-STATE RELAYS CONNECTED TO THE MP-3000 DISCRETE INPUTS. CHARGING CURRENT THROUGH THE CAPACITOR COULD CAUSE A FALSE INDICATION OF A CLOSED CONTACT. KEEP TOTAL CAPACITANCE BELOW 0.05 MICROFARADS.

6.2.5 Analog output wiring

Terminals 24 and 25 provide an isolated source of dc current between 4 and 20 mA, the exact value indicating an internal MP-3000 measurement. This current source, if used, is typically connected to a remote panel meter or a programmable logic controller.

The measurement selection is made via MP-3000 setting. Choices include motor current; stator winding temperature; and fill level of the rotor thermal-model bucket between cool level and trip level. See Setting P11L1 in Section 5.

The burden of the connected current loop should be less than 1000 ohms.

6.2.6 URTD Wiring

Connect a source of 120 Vac only to the power terminals of connector J3 on the URTD module. Connect either terminal 16 or terminal 32 (but not both) to a non-current-carrying safety ground.

Figure 6.7 shows connections between the URTD and the MP-3000. Use either the optical fiber or the electrical 3-wire connection. It is not necessary to connect both. If both are connected, the MP-3000 will use data from the optical fiber. It will default to the wired connection only if the fiber is removed or fails.

NOTE: The optical fiber is the much-preferred method of transmitting temperature data from the URTD to the MP-3000. It is also easier to install.

Preassembled plastic optical fibers with connectors can be ordered from Cutler-Hammer, or from any distributor of Agilent Technologies® optical fiber products:

In addition, these same distributors offer long rolls of cable with connectors which can be installed in the field. Some distributors will make custom lengths to order.

Length	*Cutler-Hammer Catalog Number*	*Agilent Technologies Number*
1 meter HBFR-RLS001	MPFO-1	HBFR-ELS001 or
5 meters HBFR-RLS005	MPFO-5	HBFR-ELS005 or
10 meters HBFR-RLS010	MPFO-10	HBFR-ELS010 or
Uncut fiber		HBFR-EUS(length)

The fiber length should not exceed 120 meters (400 feet). For long runs over 10 meters, be sure to use H-P extra low loss plastic fiber HBFR-ELS or -EUS. Do not splice fiber. Maximum short-term pulling force is 50 Newtons (11 pounds).

Surplus length of a precut fiber causes no problems. Simply coil and tie the excess fiber at a convenient point. Avoid high tie pressure. Bending radius of the fiber should be greater than 2 inches.

The fiber terminations simply snap into or out of the connectors of the URTD and MP-3000.

When using three-wire shielded cable, wire according to the connection guidelines in Table III of the Universal RTD Module IL 17367. The three-wire shielded cable should be #16 AWG or #18 AWG. Connect the cable shield *only* at the MP-3000 end, at terminal 23. Insulate the shield and do not connect at the URTD end.

CAUTION

IF THE MP-3000 IS SUPPLIED FROM 240 VAC, THE URTD COMMUNICATIONS COMMON TERMINAL 22 IS AT 120 VAC WITH RESPECT TO THE SUPPLY NEUTRAL.

The maximum cable length is 150 meters (500 feet).

6.2.7 Wiring RTDs to the URTD Module

Consult URTD Module Instruction Leaflet I.L.17367.

Three URTD terminals are provided for each RTD input. Terminals 1-15 and 17-19 are inputs for up to six winding RTDs. Terminals 20 to 25 accept up to two motor bearing RTDs. Terminals 26-31 accept up to two load bearing RTDs. Terminals 33 to 35 accept an auxiliary RTD.

The three terminals for any unused RTD input channel should be wired together. For example, if MW5 and MW6 are unused, MW5 terminals 13, 14, and 15 should be wired together; and MW6 terminals 17, 18, and 19 should be separately wired together.

See Figure 6.9 for wiring of RTDs to the URTD inputs. Use #18 AWG, three-conductor shielded cable. Note the connection rules in the Figure. When making connections to a two-lead RTD, connect two of the cable conductors to one of the RTD leads as shown. Make this connection as close to the motor as possible. Connect the third cable conductor to the remaining RTD lead.

Connect the shield and drain wire, along with the one cable conductor, to the middle of the three RTD input channel terminals as shown in Figure 6.9. The RTD cable shield should be connected only at the URTD end, and insulated at the RTD end. The RTDs themselves must not be grounded at the motor.

Remember to set the URTD module DIP switches according to the types of RTDs in each of the winding, motor bearing, load bearing, and auxiliary groups. See I.L. 17367.

