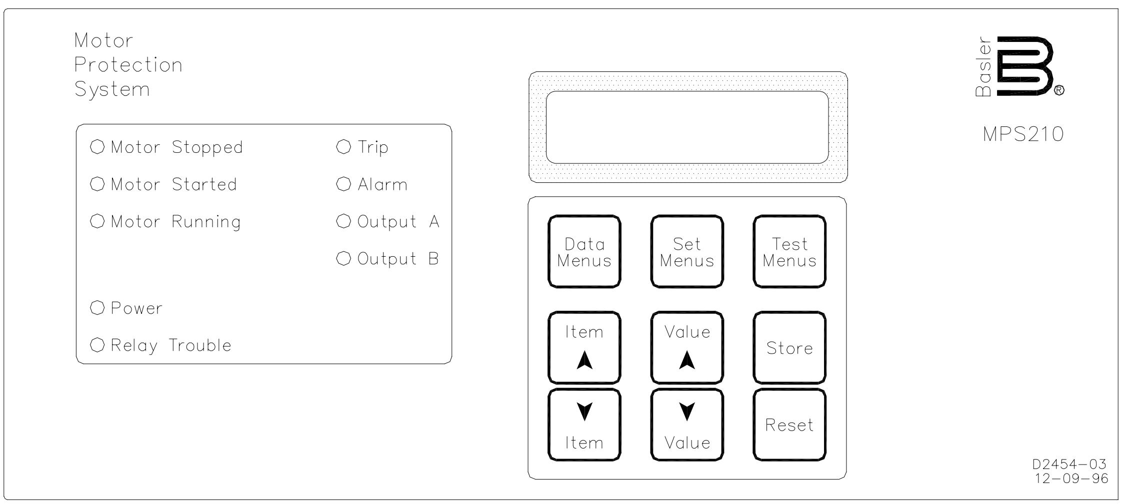
INSTRUCTION MANUAL

FOR

MOTOR PROTECTION SYSTEMS
MPS200 AND MPS210



Basler Electric

Publication: 9308300990
Revision: D 05/06

INTRODUCTION

This instruction manual provides information about the operation and installation of the MPS200 and MPS210 Motor Protection Systems. 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.

First Printing: February 1997

Printed in USA

May 2006

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.

BASLER ELECTRIC
ROUTE 143, BOX 269
HIGHLAND IL 62249 USA
http://www.basler.com, info@basler.com
PHONE +1 618.654.2341 **FAX +1 618.654.2351**

REVISION HISTORY

The following information provides a historical summary of the changes made to the instruction manual for the MPS200 and MPS210. Revisions are listed in chronological order.

Manual Revision and Date	Change
—, 01/05	• Initial release
A, 11/97	• Added draw-out option to style chart and terminals, panel drilling, and dimensional illustrations for draw-out option.
B, 05/98	• Added Table 1-1, Voltage Sensing Connections. • Added autotransformer starting material to Section 2. • Added Figure 4-7, Voltage Input Connections. • Added Table 5-2, Voltage Transformer Settings. • Corrected the thermal characteristic curves in Figure 5-17 and 5-18. • Added thermal protection dynamic response curve to Section 5. • Revised the output relay test procedures of Section 6. • Added Section 8, *Manual Change Information*.
C, 10/98	• Corrected the shield connection terminal reference in Figure 4-6, MPS210 Typical Connection Diagram.
D, 05/06	• Corrected the labeling of the RS-485 terminals in Figures 3-2, 3-3, 3-4, 4-2, 4-5, and 4-6. • Moved maintenance information of Section 7 to Section 4 and deleted Section 7. • Moved instruction manual change information from Section 8 to manual introduction and deleted Section 8.

This page intentionally left blank.

CONTENTS

SECTION 1 • GENERAL INFORMATION 1-1
INTRODUCTION 1-1
MEASURED, CALCULATED, AND RECORDED DATA 1-1
Measured Data 1-1
Calculated Data 1-1
Statistical Data 1-1
Fault Data 1-1
MOUNTING 1-1
PROTECTION 1-2
Voltage Based 1-2
Current Based 1-2
Power Based 1-2
Temperature Based 1-2
General Faults Based 1-2
CONTROL 1-2
Control Sources 1-2
Motor Control (MPS210 Only) 1-2
OPERATING POWER 1-3
INPUTS 1-3
Current 1-3
Voltage 1-3
RTDs 1-4
MPS200 and MPS210 Contact Sensing Inputs 1-4
MPS210 Contact Sensing Inputs 1-4
OUTPUTS 1-5
MPS200 1-5
MPS210 1-5
METERING 1-5
COMMUNICATION 1-5
MODEL AND STYLE NUMBER 1-6
SPECIFICATIONS 1-6
Current Sensing Inputs 1-6
Voltage Sensing Inputs 1-6
Contact Sensing Inputs 1-6
RTD Inputs 1-7
Output Contacts 1-7
Power Supply 1-7
Accuracy 1-7
Ranges 1-7
Unbalance Trip and Alarm 1-8
Communications 1-8
Surge Withstand Capability 1-8
Impulse Test 1-8
Radio Frequency Interference 1-8
Isolation 1-8
UL Recognition 1-8
Ambient Temperature Range 1-9
Mounting 1-9
Weight 1-9
OVERLOAD CHARACTERISTIC CURVES 1-9

SECTION 2 • APPLICATION 2-1
INTROLDUCTION 2-1
MPS200 2-1
MPS210 2-1
MPS210 MOTOR CONTROL 2-1
Direct On-Line Starting 2-1
Wye/Delta Starting 2-3

Autotransformer Starting 2-5
MOTOR SETTING EXAMPLE 2-8
System Parameters 2-9
Motor Parameters 2-9
Current Settings 2-9

SECTION 3 • CONTROLS AND INDICATORS 3-1
INTRODUCTION 3-1
INDICATORS 3-1
CONTROLS 3-2
REAR PANEL 3-3

SECTION 4 • INSTALLATION 4-1
GENERAL 4-1
DIELECTRIC TEST 4-1
MOUNTING 4-1
CONNECTIONS 4-1
MAINTENANCE 4-1

SECTION 5 • MENUS AND SETTINGS 5-1
GENERAL 5-1
TOP LEVEL MENUS 5-1
Data Menus 5-1
Set Menus 5-7
Test Menus 5-15
SETTINGS AND CONFIGURATION 5-16
Communication Settings 5-16
System Parameter Settings 5-16
Voltage Settings 5-22
Current Settings 5-23
Power Settings 5-28
Temperature Settings 5-29
Tripping/Alarm Options 5-30

SECTION 6 • TESTING 6-1
GENERAL 6-1
REQUIRED TEST EQUIPMENT 6-1
MPS RELAY CONNECTIONS 6-1
CONFIGURATION 6-3
SELF TEST 6-3
INPUT TEST DATA 6-3
LOGIC INPUTS 6-4
OUTPUT RELAYS TEST 6-5
MPS200 and MPS210 Relays 6-5
MPS210 Relays ONLY 6-5
RESTORE SETTINGS 6-6

SECTION 1 • GENERAL INFORMATION

INTRODUCTION

Motor Protection Systems MPS200 and MPS210 are compact, microprocessor-based digital relays providing complete and comprehensive protection for three-phase motors in low- and medium-voltage applications. In addition to protection, the MPS200 and MPS210 relays provide the following essential functions:

- Control
- 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. To maintain measurement accuracy, MPS200 and MPS210 relays track the power system frequency from the measured voltage. If no motor voltage input is used, the MPS200 and MPS210 relays assume that the actual frequency is the same as the programmed nominal system frequency. Hereinafter, when referring to both relays, the MPS200 and MPS210 relays are referred to as MPS relays.

Measured Data

MPS relays measure true rms voltages and currents. Measured data includes:

- Phase and line voltages
- Phase currents
- Ground current
- Real power (watts)
- Reactive power (vars)
- Power factor
- Resistance temperature detector (RTD)

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, ground fault current at time of trip, and phase voltages at time of trip.

MOUNTING

Three mounting styles are available. These styles are fixed horizontal, fixed vertical, and draw-out vertical. The draw-out vertical relay is supplied in a M1 case. The draw-out configuration allows the relay to be removed from service without tools. CT shorting is provided by shorting bars in the relay case. Section 4, *Installation*, provides mounting instructions, and dimensions for all mounting styles in panels or racks.

PROTECTION

MPS relays have 48 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 48 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.

Voltage Based

- Overvoltage (two levels)
- Undervoltage
- Phase Loss
- Phase Sequence

Current Based

- Maximum Start Time
- Too Many Starts
- Overcurrent (jam and short)
- Ground Fault Overcurrent (two levels)
- Undercurrent (two levels)
- Load Increase
- Unbalanced Currents
- Thermal Overload and Locked Rotor

Power Based

- Underpower (two levels)
- Low Power Factor

Temperature Based

- Ten RTD Sensors, (two levels each)

General Faults Based

- Self Test
- External Faults
- Control Circuit

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. Motor control functions are only available with the MPS210 relays.

Control Sources

- Local Front Panel
- RS-485 Serial Port
- Programmable Logic Controller

Motor Control (MPS210 Only)

MPS210 relays can receive motor control signals from three separate sources. These sources are: one, start and stop contact inputs; two, programmable logic controller (PLC) contact inputs; and three, communications serial link (RS-485) input. MPS210 relays support the following starting techniques.

- Direct-On-Line
- Wye/Delta
- Forward/Reverse
- Two-speed
- Start-Prevent After Trip
- Start Prevent System Not Ready

OPERATING POWER

MPS relay operating power may be either ac or dc, depending on the relay model. Available models are:

- 110 or 220 Vac, depending on the power selector switch. This switch is accessible from the MPS relay rear panel. Line frequency (50 or 60 hertz) is selected in software.
- 24/48 Vdc
- 110/250 Vdc

INPUTS

Current

MPS relays have four current inputs (three for phase current and one for ground current). Each input includes terminals for one ampere or five ampere nominal current inputs to match the CT secondary range. The ground current input can be connected residually if a separate ground CT is not available.

Voltage

Three inputs monitor the system voltage. MPS relays use the voltage inputs for the following purposes:

1. Power system frequency tracking for the current and voltage measurement function.
2. Power metering.
3. Under and Over voltage functions.
4. Voltage balance and phase sequence functions.
5. Under power and low power factor functions.

Table 1-1 provides a summary of the voltage sensing connections that can be used with the MPS. If three phase sensing voltage is not available, all of the functions included in MPS relays cannot be used.

See *Specifications* to determine if the motor supply voltage is within the allowable range for direct connection to the voltage sensing inputs without the use of voltage transformers.

If no sensing voltage is available, the MPS relay can be used as a current only protective relay and all voltage and power protective functions should be disabled. If available, any ac voltage source that is fed from the same power system as the motor can be connected for use by the frequency tracking function. If no ac voltage source is connected, the *System Parameter Settings*, *Line Frequency* setting will be used by the MPS for its measurement functions.

Table 1-1. Voltage Sensing Connections

Voltage Sensing Connection	Figure 4-7 Connection Diagram	Power Metering	Under/Over Voltage	Phase Loss/ Phase Sequence	Under Power/ Low PF
3∅, Direct Connect	a	Yes	Yes	Yes	Yes
3∅ VT, 4 Wire	b	Yes	Yes	Yes	Yes
3∅ VT, 3 Wire	c	Yes	Yes	Yes	Yes
1∅ VT, L-L	d	Unusable	Yes	Disable	Disable
1∅ VT, L-N	e	Unusable	Yes	Disable	Disable
Other AC Voltage	f	Unusable	Disable	Disable	Disable
None	N/A	Unusable	Disable	Disable	Disable

RTDs

Ten RTD inputs, each with three terminals, apply voltage from the RTDs and the MPS relay derives the temperatures. MPS relays are compatible with several RTD types. One option (RTD=C) is for Copper RTDs. A second option (RTD=P) is for 100 ohm Platinum or 120 ohm Nickel RTDs. When P type RTDs are used, the operator must select in software the RTD type (Platinum or Nickel).

MPS200 And MPS210 Contact Sensing Inputs

An optically isolated logic contact input provides system security. The AUTHORIZED KEY input must be closed (or jumpered) to change MPS relay settings. Other logic inputs are specific to the MPS210 relays.

MPS210 Contact Sensing Inputs

There are an additional nineteen optically isolated logic contact inputs in MPS210 relays to control system operation. The following list describes the nineteen input functions with any clarification in parenthesis after each function and the number of inputs in brackets. Parameters for the logic inputs are also provided after the brackets.

Speed Switch [1]

Open indicates that the motor exceeds minimum speed. Closed indicates that the motor does not turn or did not exceed minimum speed. Leave input open if speed switch is not used.

External Fault 1, 2, and 3 (normally closed contacts) [3]

Open equals trip. Closed equals run enable. If not used, disable Alarm and Trip for External Fault in the MPS relay settings.

Local Control (start contactor A, start contactor B, stop) [3]

Start A — Close the contact to operate contactor A. Open the contact to override any other input and force stop condition. Start B — Close the contact to operate contactor B. Stop — Open the contact to stop the motor. Open contact overrides any other inputs and forces stop condition.

Local/Remote [1]

Open for local control. Close for remote control.

External Lockout [1]

Open to prevent operation. Close to enable operation.

PLC Mode Selection [1]

Open for PLC control. Closed for serial communications port control.

PLC Contacts (contactor A, contactor B, reset) [3]

PLC control A — Maintained normally open contact. Open to stop the motor. Close to operate contactor A and start the motor. PLC control B — Maintained normally open contact. Open to stop the motor. Close to operate contactor B and start the motor. PLC reset — Normally open, momentary close contact. Close to reset MPS relay fault.

Position Status (contactor A (normally open), contactor B (normally closed), isolator) [6]

Contactor A status — Inputs from the contactor auxiliary contacts (one normally open and one normally closed) are used to monitor the contactors position. Contactor B status — Inputs from the contactor auxiliary contacts (one normally open and one normally closed) are used to monitor the contactors position. Isolator — Local isolator switch auxiliary contacts (one normally open and one normally closed). Prevents contactors operation when the isolator is open. Start is enabled only if terminals 17 to 40 are open and 18 to 41 are closed.

OUTPUTS

MPS relays have four Form C (SPDT) configurable outputs. The available configurations are described in the following paragraphs.

MPS200

Relay A: A dedicated trip output for thermal level 2 functions.

Relay B: A dedicated trip output for the ground fault level 2 function.

Relay C: A customer configurable output to provide an alarm output or slave to relay A or relay B.

Relay D: A customer configurable output to provide a trip output or slave to relay A or relay B.

MPS210

Relay A: An automatically configured output depending on the programmed motor starting method. Possible configurations are:

- Full-voltage contactor control for direct-on-line starting
- Contactor control for wye/delta starting
- Forward contactor control for forward/reverse starting
- High speed contactor control for two speed starting

Relay B: An automatically configured output depending on the programmed motor starting method. Possible configurations are:

- Contactor control for wye/delta starting
- Reverse contactor control for forward/reverse starting
- Low speed contactor control for two speed starting

Relay C: A customer configurable output to provide:

- An alarm output (fail-safe)
- Slave to relay A or relay B
- Contactor control for wye/delta starting

Relay D: A customer configurable output to provide:

- An trip output (fail-safe or non fail-safe)
- Slave to relay A or relay B

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, 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 stored in a computer file can be uploaded. 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
- Control MPS relay and the Motor (Start A, Start B, Stop etc. — MPS210 relays only)
- 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 **MPS210 C1V1**, the relay would have the following characteristics and operational features.

MPS210	Motor Protection System with Control
C	Copper RTD
1	110/220 Vac power supply
V	Vertical case
1	RS-485 communications link with Modbus™ protocol

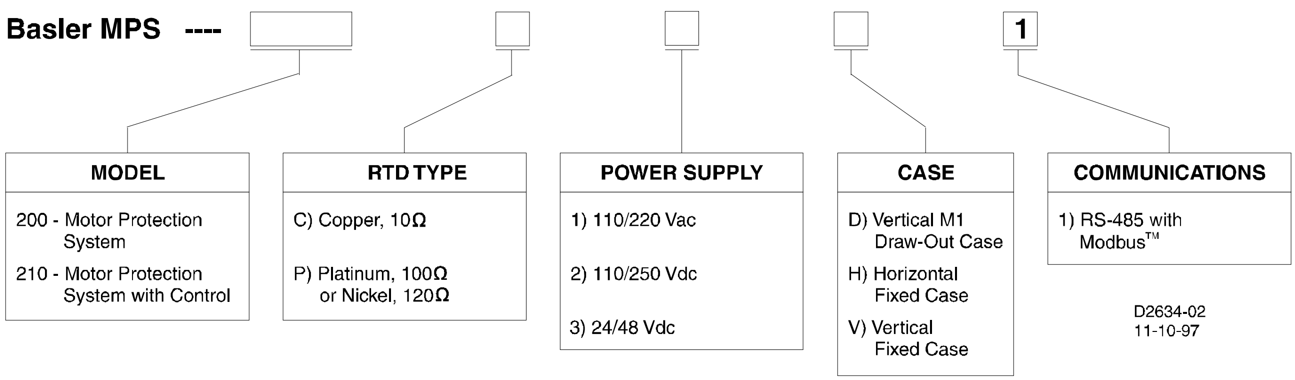


Figure 1-1. Style Number Identification Chart

SPECIFICATIONS

Current Sensing Inputs

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

Voltage Sensing Inputs

Sensing method:	True rms, 0.5 millisecond sample time
Nominal Voltage:	Direct connection 90 to 750 Vac_{L-L}, maximum permissible voltage 450 Vac_{L-N}, 750 Vac_{L-L}

Contact Sensing Inputs

Voltage level:	Internally connected to control power - no external voltage required

RTD Inputs

Type:	Copper (10 ohm), Platinum (100 ohm) or Nickel (120 ohm) depending on configuration (style) and settings
Range:	0 to 200° C
Resistance:	Maximum wire resistance = 25% of RTD at 0° C
Time Delay:	2.0 ±1.0 second

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

DC input:	19 to 60 Vdc or 85 to 300 Vdc, depending on model style number
Burden:	≤20 volt-amperes
AC input:	90 to 135 Vac or 160 to 270 Vac, depending on switch selection
Burden:	≤30 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

For power, reactive power, and power factor: when voltage ≥ 90 volts, power factor ≥ 0.5, and current is between 10 and 150%: accuracy = ±3%. When voltage ≥ 90 volts, power factor ≥ 0.5, and current is >150%: accuracy = ±7%.

Power	±3% or ±7%.
Reactive power	±3% or ±7%.
Power factor	±3% or ±7%.
RTDs	±3% of resistance
Thermal Overload Curves	
One to 10 seconds:	± 1 second
Above 10 seconds	2% ± 1 second
Threshold level	± 1.5% of overload setting
Overload pickup level	± 1.5% of overload setting

Ranges

Phase:	0.05 to 12 times nominal
Ground fault:	0.05 to 1 times nominal
Voltage:	90 to 750 Vac_{L-L}
Power (3 phase):	0 to 30 megawatts
Reactive power (3 phase):	0 to 30 megavar
Power factor (3 phase):	0 to 1
RTDs:	0 to 200°C

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	1,900 Vdc for one minute between ground and current, voltage, control, and power supply inputs.
Transverse mode	Between any of the following circuits except between the control inputs and power supply inputs (they share a common connection): current, voltage, control, and power supply inputs.
Across open contacts	1,414 Vdc for one minute

UL Recognition

Fixed horizontal and vertical relays are UL recognized per Standard 508, UL File No. E97033. Note: Output contacts are not UL recognized for voltages greater than 250 V.

Ambient Temperature Range

Operating:	–20 to +65°C (–4 to 149°F)
Display:	10 to +60°C (14 to 140°F)

Mounting

Three mounting styles are available: fixed horizontal, fixed vertical, and draw-out vertical.

Weight

9 pounds (4.08 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.

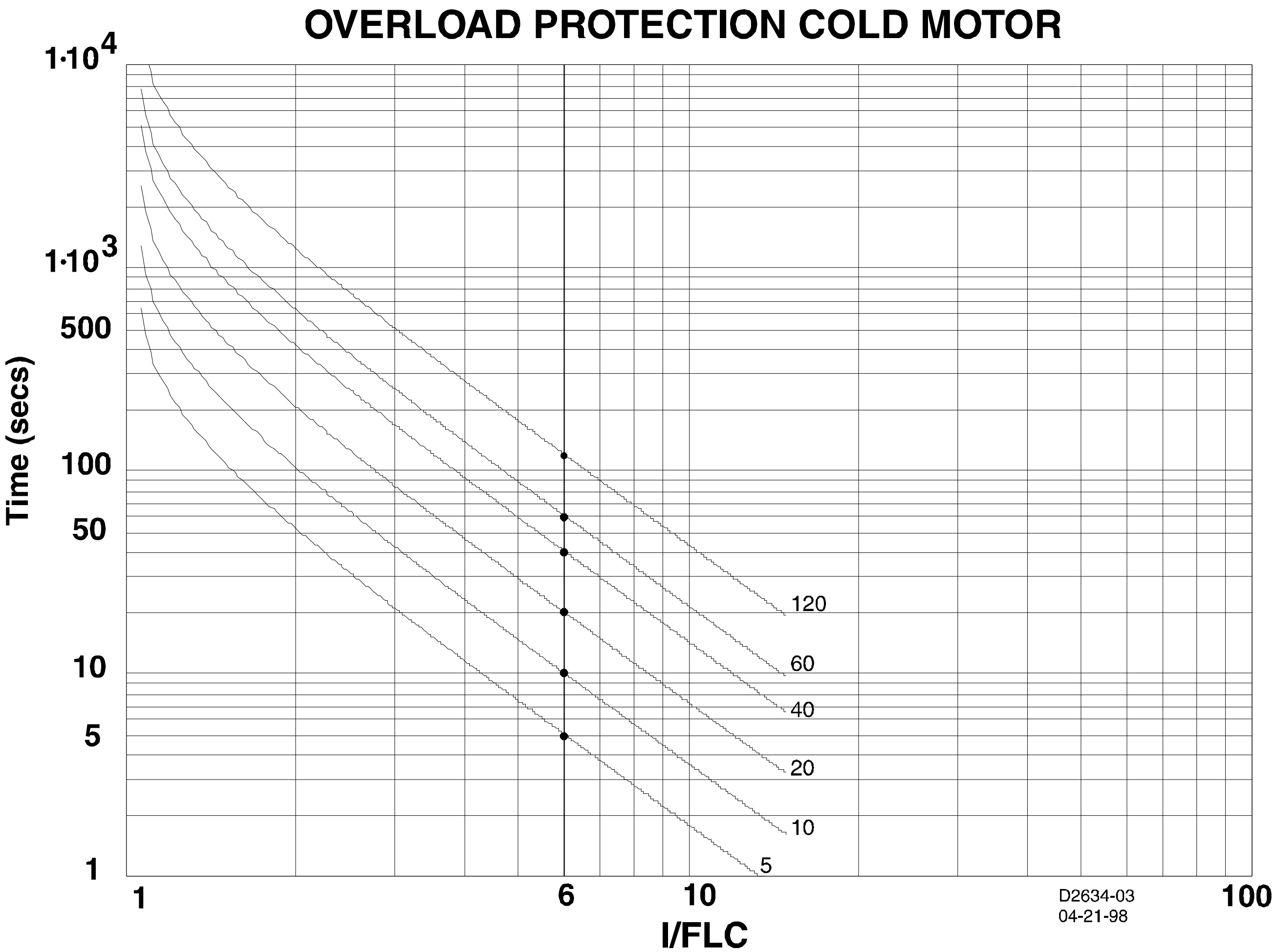


Figure 1-2. Cold Motor Overload Characteristic Curves (Labels correspond to t_{6x} setting)

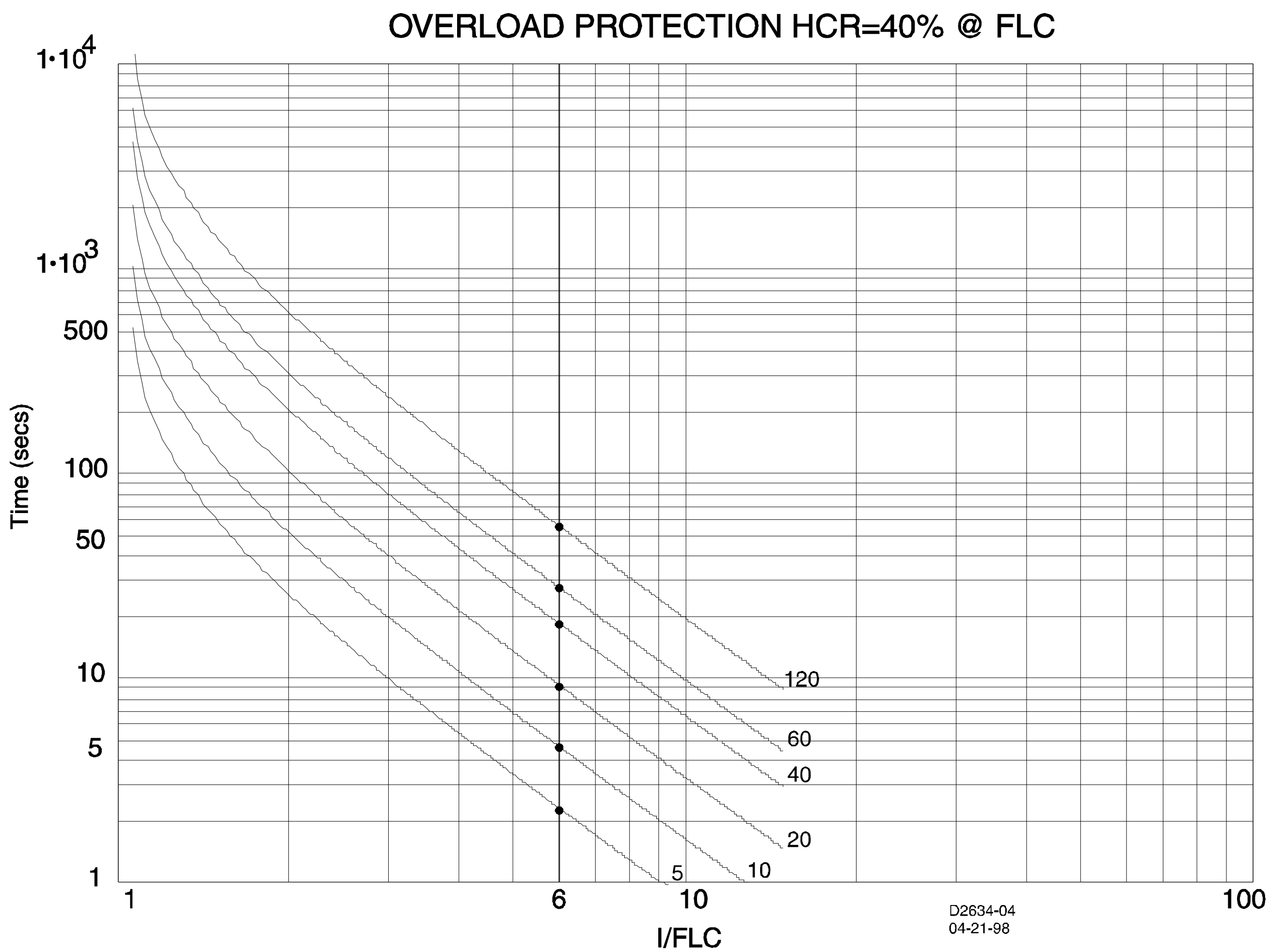


Figure 1-3. 40 % Hot/Cold Ratio Motor Overload Characteristic Curves (Labels correspond to t_{6x} setting)

SECTION 2 • APPLICATION

INTRODUCTION

The MPS200 and MPS210 are compact, microprocessor-based digital relays providing complete and comprehensive protection for three-phase motors in low and medium voltage applications. MPS relays provide the following essential functions.

