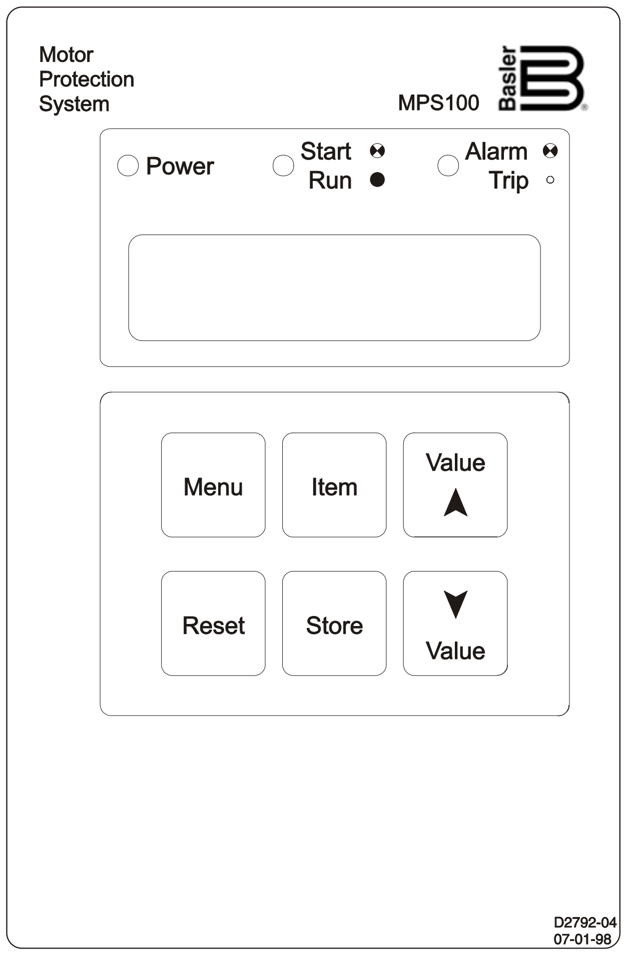
INSTRUCTION MANUAL

FOR

MOTOR PROTECTION SYSTEM

MPS100



Basler Electric

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INTRODUCTION

This instruction manual provides information about the operation and installation of the MPS100 Motor Protection System. To accomplish this, the following information is provided:

- General Information and Specifications
- Controls and Indicators
- Functional Description
- Installation
- Testing

WARNING!

To avoid personal injury or equipment damage, only qualified personnel should perform the procedures in this manual.

NOTE

Be sure that the relay is hard-wired to earth ground with no smaller than 12 AWG copper wire attached to the ground terminal on the rear of the unit case. When the relay is configured in a system with other devices, it is recommended to use a separate lead to the ground bus from each unit.

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It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric.

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REVISION HISTORY

The following information provides a historical summary of the changes made to the MPS100 instruction manual. Revisions are listed in chronological order.

Manual Revision and Date	Change
—, 07/98	• Initial release
A, 08/98	• Corrected Figures 3-2 and 4-1. • Added Section 8, *Manual Change Information*
B, 05/06	• Corrected the labeling of the RS-485 terminals in Figures 3-2, 4-1, 4-3, and 6-1. • Corrected the settings ranges for the CT PRIMARY and GND CT PRIMARY settings listed in Table 5-1. • Moved maintenance information in Section 7 to Section 4 and deleted Section 7. • Moved instruction manual change information from Section 8 to manual introduction and deleted Section 8. • Renamed the Appendix to Appendix A, *Configuration & Settings*.

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CONTENTS

SECTION 1 • GENERAL INFORMATION

INTRODUCTION

The MPS100 Motor Protection Systems is a compact microprocessor-based digital relay that provides complete and comprehensive protection for three-phase motors in low and medium voltage applications. In addition to protection, the MPS100 relay provides the following essential functions.

- Metering
- Communications

MEASURED, CALCULATED, AND RECORDED DATA

High resolution waveform sampling (every 0.5 millisecond) provides excellent measurement accuracy. This measurement accuracy is used to calculate and record specific motor related data.

Measured Data

MPS relays measure true RMS currents. Measured data includes:

- Phase currents
- Ground current
- Thermistor input

Calculated Data

MPS relays calculate percent of full motor load current, thermal capacity, time to trip, time to start, and current unbalance.

Statistical Data

MPS relays record total running hours, number of starts, number of trips, last start time duration, and last starting maximum current.

Fault Data

MPS relays record last trip, last alarm, phase currents at time of trip, and ground fault current at time of trip.

MOUNTING

Fixed vertical is the mounting style that is available for the MPS100. Section 4, *Installation*, provides mounting instructions, and dimensions for this mounting style in panels or racks.

PROTECTION

MPS relays have 21 distinct protective functions. Each relay provides a selected trip operation, alarm annunciation, or both trip and alarm protection for any of these designated functions. Of these 21 distinct protective functions, some are multiple levels and others are multiple inputs of the same protective function. The protective functions are grouped by the measured quantity and are as follows.

Current Based

- Maximum Start Time
- Too Many Starts
- Overcurrent (jam and short)
- Ground Fault Overcurrent (two levels)
- Undercurrent (two levels)

- Load Increase
- Unbalanced Currents (two levels)
- Thermal Overload and Locked Rotor
- Unstable Current
- Phase Sequence

Temperature Based

- One Thermistor (two levels)

General Faults Based

- External Faults (two inputs)
- Comm Port Failure
- Internal Failure

CONTROL

MPS relay control (human-machine interface type control) is available locally through the front panel and remotely through the RS-485 serial link using the Modbus™ Protocol.

Control Sources

- Local Front Panel
- RS-485 Serial Port

OPERATING POWER

Operating power input for the MPS relay may be either 110 or 220 Vac, depending on the relay model.

INPUTS

The relay monitors three phase and ground currents individually. The ground current can be obtained from a ground sensor (doughnut) or a residually connected current transformer. Nominal current input can be 1 or 5 amperes, based on the style chart configuration.

Thermistor

The thermistor input setting range is from 100 to 30 kilo-ohms. The thermistor type can be positive temperature coefficient (PTC) where resistance increases with an increase in temperature or negative temperature coefficient (NTC) where resistance decreases with an increase in temperature.

MPS100 Discrete

Inputs 1 and 2 can be programmed as either remote resets or external faults. The reset is normally open and the external fault can be selected to be normally open or normally closed.

OUTPUTS

MPS relays have four form C configurable outputs. The available configurations are described in the following paragraphs.

- Relay A: An alarm (fail-safe).
- Relay B: A trip (regular or fail-safe)
- Relay C: Can be set as auxiliary contacts for any or all of the protection functions. When set they will operate with either the trip or alarm of the associated function.
- Relay D: Can be set as auxiliary contacts for any or all of the protection functions. When set they will operate with either the trip or alarm of the associated function.

METERING

Measured, calculated, and recorded data were described in previous paragraphs in this section. All of these data can be metered (observed) at the front panel liquid crystal display (LCD) or through the serial communications link. Using the Modbus™ protocol, these data can be accumulated and analyzed for consumption or use, for developing existing trends, and estimating future requirements such as in distribution planning.

COMMUNICATIONS

Communications through the RS-485 serial link and the ModBus™ protocol makes it very easy for operators to change relay settings from a remote location. One setting can be changed or an entire new group of settings uploaded from a computer file. Multiple MPS relays can be connected to a single host computer through the RS-485 serial link. Up to 247 MPS relays can be interconnected and are addressable using addresses 1 to 247. Selectable baud rates are 1200, 2400, 4800, and 9600. The following information and controls can be accessed through the serial communications link.

- Read data parameters
- Read and write parameter settings
- Reset faults

MODEL AND STYLE NUMBER

MPS relays are identified by a combination of letters and numbers that make up the style number and define the electrical characteristics and operational features. The model number, together with the style number, describe the options included in a specific device and appear on the rear panel.

Upon receipt of a relay, be sure to check the style number against the requisition and the packing list to ensure that they agree.

Figure 1-1 is the style number identification chart and defines the electrical characteristics and operational features included in MPS relays. For example, if the model and style number were **MPS100 51V1**, the relay would have the following characteristics and operational features.

MPS100 Motor Protection System with Control
5 5 amp sensing
1 110 Vac power supply
V Vertical case
1 RS-485 communications link with Modbus™ protocol

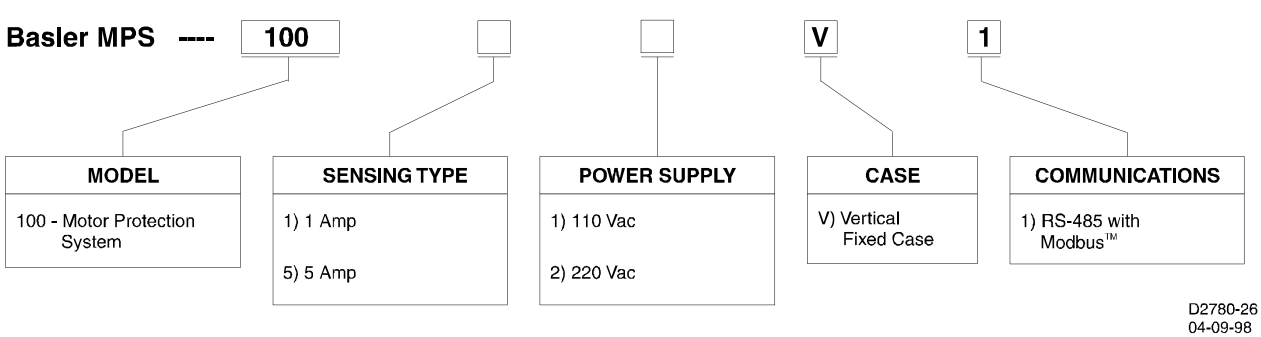

Figure 1-1. Style Number Identification Chart

SPECIFICATIONS

Current Sensing Inputs

Sensing Method:	True RMS, 0.5 millisecond sample time
Input current:	
Phase	Maximum continuous = 3 times rated 1 second = 50 times rated, 2 seconds = 30 times rated
Ground	Maximum continuous = 1 time rated 1 second = 17 times rated, 2 seconds = 10 times rated
Input Burden:	
1 Ampere:	≤0.1 volt-ampere at 1 ampere nominal, ≤100 milliohms
5 Amperes:	≤0.5 volt-ampere at 5 amperes nominal, ≤20 milliohms

Contact Sensing Inputs

Voltage level:	Connect to same level as power supply.

Thermistor Input

Type:	PTC - Resistance increases with an increase in temperature NTC - Resistance decreases with an increase in temperature
Range:	100 - 30 kΩ
Accuracy:	100 ohms up to 5 kΩ, ± 3% above 5 kΩ
Time Delay:	0.5 ± 0.2 seconds

Output Contacts

Tripping Duty	
Make and carry:	30 amperes per ANSI 37.90
Continuous:	5 amperes
Break Resistive Or Inductive:	0.3 amperes at 125 Vdc or 250 Vdc (L/R=0.04 maximum)

Power Supply

AC input:	88 to 125 Vac or 150 to 260 Vac, depending on style number
Burden:	≤10 volt-amperes

Accuracy

Phase current:	
Below 0.9 times nominal:	± (3% + 0.02 times nominal)
0.9 to 1.5 times nominal :	±1.5% of nominal
1.5 to 14 times nominal:	±5% of nominal
Ground fault current	
Below 14 times nominal:	±3% of full scale
Voltage	±1% of full scale

Ranges

Phase:	0.05 to 12 times nominal
Ground fault:	0.05 to 1 times nominal
Thermistor:	100 to 30k

Unbalance Trip And Alarm

Method	$$Unbalance = 100\left(\frac{I_{max} - I_{min}}{I_r}\right)[\%]$$ I_{max} = maximum of phase currents I_{min} = minimum of phase currents I_r = maximum phase current or motor full load current, whichever is greater

> **NOTE**
> Variable I_r prevents unnecessary tripping at low currents

Level 1	
Alarm threshold level	50% of unbalanced setting ±2%
Alarm fixed delay	1.0 ±0.5 second
Level 2	
Trip threshold level	Unbalanced current setting ±2%
Trip delay	
One to 10 seconds:	± 1 second
Above 10 seconds	± (1 second ± 2%)

Communications

Protocol	Modbus™
Baud rate	1200, 2400, 4800, or 9600
MPS relay address range	1 to 247

Surge Withstand Capability

Oscillatory	Qualified to ANSI/IEEE C37.90.1-1989 Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
Fast transient	Qualified to ANSI/IEEE C37.90.1-1989 *Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems*

Impulse Test

Qualified to IEC 255-5

Radio Frequency Interference

(RFI)	Field tested using a 5 watt, hand held transceiver operating at random frequencies centered around 144 MHz and 440 MHz, with the antenna located 6 inches from the relay in both horizontal and vertical planes.

Isolation

Common mode	1,500 Vac for one minute between ground and current, discrete inputs, and power supply inputs.
Transverse mode	1,500 Vac between any of the following circuits (they share a common connection): current, discrete inputs, and power supply inputs.
Across open contacts	1,414 Vdc for one minute

Ambient Temperature Range

Operating: –20 to +65°C (–4 to 149°F)

Display: –10 to +60°C (14 to 140°F)

Mounting

Fixed, vertical

Weight

2.15 pounds (0.975 kilograms)

OVERLOAD CHARACTERISTIC CURVES

Figure 1-2 illustrates overload characteristic curves for a cold motor. Figure 1-3 illustrates the overload characteristic curves for a motor with a 40 percent hot/cold ratio.

