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Protective relays
MP-3000 motor protection

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Powering Business Worldwide

MP-3000 motor protection

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- Optional interface capability to computer network for data collection, storage and/or printout via the Cutler-Hammer® PowerNet™ system

Physical characteristics

- User-friendly interface
- Large LED display
- Optional quick-release drawout case
- Height: 10.25 inches (260.4 mm)
- Width: 6.72 inches (170.7 mm)
- Depth: 2.54 inches (64.5 mm) without PONI, 4.39 inches (111.5 mm) with PONI

Standards and certifications

- UL® recognized (file number E154862)
- UL 1053 recognized
- UL 508 recognized
- ANSI C37.90, C37.90.1, C37.90.2
- CSA®

General description

Eaton's Cutler-Hammer MP-3000 motor protection relay is a multi-functional microprocessor-based protective relay for the protection of any size motor at all voltage levels. It is most commonly applied on medium voltage or larger motors. The MP-3000 relay is a current-only device that provides complete and reliable motor protection, monitoring, and starting control functions.

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 two-stage contact disconnects and self-shorting CT circuit terminal blocks. A spare self-shorting terminal pair is available for use as a relay removal alarm or for continuous motor operation (non-failsafe mode) on relay removal. The optional communication module is externally mounted on the fixed mount case and internally mounted in the drawout case.

The MP-3000 motor protection relay has three-phase and one ground current inputs. Both a 5A and 1A version are available. The ground protection and metering functions can be used with either a zero sequence ground CT or from the residual connection of the phase CTs. The zero sequence ground CT provides greater ground fault sensitivity than the residual connection. The unit is user-programmable for 60 Hz or 50 Hz operation.

The MP-3000 motor protection relay has two discrete inputs, four Form C (1 NO and 1 NC) contacts and one 4 to 20 mA analog output. A fused source is available for the discrete inputs on the MP-3000. This eliminates additional control circuit wiring. The relay provides maximum user flexibility to configure the I/O. All inputs and outputs (except for the trip output) are user-programmable. In addition, the relay has 10 LEDs for the indication of protection on, program mode, monitor mode, view setting mode, history mode, log mode, trip, alarm, auxiliary 1 and auxiliary 2 operation. Monitor mode provides display indication of the discrete input states. The program mode provides testing of the output relays, target LEDs, and analog circuit.

A user-friendly operator interface and display provides quick access to the settings, monitored values, motor history, and operational logs. The large LED alphanumeric character display provides easy viewing from any angle in any light. Simple keypad operation provides 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 help function provides an online description display of functions, abbreviations, and operations.

Optimum motor protection

The MP-3000 motor protection relay has been designed for maximum motor operation and protection. It permits running the motor close to its design limits while protecting it against excessive heating and damaging overload conditions. The MP-3000 field-proven protection algorithms were developed based on motor designs and operating parameters for optimum operation and protection while minimizing nuisance tripping.

The MP-3000 motor protection relay utilizes a patented protection algorithm and measurement technique based on proven positive and negative (unbalance) sequence current sampling and true Rms calculations.

Features

- Built-in help program
- Built-in test mode
- LED indication
- Microprocessor-based
- Self diagnostics
- Programmable binary inputs
- Programmable outputs
- Real-time clock

Alarming

- Ground fault
- I^2t overload
- Jam/stall
- Underload
- Phase unbalance
- Temperature

Control features

- Transition for reduced voltage starts:
  - Transition on current level
  - Transition on time
  - Transition on current level or time
  - Transition on current level and time
- Incomplete sequence delay
- Permits number of cold starts
- Limits number of starts per time
- Time between starts
- Antibackspin time delay
- Mechanical load shedding
- Zero speed switch for long acceleration motors
- Motor stop input for synchronous motor applications
- Remote trip input
- Differential trip input
- Emergency override

Monitoring functions

- Motor currents:
  - Average current (I av)
  - Individual phase and ground current in primary amperes
  - Percent of full load
  - Percent phase unbalance
- RTD temperatures:
  - Individual winding
  - Motor bearing
  - Load
  - Auxiliary temperature
- Motor conditions:
  - Percent of I^2t thermal bucket
  - Time before start
  - Remaining starts allowed
  - Oldest start time
- Time and date

History

- Motor history:
  - Operational counter
  - Runtime
  - Highest starting and running currents
  - Highest percent phase unbalance
  - Maximum winding, bearing, and load RTD temperatures
  - Number of emergency overrides
- Trip history (number of trips):
  - Ground faults
  - Overloads
  - Instantaneous overcurrent
  - Jam
  - Underload
  - Phase unbalance
  - RTDs
  - Phase reversal
  - Incomplete sequence
  - Remote, differential
  - Communication
  - Starts exceeded
  - Time between starts
  - Transition
- Alarms history (number of alarms):
  - Ground faults
  - Overloads
  - Jam
  - Underload
  - Phase unbalance
  - RTDs
  - Starts exceeded
- Permanent history (record which cannot be reset):
  - Total trips
  - Runtime
  - Operations count

Logging

- Log book (chronological list of events)
- Event log (detailed information of trips and alarms)
- Start log (data on most recent two starts)

User interface

The MP-3000 motor protection relay has a user-friendly interface that makes it easy to retrieve important information or make setting changes. LEDs provide visual indication of display and keypad mode. The pushbuttons are clearly labeled and quickly access the desired information.