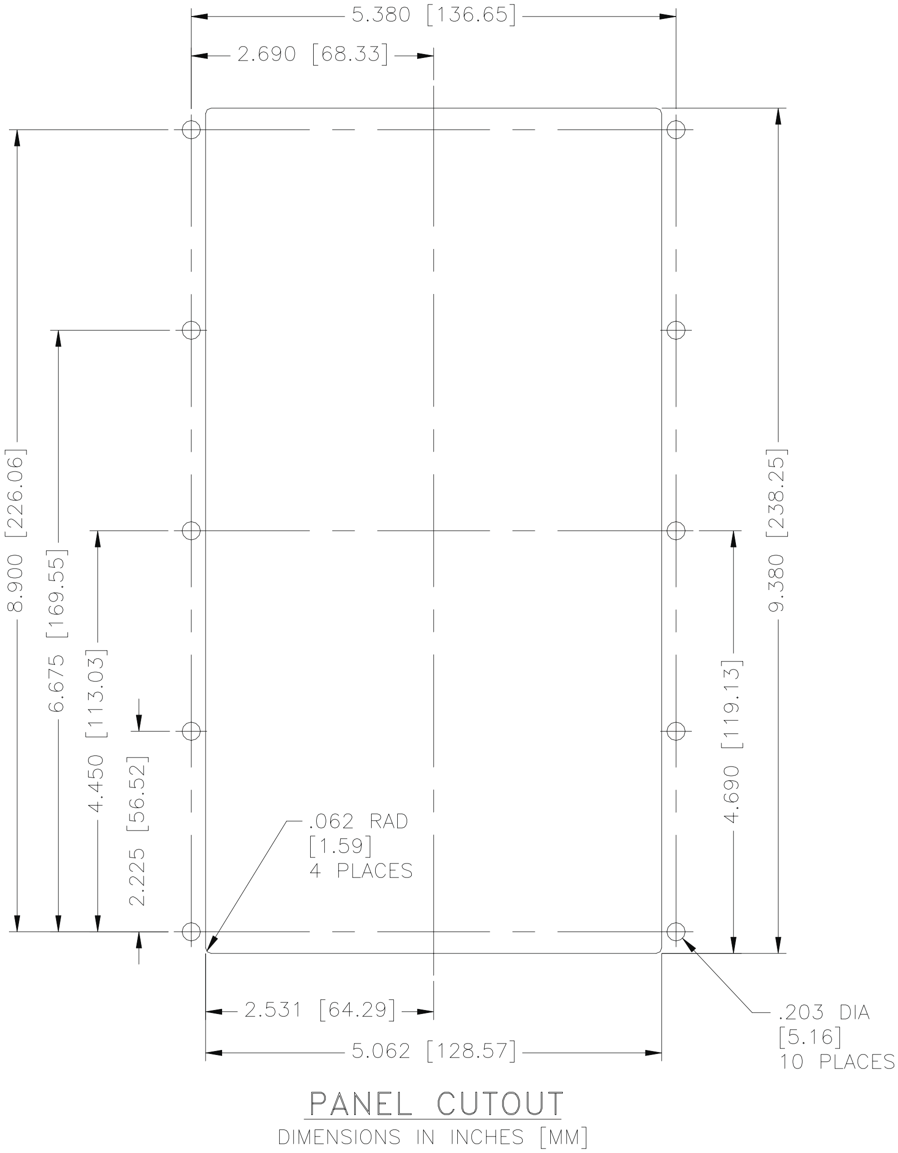


Fig. 6.1 Panel Cutout Dimensions

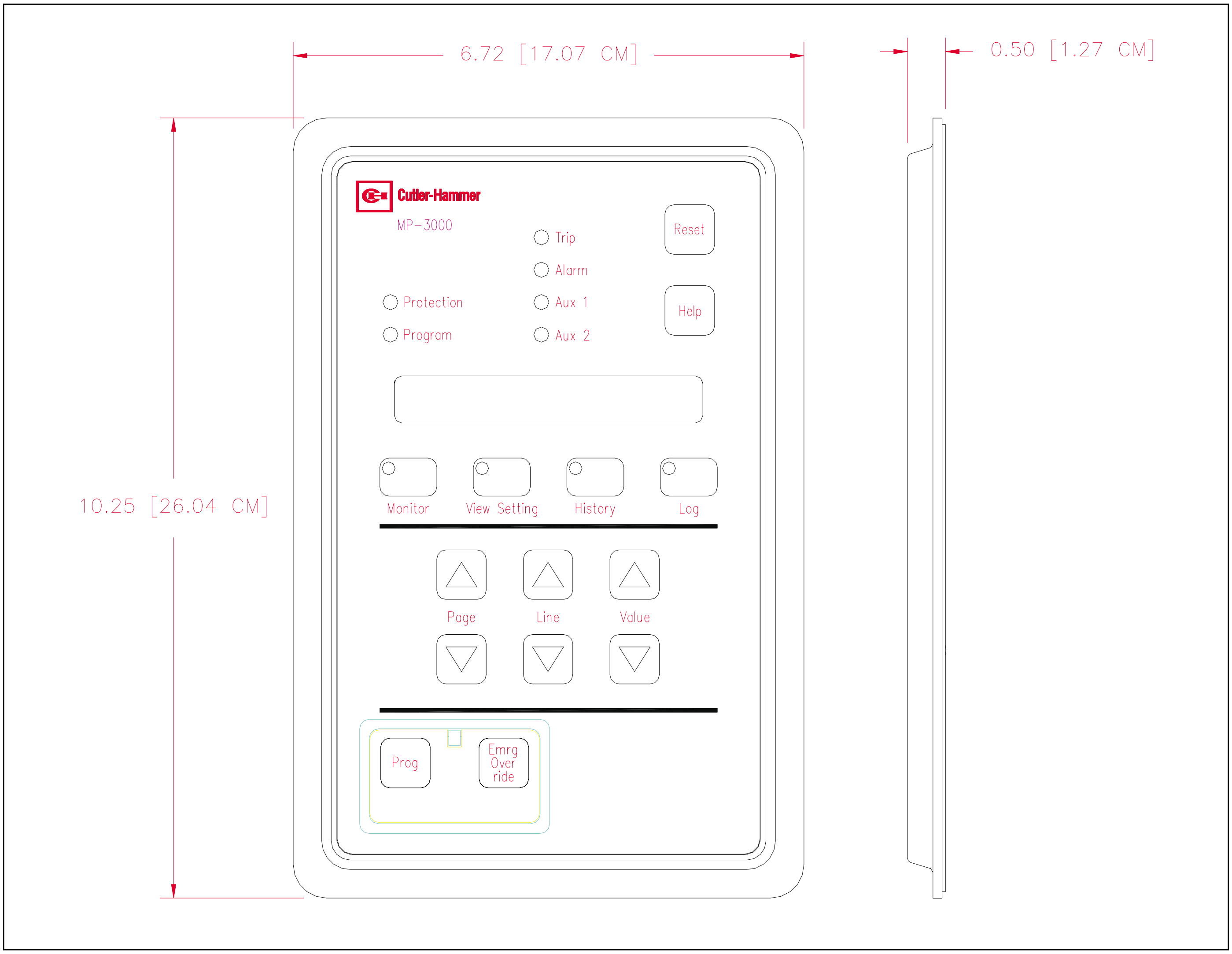


Fig. 6.2 Faceplate Dimensions

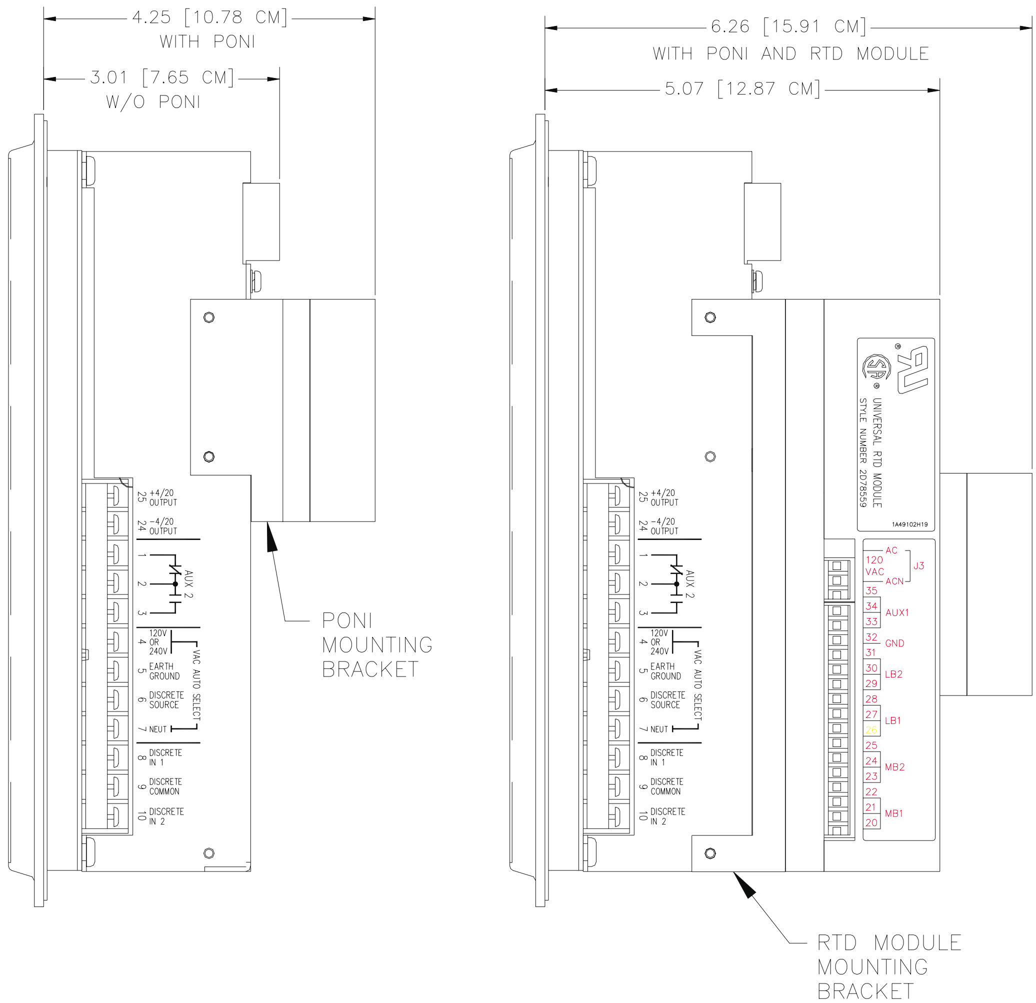


Fig. 6.3 MP-3000 Case Depth Dimensions

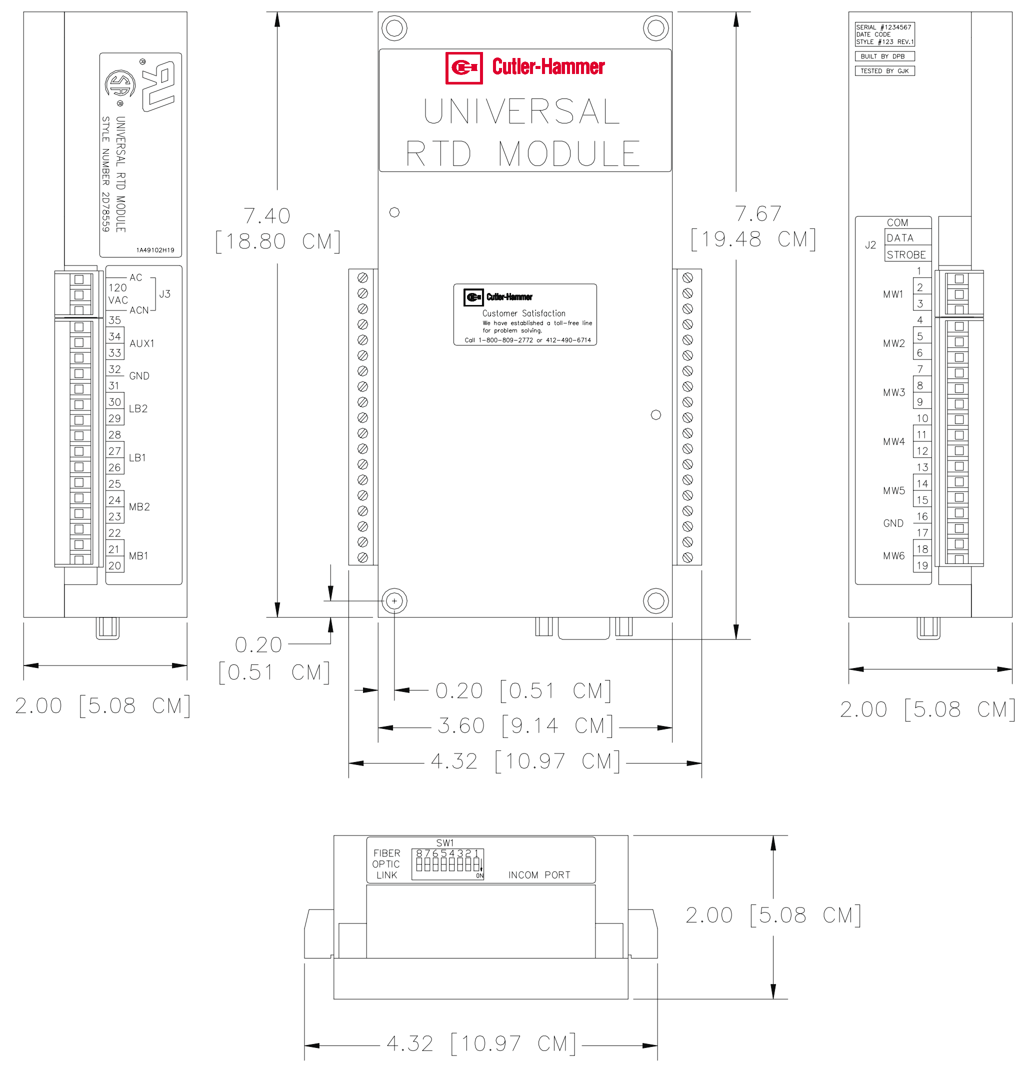


Fig. 6.4 Universal RTD Module Mounting Dimensions

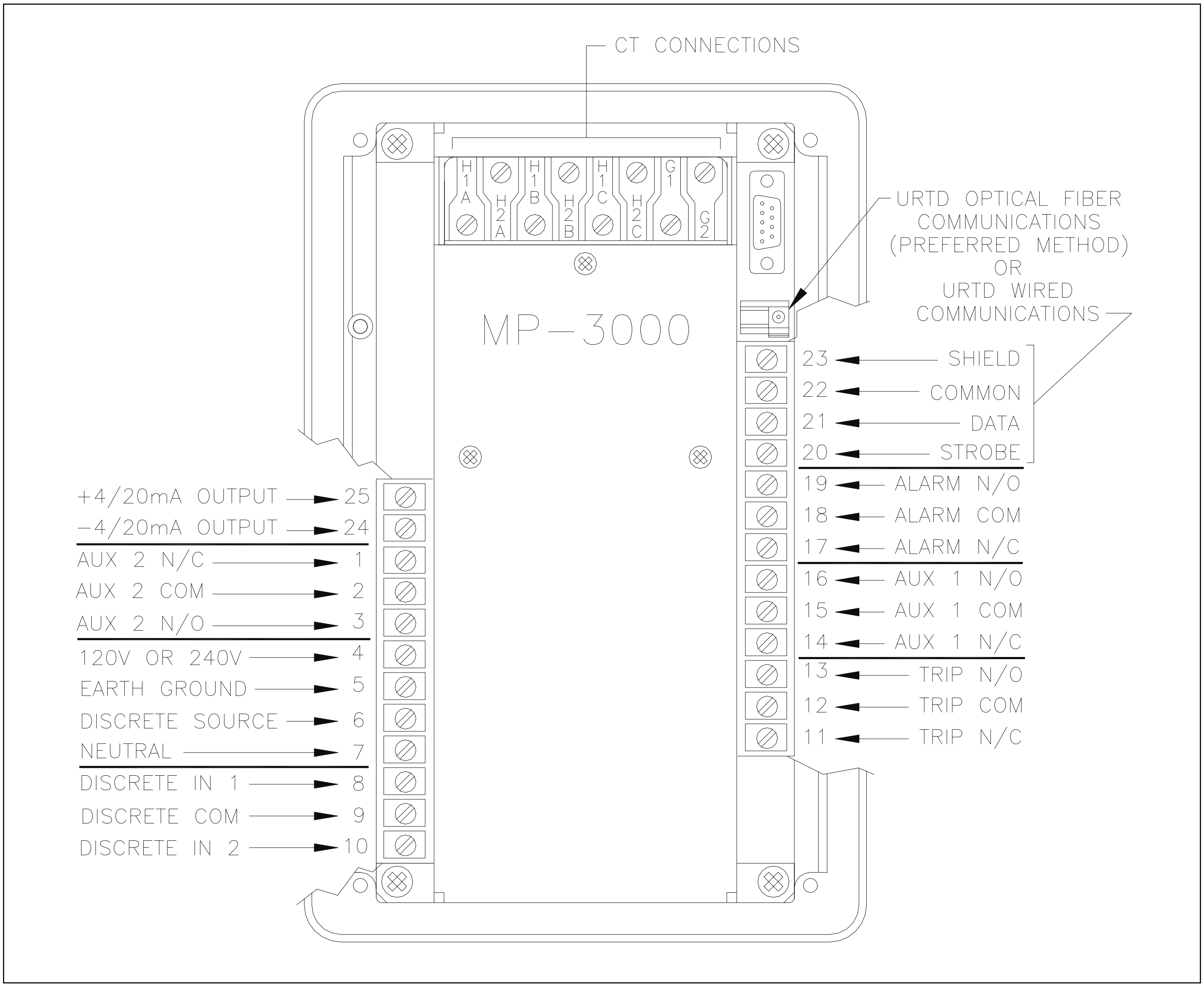


Fig. 6.5 Rear Panel Terminals

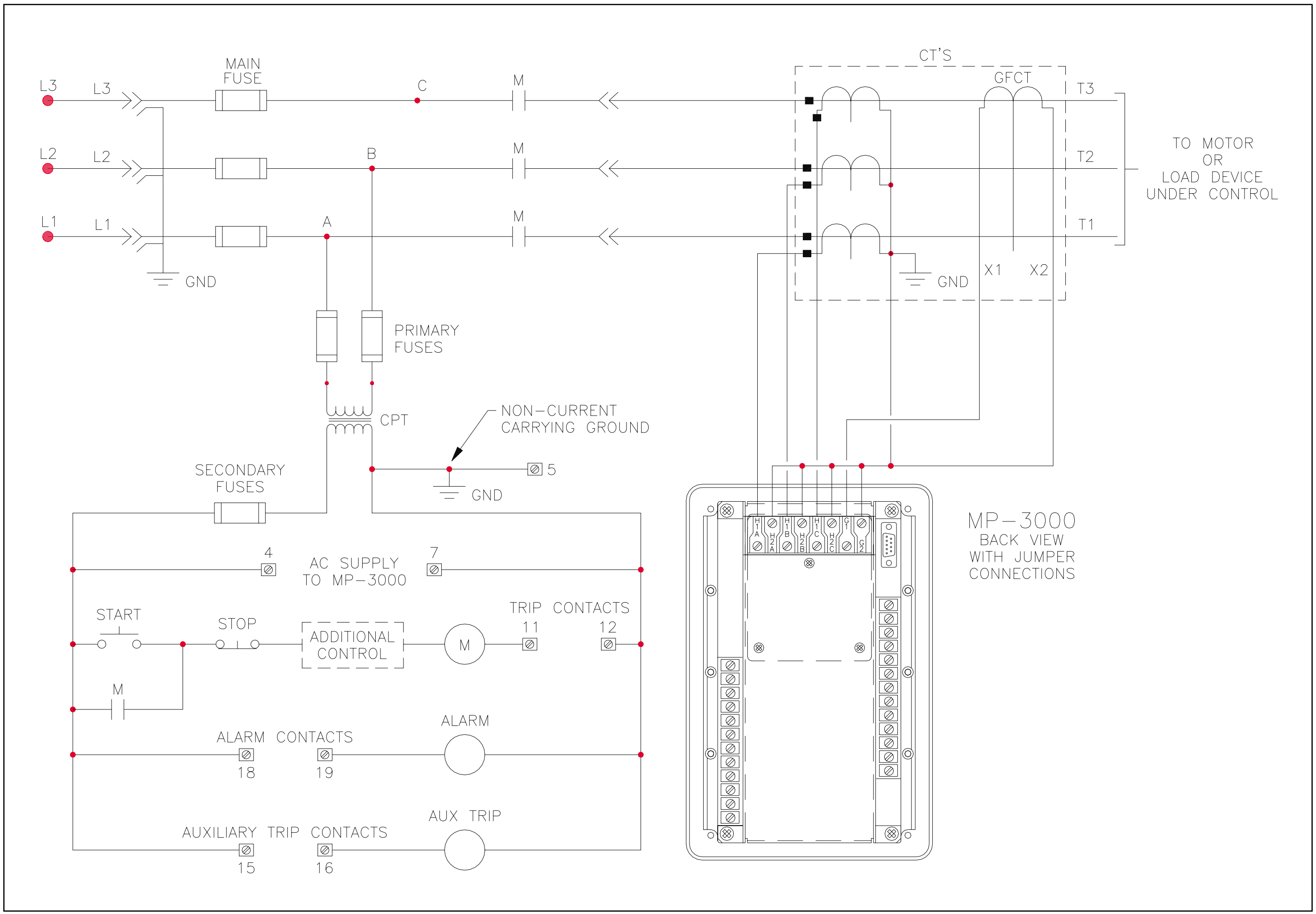


Fig. 6.6 Typical Ct Circuits and Motor Control Wiring

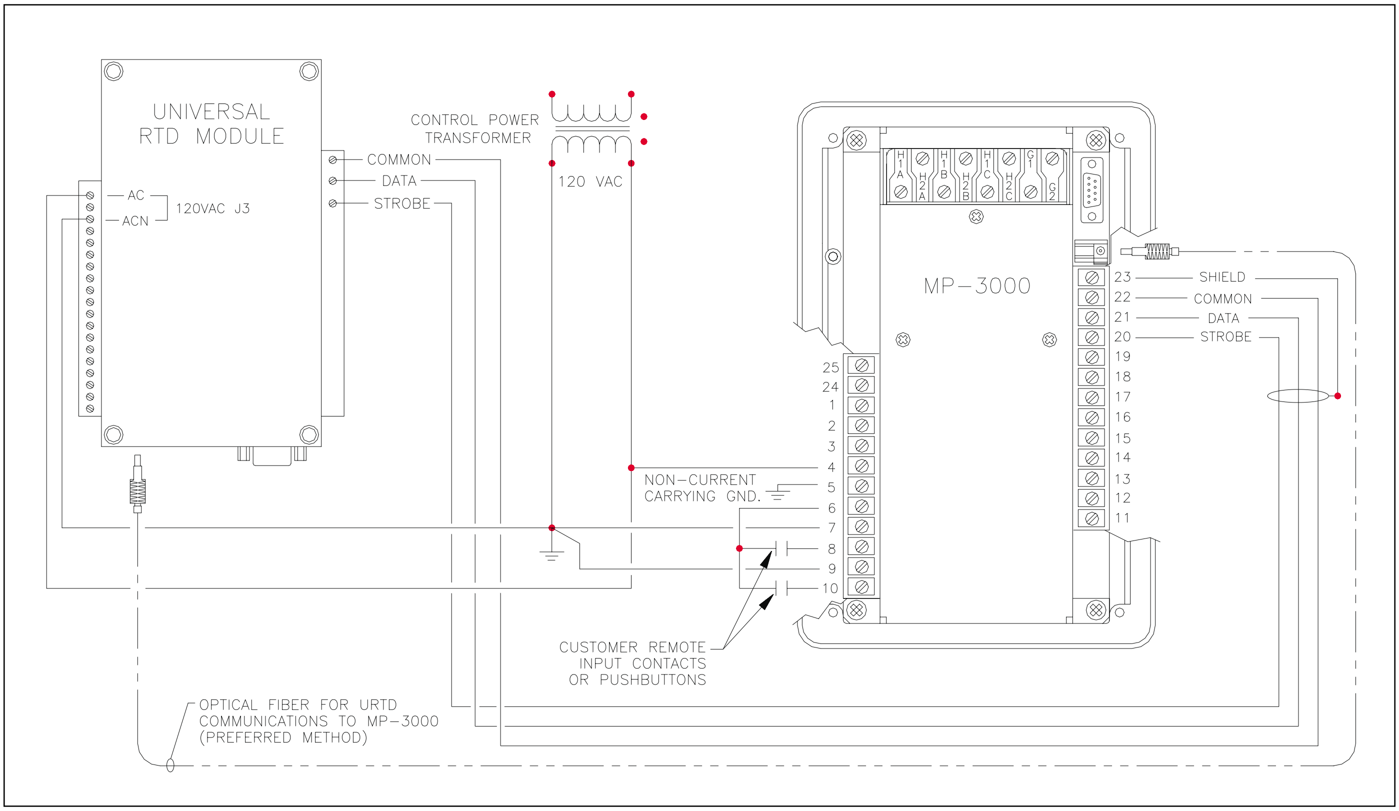


Fig. 6.7 Typical ac Supply and URTD Wiring

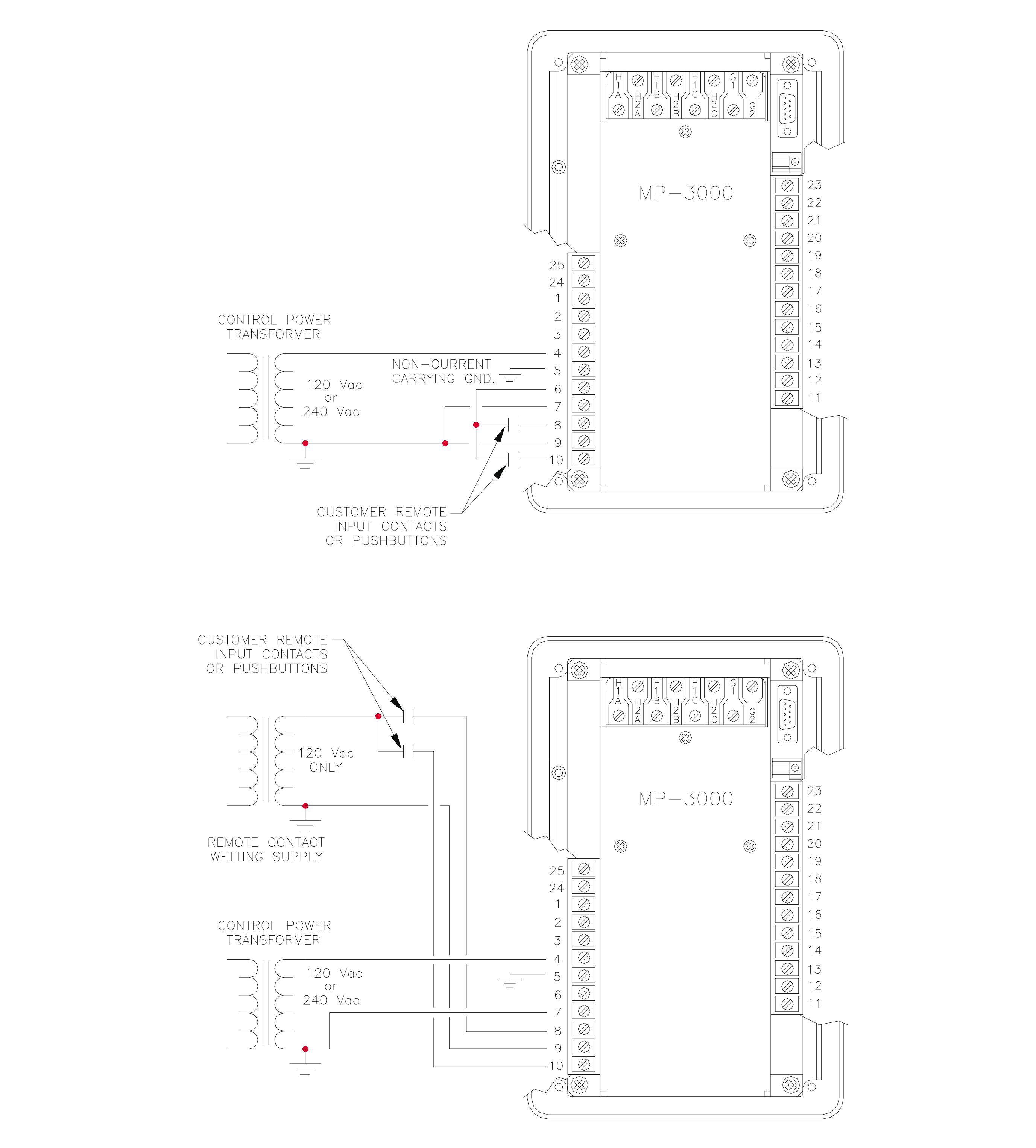
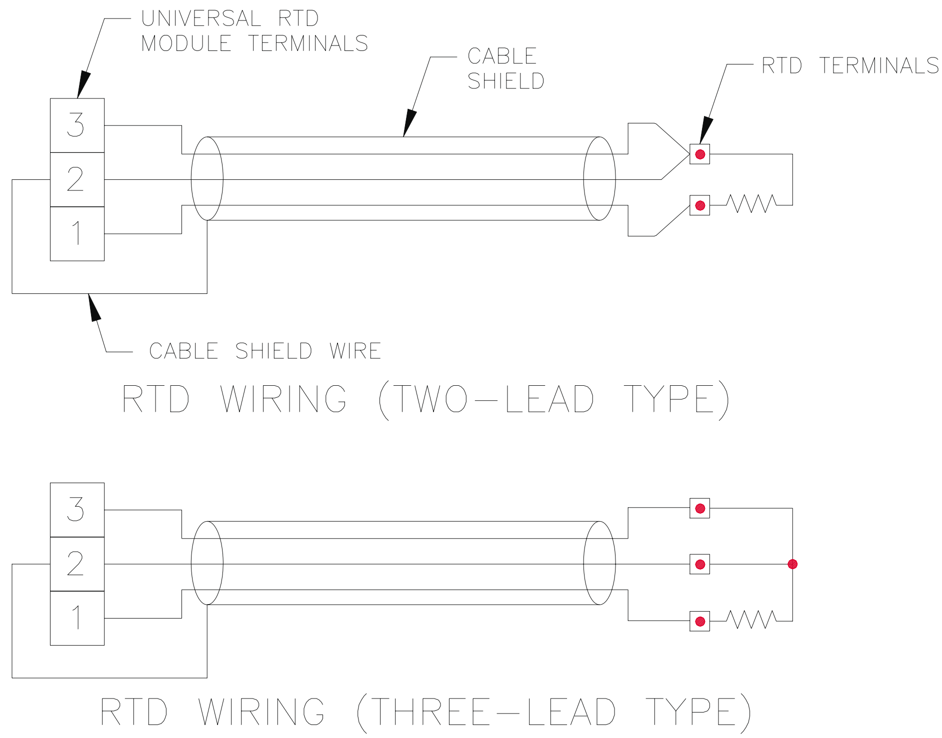


Fig. 6.8 Alternatives for Discrete Input Wiring



NOTES:

1. CONNECT CABLE SHIELD AT RTD MODULE TERMINALS ONLY. CUT SHIELD SHORT AT MOTOR END AND USE SHRINK TUBING OR ELECTRICAL TAPE TO INSULATE.
2. RTD'S MUST NOT BE GROUNDED AT THE MOTOR, AND NO COMMON CONNECTIONS BETWEEN INDIVIDUAL RTD'S SHOULD BE MADE AT THE MOTOR OR THE MP-3000.
3. TERMINAL 16 OR 32 ON THE RTD MODULE SHOULD BE CONNECTED TO AN EARTH GROUND.

Fig. 6.9 RTD Wiring to URTD Module

SECTION 7—STARTUP

7.0 General

This section lists the procedure for applying ac power to an MP-3000 for the first time. Use it as a checklist to reduce the chance of skipping an item.

DANGER

ONLY QUALIFIED PERSONNEL FAMILIAR WITH THE MP-3000, THE MOTOR STARTER, AND ITS ASSOCIATED MECHANICAL EQUIPMENT, SHOULD PERFORM THESE STARTUP PROCEDURES. FAILURE TO COMPLY CAN RESULT IN SERIOUS OR FATAL INJURY AND/OR EQUIPMENT DAMAGE.

CAUTION

DO NOT USE A MEGGER® OR OTHER HIGH-VOLTAGE INSULATION TESTER ON CIRCUITS CONNECTED TO THE MP-3000 TERMINALS. FAILURE TO COMPLY COULD RESULT IN EQUIPMENT DAMAGE. IF WIRING INSULATION IS TO BE TESTED, DO SO BEFORE CONNECTING THE RELAY, ITS OPTIONAL ACCESSORY MODULES, OR OTHER VULNERABLE DEVICES IN THE MOTOR CONTROL SYSTEM.

7.1 Power-off Checks

With the incoming ac power isolation switch locked off, perform these checks:

- Open the isolation switch feeding control power to the MP-3000.
- Check to be sure there is no possibility of backfeeding control power through the control transformer, which will result in voltage being present on the primary of the transformer.
- Make sure that any foreign sources of power, such as those connected to the MP-3000 output relay terminals or discrete input terminals, are off.
- Check the wiring for conformance to the wiring plan developed for the application.
- Make sure that the ct secondary current rating and the MP-3000 ct input rating style agree (either 5A or 1A).

7.2 Initial AC Power Checks

Refer to Figure 6.8, MP-3000 Rear Panel Terminals, as necessary. Also, see URTD terminals in Figure 6.6, and URTD I.L. 17367.

- With the power still off, disconnect the ac control power lead to terminal 4 (120 or 240 Vac power input to relay).
- Disconnect and insulate the contactor lead from the trip relay terminal 12, to prevent contactor energization during most of this testing.
- If the optional URTD is used, disconnect the 120 Vac power connector J3 from the URTD module.
- Connect an ac voltmeter between the wire just disconnected from terminal 4, and terminal 7 (neutral of power input to relay).
- Turn ac power on to the MP-3000, and to the separate remote contact-wetting source if one is used. Usually, the contacts to be read by the discrete inputs will be energized from terminal 6 of the MP-3000 rather than a separate remote source.
- Verify that either 120 Vac or 240 Vac on the lead disconnected from terminal 4. The MP-3000 automatically configures its power supply to work with one or the other value. Nominal values other than 120 Vac or 240 Vac, including values in between 120 and 240, are not recommended. However, the MP-3000 is well able to handle depressions, dips, and limited sustained variations in the normal course of service. See Specifications.
- If the optional URTD module is to be powered from terminals 4 and 7 of the MP-3000, the supply must be 120 Vac only. The URTD is rated only for 120 Vac, and cannot operate from 240 Vac. If necessary, use an auxiliary 240V/120V step-down transformer for the URTD, able to handle 6VA burden.
- Turn off ac power. Troubleshoot wiring if necessary.
- Once ac supply voltage is correct, reconnect the lead disconnected from terminal 4.
- Disconnect the discrete input leads, if used, to terminals 8 and 10.
- Connect voltmeters between the leads just disconnected from terminals 8 and 10, and terminal 9, the discrete input common.
- Close or jumper the contacts which are read by the discrete inputs, if used.

7.3 Initial Checking with AC Power to Relay

- Turn on ac power again. The MP-3000 is now energized.
- Check the voltage between MP-3000 terminals 6 and 7. It should be approximately 120 Vac, regardless of 120V or 240 V supply.
- If discrete input 1 is used, verify that 120 Vac is present on the lead disconnected from terminal 8, measured to terminal 9.
- If discrete input 2 is used, verify that 120 Vac is present on the lead disconnected from terminal 10, measured to terminal 9.
- Place the relay in Program mode. Navigate to the SP TEST page.
- Page to P13L7, state of discrete input 1. It should report DI 1 OFF.
- Page to P13L8, state of discrete input 2. It should report DI 2 OFF.
- Check voltage across power terminals of URTD power connector plug removed from J3. Confirm 120 Vac.
- Turn off ac power again. Troubleshoot discrete input and/or URTD wiring if necessary.
- Reinstall power plug into J3 of URTD.
- Check URTD configuration DIP switches, to insure they are set for the types of RTDs actually installed in the motor and load equipment. See URTD I.L. 17367 for specifics.
- Reconnect the leads disconnected from terminals 8 and 10.
- Turn on ac power again.
- Recheck P13L7, state of discrete input 1, if used. It should report DI 1 ON.
- Recheck P13L8, state of discrete input 2, if used. It should report DI 2 ON.
- Turn off ac power again. Troubleshoot discrete input wiring.
- Remove jumpers on remote contacts or set to normal state.
- Use the MP-3000 discrete input test page indications to test the actual operation of the contacts, if possible.

7.4 Further Checking of the Relay with AC Power

- Apply ac power to the relay and optional URTD.
- The MP-3000 will quickly initialize and display its status, usually READY—3, unless the relay sample has been subjected to an unusual combination of settings and recent prior service or testing. Usually, one or more output relays can be heard to click as they are energized.
- The Protection LED on the faceplate should light.
- If the URTD is connected, push the Monitor mode button and navigate to the MONT RTD page. If the MONT RTD page cannot be accessed, the URTD module is dead or not communicating with the relay at all. Troubleshoot communications wiring or optical fiber, and URTD power.
- Check the 11 temperature display lines. Each connected RTD should display an appropriate value (e.g. 25 at room temperature). Non-functioning or unused RTD inputs display a — character for a value.

7.5 Checking Data Communications

- If the relay is equipped with a PONI, check to confirm that the communications network is connected.
- Visit the PowerNet or other host and check the monitoring displays for the particular MP-3000.
- Confirm that you are viewing displays for the correct relay. This is easily done by disconnecting and reconnecting the network connector.
- If communications can't be established, check for address conflicts on the network (multiple devices set to the same address) or incorrect setting of the address switches on the PONI.

7.6 Entering Relay Settings

- Make a copy of Table 4.3 as a worksheet for recording setting choices.
- Read Sections 5 and 9 carefully for guidance in selecting settings.
- If the MP-3000 is to talk to an older IMPACC system in the IQ2 EN mode, see Section 10 for setting restrictions.
- If desired, PowerNet or PowerPort data communications can be used to download a preconfigured setting record to the relay from a disk file or from a convenient worksheet on the host display. IMPACC cannot be used to enter settings to an MP-3000.
- If electronic communication is not used, enter the settings through the front panel in Program mode, using the **Program** button behind the security door.
- After settings have been entered, exit the program mode by pushing the **Program** button again.
- Verify that the settings have been correctly entered using the **View SP** mode button.
- Reconfirm that the motor nameplate values agree with the corresponding relay settings.
- Reconfirm that the ratios of the phase and ground Cts in the gear agree with the PCT and GCT settings of the relay.

CAUTION

THE MP-3000 HAS 154 SETTINGS, WHICH ARE EASY TO CONFUSE. DO NOT ATTEMPT TO ENTER VALUES WITHOUT USING THE APPROPRIATE SET POINT RECORD SHEET. IMPROPER OPERATION AND/OR PERSONAL INJURY COULD RESULT IF THIS PROCEDURE IS NOT FOLLOWED.

7.7 Checking Contact Outputs

DANGER

BE AWARE OF WHETHER CONTROL POWER IS APPLIED TO THE OUTPUT CONTACTS BEFORE TESTING. AVOID *UNEXPECTED* OPERATION OF THE MOTOR CONTACTOR OR OTHER CONTROLLED DEVICES DURING TESTING. PERSONAL INJURY OR DAMAGE COULD RESULT.

- Determine the mode of each of the output relays. See settings P12L1 through P12L4.
- If possible and safe, use a live test of the actual wiring or devices operated by the MP-3000 output contacts to verify contact operation and check wiring.
- If contacts are energized, a voltmeter can be used to check. Use an ohmmeter or continuity checker *only* on dead, disconnected circuits.
- With MP-3000 power applied, each output relay set for Mode 1 should have its NO contact open and its NC contact closed.
- Each relay set for Mode 2 should have its NO contact closed, and its NO contact open.
- Enter Program mode. Navigate to Page 13, SP TEST. Settings P13L2 to P13 L5 can be used to set up each of the output relays for test.
- Push the Reset button, as explained in Section 5, to toggle the state of each of the relays in turn. Check the switching of the output relay, and the energization of controlled circuits if possible.
- Exit Program mode.

7.8 Checking the Complete Motor Drive System

DANGER

THE CONTACTOR CONTROL CIRCUIT IS TO BE RECONNECTED. AT THIS TIME THE MOTOR ASSOCIATED WITH THE APPLICATION CAN BE STARTED. IT IS IMPORTANT TO ENSURE THAT ALL SAFETY PRECAUTIONS ASSOCIATED WITH ROTATING EQUIPMENT AND THE ASSOCIATED DRIVEN MECHANISM BE TAKEN. FAILURE TO DO SO CAN RESULT IN SERIOUS OR FATAL INJURY AND/OR EQUIPMENT DAMAGE.

- Disconnect all ac power from the system.
- Reconnect the contactor lead to MP-3000 trip relay terminal 12.
- Check all rotating components and driven mechanisms associated with the motor for secure connections.
- Clear away any loose or foreign objects.
- Clear all personnel from the area of the motor and driven mechanisms.

- Turn on all ac power.
- Make sure the MP-3000 Protection LED is on, and that the display says READY—3.
- Follow any startup procedures for the load equipment.
- Start the motor using the external start switch or contacts.
- Using the information supplied by the application engineer or equipment manufacturer, verify that the motor is operating properly.
- With the motor running, use a clamp-on type ammeter to measure the ac current on each of the motor phases.
- Verify that the $I_{A,}$ $I_{B,}$ and I_C currents, as indicated by the MP-3000 on the MONT I Page of the Monitor mode are within about 5% of the ammeter values.
- If the current during this test is well below FLA, or if the cts are far from the optimum ratio, errors may be larger. This test is intended to show incorrectly set ct ratios or faulty wiring, rather than precision of measurements.
- If a ground Ct is connected, check ground current IG. Investigate the cause of any abnormal ground leakage current flow.
- Check the percent unbalance display %UB for consistency with the ammeter measurements, given the acceptable error ranges.
- A negative sign on the unbalance display indicates that the relay is programmed for a reversing motor, and that it believes the motor is running in reverse. Since an MP-3000 programmed for a reversing starter won't trip for reversed phase sequence, this gives a convenient check that the phase sequence is properly wired.
- If the analog transducer output is connected, determine which measurement it is transmitting - view Setting P11L1.
- Check that the analog output current corresponds to the displayed value of the selected parameter.
- If a PowerNet data communications host is connected, upload the starting current profile and check for coordination with cold-start protection curves on the PowerNet display.
- It is wise to verify the ability of the MP-3000 to open the contactor and trip the motor. The easiest way is by remote trip, via remote trip contact or data communications. Many other internal functions can be manipulated to force a relay trip. One technique is to connect a shorting jumper across the relay current terminals for one of the three phases—this should produce an unbalance trip, or a thermal trip after some time.

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SECTION 8—MOTOR THERMAL PROTECTION BASICS

8.0 General

This section describes how the MP-3000 hardware and software function together to control, monitor, and protect the motor.

8.1 Sensing Inputs

The MP-3000 receives motor phase currents from 3 main motor phase current transformers. See Figure 3-1. If an optional ground fault transformer is used, the MP-3000 monitors ground leakage or fault current as well.

The MP-3000 takes 36 samples per power cycle of the input current signals, digitizes each sample, and stores it in the microprocessor memory. From these samples, the MP-3000 computes rms currents and average currents; plus phasor calculations leading to direct and precise measurement of positive and negative sequence currents—see below. The high sampling rate, plus a unique patented sample-shifting technique, allows the MP-3000 to properly measure and account for the impact of harmonics in heating the motor.

If the optional URTD module is used, the MP-3000 gathers winding temperature data from up to six resistance temperature detectors (RTDs) embedded in the stator windings of the motor. It can monitor four RTDs associated with the motor bearings and load bearings. It can also monitor one auxiliary RTD, such as motor case temperature.