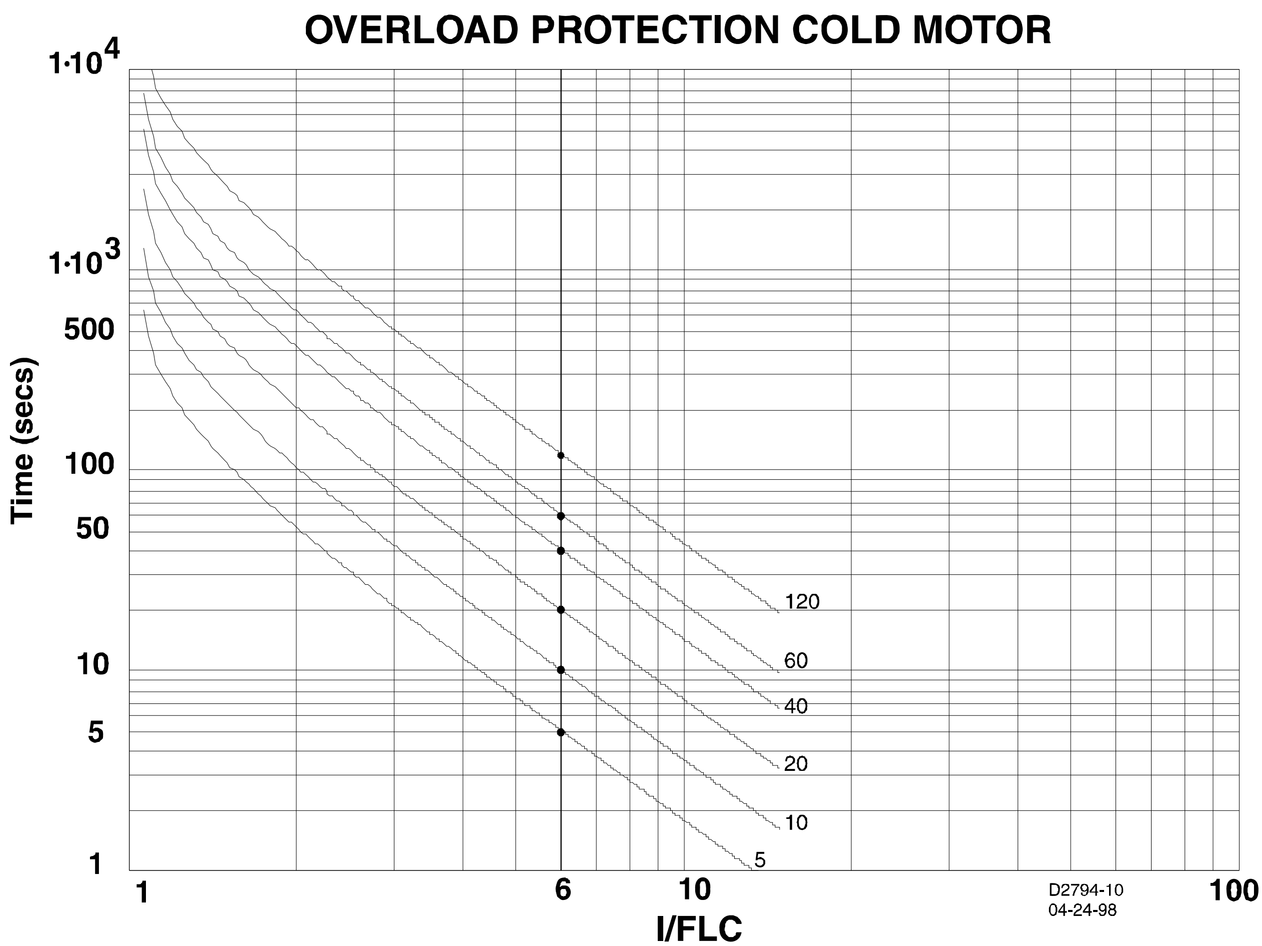

Figure 1-2. Cold Motor Overload Characteristic Curves (t6x)

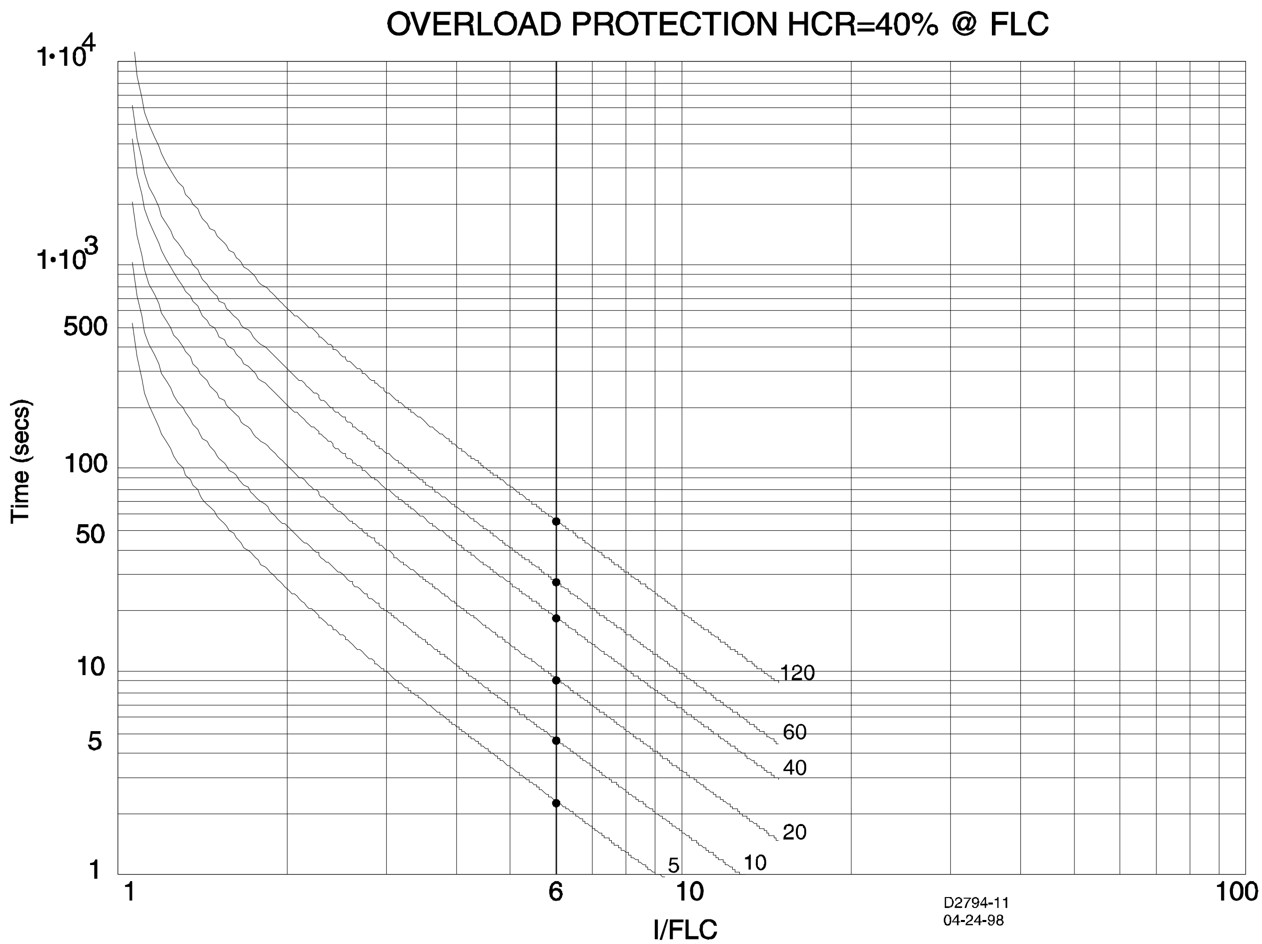

Figure 1-3. 40 % Hot/Cold Ratio Motor Overload Characteristic Curves (t6x)

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SECTION 2 • APPLICATION

INTRODUCTION

MPS 100 relays are compact, microprocessor-based digital relays providing complete and comprehensive protection for three-phase motors in low and medium voltage applications. MPS 100 relays provide the following essential functions.

- Protection
- Metering
- Communications

Settings for MPS 100 relays are provided in the following paragraphs. A complete description for the system and motor parameters that are used in these applications is provided in Section 5, *MENUS AND SETTINGS*. For additional motor protection applications, contact the Customer Service Department of the Power Systems Group, and request publication *Motor Protection Application Considerations*.

MOTOR SETTING EXAMPLE

This motor setting example uses specific system and motor parameters for a hypothetical motor. Some settings, such as NUMBER OF STARTS, are not provided because they are not critical to the setting example and are determined from the process and motor data.

System Parameters

Line voltage 2400

Line frequency 60

Voltage transformer (VT) primary 2400

VT secondary 120

Motor full load current (FLC) 313

Current transformer (CT) primary 400

Ground CT primary 400

$$FLC = \frac{746 \cdot HP}{\sqrt{3} \cdot \text{voltage} \cdot \text{PF} \cdot \text{efficency}}$$

$$FLC = \frac{746 \cdot 1500}{\sqrt{3} \cdot 2400 \cdot 0.897 \cdot 0.958} = 313$$

Motor Parameters

Voltage.. 2400

Horse power (HP) 1500

Efficiency 95.8

Locked rotor current (cold) ....6.8 pu @ V=1 pu

Maximum stall time (cold) (t_{LRC}).........18 seconds

Maximum stall time (hot) (t_{LRH}) ....12.6 seconds

Service factor.. 1.15

Power factor (PF) 0.897

Current Settings

MAX START TIME.. Determined from the motor load characteristic. For typical low inertia systems, use the default setting (10 seconds). In an operating system, data from the MPS relay statistical page (last start duration) can direct changes for MAX START TIME.

NUMBER OF STARTS....................................... Determined from the process and motor data.

START PERIOD .... Determined from the process and motor data.

START INHIBIT .... Determined from the process and motor data.

U/C LEVEL settings.. Process specific; use default value.

LOAD INCREASE .... To be determined from calculations. Use as an alarm to prompt operators to consult TIME TO TRIP-O/L on the CALCULATED DATA page.

O/C LEVEL 1 JAM .... If the load torque increases beyond the pullout torque, the motor will stall at a low speed or stop. During this time, stator current approaches or equals the locked rotor current value. The jam setting must be less than 80% of the locked rotor current. For this example:

$$0.80 \cdot 6.8 = 5.44 \; or \; 544\%$$

$\therefore$ use 400% (default setting)

O/C LVL 1 DELAY .... Because the motor has thermal protection, the jam delay should be set to minimize mechanical damage to the process equipment without causing nuisance trips from momentary surges. The default delay (2.0 seconds) assures tripping much sooner than the thermal protection.

O/C LEVEL 2 SHORT .... To provide maximum fault coverage for phase-to-ground faults in the motor winding under the largest source impedance contingency, the short circuit level should be set close to the locked rotor value. It is not necessary to consider the dc offset in the starting current (because the MPS relay filters it out). A setting of 130% of the locked rotor current at nominal voltage should be secure because the actual locked rotor current will be less due to the voltage drop during starting.

$$1.30 \cdot 6.8 = 8.83 \; or \; 883\%$$

$\therefore$ use 880% setting

O/C LVL 2 DELAY .... Unless coordination with other devices is required, set the trip delay to zero. This provides a response within 70 milliseconds.

OVERLOAD PICKUP .... The default setting (105%) corresponds to a thermal limit with a 4% margin.

$$1.05^2 = 1.103$$

$$1.103 \div 115 = 0.959$$

A setting of 107% would reduce this margin to zero. It is recommended to maintain a margin because a motor does not last as long under continuous service factor loading as it would under rated HP loading.

THERMAL LEVEL 1 .... Typically used as an alarm. Use the default setting (80%). Commissioning tests will confirm if the thermal capacity remains below this value during normal starting.

t6x TIME .... A relay setting philosophy can be driven by the process or by the motor thermal limits. By process driven, we mean to set the thermal characteristic as sensitively as the motor load will allow. Load variations are usually easier to predict than it is to obtain the running motor thermal limits. In this example, the maximum start time is less than the safe stall time. Because locked rotor protection is provided by the MAX START TIME, we can base the t6x TIME setting on the process requirements.

Assume that we want to trip when the motor is running for 300 seconds at a 200% overload which is up from the continuous 0.9 pu load (hot).

$$t6x = \frac{t}{C \cdot \ln\left(\frac{I^2 - \alpha \cdot I_{OL}{}^2}{I^2 - \cdot I_{OL}{}^2}\right)}$$

Where:

t = time (300 seconds)

I = trip current (2)

I_L = continuous load current (0.9)

I_{OL} = overload setting (1.05)

α = thermal capacity decrease due to load current I_L

Before we can solve for t6x, we must find C and α.

$$C = \frac{1}{\ln\left(\frac{6^2}{6^2 - I_{ol}{}^2}\right)}$$

$$C = 32$$

$$\alpha = \left(\frac{I_L}{I_{OL}}\right)^2 \cdot \frac{(100 - HCR)}{100}$$

Before we can solve for α, we must find HCR.

HCR is the hot/cold ratio. The motor manufacturer supplied the maximum stall times for the hot and cold (ambient) conditions. By definition:

$$HCR = 100\left(\frac{t_{LRH}}{t_{LRC}}\right)$$

Where:

t_{LRH} = maximum stall time hot (12.6)

t_{LRC} = maximum stall time cold (18)

$$HCR = 100\left(\frac{12.6}{18}\right)$$

$$HCR = 70$$

This means that the available thermal capacity is reduced from 100% to 70%.

Solving for α:

$$\alpha = \left(\frac{0.9}{1.05}\right)^2 \cdot (1 - 0.7)$$

$$\alpha = 0.22$$

Solving for t6x:

$$t6x = \frac{300}{32 \cdot \ln\left(\frac{2^2 - 0.22 \cdot 1.05^2}{2^2 - \cdot 1.05^2}\right)}$$

$$t6x = 36.073$$

Now that we have set the t6x TIME, determine the approximate time to trip with a locked rotor (t_{LR}).

$$t_{LR} = t6x \cdot \left(\frac{6}{I_{LR}}\right)^2$$

$$t_{LR} = t6x \cdot \left(\frac{6}{6.8}\right)^2 = 28.0 \text{ seconds}$$

Looking at the MAX START TIME setting (10 seconds) and time to trip with a locked rotor (28.0 seconds), we can say that no spurious trips will occur.