Protection functions

The MP-3000 motor protection relay provides protection against motor overloads, short circuits, and abnormal operating conditions.

Intel-I-Trip (I^2t) overload protection

The MP-3000 motor relay features the exclusive Cutler-Hammer Intel-I-Trip intelligent overload protection system. Intel-I-Trip develops custom overload curves simply from motor nameplate data. Intel-I-Trip protects motors from potentially damaging overload and abnormal operating conditions.

The Intel-I-Trip intelligent overload protection feature utilizes field-proven measurement techniques and a patented motor thermal protection model. The MP-3000 motor relay's unique measurement technique samples the current waveforms 36 times per cycle, providing accurate measurements of the positive and negative sequence currents. The negative sequence current causes a greater heating effect on the rotor and has a greater impact on the thermal model in the relay. Intel-I-Trip utilizes these measurements in its motor model to safely protect the motor against the heating effects of these currents.

The motor thermal model is analogous to a bucket that is being filled and drained at the same time. The fill rate is dependent on the motor currents and the drain is based on motor design principles. The size of the bucket is equivalent to the thermal capacity associated with the mass of the motor. Intel-I-Trip integrates these rates and will issue a trip when the thermal capacity is filled.

Intel-I-Trip features adaptive trip characteristics that adjust the trip times based on measured motor temperature when RTDs are used.

Instantaneous overcurrent

The MP-3000 motor protection relay provides an instantaneous phase overcurrent function to trip the motor for high fault current levels and save the fuses. This function can be disabled and has an adjustable time delay on starting to avoid nuisance tripping on inrush.

Phase unbalance protection

Motor supply circuits are often fed through fuses and can be run with a single-phase fuse blown, referred to as single phasing the motor. The MP-3000 motor protection relay measures the current unbalance and can be used to alarm or trip the motor before damage occurs. Pickup, start, and run timers and a separate alarm setting are provided.

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 breakdown to ground. The relay ground circuit can be connected residually from the three-phase CTs. The ground fault protection has pickup and time delay set points or can be disabled.

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.

Underload protection

The user selectable underload 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.

Reduced voltage starting

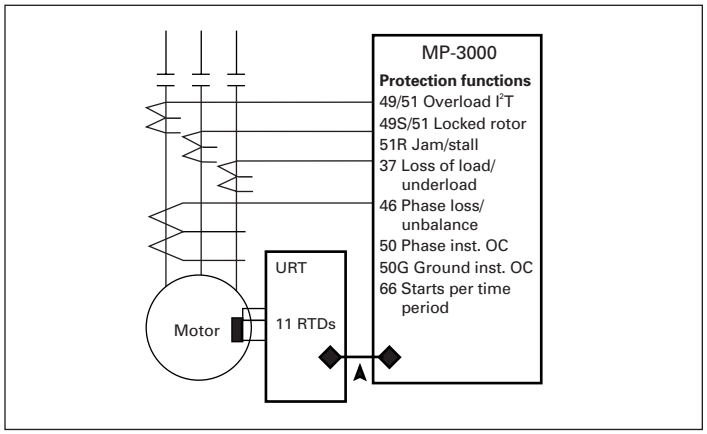

Figure 1. MP-3000 motor relay protection functions

The MP-3000 motor protection relay provides a transition and incomplete sequence function for reduced voltage starting. The user can select to transition based on the current level and/or on time.

Antibackspin

The stop function is programmable from 2–20%.

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 relay provides an antibackspin timer to prevent starting the motor while it is spinning in the reverse direction. The timer begins counting from the moment a stop is declared by the relay.

Start control timers

Motors typically have limits to the number of cold starts, starts per time period, or time between starts that are permitted without damage. The MP-3000 motor protection relay incorporates these timers to prevent starting the motor beyond its capabilities.

Load shedding

The MP-3000 motor protection relay provides a mechanical load-shedding feature that can be used to control an upstream process. The load-shedding function closes a contact on an overload condition to control an upstream process from adding more load until the overload condition is gone.

Emergency override

The MP-3000 motor protection relay has a user-programmable feature that will let the operator reset the start inhibitor timers and thermal overload bucket. This function is intended for use in emergency conditions only, and it may result in motor damage or failure.

Long acceleration motors

Large motors with a high inertia may experience starting currents that exceed the locked rotor current and time. The MP-3000 motor protection relay has logic and provisions for a zero speed switch input to differentiate between a stall and start condition. If the motor is spinning, then the relay will not trip on the normal locked rotor time allowing the motor to start.

Remote/differential trip

One of the binary 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 information and utilizes the trip contacts of the MP-3000 motor protection relay. It will also record and log the motor information at the time of the trip.