MPS200

- Protection
- Metering
- Communications

MPS210

- Protection
- Metering
- Communications
- Control

Applications for MPS relays, appropriate settings, and system interconnections are provided in the following paragraphs. A complete description of the system and motor parameters that are used in these applications is provided in Section 5, *Menus and Settings*.

MPS210 MOTOR CONTROL

In addition to all the protective and metering features of the MPS200, the MPS210 includes control functions for various starting methods and local/remote controls.

CAUTION

Equipment damage may occur if the relay case (terminal C18) is not hard-wired to earth ground.

Direct On-Line Starting

Direct on-line starting is the most common starting method for three-phase motors operating from low and medium voltages. Figure 2-1 provides typical ac and dc connections for this common starting method. When the START pushbutton (terminals 1 and 24) is depressed, MPS output contactor A (terminals 44 and 46) closes and causes motor contactor M to close. Full voltage is applied to the motor through the motor contactor. On the MPS210 front panel, the yellow Motor Started LED turns ON. Notice that the logical inputs for the contactor A status to the MPS210 are required inputs. (Contact A status inputs are only required if using the welded contact setting or the control circuit open setting. In this illustration, logical inputs for the contactor A status are the 52a and 52b auxiliary inputs from the M motor contractor.) If the logical inputs for the isolator (terminals 18 and 41), stop (terminals 3 and 26), and interlock (terminals 10 and 33) are not used, the inputs must be jumpered. When the average motor current falls below 115% of full load current, the Motor Started LED turns OFF, and the Motor Running LED turns ON.

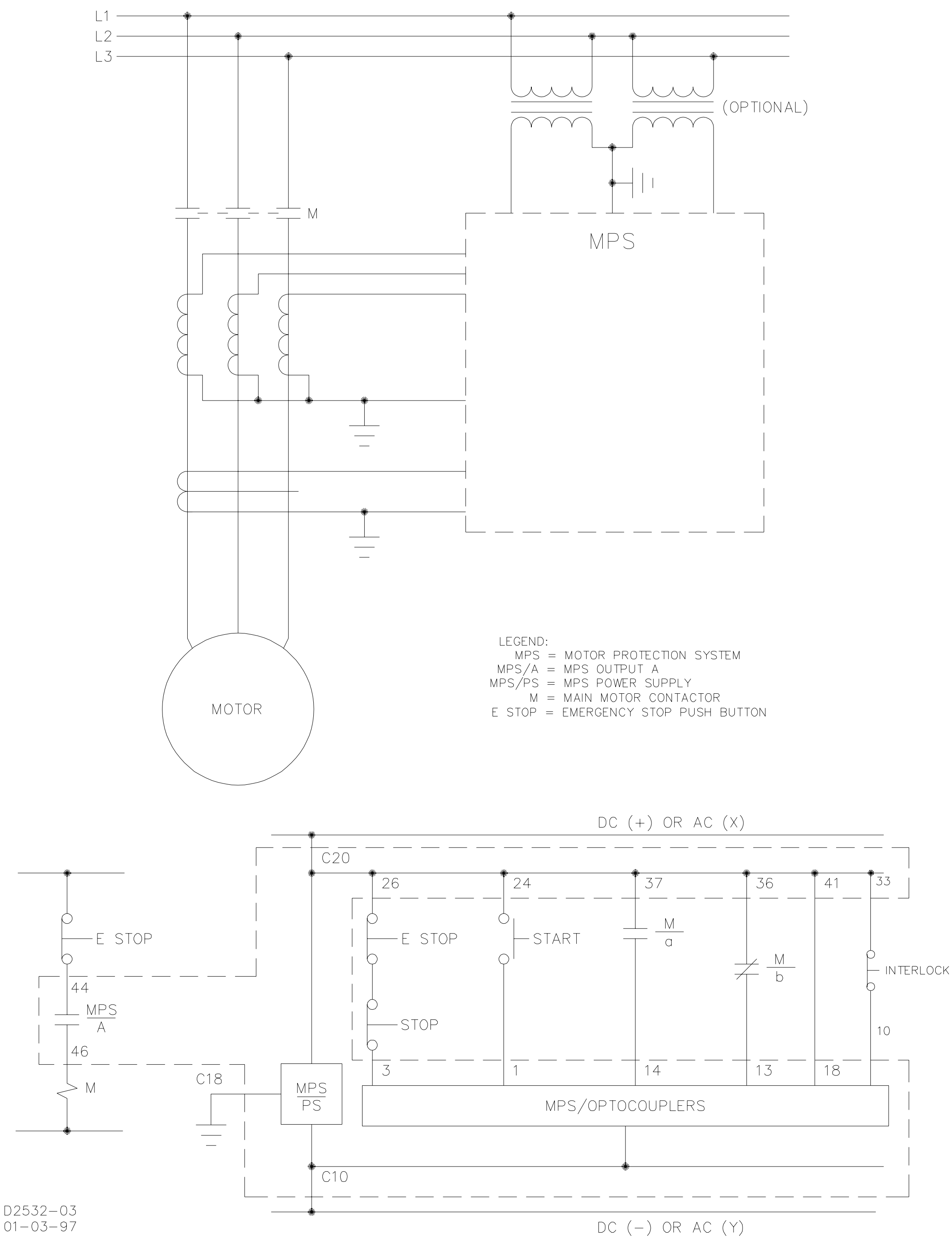


Figure 2-1. Direct-On-Line Starting Typical Connection Diagram

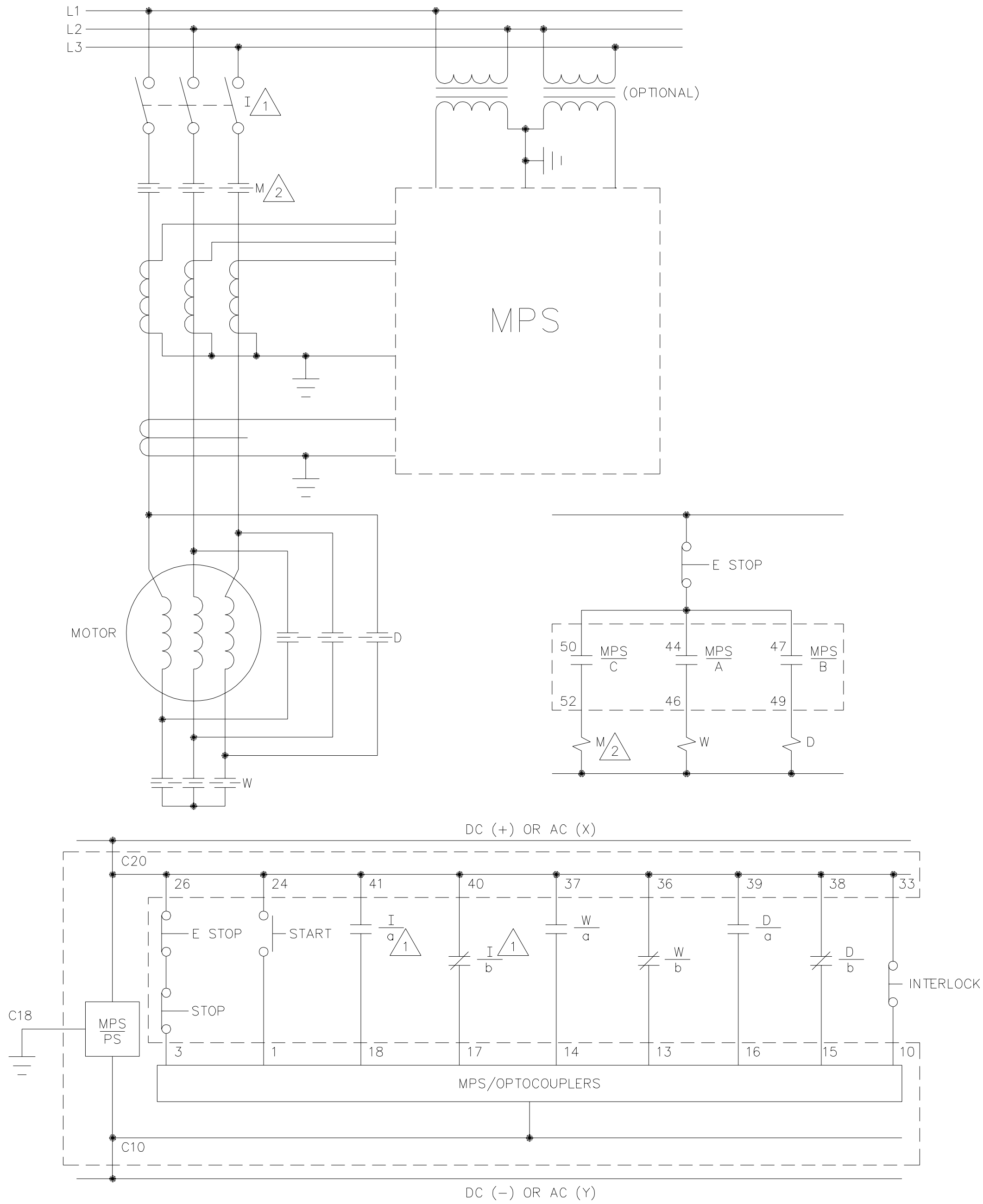
Wye/Delta Starting

This starting method applies a reduced voltage at the beginning of the starting sequence with a wye connection and then changes to a delta connection to complete the starting sequence. Doing this reduces the starting torque and voltage drop on the motor bus. Voltage drop can adversely affect other equipment on the bus when starting large motors. A downside to this starting method is that we are effectively performing a motor bus transfer when we switch from wye to delta.

In this application (Figure 2-2), contactor C is configured to operate in the start/run mode. This setting is made in the SYSTEM PARAMETERS page of SET MENUS. When a start signal is given, MPS contactors A and C close. This causes motor contactors M and W to close connecting the motor in the wye configuration (applying reduced voltage). To transfer to the delta configuration, the MPS contactor A opens and contactor B closes. MPS contactor C remains closed until the motor is to be stopped. Notice the logical inputs for the isolator status contacts (terminals 41 and 18, and 40 and 17). These inputs will trip or lockout the motor if the upstream breaker is not closed.

When a motor is disconnected from the supply, the speed decays and a slip frequency between the motor and the system occurs. Residual voltage remains on the motor terminals and decays exponentially with time. Depending on the slip frequency at reclosure, excessive mechanical forces can be generated. A worst case scenario is the motor breaker closure with the motor 180 degree's out of phase with the system and high residual voltage. Extremely high instantaneous torque results and typically breaks the motor shaft. The normal approach to this problem is to either reclose fast enough so that there is negligible phase angle shift or to wait long enough so that the residual voltage is less than 20 percent. In our wye/delta motor starting, we are switching from the wye contactor for starting to the delta contactor for running. We must make sure that the W contactor has time to drop out before the D contactor picks up, but is not delayed so long that the motor has a chance to slow down enough to cause a problem. Typically, the maximum time to have the motor de-energized is 200 milliseconds. This setting in the MPS210 is called the *transition time*. Transition time should be set longer than the maximum dropout time for contactor W (controlled by output A). Typically, the maximum dropout time is 100 milliseconds. One exception is when there are extremely high inertia loads that may take several minutes to slow down when voltage is removed. Transition time can then be extended.

When the transition (from wye starting to delta running) occurs in MPS210 relays is determined by two variables. Those two variable are the MAX TIME IN STAR setting and the motor current. (The MAX TIME IN STAR setting determines the maximum and minimum time that contactor A remains closed during a starting sequence. The minimum time is 25 percent of the MAX TIME IN STAR setting.) If the starting time is between the maximum and minimum times and the motor current drops below the STAR TO DELTA AT current setting, the MPS210 transitions from wye starting to delta running.



LEGEND:
MPS = MOTOR PROTECTION SYSTEM
/A = OUTPUT A
/B = OUTPUT B
/C = OUTPUT C
/PS = POWER SUPPLY
I = MOTOR ISOLATOR SWITCH
M = MAIN MOTOR CONTACTOR
W = MOTOR STARTING CONTACTOR (WYE)
D = MOTOR RUNNING CONTACTOR (DELTA)
E STOP = EMERGENCY STOP PUSH BUTTON

NOTES:

1. ISOLATOR SWITCH I IS OPTIONAL. INPUTS 41 AND 18 MUST BE SHORTED AND INPUTS 40 AND 17 MUST BE OPEN IF THE SWITCH IS NOT USED.

2. MAIN CONTACTOR M IS OPTIONAL. IF IT IS USED, IT CAN CONTROLLED BY OUTPUT C (CONFIGURED TO START/RUN) AS SHOWN.

D2532-02
1-3-97

Figure 2-2. Wye/Delta Starting Typical Connection Diagram

Autotransformer Starting

Although not labeled as such, the Wye-Delta starting mode is applicable to autotransformer starting schemes. The two starting methods, closed and open circuit starting, are described below.

Closed Circuit Starting

See Figure 2-4 for contact logic and timing diagram. When the Start command is received by the MPS210, the A relay contact closes and energized the N contactor for T_A seconds, the setting labeled “Maximum Time in Star”, provided the current setting for “Star to Delta at” is set to a low value (minimum = 70% FLC). If the user wishes to control the switching with current (like the Wye-Delta starting), the ”Star to Delta at” can be set to the desired value and switching will take place whenever the current or time limit are reached. Figure 2-3 illustrates this concept with a plot of typical motor starting current.

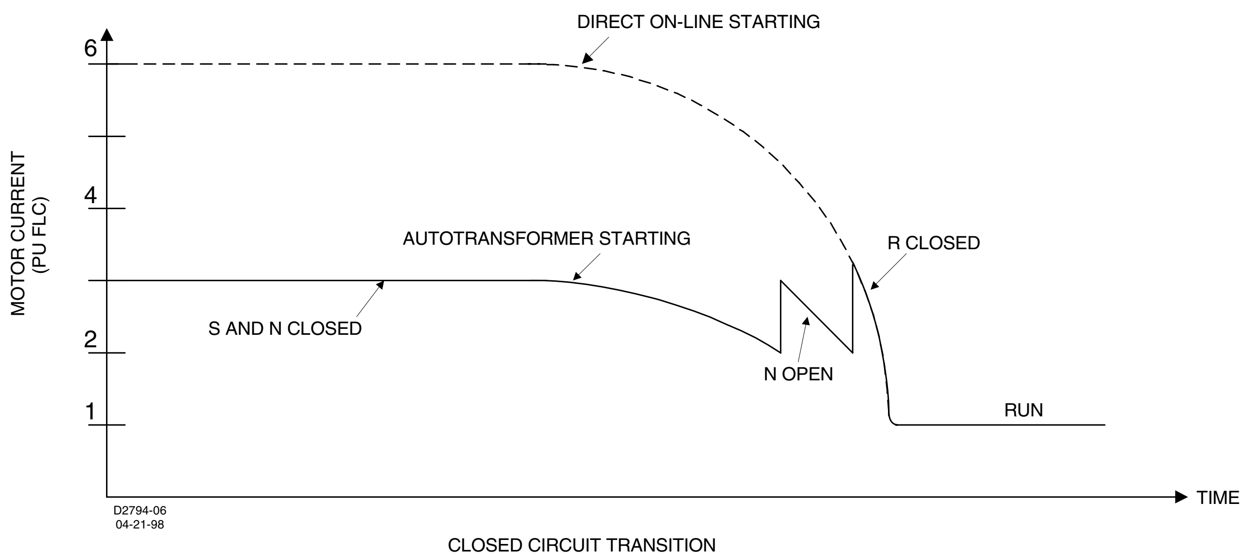


Figure 2-3. Typical Starting Current

The N contactor in turn picks up the S contactor which seals itself in, provided the R contactor is reset. At the end of T_A (or current switched transition) the neutral contactor N opens. The motor current is now reactor limited. After T_B, the time labeled “Transition Time” in the MPS, the R contactor is energized through MPS relay B. The R contactor drops out the S contactor and the motor is now directly on the line.

By connecting N on R contactor status contacts (a and b “fingers”) to the MPS A and B status inputs, the MPS will provide incomplete sequence protection. This protection is critical in case the N or S contactors are defective.

A variation providing greater security may be considered. See Figure 2-5.

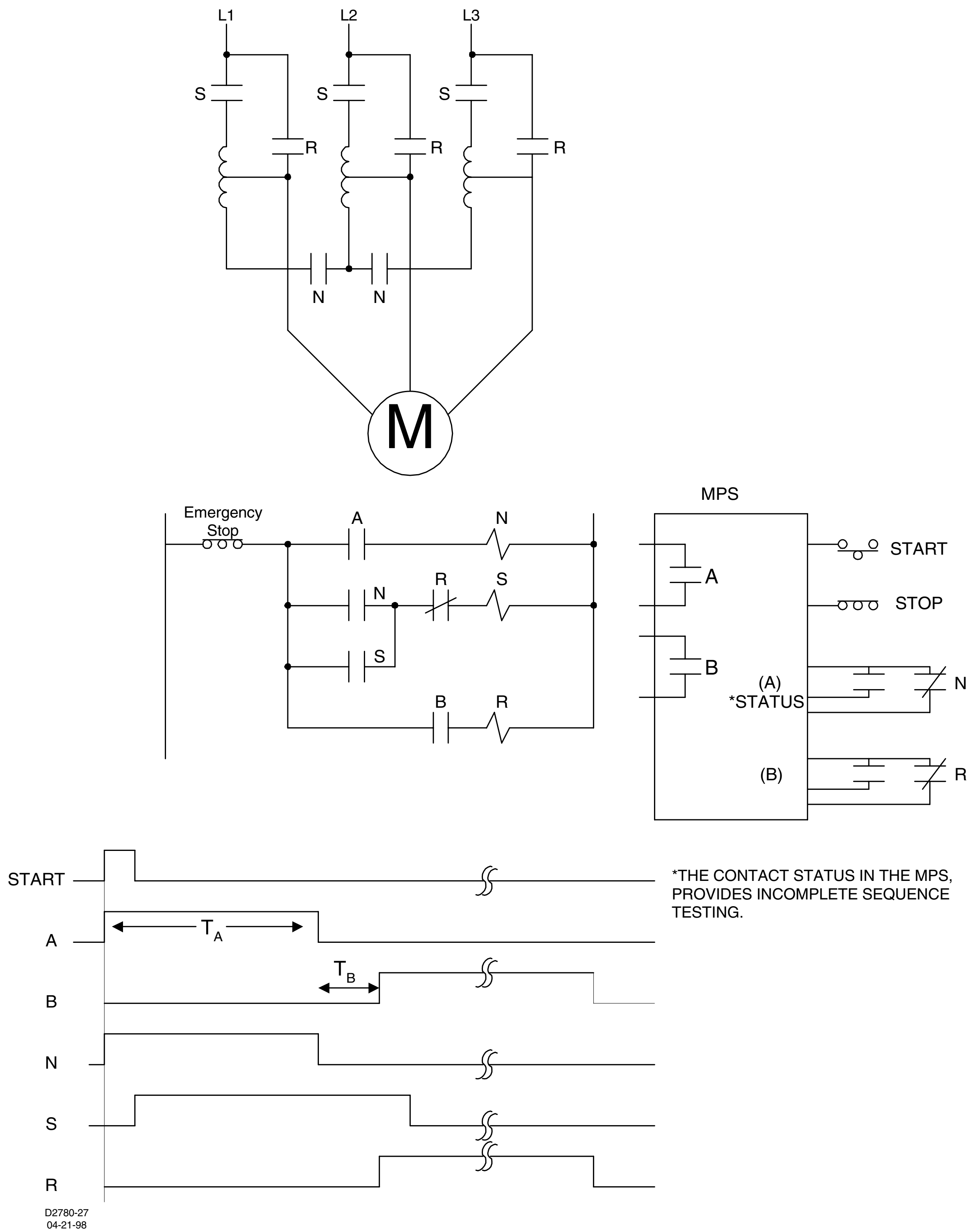
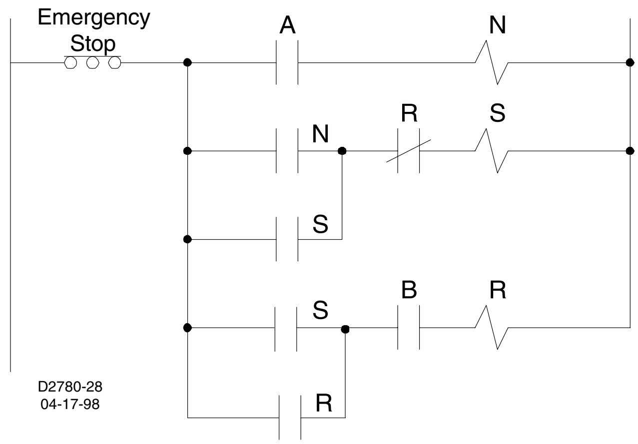


Figure 2-4. Autotransformer With Closed Circuit Starting



NOTE: This arrangement assures that the S contactor is included in the incomplete sequence test (if S does not operate, R will not be energized). The MPS will report an "open control circuit" for the contactor associated with its output relay B.