HOT/COLD RATIO .... From solving for the previous t6x TIME, HCR = 70. The running motor steady state available thermal capacity (TC) is further modified by the continuous load current (I_L)

$$TC = \left(\frac{I_L}{I_{OL}}\right)^2 \cdot (100 - HCR)$$

$$TC = \left(\frac{0.9}{1.05}\right)^2 \cdot (100 - 70) = 22\%$$

This indicates that the motor is running at 22% of the motor thermal capacity.

COOL TIME FACTOR .... Consult the motor manufacturer or use the conservative default value of 5. If the thermal capacity of the motor has increased above 50%, the motor can not be restarted until the thermal capacity decreases below

50%. In order to restart the motor and bypass the thermal capacity protection, the thermal capacity can be reset from the front panel.

STALL TIME FCTR .... In this setting example, this feature is not used. To disable this feature, insure that the speed switch input is OPEN. To justify disabling this feature, calculate the stall time factor (STF) for a thermal trip of 90% of the max stall time.

$$STF = 90\left(\frac{t_{LRC}}{t6x \cdot \left(\frac{6}{I_{lr}} \right)^2} \right)$$

$$STF = 90\left(\frac{18}{36 \cdot \left(\frac{6}{6.8} \right)^2} \right) = 57.8$$

Setting STALL TIME FCTR = 58% would cause a trip to occur at 90% of 18 seconds or 16.2. Our maximum start time is set to ten seconds. From this we can see that the stall time factor would never be effective. If a motor had a high inertia load and the maximum start time was set to 30 seconds, then the MPS relay would trip in 28 seconds based on the t6x curves. The stall time factor would be required in that specific system. When the motor starts, the speed switch opens and the stall time factor is disabled.

UNBALANCE LVL 2 .... This setting determines the maximum allowable continuous current unbalance (threshold) before unbalance protection is enabled. In this example, no specific motor data is available. Referring to MG1-1993 and to the measured sustained voltage unbalance on the feeder supplying this particular motor, we find that:

- MG1-1993-14.35 and 20.56 warns that operation at more than 5% voltage unbalance is harmful to motors. In fact, lower unbalances can be damaging.
- From the feeder supply: Vn = 120, Vab A = 121.5, Vbc B = 125, Vca C = 123.7

Calculations for a typical motor and for this 1.5**% NEMA voltage unbalance** show that the **corresponding MPS relay current unbalance** at full load is about 17%. This value is therefore the minimum UNBALANCE LVL 2 setting. **A setting of 20% should be selected.** This illustrates that the NEMA voltage unbalance must not be confused with the MPS relay current unbalance setting. It is important to remember that continuous unbalance adds significant heating to the motor. It may be necessary to derate the motor if the unbalance is high. A derating table can be found in MG1-14.34.

U/B LVL 2 MAX T .... Because no specific motor data is available, in this example we will use the default value for U/B LVL 2 MAX T (30 seconds). With this setting and a 20% voltage dip on a single phase, what is the time to trip? Based on calculations not shown here, we find that the given voltage dip causes the MPS relay to sense a 60% current unbalance.

$$t_{trip} = \frac{(\text{U / B LVL 2 MAX T}) \cdot 100}{(\text{UB})^2}$$

$$t_{trip} = \frac{30}{60^2} \cdot 100 = .83 \text{ seconds}$$

Based on these calculations, 0.83 seconds is the maximum clearing time for the system ground fault. It is desirable to coordinate the motor unbalance setting with the delayed clearing of the system ground fault.

This completes the motor setting example using specific system and motor parameters for a hypothetical motor. Some settings were not provided because they are not critical to the setting example and are determined from the process and motor data.

SECTION 3 • CONTROLS AND INDICATORS

INTRODUCTION

Operators interface with the MPS relay through the front panel controls and indicators or through the serial communications link. Figure 3-1 shows an MPS100 relay front panel with the three light emitting diodes (LEDs), the two-line, 16 character liquid crystal display (LCD), and the six pushbutton switches for local interface.

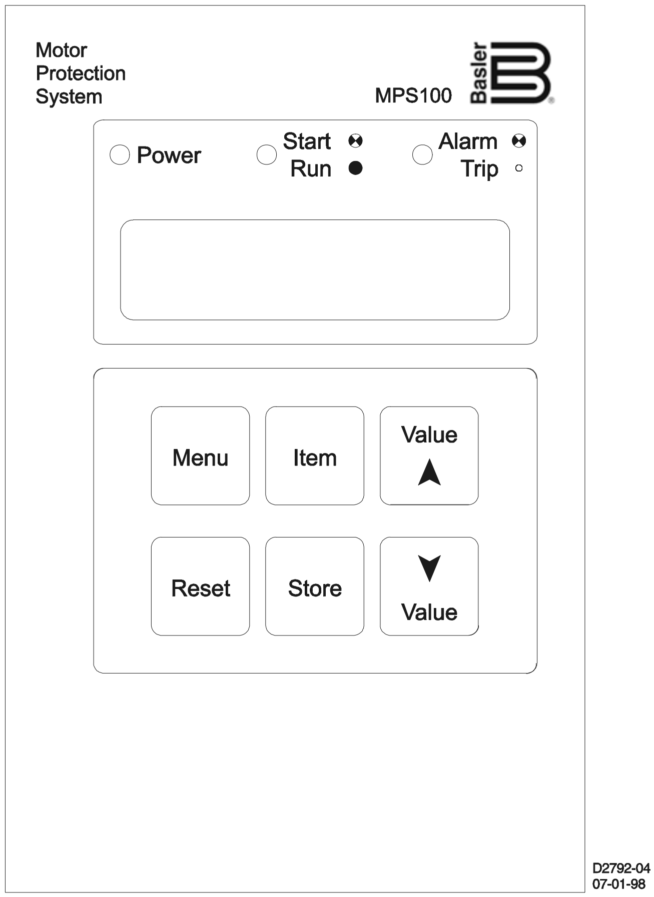

Figure 0-1. MPS100 Controls and Indicators

INDICATORS

Table 3-1 provides the name and description for each indicator of the MPS100 relay.

Table 3-1. MPS Relay Indicators

Indicator Name	Description
Power	Green LED lights when the MPS relay is energized.
Start/Run	Flashes during starting. A start condition is when the current to a motor that was not previously running increases above 115% of Full Load Current. Steady on when in run.
Alarm/Trip	Flashes in an alarm condition. Steady on in a trip condition

CONTROLS

Table 3-2 provides the name and description for each control.

Table 3-2. MPS Relays Controls

Control Name	Description
Menu	This pushbutton scrolls the display through the menu pages. There are five data menu pages: • System Parameter Settings • Protection Settings • Tripping/Alarm Options • Actual Data • Statistical Data An additional menu is available by pushing Menu and Value ⮟ simultaneously. This accesses the Test/Maintenance Options Menu.
Item	This pushbutton scrolls through parameters on the selected page. Press and hold for more than 0.5 seconds to scroll the parameters at a fast rate.
Value ⮝	This pushbutton increases the parameter value. Press and hold to increase the parameter value at a fast rate. Changes are permitted only when the authorized key (logical contact input) is closed.
Value ⮟	This pushbutton decreases the parameter value. Press and hold to decrease the parameter value at a fast rate. Changes are permitted only when the authorized key (logical contact input) is closed.
Store	This pushbutton stores the displayed parameter value in non-volatile memory.
Reset	Press and hold for more than 0.5 seconds to reset. Press momentarily to change direction scroll caused by item. An "_" in the lower left corner of the display indicates reverse (up) scroll. Pressing Reset or pressing nothing for 10 seconds caused scroll to return to forward (down).

REAR PANEL

Figures 3-2 shows the MPS100 rear panel layout. Connectors are European type (Euro Standard DIN) with wire clamps.

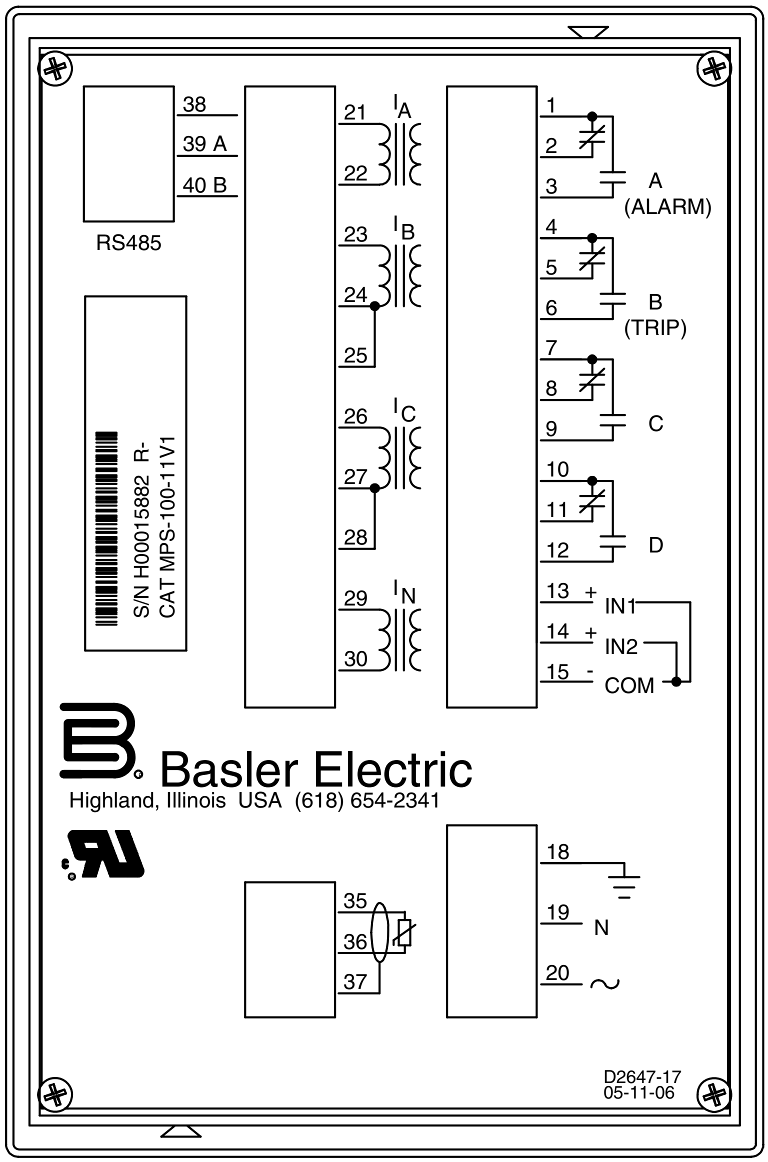

Figure 0-2. MPS100 Rear Panel Layout

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SECTION 4 • INSTALLATION

GENERAL

When not shipped as part of a control panel, the MPS relay is shipped in a sturdy carton to prevent damage during transit. Upon receipt, check the part number against the requisition and packing list to see that it agrees. Visually inspect for damages that may have occurred during shipment. If there is evidence of damage, file a claim with the carrier and notify the Regional Sales Office, or contact the Sales Representative at Basler Electric, Highland, Illinois.

DIELECTRIC TEST

In accordance with IEC 255-5 and ANSI/IEEE C37.90-1989 (Dielectric Tests), 1,414 Vdc may be applied across open circuits for one minute. Also, 1,500 Vac may be applied in the following manner for one minute.

- Between ground and current, discrete inputs. or power supply inputs
- Between any of the following circuits (they share a common connection): current, control, discrete inputs ,and power supply inputs.

MOUNTING

A dimensions diagram and panel cutting diagram for the MPS100 is provided in Figure 4-1. Figure 4-2 shows the typical (top or bottom) mounting hardware. The mounting hardware provided with the MPS100 must be attached to the top and bottom of the MPS100 in order to mount the relay.

CONNECTIONS

WARNING!

The CT circuits must be shorted before disconnecting the MPS100 current sensing inputs.

The MPS100 relay must be disconnected before it can be removed from the system. Connectors are Euro DIN Standard. **It is important to provide a ground connection to terminal 18. Connect all shield wires to terminal 18.**

CAUTION

Equipment damage may occur if MPS100 terminal 18 is not hard-wired to ground.

Incorrect wiring may result in damage to the relay.

Figure 4-3 illustrates typical connections for the MPS100 relay.

MAINTENANCE

MPS relays require no preventative maintenance. However, periodic testing may be performed according to scheduled practices.

If a relay fails to function properly, contact the Technical Sales Support Department at Basler Electric.