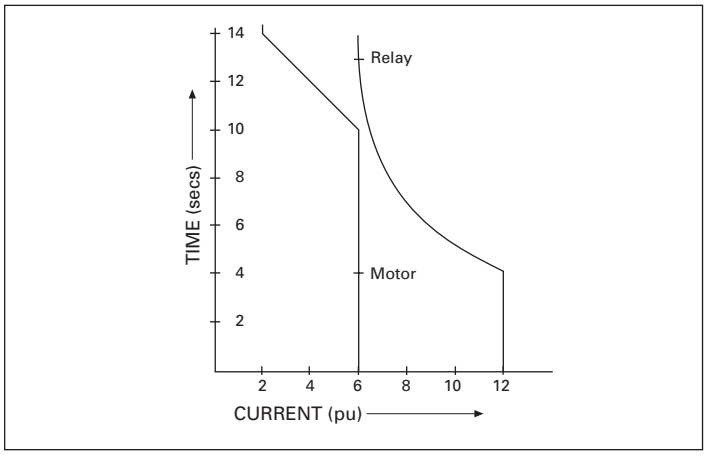

Figure 2. Motor starting profile time/current chart

Specifications

Control power

Nominal rating:	120 Vac or 240 Vac (+10%, –25%)
Frequency:	50 or 60 Hz
Power use:	15 VA maximum URTD: 6 VA maximum IPONI: 1 VA maximum
Operating range:	120 Vac: 90–132 Vac 240 Vac:180–264 Vac
Ride-through time:	20 cycles at nominal Vac

Current inputs

Nominal (I_n):	1A or 5A
CT rating:	2 x I_n continuous 40 x I_n for 1 second
Phase burden:	0.25 VA at 5A 0.01 VA at 1A

Metering accuracy

Phase current:	± 1 % of I_n (0%–100%) saturation 57A
Ground current:	± 1.5 % of I_n (0%–55%) saturation 20A

Discrete inputs

Number of inputs:	2 programmable
Rating:	1.2 VA at 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 seconds
(Resistive)	Break 0.25A at 250 Vdc Break 5A at 120 240 Vac
Continuous:	5A at 120/240 Vac 5A at 30 Vdc

Analog output

Rating:	± 4 to 20 mA programmable
Maximum load:	1K ohm
Accuracy:	1%

Motor overload protection (I^2t)

Full load amperes:	10 to 3000A
Locked rotor current: time:	300 to 1200% FLA 1 to 20 seconds
Ultimate trip current:	85 to 125% FLA
Phase CT ratio:	10 to 4000: I_n
Ground CT ratio:	10 to 4000: I_n
Timing accuracy:	± 2.5% or ±100 mS For I > 1.1x U.T.C.
CT/FLA range:	4 to 1

Trip setting range

Ground fault (GF):	Off, 2% to 55% CT ratio
GF S/R time delay:	0 to 60 cycles
Timer accuracy:	± 20 mS
Instantaneous O.C.:	Off, 300 to 1600% FLA
IOC S/R time delay:	0 to 60 cycles
Timer accuracy:	±20 mS
Jam trip:	Off, 100 to 1200% FLA
Underload trip:	Off, 1 to 90% FLA
Phase unbalance trip:	Off, 4 to 40% I_{neg}/I_{pos}
Start delay timers:	0 to 120 seconds
Run delay timers:	0 to 240 seconds
Timer accuracy:	±100 mS

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, 1 to 90% FLA
Phase unbalance:	Off, 4 to 40% I_{neg}/I_{pos}
Run delay timers:	0 to 240 seconds

Start control functions

Starts per time:	Off, 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 seconds
Inc. sequence timer:	Off, 1 to 240 seconds
Long acceleration timer:	Off, 1 to 1200 seconds
Antibackspin timer:	Off, 1 to 3600 seconds

RTD inputs: (requires URTD module)

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

URTD module communications

Interface:	Electrical (3-wire) Fiber optic (preferred) 600-foot maximum
Fiber optic cable:	Type HFBR-PNS005 400-foot maximum

Clock

Accuracy:	±1 minute/month at 25°C

IPONI communications

Type:	2-wire, FSK
Baud rate:	1200 or 9600 baud
Protocol:	INCOM™
Functions:	Read/write set points Read metered values Read trip/alarms Read events/history View starting profile Reset functions emergency override trip

MPONI communications

Type:	5-wire, 485
Baud rate:	1200 or 9600 baud
Protocol:	Modubs® RTU
Functions:	Read metered values Read trip/alarms

DPONI communications

Type:	J wire
Baud rate:	500k, 250k, 128k
Protocol:	DeviceNet™
Functions:	Read metered values Read trip/alarms

Logging

Log book:	100 events
Log event:	20 trips and alarms
Log start:	Last 4 starts
Start profile:	Last 4 starts (communication only)
History records:	Motor, trips, alarms, and permanent records

Memory

	Data retained 100 years Clock maintained 30-day no battery backup

Environmental ratings

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

Dimensions

Height:	10.25 in (260.4 mm)
Width:	6.72 in (170.7 mm)
Depth:	3.70 in (94.0 mm)
Weight:	7 lbs (3.2 kg)