Figure 2-5. Variation of Autotransformer With Closed Circuit Starting

> **CAUTION**
>
> There may be a rare condition between the R and S contacts in series with the B relay contact. Make sure the R contact picks up before the S contact drops out.

<u>Open Circuit Starting</u>

See 2-7 for contact logic and timing.

When the Start command is received by the MPS, the A relay energizes the S contactor for T_A ("Maximum Time in Star" setting) or if the current drops below the "Star to Delta at" setting. This setting can be set to the minimum if current switching is not desired. The motor starts at reduced voltage. At the end of T_A, the S contactor which opens the motor is now disconnected from the supply until the MPS B relay energized the R contactor, after the T_B, "Transition Time" setting, time has expired. This time must be as short as possible to avoid significant deceleration and subsequent torque surge. by connecting status a and b contacts from the S and R contactors to the MPS A and B status inputs, incomplete sequence protection is provided. Figure 2-6 illustrates a typical open circuit transition.

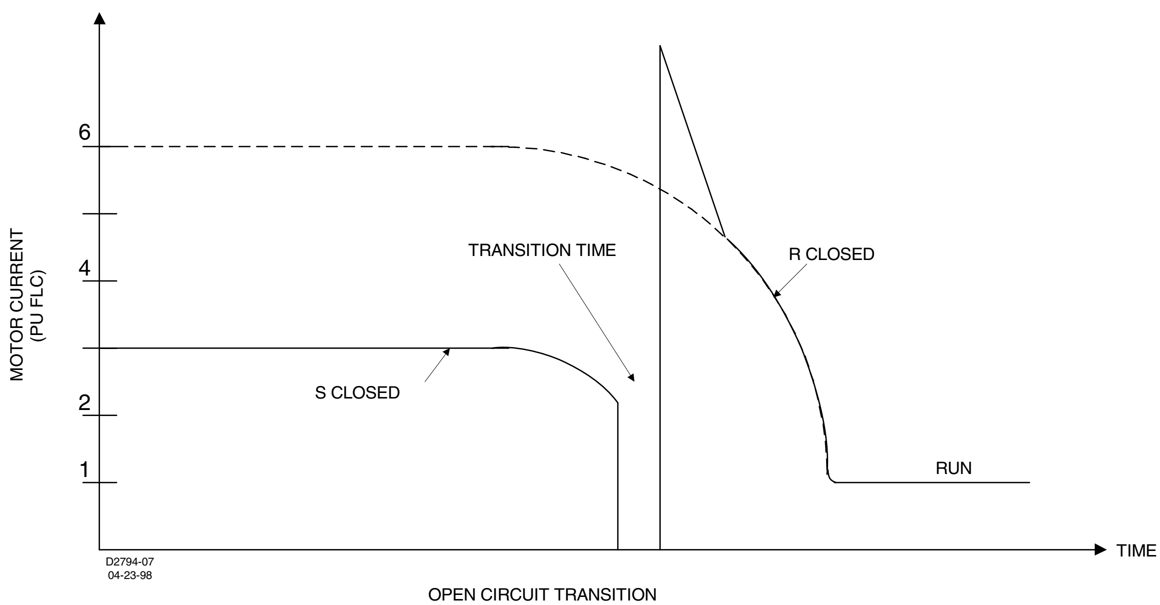


Figure 2-6. Typical Open Circuit Transition

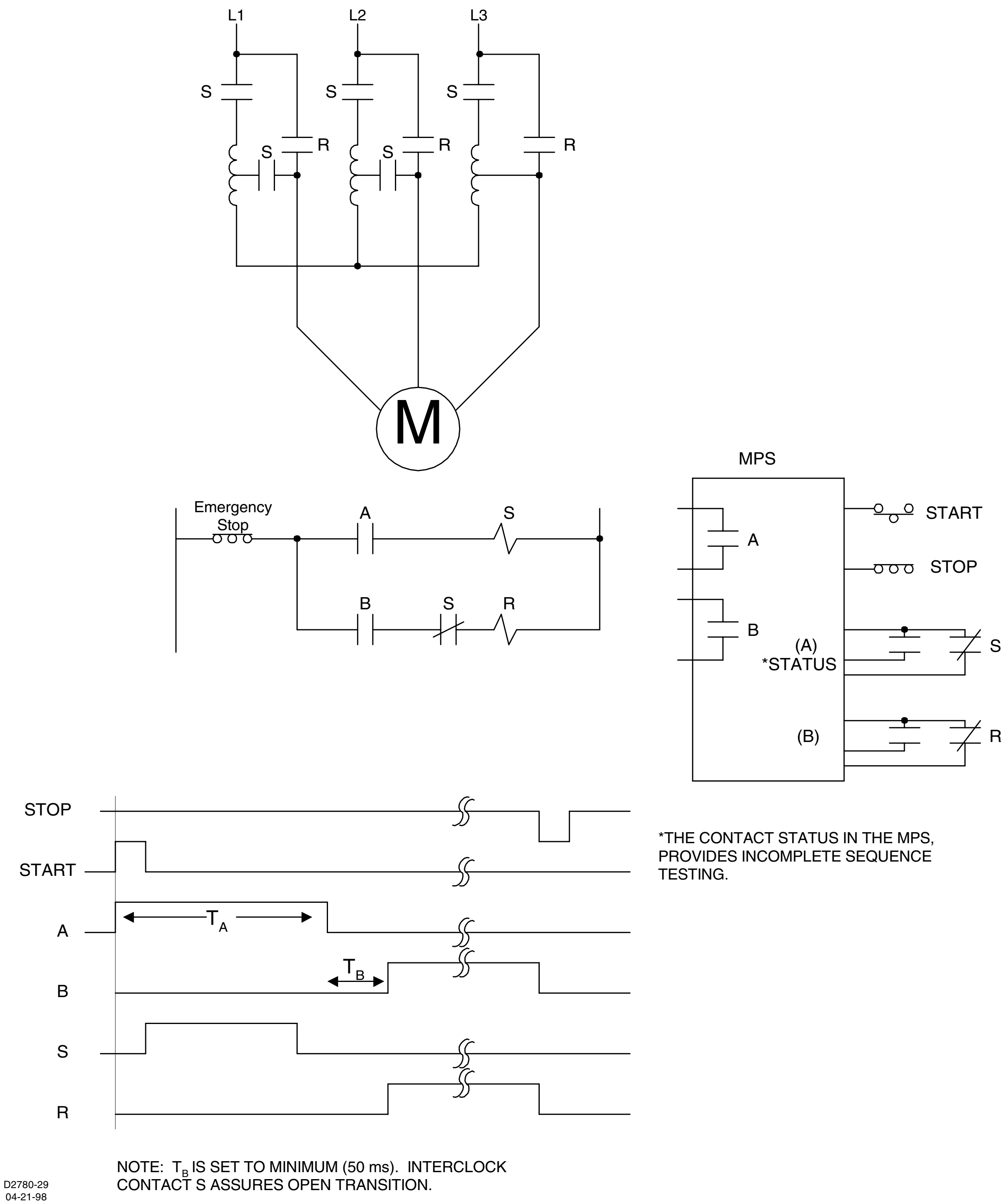


Figure 2-7. Autotransformer With Open Circuit Starting

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:

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

∴ 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.

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

∴ 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:

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

$$t6x = 36.073 \text{ seconds}$$

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 running at 0.9 FLC for a long time has used 22% of its thermal capacity. Note that there is only 78% left.

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. See Figure 2-8 for an illustration of this example.

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 NEMA MG1-1993 and to the measured sustained voltage unbalance on the feeder supplying this particular motor, we find that:

- NEMA 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 de-rate the motor if the unbalance is high. A de-rating table can be found in NEMA 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.

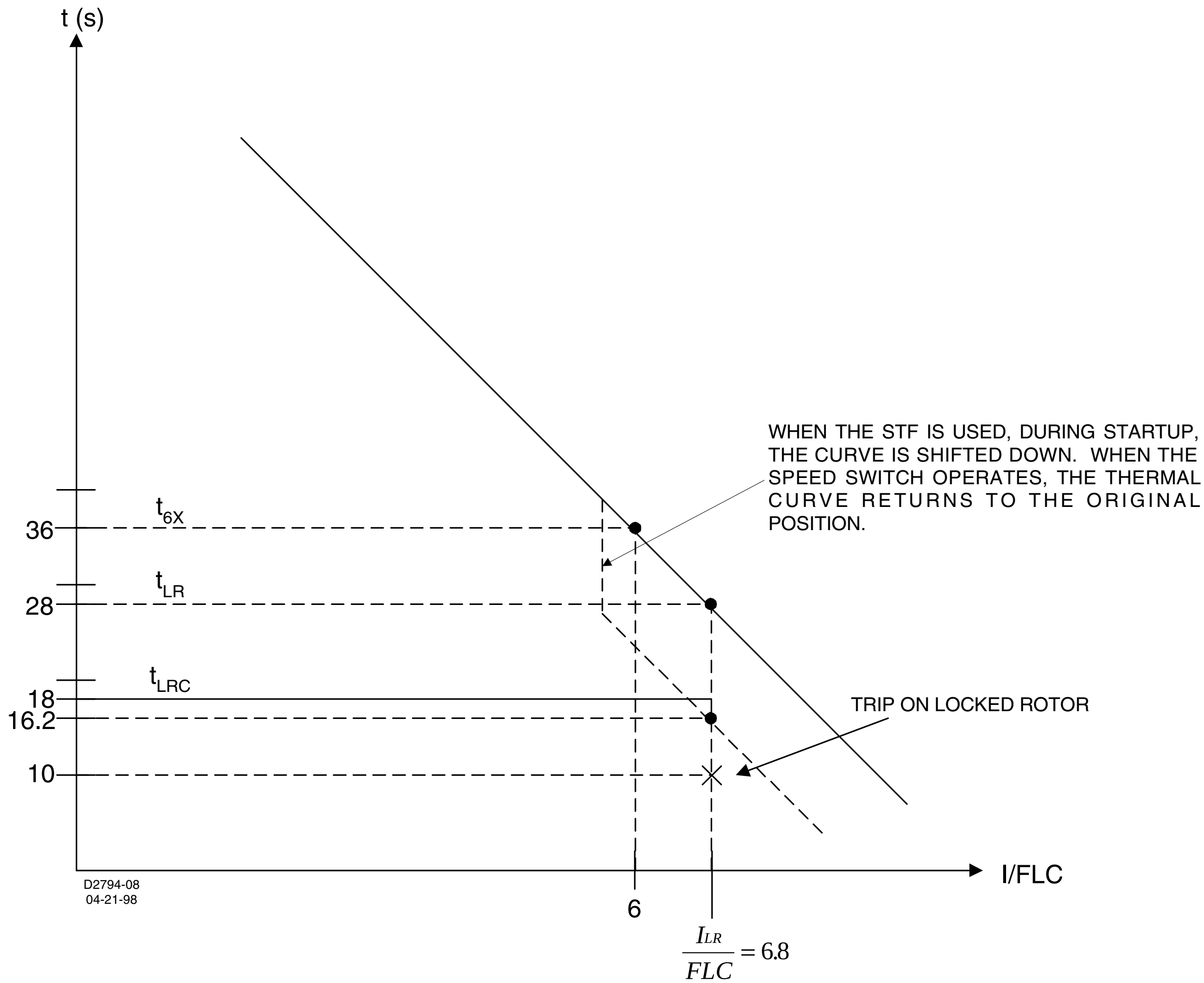


Figure 2-8. Motor Setting Example Illustration

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 MPS relays through the front panel controls and indicators or through the serial communications link. Figure 3-1 shows an MPS210 relay front panel with the nine light emitting diodes (LEDs), the two-line, sixteen-character liquid crystal display (LCD), and the nine pushbutton switches for local interface.

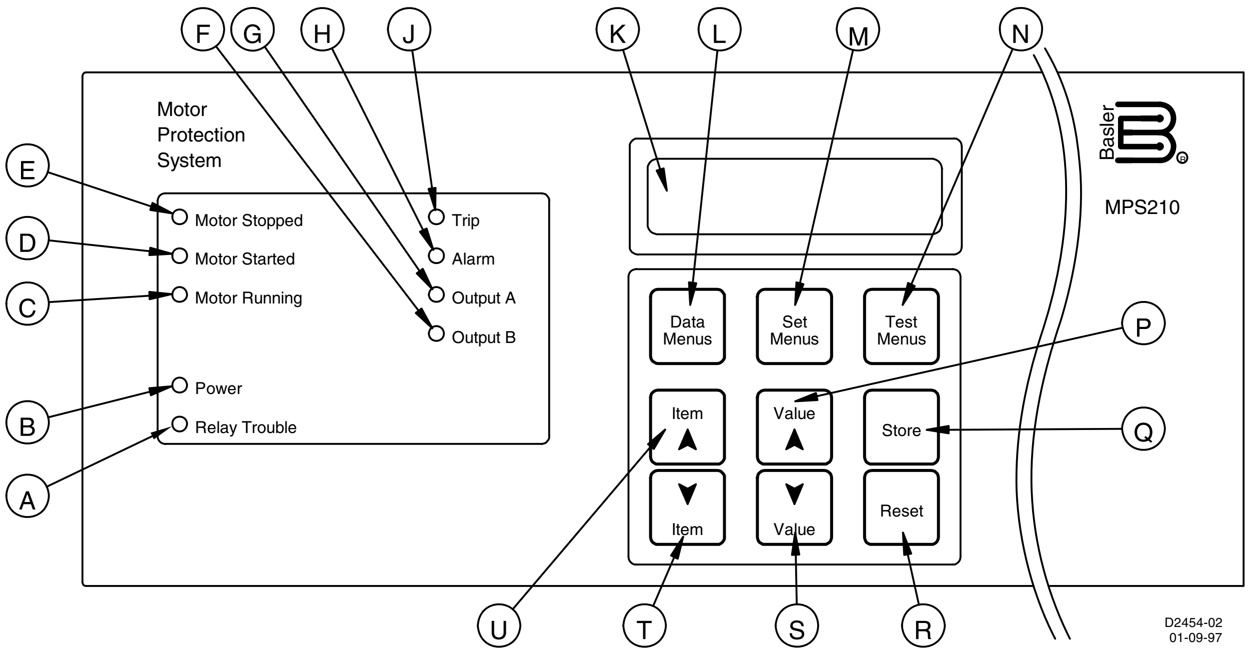


Figure 0-1. MPS210 Front Panel Controls and Indicators

INDICATORS

MPS200 relays have the same controls and indicators for local operator interface. Table 3-1 lists the name and description for each indicator.

Table 3-1. MPS Relays Indicators

Locator	Indicator Name	Description
A	**Relay Trouble**	Red LED lights when the MPS relay self-test detects a malfunction. LED remains ON until fault is cleared and the relay is reset.
B	**Power**	Green LED lights when the MPS relay is energized.
C	**Motor Running**	Red LED lights when the motor start process is complete (motor average current is less than 115% of full load current).
D	**Motor Started**	Yellow LED lights in response to the start command. Indicates that the start command is ON and the motor average current is greater than 115% of full load current.
E	**Motor Stopped**	Green LED lights when a trip condition is detected or when the motor average current is less than 12% of full load current.
F	**Output B**	Red LED lights when relay B is energized.
G	**Output A**	Red LED lights when relay A is energized.

Table 3-1. MPS Relays Indicators - Continued

Locator	Indicator Name	Description
H	**Alarm**	Red LED lights when a programmed alarm condition exists. LED remains ON until alarm is cleared and the relay is reset.
J	**Trip**	Red LED lights when a programmed trip condition exists. LED remains ON until trip is cleared and the relay is reset.
K	**Visual Display**	Two line, 16 character backlit display presents all messages and displays.

CONTROLS

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

Table 3-2. MPS Relays Controls

Locator	Control Name	Description
L	**Data Menus**	This pushbutton scrolls the display through the data menu pages. There are five data menu pages: 1. Measured Data 2. Calculated Data 3. Logical Inputs And Contact Status 4. Statistical Data 5. Fault Data
M	**Set Menus**	This pushbutton scrolls the display through the settings menu pages. There are seven settings menu pages: 1. Communication Settings 2. System Parameter Settings 3. Voltage Settings 4. Current Settings 5. Power Settings 6. Temperature Settings 7. Tripping/Alarm Options
N	**Test Menus**	This pushbutton selects the test menu page. There is one test menu page: Test/Maintenance Options.
P	**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.
Q	**Store**	This pushbutton stores the displayed parameter value in non-volatile memory. Changes are permitted only when the authorized key (logical contact input) is closed.
R	**Reset**	This pushbutton cancels the displayed alarm or trip and resets the MPS relay. Pressing the pushbutton once, waiting one second and pressing the pushbutton again resets the thermal capacity.
S	**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.
T	**Item**	This pushbutton scrolls the page forward/up through the parameters on the selected page. Press and hold to scroll the parameters at a fast rate.
U	**Item ↑**	This pushbutton scrolls the page backward/down through the parameters on the selected page. Press and hold to scroll the parameters at a fast rate.

REAR PANEL

Figures 3-2 and 3-3 show the MPS 200 and MPS210 rear panel layouts for fixed horizontal mounting. Connectors are barrier block type with screw terminals for spade connectors and European type (Euro Standard DIN) with wire clamps. Figure 3-4 shows the MPS210 draw-out case rear panel layout.

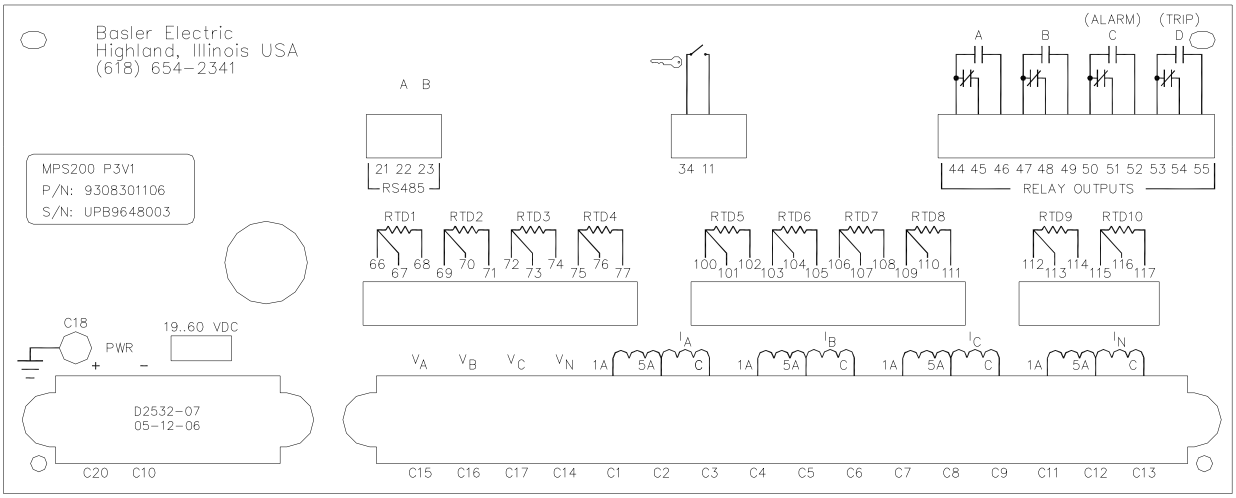


Figure 0-2. MPS200 Rear Panel Layout

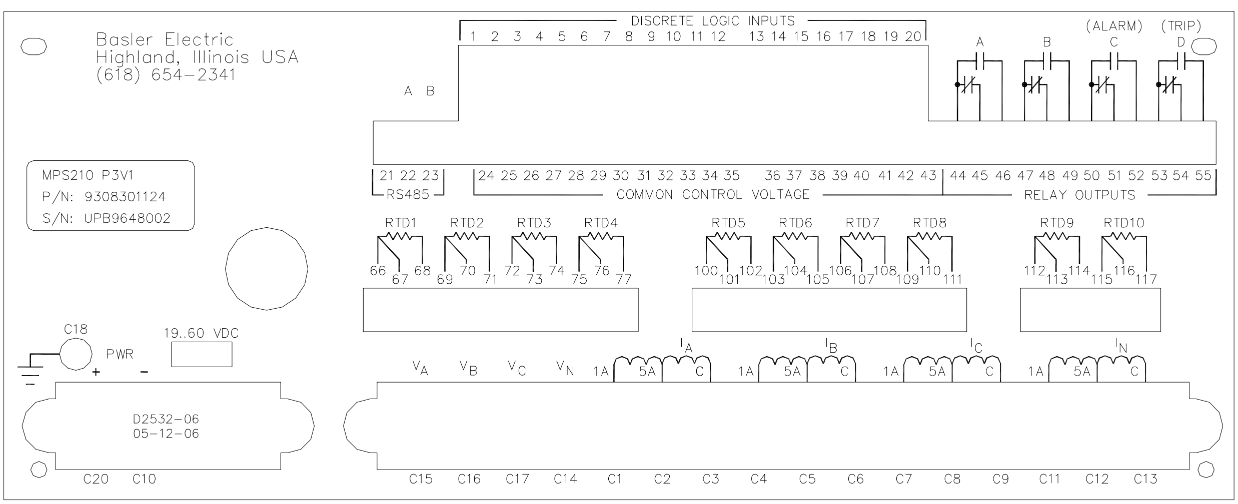


Figure 0-3. MPS210 Rear Panel Layout

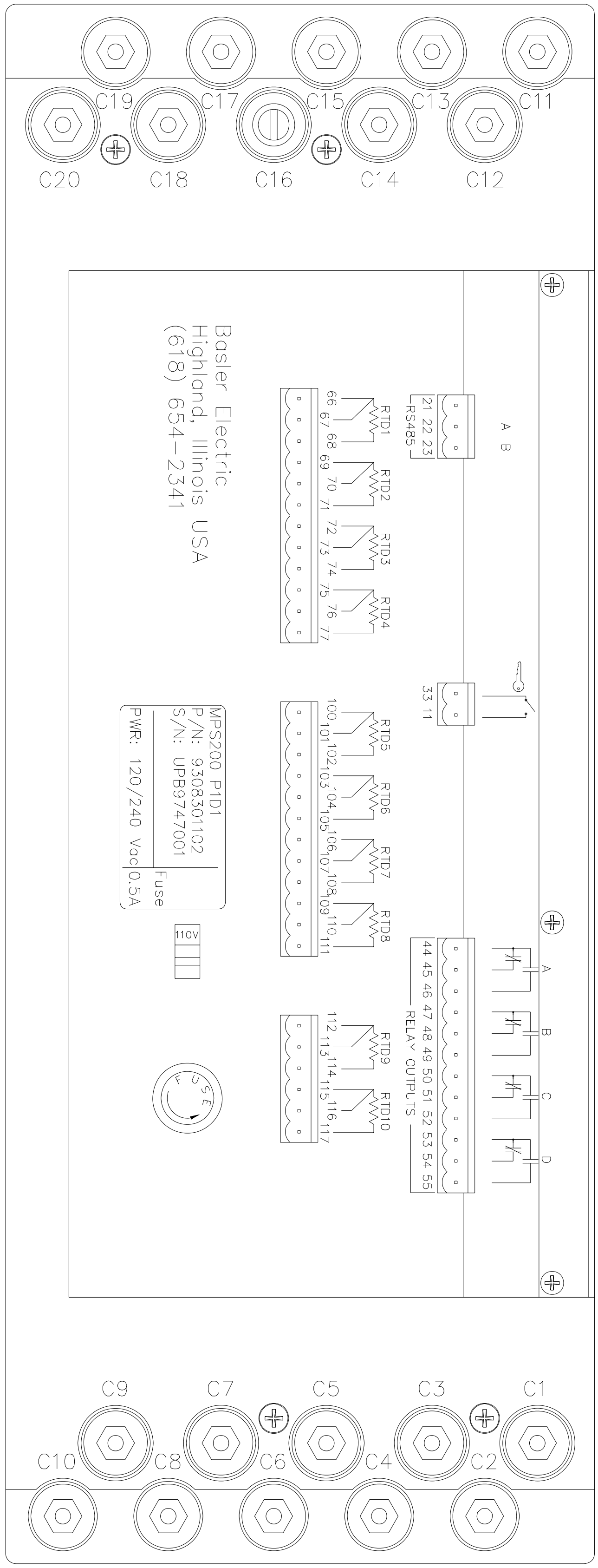


Figure 3-4. MPS210 Draw-out Case Rear Panel Layout

SECTION 4 • INSTALLATION

GENERAL

When not shipped as part of a control panel, MPS relays are shipped in sturdy cartons to prevent damage during transit. Upon receipt, check the part number against the requisition and packing list to see that they agree. 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, 2,121 Vdc may be applied in the following manner for one minute.