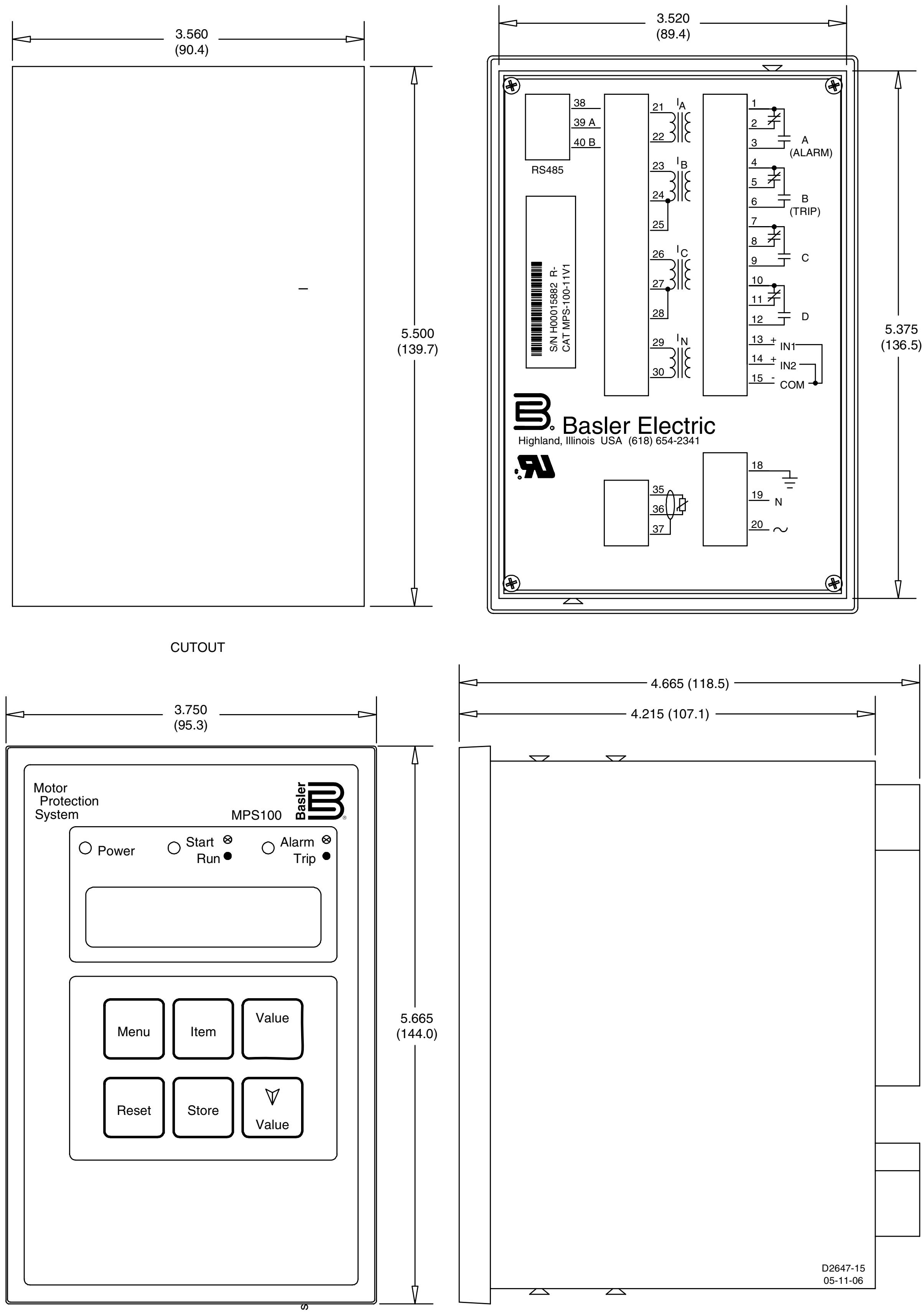
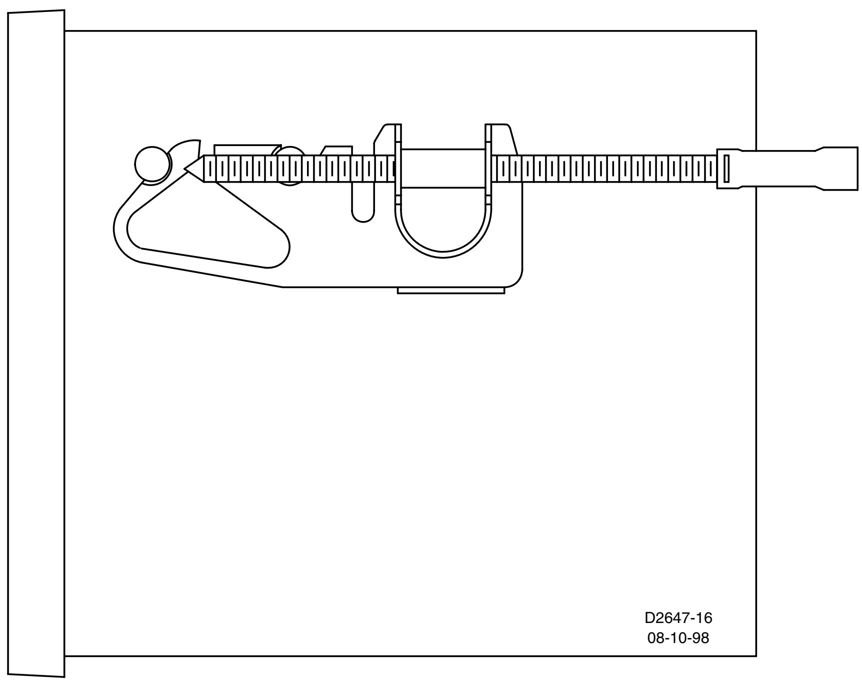
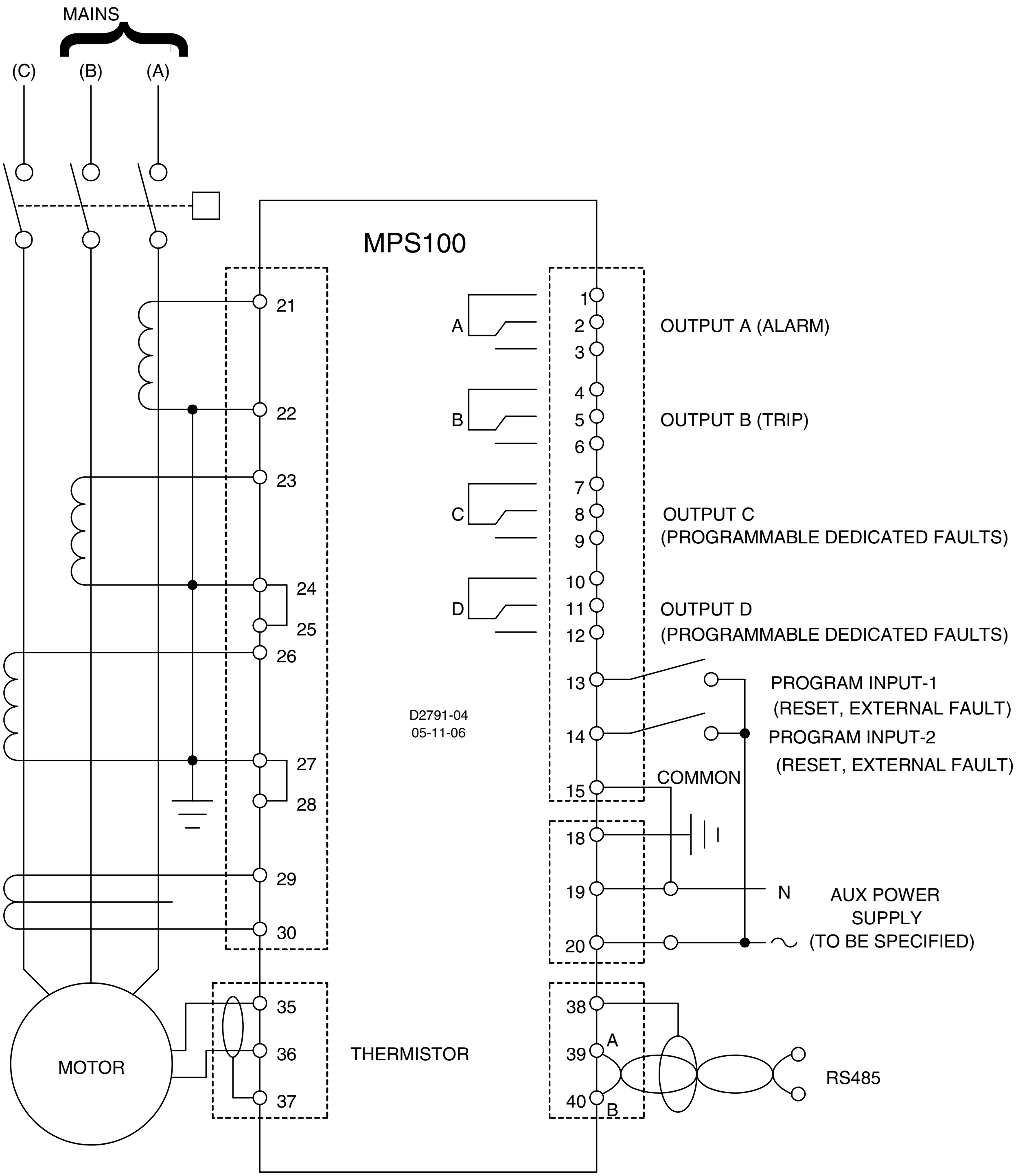


Figure 0-1. Fixed Case Panel Cutout and Outline Dimensions



TYPICAL TOP AND BOTTOM

Figure 0-2. Typical Top/Bottom View Showing Mounting Hardware



NOTES:

1. All relay contacts shown when MPS100 is not powered.

Figure 0-3. MPS100 Typical Connection Diagram

SECTION 5 • MENUS AND SETTINGS

GENERAL

This section describes the display menus and settings available at the MPS100 front panel and through the serial communications link. Refer to Section 3, *Controls And Indicators* for a description of the controls, indicators, and individual functions. There are five menus that contain subordinate pages. An in-depth description for each menu and the subordinate pages are provided in the following paragraphs. A description for the parameters, the parameter ranges, and the default values is also provided in this section.

MENUS

To view a menu, press the pushbutton **Menu**. The menu can be accessed at any time by pressing the **Item** pushbutton. Each menu has a number of subordinate pages that are displayed by pressing the **Item** pushbutton.

Menu

Figure 5-1 shows the five main menus available. Each time the **Menu** pushbutton is pressed, the next menu is displayed.

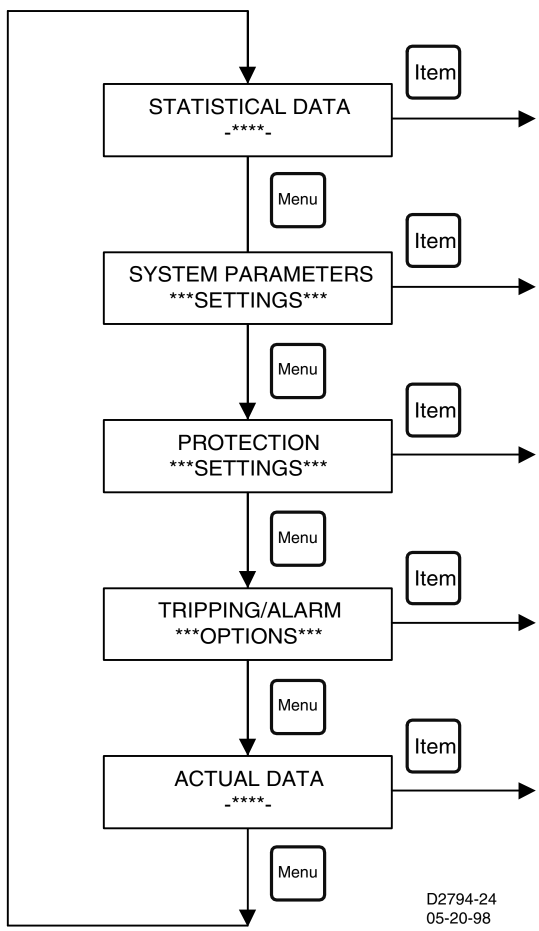


Figure 5-1. Menus Available Pages

Suppose that you want to view the calculated time to overload trip. Press the **Menu** pushbutton until the Actual Data page is displayed. Figure 5-2 shows the eight subordinate pages. **TIME TO TRIP-O/L** is the seventh page down. Press the **Item** pushbutton seven times and **TIME TO TRIP-O/L** is displayed. Default values are as shown in all of the following Figures.

NOTE: By pressing the Reset pushbutton momentarily will change the direction of scroll caused by **Item**. An "_' in the lower left corner of the display panel indicates reverse (up) scroll. Pressing **Menu** or pressing nothing for 10 seconds causes scroll to return to forward (down).

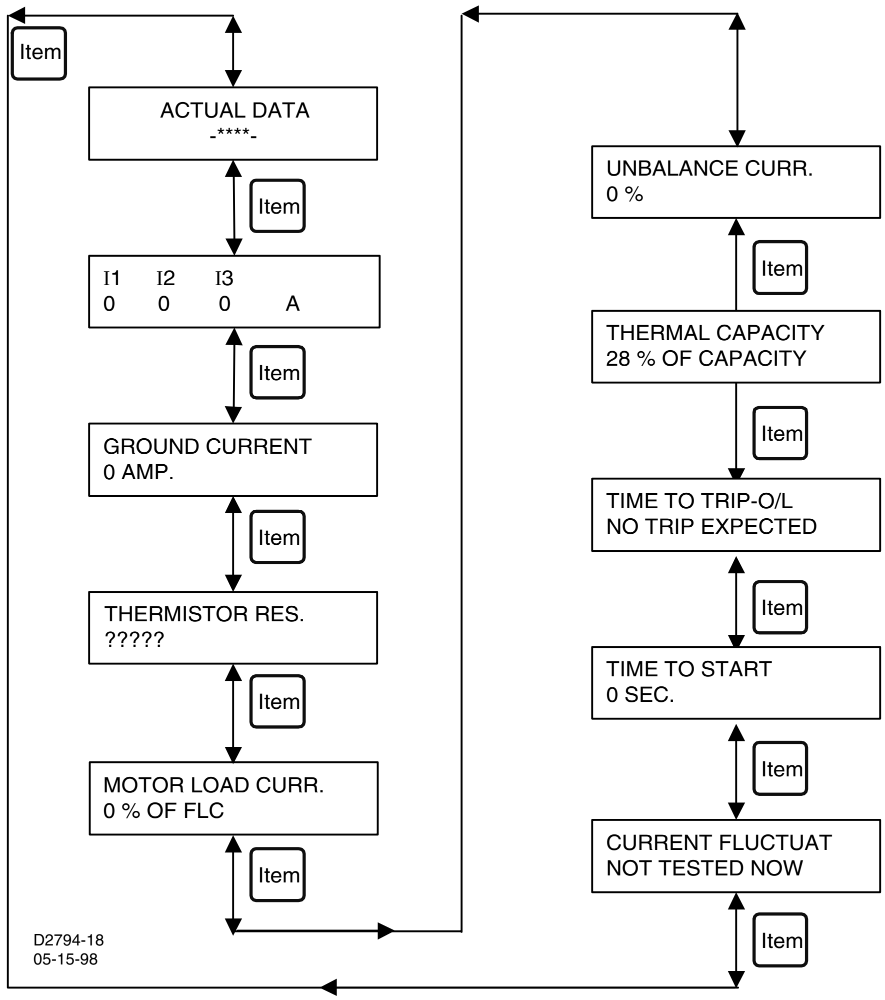


Figure 5-2. ACTUAL DATA And Subordinate Pages

At this point, you may scroll up or down or do nothing. After approximately five minutes the display returns to the default screen page. Figures 5-3 through 5-8 show the other available pages for each menu.