Technical data

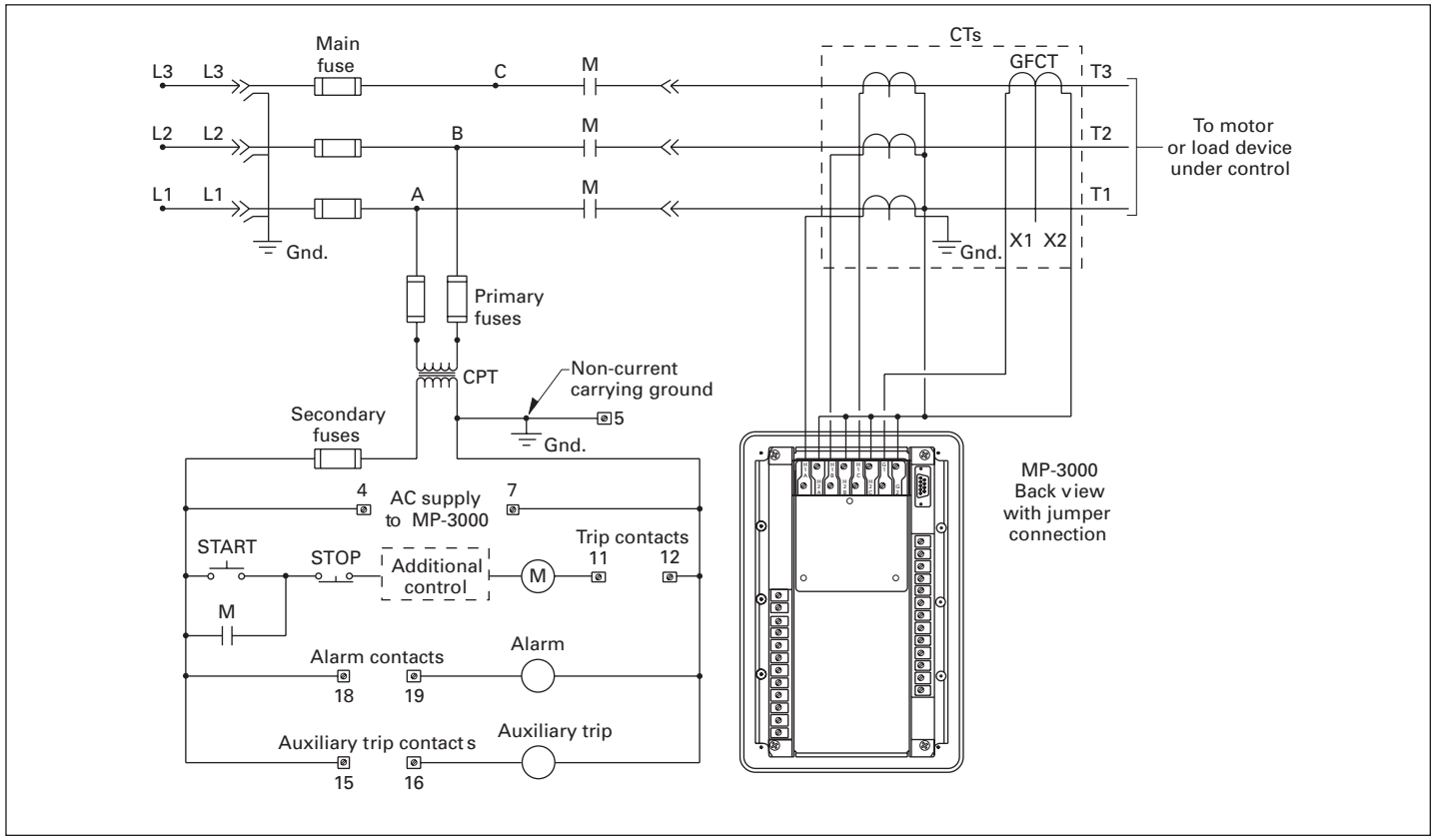

Figure 3. MP-3000 wiring

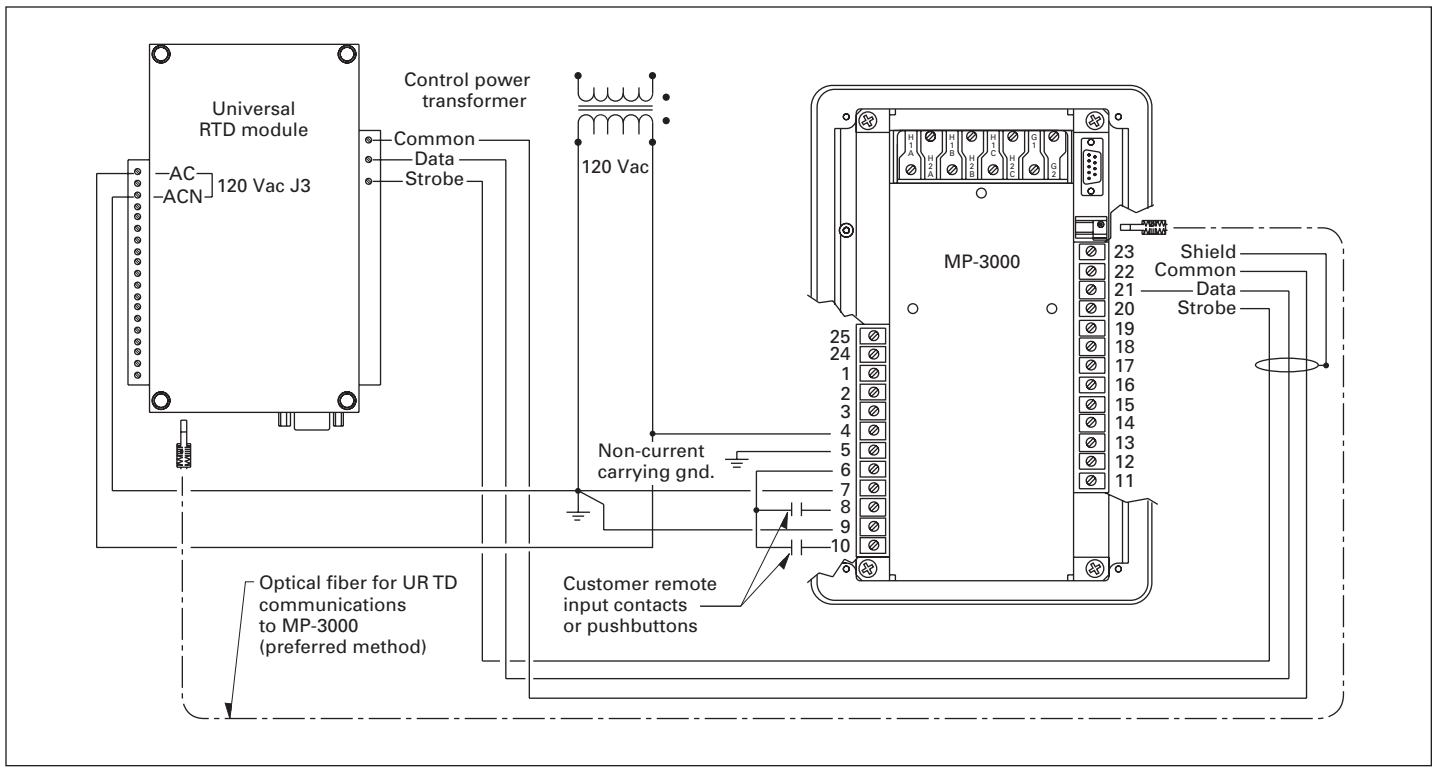

Figure 4. MP-3000 control and URTD wiring

Technical data (continued)