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

MOUNTING

Three mounting styles are available. These are fixed horizontal, fixed vertical, and draw-out vertical. Figure 4-1 provides panel cutout and outside dimensions for fixed horizontal and vertical mounting styles in panels or racks. In vertical mounting styles, the long dimension is the vertical dimension, and in horizontal mounting styles, the long dimension is the horizontal dimension. Figure 4-2 provides the overall dimensions for draw-out style relays. Figure 4-3 gives the draw-out case cutout dimensions and Figure 4-4 provides the dimensions of the front cover. Dimensions are in inches (millimeters in parentheses).

CONNECTIONS

MPS relays in fixed horizontal or vertical cases must be disconnected before they can be removed from the system. Connectors are Euro DIN Standard for the discrete logic inputs, control voltages, outputs, RTD inputs, and communications serial link. Operating voltage and measurement inputs (voltage and current) are connected to barrier type terminal strips mounted on the rear of the relay. These terminal strips have 6-32 screws that accept wire sizes of 12 AWG and smaller or 0.312 inch wide rings and spade terminals. **It is important to provide a ground connection for case ground (terminal C18). Connect all shield wires to terminal C18.**

> **CAUTION**
>
> Equipment damage may occur if the relay case (terminal C18) is not hard-wired to earth ground.
>
> Incorrect wiring may result in damage to the relay.

The paddles of the draw-out case connect the power supply, voltage, and current inputs to the relay. The relay can be removed from service simply by removing the paddles. CT shorting is provided by shorting bars in the relay case. If the relay is to be removed from the case, the DIN connectors must be unplugged from the back of the case.

Figure 4-5 illustrates typical MPS200 connections and Figure 4-6 illustrates typical MPS210 connections.