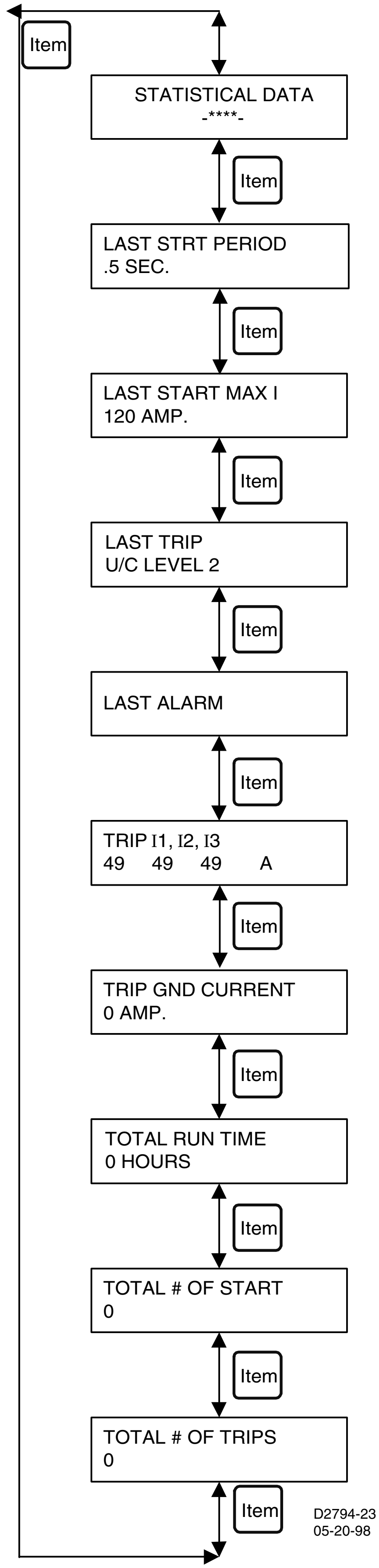


Figure 5-3. STATISTICAL DATA And Subordinate Pages

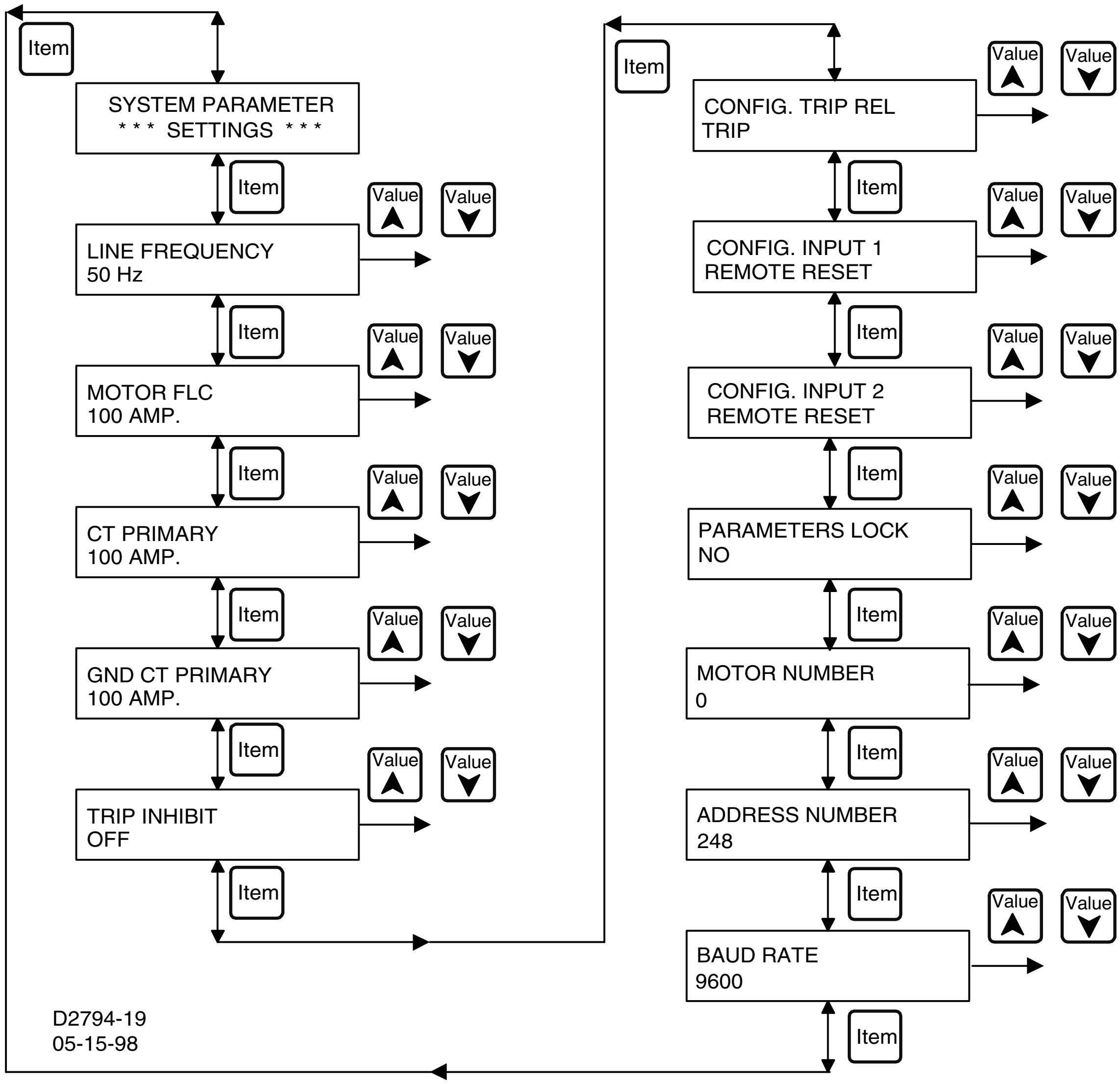


Figure 5-4. SYSTEM PARAMETERS SETTINGS And Subordinate Pages

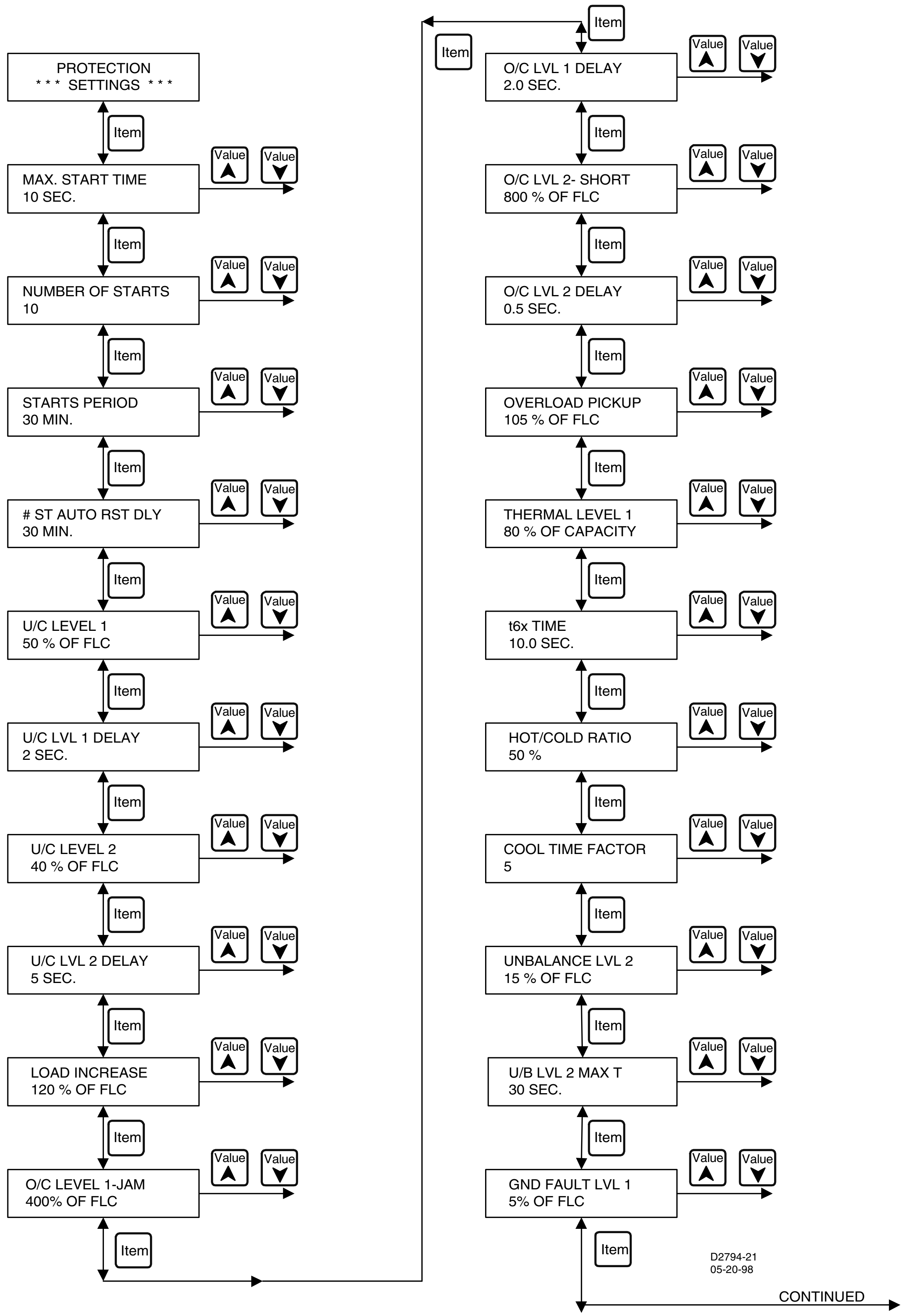


Figure 5-5. PROTECTION SETTINGS And Subordinate Pages

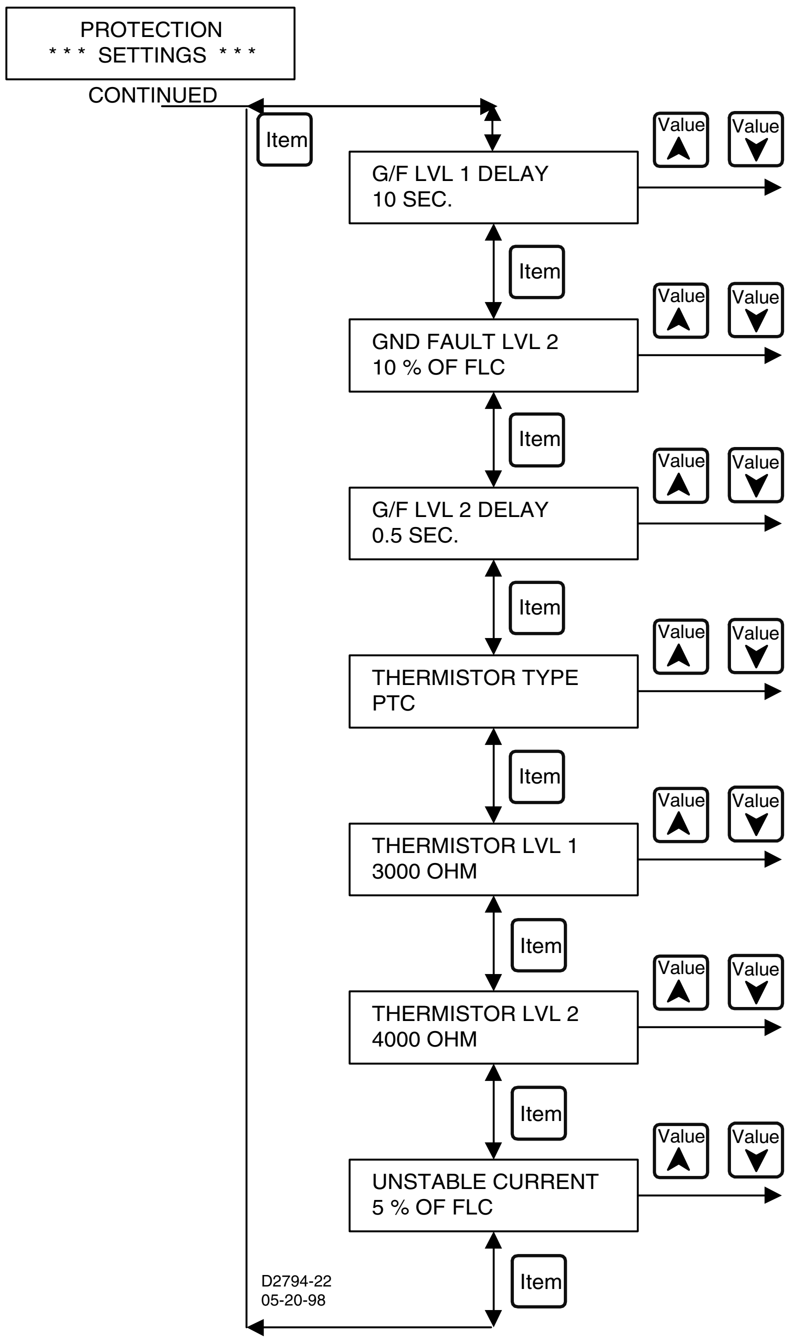


Figure 5-6. PROTECTION SETTINGS - Continued

Legend For Figure 5-7:

U/C LEVEL 1
U/C LEVEL 2
LOAD INCREASED
O/C LEVEL 1-JAM
O/C LVL 2-SHORT
THERMAL LEVEL 1
THERMAL LEVEL 2
UNBALANCE LVL 1
UNBALANCE LVL 2
PHASE SEQUENCE
GND FAULT LVL 1
GND FAULT LVL 2
COMM PORT FAILED
INTERNAL FAILURE
EXTERNAL FAULT 1
EXTERNAL FAULT 2
THERMISTOR LVL 1
THERMISTOR LVL 2
UNSTABLE CURRENT

NOTE: Each screen setting change must be saved before scrolling to the next screen or the change will be lost.