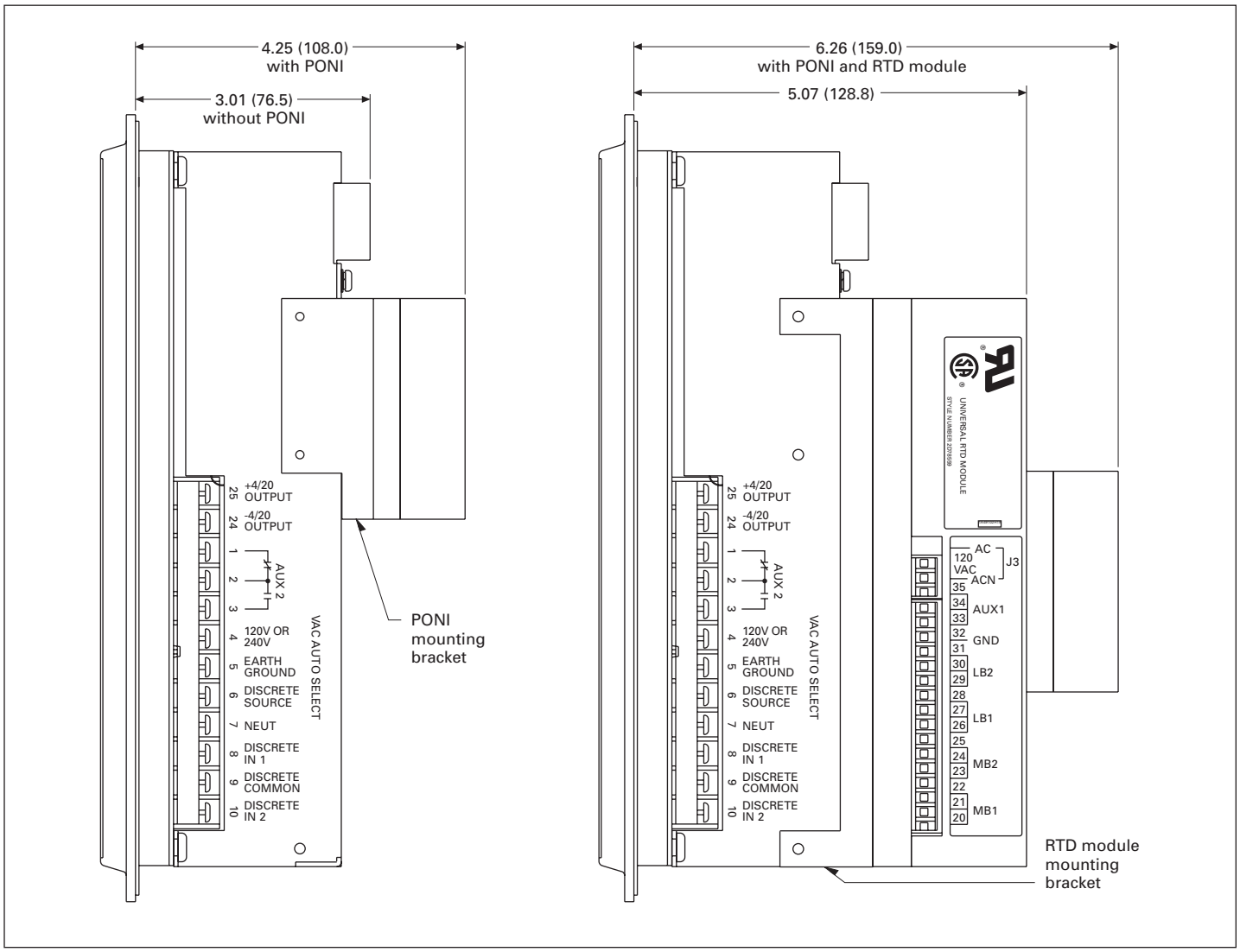

Figure 5. MP-3000 PONI and URTD mounting

Technical data (continued)