8.2 Protective Functions

Protective functions continuously monitor motor operating conditions such as current history and temperature. When measured or derived measurements exceed user-selected levels, an alarm condition is initiated, and then, if necessary, a trip output opens the motor contactor or trips a breaker.

The MP-3000 can protect the motor, starter, and load in the following ways:

- Stator and rotor thermal protection by modeling of heating and cooling effects, including heating by negative sequence currents.
- Stator overtemperature protection by direct measurement (with optional URTD module).
- Instantaneous overcurrent protection for faults.
- Ground fault protection.
- Phase reversal protection.
- Phase unbalance protection.
- Motor bearing, load bearing, and auxiliary RTD temperature protection (with optional URTD module).
- Jam protection.
- Underload protection.
- Transition trip for abnormal starting time-versus-current behavior.
- Incomplete sequence protection (missing status feedback from load or starter).
- Trip-bypass output for failure of contactor to interrupt current after a trip command.
- Zero-speed switch stalled-motor trip protection.
- Process load shedding function to forestall impending jam or thermal trips.
- Jogging protection—minimum time between starts, maximum number of starts per set time, maximum number of consecutive cold starts, and minimum time between stop and start (antibackspin protection).

Many of these functions also have separate alarm thresholds to warn the user, who may be able to act before a trip occurs.

The MP-3000 has four output relays. The Trip relay is connected in series with the motor contactor, and de-energizes the contactor or blocks starting for any MP-3000 trip condition. All trips are steered to this relay.

The three other relays are designated as Alarm, Auxiliary 1, and Auxiliary 2. Normally, all alarm and warning conditions are steered to the Alarm relay. However, the Alarm relay and the two Auxiliary relays are all fully programmable. They can be set by the user to operate for a designated list of internal MP-3000 measured or calculated conditions.

8.2.1 Direct Load-Based Protection

The monitored level of actual motor current is used to determine when the instantaneous overcurrent trip, jam trip, load shedding, underload trip, transition trip, and load-shedding settings have been reached. Also, direct temperature feedback from the stator, load bearing, motor bearing, and auxiliary RTDs are compared with respective settings. If necessary, the relay gives alarm and/or trip outputs.

8.2.2 Thermal-Model and Rotor Temperature Protection

Each motor has a specific damage curve. Usually it is called the I^2t (current squared multiplied by time) curve. With larger horsepower motors, the thermal capability is usually rotor-limited, so it is important to track the total heating of the rotor. In ac motors, the current balance between phases is of major concern due to the additional rotor heating associated with the negative sequence component of an unbalanced phase current condition. Current unbalance is usually caused by voltage unbalance, the result of single-phase loads on a 3-phase system, and/or motor winding unbalance.

Any unbalanced set of three-phase currents or voltages can be mathematically transformed into a linear combination of positive, negative, and zero sequence components. The measured current phasor in each phase is the sum of the three sequence component phasors in that phase. The zero-sequence component is a common-mode component which is equal in the three phases, and requires a neutral or ground path for return. So, in a motor without a neutral return, we see no zero-sequence current unless there is a ground fault. Thus we focus on the positive and negative sequence components which can routinely be present.

For analysis and understanding, consider the motor to have two tandem virtual rotors as shown in Figure 8.2. One is driven only by the positive-sequence current I_1, which is symmetrical and balanced. The other is driven only by counterrotating negative-sequence current I_2, directly related to unbalanced current; and produces a proportional torque in the reverse direction. If perfect current balance and phase-angle symmetry exists among the three phases, then I_1 would be the only component of line current squared, with no effect from the second rotor. This positive sequence component of current produces the motor output torque and work.

The negative sequence current I_2 is a 3-phase current component with a reverse phase rotation compared to that of the ac source. This current generates a reverse torque in the second rotor, and works against the main action of the motor, doing negative work. Because the negative work caused by I_2 stays within the rotor, it is completely absorbed as heat and therefore has a far more significant effect on the rotor heating than the balanced I_1.

Use phasor analysis to determine the sequence currents from physical phase current phasors. Any 3 phase ac current without external ground or neutral return path can be represented by the addition of I_1 and I_2 phasors in each phase. For an example, refer to the unbalanced motor currents of Figure 8.3. In this case, the three phase currents in the motor are I_A, I_B, and I_C. Note that I_B and I_C are of about the same *magnitude* as I_A, yet are noticeably displaced in *phase position*. This is an example of a serious negative-sequence condition which is threatening to the rotor, yet is not reflected in the current magnitudes alone.

To calculate the positive sequence component in phase A, rotate the phase B current phasor 120 degrees in the positive direction and the phase C phasor 240 degrees in the positive direction. Refer to Figure 8.4. The formula for I_{A1} is:

$$I_{A1} = \frac{I_A + (I_B \text{ Đ}120^\circ) + (I_c \text{ Đ}240^\circ)}{3}$$

Note that these are phasor (vector) operations with a phasor result. The positive sequence phasors in phases B and C have the same magnitude as the phase A positive sequence phasor, but lag the phase A component by exactly 120 and 240 degrees respectively. This balanced set of phasors drives the motor's useful work.

To calculate the negative sequence component in phase A, rotate the phase B current phasor 120 degrees in the negative direction and the phase C phasor 240 degrees in the negative direction. Refer to Figure 8.5. The formula for I_{A2} is:

$$I_{A2} = \frac{I_A + (I_B \text{ Đ-}120^\circ) + (I_c \text{ Đ- }240^\circ)}{3}$$

The negative sequence phasors in phases B and C have the same magnitude as the phase A positive sequence phasor, but lead the phase A component by exactly 120 and 240 degrees respectively. This balanced set of phasors represents the net effect of magnitude or phase unbalance and only heats the rotor.

Certain harmonics in the phase currents produce torques in the rotor, just like positive and negative sequence currents. In particular, the 7^{th} and 13^{th} and certain higher harmonics act like positive sequence. The 5^{th}, 11^{th}, and certain other higher harmonics act like negative sequence. This can also influence motor performance and heating. The MP-3000 sequence calculations also capture these harmonic currents and include their effect in the thermal modeling.

Prior to the use of a microprocessor in a multifunction motor protection relay, there was no reasonable way of modeling the total heating effects of the positive and negative sequence components on a continuous basis. Therefore, oversimplified assumptions were used with available relays. This resulted both in nuisance tripping and in motor burnouts or life reduction. The MP-3000 uses a unique, patented calculation for determining these values from current samples and modeling their effects. The effective current squared, as used in the calculation for rotor heating, is:

$$I^2 = I_1^2 + kI_2^2$$

Here 1_2^2 is weighted by k because of the disproportionate heating caused by the negative sequence current component. The effects of both the positive and negative sequence currents are accurately taken into account. Their **combined** effect is incorporated into a rotor protection algorithm that effectively keeps track of the temperature of the rotor.

It is not necessary to pick an arbitrary phase unbalance setting to trip the motor, although such an unbalance trip function is additionally included in the relay to speed up tripping without heating for grossly unbalanced conditions. As long as the combined effect of the positive and negative sequence currents does not approach the motor damage curve, the MP-3000 will allow the motor to run.

8.2.3 Thermal Bucket

The MP-3000 models heating as the filling of a thermal reservoir or accumulating bucket whose size is determined by the thermal capacity of the motor. This capacity is calculated in the relay from motor nameplate constants. The filling is proportional to effective I^2 over time, where effective I^2 includes the disproportionate heating effect of negative-sequence currents. Cooling is also modeled as draining of the bucket. The loss of equilibrium between heating and cooling leads to an eventual thermal trip. The thermal bucket filling in percent can be observed continuously on the MP-3000 display, via data communications, or via the 4-20 mA transducer output.

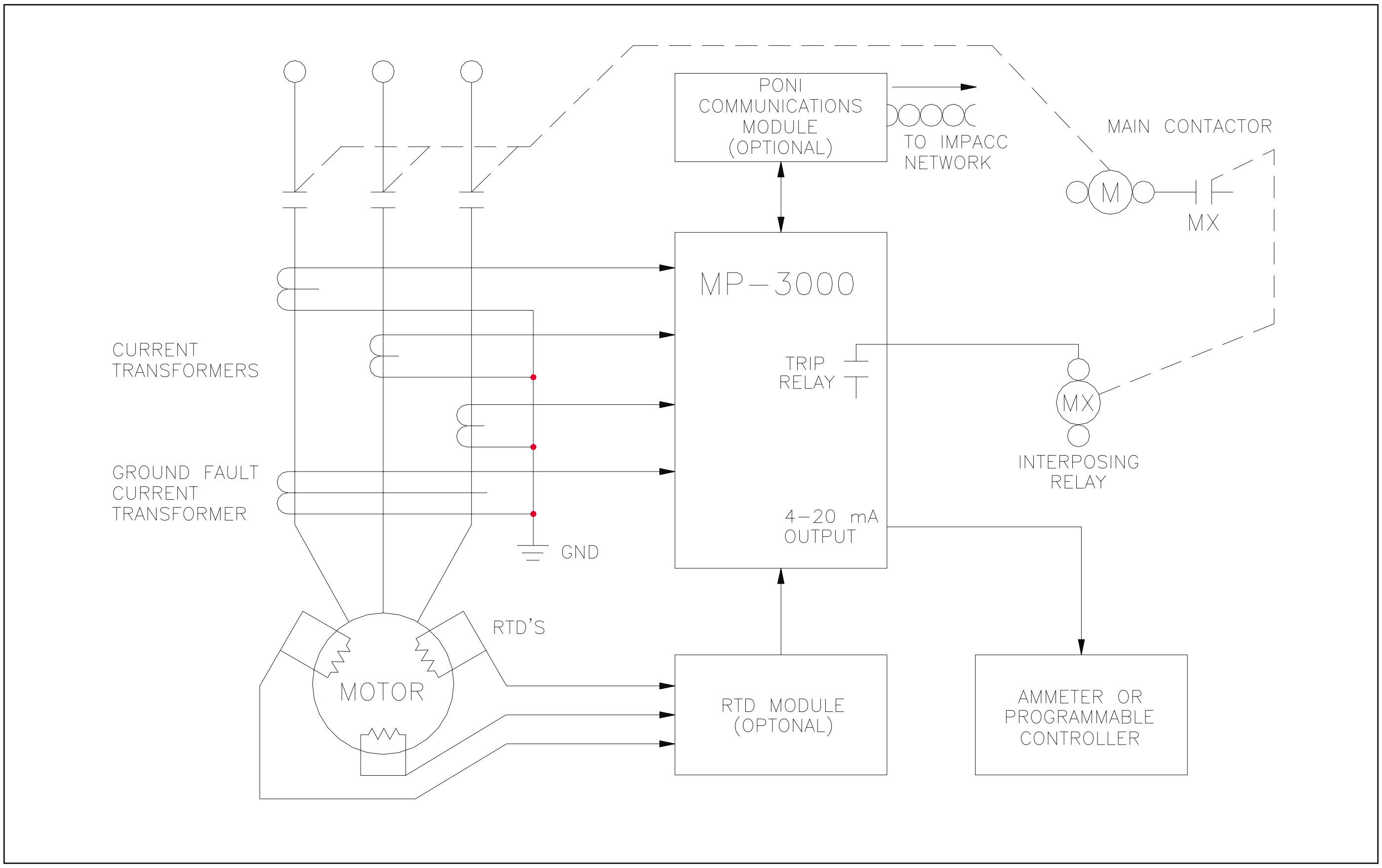

Fig. 8.1 System Overview

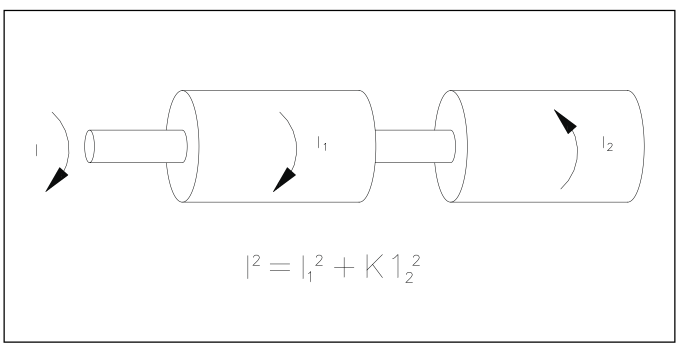

Fig. 8.2 Torques from Sequence Currents

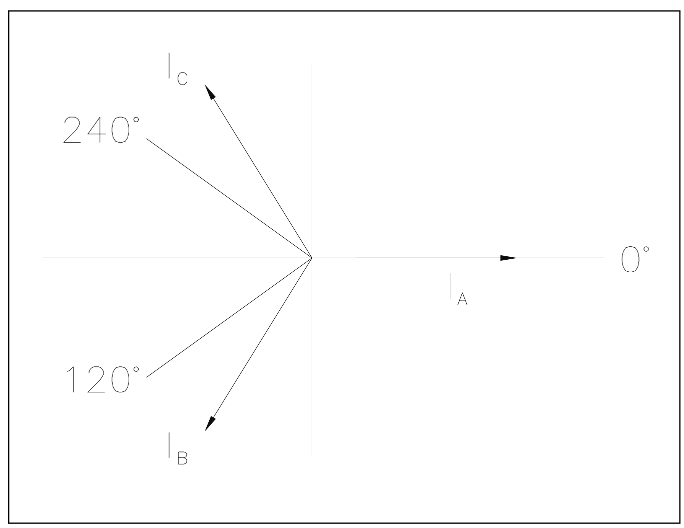

Fig. 8.3 Unbalanced Motor Current Example

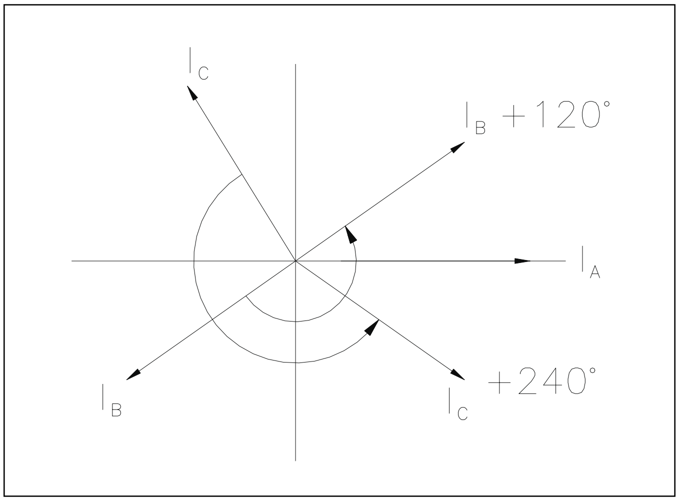

Fig. 8.4 Positive Sequence Component Calculation

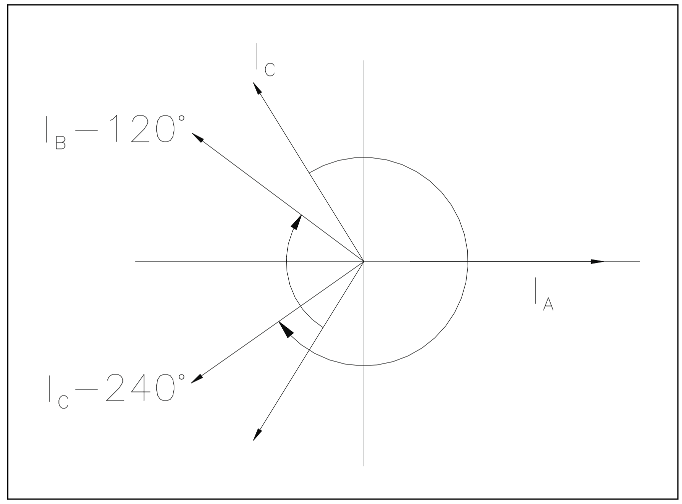

Fig. 8.5 Negative Sequence Component Calculation

SECTION 9—APPLICATIONS AND SETTINGS

9.0 General

This section is a supplement to Section 5, giving more engineering and application guidance for particular functions and settings.

Use this data in conjunction with Section 5 and Table 4.3, to develop settings for the MP-3000, as well as making appropriate wiring design. Note that particular settings are designated as PnLm, where Pn is the page number and Lm is the line number of the particular setting in Table 4.3, and in the page-line-value scheme of accessing settings on the front panel of the MP-3000.

9.1 Motor Protection

The MP-3000 protects the motor, starter, and load in the following ways:

- Stator and rotor thermal protection by modeling of heating and cooling effects, including heating by negative sequence currents.
- Stator overtemperature protection by direct measurement (with optional URTD module).
- Instantaneous overcurrent protection for faults.
- Ground fault protection.
- Phase reversal protection.
- Phase unbalance protection.
- Motor bearing and load bearing temperature protection (with optional URTD module).
- Jam protection.
- Underload protection.
- Incomplete sequence protection (missing status feedback from load).
- Trip-bypass output for failure of contactor to interrupt current after a trip.

9.1.1 Thermal Modeling and Overload Protection without RTDs

Refer to Figure 9.1. The motor overload protection function, called the I^2T algorithm, calculates the rotor and stator temperature based on effective heating current, integrated over time. Positive and negative sequence current magnitudes are calculated in separate accurate algorithms. The effective heating current is the sum of the positive and negative sequence currents, with a heavy weighting factor on the negative sequence contribution. This models the disproportionate rotor heating effect of the negative sequence current (see Motor Thermal Protection Basics, Section 8). Certain harmonic currents such as the 5^{th} and 11^{th} also produce the same heating effects as fundamental-frequency negative sequence current; this harmonic heating effect is also measured and modeled.

The temperature rise caused by current flow is modeled with a thermal accumulator or bucket whose size or capacity is derived from motor nameplate data entered as settings. The flow of effective heating current into the bucket causes it to fill. Cooling is modeled by a gradual emptying of the bucket. The settings which influence the heating and cooling models are:

- Full-load amperes (FLA, P1L1)
- Locked-rotor current (LRC, P2L2)
- Maximum allowable stall or locked-rotor time (LRT, P1L3)
- Ultimate trip current (UTC, P1L4), which is usually service factor times 100 percent.

The MP-3000 thermal bucket fills and proceeds towards a trip only when the effective heating current is above the ultimate trip current setting, P1L4. The modeling is based on an ambient temperature of 40 degrees C. A programmable I2T alarm I2TA, P4L2 informs the user when the bucket reaches the user-set level between 60 percent and 100 percent full.

Without manual process load reduction, automatic process load shedding (see 9.1.5), or other remedial action after an alarm, the relay eventually trips and displays the message LRC/I2T (Locked Rotor/ Thermal Overload). The trip contact blocks motor restarting until the temperature, as reflected in the thermal accumulator bucket level, cools below the alarm level setting I2TA, P4L2.

NOTE: If stator RTDs are not used and the ambient may rise above 40 degrees C, the ultimate trip current should be set *below* that indicated by the nameplate service factor to avoid stator insulation damage or loss of life.

9.1.2 Overload Protection with RTDs

Connect from one to six stator RTDs to the optional URTD module, and connect the URTD data communications output to the MP-3000 using an optical fiber (recommended) or wired connection. The MP-3000 can then perform enhanced motor protection in two ways:

1. Direct measurements of the winding temperature are checked against user-programmed alarm and trip temperature settings.
2. The thermal modeling combines the measured temperature with the effective heating current and the motor constants to more accurately model cooling as a function of temperature (more heat is dissipated as the temperature rises). Loadability of the motor is much improved.

If more than one RTD is connected, the hottest of up to six *stator* RTD temperature measurements is used for protection. Note that motor bearing, load bearing, and auxiliary RTD inputs are ignored by the motor thermal algorithm. These other RTD inputs have their own alarm and trip settings.

If stator temperature measurements are available, the algorithm may restrain from tripping even if the effective current is above the ultimate trip current setting, depending on stator temperature reports. It is still important to set a correct ultimate trip current, so that the motor is well protected if the RTDs, the module, or its communications to the relay fail - the algorithm falls back to use of UTC. Also, note that if the winding trip temperature WD T is set to OFF, the algorithm reverts to the non-RTD calculation which is based strictly on UTC.

NOTE: Many users have the false impression that connecting RTDs makes the motor relay more conservative and more likely to trip under heavy load conditions. *The reverse is actually true*—use of RTDs greatly increases motor loadability. With RTD measurements, the MP-3000 is able to allow the motor to operate safely with significantly higher sustained levels of loading at normal ambient temperatures. Along with this, it can effectively protect the motor when the ambient rises to any level above 40 degrees C. See 9.1.4 below.

9.1.3 Protection Curve

Refer to the example of Figure 9.2. The motor protection curve defines the current versus time limit that the MP-3000 develops from programmed setting values. Ideally, this curve is located as close as possible to the motor damage curve for maximum utilization of the motor capacity. When the integrated effective heating current squared exceeds this limit curve at any time in the start or run cycle, the MP-3000 trips the motor.

The MP-3000 automatically calculates the correct motor protection curve from nameplate or manufacturer values of full-load amperes (FLA, P1L1); locked-rotor current (LRC, P1L2); maximum allowable stall or locked-rotor time (LRT, P1L3); and service factor as used to set ultimate trip current (UTC, P1L4). The following subsections describe how such a typical curve is obtained.

Note that, for now, we assume that the three phase currents are balanced and have proper 120 degree phase relationship (i.e., only positive sequence current). If negative sequence current reflecting unbalance is present, the MP-3000 gives much heavier weighting to the heating effect of these currents, and tripping will occur sooner than expected from balanced-current curves.

9.1.3.1 Instantaneous Overcurrent Function

This function is intended mainly to trip for high-current faults. The example instantaneous overcurrent setting used in Figure 9.2 is 12 times (1200 percent) of FLA. In general, the instantaneous overcurrent setting (IOC, P3L4) should be at least 1.5 times LRC - well above the locked-rotor current normally seen at the moment of a start.

⚠ CAUTION

MOST CONTACTORS ARE NOT RATED TO INTERRUPT HIGH-CURRENT FAULTS. FREQUENTLY, THE MOTOR CONTROL CENTER ALSO CONTAINS FUSES, WHICH CAN INTERRUPT THESE FAULT CURRENTS.

THE MP-3000 TRIP COMMAND IS INTENDED TO OPEN ALL THREE PHASES VIA THE CONTACTOR AND BLOCK FURTHER STARTING, BUT THE FUSES MUST INTERRUPT THE LARGE CURRENT IN FAULTED PHASE(S). IF THE CONTACTOR INTERRUPTING RATING IS EXCEEDED WHEN THE MP-3000 TRIPS WITHOUT THIS FUSE BACKUP, THE CONTACTOR OR MOTOR CONTROL CENTER COULD BE DESTROYED IN A HAZARDOUS OR EXPLOSIVE CASCADING FAULT SITUATION.

ANOTHER ACCEPTABLE APPLICATION IS TO CONNECT THE MP-3000 TO DIRECTLY TRIP A CIRCUIT BREAKER WHICH HAS AN INTERRUPTING RATING EXCEEDING THE HIGHEST AVAILABLE BOLTED-FAULT CURRENT.

IOC should trip fast; no run or pickup delay is provided. A start delay (IOCSD, P3L5) is set at a minimum of two cycles, or more if needed to block IOC tripping on magnetizing inrush when the motor is first energized. Note that the entered IOCSD value is the total IOC trip time, including pickup time of the basic IOC measurement algorithm, and cannot be set below two cycles.

9.1.3.2 Locked-Rotor Function

The family of curves shown in Figure 9.2 is based upon a locked-rotor current setting (LRC, P1L2) of 6.1 times (610 percent) of FLA (P1L1) and a family of locked-rotor or stall time settings (LRT, P1L3).

All curves shown in Figure 9.2 are based on a maximum allowable stall time from a *cold* start. The nameplate LRT used for setting is normally a cold-start value. Since the thermal algorithm actually retains recent operating history as reflected in the thermal bucket level, it is not necessary to program the MP-3000 for hot starts—hot start protection is automatic. Note that the effective limit curve for a hot start is actually more restrictive, i.e. more limiting in time and current, than the cold-start curve of Figure 9.2.

The Emergency Overrride function, if invoked, lowers the thermal bucket to cold level regardless of recent history and restores the cold-start curve. Use this only for a *real* process emergency—it defeats the thermal-modeling protection, and the motor is at risk.

9.1.3.3 Ultimate Trip

The setting for the ultimate trip function is the value of current above which the motor can be damaged over time. Figure 9.2 shows a setting of 100 percent, reflecting a nameplate service factor of 1.0 and an ambient temperature that doesn't rise above 40 degrees C. If the motor has a service factor different from 1.0, the ultimate trip current level is adjusted accordingly. Other common service factors are 0.85 (UTC=85%) and 1.15 (UTC=115%).