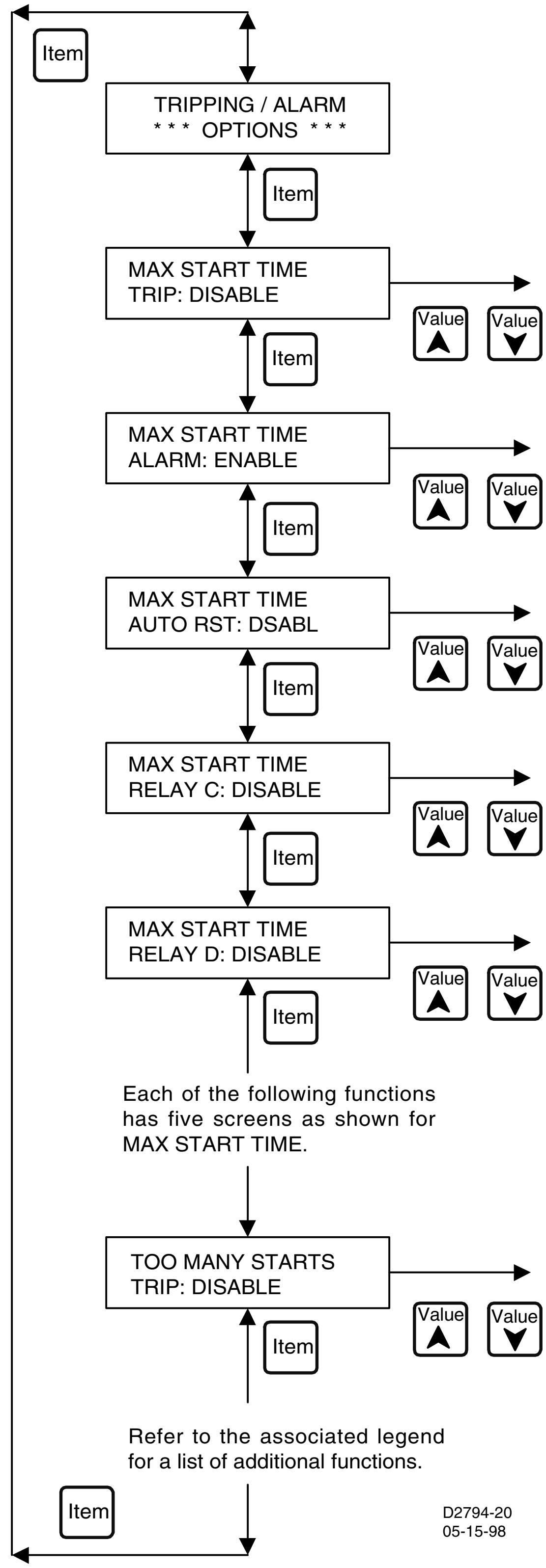


Figure 5-7. TRIPPING / ALARM OPTIONS Available Pages

Additional Option

By pressing Menu and Value ↓, simultaneously, the Test/Maintenance Options menu can be accessed. Figure 5-8 shows the four pages available in the test menus. Notice that the arrows indicate either direction. To scroll through the **TEST/MAINTENANCE OPTIONS**, press the **Item** pushbutton. To perform a test/maintenance function, press the pushbuttons as shown in Figure 5-8.

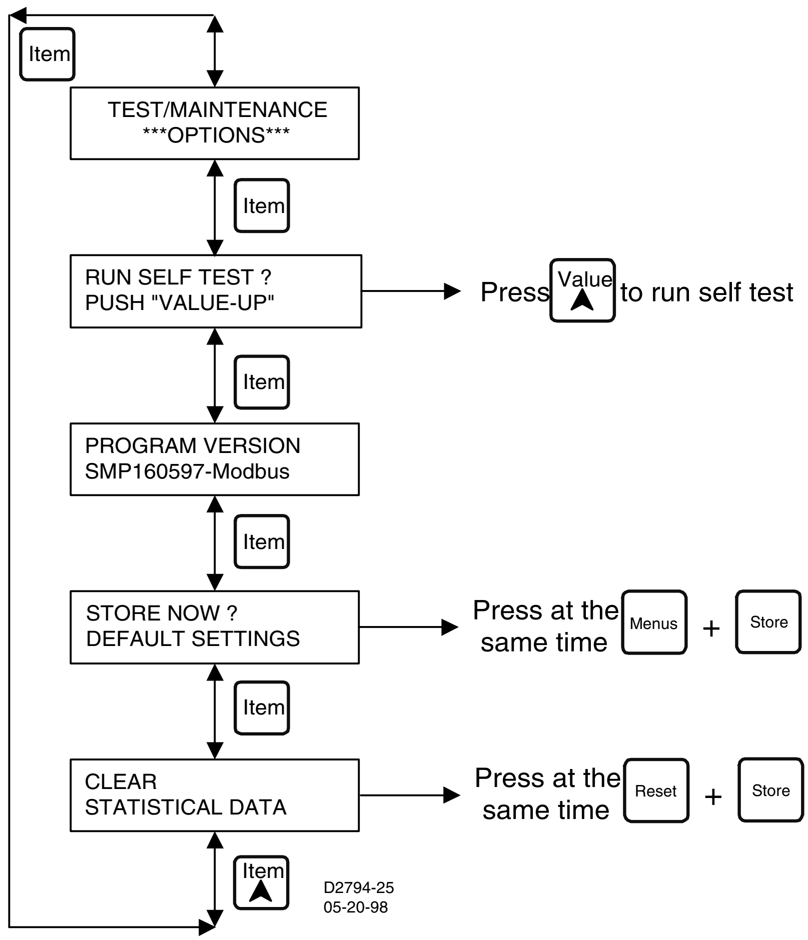


Figure 5-8. TEST/MAINTENANCE OPTIONS And Subordinate Pages

SETTINGS AND CONFIGURATION

Settings and configuration describe the parameters available for MPS relays. These parameters affect the MPS relay operation and the protection that is provided. Each of these setting groups is part of the display menu that is accessed at the front panel or through the serial communications link. This section lists all the menus and the default settings associated with each parameter. The settings range and default values for each parameter is in the associated table.

System Parameter Settings

These paragraphs describe the parameters set with the system parameter settings of the *System Parameters Settings* menu. Table 5-1 is a list of the parameters, ranges, and default settings.

LINE FREQUENCY

Set to the nominal system frequency.

MOTOR FLC

Set to the full-load current on the motor name plate.

CT PRIMARY

Set to the rated primary current of each phase CT.

GND CT PRIMARY

Set to the rated primary current of the ground fault protection CT. If residual CT connections are used, set to the same value as the CT PRIMARY.

TRIP INHIBIT

If a motor contactor is not rated adequately for the available short circuit current, this setting can be used to block an overcurrent trip to prevent damage to the contactor. See the following CAUTION.

CAUTION

If the trip inhibit feature is used, well-coordinated backup protection must be provided at the upstream fuse or breaker to avoid damage to the contactor and motor.

To minimize damage to the motor in the event that the backup protection fails, the MPS relay THERMAL LEVEL 2 trip overrides TRIP INHIBIT. For proper coordination, the upstream backup protection must be faster than the MPS thermal overload function at all currents above the TRIP INHIBIT setting. Except for special circumstances, this parameter should be set to OFF.

CONFIG. TRIP REL

Configures relay B as TRIP or TRIP - FAIL SAFE.

CONFIG. INPUT 1

Configures discrete input 1 as REMOTE RESET, EXT. FAULT 1N/O, or EXT. FAULT 1 N/C.

CONFIG. INPUT 2

Configures discrete input 2 as REMOTE RESET, EXT. FAULT 2 N/O, or EXT. FAULT 2 N/C.

PARAMETERS LOCK

Set to YES to prevent settings of parameters changes, resetting thermal capacity, storing and self testing.

MOTOR NUMBER

This setting can be used for convenience to identify the motor and has no effect on MPS relay operation.

ADDRESS NUMBER

This setting establishes the address on the serial communication link. Setting the value to 248 disables MPS relay communications. The host computer typically has address zero.

BAUD RATE

This setting establishes the baud rate (bits per second) of the MPS relay serial communication port and must match the baud rate of the modem or serial device connected to the port. This setting can only be changed with the front-panel pushbutton switches. To make the new baud rate active, operating power must be removed and then reapplied.

Table 5-1. System Parameter Settings Table

System Parameter Settings		
Parameter	**Range**	**Default**
LINE FREQUENCY	50, 60 Hz	60 Hz
MOTOR FLC	1 to 2,000 A	100 A
CT PRIMARY	1 to 1,500 A	100 A
GND CT PRIMARY	1 to 1,500 A	100 A
TRIP INHIBIT	400 to 1,000 % of MOTOR FLC; OFF	OFF
CONFIG. TRIP REL	TRIP or TRIP-FAIL SAFE	TRIP
CONFIG. INPUT 1	REMOTE RESET, EXT. FAULT 1 N/O, or EXT. FAULT 2 N/C	REMOTE RESET
CONFIG. INPUT 2	REMOTE RESET, EXT. FAULT 1 N/O, or EXT. FAULT 2 N/C	REMOTE RESET
PARAMETERS LOCK	YES/NO	NO
MOTOR NUMBER	0 to 320	0
ADDRESS NUMBER	1 to 248	33
BAUD RATE	1200, 2400, 4800, 9600	9600

Protection Settings

These paragraphs describe the parameters set with the current settings of the *PROTECTION SETTINGS* menu. Table 5-2 is a list of the parameters, ranges, and default settings.

MAX. START TIME

The MPS relay counts the start time from the current exceeding 115% of FLC to the point when the motor current decreases to (OVERLOAD PICKUP +10%) of MOTOR FLC. If the actual start time exceeds this setting, the MPS relay will provide a trip or alarm depending on trip/alarm options settings. This item should be set above the highest start time expected for this application. The actual start time (LAST START PERIOD) measured by the MPS relay is saved as part of the Statistical Data and can be used to verify the expected start time.

NUMBER OF STARTS

If the total number of starts within the STARTS PERIOD time window exceeds this setting, protection function TOO MANY STARTS operates.

STARTS PERIOD

This setting determines the time window during which MPS relay counts the total number of starts. This is a dynamic window, always looking back from the present time.

 # ST AUTO RST DLY

Following an operation of the TOO MANY STARTS protection function, AUTO RESET of the function TOO MANY STARTS is inhibited for the # ST AUTO RST DLY period.

U/C LEVEL 1

Undercurrent protection is only active when the motor is in RUN mode. This level is primarily intended for an alarm and is usually set higher than U/C LEVEL 2. Sustained undercurrent may be an indication of total or partial loss of load and may justify trip or alarm conditions in some applications.

U/C LVL 1 DELAY

This setting defines the time delay before U/C LEVEL 1 operates.

U/C LEVEL 2

This level is primarily intended for a trip and is usually set lower than U/C LEVEL 1, but is otherwise identical.

U/C LVL 2 DELAY

This setting defines the time delay before U/C LEVEL 2 operates.

LOAD INCREASE

This function is only active when the motor is in RUN mode. It provides an operation when the average motor current exceeds the setting for more than 5 seconds.

O/C LEVEL 1 - JAM

This function detects a jam or stall condition in a running motor. A trip or alarm is generated if the average motor current is above the setting for longer than the O/C LVL 1 DELAY.

O/C LVL 1 DELAY

Sets a definite time delay before jam or stall overcurrent protection operates.

O/C LVL 2 - SHORT

This function detects a short-circuit in the motor. A trip or alarm is generated if any of the phase currents is above the setting for longer than the O/C LVL 2 DELAY. The transient overreach of this function due to a dc offset is under 1% and may be disregarded in setting the pickup value. The pickup should be set at least 5% above the highest expected start current. The actual start current (LAST START MAX I) measured by the MPS relay is saved as part of the Statistical Data and can be used to verify the expected starting current.

O/C LVL 2 DELAY

Sets a definite time delay before short-circuit overcurrent protection operates. This delay is in addition to the normal operating time for this function of 40-80 ms.

OVERLOAD PICKUP

Sets the pickup threshold for thermal overload functions. This setting should be kept at the default of 105% for motors with service factors of 1.1 to 1.15. The pickup should be kept at least 5% below the service factor of the motor.

THERMAL LEVEL 1

This function is intended to generate an alarm when the THERMAL CAPACITY exceeds the setting.

t_{6x} TIME

This setting, in conjunction with OVERLOAD PICKUP, establishes the overload characteristic curve for THERMAL LEVEL 2 protection. Figure 5-9 contains the families of curves for cold motor conditions. A cold motor is defined as at ambient temperature and has an available THERMAL CAPACITY of 100%. A hot motor has been running at just under the overload pickup current long enough to attain a steady-state temperature. The percent of the total THERMAL CAPACITY (100%) at which the motor will operate at for steady state load levels can be determined from the following equations.

I > O/L PickUp Setting: $TC = 100 \bullet \left(\frac{I}{I_{OL}} \right)^2$ (%)

I < O/L PickUp Setting: $TC = 100 \bullet \left(\frac{I}{I_{OC}} \right)^2 \bullet \left(\frac{1 - HCR}{100} \right)$ (%)

This is the thermal level indicated by the MPS TC register. A trip occurs when the TC register reaches 100.

Where:

TC = the steady-state THERMAL CAPACITY in %

HCR = the HOT/COLD RATIO setting

I = the steady-state current in % of MOTOR FLC

OLPU = the OVERLOAD PICKUP setting.