MAINTENANCE

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

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

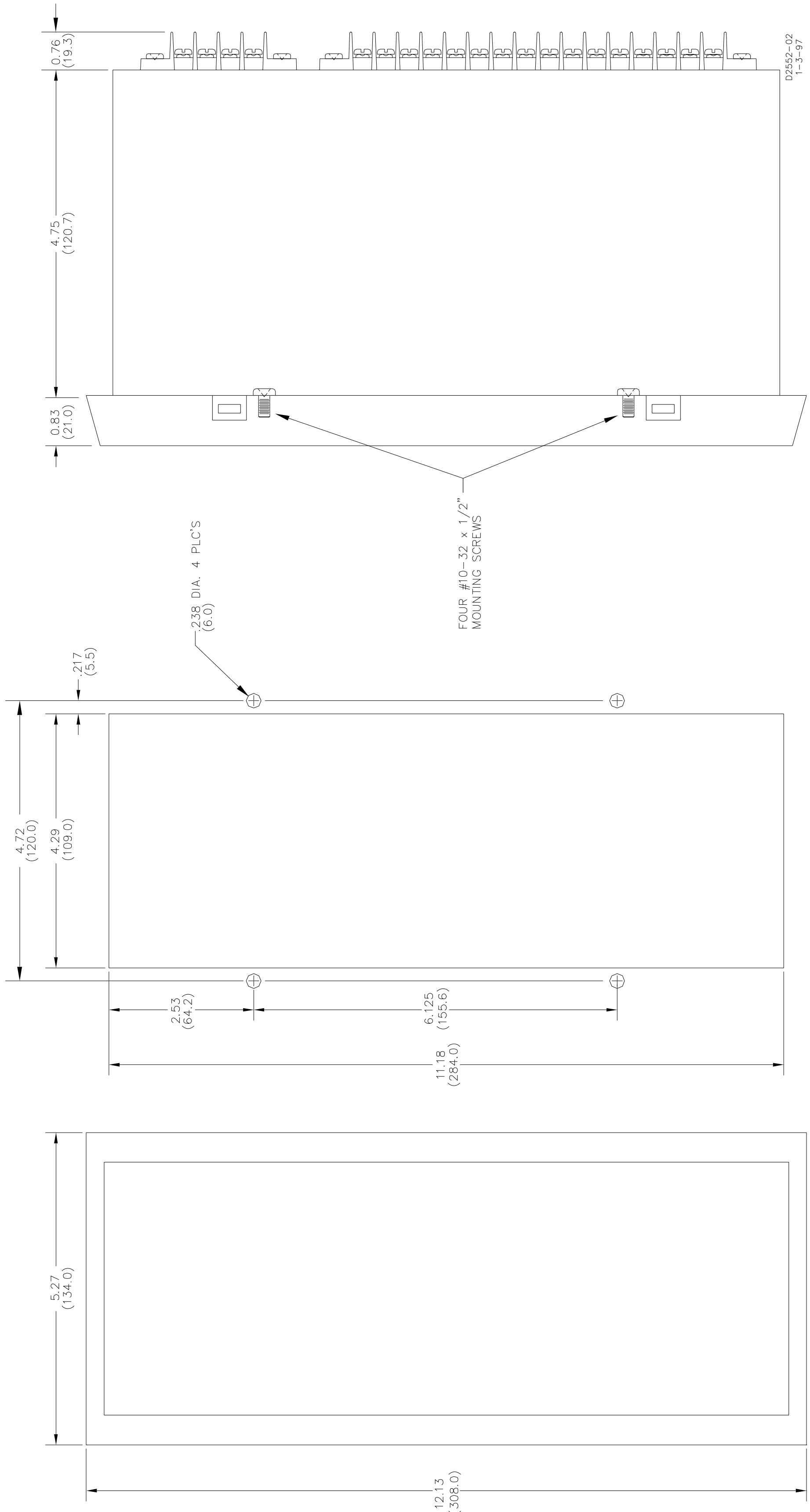


Figure 4-1. Fixed Case Panel Cutout And Outline Dimensions

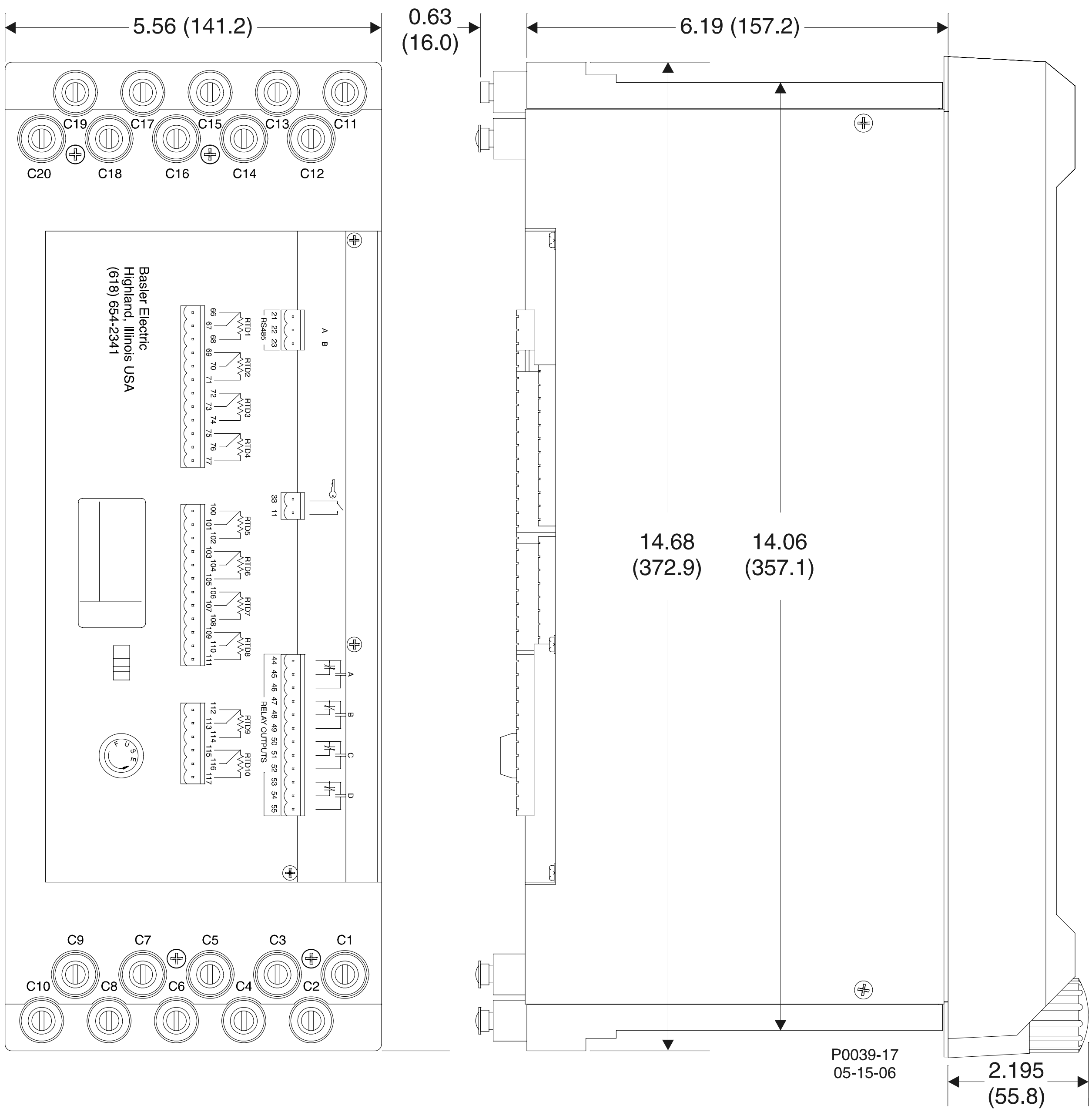


Figure 4-2. Draw-Out Case Overall Dimensions

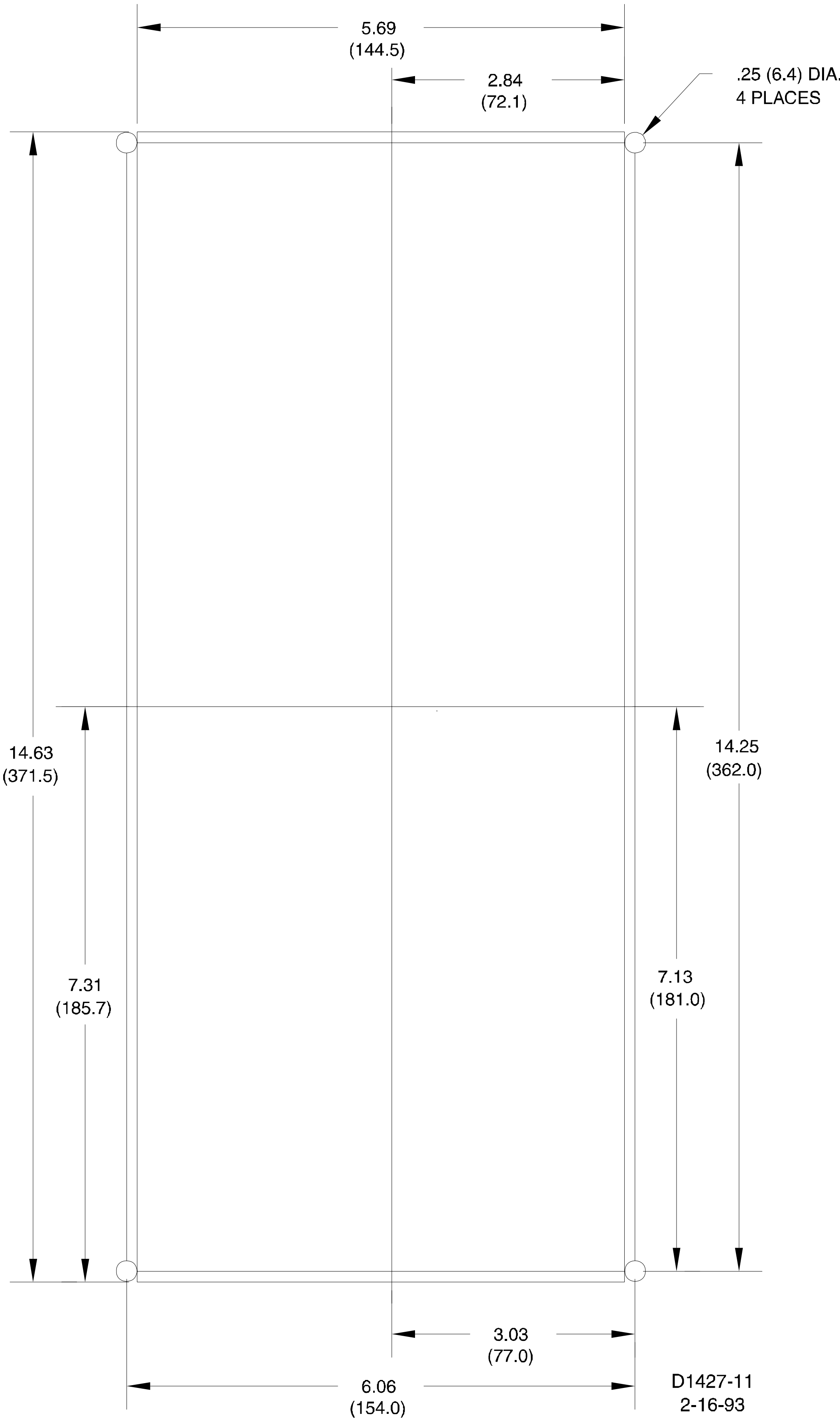


Figure 4-3. Draw-Out Case Cutout Dimensions

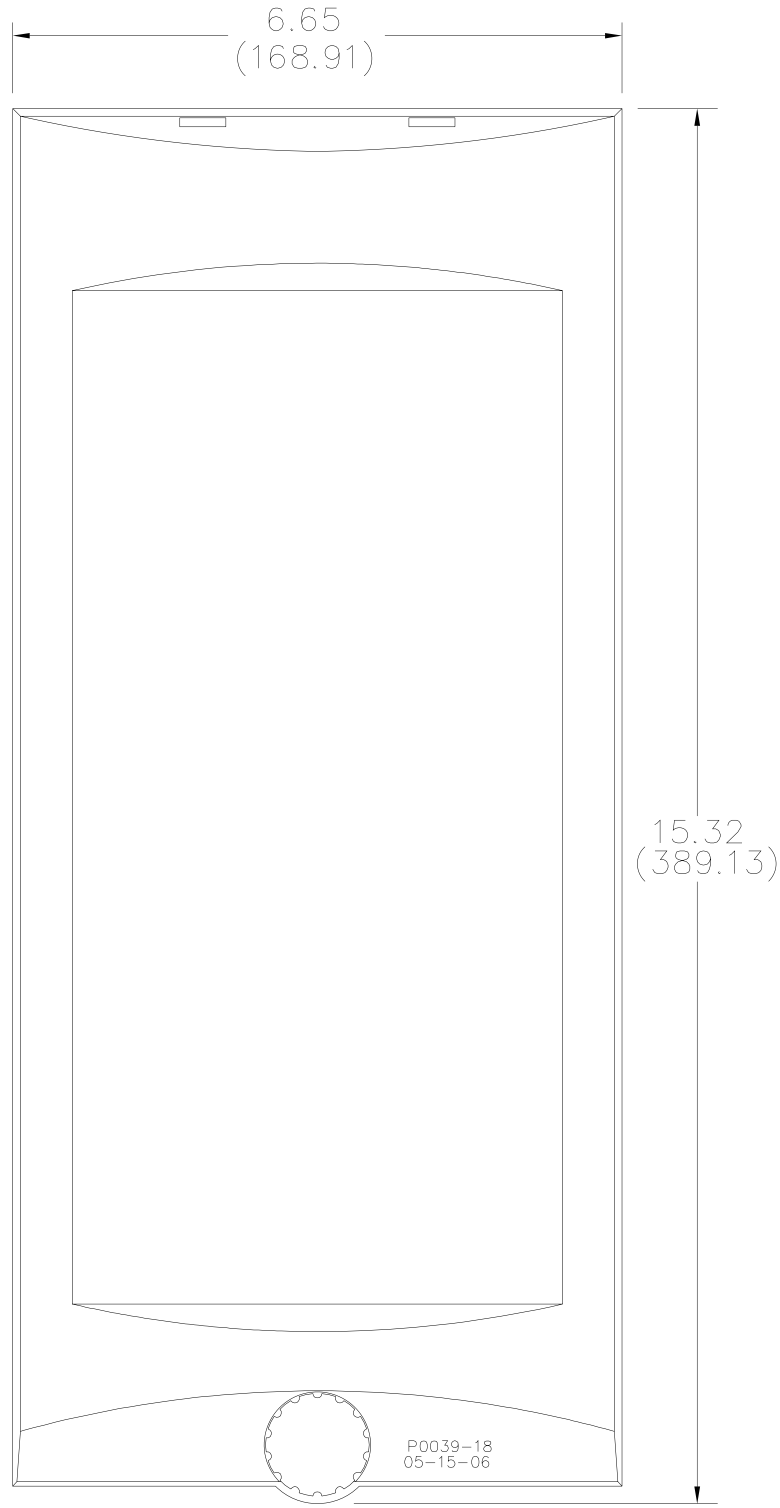


Figure 4-4. Draw-Out Case Front Cover Dimensions

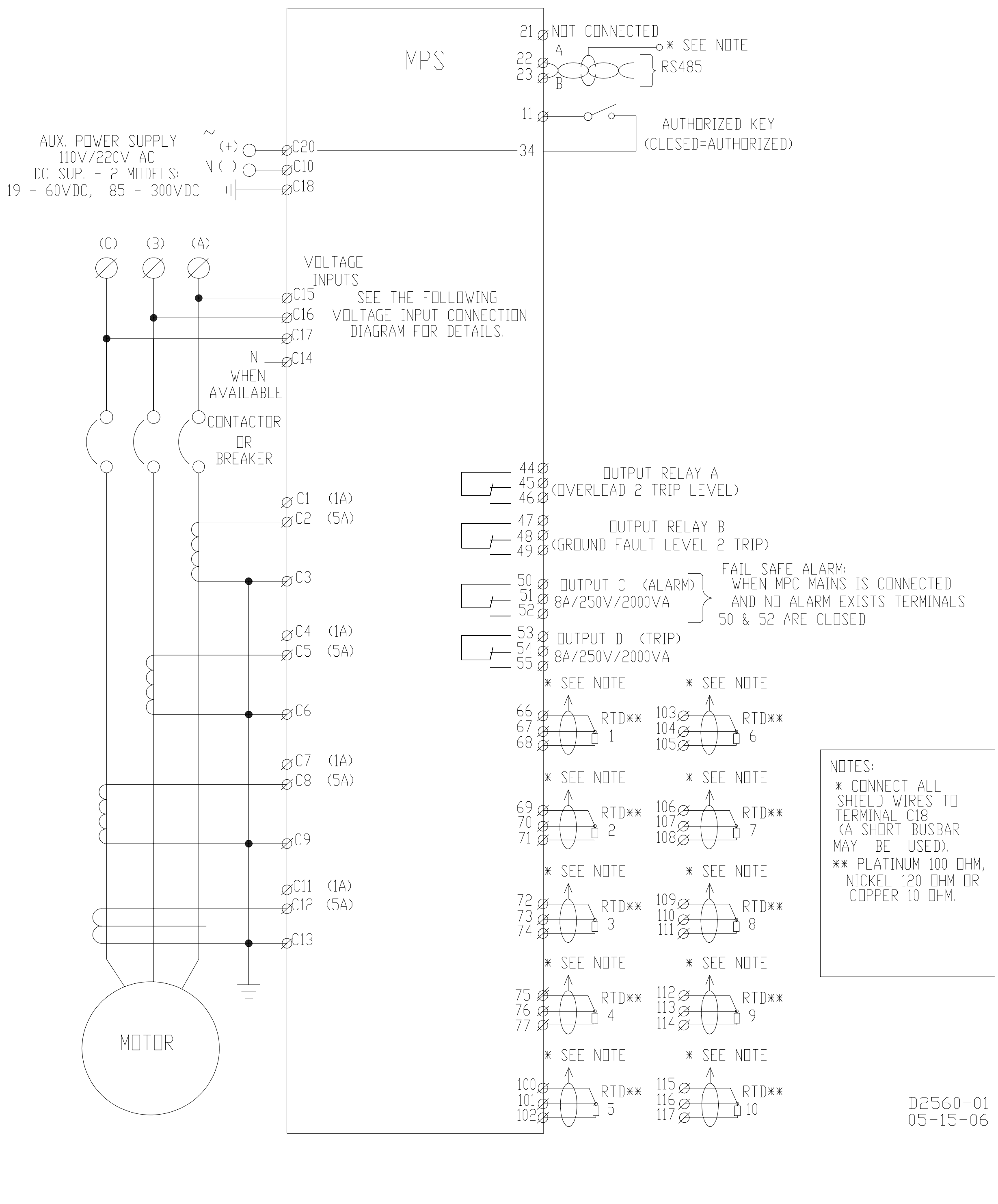


Figure 4-5. MPS200 Typical Connection Diagram

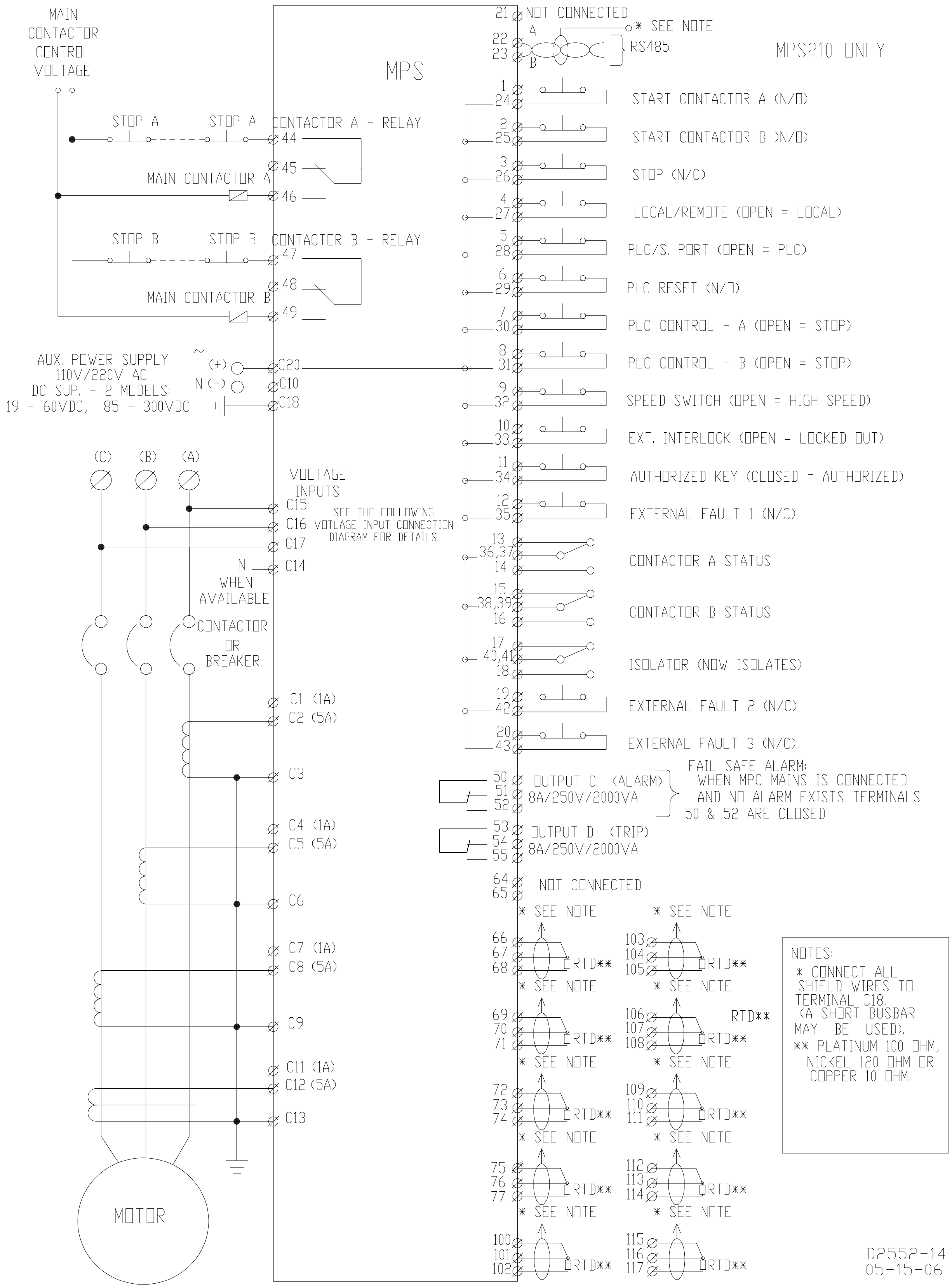


Figure 4-6. MPS210 Typical Connection Diagram

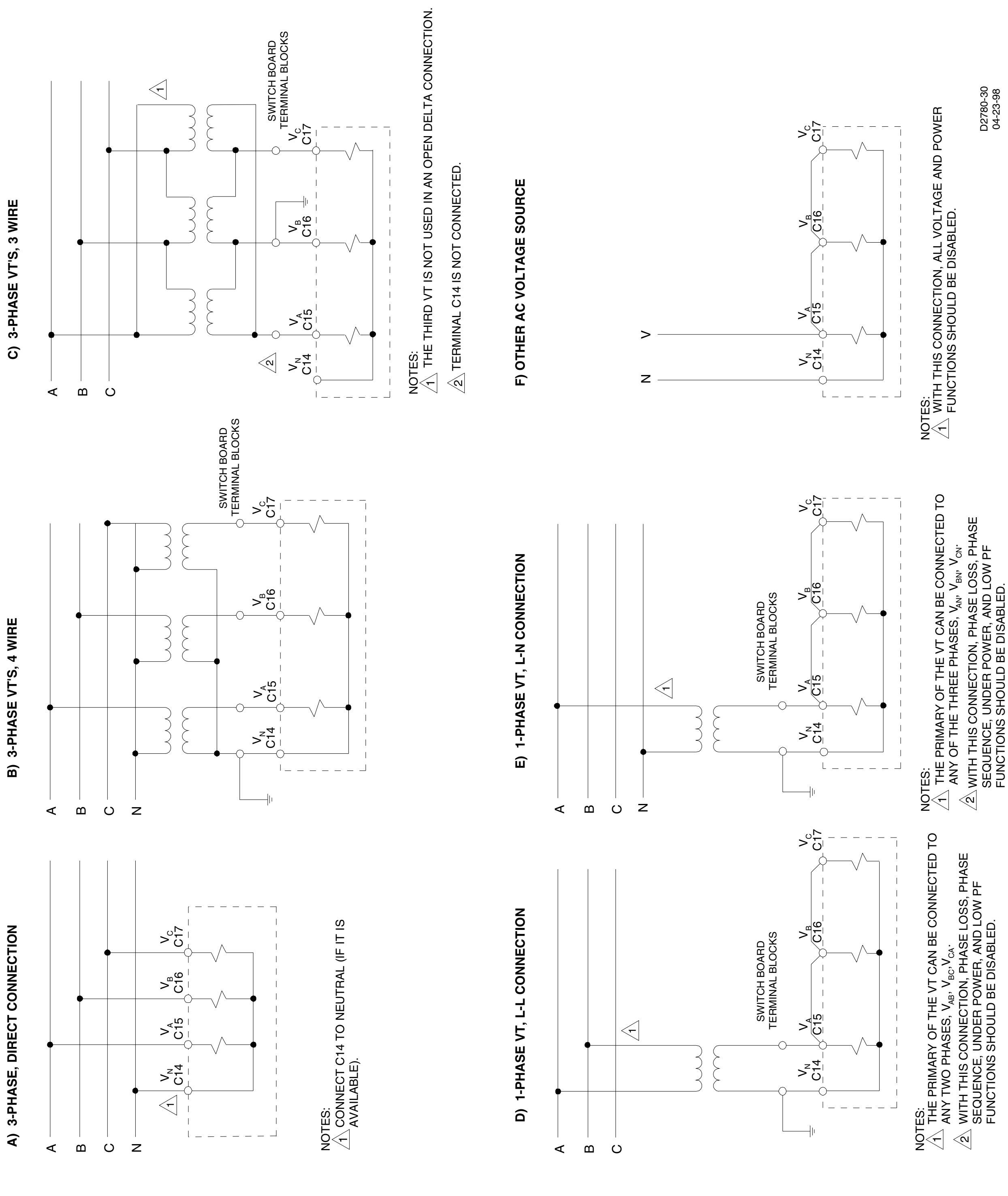


Figure 4-7. Voltage Input Connections

SECTION 5• MENUS AND SETTINGS

GENERAL

This section describes the display menus and settings available at an MPS relay front panel and through the serial communications link. Refer to Section 3, *Human Machine Interface (Controls And Indicators)* for a description of the controls, indicators, and individual functions. There are three top level menus (**Data Menus**, **Set Menus**, and **Test Menus**) and subordinate pages for each menu. An in depth description for these menus and the subordinate pages are provided in the following paragraphs. A description for the parameters, the parameter range, and the default values is also in this section.

TOP LEVEL MENUS

To view a top level menu, press the pushbutton **Data Menus**, **Set Menus**, or **Test Menus**. Each menu can be accessed at any time by pressing the desired menu pushbutton. Each of these menus has a number of subordinate pages that are displayed by pressing an **Item** up or down pushbutton.

Data Menus

Figure 5-1 shows the five pages available in the data menus. Notice that the arrows indicate only one direction. Press the **Data Menus** pushbutton to scroll the display through the data menus pages. Each time the **Data Menus** pushbutton is pressed, the next page is displayed.

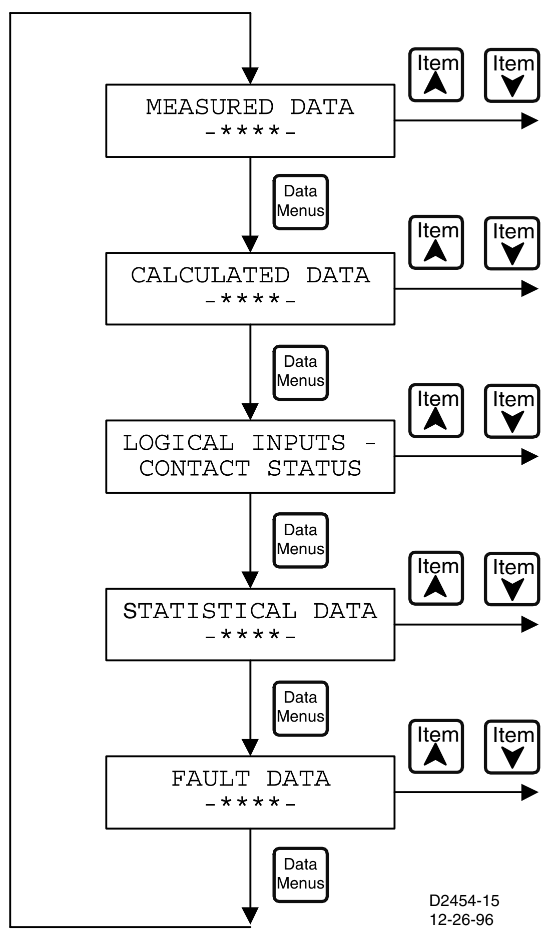


Figure 5-1. Data Menus Available Pages

Suppose that you want to view the calculated time to overload trip. Press the **Data Menus** pushbutton twice and the calculated data pages is displayed. Figure 5-2 shows the five subordinate pages. **TIME TO TRIP-O/L** is in the center of the subordinate displays. Press the **Item** ∧ or **Item** ∨ pushbuttons three times and **TIME TO TRIP-O/L** is displayed. Default values are as shown in all of the following Figures.

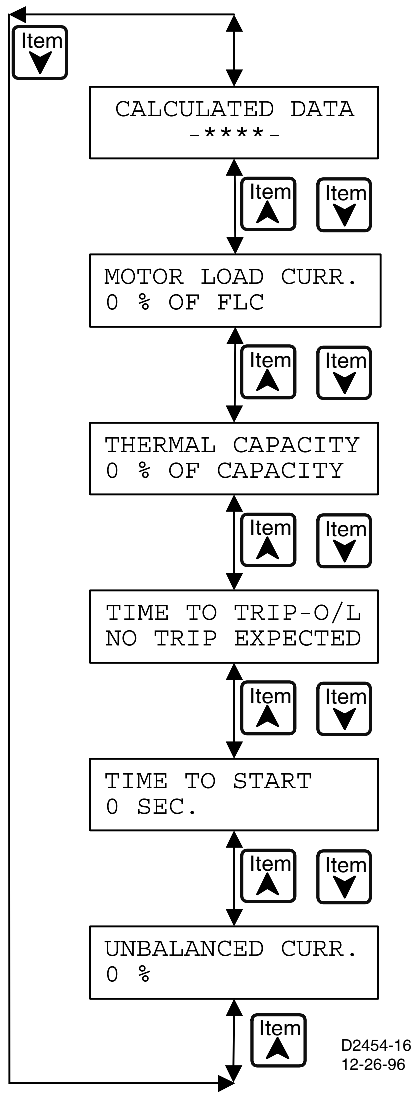


Figure 5-2. CALCULATED DATA And Subordinate Pages

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 5-7 show the other available pages for **Data Menus**. Figure 5-4 provides the available displays for **LOGICAL INPUTS - CONTACT STATUS** when **System Parameters**, **PROTECTION ONLY** is set to YES. Figure 5-5 provides the available displays when **System Parameters**, **PROTECTION ONLY** is set to NO.

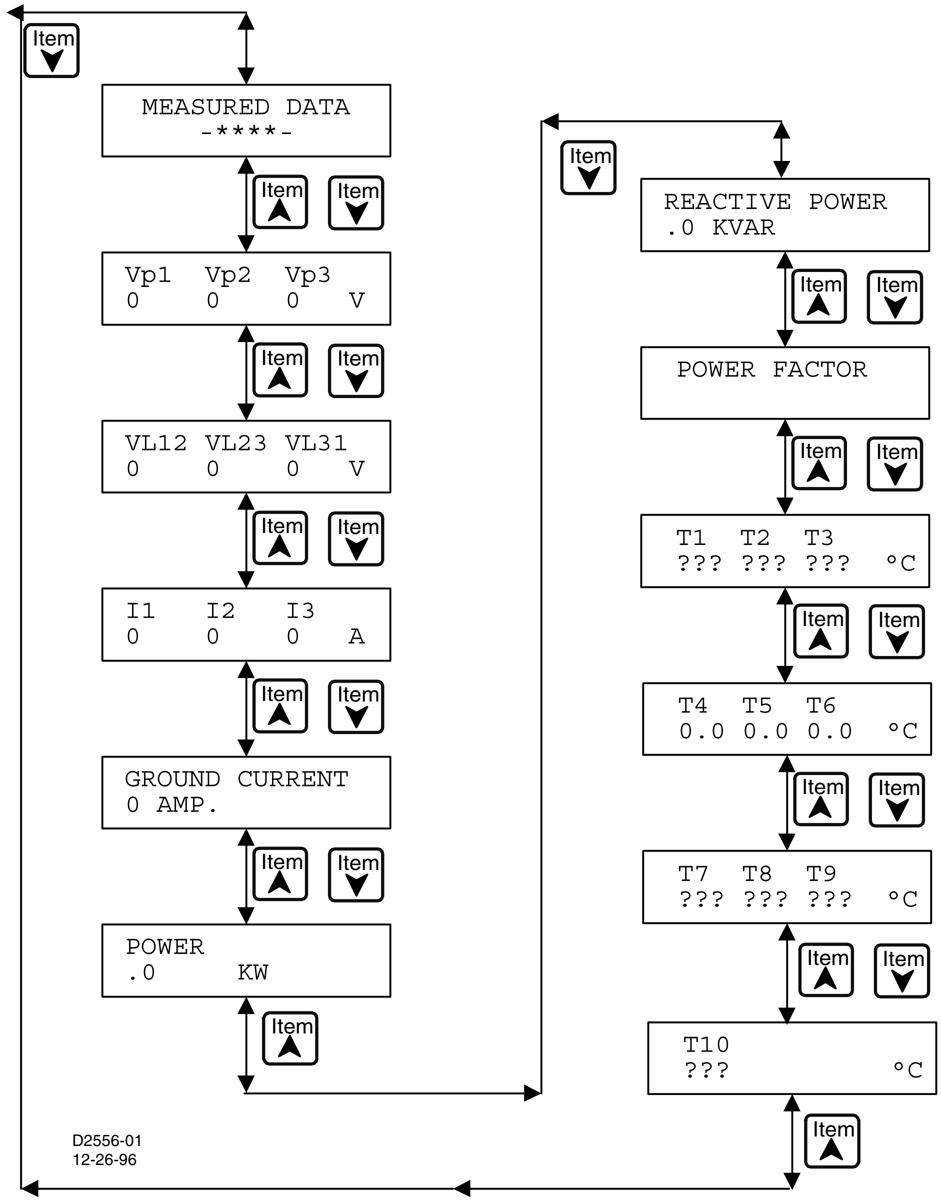


Figure 5-3. MEASURED DATA And Subordinate Pages

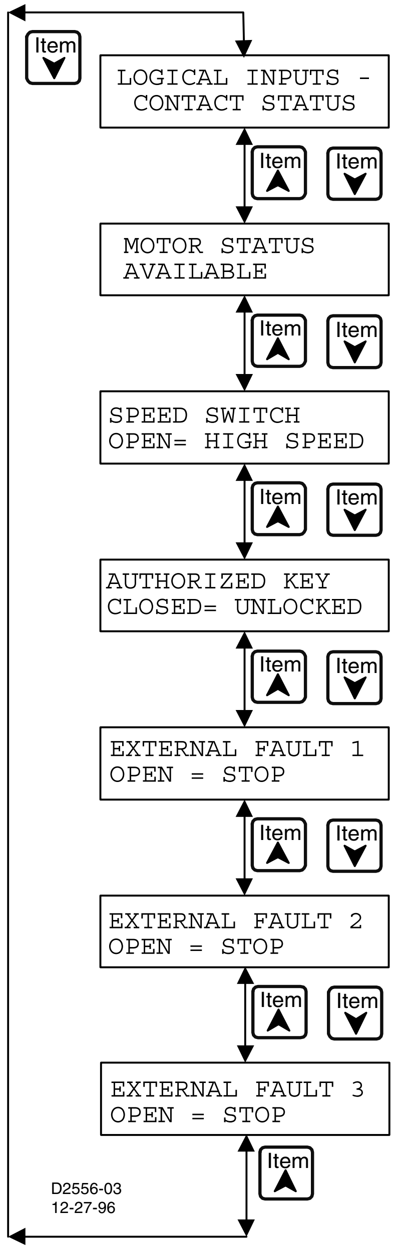


Figure 5-4. LOGICAL INPUTS - CONTACT STATUS And Subordinate Pages (Protection Only)

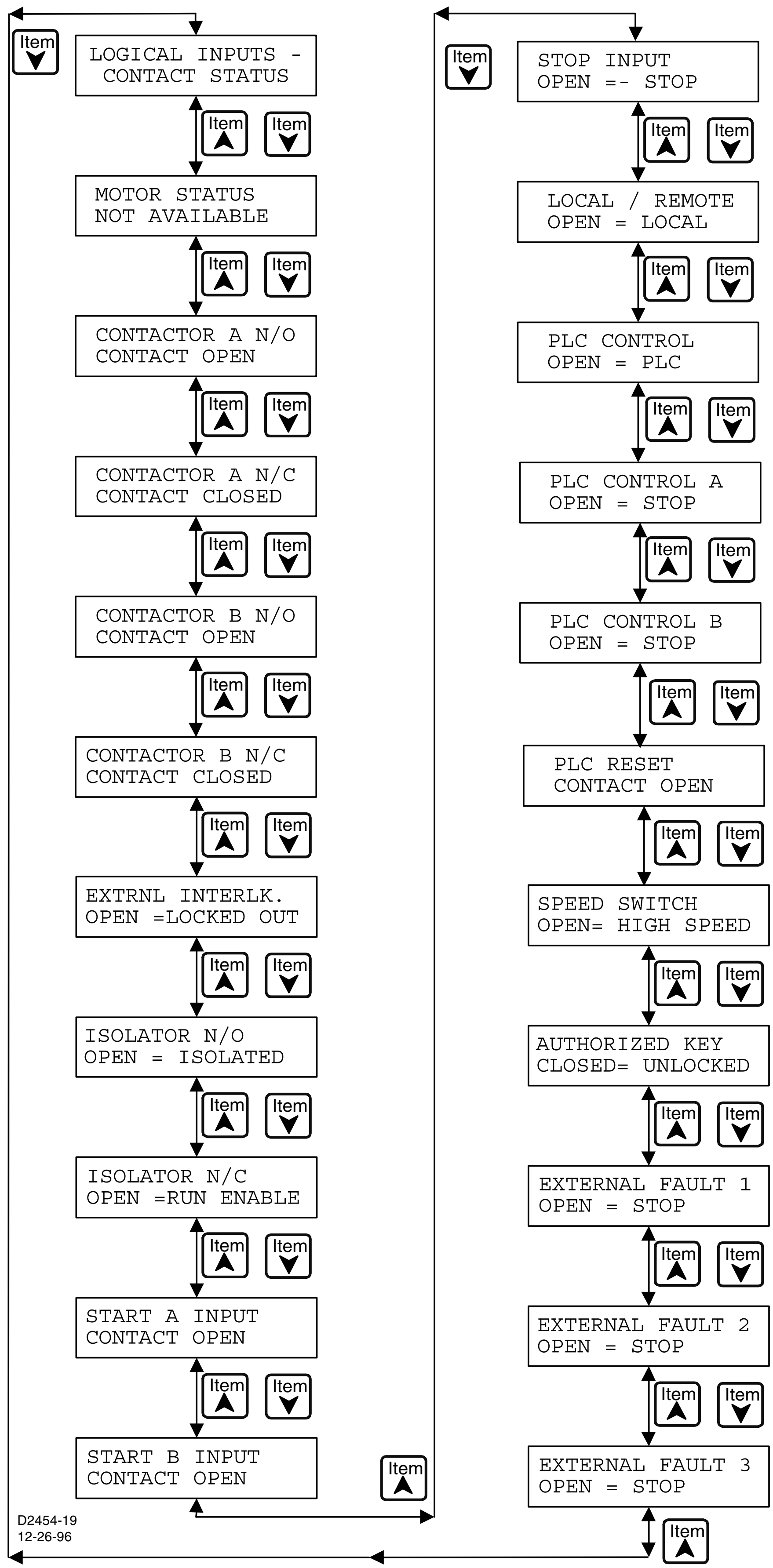


Figure 5-5. LOGICAL INPUTS - CONTACT STATUS And Subordinate Pages (Protection And Control)

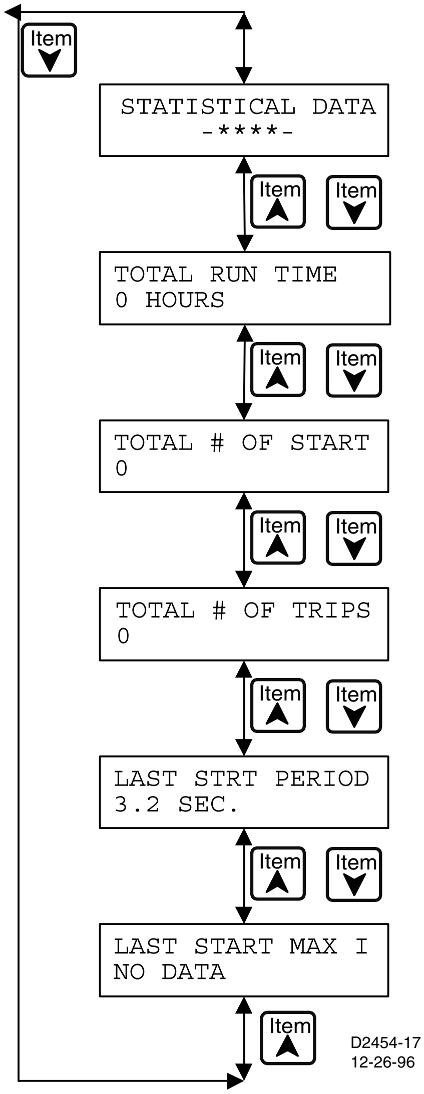


Figure 5-6. STATISTICAL DATA And Subordinate Pages

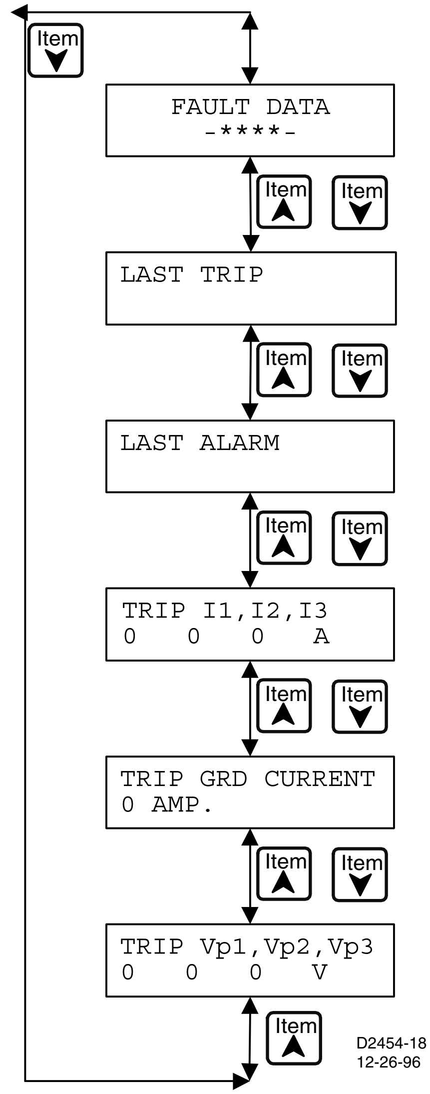


Figure 5-7. FAULT DATA And Subordinate Pages

Set Menus

Figure 5-8 shows the seven pages available in the set menus. Notice that the arrows only indicate one direction. Press the **Set Menus** pushbutton to scroll the display through the set menus pages. Each time the **Set Menus** pushbutton is pressed, the next page is displayed. To scroll through the **COMMUNICATION SETTINGS** or other pages, press the **Item** ∧ or **Item** ∨ pushbuttons for that page.