As explained above and in Section 5, UTC sets the upper continuous limit if stator RTD temperature measurements are not available. The time to trip after the UTC threshold is crossed depends on recent operating history, and on the thermal-bucket size defined by settings. With stator RTDs reporting acceptable temperature, the algorithm can allow sustained operation above UTC. Make sure the winding direct thermal trip temperature setting (WD T) is not turned OFF, or the algorithm reverts to strict use of UTC.

9.1.3.4 Underload Functions

When the motor is running, a current reduction might indicate a malfunction in the load. Underload protection recognizes mechanical problems, such as a blocked flow or loss of back pressure in a pump, or a broken drive belt or drive shaft.

Refer to the underload protection limit—the left vertical line - in the Underload–Jam Protection Curve example of Figure 9.3. Here, the underload trip is set at 60% of FLA. The MP-3000 has settings for underload alarm (ULA, P4L5), and underload trip (ULT, P3L9). Each can be disabled by setting to OFF. These would be represented by two such vertical lines, both below the normal load current. Be sure to set the alarm level *above* the trip level. Both trips and alarms are held off by start delay ULSD, P3L10. Each has its own run or pickup delay - ULTR, P3L11 and ULAR, P4L4. Use the start delay to block tripping until the load stabilizes after a start; and use run delays to avoid nuisance alarms or trips for load transients.

9.1.3.5 Jam Functions

When the motor is running, a current increase way above normal load might indicate a malfunction in the load. Jam protection recognizes mechanical problems, such as broken drive gears.

Refer to the jam protection limit—the right vertical line - in the Underload–Jam protection curve example of Figure 9.3. Here, the jam trip is set at 150% of FLA. The MP-3000 has settings for jam alarm (JMA, P4L3), and jam trip (JMT, P3L6). Each can be disabled by setting to OFF. These would be represented by two such vertical lines, both well above the normal load current. Be sure to set the alarm level *below* the trip level. Both trips and alarms are held off by start delay JMSD, P3L7. Each has its own run delay - JMTR, P3L8 and JMAR, P4L4. Use the start delay to block tripping until the motor current drops to continuous load level; and use run delays to avoid nuisance alarms or trips for load transients.

9.1.4 Complete Motor Protection Curves

To illustrate the protection features of the MP-3000, two sample curves are shown. Using specific motor data, typical motor protection curves for the MP-3000 without RTDs are shown in Figure 9.4. The use of RTDs is assumed in Figure 9.5. The following data were used:

- Balanced currents during start and run cycles.
- Instantaneous overcurrent limit IOC of 12 times FLA

- Locked-rotor amperes of 6.1 times FLA
- Maximum allowable stall or locked-rotor time of 15 seconds, cold start
- Ultimate trip level of 100 percent of FLA (service factor = 1.0)
- Motor running; normally loaded at 90 percent of FLA
- Underload protection at 60 percent of FLA with a 5-second run delay
- Jam protection at 180 percent of FLA with a 5-second run delay

The MP-3000 recognition of the transition from start to run has no impact on this protection curve, but defines when the displays and indications change from START to RUN. For a reduced-voltage starter, the transition function also defines when the AUX2 output relay switches the starter from reduced to normal running voltage. See 9.2.1 below. The user might elect to transition on time (e.g. set P5L7 to TRN TIME and P5L6, TRNT=10 seconds) or current (e.g. set P5L7 to TRN I and P5L5, TRNC to 130 % of FLA), among other options.

Figure 9.5 shows the impact of a stator RTD measurement. Look at the time period after 60 seconds (near the top). When RTDs report low stator temperature, the motor can run continuously with current well above (to the right of) the UTC line. The lower the stator temperature, the higher the acceptable sustained current moves beyond UTC - 200% of FLA in the example. A hotter stator, perhaps caused by a high ambient temperature or a cooling blockage, shifts the curve to the left and lowers the acceptable level of I^2t. Be sure to set a suitable RTD temperature trip value (WD T) according to 9.1.8 below; a setting of OFF causes the relay to revert to the non-RTD algorithm even if RTDs are connected.

9.1.5 Load Shedding Function

In some applications, the MP-3000 can forestall a jam alarm or trip, or a thermal trip, by sending a signal to the process to reduce loading. The load-shedding function, if enabled, will close or open the AUX1 contact to shed process load when the motor load current goes above the load-shed threshold LSPU, P9L1, for a time exceeding the load-shed run delay LSDL, P9L3. This could, for example, be connected to stop flow of material into the driven process until the load current drops below the load-shed dropout threshold LSDO, P9L2 for time LSDL, P9L3.

Set the load-shed pickup current LSPU, P9L1 comfortably below the jam trip level. It may be useful to set it below UTC, P1L4, particularly if RTDs are not used. See Section 5 explanation for settings P9L1 to P9L3, and for imposed relationship rules on load shedding pickup, dropout, and time delay settings.

9.1.6 Long Acceleration Time

The user can temporarily defeat the I^2t thermal protection limit after a start by setting a Long Acceleration Time delay (LAT, P5L10). This can be a dangerous setting which blocks thermal tripping and holds the bucket at a 100% level if the load takes a long time to reach running speed. An example is a motor spinning a large centrifuge. In using LAT, the user is taking advantage of the partial cooling from airflow produced by motor spinning at below-normal speed, as compared to unfanned heating of a locked rotor. The motor must be rated for this severe starting duty. Also, the user must insure that the motor actually has begun to spin well before the locked-rotor time has expired. This is accomplished by connecting a zero-speed switch to Discrete Input 1 and setting P5L11 ZSW = ON. The zero-speed switch is a contact that is closed when the motor is at rest, and opens as the motor begins to spin, usually at 5-10% of running speed. If ZSW is set to ON and the MP-3000 does not see the contact open in ½ the locked-rotor time setting, it trips the motor.

WARNING

TURN OFF LAT UNLESS THE APPLICATION SPECIFICALLY DEMANDS IT. USE A ZERO-SPEED SWITCH WITH LAT. USING AN LAT SETTING GREATER THAN LOCKED-ROTOR TIME WITHOUT A ZERO-SPEED SWITCH WILL TEMPORARILY DEFEAT THERMAL PROTECTION, AND RUIN THE MOTOR IF THE ROTOR ACTUALLY IS LOCKED.

If LAT is used, check the settings of transition time TRNT, P5L6 and jam start delay JMSD, P3L7 to be sure they are coordinated with the prolonged starting cycle.

9.1.7 Using The Starting Current Profile Function

If the MP-3000 is communicating with a Cutler-Hammer PowerNet host computer, the user can upload the actual time history of the starting current from the moment of a particular start to a time well past the set locked-rotor time. The actual current-versus-time profile can be visually checked against the cold-start protection curve, which PowerNet plots for comparison. The PowerNet plot also includes the long-acceleration extension of the thermal curve, and the jam trip limit. The profiled starting current is the average rms phase current.

The MP-3000 stores the last four starting current profiles. This profile data cannot be read on the front-panel display.

9.1.8 Thermal Protection by Direct Measurement

The effects of the motor winding temperature alarm and trip (P2L2 and P2L3) settings, which can be used with RTDs, are not shown in Figure 9.5. These direct temperature functions protect independently of the I^2t algorithm. For the thermal algorithm to take advantage of the stator RTDs, the thermal direct tripping must be turned on by setting a suitable temperature for trip, not OFF. The settings for these functions should be based on the recommended maximum stator insulation temperature, as indicated by the motor manufacturer's insulation classification on the nameplate.

Table 9-1 Example Insulation Temperature Classes (from NEMA MG-1)

Class	*A*	*B*	*F*	*H*
Ambient Temp., deg. C	40	40	40	40
Allowable Rise, deg. C	60	80	105	125
Hot Spot Allowance, deg. C	5	10	10	15
Hot Spot Temp., deg. C	105	130	155	180

NOTE: Rising winding temperature has to travel through the insulation and stator iron to heat the RTD. When setting stator temperature alarm and direct thermal trip temperatures, keep in mind that the actual hottest-spot insulation temperature may be 5 to 15 degrees C above the hottest RTD measurement. This additional temperature rise above insulation rating may cause the insulation to age twice as quickly as it would if kept within rating. Set thermal trip temperature a little below insulation rating for longest motor life.

9.1.9 Unbalance Protection

Unbalanced or negative-sequence currents are usually caused by unbalanced supply voltage. Certain harmonics, such as 5th and 11th, also cause the same undesirable effects in the motor even though the harmonics are balanced.

The thermal algorithm incorporates the accentuated heating effect of negative sequence currents or these certain harmonics, and trips more rapidly for unbalanced conditions than would be expected from the cold-start balanced protection curve.

In *addition* to the thermal algorithm, the MP-3000 includes a percent-unbalance function which alarms and/or trips based on direct measurement of unbalance. This can be used to speed up tripping and avoid motor heating for a gross problem such as depressed voltage on one phase, loss of a phase, or an uncleared power-system fault external to the protected motor.

The unbalance is the ratio of negative sequence to positive sequence current. If the motor can be started in either direction (P1L8 = REV), the MP-3000 takes the larger of the two sequence currents at the time of the start as the positive sequence current.

The sequence currents are accurately calculated according to the definition, which relates directly to heating. Note that significant negative sequence current is present if the phase angles are not symmetrical, even though the three phase current magnitudes are equal.

The unbalance trip and alarm functions can each be set from 4% to 40%, or OFF. A common start delay is provided (UBSD, P3L13), plus separate trip (UBTR, P3L14) and alarm (UBAR, P4L8) run delays. Use the run delays to ride through external-system unbalanced faults, which could last for several seconds – check time curve settings of feeder relays or fuses. Keep in mind that high-resistance or arcing faults, which may take a longer time to clear, have less tendency to severely depress voltage than a solid fault.

9.1.10 Ground Fault Protection Application

Use this fault-protection function with a flux-canceling ground fault Ct. This Ct has a large primary window through which all three phase conductors can pass. The most common ground fault Cts have a ratio of 50:5 or 50:1.

The MP-3000 is recognized to UL 1053, Ground Fault Protective Device standard. This may eliminate the need for a separate ground fault protector in many applications that formerly required it.

Note that the ground fault trip and alarm current settings GFT, P3L1 and GFA, P4L1 are based on percentage of ground Ct rated primary current, not on FLA or the phase ct ratio. For example, setting 10% gives a trip or alarm for an actual ground leakage current of 5 A with a 50:5 Ct (GCT, P1L6 = 50).

Obviously, this function is only useful for a grounded power system—the ground return is normally made from the neutral of the secondary wire winding of the supply power transformer. Resistance grounding is acceptable, as long as the resulting fault current is at a level the relay can be set to detect.

The ground ct, which provides sensitive protection for high-resistance ground faults, may saturate for a robust heavy-current ground fault in a solidly grounded system. Minimize the saturation problem by minimizing the burden - use the shortest and heaviest leads possible between the ground Ct and the relay. The MP-3000 itself has very low burden, usually much lower than the connecting wiring. Calculate the current magnitude which saturates the ground ct, considering the ct secondary voltage capability; and the total burden of the ct secondary winding itself, the connecting wires, and the relay. Make sure this saturation current is well above the minimum sensitivity of the *phase* IOC function and/or the motor fuses.

Residual connection – wired summation of the phase Ct circuits through the ground Ct input – requires a much higher GFT setting to avoid false tripping. Thus sensitivity is not nearly as good as with a separate flux-canceling Ct. If the relay is installed where a residual connection is used, GCT should be set to the same value as PCT. The user must then set the ground fault trip level at a high value to avoid nuisance tripping from Ct ratio errors, third harmonic and certain higher harmonics, or other measurement errors producing false residual currents. Monitor the metered ground current during various loading conditions to insure good margin between these error currents and the ground fault trip current setting GFT, P3L1. Also, watch out for phase Cts which saturate during motor starting - the saturation will produce a large residual current and a ground fault trip. This may be a problem if the Cts have low voltage capability (e.g. C5 or C10), or if they have long wiring runs or are otherwise heavily burdened.

9.2 Motor Cycle Monitoring

This refers to the MP-3000 functions that monitor the motor during periods of normal operation. Normal operation includes the start cycle, run cycle, and stop cycle. Trips may occur at any time. The MP-3000 time-tags many critical changes of state and stores them with supporting data in log books and history records.

The primary function of the MP-3000 is to alarm, and to trip and block the motor contactor for faults and abnormal or dangerous operating conditions. It can also exercise some active control of a normally functioning motor and/or its load. Active control functions include transition control to full running voltage for a reduced-voltage starter as explained next; and process load shedding to reduce overload as explained in 9.1.5 above. Others can be programmed by assigning a particular internal MP-3000 measurement to a contact output with output relay settings.

9.2.1 Start Cycle and Transition Tripping

Figure 9.6 shows an example of how the MP-3000 reacts to a normal operating-cycle current profile. Initially, the motor is stopped and the current is zero. As long as the MP-3000 is not in a trip state, it will permit contactor energization by closing its trip contact in series with the contactor. The contactor is energized by the operator or process control system through a normal two-wire or three-wire motor control scheme, external to the MP-3000. The MP-3000 declares a motor start when it sees motor current exceeding 30 percent of the FLA setting (P1L1). The message START is displayed and the transition timer (TRNT, P5L6) begins to run. Also, the MP-3000 watches the large starting current, noting when the current falls below the transition level TRNC, P5L5.

Using the TRN XXX setting P5L7, the user can select one of four transition behaviors:

TRN TIME—Transition to RUN after time setting (P5L6) only. Ignore current.

TRN I—Transition when starting current drops below setting (P5L5) only. If the time set in TRNT P5L6 expires before the current transition, trip the motor.

TRN T+C—Transition on time or current, whichever comes first.

TRN T/C—Transition on time and current. Both must occur, and the current must drop below the setting before the time delay expires. If the timer expires before the current falls below the set transition level, trip the motor.

If there is no transition trip, and the relay declares a successful transition, the display and data communications messages say RUN. If P10L1 is set to TRN ON, the AUX 2 output relay will operate its contact when the transition is declared. This contact controls a reduced-voltage starter, switching to full running voltage.

Even if the transition control output contact is not used, set the transition function to provide clear indications of the actual state of the motor (START versus RUN) on the front-panel display and via data communications. A good way to do this is to use the settings of P5L7 = TRN T+C and P5L5 = 130% of FLA. Modify the latter, if needed, to lie at a transition value between the starting current and post-start maximum load current. Set transition timer well beyond normal start time to avoid a transition trip.

9.2.2 Start Delays

When the MP-3000 declares a START, all start timers of enabled functions begin to time. Each of these timers blocks the respective function until the set delay expires. These start timers don't care about transition—they run for the set time, which may be less than or greater than the time of transition. These timers include:

- Ground fault start delay (GFSD, P3L2)
- Instantaneous overcurrent start delay (IOCSD, P3L5)
- Jam trip and alarm start delay (JMSD, P3L7)
- Underload trip and alarm start delay (ULSD, P3L10)
- Unbalance trip and alarm start delay (UBSD, P3L13)

Also, at the time of the start, the counters and timers for the jogging controls are updated. These include starts allowed per time (ST/T and T/ST, P5L1 and P5L2), time between starts (TBS, P5L3), and number of cold starts allowed (NOCS, P5L4). If a jogging limit is reached, only a STEX alarm occurs, but if the limit still applies when the motor next stops then the motor is tripped and blocked at that time.

9.2.3 Run Cycle

Once the transition occurs, the MP-3000 declares the run state for the motor; a RUN message is displayed and communicated to the PowerNet host.

9.2.4 Run Delays

Note that run delays on trip and alarm functions don't have any particular relationship to the transition to the RUN state of the relay. Run delays are pickup delays on active functions, which are able to measure as soon as the respective start delay has expired—see 9.2.2 just above. The primary function of run or pickup delays is to prevent nuisance tripping. These delays are:

- Ground fault run delay (GFRD, P3L3).
- Jam trip run delay (JMTR, P3L8).
- Underload run delay (ULTR, P3L11).
- Phase unbalance alarm run delay (UBTR, P3L14).
- Jam alarm run delay (JMAR, P4L4)
- Underload alarm run delay (ULAR, P4L6)
- Unbalance alarm run delay (UBAR, P4L8)
- Load shed delay for pickup and dropout (LSDL, P9L3)

9.2.5 Stop Cycle

The run cycle continues until the motor current level falls below 2% of rated ct secondary current on all three phases (0.1 A for 5 A Cts). Then, a stop is declared. Jogging limits, as listed in 9.2.2 above plus antibackspin time delay (ABKS, P5L12) are checked and if required, the MP-3000 trips with the appropriate display message(s). Remaining jogging block times are displayed and counted down, telling the user how long to wait. If there are no such starting block conditions in effect, the MP-3000 closes (or never opens) the trip contact and displays READY —3.

9.2.6 Trips and Trip Bypass

If any of the motor protective functions operate while the motor starts or runs, the MP-3000 opens its trip contact and displays the cause(s) of the trip. It may also open its trip contact *after* a stop is recognized if any jogging function time limit is blocking the next start. In either case, the MP-3000 expects that the contactor is then open in response and that no current flows.

If the MP-3000 sees noticeable current for more than about a second whenever it is tripped, it declares a *trip bypass* and a message is displayed. This means that the relay blocking of the contactor has been circumvented by the user to start the motor. If the current fails to stop when the MP-3000 trips a running motor, it may be because of a user trip bypass, or because of a stuck contactor.

Consider the possibility of backup protection for a contactor opening failure. Configure the AUX1 or AUX2 output relay to pick up for a trip bypass. Connect the contact to trip an upstream breaker. This will protect the motor from damage in case of a stuck contactor (at the cost of interrupting other loads connected to the same breaker).

9.2.7 Armed/Disarmed Mode

If the MP-3000 is DISARMED (P12L18), trip messages are displayed but the trip relay will not be operated. This is useful in a critical process, if it is imperative to keep the motor running while settings are changed or the relay is replaced. Commission the new relay or settings in the DISARMED state. Make sure the relay is also set for RUN PGM (P12L6) before commissioning. Watch for any trip messages and observe the contents of the thermal bucket for a while. When it is apparent that the relay behavior is secure and stable, change P12L18 to ARMED.

9.3 Ac Line Interruptions

The MP-3000 has an exceptional ability to ride through voltage sags and interruptions, even longer than a delayed-dropout contactor it controls. With this capability, most users can avoid the addition of a dc battery supply or an uninterruptable power supply (UPS).

The relay will operate continuously for ac supply voltages down to 55% of rated value (66 Vac for a 120 Vac supply system; 132 Vac for a 240 Vac supply).

For a complete supply interruption, the nominal ride-through rating is 30 cycles. The relay will typically continue to operate for 25 to 50 power cycles, depending on power supply loading variables:

- Number of output relays picked up.
- Current being delivered by the 4-20 mA analog transducer output port.
- Type of PONI communications module powered by the MP-3000, if any.
- Electrical URTD communications (using recommended optical communications lowers this burden slightly).

The one load which may depress the MP-3000 ride-through times well below 25 cycles is the use of a Cutler-Hammer Ethernet PONI (EPONI) for communications – particularly the EPONI with optical fiber communications. In this case, ride-through could fall to 10-13 cycles. However, this is easily remedied by powering the EPONI from its own optional external power transformer. Then, the MP-3000 ride-through will return to its 30 to 50 cycle range.

In applying this ride-through capability, consider the external factors:

- Typical utility feeder fault tripping and reclosing systems on overhead medium- or high-voltage feeder lines up to 161 kV cause interruptions of 15 to 20 cycles, especially during thunderstorms.
- For higher or extra-high voltage supply circuits to large plants, interruptions may be longer, up to 30 cycles. Determine if the power system has special mitigating features like multiple well-separated sources, or local paralleled generation.
- Conventional motor contactors will drop out in 3 to 5 cycles, stopping the motor.
- Special delayed-dropout contactors are available which store energy, and will ride through interruptions of 15 to 20 cycles.
- Latching contactors or motor breakers may also be used—they trip only by active unlatching or trip coil energization.

The MP-3000 will declare a motor stop after about 20 cycles of no current. The only way to extend this time is to assign the MOTOR STOP function to one of the discrete inputs, and connect an external stop-indicating contact (see Section 5.6.1).

If the ac supply returns after the stop declaration, but before the MP-3000 microprocessor shuts down, the relay can go through another start cycle and return to the RUN state without ever tripping the motor. However, this on-the-fly restart declaration won't happen if the relay has antibackspin or other jogging timer blocking in effect—the relay will trip at the moment it declares a stop.

WARNING

BEWARE OF REENERGIZING MANY LARGER MOTORS AFTER AN INTERRUPTION OF OVER 20 CYCLES BUT LESS THAN SEVERAL SECONDS. THE INDUCED ROTOR CURRENT DECAYS SLOWLY, YET THE ROTOR SLOWS ITS ROTATION AND DEVELOPS A LARGE ANGULAR DIFFERENCE FROM THE DISCONNECTED STATOR FIELD. WHEN THE STATOR IS REENERGIZED AFTER, SAY, 30 OR 40 CYCLES, THE SUDDEN TORQUE SHOCK CAN BREAK A SHAFT KEY OR DO MORE SERIOUS MECHANICAL DAMAGE. USE A CONTACTOR WITH AN APPROPRIATE DROPOUT DELAY.