The overload curves in Figure 5-10 are based on an OVERLOAD PICKUP setting of 105% and a HOT/COLD RATIO of 40 %. The t_{6x} TIME setting is the operating time of THERMAL LEVEL 2 at a current equal to six times the MOTOR FLC when it is in cold condition.

HOT/COLD RATIO

This setting is the available thermal capacity of the motor in percentage of cold motor capability.

COOL TIME FACTOR

This setting is the ratio of the cooling time constant of the stopped motor to the heating/cooling time constant of the running motor. It is used to model motor cooling after a STOP condition.

UNBALANCE LVL 2

The MPS relay provides two levels of current unbalance protection. UNBALANCE LVL 2 sets the operating time as inversely proportional to the square of the percentage unbalance, with a minimum delay of 1 second. Figure 5-11 contains the characteristic curves for this function. The percentage unbalance is computed with the formula:

% UNBALANCE = 100 $(I_{max}-I_{min})/I_r$

Where:

I_{max} = the largest of the three line currents

I_{min} = the smallest of the three line currents

I_r = the larger of I_{max} and MOTOR FLC.

This setting defines the threshold below which current unbalance protection is blocked. UNBALANCE LVL 1 is automatically set at 50% of UNBALANCE LVL 2, with a factory-set time delay of 1 second. The level 1 function is intended as an alarm, while level 2 serves as a trip.

To find the setting $t_{10\%}$ that will produce a trip in t_{trip} seconds for a given unbalance UB p.u., use the following equation:

$$t_{10\%} = \frac{T_{TRIP} \bullet (UB)^2}{100}$$

Example. Find $t_{10\%}$ to cause a trip in 5 seconds for a 40% unbalance:

$$t_{10\%} = \frac{5 \bullet 40^2}{100} = 80\,seconds$$

U/B LVL 2 MAX T

This setting selects the characteristic curve and represents the function's operating time at an unbalance of 10%.

GND FAULT LVL 1

This level of ground-fault protection is primarily intended as an alarm and is usually set lower than GND FAULT LVL 2. The transient overreach due to dc offset is under 1 % and can be disregarded in setting the pickup value. See the CURRENT INHIBIT setting described below for possible blocking of this function at very high fault currents.

G/F LVL 1 DELAY

Set to the time delay desired for ground-fault level 1.

GND FAULT LVL 2

This level of ground-fault protection is primarily intended as trip and is usually set higher than GND FAULT LVL 1, but is otherwise identical.

G/F LVL 2 DELAY

Set to the time delay desired for ground-fault level 2.

THERMISTOR TYPE

PTC = resistance increases with a temperature increase.

NTC = resistance decreases with a temperature increase.

THERMISTOR LEVEL 1

This type of fault protection occurs when the measured resistance increases above the set value for PTC (decreases below the set value for NTC).

THERMISTOR LEVEL 2

This type of fault protection occurs when the measured resistance increases above the set value for PTC (decreases below the set value for NTC).

UNSTABLE CURRENT

Provides unstable current protection. The MPS relay measures the fluctuation of current. Fault occurs if this setting has exceeded for 2 minutes. The setting range is 1 to 10%. The fluctuation frequency that is detected is 0.5 to 3 Hz. % UNSTABLE CURRENT is determined using the same formula as used for UNBALANCE.

Table 5-2. Protection Settings

Protection Settings		
Parameter	**Range**	**Default**
MAX. START TIME	1 to 250s	10 s
NUMBER OF STARTS	1 to 10	10
STARTS PERIOD	1 to 60 min	30 min
# ST AUTO RST DLY	1 to 60 min	15 min
U/C LEVEL 1	10 to 90% of MOTOR FLC	50%
U/C LVL 1 DELAY	1 to 60 s	2 s
U/C LEVEL 2	10 to 90% of MOTOR FLC	40%
U/C LVL 2 DELAY	1 to 60 s	5 s
LOAD INCREASE	60 to 150% of MOTOR FLC	120%
O/C LEVEL 1 - JAM	100 to 500% of MOTOR FLC	400%
O/C LVL 1 DELAY	0.5 to 10 s	2.0 s
O/C LVL 2 - SHORT	400 to 1200% of MOTOR FLC	800%
O/C LVL 2 DELAY	0 to 4 s	0.5 s
OVERLOAD PICKUP	60 to 130% of MOTOR FLC	105%
THERMAL LEVEL 1	50 to 99% of THERMAL CAPACITY	80%
t_{6x} TIME	0.5 to 120 s	10.0 s
HOT/COLD RATIO	20 to 100% of THERMAL CAPACITY	50%
COOL TIME FACTOR	1 to 15	5
UNBALANCE LVL 2	10 to 40% of MOTOR FLC	15%
U/B LVL 2 MAX T	20 to 120 s	30 s
GND FAULT LVL 1	1 to 100% OF MOTOR FLC	5 %
G/F LVL 1 DELAY	1 to 60 s	10 s
GND FAULT LVL 2	1 to 100% of MOTOR FLC	10 %
G/F LVL 2 DELAY	0.0 to 2.0 s	0.5 s
THERMISTOR TYPE	PTC/NTC	PTC
THERMISTOR LEVEL 1	100 Ω to 30 kΩ	3,000 Ω
THERMISTOR LEVEL 2	100 Ω to 30 kΩ	4,000 Ω
UNSTABLE CURRENT	10% Max of FLC, 1% Min of FLC	5% of FLC

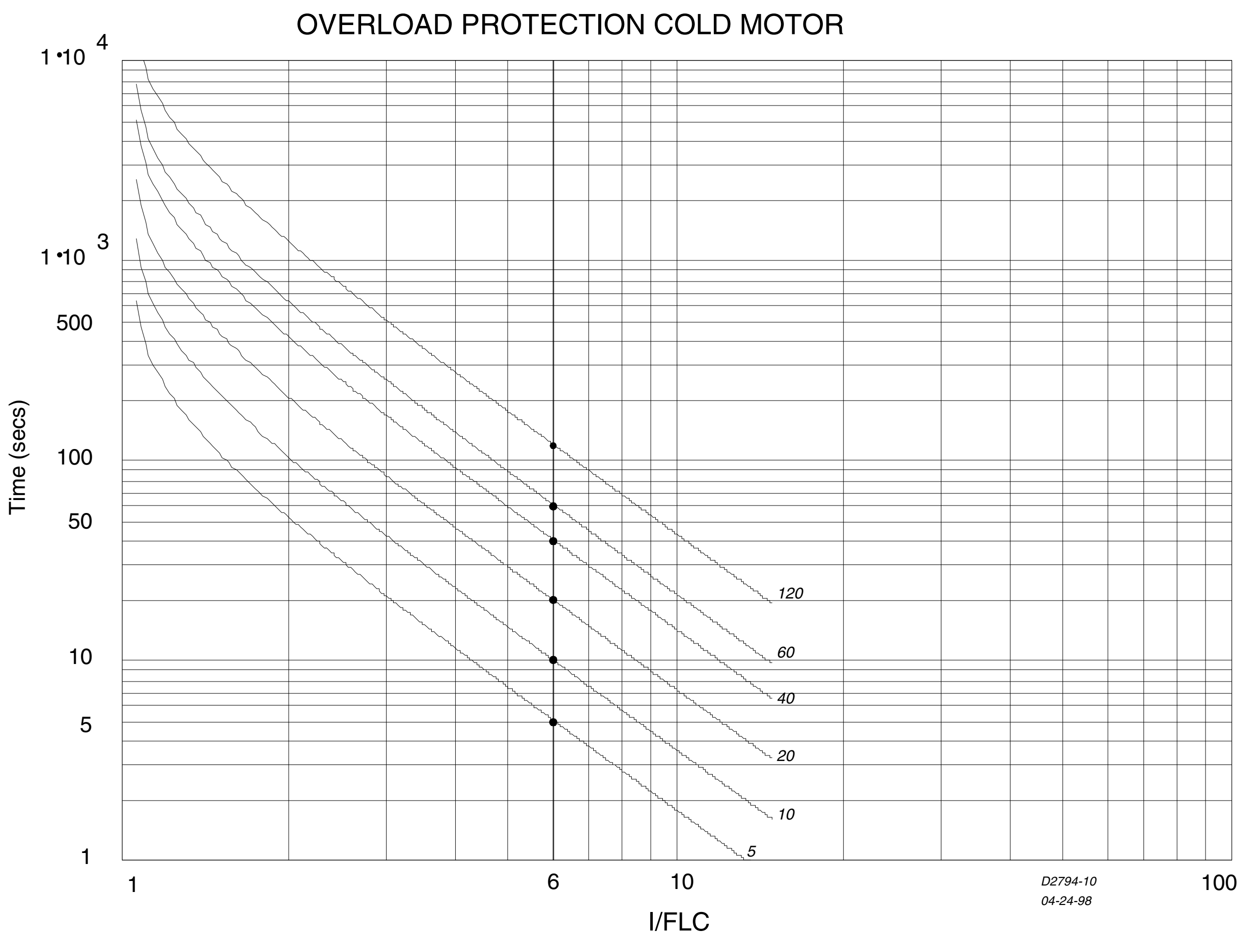


Figure 5-9. Cold Motor Thermal Characteristic Curves (t_{6x})

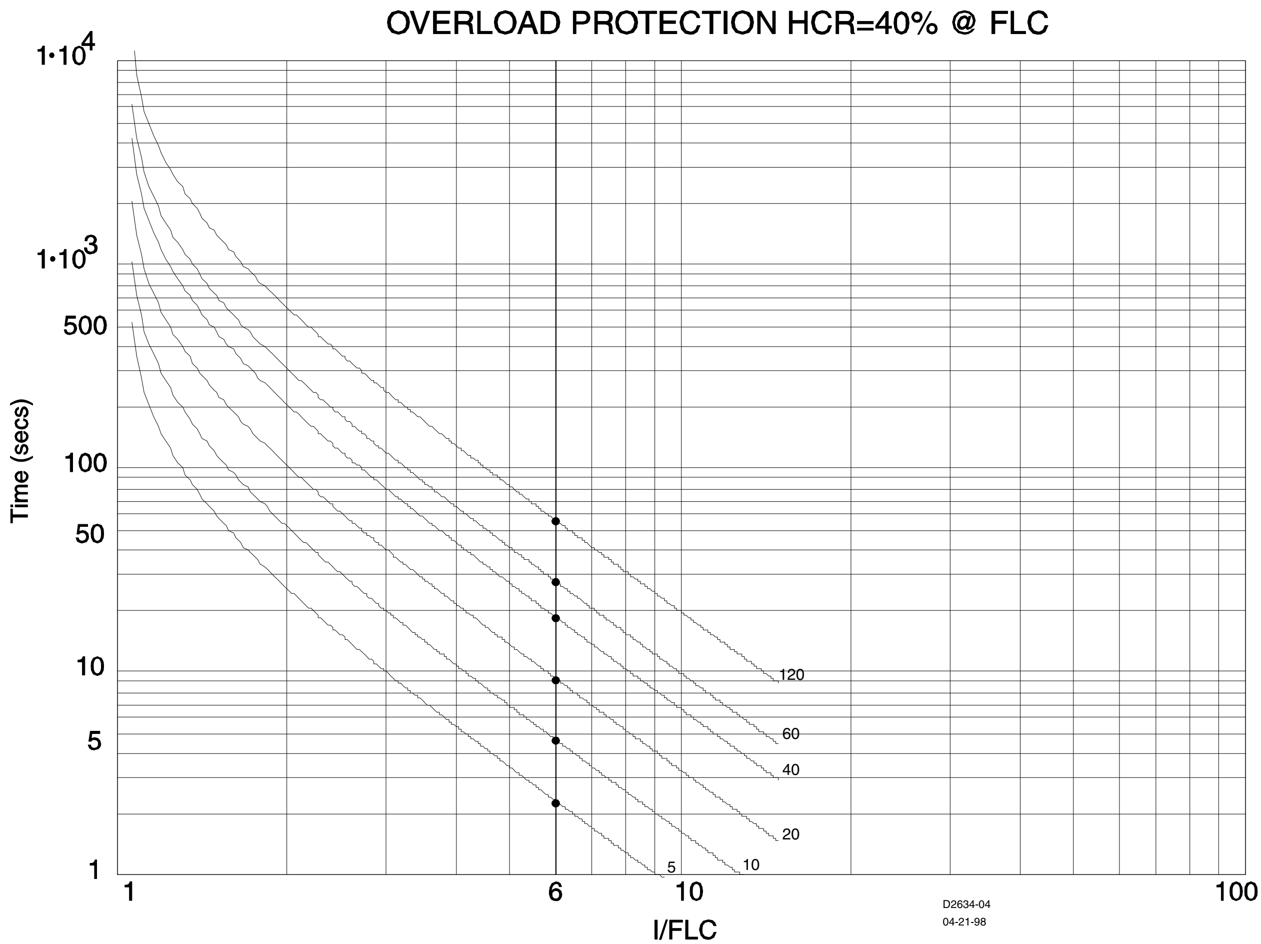


Figure 5-10. 40% Hot/Cold Ratio Motor Thermal Characteristic Curves (t_{6x})