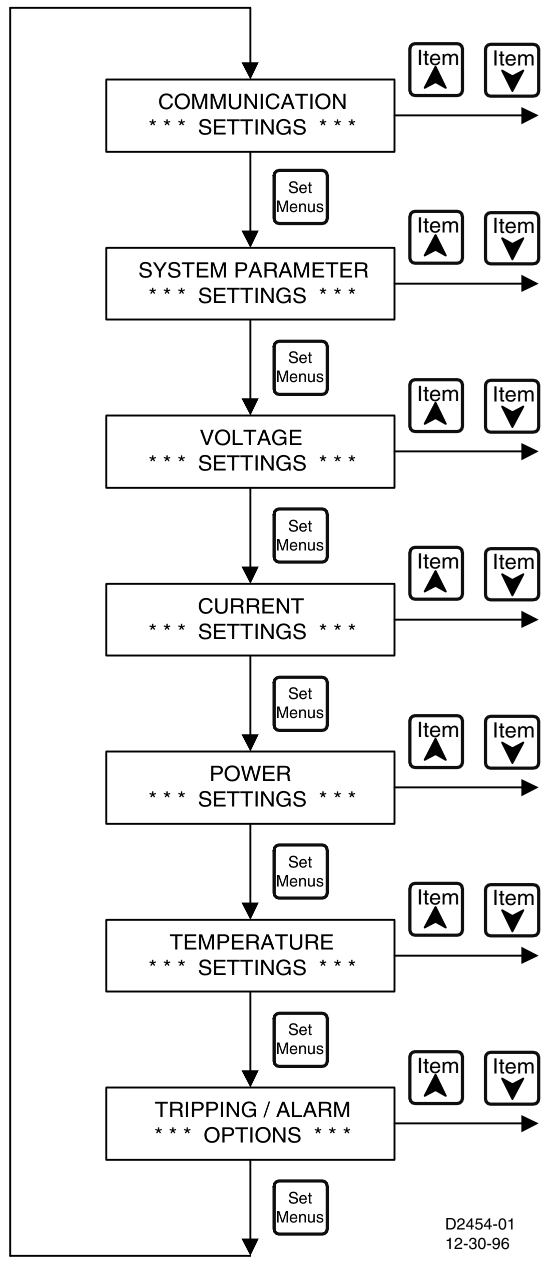


Figure 5-8. Set Menus Available Pages

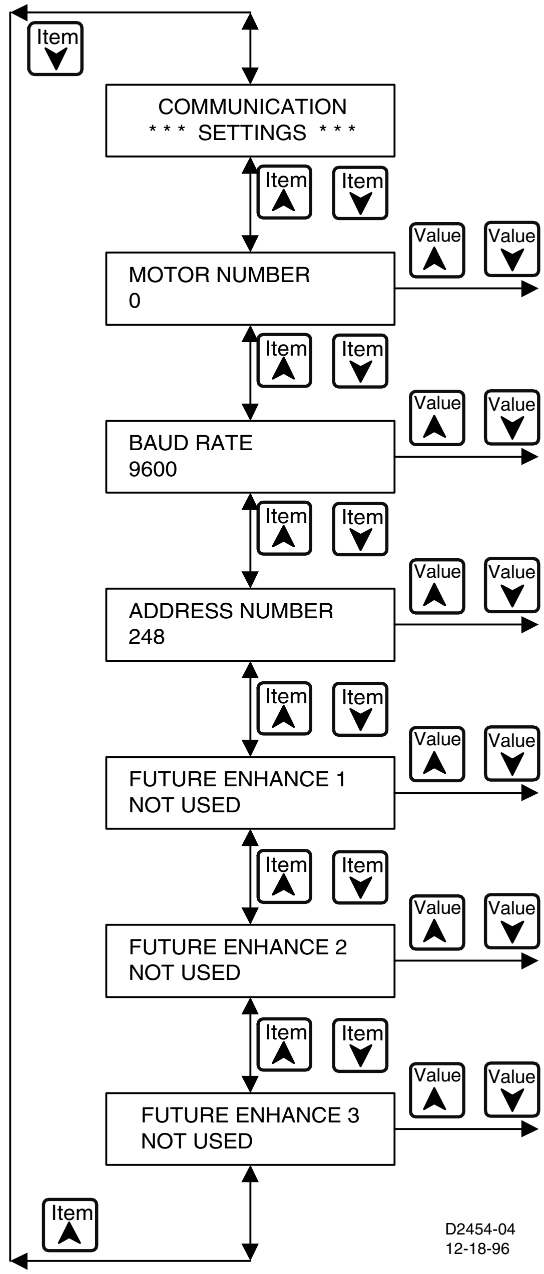


Figure 5-9. COMMUNICATION SETTINGS Available Pages

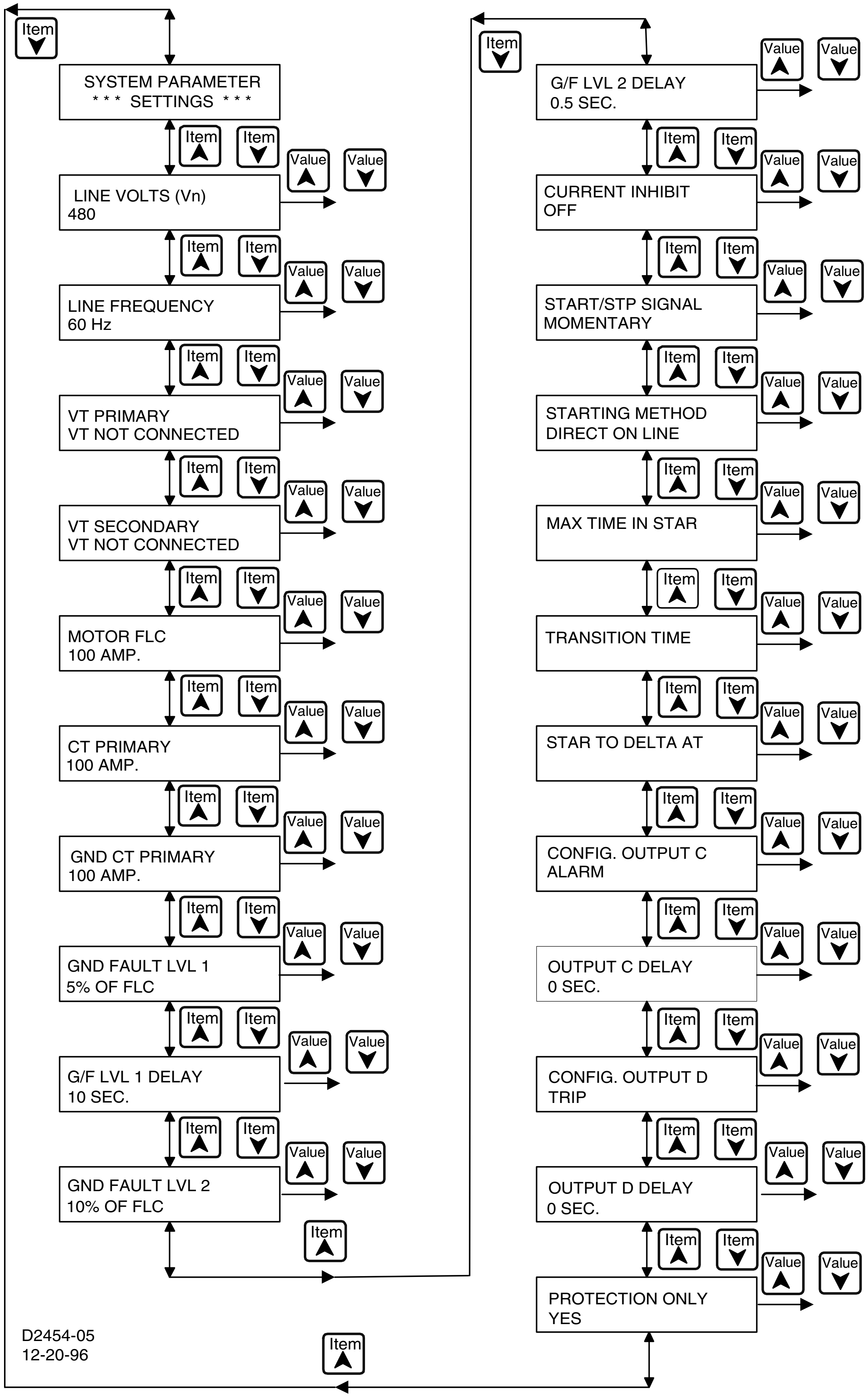


Figure 5-10. SYSTEM PARAMETER SETTINGS Available Pages

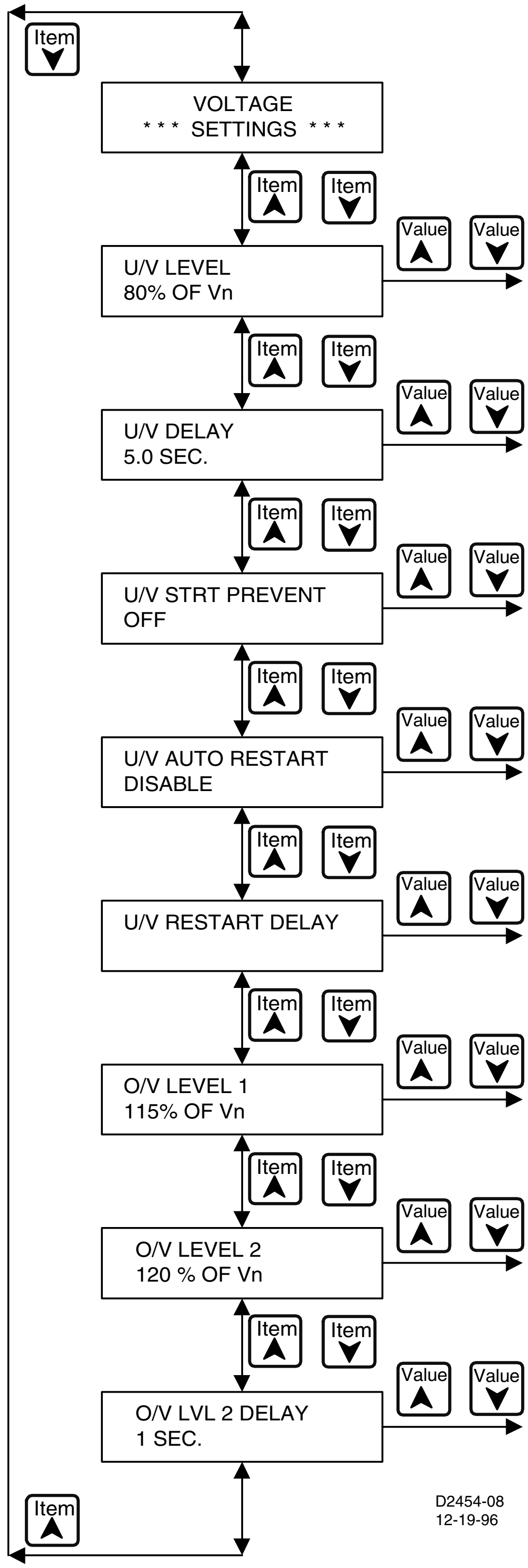


Figure 5-11. VOLTAGE SETTINGS Available Pages

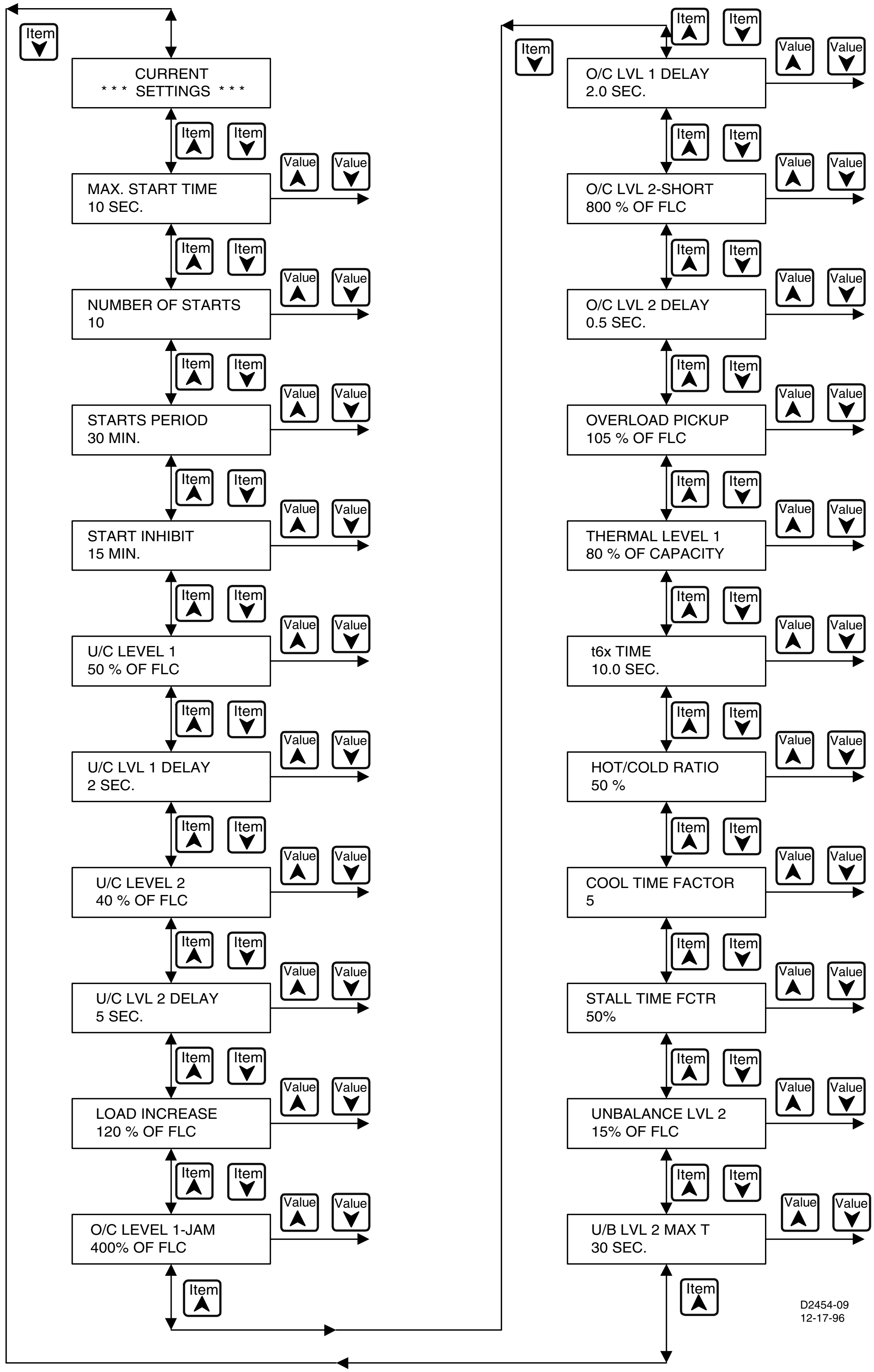


Figure 5-12. CURRENT SETTINGS Available Pages

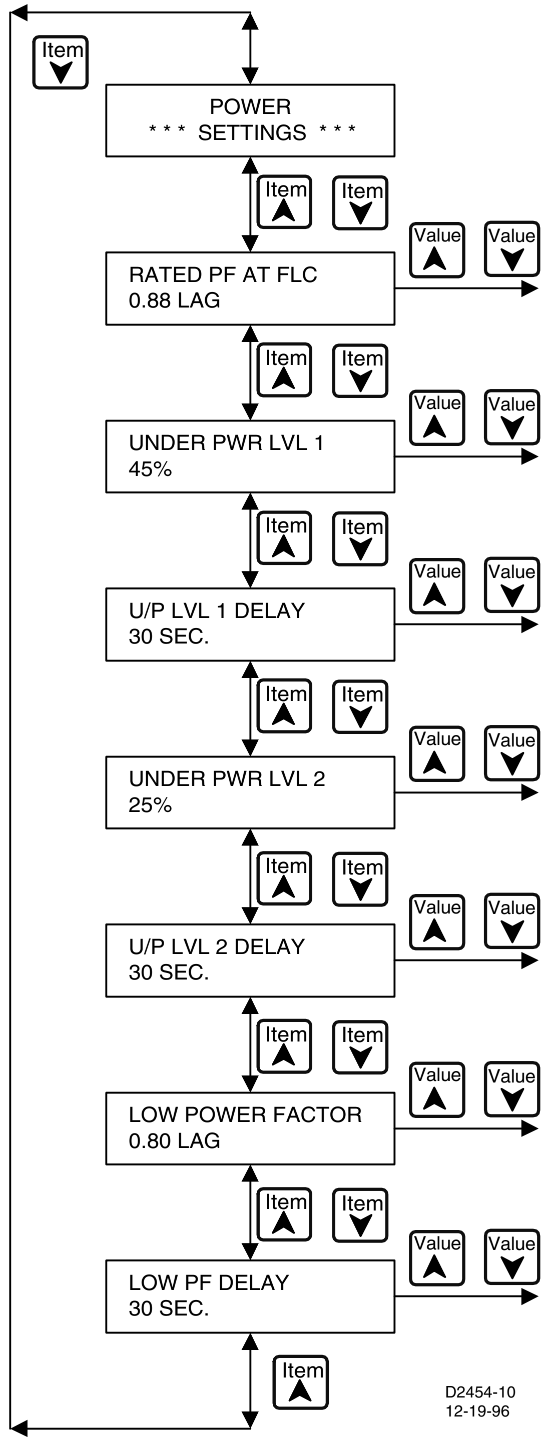


Figure 5-13. POWER SETTINGS Available Pages

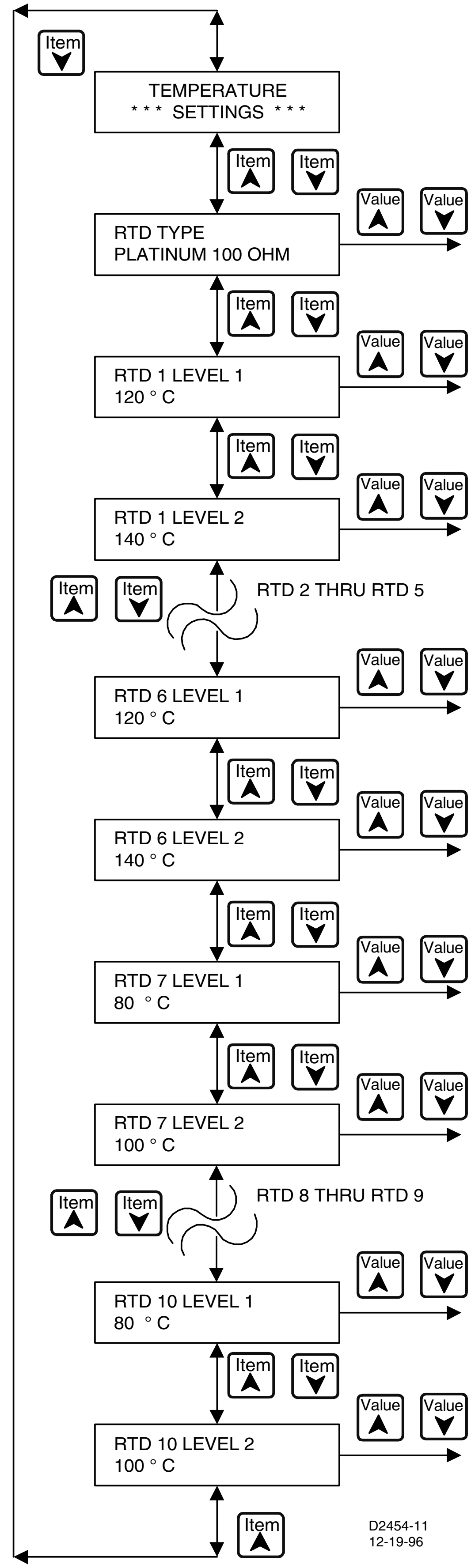


Figure 5-14. TEMPERATURE SETTINGS Available Pages

Legend For Figure 5-15:

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
UNDERVOLTAGE
O/V LEVEL 1
O/V LEVEL 2
PHASE LOSS
PHASE SEQUENCE
GND FAULT LVL 1
GND FAULT LVL 2
COMM PORT FAILED
INTERNAL FAILURE
CONTROL CIR OPEN
WELDED CONTACTOR
EXTERNAL FAULT 1
EXTERNAL FAULT 2
EXTERNAL FAULT 3
RTD 1 LEVEL 1
RTD 1 LEVEL 2
↓
RTD 10 LEVEL 1
RTD 10 LEVEL 2
UNDER PWR LVL 1
UNDER PWR LVL 2
LOW POWER FACTOR

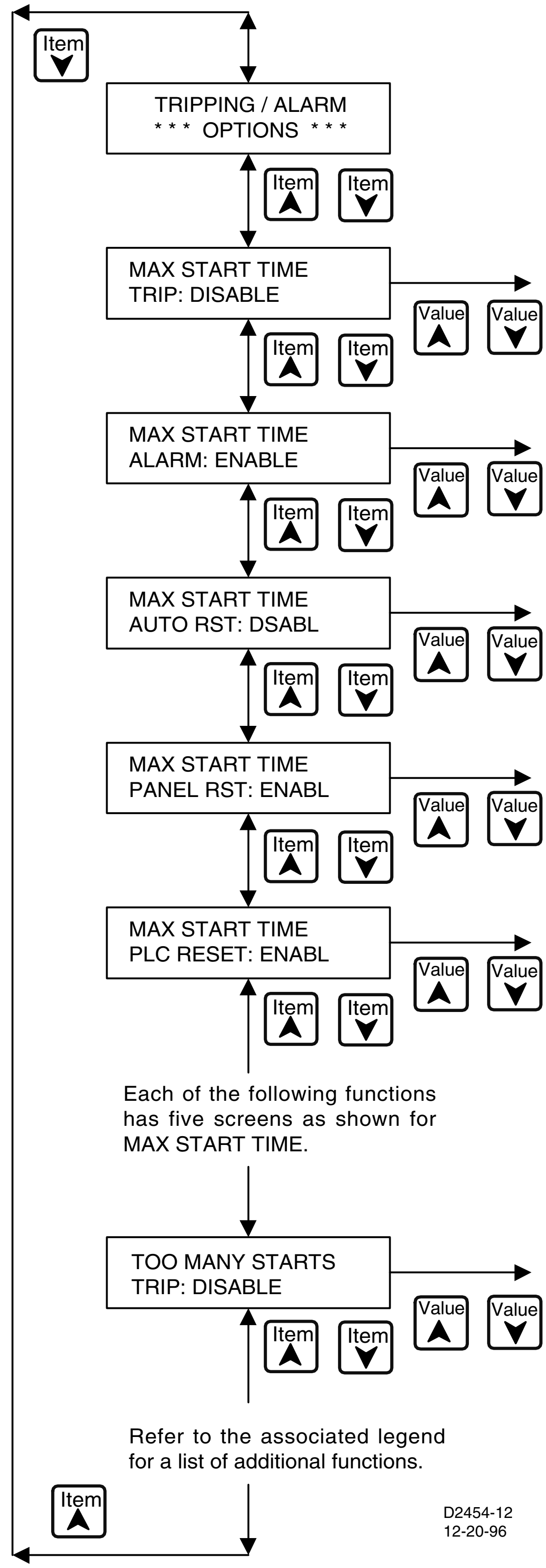


Figure 5-15. TRIPPING / ALARM OPTIONS Available Pages

Test Menus

Figure 5-16 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** ∧ or **Item** ∨ pushbuttons for that page. To perform a test/maintenance function, press the pushbuttons as shown in Figure 5-16.

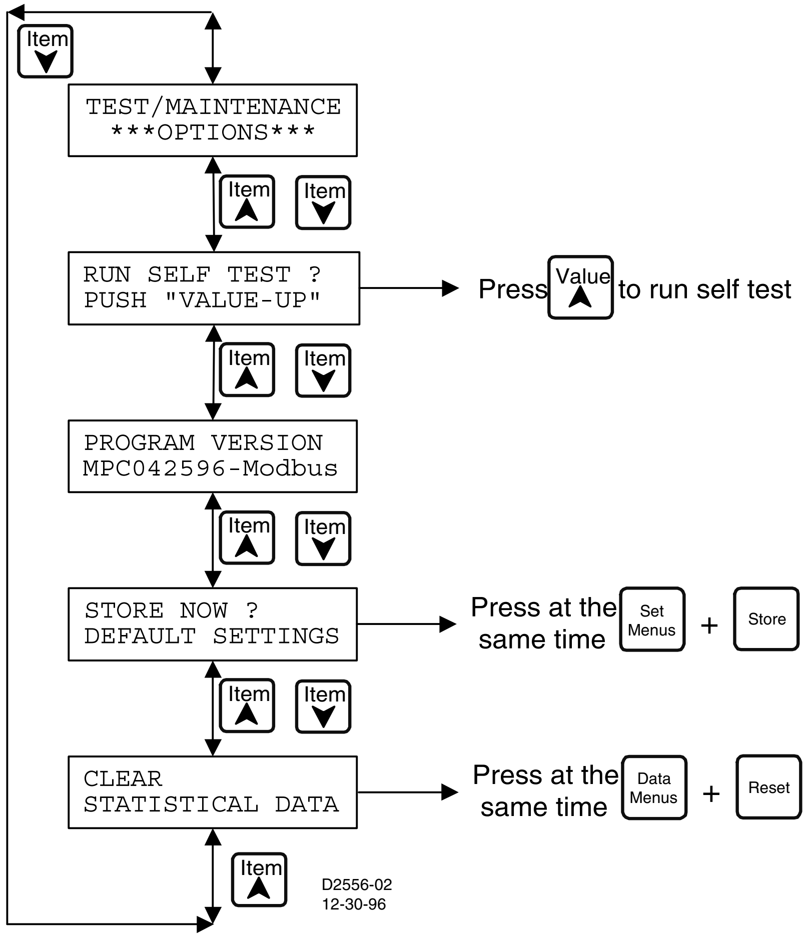


Figure 5-16. Test Menus Available Pages

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.

Communication Settings

This paragraph describes the parameters set with the communication settings of the *SET MENUS* page.

MOTOR NUMBER

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

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.

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.

FUTURE ENHANCE 1, 2, 3

These settings are reserved for future enhancements to the system communication capabilities. These should all be set to NOT USED.

Table 5-1. Communication Settings Table

Communication Settings		
Parameter	**Range**	**Default**
MOTOR NUMBER	0-320	0
BAUD RATE	110, 300, 1200, 2400, 4800, 9600	9600
ADDRESS NUMBER	1-248	33
FUTURE ENHANCE 1	USED, NOT USED	NOT USED
FUTURE ENHANCE 2	USED, NOT USED	NOT USED
FUTURE ENHANCE 3	USED, NOT USED	NOT USED

System Parameter Settings

This paragraph describes the parameters set with the system parameter settings of the *SET MENUS* page.