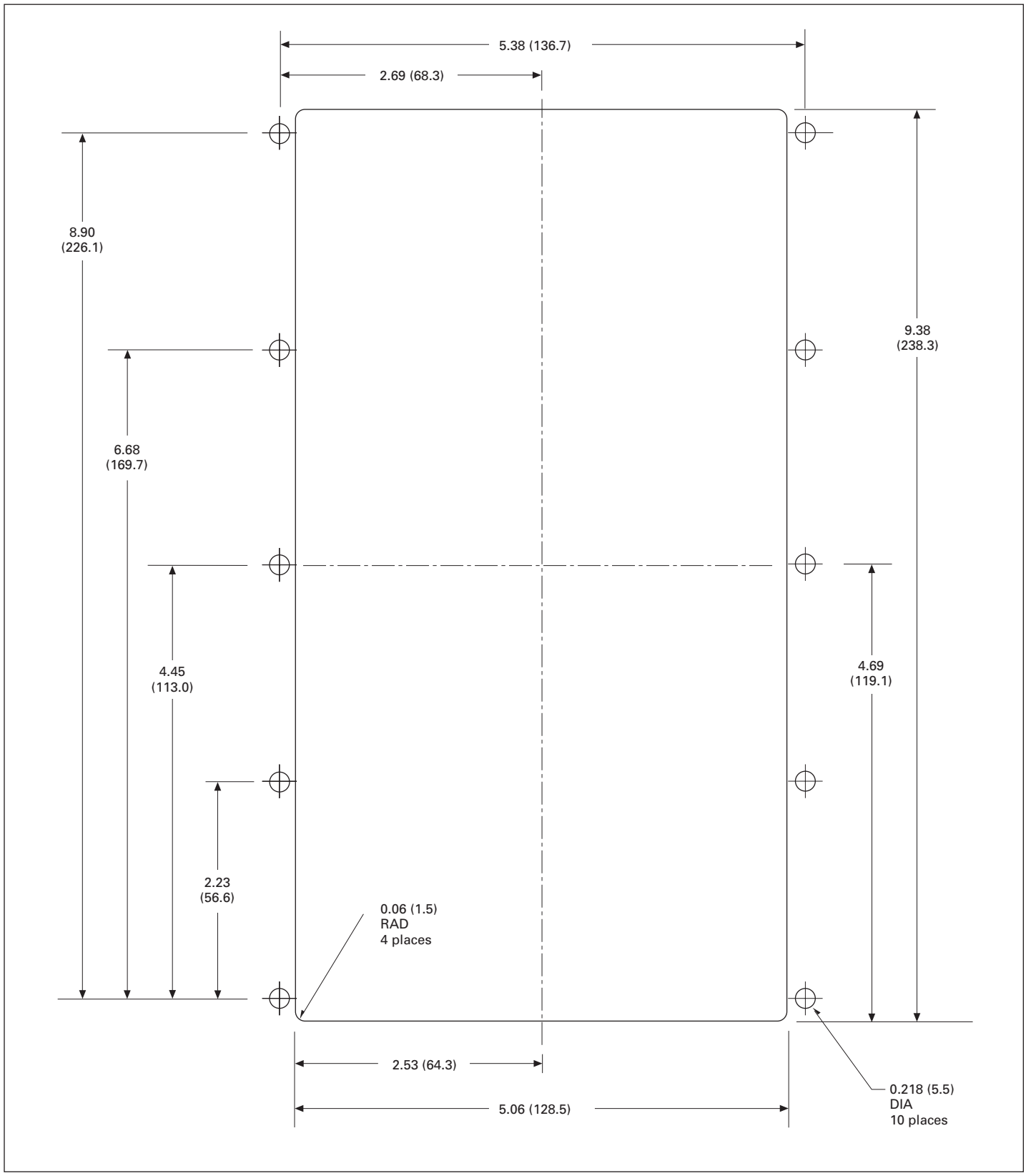

Figure 6. Drilling pattern

Technical data (continued)