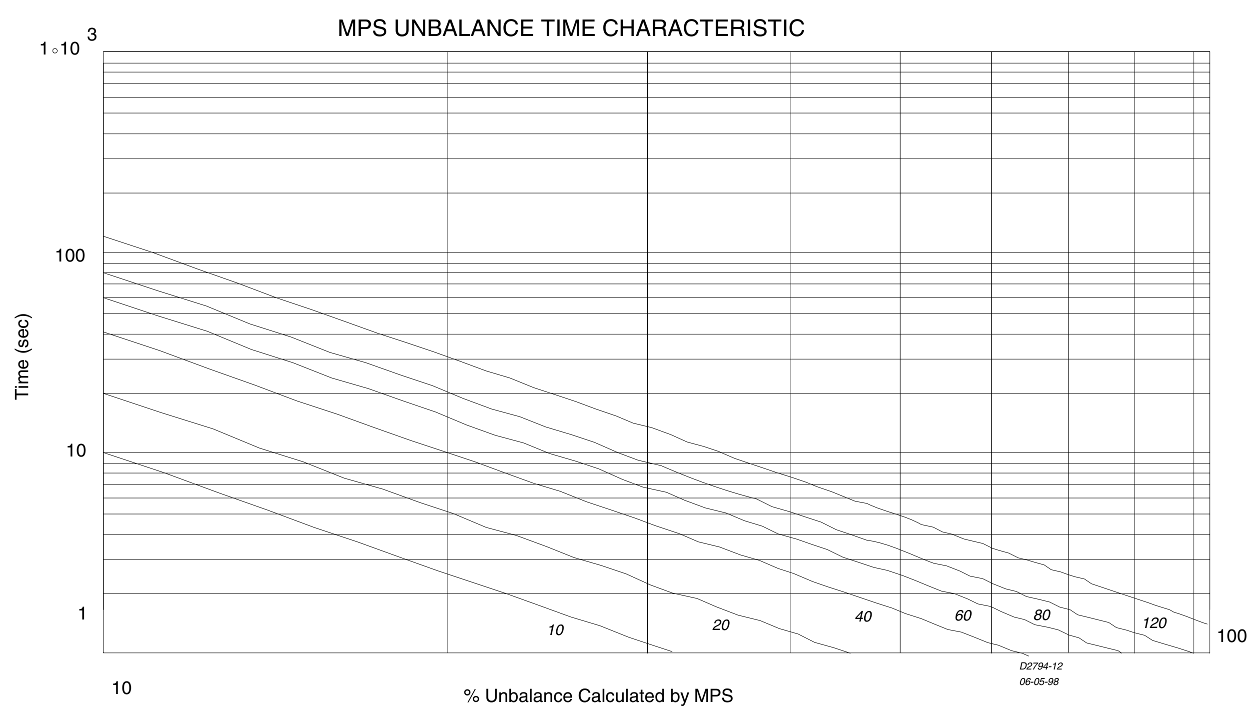


Figure 5-11. Percent Unbalance Calculated By MPS Relay

Tripping/Alarm Options

These paragraphs describe the parameters set with the Tripping/Alarm Options menu. Table 5-3 is a list of the tripping/alarm option settings.

TRIP

When this option is enabled and the trip function operates, the MPS relay performs the following operations:

- Turns on the TRIP/ALARM LED.
- Energizes output relay B if it is configured for TRIP.
- De-energizes output relay B if it is configured as TRIP-FAIL SAFE.
- Energizes output relay C if relay C is selected for given fault.
- Energizes output relay D if relay D is selected for given fault.

ALARM

When this option is enabled and the alarm function operates, the MPS relay performs the following operations:

- Flashes the TRIP/ALARM LED.
- De-energizes output relay A.
- Energizes output relay C if relay C is selected for given fault.
- Energizes output relay D if relay D is selected for given fault.

AUTO RST

When this option is enabled, the MPS relay automatically resets when the condition causing the function to operate has reverted to normal. This option also resets any TRIP or ALARM message on the LCD. The fault data in the MPS relay memory is retained. This option should be kept disabled unless particular conditions warrant its use.

Table 5-3. Tripping/Alarm Options Table

Function	Trip	Alarm	Auto Rst	Relay C	Relay D	When Active
MAX START TIME	DSABL	ENABL	DSABL	ENABL	ENABL	START
TOO MANY STARTS	DSABL	DSABL	DSABL	ENABL	ENABL	START
U/C LEVEL 1	DSABL	ENABL	DSABL	ENABL	ENABL	RUN
U/C LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	RUN
LOAD INCREASED	DSABL	ENABL	DSABL	ENABL	ENABL	RUN
O/C LEVEL 1-JAM	ENABL	ENABL	DSABL	ENABL	ENABL	RUN
O/C LVL 2-SHORT	ENABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
THERMAL LEVEL 1	DSABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
THERMAL LEVEL 2	ENABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
UNBALANCE LVL 1	DSABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
UNBALANCE LVL 2	ENABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
PHASE SEQUENCE	ENABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
GND FLT LVL 1	DSABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
GND FLT LVL 2	DSABL	ENABL	DSABL	DSABL	DSABL	ALWAYS
COMM PORT FAILED	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
INTERNAL FAILURE	DSABL	ENABL	DSABL	DSABL	DSABL	ALWAYS
EXTERNAL FAULT 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
EXTERNAL FAULT 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
THERMISTOR LVL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
THERMISTOR LVL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS

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SECTION 6 • TESTING

INTRODUCTION

You may prefer to test your relay before installation. To test the function of MPS relays, perform the procedures provided in the following paragraphs.

REQUIRED TEST EQUIPMENT

A specific test set is not required to provide switched inputs to the logic input circuits. Jumpers or switches may be used to simulate these inputs. Single-phase voltage and current generators may be used to verify inputs and outputs.

MPS RELAY CONNECTIONS

> **CAUTION**
>
> Equipment damage may occur if the relay case (terminal 18) is not hard-wired to earth ground.

Step 1. Verify that your MPS relay power supply is rated for your operating voltage.

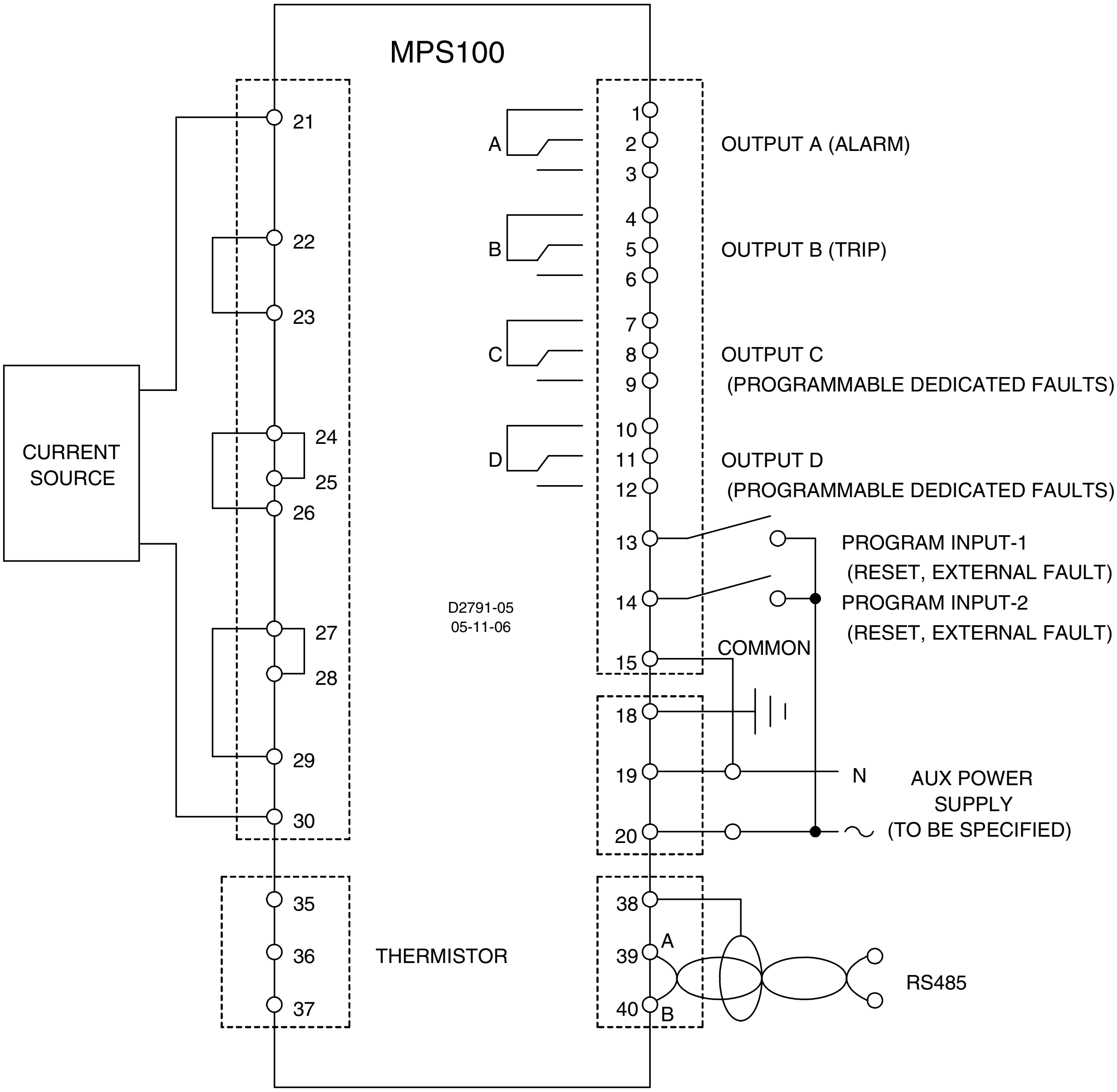
Step 2. Connect operating power, current inputs, and discrete inputs as required to the appropriate terminals (refer to the typical connection diagram, Figure 4-2).

Step 3. Connect the current inputs in series as follows: terminals 22 to 23, terminal 24 to 26, and terminal 27 to 29.

Step 4. Connect the input common terminal 15 to 19. Remove the protective tape from the relay's display.

Step 5. Apply input power to the relay.

Step 6. Verify that the **Power** LED is ON.



NOTES:
1. All relay contacts shown when MPS100 is not powered.

Figure 6-1. Typical Test Connections

CONFIGURATION

Step 1. Close the authorized key input.

Step 2. Use the **Menu** key to advance to the Protection *** Settings *** screen. Use the **Item** key to advance to setting parameters listed below. Use **Value** ↑ or **Value** ↓ to select the settings listed below. Use the **Store** key to save after each setting is changed.

GND FAULT LVL 1 100%
GND FAULT LVL 2 100%

Step 3. Use **Menu** key to advance to the Tripping / Alarm *** Options*** screen. Use the **Item** key to advance to setting parameters listed below. Use **Value** ↑ or **Value** ↓ to select the settings listed below. Use the **Store** key to save after each setting is changed.

GND FAULT LVL 1 RELAY C: ENABLE
GND FAULT LVL 2 RELAY D: ENABLE

SELF TEST

Step 1. Verify that operating power has been applied for one minute.

Step 2. Press **Menu** and **Value** ↓ simultaneously. Use **Item** key to advance to the "Run Self Test?" Screen. Use **Value** ↑ to initiate self test.

Step 3. The display will read "SELF TEST PASSED" .

INPUT TEST DATA

Step 1. Connect the thermistor input, terminals 35 and 36, to a 10K ohm resistor.

Step 2. Apply current to the current input terminals, 21 and 30, according to the table below.

STYLE NUMBER	CURRENT INPUT
MPS100 1xxx	1 amp
MPS100 5xxx	5 amp

Step 3. Use the **Menu** key and advance to the "ACTUAL DATA ****" screen. Use the **Item** key to advance to the display screens in the table below.

ACTUAL DATA ****
I1 I2 I3 95-105 95-105 95-105 A
GROUND CURRENT 95-105 AMP
THERMISTOR RES. 8.5-11.5 KOHM

OUTPUT TEST

Step 1. Remove current from input terminals 21 and 30, and press the **Reset** key for at least one second.

Step 2. Verify that output relay contacts are as follows:

1 to 3	Closed
4 to 6	Open
7 to 9	Open
10 to 12	Open

Step 3. Apply current to the current input terminals, 21 and 30, according to the table below.

STYLE NUMBER	CURRENT INPUT
MPS100 1xxx	0.6 amp
MPS100 5xxx	3 amp

Step 4. Wait 10 seconds and verify that output relay contacts are as follows:

1 to 3	Open
4 to 6	Open
7 to 9	Closed
10 to 12	Open

Step 5. Alarm LED should be flashing on and off.

Step 6. Increase the current at input terminals, 21 and 30, according to the table below.

STYLE NUMBER	CURRENT INPUT
MPS100 1xxx	1.1 amp
MPS100 5xxx	5.5 amp

Step 7. Verify that output relay contacts are as follows:

1 to 3	Open
4 to 6	Closed
7 to 9	Closed
10 to 12	Closed

Step 8. Remove current from input terminals 21 and 30.

Step 9. Verify that output relay contacts are as follows:

1 to 3	Open
4 to 6	Closed
7 to 9	Closed
10 to 12	Closed

Step 10. Alarm LED should be on.

DISCRETE INPUT TEST

Step 1. Alarm LED should be on.

Step 2. Close the switch between terminals 20 and 13 momentarily.

Step 3. Alarm LED should be off.

Step 4. Apply current to the current input terminals 21 and 30 according to the table below.

STYLE NUMBER	CURRENT INPUT
MPS100 1xxx	1.1 amp
MPS100 5xxx	5.5 amp

Step 5. Wait 10 seconds and verify that trip contacts 4 and 6 closes.

Step 6. Alarm LED should be on.

Step 7. Remove current from input terminals 21 and 30.

Step 8. Close switch between terminals 20 and 14 momentarily.

Step 9. Alarm LED should be off.

RESTORE SETTINGS

Step 1. Verify that operating power is still applied.

Step 2. Press the **Menus** and **Value** ↓ pushbutton and the display should read **TEST/MAINTENANCE *** OPTIONS *****.

Step 3. Press the **Item** pushbutton to advance to the **STORE NOW ? DEFAULT SETTINGS** page.

Step 4. Press at the same time the **Menus** and **Store** pushbuttons.

Step 5. Observe that **Data Saved OK** is displayed for approximately two seconds.

Step 6. Press the **Item** pushbutton to scroll to the CLEAR STATISTICAL DATA page.

Step 7. Press at the same time **Reset** and **Store** pushbuttons.

Step 8. Observe that **Data Saved OK** is displayed for approximately two seconds.

Refer to Section 5, *Menus And Settings* for the default settings.

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