LINE VOLTS (Vn)

Set this parameter to the nominal line-to-line (primary) system voltage.

LINE FREQUENCY

Set to the nominal system frequency.

VT PRIMARY

Set per Table 5-2, depending on the voltage sensing connection used.

> **NOTE**
>
> For applications using the "1∅ VT, L-L" connection, the user should divide the VT primary rating by 1.73 to obtain the equivalent system line to neutral voltage. This conversion is necessary for the MPS to correctly calculate the VT ratio since, in this connection, the line to line voltage is connected to the MPS phase to neutral voltage sensing elements.

VT SECONDARY

Set per Table 5-2, depending on the voltage sensing connection used.

> **NOTE**
>
> For applications using the "3∅ VT, 4 Wire" or "1∅ VT, L-N" connections, the VT secondary rating may be 66.4 volts (115 volt base) or 69.3 volts (120 volt base). This is below the minimum VT secondary setting of 95 volts. In these applications, the user should multiply both the VT PRIMARY setting and the VT SECONDARY setting by 1.73 and enter the equivalent system line to line voltages instead of the VT nameplate values.

Table 5-2. Voltage Transformer Settings

Voltage Sensing Connection	Figure 4-6 Connection Diagram	VT Primary Setting	VT Secondary Setting
3∅, Direct Connect	a	Not Connected	Not Connected
3∅ VT, 4 Wire	b	VT Name Plate	VT Name Plate, See Note
3∅ VT, 3 Wire	c	VT Name Plate	VT Name Plate
1∅ VT, L-L	d	VT Name Plate	VT Name Plate
1∅ VT, L-N	e	VT Name Plate/1.73 See Note	VT Name Plate, See Note
Other AC Voltage	f	Not Connected	Not Connected
None	N/A	Not Connected	Not Connected

MOTOR FLC

Set to the full-load current on the motor name plate. For STARTING METHOD of TWO SPEED, set to the full-load current corresponding to HIGH speed operation.

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.

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 other wise identical.

G/F LVL 2 DELAY

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

CURRENT INHIBIT

If a motor contactor is not rated adequately for the available short circuit current, this setting can be used to block the operation of Relays A, B, and D to prevent damage to the contactor. See the following caution.

> **CAUTION**
>
> If the current inhibit feature is used, well-coordinated backup protection must be provided at the upstream fuse of 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 allows operation of the output relays A, B, and D on the thermal overload function. For proper coordination, the upstream backup protection must be faster than the MPS thermal overload function at all currents above the CURRENT INHIBIT setting. Except for special circumstances, this parameter should be set to OFF.

START/STP SIGNAL

If the MPS210 relay PROTECTION ONLY feature is set to NO, set this parameter to select maintained or momentary start and stop inputs.

STARTING METHOD

If PROTECTION ONLY is set to NO, set this parameter to the motor starting method. MPS210 relays can be configured for DIRECT ON LINE, STAR/DELTA, TWO SPEED and REVERSING. Note that output relays A and B are configured automatically based on this setting and that output relay C can be configured as a START/RUN contactor for the STAR/DELTA starting method.

MAX TIME IN STAR

Set to the maximum time that output relay A can be energized during the STAR/DELTA starting sequence. The actual time in star is automatically shortened if the starting current drops below the STAR TO DELTA AT setting within the maximum time window. Notice that the MPS relay design sets the minimum time in star to 25% of MAX TIME IN STAR.

TRANSITION TIME

A transition time during which both star and delta contactors are de-energized is required for a successful STAR/DELTA starting sequence. To provide an adequate margin, set to a time longer than the maximum dropout time of the star contactor.

STAR TO DELTA AT

Set to the current level at which the star period can end during the START sequence. This parameter can be used to shorten automatically the overall starting time of the motor. Note that the star period will end at MAX TIME IN STAR even if the motor current is higher that STAR TO DELTA AT.

LOW SPEED FLC

Set equal to the name plate full-load current in terms of primary amperes for low-speed operation.

LOW SPEED t_{6x} TIME

This parameter determines which thermal overload protection curve is used in low-speed operation. It specifies the THERMAL LEVEL 2 operating time at six time the LOW SPEED FLC (with the motor at ambient temperature). Figure 5-17 contains the thermal overload characteristic curves for a cold motor. Figure 5-18 contains the thermal overload characteristic curves for a motor with a hot/cold ratio equal to 40 percent. The equations following Figure 5-18 are the equations used to develop the shifted characteristic curves in Figure 5-18.

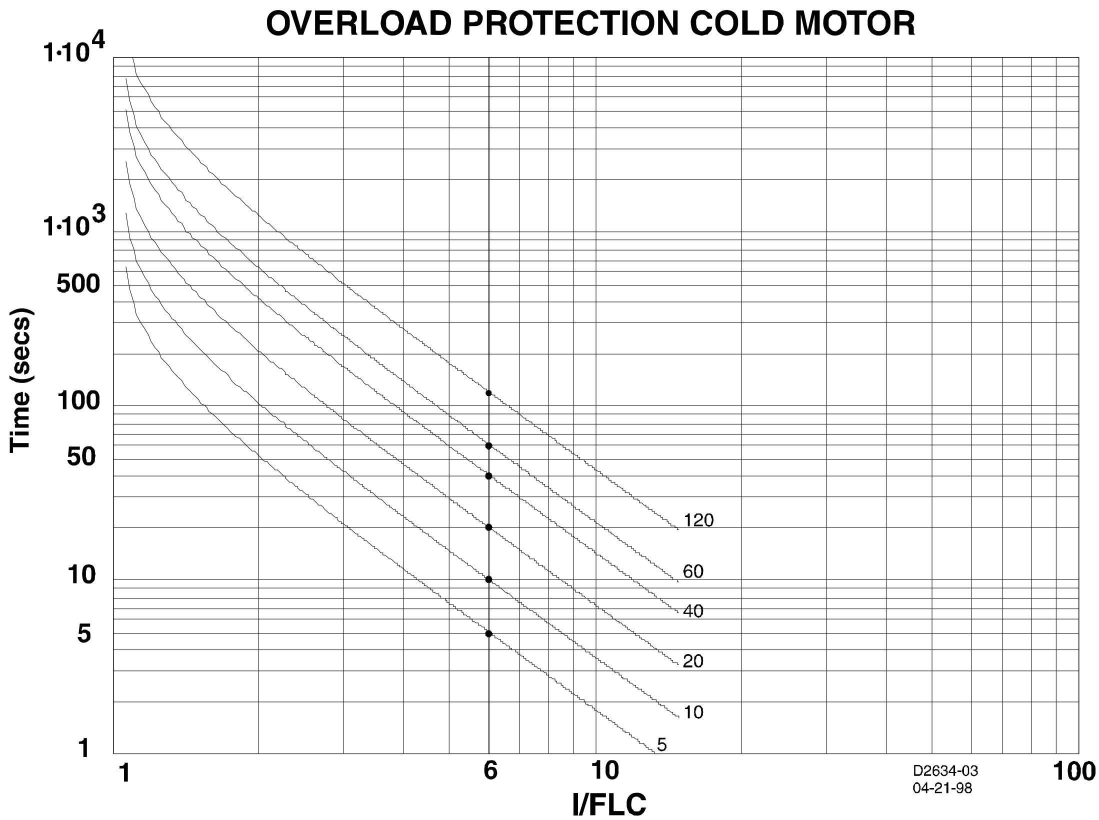


Figure 5-17. Cold Motor Thermal Characteristic Curves (Labels correspond to t_{6x} setting)

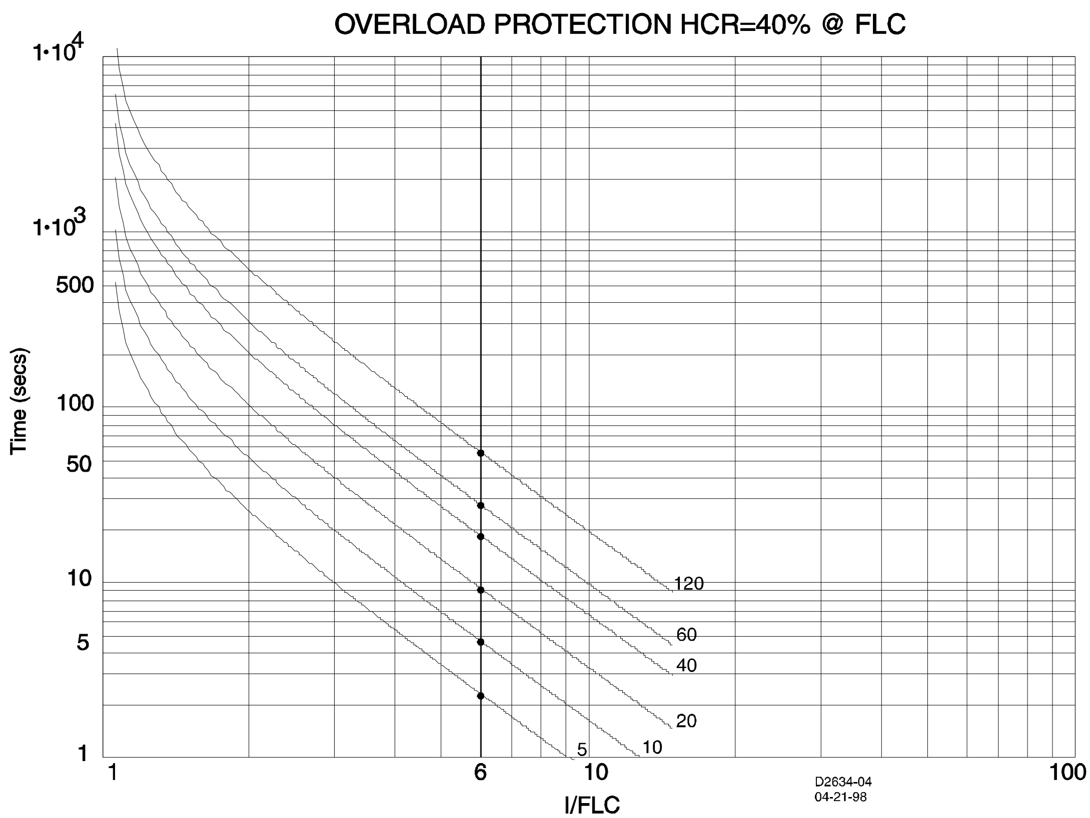


Figure 5-18. 40% Hot/Cold Ratio Motor Thermal Characteristic Curves (Labels correspond to t_{6x} setting)

$$\alpha = \left(\frac{I_l}{I_{ol}}\right)^2 \cdot (1 - HCR)$$ (To bias the thermal register in proportion to load current.)

$$C = \frac{1}{\ln\left(\frac{6^2}{6^2 - I_{ol}^{\ 2}}\right)}$$ (To adjust the time for different overload pickup settings.)

$$t_{trip} = C \cdot t_{6x} \cdot \ln\left(\frac{I^2 - \alpha \cdot I_{ol}^{\ 2}}{I^2 - I_{ol}^{\ 2}}\right)$$

Where:

I = current in per unit multiple of FLC

I_{ol} = overload current setting in p.u. multiple of FLC

t_{6x} = trip time for I=6XFLC setting

I_l = load current before overload

CONFIG. OUTPUT C

Set to the desired configuration for output relay C.

Alarm Output relay is picked up normally and drops out with an adjustable time delay on any alarm condition or on loss of the MPS relay control power.

- *Contactor A*. Configures output relay C to operate with output relay A (contactor A control), but with an adjustable time delay.
- *Contactor B.* Configures output relay C to operate with output relay B (contactor B control), but with an adjustable time delay.
- *START/RUN*. When used with the star/delta starting method, this configuration can be used to control the main contactor with output relay C. The relay is energized on a successful START command and stays energized through the motor START and RUN modes.

OUTPUT C DELAY

Set to the desired time delay for output relay C. The setting should be zero seconds unless a specific application requires it to be otherwise.

CONFIG. OUTPUT D

Set to the desired configuration for output relay D.

- *TRIP.*The output relay is normally dropped out and picks up on any trip condition.
- *TRIP-FAIL SAFE*. Similar to the TRIP option with the addition of fail-safe operation. The output relay is normally energized and drops out on any trip condition or on loss of control power to the MPS relay.
- *START/RUN*. When used with the star/delta starting method, this configuration can be used to control the main contactor with output relay C. The relay is energized on a successful START command and stays energized through the motor START and RUN modes.
- *Contactor A*. Configures output relay D to operate with output relay A (contactor A control), but with an adjustable time delay.
- *Contactor B*. Configures output relay D to operate with output relay B (contactor B control), but with an adjustable time delay.

OUTPUT D DELAY

Set to the desired time delay for output relay D, if it is configured as CONTACTOR A or B. This setting adds no delay if output relay D is configured as TRIP or TRIP-FAIL SAFE.

PROTECTION ONLY

Set this function to NO if the MPS relay is used for motor control as well as protection.

If the MPS relay is used for protection only, then this function can be set to YES. If PROTECTION ONLY is set to YES, then the following conditions also apply.

- All of the contact inputs will be ignored except for the following:
  1. Authorized key-switch input.
  2. Speed-switch input.
  3. Three external fault inputs.
- All control functions will be disable, including start, auto start, stop, output relays A and B, and LEDs A and B.
- The MPS relay will consider the motor to be in STOP mode whenever the motor current is less than twelve percent of the MOTOR FLC or when it produces a TRIP output. Note that the no-load current of a synchronous motor depends on the field current and should be adjusted so that the no-load current is at least twelve percent.
- With the motor in STOP mode, the MPS relay goes to START mode when the motor current rises above the OVERLOAD PICKUP plus ten percent of MOTOR FLC. Once in START mode, the MPS relay will go to RUN mode when the motor start current drops below the same threshold.

NOTE

When PROTECTION ONLY is set to YES, the MPS relay must be in START mode before it can go to RUN mode.

Table 5-3. System Parameter Settings Table

System Parameter Settings		
Parameter	**Range**	**Default**
LINE VOLTS (Vn)	100 to 22 kV	480 V
LINE FREQUENCY	50, 60 Hz	60 Hz
VT PRIMARY	100 to 22 kV, NOT CONNECTED	NOT CONNECTED
VT SECONDARY	95 to 660 V, NOT CONNECTED	NOT CONNECTED
MOTOR FLC	1 to 2,000 A	100 A
CT PRIMARY	1 to 2,000 A	100 A
GND CT PRIMARY	1 to 2,000 A	100 A
GND FAULT LVL 1	1 to 100% OF MOTOR FLC	5 %
G/F LVL 1 DELAY	1 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
CURRENT INHIBIT	400 - 1,000 % of MOTOR FLC; OFF	OFF
START/STP SIGNAL	MOMENTARY, MAINTAINED	MOMENTARY
STARTING METHOD	DIRECT ON LINE, STAR/DELTA, REVERSING, TWO SPEED	DIRECT ON LINE
MAX TIME IN STAR	1 to 60 s	10 s
TRANSITION TIME	50 to 2,000 ms	200 ms
STAR TO DELTA AT	70 to 200 % MOTOR FLC	150 %
LOW SPEED FLC	1 to 2000 A	10 A
LOW SPEED t6x TIME	0.5 to 120 s	10 s
CONFIG. OUTPUT C	ALARM, CONTACTOR A, CONTACTOR B, START/RUN	ALARM
OUTPUT C DELAY	0 to 120 s	0 s
CONFIG. OUTPUT D	TRIP, TRIP-FAIL, CONTACTOR A,	TRIP

System Parameter Settings		
Parameter	Range	Default
	CONTACTOR B	
OUTPUT D DELAY	120 s	0 s
PROTECTION ONLY	YES, NO	NO

Voltage Settings

This paragraph describes the parameters set with the voltage settings of the *SET MENUS* page.

U/V LEVEL

This function sets the threshold for undervoltage protection. It is active only when the motor is in START or RUN mode. The MPS relay computes an average of the three line-to-line voltages and compares it with the threshold set for this function. Undervoltage protection can be used with either single- or three-phase VT inputs. If no voltage input is connected to the MPS relay, both the trip and alarm options of this function may be disabled.

U/V DELAY

This function sets a definite time delay to undervoltage protection operation. This delay can be used to prevent nuisance operations during normal dips in the motor supply voltage.

U/V STRT PREVENT

This function establishes the minimum voltage at the motor bus before the MPS relay will allow the motor to be started. If no voltage signal is connected to the MPS relay, this setting must be OFF.

U/V AUTO RESTART

This function is applicable only when START/STP SIGNAL is set to MOMENTARY and an ac auxiliary power supply is used. It should be set to DISABLE unless both of these conditions are met. When this function is set to ENABLE, the MPS relay automatically restarts the motor following a momentary outage of the auxiliary power supply, as follows:

- Immediate restart if the outage duration is less than 0.2 second.
- Delayed restart (according to U/V RESTRT DELAY) if the outage duration is between 0.2 and 4.0 seconds.
- No restart if the outage lasts longer than 4.0 seconds.

U/V RSTRT DELAY

Sets the time delay before a restart following an outage of the auxiliary power supply lasting between 0.2 and 4.0 seconds. This delay can be used to stagger restarting of multiple motors after a momentary disturbance.

O/V LEVEL 1

This level of overvoltage protection is primarily intended as an alarm and is usually set lower than O/V LEVEL 2. The time delay is factory set to 1 second. Overvoltage protection can be used with either single- or three-phase VT inputs.

O/V LEVEL 2

This level of overvoltage protection is primarily intended as a trip, is usually set higher than O/V LEVEL 1, and has an adjustable time delay. The previous paragraph applies to this item also.

O/V LVL 2 DELAY

This setting provides a definite time delay for the O/V LEVEL 2 function. This delay can help prevent nuisance operations during normal momentary overvoltage conditions in the motor power supply.

Table 5-4. Voltage Settings Table

Voltage Settings		
Parameter	**Range**	**Default**
U/V LEVEL	50 to 95% of Vn	80%
U/V DELAY	0.2 to 10 s	5.0 s
U/V STRT PREVENT	51 to 95% of Vn or OFF	OFF
U/V AUTO RESTART	DISABLE, ENABLE	DISABLE
U/V RSTRT DELAY	0.1 to 120 s	4.0 s
O/V LEVEL 1	100 to 120% of Vn	115%
O/V LVL 1 DELAY	Fixed	1 S
O/V LEVEL 2	100 to 120% of Vn	120%
O/V LVL 2 DELAY	1 to 100 s	1 s

Current Settings

This paragraph describes the parameters set with the current settings of the *SET MENUS* page.

MAX. START TIME

The MPS relay counts the start time from a successful START command 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 drop out of START mode. 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.

START INHIBIT

Following an operation of the TOO MANY STARTS protection function, the MPS relay inhibits any new attempts to start the motor for a time equal to this setting. AUTO RESET of the function TOO MANY STARTS is also inhibited for the START INHIBIT 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 milliseconds.

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 5-17 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: $TC = 100 \bullet \left(\frac{I}{I_{OC}} \right)^2 \bullet \left(\frac{1 - HCR}{100} \right)$ (%)

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.

This is the thermal level indicated by the MPS TC register. A trip occurs when the TC register reaches 100. See Figure 5-19. The overload curves in Figure 5-18 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.

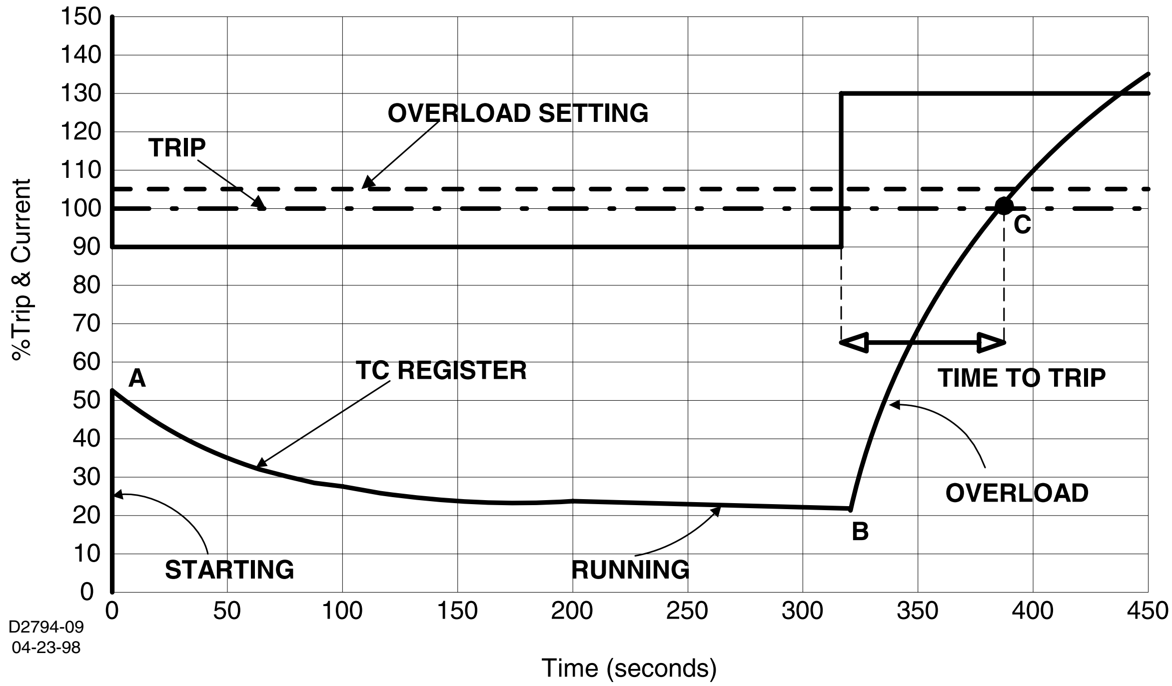


Figure 5-19. Thermal Protection Dynamic Response

<u>*Example Of Starting And Overload Sequence*</u>

Settings: t_{6x} = 2s, HCR = 70%, IOL = 105%

During starting, the current reaches 600% of full load. The TC register increases very rapidly, but stops at 50%, when the current falls below the overload limit. During the running phase, the TC levels of a value are given by Equation 2. At B, the motor experiences a 130% overload. The TC register increments toward the value given by Equation 1. At C, it crosses 100%, causing the relay to trip.

Between points B and C, the relay continuously displays the time remaining before the trip. The time constant T for the Thermal characteristic is determined by the t_{6x} and the overload setting. The time constant T, i.e, the time for the thermal register to change by 63%, can be obtained from the t_{6x} and overload setting through the following equation:

$$T = t_{6x} \bullet \frac{1}{\ln\left(\frac{6^2}{6^2 - I_{OI}^2}\right)}$$

For specific overload settings, this equation is simplified as follows.

I_{OL}	1	1.05	1.1	1.15
T(s)	35.5•t_{6x}	32•t_{6x}	29.2•t_{6x}	26.7•t_{6x}

Conversely, the t_{6x} setting can be found, given a time constant T, and an overload setting. For an overload setting of 1.05 pu, the t_{6x} setting is

$$t_{6x} = \frac{T(s)}{32} \text{ seconds}$$

The trip time for a constant overload level I is given by the following equation.

$$t_{trip} = T \bullet \ln\left(\frac{I^2 - \propto I_{OL}^2}{I^2 - I_{OL}^2}\right)$$

Where:

$\propto \quad = \left(\frac{I_{LOAD}}{I_{OL}}\right)^2\left(1-\frac{HCR}{100}\right)$

I_{OL} = overload setting

I_{LOAD} = steady state load before the overload occurs

ln = natural logarithm

For the example given,

$$\propto = \left(\frac{0.9}{1.05}\right)^2\left(1-\frac{70}{100}\right) = 0.22$$

$$t_{trip} = 32 \bullet 2 \bullet \ln\left(\frac{1.3^2 - 0.22 \bullet 1.05^2}{1.3^2 - 1.05^2}\right) = 58 \text{ seconds}$$

HOT/COLD RATIO

This setting is the available thermal capacity of the motor in percentage of cold motor capability. It is given by the ratio of hot to cold maximum safe stall times.

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.

STALL TIME FCTR

This setting is the ratio of the motor thermal time constant with the speed switch closed versus the motor thermal time constant with the speed switch open. It is used when the start time of a high inertia motor exceeds the safe stall time. This setting determines the modification of the overload curve used by the MPS relay during a part of the motor starting mode. The t_{6x} TIME is reduced to (t6x TIME) X (STALL TIME FACTOR)/100 until there is evidence of motor rotation. A speed switch input must be used to detect the rotation of the motor.