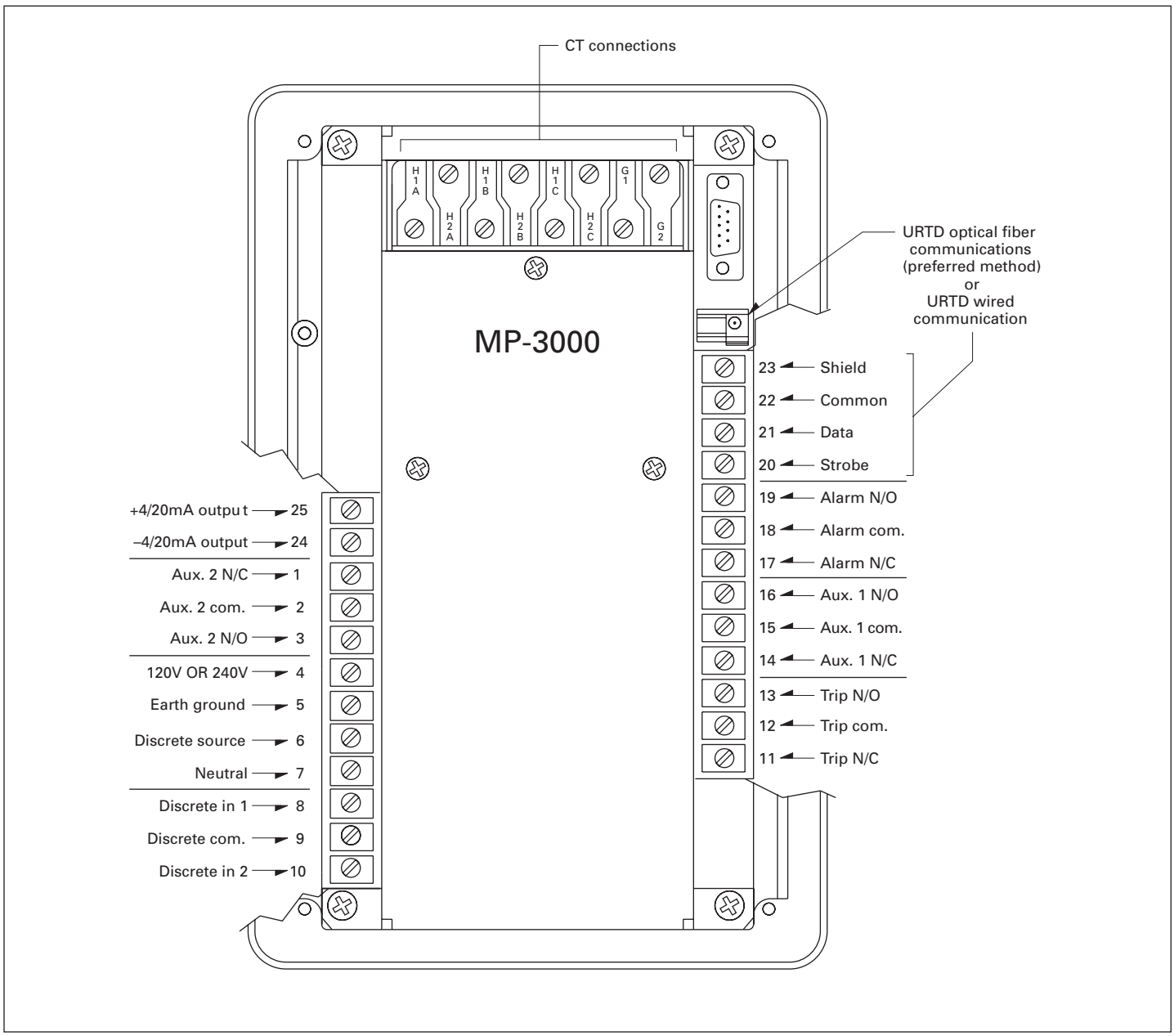

Figure 7. MP-3000 terminal identification

Technical data (continued)