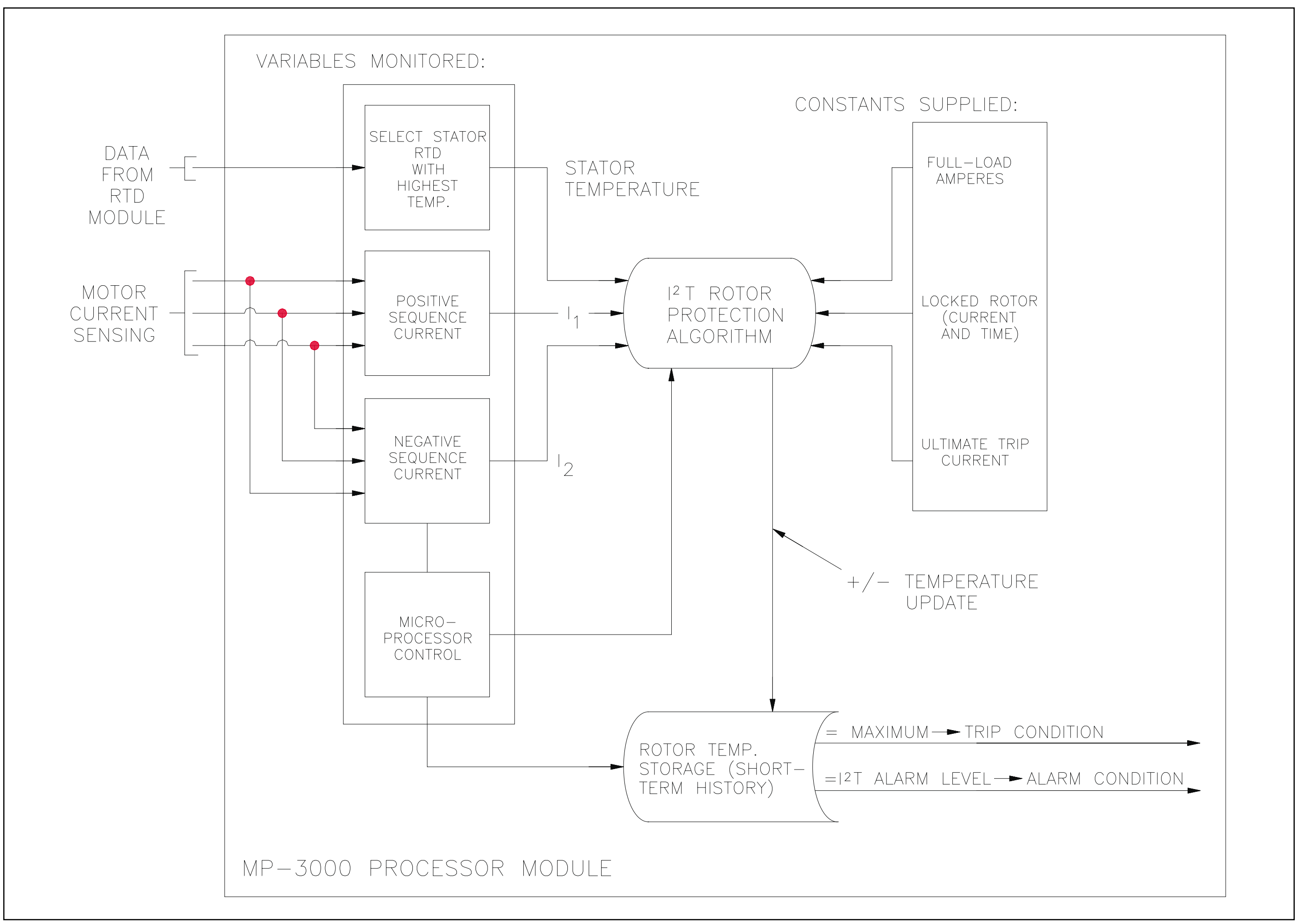

Fig. 9.1 Rotor Temperature Tracking

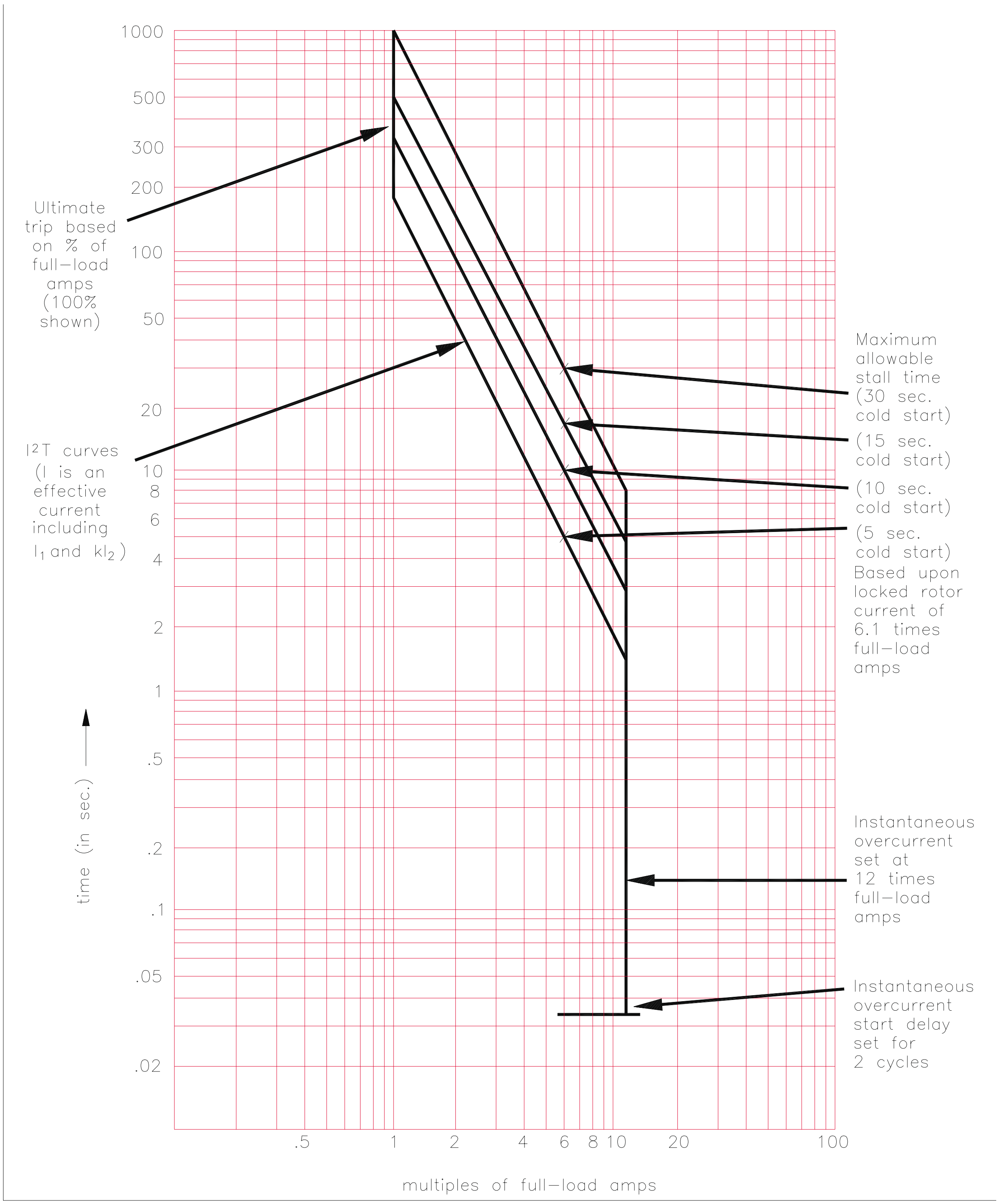

Fig. 9.2 Motor Protection Curve

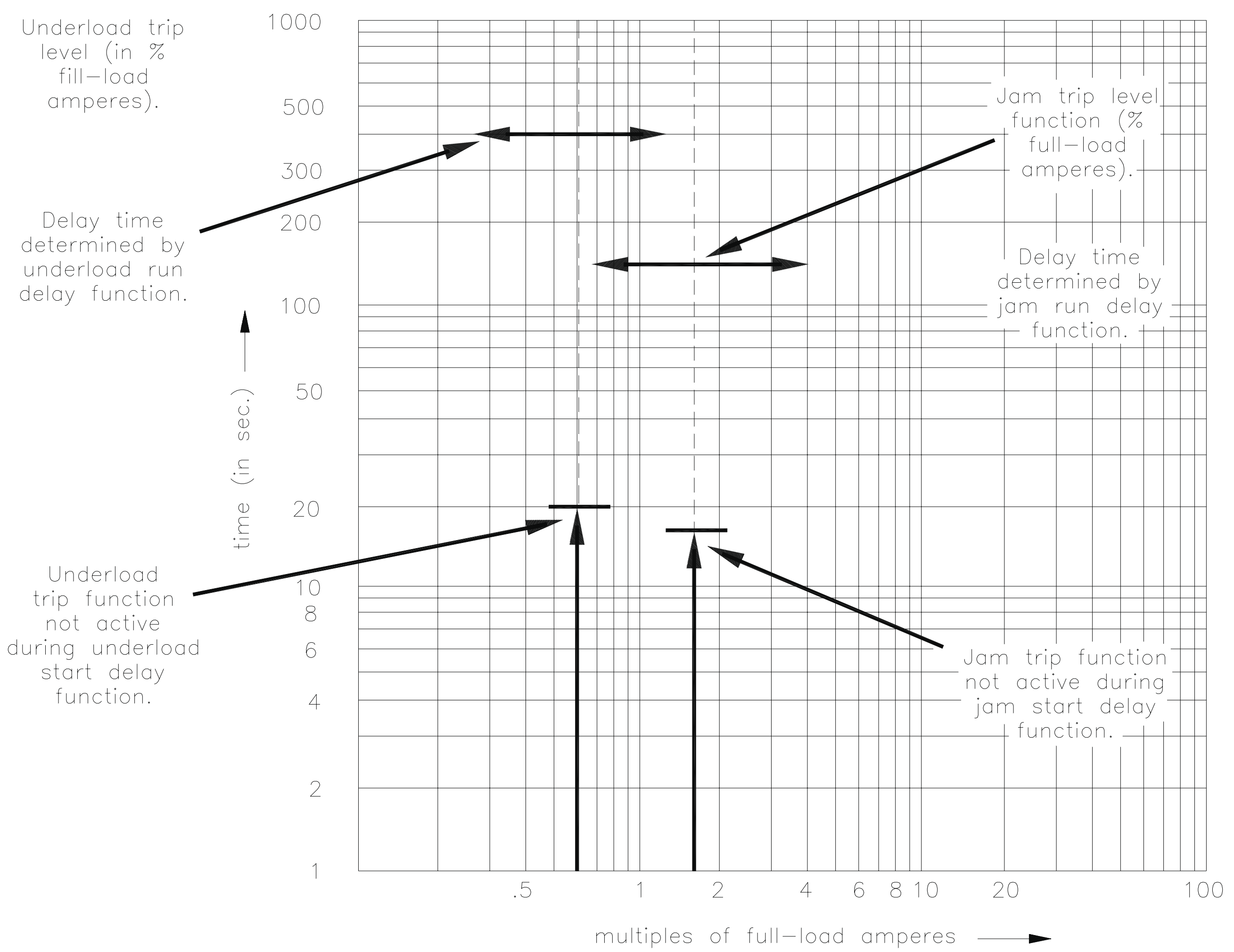

Fig. 9.3 Underload Jam Protection Curve

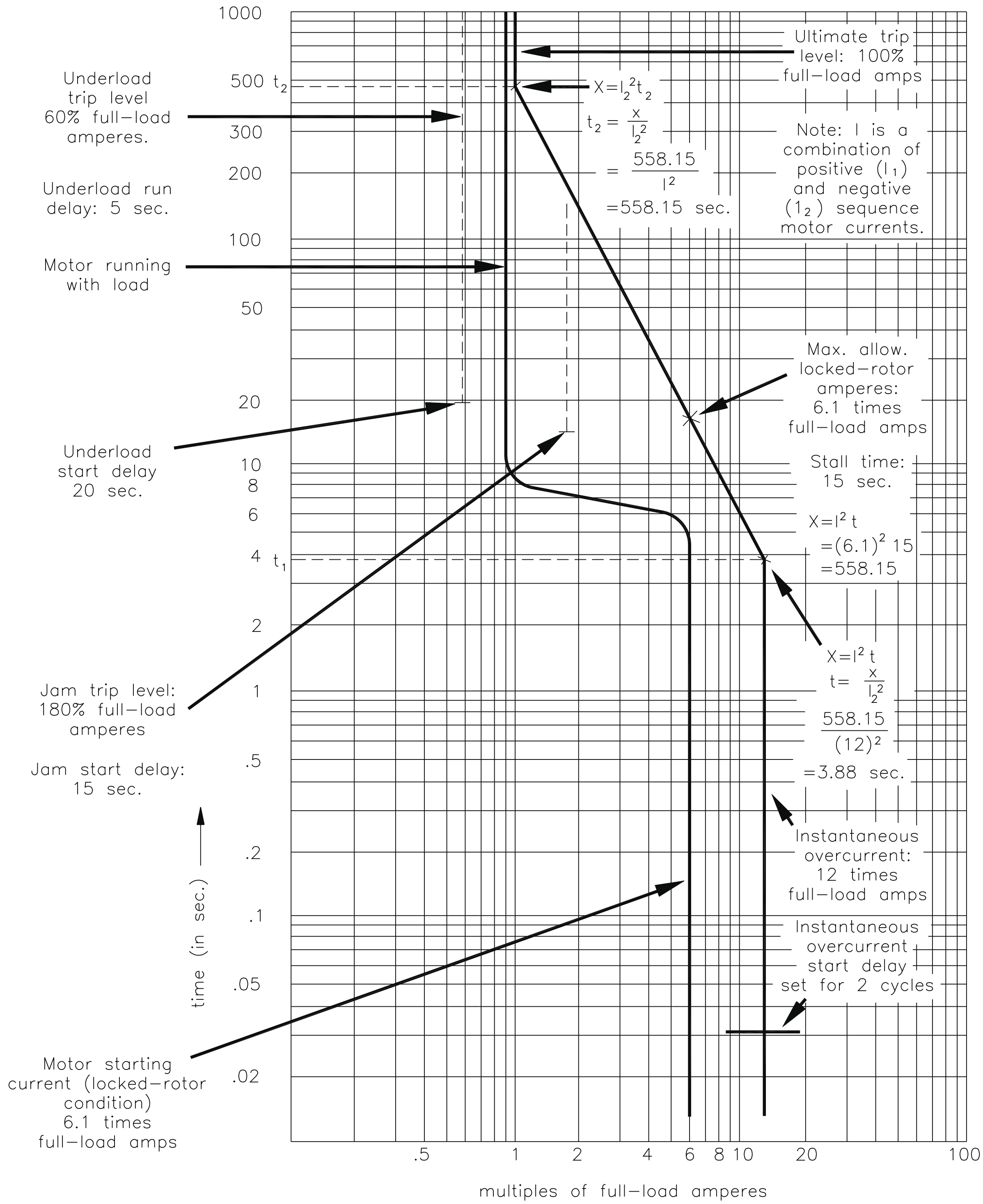

Fig. 9.4 Motor Protection Curve Example (without RTDs)

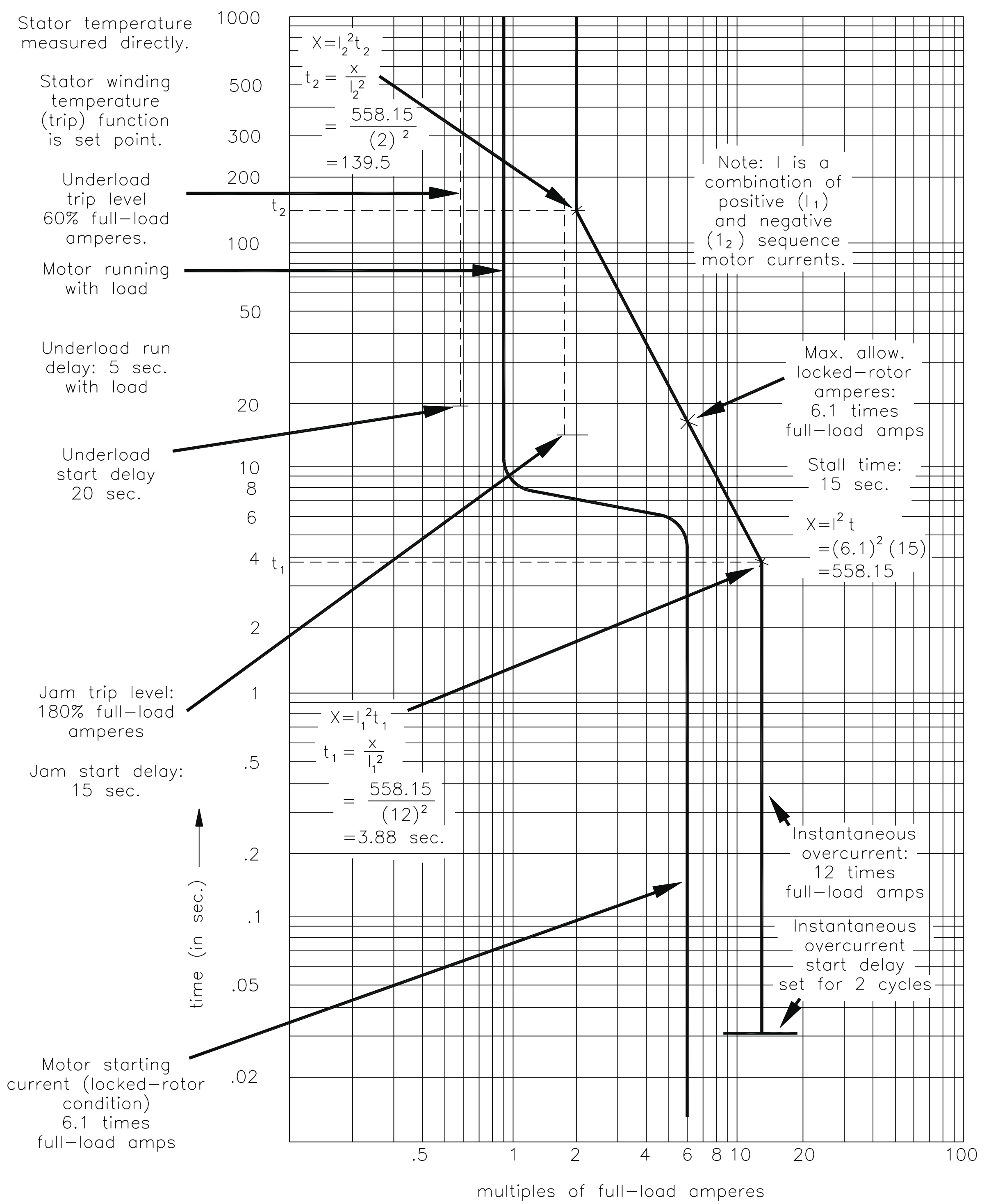

Fig. 9.5 Motor Protection Curve Example (with RTDs)

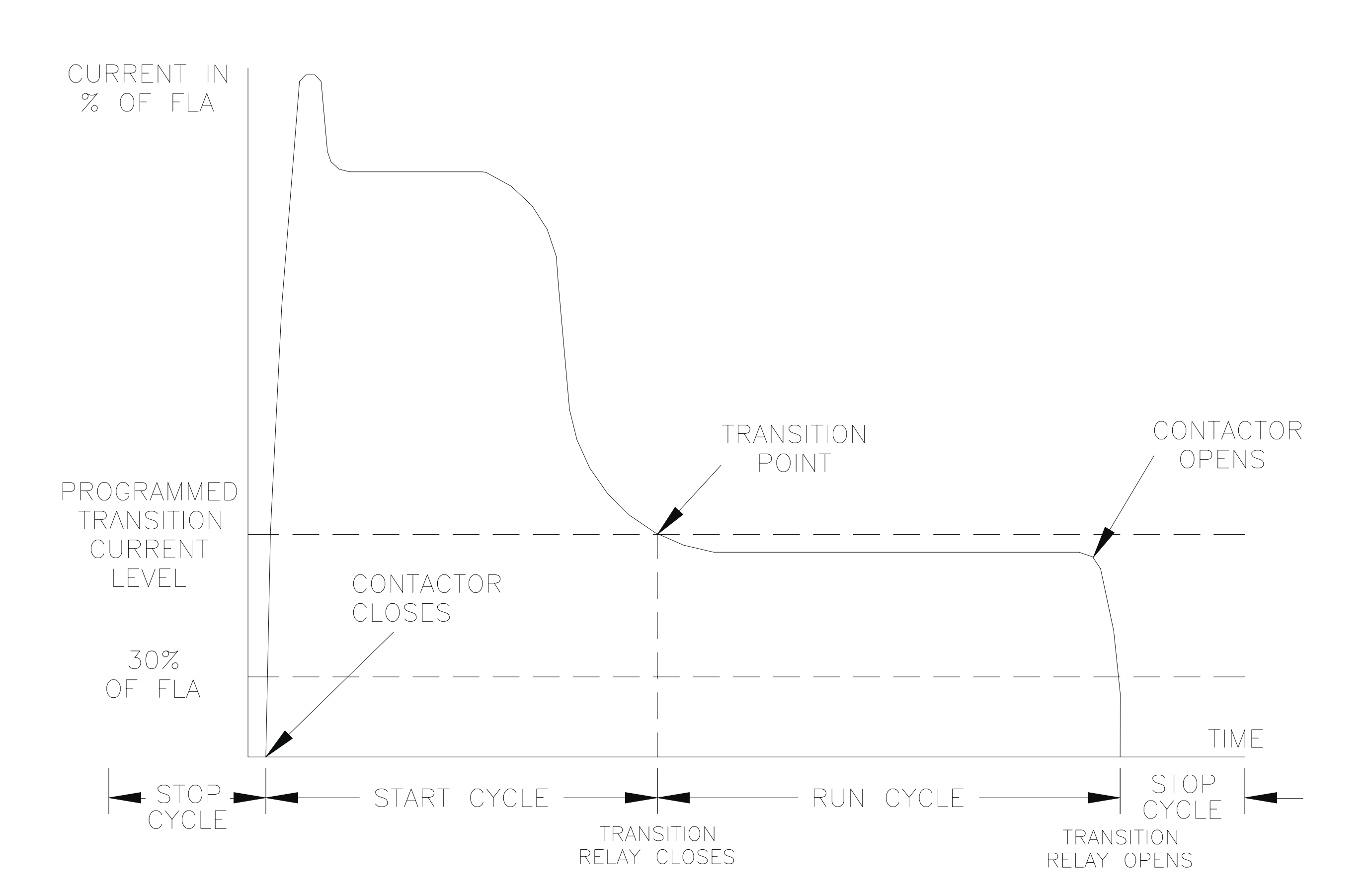

Fig. 9.6 Motor Start and Run Cycles

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SECTION 10—DATA COMMUNICATIONS

10.1 General

Most MP-3000 settings and operating data can be viewed or changed on the front-panel alphanumeric display. However, with the large volume of information and settings, many users will find it more convenient to view or manipulate the data on a host computer with its large graphic display.

The MP-3000 can communicate with Cutler-Hammer PowerNet®, PowerPort®, and previous-generation IMPACC® distributed control systems or host software via the communications port and an optional accessory PONI module mounted on or near the back of the relay.

PowerNet is a high speed, Ethernet based power management system, that networks state-of-the-art meters, relays, trip units, motor protectors, starters and transfer switch controllers for efficient energy management, real-time monitoring, alarming and trending of your electrical distribution system.

PowerPort is free software that can be downloaded from the Cutler-Hammer web site at www.ch.cutler-hammer.com. PowerPort is a portable, scaled-down version of the flexible and powerful PowerNet Power Management Software. Whereas PowerNet communicates to multiple devices over a network, PowerPort communicates to one device at a time via a direct connection. With PowerPort, you can configure a single device and view both real time and historical data from that device. The physical connection between a MP-3000 and a Personal Computer (PC) can be made in two ways: an RS232-PONI can be used (see Section 10.2) directly, or an I-PONI (see Section 10.2) with either a MINT II or a PMCOM5 to connect the INCOM network to the serial port of a PC. For details see the technical data sheet TD.17B.01.T.E at the above web site.

In addition to monitoring and programming, PowerNet and PowerPort can execute control through communications; including remote tripping, resetting, and emergency override.

One particular logging function, the starting current profile display, cannot be viewed on the relay faceplate. The profile data must be uploaded to a host computer using PowerNet, or PowerPort after the start. PowerNet and PowerPort provide an informative plot of the actual starting current curve, plotted along with the cold-start protection limit curve, for checking of coordination. Profiles are saved for the last four starts.

Older IMPACC systems do not directly support the MP-3000. However, the MP-3000 can be set to emulate the communications of the older Cutler-Hammer or Westinghouse IQ 1000 II motor relay. Download of settings is not possible in IMPACC.

10.2 Choosing a PONI

The PONI (Product Operated Network Interface) module is interchangeable among a number of available styles and provides the physical and electrical interface to several communications links or networks. The MP-3000 can work with at least the following PONI types:

- **I-PONI–INCOM Network PONI**—the recommended means of connecting to the robust INCOM communications network.
- **B-PONI–Buffered INCOM Network PONI**—an older INCOM PONI type which can only be used for communications in IQ 1000 II compatible mode. See Section 10.6 below.
- **RS232-PONI–RS-232 serial port PONI**—for connecting to the serial port of a PowerNet host computer or other serial device.
- **D-PONI–DeviceNet® PONI**—a translating PONI for connection to a DeviceNet control network. Check the firmware version of the D-PONI for compatibility with an IQ 1000 II or an MP-3000.
- **E-PONI–Ethernet PONI with 10BaseT or optical-fiber network connections**—for direct connection to a facility LAN which ties the MP-3000 to a PowerNet host client computer.

Contact a Cutler-Hammer sales engineer or the Power Management Products factory for updated information on availability of PONI types.

Each type of PONI has its own instruction leaflet, with information on mounting and connection.

10.3 Mounting the PONI

Attach the PONI to the back of the MP-3000 using the mounting bracket supplied with the MP-3000. If the URTD module is to be mounted on the back of the relay, mount the URTD module with its own bracket first; then attach the PONI to the back of the URTD module without the PONI mounting bracket. Section 6, Figure 6.3 shows the depth of the relay, with or without URTD module, and PONI attached to the back.

NOTE: Figure 6.3 applies for I-PONI, B-PONI, and D-PONI. The RS232-PONI is 0.1 inch deeper than Figure 6.3 shows. The E-PONI is 0.5 inch deeper than Figure 6.3 shows, as well as being larger in other dimensions.

10.4 Connecting the PONI to the relay

Each PONI type has a ribbon cable with a 9-pin D-sub connector. This plugs into the mating 9-pin D connector above the right (rear view) terminal block of the MP-3000. Secure with captive screws.

The PONI gets its operating power from the MP-3000 through the ribbon cable.

NOTE: The E-PONI draws more power from the relay than the other PONI types, and the E-PONI with optical Ethernet communications demands the most power. This can reduce the ability of the MP-3000 to ride through prolonged interruptions in the ac supply. See details in Section 9.3.