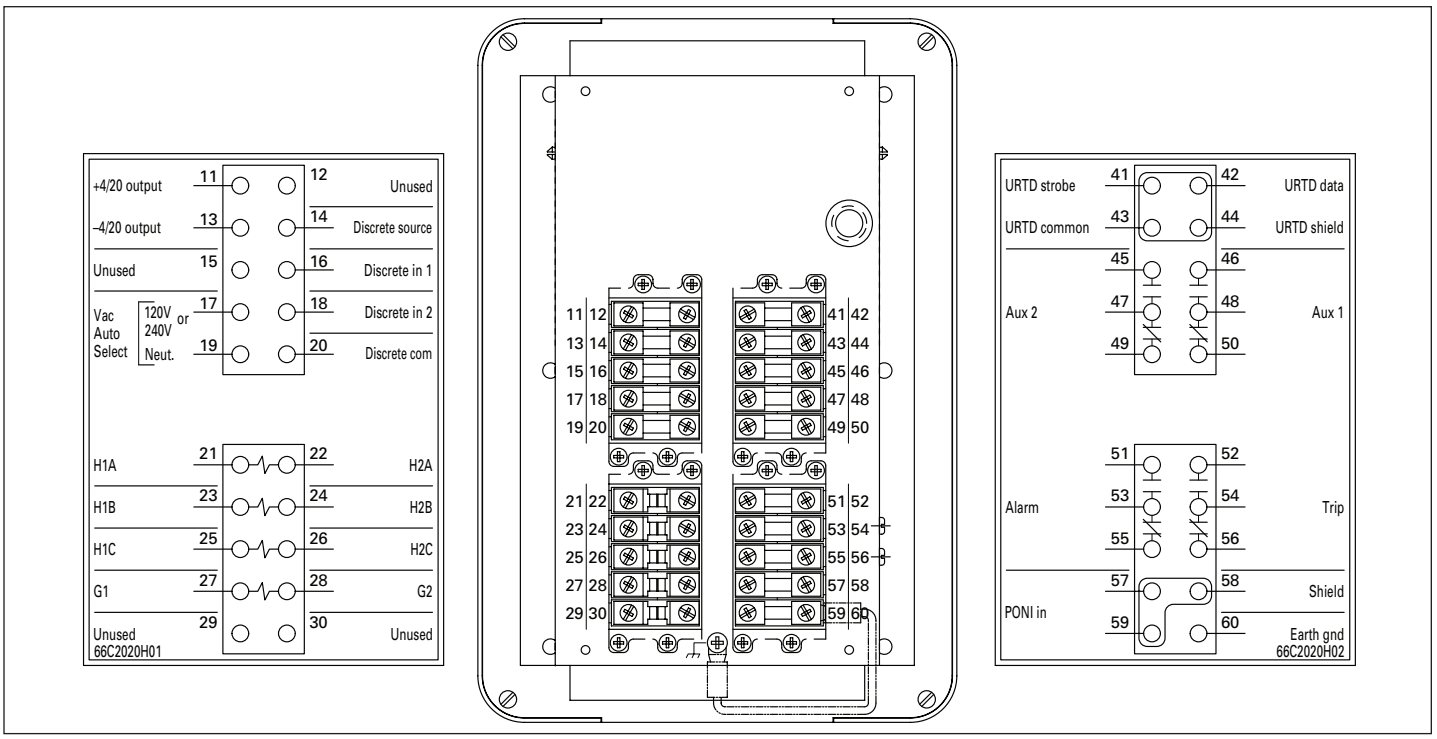

Figure 8. MP-3000 drawout case

Ordering information

Table 1. MP-3000 motor protection

Description	Catalog number
MP-3000 drawout, 5A with RS232	MP3011
MP-3000 drawout, INCOM, 5A with RS232	MP3012
MP-3000 Drawout, Modbus, 5A with RS232	MP3013
MP-3000 Drawout, DeviceNet, 5A with RS232	MP3014
MP-3000 drawout, 1A with RS232	MP3111
MP-3000 drawout, INCOM, 1A with RS232	MP3112
MP-3000 Drawout, Modbus, 1A with RS232	MP3113
MP-3000 Drawout, DeviceNet, 1A with RS232	MP3114
MP-3000 fixed case, 5A with RS232	MP3010
MP-3000 fixed case, INCOM, 5A with RS232	MP3010-INCOM
MP-3000 fixed case, Modbus®, 5A with RS232	MP3010MODBUS
MP-3000 fixed case, DeviceNet, 5A with RS232	MP3010DEVICEN
MP-3000 fixed case, 1A with RS232	MP3110
MP-3000 fixed case, INCOM, 1A with RS232	MP3110-INCOM
MP-3000 fixed case, Modbus, 1A with RS232	MP3110MODBUS
MP-3000 fixed case, DeviceNet, 1A with RS232	MP3110DEVICEN
MP-3000 fixed case, INCOM, 5A with RS232, URTD	MP3010VPI
MP-3000 fixed case, Modbus, 5A with RS232, URTD	MP3010VPM
MP-3000 fixed case, DeviceNet, 5A with RS232, URTD	MP3010VPD
MP-3000 fixed case, INCOM, 1A with RS232, URTD	MP3110VPI
MP-3000 fixed case, Modbus, 1A with RS232, URTD	MP3110VPM
MP-3000 fixed case, DeviceNet, 1A with RS232, URTD	MP3110VPD

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