If voltage interruption ride-through is important and the E-PONI is used, power the E-PONI through its external-power connector from a separate power supply. This unburdens the MP-3000 power supply and restores full 25 to 50 cycle ride-through capability. See E-PONI instructions.

NOTE: For the MP-3000 only, PONIs can be “hot-plugged”—connected or disconnected with the MP-3000 powered. Hot-plugging may or may not be allowed with various combinations of other communicating products and PONI types—check instructions of each device.

10.5 Connecting the PONI to the network or host

Figure 10.1 shows an outline of the I-PONI. The INCOM network comprises a shielded twisted-pair conductor which is daisy-chained from one communicating device to the next as shown. There is only one INCOM network master, which is either a MINT (INCOM network to RS-232 port converter) or a CONI/CONI III (ISA card for PC with INCOM port on the rear flange).

INCOM provides full galvanic isolation of every communicating device from the network, and works reliably in noisy industrial environments. See IMPACC Systems Communications Manual, I.L 17384. For best results, follow the network wiring rules in the PONI I.L. and in the

IMPACC wiring specification, T.D. 17513. Proper handling of shield grounds (don't ground them everywhere) is important to good noise immunity.

For INCOM, every communicating device must be set to a unique address on the network, using address switches on the I-PONI or B-PONI as shown in Figure 10.1. Also, all devices must be communicating at the same baud rate, which will usually be 9600 unless some old devices are on the network.

For the RS232-PONI, use a computer serial communications cable to connect to the serial port of the PC running the host software. See PONI I.L. for pinout.

For DeviceNet and Ethernet connections, refer to the instructions for those PONIs.

PowerNet software is supplied with its own comprehensive instructions, which explain how to access MP-3000 data and control capabilities at the host client computer.

10.6 Emulating the IQ 1000 II with IMPACC host systems, B-PONI, and some D-PONIs

IMPACC host systems, B-PONI, and some translating D-PONIs predate the MP-3000, and cannot directly communicate with it. However, the MP-3000 has a communications mode in which it emulates the older IQ 1000 II relay, with which IMPACC, the B-PONI, and some D-PONIs can communicate.

To emulate IQ 1000 II communications, setting P12L15 should be set to **IQ2 EN**. If this mode is selected, the *communications* functionality of the MP-3000 will be restricted to that of the IQ 1000 II. The full *application* functionality of the MP-3000 is still available via the front panel even when set to IQ2 EN - only data communications are restricted. However, there is an important catch.

Table 10.1 lists the 50 (out of 154) MP-3000 settings, which correspond to 27 settings of the IQ 1000 II, for which the MP-3000 offers wider ranges or new options. If any of *these* settings are set to values which were not available in the IQ 1000 II (right column of table), then the MP-3000 cannot report settings to the host, and communications will not function.

The *IQ 1000 II Range* column gives the allowed setting ranges for these, so that the relay can talk to IMPACC in the IQ2 EN mode. The MP-3000 is shipped from the factory with default settings which support these IQ2 EN communications. But the default settings must be tailored to the motor—check the allowed ranges below. So, the application abilities of the MP-3000 may be slightly abridged if it must communicate with an older host.

Table 10.1 Allowed Ranges of MP-3000 Settings for Communications in IQ 1000 II Emulation Mode

MP-3000 Setting	*IQ 1000II Setting*	*Setting Description*	*IQ 1000II Range (Stay within these ranges to communicate in IQ 2 EN mode.)*	*MP-3000 Range (Stay within these ranges to communicate in IQ 2 EN mode.)*
P2L2	3	Winding temperature trip	0-199 C	OFF
P2L4	4	Motor bearing temp trip	0-199 C	OFF
P2L6	5	Load bearing temp trip	0-199 C	OFF
P2L8	6	Auxiliary temp trip	0-199 C	OFF
P2L3	7	Winding temperature alarm	0-199 C	OFF
P2L5	8	Motor bearing temp alarm	0-199 C	OFF
P2L7	9	Load bearing temp alarm	0-199 C	OFF
P2L9	10	Auxiliary temp alarm	0-199 C	OFF
P3L1	11	Ground Fault trip level	1-12 A	OFF, .2-2200 A
P3L2	12	Ground Fault Start Delay	1-20 Cycles	2-60 Cycles
P3L3	14	Ground Fault Run Delay	0-10 Cycles	0-60 Cycles
P3L5	16	IOC Start Delay	1-20 Cycles	2-60 Cycles
P1L3	18	Locked Rotor Time	1-60 s	1-120 s
P1L4	19	Ultimate Trip Current	85-125	85-150
P4L2	20	I2T Alarm	60-100%	OFF,60-99%
P4L3	22	Jam Alarm	100-1200% of FLA	OFF
P3L6	23	Jam Trip	100-1200% of FLA	OFF
P3L7	24	Jam Start Delay	0-60 s	0-1200 s
P3L10	28	Underload start delay	0-100 s	0-120 s
P3L11	29	Underload run delay	1-10 s	0-240 s
P4L7	30	Phase Unbalance Alarm	10-50%	OFF, 4 – 40%
P5L5	37	Transition current	50-150% FLA	10 – 300% FLA
P5L6	38	Transition time	0-240 s	0-480 s
P5L8	40	Incomplete Sequence time	1-60s	OFF, 1-240s
P5L12	41	Antibackspin time	0-600s (0 means OFF)	OFF,1-3600 seconds
P6L1	46	Program discrete input	REM RST, REM TRIP, DIF TRIP, MTR STOP, RST DBL	EMG OVR, ZERO SW
P9L1 Through P9L25	48	Trip State for AUX1 relay	All trips, IOC only, I2T only, GFLT only, JAM only, UL only, MBT only, LBT only, WT only, and REV only	Fully Programmable—over 4,194,304 possibilities including new load shed function

10.7 PowerNet INCOM communications protocol

The communications messaging protocol specification for the MP-3000 is open and available to users and communications systems integrators without charge. Check the Cutler-Hammer Power Management Products web site link at **http:\\www.cutlerhammer.eaton.com,** your Cutler-Hammer distributor, or the factory for detailed specifications and documentation.

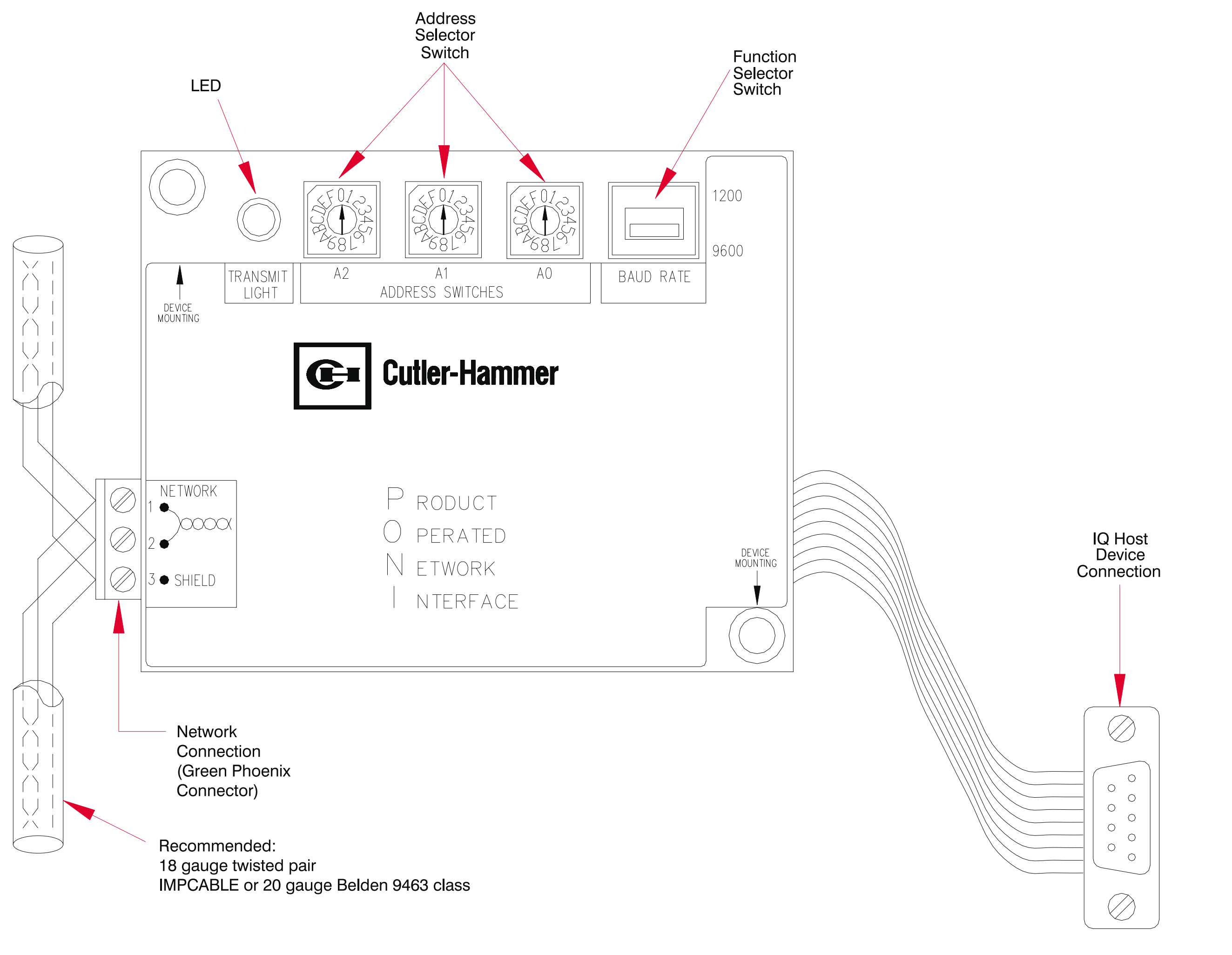

Fig. 10.1 Typical PONI Module

SECTION 11—TESTING

11.0 General

The MP-3000 requires no maintenance. Do not remove the rear cover. In most applications, normal cycles of use will demonstrate that the relay is functioning properly. Use the following procedures for bench checkout, or for verification of inputs and outputs that haven't been observed to function for one year or more. Users with normally trouble free applications should check the alarm relay, and the annunciator to which it is connected, at least annually.

11.1 What to test

The MP-3000 microprocessor routinely checks most of its own electronics, plus program memory and the writable, nonvolatile data storage memory. If it detects malfunctions, it reports specific messages, and has settings to alarm the user and/or trip the motor as desired. See Setting P12L16 in Table 4.3 and Section 5.12.16.

It is neither necessary nor beneficial to test individual functions of a multifunction microprocessor relay for maintenance purposes. All functions are performed by the same microprocessor electronics. It is important only to make sure the settings are correct (use View Setting mode any time), and to confirm that the inputs and outputs are working with the application wiring.

To test the MP-3000 inputs and outputs, use the SP TEST page in the Program mode. Refer to Sections 5.0 and 5.13 and to Table 4.3 for details on using the Program mode to activate test settings P13L1 to P13L8.

11.2 Tests on a Running Motor

In order to use any of the test settings on a running motor, the relay must be set to allow programming while running. See STOP PGM versus RUN PGM in Section 5.12.6 and Setting P12L6.

To test the *trip output* relay, the motor must be stopped in any case. An attempt to test this while the motor runs will bring an ILLEGAL message.

All other inputs and outputs can be tested while the motor runs.

⚠ DANGER

USING THE TEST SETTINGS WILL CHANGE THE STATE OF OUTPUTS, REGARDLESS OF THE FUNCTIONS NORMALLY OPERATING THOSE OUTPUTS. UNLESS TESTING IS URGENT, WAIT UNTIL THE MOTOR IS STOPPED TO RUN TESTS. IF THE MOTOR IS RUNNING, MAKE SURE THAT CHANGING THE OUTPUT STATE WILL NOT CREATE A DANGEROUS SITUATION IN THE MOTOR, STARTER, OR PROCESS.

11.3 Verifying Current Inputs

If the motor current readings were checked at the time of commissioning as described in Section 7, it is often adequate just to periodically observe the motor load current readings during normal motor operation. Use the phase current values on the MONT I page of the Monitor mode, or check values by remote communications. A clip-on ammeter can also be used, but allow tolerance for errors in the clip-on ct and in the main cts of the motor starter.

11.4 Bench Test of Current Inputs

Use a 3-phase source or relay test set to simulate motor load current; check correctness of readings considering the scaling of the PCT and GCT Ct ratio settings P1L5 and P1L6.

If a 3-phase source is not available, use the single-phase test mode of the MP-3000. Set P13L1 to 1 PHASE. A single current around 3.5 to 4 A can be applied to all four ct inputs, daisy-chained in series; observe the metered values considering PCT and GCT.

⚠ WARNING

BE SURE TO RETURN SETTING P13L1 TO 3 PHASE BEFORE RETURNING THE RELAY TO SERVICE. ALL PROTECTION FUNCTIONS THAT CHECK PHASE BALANCE OR SEQUENCE ARE DISABLED IN 1 PHASE TEST MODE. SEEING THE DISPLAY READY —1 IN THE MOTOR STATE MODE WHEN THE MOTOR IS STOPPED IS A WARNING THAT THE SETTING IS AT 1 PHASE. THE CORRECT DISPLAY IS READY —3.

11.5 Testing the Trip Relay

Stop the motor. The test is blocked if the motor is running. Enter Program mode, go to test setting P13L2. The trip relay contacts (terminals 11 through 13) can be monitored for proper operation, or observe the controlled-circuit operation. Refer to Figure 6.5 for rear panel terminal layout. To use this function:

- Determine whether the MP-3000 trip relay is configured for MODE 1 or MODE 2 operation - see SYSTEM Page Setting P12L1.
- If MODE1, the trip relay is normally de-energized. Set up for the test by selecting TRP ENER in P13L2.
- If MODE 2, the trip relay is normally energized. Set up for the test by selecting TRP DENR in P13L2.
- Push the **Reset** button to test the relay. The **Trip** LED also lights. Release the button to revert to the prior output state.

11.6 Testing the Alarm Relay

Use setting P13L3. The procedure is the same as for the trip relay test. Press the Reset pushbutton to light the Alarm LED and activate the alarm contacts (terminals 17 through 19). If the MP-3000 is set for RUN PGM, this output can be tested while the motor runs.

11.7 Testing the AUX1 Relay

Use setting P13L4. The procedure is the same as for the trip relay test. Press the Reset pushbutton to light the Aux 1 LED and activate the Aux 1 contacts (terminals 14 through 16). If the MP-3000 is set for RUN PGM, this output can be tested while the motor runs.

11.8 Testing the AUX2 Relay

Use setting P13L5. The procedure is the same as for the trip relay test. Press the Reset pushbutton to light the Aux 2 LED and activate the Aux 2 contacts (terminals 1 through 3). If the MP-3000 is set for RUN PGM, this output can be tested while the motor runs.

11.9 Testing the Analog Output

To test the 4-20 mA analog transducer output at terminals 24 and 25, use P13L6. Set the test output current level to be 4, 12, or 20 mA. Press the Reset button to force the selected test output current; release to return to the normal measurement-driven output.

11.10 Checking Discrete Input 1

Use P13L7 to see if discrete input 1 is either on or off. Apply or remove 120 Vac to check both states.

11.11 Checking Discrete Input 2

Use P13L8 to see if discrete input 2 is either on or off. Apply or remove 120 Vac to check both states.

SECTION 12—TROUBLESHOOTING

12.0 General

This section is designed to assist maintenance personnel in carrying out troubleshooting procedures. It gives three general areas of information:

- Operator Panel monitoring procedures (Paragraph 12.1)
- Troubleshooting monitored equipment (Paragraph 12.2)
- Troubleshooting the MP-3000 (Paragraph 12.3)

WARNING

ALL MAINTENANCE PROCEDURES MUST ONLY BE PERFORMED BY QUALIFIED PERSONNEL WHO ARE FAMILIAR WITH THE MP-3000 AND ITS ASSOCIATED MOTOR AND MACHINES. FAILURE TO OBSERVE THIS WARNING CAN RESULT IN SERIOUS OR FATAL PERSONNEL INJURY AND/OR EQUIPMENT DAMAGE.

ALL CORRESPONDENCE WITH CUTLER-HAMMER, WHETHER VERBAL OR WRITTEN, SHOULD INCLUDE THE SOFTWARE VERSION NUMBER WHICH APPEARS AS THE FIRST DISPLAY ON THE MONT MTR PAGE OF THE MONITOR MODE DISPLAY. SEE TABLE 4.2.

12.1 Panel Operations

The Operator Panel performs the following operations:

- System status message reporting (Paragraph 12.1.1)
- Programming setting values (Paragraph 12.1.2)
- Reviewing setting values (Paragraph 12.1.3)
- Monitoring motor operating parameters (Paragraph 12.1.4)
- Retrieving motor history data (Paragraph 12.1.5)
- Retrieving the logs of motor events (Paragraph 12.1.6)

Viewing the motor starting current profile (Paragraph 12.1.7) is available only through PowerNet, not on the front panel.

12.1.1 System Status Messages

The Display Window provides a reporting function during the normal operation of the MP-3000 with the Default Mode display. This group of messages is referred to as the system status messages. Table 4.1 lists the normal operation reporting messages.

12.1.2 Programming Settings

The Operator Panel is used to enter setting values. See Section 5 for a detailed procedure for entering or modifying setting values.

12.1.3 Reviewing Settings

141 of the 152 settings which actually configure MP-3000 functions can be reviewed at any time, even with the motor running. Press the View Setting mode button, and navigate through the settings in the same way as in the Program mode. Table 4.3 lists the settings. View Setting mode does not allow any changes.

To check settings of the real-time clock, use the MONT TIM page of the Monitor mode.

12.1.4 Monitoring Motor Operation

The Monitor mode allows maintenance personnel or operators to observe motor operating conditions including phase currents, unbalance, motor temperatures, thermal-model bucket level, and time limits on restarting imposed by jogging functions. See Table 4.2 for a listing and description of these parameters. Note that software version number appears in this mode.

12.1.5 Reviewing Motor History Data

Push the History mode button. See Table 4.4 for the four pages of information available for review in the History Mode, including the numbers of each of the different types of trips and alarms, and the highest currents and temperatures with time tags. The accumulation of these historical values can be selectively cleared and restarted using settings P14L1 to P14L4 in the Program mode. See Section 5.14.

12.1.6 Reviewing the Logged Motor Data

Push the Log mode button. Pages include a log book of the last 100 events, a log of the last 20 abnormal events with more details, and a detailed log of the last 4 starts. The MP-3000 logs motor events in chronological order with details and time tag as shown in Table 4.5.

12.1.7 Reviewing the Motor Starting Current Profile Curve

One particular logging function, the starting current profile display, cannot be viewed on the relay faceplate. The profile data must be uploaded via data communications to a PowerNet host computer after the start. PowerNet provides an informative plot of the actual starting current curve, plotted along with the cold-start protection limit curve, for checking of coordination. See Figure 2.1 for an example. The MP-3000 stores the profiles for the last 4 starts. See PowerNet Help function or users manual for instructions on viewing the profile. See Section 10 for information on connecting data communications to the MP-3000.

12.2 Troubleshooting MP-3000 Monitored Equipment

If the monitored equipment malfunctions, certain troubleshooting information from the MP-3000 assists in localizing the problem. The description is given in two categories—alarm conditions (Paragraph 12.2.1) and trip conditions (Paragraph 12.2.2).

WARNING

TROUBLESHOOTING PROCEDURES INVOLVE WORKING AT TIMES IN EQUIPMENT AREAS WHERE POTENTIALLY LETHAL VOLTAGES ARE PRESENT. PERSONNEL MUST HAVE ADEQUATE TRAINING AND EXERCISE EXTREME CAUTION TO AVOID INJURY, INCLUDING POSSIBLE FATAL INJURY.

12.2.1 Alarm Conditions

An alarm condition occurs when one of the electrical characteristics exceeds its programmed setting value. Start delays, and run or pickup delays, must expire before the alarm is raised. The red alarm LED lights and a message appears in the display window to assist with the isolation process. Multiple alarms are alternated or cycled in the display.

Connect external devices, such as an annunciator, to the Alarm relay of the MP-3000, to get the attention of operators who can act to solve the problem. The form c alarm relay contacts are brought out to terminals 17, 18, and 19 - see Figure 6.5.

Setting Page 8, settings P8L1 to P8L22, allow the user to select which alarm or trip events operate the alarm relay. Normally, the user should direct all alarms of functions in use to the alarm relay by these settings.

It is recommended to use the alarm relay in Mode 2, and to direct all alarm conditions to it. Connect the annunciator to terminals 17 and 18. With this connection, an alarm is raised if the relay or its power supply fails; as well as for all other problems the MP-3000 can actively report.

However, if the MP-3000 is deenergized routinely in service, use the alarm relay in Mode 1 and connect the annunciator to terminals 18 and 19 to avoid nuisance alarms.

The alarm condition is automatically cleared if the measurement causing the condition falls below the alarm setting. At this time, the Alarm LED and Alarm relay will reset.

All possible alarm conditions are listed in Table 12.1. Related probable causes and solutions are also shown in this table.

12.2.2 Trip Conditions

A trip condition operates the trip contact; and other contacts programmed to respond to the particular offending condition. These conditions fall into two groups:

- When the measurement is greater than the programmed setting value. Start delays, and run or pickup delays, must expire before the function can trip. The red Trip LED lights and a message appears in the Display Window to assist the operator.
- The MP-3000 may detect a malfunction. Is usually external to the motor control – such as a broken report-back signal circuit from the machine or process. There are also conditions that may be internal to the control system, such as a bypass of the trip contact or an MP-3000 internal self-monitoring failure. See Paragraph 12.3).

NOTE: The STEX alarm is conditional. While the motor is running, it is an alarm. If the motor is stopped before it clears, it becomes a trip. Refer to Sections 5.5.1 and 5.5.2.

Trip conditions have these features:

- A time tag and a listing of the metering values just prior to the occurrence of a trip is stored in memory and can be recalled by using the Log Mode Display (Table 4.5).
- For IOC and ground fault trips, the offending transient fault overcurrent values are saved in the log with the time tag.
- The Display Window automatically alternates between the last item displayed and the cause of the trip condition. If two or more trip conditions occur at the same time, the display alternates between or among the menu item and the cause of each trip.
- The internal Trip relay is always actuated. The other three output relays may be actuated, depending on output configuration settings and which specific trip occurred.
- The trip condition must be manually reset by using the Reset pushbutton. The remote reset input (terminal 8), the REMOTE INPUT or INCOM command, can also be used to reset the trip condition.

NOTE:

- A thermal-model trip (I2T trip) cannot be reset until the thermal bucket level drops (cools) below the I2T *alarm* setting.
- A trip caused by a jogging function (starts per time exceeded, antibackspin timing, time between starts) is not cleared by resetting, and counts down with remaining time visible on the display. The trip then clears itself.

Trip conditions from operating causes or motor problems are listed in Table 12.3. Related probable causes and solutions are also shown in this table.

NOTE: If the MP-3000 is in Program mode with the motor running and a trip condition occurs, the relay exits the Program mode without saving any setting changes which might have been entered in the scratchpad area up to that time. After diagnosing the trip, begin the reprogramming job over again. Note that the relay was protecting the motor with only its old settings at the time of the trip.

12.3 Troubleshooting the MP-3000

Troubleshooting the MP-3000 is straightforward. If the Operator Panel is inoperative (either the LEDs and the Display Window are off or they are not responding properly), check Table 12.3. When doing so, keep in mind that the most likely and easy to check problems are listed first.

WARNING

IF THE MP-3000 IS REPLACED, THE USER MUST REPROGRAM ALL SETTING VALUES FOR THE SPECIFIC APPLICATION IN THE NEW UNIT. *DO NOT* ATTEMPT TO RESTART THE MOTOR UNTIL ALL VALUES ARE ENTERED AND CHECKED. DAMAGE TO EQUIPMENT AND/OR PERSONNEL INJURY MAY OCCUR IF THIS PROCEDURE IS NOT FOLLOWED.

The MP-3000 can prevent saving settings that are inconsistent with proper protection. If a programming error of this type occurs the user will not be able to exit the programming mode by pushing **Prog**. See Section 5.0.1 *Conditional Setting Ranges* for more information.

The MP-3000 performs continuous internal diagnostic checks. If a malfunction is detected during a diagnostic check, one of the messages listed in Table 12.4 is displayed. The user setting P12L16 determines whether the relay just alarms for these problems, or alarms and trips the motor.

WARNING

USERS WITH CRITICAL PROCESSES MAY CHOOSE TO ALARM ONLY, BUT IT IS ESSENTIAL TO REPLACE THE RELAY AS SOON AS POSSIBLE. ASSUME THAT THE RELAY IS NOT PROTECTING THE MOTOR IF ONE OF THESE ALARMS OCCUR. MANUALLY MONITOR THE MOTOR AND PROCESS CLOSELY. DO NOT RELY ON MP-3000 DISPLAYS IN THIS CASE.

If the motor trips or alarms for one of these failures, the MP-3000 must be replaced. Return to the factory for repair. There are no user service procedures.

12.4 Technical Assistance

For information, technical assistance, or referral to an authorized distributor, or instructions for returning products for repair, contact Cutler-Hammer Power Management Applications Support at **1-800-809-2772, Option 1**. Or connect to our web site at **www.ch.cutler-hammer.com** and follow the **Power Management Products** link.

Table 12.1 Alarm Conditions

Display	*Complete Help Message*	*Probable Cause*	*Solution*
GND FAULT	GROUND FAULT ALARM	Insulation failure—ground current leakage	**DANGER.** Personnel hazard. Stop and isolate motor as soon as possible to avoid more dangerous or damaging fault. Get expert evaluation of motor insulation condition.
%I2T	I2T ALARM	The thermal-model bucket level has exceeded the alarm setting (60 to 100% of trip level).	•Determine if the motor is seeing larger than expected sustained loading. •Check for unbalance in supply currents or voltages causing negative-sequence heating. •Check for abnormal system voltage level. •Check for cooling air blockage or abnormal ambient. •Monitor the bucket level in Monitor mode to be sure level does not continue to rise to trip level.
STEX A	ALLOWED STARTS EXCEEDED, WAIT IN MINUTES	All of the allowed count of starts in the set time period have been used.	Wait the number of minutes shown on the display before restarting.
WD TEMP MB TEMP LB TEMP AX TEMP	STATOR WINDING TEMPERATURE ALARM MOTOR BEARING TEMPERATURE ALARM LOAD BEARING TEMPERATURE ALARM AUXILIARY OVER TEMPERATURE ALARM	In each case, the temperature is equal to or greater than the alarm setting value.	Check the problem value in the Monitor mode and determine the cause. Stator heat may be due to overload, or to cooling air flow blockage. Bearing heat usually indicates impending failure or lack of lubrication.
PH UNBAL JAM UNDER L	PHASE UNBALANCE ALARM LOAD JAM ALARM UNDER LOAD RUN ALARM	The electrical value has crossed the alarm threshold.	For unbalance, check source voltage balance, single-phase external loads, and uncleared unbalanced faults. Jam and underload—look for mechanical failures in driven process equipment.
RTDF 3W RTDF FIB URTDF	FAILED RTD COMMUNICATION -FIB- FIBER CHAN -3W- THREE WIRE CHAN FAILED URTD COMMUNICATION (log display only)	RTD temperature information reporting through designated medium has been lost.	Check wire or fiber channel medium for damage or disconnection. Check URTD module for power or malfunction.
RTF XX	RTD CHANNEL FAILED ALARM (xx = channel that failed)	A particular RTD or input to the URTD has failed.	Troubleshoot the designated RTD.
IOC GND FLT	INSTANTANEOUS OVERCURRENT TRIP GROUND FAULT TRIP	Electrical fault (short circuit) in insulation of motor or connecting circuits. **Note:** If a motor trips on IOC at the moment of starting, and an expert has confirmed no fault, the trip may be due to magnetic inrush. Adjust IOC trip level and start delay to ride through inrush peak.	**DANGER.** Shut down and lock out motor. Get expert help in evaluating condition of motor and repair needs. Do not try to restart without expert evaluation. After or during repair or replacement of motor, check fuses in starter and replace blown fuses.
JAM	LOAD JAM TRIP	Malfunction or jam of the driven process equipment.	Lock out motor starter for safety. Check process equipment.

Display	*Complete Help Message*	*Probable Cause*	*Solution*
UNDER L	UNDER LOAD RUN TRIP	Breakage or malfunction in the process driven equipment or drive shaft	Lock out motor starter for safety. Check shaft couplings, shaft keys for breakage. Look for blockage of process material flow to motor-driven equipment.
MB TEMP LB TEMP WD TEMP AX TEMP	MOTOR BEARING OVER TEMP TRIP LOAD BEARING OVER TEMP TRIP STATOR WINDING OVER TEMP TRIP AUXILIARY OVER TEMP TRIP	Bearings or bearing lubrication system has failed. Also, check RTD integrity. Sustained overloading of motor or cooling air flow blockage.	If RTD is OK, bearing will probably need replacement. Check airflow path. Look for cause of abnormal loading. Check for abnormal supply voltage.
LRC/I2T	LOCKED ROTOR/THERMAL OVERLOAD TRIP	The thermal-model bucket has filled to the trip level. **Note:** This trip cannot be reset until the thermal-model bucket has cooled (emptied) below the user-set I2T alarm level. This time depends on motor nameplate values entered as settings.	•Determine if the motor is seeing larger than expected sustained loading. •Check for unbalance in supply currents or voltages causing negative-sequence heating. •Check for abnormal system voltage level. •Check for cooling air blockage or abnormal ambient.
INC SEQ	INCOMPLETE SEQUENCE TRIP	Discrete input 2 has been set for the incomplete sequence timing function via setting P7L1. The 120 Vac feedback signal from the process or starter, expected within the user-set time delay, was not received in time after the start or transition. Also, the discrete input 2 must remain energized during the run cycle, until the motor stops. An interruption over 25 cycles will cause an incomplete sequence trip.	•Check to be sure this function has been intentionally enabled. •Check process feedback wiring to be sure 120 Vac signal is delivered in the expected time. • Use DI 2 test to confirm that relay sees input. • Check setting P5L8 against process feedback time. • Check setting P5L9 to be sure correct timing start point is selected - start or transition. •If timing from transition, be sure transition current and time settings are correct.
ZSW TRIP	ZERO SPEED SWITCH INPUT FAILED TO BE FALSE WITHIN 1/2 OF LOCKED ROTOR TIME, OR WAS FALSE AT START.	Discrete input 1 has been set for zero-speed switch sensing via setting P6L1. The 120 Vac zero speed switch contact input was not present at the moment of the start; or it did not go away in one-half of the set locked rotor or stall time P1L3. This may be due to a motor which is unable to start spinning when it is energized.	•Check to be sure this function has been intentionally enabled. •If ZSW trip occurs at the moment of starting, check process wiring and contact to be sure 120 Vac signal is delivered to DI 1 when the motor is stopped. •Check to be sure the motor isn't stalled and actually begins to spin. •If ZSW trip occurs after 1/2 the locked rotor time setting, check to be sure the contact on the motor opens and the 120 Vac signal goes away before this time. Usually, a zero-speed switch should open when the motor has reached 5% to 10% of its normal running speed. • Use DI 1 test to confirm that the relay sees the expected input voltage.

Display	*Complete Help Message*	*Probable Cause*	*Solution*
REMOTE	REMOTE TRIP	Either or both of discrete input 1 and/or discrete input 2 are set to indicate remote trip contact input. The input configure in this way was energized with 120 Vac.	Determine the source of the remote contact operation requesting the trip.
DIF TRIP	DIFFERENTIAL TRIP	Either or both of discrete input 1 and/or discrete input 2 are set to indicate differential trip contact input from an external differential relay. The input configured in this way was energized with 120 Vax.	**DANGER:** Shut down and lock out motor. A differential relay operation indicates an electrical fault. Get expert help in evaluating condition of motor and repair needs. Do not try to restart without expert evaluation. After or during repair or replacement of motor, check fuses in starter and replace blown fuses.
PH UNBAL	PHASE UNBALANCE TRIP	• Source voltage unbalance due to remote fault or single-phase loading. • Single phasing of the motor.	•Check voltage balance •Check integrity of feeder connections. •Check fuses in starter. •Do not attempt restart until cause of single-phasing is found.
PH REVRS	PHASE REVERSAL TRIP	At the time of starting, the phase sequence was reversed. The MP-3000 is set for non-reversing starter; the motor is never supposed to run backwards.	**DANGER.** Careless diagnosis and correction could lead to starting the motor in the wrong direction. The cause is: •Incoming source has swapped phases. Swap two of the incoming power leads L1, L2, or L3 to correct. •Ct wiring has swapped phases. Check wiring at Ct and relay end. Change the MP-3000 current transformer wiring by swapping the current transformer wiring terminals H1B-H2B with H1C-H2C. •Clearly mark the new wiring and update the drawings for future reference. •Check motor for correct direction of rotation at the moment of starting.
T BYPASS	TRIP BYPASS	The MP-3000 tripped, yet continued to see current flowing to the motor for more than a second after the trip.	•The contactor or breaker is stuck or jammed. •Or, someone has bypassed the trip contact so that the contactor remained energized after the trip. •Immediately open upstream source breaker or loadbreak switch. Lock out this switch and diagnose problem or find bypass in starter.
INCOM	INCOM REMOTE TRIP	A remote PowerNet or other data communications host requested a motor trip.	Determine the cause of the remote trip.
STEX MMM STEX T	MAX NUMBER OF STARTS PER TIME REACHED, REMAINING MINUTES ACTIVE SHOWN STARTS PER TIME TRIP (log display only)	Too many starts were performed in the user-set period of time.	Wait for the oldest start to clear from the stack. Observe countdown on display. See settings P5L1 and P5L2.

Display	Complete Help Message	Probable Cause	Solution
TBS MMM	TIME BETWEEN STARTS TRIP, REMAINING MINUTES ACTIVE SHOWN	Restarting blocked until user-set time between starts has expired.	Wait the indicated time before restarting. **Note:** The number of cold starts (NOCS) setting may suppress this blocking during the first n cold starts.
TRANSIT	LOW TO HIGH VOLTAGE TRANSITION ERROR TRIP	Starting current was still above the transition threshold P5L5 when the transition timer P5L6 delay expired.	•This trip is initiated only if setting P5L7 is set to TRN I or TRN T/C. Check the correctness of transition settings. •Check motor and load for a cause of slower than expected acceleration.

Table 12.3 Troubleshooting: Operator Panel Malfunctioning

Symptom	Probable Cause	Solution
All LEDs and displays are off or unintelligible.	Incoming ac deficient. MP-3000 malfunctioning	The MP-3000 operates down to 55% of rated voltage, but such a low voltage isn't normal and should be diagnosed. Verify that 120 or 240 Vac (±15%) exists between terminals 4 and 7. Remove ac power completely for 10 seconds and reapply. If problem persists, return the MP-3000 to the factory for repair.
OPTO ERR message	Optocoupler failure trip based on bad timing of ac input waveform zero crossings.	Check the frequency setting P1L7 for 50 or 60 Hz as appropriate. Make sure 120 Vac is used for discrete inputs. Energizing with dc will cause this error message.
Metered current readings too low or too high.	Incorrect current transformers and/or PCT ratio setting P1L5.	Acceptable Ct ratio is dictated by motor nameplate FLA. PCT should be set to the actual Ct ratio. See Ct application advice in Section 5, paragraph 5.1.5.

Table 12.4 Internet Diagnostic Failure Messages

Display	Complete Help Message
A/D ERR	A/D CONVERTER ERROR TRIP
RAM ERR	RAM ERROR TRIP
ROM ERR	ROM ERROR TRIP
OPTO ERR	OPTOCOUPLER FAILURE TRIP[1]
ZRAM ERR	NON VOLATILE MEMORY ELEMENT SHOULD BE REPLACED

NOTES:

1. Refer to Table 12.3 for OPTO ERR.
2. Setting P12L16 lets the user choose whether these internal failures produce alarm plus trip, or just an alarm.

SECTION 13—DRAWOUT CASE OPTION FOR THE MP-3000 MOTOR PROTECTION RELAY

CAUTION

COMPLETELY READ AND UNDERSTAND THIS INSTRUCTION BOOK BEFORE ATTEMPTING INSTALLATION, OPERATION OR APPLICATION OF THE EQUIPMENT. IN ADDITION, ONLY QUALIFIED PERSONS SHOULD BE PERMITTED TO PERFORM ANY WORK ASSOCIATED WITH THE EQUIPMENT. ANY WIRING INSTRUCTIONS PRESENTED IN EITHER DOCUMENT MUST BE FOLLOWED CLOSELY. FAILURE TO DO SO COULD CAUSE PERMANENT EQUIPMENT DAMAGE.

13.1 Introduction

This section describes the Drawout Case option for the MP-3000 Motor Protection Relay.

The basic operation of the MP-3000 relay is applicable to all styles of the drawout case. Table 13.1 lists the Drawout Case versions.

Table 13.1 Ordering Information

Description	*Cat. No.*	*Style No.*
MP-3000 Drawout Relay, 5 A, no communications	MP-3001	66D2033G01
MP-3000 Drawout Relay, 5 A, built in INCOM communications	MP-3002	66D2033G02
MP-3000 Drawout Relay, 1 A, no communications	MP-3101	66D2033G03
MP-3000 Drawout Relay, 1 A, built in INCOM communications	MP-3102	66D2033G04
MP-3000 Drawout **Inner Chassis**		
5 A, no communications	MP-3001-IC	66D2029G01
5 A, INCOM communications	MP-3002-IC	66D2029G02
1A, no communications	MP-3101-IC	66D2029G03
1A, INCOM communications	MP3102-IC	66D2029G04
MP-3000 Drawout **Outer Case**	MP-3001-OC	66D2035G01

13.2.1 General Description

The purpose of the Quick Release Drawout Case is to remove the relay from service without disconnecting the wires. The MP-3000 Drawout Relay maintains the same electrical and operating specifications as the standard MP-3000. Specifications for the Drawout connectors are shown in table 13.2.

Table 13.2 Drawout connector Specifications

Make/Break Rating	10 A @ 240 Vac nominal 0.25 A @ 280 Vdc maximum
Terminal Wire Gauge	No. 14 to No. 10 AWG
Screw Torque Requirements	18 inch-pounds

The MP-3000 Drawout consists of two assemblies: an inner chassis, and an outer chassis (see Figure 13.1). The outer chassis consists of an aluminum housing with terminal blocks, a molded plastic flange with quick-release actuators, and a locking mechanism.

Fig. 13.1 MP-3000 Drawout Relay

13.2.1 Self-Shorting Ct Connections

The Drawout terminal blocks features self-shorting, or short-before-break set of contacts, for Ct connections that maintain circuit continuity when the device is removed. These self-shorting contacts will prevent damaging voltages from existing across the current transformer windings.

An extra set of self-shorting terminals are provided that may be used to keep the motor running while the relay is out of its case or to provide a No Protection Alarm (see Section 13.5 for more information).

13.3 Installation

NOTICE

THE FOLLOWING MATERIAL SUPPLEMENTS INSTALLATION INFORMATION IN SECTIONS 6.1.1, 6.1.2, AND 6.1.3, AND FIGURES 6.1 AND 6.3. REFER TO THESE SECTIONS FIRST.

13.3.1 Panel Preparation

The Drawout case uses the same Panel Cutout as the fixed mount MP-3000, IQ1000II and IQ1000. When mounting the Drawout Case in a panel, it is necessary to prepare a cutout for the device per Figure 13.2. If a standard IQ cutout exists, no additional panel setup is required; the Drawout will mount securely in an existing 6-hole or 10-hole cutout.

13.3.2 MP-3000 Drawout Relay Parts List

Before mounting the Drawout Relay, check the contents of the box for the parts listed in Table 13.3 and shown in Figure 13.3.

Table 13.3 MP-3000 Drawout Relay Parts List

Description	*Quantity*
MP-3000 Drawout Inner Chassis	1
MP-3000 Drawout Outer Case	1
Outer Flange	1
Mounting Hardware – #10-32 nuts & lock washers	6 each
MP-3000 Instruction Book – I.B. 17562	1

13.3.3 Mounting the MP-3000 Drawout Relay

1. Remove the Drawout Inner Chassis from the outer case.

2. Place the outer case flush against the backside of the panel so that the case studs project through their respective holes. Refer to Figure 13.3 for panel mounting diagram.

3. The plastic outer flange is seated on the front of the panel and is attached to the top, center, and bottom studs that protrude through the panel with the #10-32 hex nuts and lock washers included with the relay.

   NOTE: Use only the supplied narrow-profile nuts. Standard-width 10-32 hex nuts will interfere with the insertion of the inner chassis.

4. The relay inner chassis can now be inserted into the case and checked for seating into the latching mechanism.

13.3.4 Mounting the URTD Module

There are no provisions for mounting the URTD module on the MP-3000 Drawout Case. The URTD module must be mounted remotely to the MP-3000 Drawout.

The URTD module has both an electrical and fiber optic communication interface to the MP-3000 relay. The electrical connections are made through the terminal blocks. The fiber optic cable is run through the opening in the back of the outer case and connected directly to the inner chassis before it is fully inserted—see Section 13.4.1.

13.3.5 Mounting The PONI Communication Module

The MP-3000 Drawout Relay must be ordered with the communication module as it is integral to the inner chassis construction and wired through the terminal connectors. The MP-3000 drawout relay is available with INCOM communications only.

The communication address is set via switches accessible on the inner chassis.

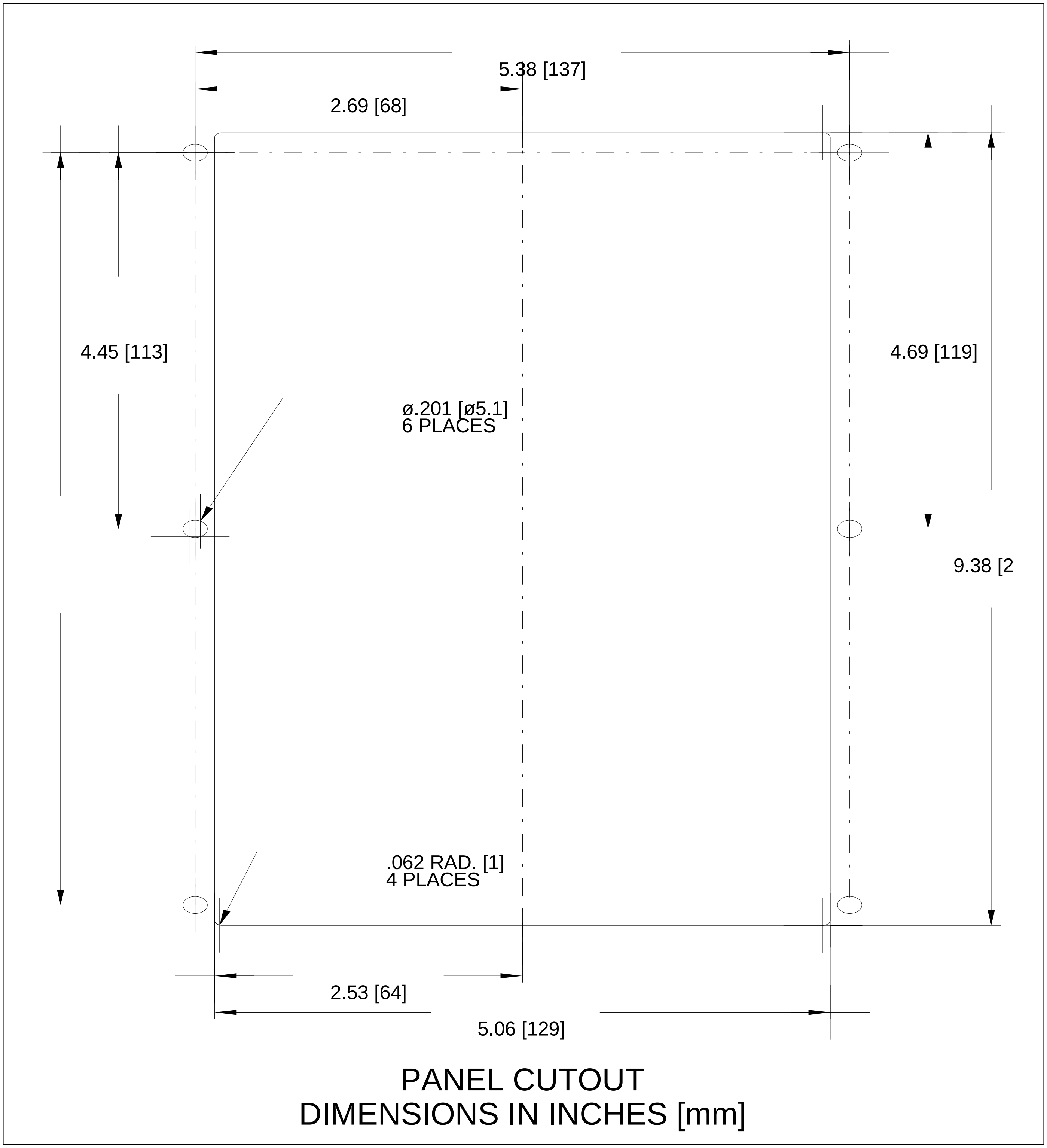

Fig. 13.2 MP-3000 Drawout Panel Mounting

13.4 Wiring and Setup

WARNING

ENSURE THAT THE INCOMING AC POWER SOURCES ARE DISCONNECTED BEFORE PERFORMING ANY WORK ON THE MP-3000 PROTECTIVE RELAY OR ITS ASSOCIATED EQUIPMENT. FAILURE TO OBSERVE THIS PRACTICE COULD RESULT IN SERIOUS INJURY, DEATH AND/OR EQUIPMENT DAMAGE.

The following material supplements the information in Section 6.2.

Refer to Figures 13.4 through 13.7 for the MP-3000 drawout typical connection and wiring diagrams. Note the following:

1. Direct wire connections to the terminal blocks must be sizes #14 AWG to #10 AWG. The appropriate sized spade and ring lugs can also be used to accommodate the wires.

2. In each terminal block, you must wire the lower tier terminals before the upper tier terminals.

3. All contacts are shown in the deenergized position.

NOTE: Each output relay may be configured for mode 1 or mode 2 operation. In mode 2, the relay is energized when control power is applied to the MP-3000. For mode 2 operation, the contacts will normally be in the opposite state from that shown. See Section 13.5.

4. The INCOM communications LED can be seen through a hole in the outer case on the left side.

NOTE: All wiring must conform to applicable federal, state, and local codes.

13.4.1 Fiber Optic Installation

The URTD fiber optic cable is connected directly to the inner chassis. The following instructions describe the proper installation procedure:

1. Remove the relay inner chassis from the outer case assembly.

2. Route the fiber optic cable through the grommeted hole in the back of the outer case – see Figure 13.1.

3. The fiber should be long enough to extend 2 – 3 inches out of the front of the case.

4. Carefully hold the fiber to the left inner side of the case and insert the relay inner chassis half way into the case.

5. Connect the fiber cable to the fiber optic connector on the relay inner chassis. The fiber plug on the cable has a latching mechanism that locks the fiber cable into the fiber outlet.

6. Carefully push the relay inner chassis the rest of the way into the case until the quick release latches engage.

NOTE: Be careful not to kink or bend the fiber cable when inserting the relay inner chassis.

Fiber cable disconnection

To remove the relay inner chassis from the case when the fiber cable is used perform the following procedure:

1. Unlatch the inner chassis from the case and remove half way out.

2. Disconnect the fiber cable by squeezing the connector latch and gently pull the fiber plug from the fiber socket.

NOTE: Failure to disconnect the fiber cable from the relay inner chassis can result in damage to the fiber and possibly the fiber socket.

3. Continue to remove the relay inner chassis.

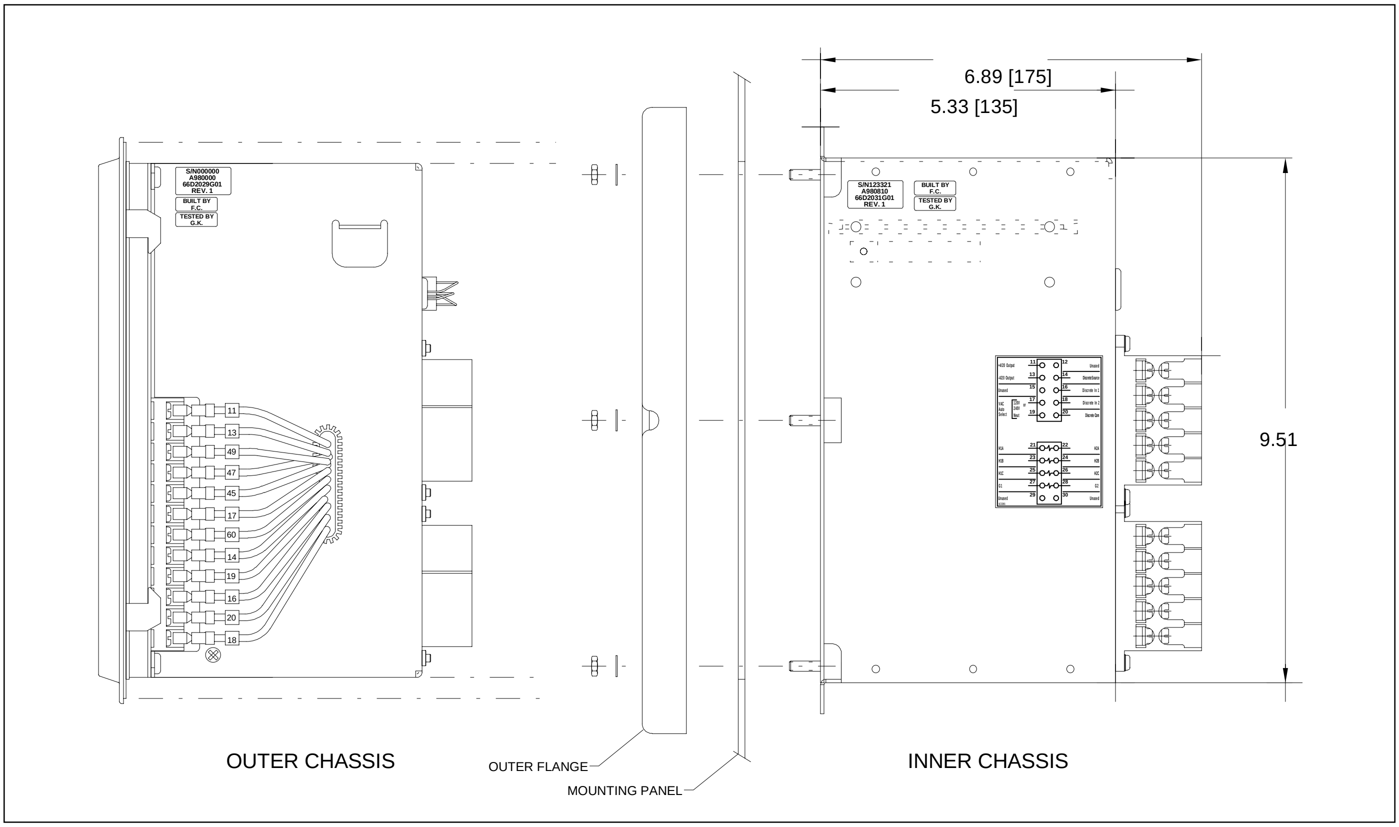

Fig. 13.3 MP-3000 Drawout Panel Mounting

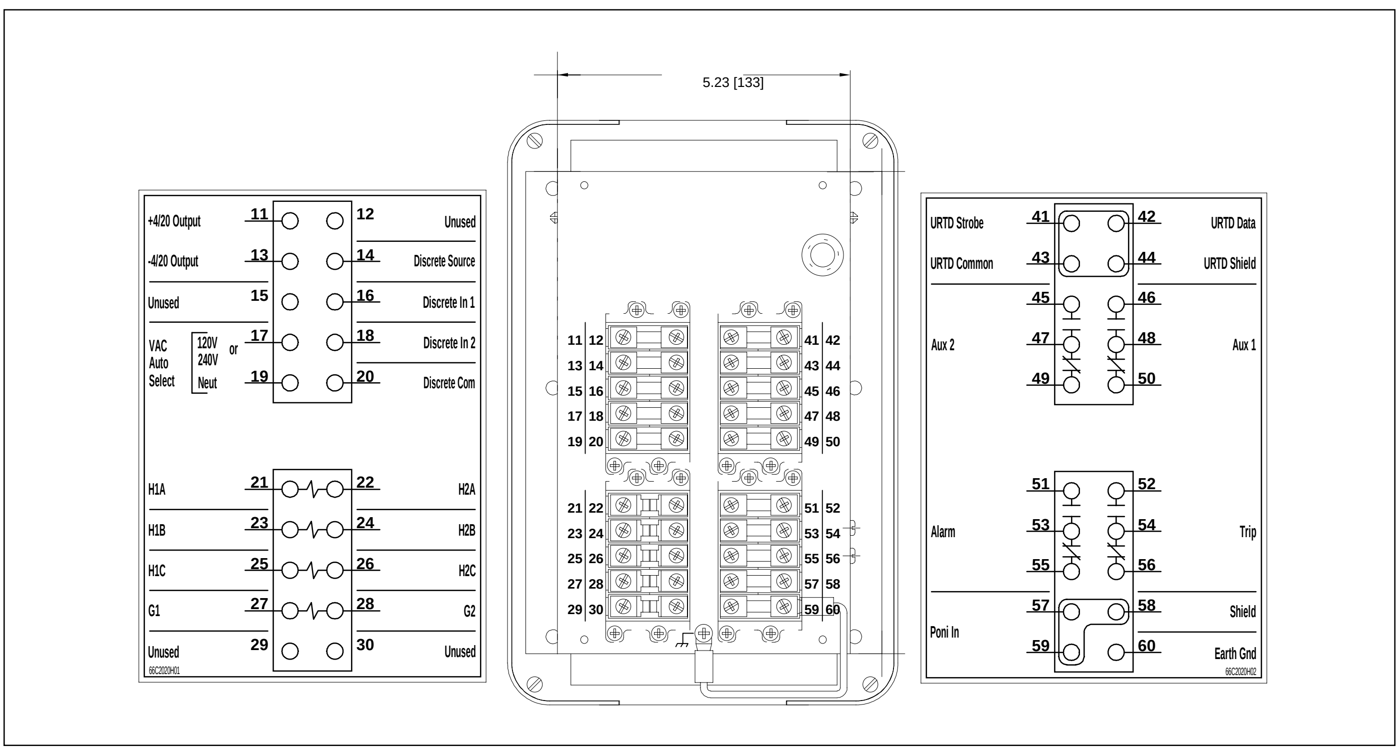

Fig. 13.4 Rear View of MP-3000 Drawout Outer Case

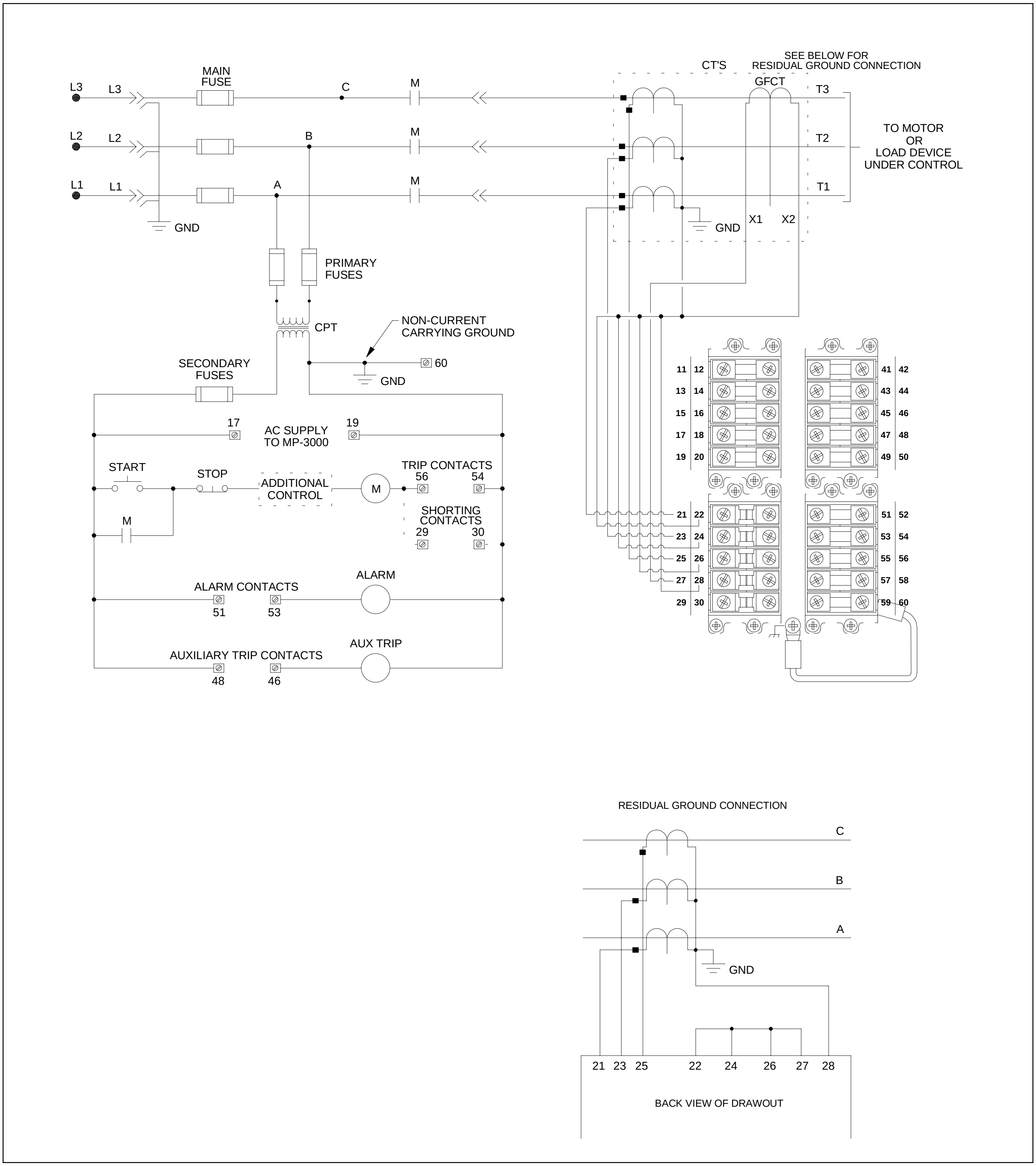

Fig. 13.5 MP-3000 Drawout Typical Ct Circuits and Motor Control Wiring

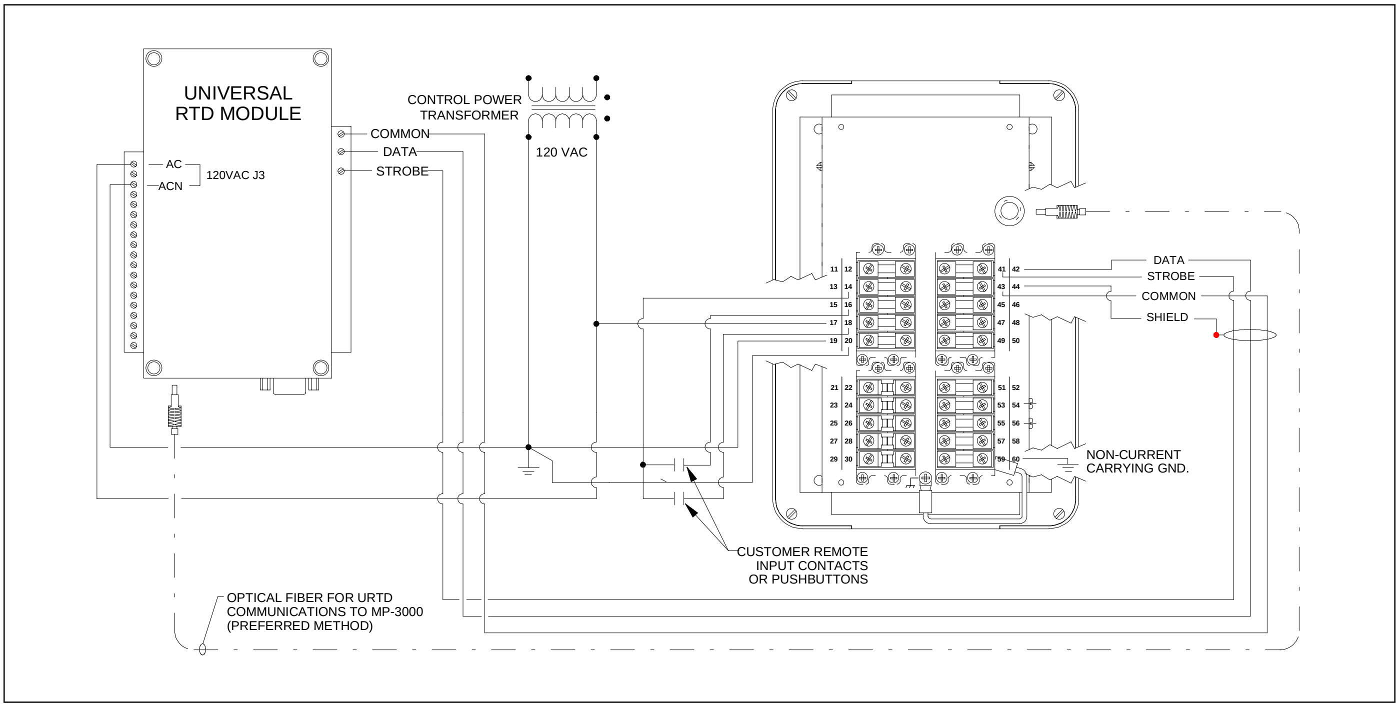

Fig. 13.6 MP-3000 Drawout Typical AC Supply and urtd wiring

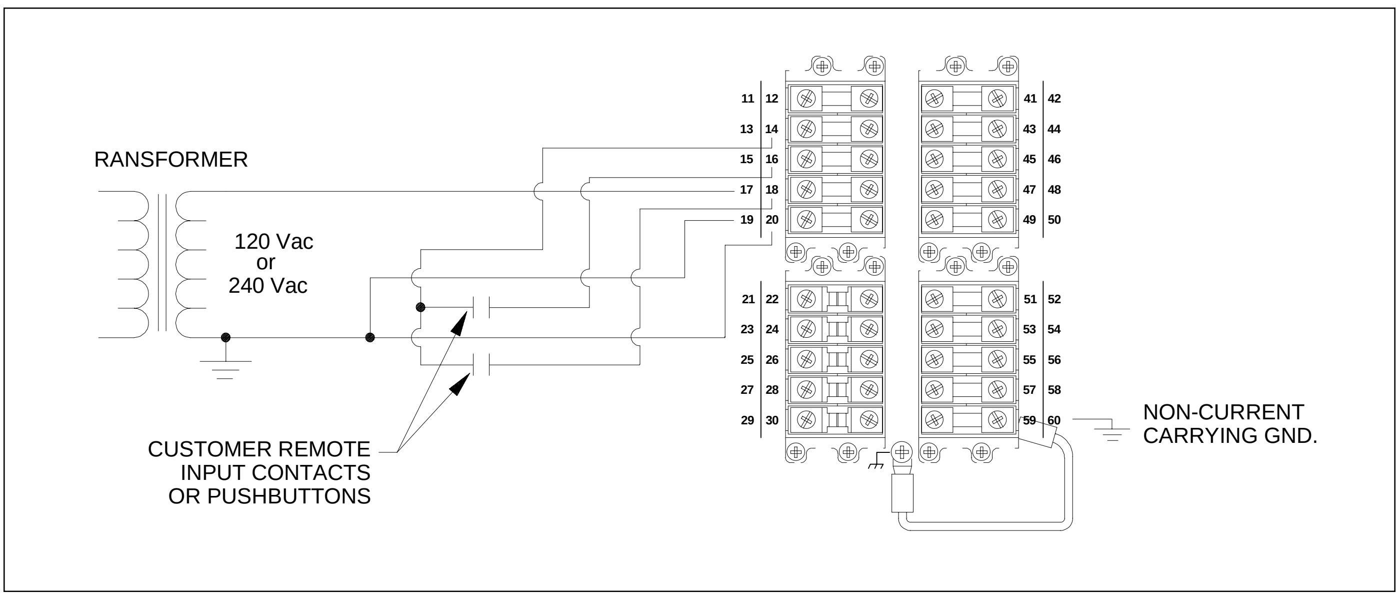

Fig. 13.7a MP-3000 Drawout Alternatives for Discrete Input Wiring

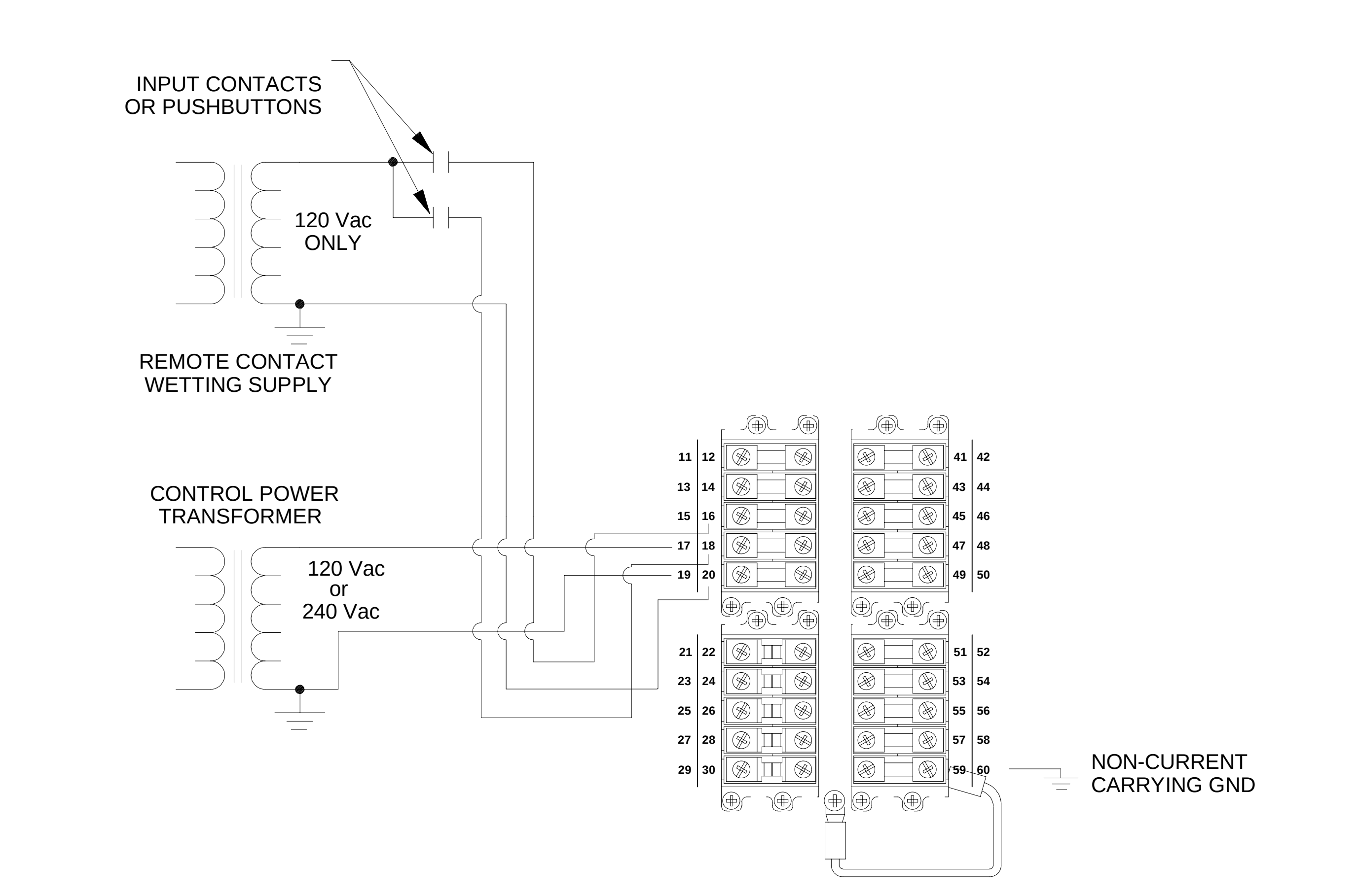

Fig. 13.7b MP-3000 Drawout Alternatives for Discrete Input Wiring

13.5 Application Considerations

13.5.1 Mode 1 and Mode 2 Output Contacts

The outputs of the MP-3000 relay can be configured in either mode 1 or mode 2 operation. Refer to sections 5.12.1 and 6.2.2 for more information on the functionality of mode 1 and 2.

Upon removal of the relay inner chassis from the case, all contacts will be disconnected unless the spare self-shorting contact is used as described in Section 13.5.2.

13.5.2 Use of Spare Self-Shorting Contact

The MP-3000 drawout case provides a spare self-shorting contact on terminals 29 and 30 (refer to Figure 13.4). This contact may be used for continuous motor operation with the relay inner chassis removed from the case while in mode 1 setting. It can also provide a protection out of service when the relay is removed from the case.

Continuous Motor Operation

To provide for continuous motor operation when the relay is removed simply set the relay trip output to Mode 1 operation and wire accordingly. Wire terminals 29 and 30 in parallel with the normally closed trip contacts terminals 54 and 56. Figure 13.5 shows this optional wiring configuration.

This feature is not recommended for Mode 2 operation.

Relay Out of Service Alarm

The spare self-shorting contact may be connected to provide a relay out of service alarm simply by wiring terminals 29 and 30 to an alarm or annunciation panel. Proper control voltage must be supplied for the alarm. When the relay is removed from its case, the self-shorting terminals 29 and 30 will close. When the relay inner chassis is reinstalled, the contact opens and the alarm is removed. Note that this alarm can only be reset when the relay is installed in its case.

13.5.3 Armed/Disarmed Operation

The ARMED/DISARMED feature is most useful when the relay is fitted in the optional drawout case. This feature blocks operation of the trip output contacts but not the protection displays. This permits the insertion of the relay without risk of tripping a critical motor due to improper setting. The relay will provide relay alarm and trip status indication. If this occurs upon insertion, the user has the option to review applicable protection settings to verify they are correct. Refer to sections 5.12.18 and 9.2.7 for more information on the proper application and considerations of the ARM/DISARM feature.

NOTE: The relay must be placed back into the ARMED mode before completing the installation. Failure to do so will disable the motor protection and may result in serious motor and equipment damage.

13.6 Drawout Operation

13.6.1 Inserting the Relay

Before the MP-3000 is inserted into the Drawout Outer Case:

- Verify that all wiring is correct as shown in the wiring diagram.
- Set the INCOM communication device address.
- If the URTD fiber optic cable is used refer to Section 13.4.1 for special instructions concerning the proper installation of the fiber.

When inserting the MP-3000 inner chassis into the drawout outer case, use the guides to align the exterior of the inner chassis with the interior of the outer case. Slide the unit into the Case using the guides, pressing firmly until all four latches located on the sides of the device are seated and latched into place. *Tabs on the MP-3000 Drawout Inner Chassis will prevent the inner chassis from being inserted upside down or being inserted into an outer case of another relay or IQ metering product.*

CAUTION

THE MP-3000 INNER CHASSIS MUST BE FULLY INSERTED AND FULLY LATCHED IN TO ITS DRAWOUT OUTER CASE FOR PROPER OPERATION OF THE DEVICE.

When the unit is seated properly, the quick release buttons at the top and bottom of the unit will return to their non-compressed position. The device can now be secured in the outer case by inserting a locking ring or meter seal in the provided slot.

13.6.2 Removing the Relay

WARNING

REMOVAL OF THE MP-3000 INNER CHASSIS FROM THE DRAWOUT OUTER CASE EXPOSES LIVE PARTS, WHERE THE HAZARD OF A FATAL ELECTRIC SHOCK IS PRESENT. ALWAYS DISCONNECT ANY CONTROL OR SOURCE POWER BEFORE TOUCHING ANYTHING ON THE INTERNAL OR EXTERNAL PARTS OF THE DRAWOUT OUTER CASE.

When removing the Inner Chassis from the Drawout Outer Case, first remove any locking ring that has been installed. Press the top and bottom quick release buttons simultaneously, and pull the relay out by its front panel.

NOTE: If the URTD fiber cable is used, refer to Section 13.4.2 for proper removal of the relay to prevent damage to the fiber optics.

13.7 Warranty and Liability Information

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13.8 Technical Assistance

For additional information, technical assistance, or referral to a local authorized distributor, contact Power Management Applications Support at **1-800-809-2772 or www.ch.cutler-hammer.com** and follow the power management products link.

Cutler-Hammer
Pittsburgh, Pennsylvania U.S.A.

Publication No. I.L. 17562A
May 2001
Printed in U.S.A./00000000