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 5-19 contains the characteristic curves for this function. The percentage unbalance is computed with the formula:

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

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:

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

U/B LVL 2 MAX T

This setting selects the characteristic curve and represents the function's operating time at an unbalance of 10%. In Figure 5-20, the relay setting corresponding to each curve is found at the intersection of the curve with the y axis.

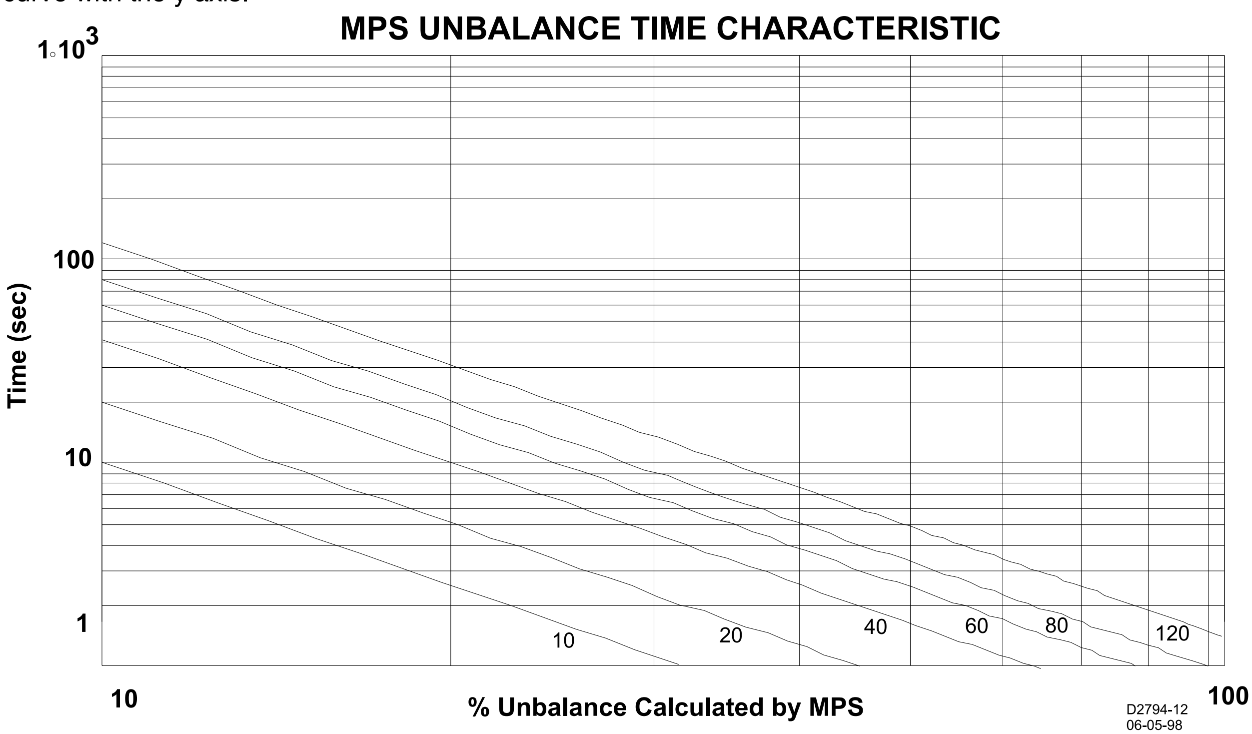


Figure 5-20. Percent Unbalance Calculated By MPS Relay

Table 5-5. Current Settings Table

Current Settings		
Parameter	**Range**	**Default**
MAX. START TIME	1 to 250 s	10 s
NUMBER OF STARTS	1 to 10	10
STARTS PERIOD	1 to 60 min	30 min
START INHIBIT	1 to 60 min	30 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

Current Settings		
Parameter	**Range**	**Default**
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
STALL TIME FCTR	20 to 100%	50%
UNBALANCE LVL 2	10 to 40% of MOTOR FLC	15%
U/B LVL 2 MAX T	20 to 120 s	30 s
U/B LVL 1	Fixed	50% of U/B LVL 2
U/B LVL 1 DELAY	Fixed	1 s

Power Settings

This paragraph describes the parameters set with the power settings of the *SET MENUS* page.

RATED PF AT FLC

Set this to the rated power factor (PF) of the motor at full-load current, as supplied by the motor manufacturer. The MPS calculates the rated power of the motor using the following formula to process the underpower functions:

Rated Power = 1.732 X (Line Voltage, Vn) X (Motor FLC)

UNDER PWR LVL 1

The MPS relay provides two levels of underpower protection, with individually adjustable definite time delays. Underpower protection is operational only when the motor is in RUN mode. Level 1 is primarily intended as an alarm and is usually set higher then Level 2. Sustained underpower may be an indication of total or partial loss of motor load and may justify an alarm or trip. A three-phase voltage input is required for proper operation of these functions. Trip and alarm options for this function must be disabled if three-phase voltage is not connected to the MPS relay.

U/P LVL 1 DELAY

Sets the time delay for the UNDER PWR LVL 1 function.

UNDER PWR LVL 2

This function is identical to UNDER PWR LVL 1, except that it is primarily intended as a trip and is usually set lower.

U/P LVL 2 DELAY

Sets the time delay for the UNDER PWR LVL 2 function.

LOW POWER FACTOR

Low power factor protection operates when the lagging power factor drops below the set value for a time longer than the LOW PF DELAY. It is operational only when the motor is in RUN mode. This function can be used to detect a loss of power factor correction in an induction motor or a loss of field in a synchronous motor. A three-phase voltage input is required for operation of this function. Trip and alarm options for this function must be disabled if three-phase voltage is not connected to the MPS relay.

LOW PF DELAY

Sets the definite time delay for low power factor protection.

Table 5-6. Power Settings Table

Power Settings		
Parameter	**Range**	**Default**
RATED PF AT FLC	0.50 to 0.99	0.88
UNDER PWR LVL 1	5 to 99% of calculated rated power	45%
U/P LVL 1 DELAY	1 to 120 s	30 s
UNDER PWR LVL 2	5 to 99% of calculated rated power	25%
U/P LVL 2 DELAY	1 to 120 s	30 s
LOW POWER FACTOR	0.20 to 0.98(LAG)	0.80
LOW PF DELAY	1 to 120 s	30 s

Temperature Settings

This paragraph describes the parameters set with the temperature settings of the *SET MENUS* page.

RTD TYPE

Two distinct families of MPS relay models cover the three types of resistance-temperature detectors (RTDs). Before setting this item, verify that the MPS relay model in use matches the type of available.

RTD X LVL 1, RTD X LVL 2

The MPS relay back panel has ten inputs for RTDs. Each RTD has two levels of settings available. Level 1 is normally intended as an alarm and is set lower then Level 2, which is intended as a trip. In addition, the MPS relay will alarm and block tripping by and open RTD. These settings should be based on motor insulation temperature class and/or bearing temperature limits, with adequate margins.

Table 5-7. Temperature Settings Table

Temperature Settings		
Parameter	**Range**	**Default**
RTD TYPE	Copper 10 ohms, Platinum 100 ohms, Nickel 120 ohms	Platinum 100 ohms
RTD 1 LVL 1	0 to 200°C	120°C
RTD 1 LVL 2	0 to 200°C	140°C
RTD 2 LVL 1	0 to 200°C	120°C
RTD 2 LVL 2	0 to 200°C	140°C
RTD 3 LVL 1	0 to 200°C	120°C
RTD 3 LVL 2	0 to 200°C	140°C
RTD 4 LVL 1	0 to 200°C	120°C
RTD 4 LVL 2	0 to 200°C	140°C
RTD 5 LVL 1	0 to 200°C	120°C
RTD 5 LVL 2	0 to 200°C	140°C
RTD 6 LVL 1	0 to 200°C	120°C
RTD 6 LVL 2	0 to 200°C	140°C
RTD 7 LVL 1	0 to 200°C	80°C
RTD 7 LVL 2	0 to 200°C	100°C
RTD 8 LVL 1	0 to 200°C	80°C
RTD 8 LVL 2	0 to 200°C	100°C
RTD 9 LVL 1	0 to 200°C	80°C
RTD 9 LVL 2	0 to 200°C	100°C
RTD 10 LVL 1	0 to 200°C	80°C
RTD 10 LVL 2	0 to 200°C	100°C

Tripping/Alarm Options

This paragraph describes the parameters set with the Tripping/Alarm Options of the *SET MENUS* page.

TRIP

When this option is enabled, the MPS relay performs the following operations when the function operates.

MPS200 Relay Only

- A contact closes on thermal level 2 trip.
- B contact closes on ground fault level 2 trip.
- Turns on the TRIP LED.

MPS210 Relay Only.

- De-energizes output relays A and B.

MPS200 And MPS210 Relays

- Energizes output relay D if it is configured as TRIP B.
- De-energizes output relay D if it is configured as TRIP-FAIL SAFE.

ALARM

When this option is enabled, the MPS relay performs the following operations when the function operates.

- Turns on the ALARM LED.
- De-energizes output relay C if it is configured as ALARM.

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.

PANEL RST

When this option is enabled, and the MPS relay is in Local Control mode, the MPS relay can be reset from the front panel following operation of the function without authorized key switch input. This option should be disabled for all critical protection functions that must be reported or recorded before reset. A person with authorized key may always reset the MPS relay regardless of this setting.

PLC RESET

When this option is enabled, and the MPS relay is in PLC mode, the MPS relay can be reset from the PLC RESET input contact following operation of the function. If a PLC is not used, this function should be disabled.

Table 5-8. Tripping/Alarm Options Table

Function	Trip	Alarm	Auto Rst	Panel Rst	PLC Rst	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
UNDERVOLTAGE*	DSABL	ENABL	DSABL	ENABL	ENABL	RUN&START
O/V LEVEL 1*	DSABL	ENABL	DSABL	ENABL	ENABL	RUN&START
O/V LEVEL 2*	ENABL	ENABL	DSABL	ENABL	ENABL	RUN&START

Function	Trip	Alarm	Auto Rst	Panel Rst	PLC Rst	When Active
PHASE LOSS*	ENABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
PHASE SEQUENCE*	ENABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
GND FLT LVL 1 FAULT	DSABL	ENABL	DSABL	ENABL	ENABL	ALWAYS
GND FLT LVL 2 FAULT	DSABL	ENABL	DSABL	DSABL	DSABL	ALWAYS
COMM PORT FAILED	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
INTERNAL FAILURE	DSABL	ENABL	DSABL	DSABL	DSABL	ALWAYS
CONTROL CIR OPEN	DSABL	DSABL	DSABL	ENABL	ENABL	PRESTART
WELDED CONTACTOR	DSABL	DSABL	DSABL	ENABL	ENABL	PRESTOP
EXTERNAL FAULT 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
EXTERNAL FAULT 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
EXTERNAL FAULT 3	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 1 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 1 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 2 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 2 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 3 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 3 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 4 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 4 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 5 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 5 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 6 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 6 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 7 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 7 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 8 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 8 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 9 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 9 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 10 LEVEL 1	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
RTD 10 LEVEL 2	DSABL	DSABL	DSABL	ENABL	ENABL	ALWAYS
UNDER PWR LVL 1*	DSABL	DSABL	DSABL	ENABL	ENABL	RUN
UNDER PWR LVL 2*	DSABL	DSABL	DSABL	ENABL	ENABL	RUN
LOW POWER FACTOR*	DSABL	DSABL	DSABL	ENABL	ENABL	RUN

* See Table 5-6.

Table 5-9. Voltage Sensing Connections

Voltage Sensing Connection	Figure 4-7 Connection Diagram	Under/Over Voltage	Phase Loss/ Phase Sequence	Under Power/ Low PF
3∅, Direct Connect	a	Yes	Yes	Yes
3∅ VT, 4 Wire	b	Yes	Yes	Yes
3∅ VT, 3 Wire	c	Yes	Yes	Yes
1∅ VT, L-L	d	Yes	Disable	Disable
1∅ VT, L-N	e	Yes	Disable	Disable
Other AC Voltage	f	Disable	Disable	Disable
None	N/A	Disable	Disable	Disable

This page intentionally left blank.

SECTION 6 • TESTING

GENERAL

You may prefer to test your relay before installation. To test MPS relay functionality, perform the following procedures.

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 C18) is not hard-wired to earth ground.

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

Step 2. On MPS relays with ac input voltages, set the ac input switch (located on the rear panel) to the appropriate operating voltage.

Step 3. Connect operating power, voltage inputs, current inputs, and logic inputs as required to the appropriate terminals (refer to the typical connection diagram, Figure 4-2 for MPS200 relays or Figure 4-3 for MPS210 relays).

To use a single-phase power, connect power to the relay as follows. (See Figure 6-1 for a typical test connection diagram.) Connect the current inputs in series by connecting terminals C3 to C4, C6 to C7, and C9 to C11. Connect the voltage inputs in parallel by connecting terminals C15, C16, and C17 together.

Step 4. Connect logic inputs as required to the appropriate terminals (use the typical connection diagram, Figure 6-1 for MPS200 relays or Figure 6-2 for MPS210 relays).

Step 5. Connect 1% metal film resistors to the RTD inputs in accordance with Table 6-1.

Step 6. Apply operating power.

Step 7. Verify that the **Power** and **Motor Stopped** LEDs are ON.

Table 6-1. RTD Inputs

Style Number	RTD1	RTD2	RTD3	RTD4	RTD5	RTD6	RTD7	RTD8	RTD9	RTD10
MPS -2x0 Cxxx (Copper)	15 Ω	15 Ω	15 Ω	15 Ω	15 Ω	15 Ω	12 Ω	12 Ω	12 Ω	12 Ω
MPS -2x0 Pxxx (Platinum)	150 Ω	150 Ω	150 Ω	150 Ω	150 Ω	150 Ω	133 Ω	133 Ω	133 Ω	133 Ω
MPS -2x0 Pxxx (Nickel)	220 Ω	220 Ω	220 Ω	220 Ω	220 Ω	220 Ω	190 Ω	190 Ω	190 Ω	190 Ω

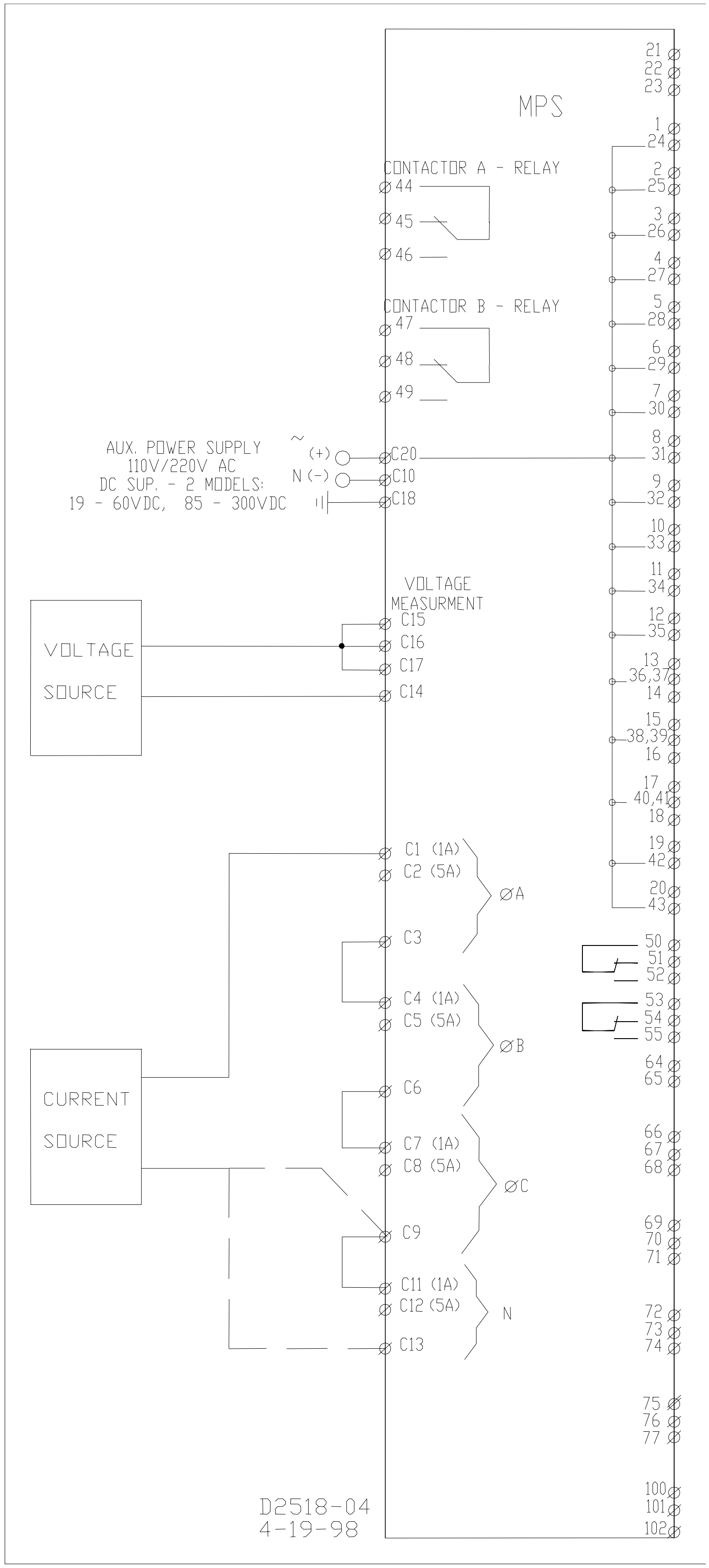


Figure 6-1. Typical Test Connection Diagram

CONFIGURATION

Step 1. Close the authorized key input.

Step 2. Use the Set Menus pushbutton and advance to the **SYSTEM PARAMETERS *** SETTINGS *** ** display. Use the **Item** ↑ or **Item** ↓ pushbutton to scroll to the settings page in the table below. Use the **Value** ↑ or **Value** ↓ pushbutton to select the test settings as shown in Table 6-2.

Table 6-2. System Parameters Settings

SYSTEM PARAMETER SETTINGS Page	Test Setting MPS 200	Test Setting MPS 210
LINE VOLTS	120 VOLT	120 VOLT
GND FAULT LVL 1	95% OF FLC	95%
GND FAULT LVL 2	95% OF FLC	95%
STARTING METHOD	N/A	STAR (WYE)/DELTA
PROTECTION ONLY	YES	NO

Step 3. Use the Store pushbutton to save the values entered.

SELF TEST

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

Step 2. Press the Test Menus pushbutton and display indicates **TEST/MAINTENANCE *** OPTIONS *****. Use the **Item** ↑ or **Item** ↓ pushbutton to advance to the **RUN SELF TEST ?**. Use the **Value** ↑ pushbutton to initiate self test.

Step 3. If self test passed, the display will read **SELF TEST PASSED** and the **Relay Trouble** LED on the front panel is NOT ON. If a failure occurred, the display will read **SELF TEST FAILED** and **Error Code = ##** designating the type of error observed and the **Relay Trouble** LED turns ON. Pressing the **Reset** pushbutton clears the error code and turns the **Relay Trouble** LED OFF.

INPUT TEST DATA

Step 1. Apply 69 Vac_{L-N} , nominal frequency, to the voltage sensing inputs C15 and C14.

Step 2. Apply 1.0 ampere, nominal frequency, to the current sensing input terminals C1 to C13 **(this current must be in phase with the voltage)**. Be aware that ground fault one and two alarm and trip should occur.

Step 3. Use the Data Menus pushbutton and advance to the **MEASURED DATA** display. Use the **Item** ↑ or **Item** ↓ pushbutton to advance to the data pages and verify that the data is displayed as in Table 6-3. If you are using single-phase power, the REACTIVE POWER measured data should be erratic and not showing a steady display as shown in Table 6-3.

> **NOTE**
> For the tolerances in the measured data in Table 6-3, refer to Section 1, *Specifications*. Indicated temperature measurements are dependent on the resistors sizes that you connected during the test setup.

Step 4. Remove sensing voltage and current.

Step 5. Press **Reset twice** to reset the relay. (Reset Thermal Capacity)

Figure 6-3. Measured Data Single-Phase Test

	Vp1, Vp2, Vp3
Voltage	64.5 to 73.5 volts
	VL12, VL23, VL31
Voltage	0 volts
	I1, I2, I3
Current	98.5 to 101.5 amperes
Ground Current	98.5 to 101.5 amperes
Power	19.25 to 22.15 kilowatts
Reactive Power	0 kvar
Power Factor	0
	T1, T2, T3, T4, T5
Cu RTD Temperature	149 to 161°C
Pi RTD Temperature	125 to 135°C
Ni RTD Temperature	115 to 125°C
	T6, T7, T8, T9, T10
Cu RTD Temperature	74 to 80°C
Pi RTD Temperature	82 to 88°C
Ni RTD Temperature	84 to 92°C

LOGIC INPUTS

Step 1. Use the Data Menus pushbutton and advance to the **LOGICAL INPUTS - CONTACT STATUS** page. Use the **Item** ↑ or **Item** ↓ pushbutton to advance to each contact sense input listed in Table 6-4 or 6-5. Toggle the logic input and verify that the displayed response changes. Depending on the sequence that you use in closing and opening the switches, some logical input displays may not occur as shown in Tables 6-4 and 6-5. If so, follow the indicated display to change/correct the logical switch sequence.

Table 6-4. MPS200 Logical Inputs

	INPUT CLOSED	**INPUT OPEN**
SENSE INPUT	**MPS 200**	**MPS 200**
AUTHORIZED KEY	UNLOCKED	LOCKED

Table 6-5. MPS210 Logical Inputs

SENSE INPUT	INPUT CLOSED MPS 210	INPUT OPEN MPS 210
CONTACTOR A N/O	CLOSED	OPEN
CONTACTOR A N/C	CLOSED	OPEN
CONTACTOR B N/O	CLOSED	OPEN
CONTACTOR B N/C	CLOSED	OPEN
EXTRNL INTERLOCK	RUN ENABLE	LOCKED OUT
ISOLATOR N/O	RUN ENABLE	LOCKED OUT
ISOLATOR N/C	ISOLATED	RUN ENABLE
START A INPUT	CLOSED	OPEN
START B INPUT	CLOSED	OPEN
STOP INPUT	RUN ENABLE	STOP
LOCAL / REMOTE	REMOTE	LOCAL
PLC CONTROL	S. _ PORT	PLC
PLC CONTROL A	START/RUN	STOP
PLC CONTROL B	START/RUN	STOP
PLC RESET	CLOSED	OPEN
SPEED SWITCH	LOW SPEED	HIGH SPEED
AUTHORIZED KEY	UNLOCKED	LOCKED
EXTERNAL FAULT 1	RUN ENABLE	STOP
EXTERNAL FAULT 2	RUN ENABLE	STOP
EXTERNAL FAULT 3	RUN ENABLE	STOP

OUTPUT RELAYS TEST

MPS200 and MPS210 Relays

Step 1. Apply 69 Vac $_{L-N}$, nominal frequency, to the voltage sensing inputs C15 and C14.

Step 2. Apply 3 Aac, nominal frequency, to the current sensing input terminals C1 to C9.

Step 3. Observe that after approximately 33 seconds, the alarm (Relay C) picks up.

Step 4. Observe that after approximately 42 seconds, the TRIP (Relay D) relay outputs close.

Step 5. Remove sensing current and voltage.

Step 6. Press Reset twice.

MPS210 Relays ONLY

Step 1. Apply 69 Vac $_{L-N}$, nominal frequency, to the voltage sensing inputs C15 and C14.

Step 2. Apply 0.8 Aac, nominal frequency, to the current sensing input terminals C1 to C13.

Step 3. Close the switches on the EXT. INTERLOCK, STOP, and ISOLATOR logic sensing inputs.

Step 4. Momentarily close the switch on the START A input.

Step 5. Observe that the **Motor Stopped** LED turns OFF, the **Motor Started** and **Output A** LEDs turn ON, and that relay outputs A and C close.

Step 6. Observe that after a short delay, the following events occur.

Motor Started and **Output A** LEDs turn OFF.

Relay output A opens.

Motor Running and **Output B** LEDs turn ON.

Relay output B closes.

Step 7. Open the stop input. Observe that the **Motor Running** and **Output B** LEDs turn OFF.

Step 8. Remove sensing current and voltage.

Step 9. Apply 69V as in Step 1.

Step 10. Apply 1A as is Step 2.

Step 11. Observe that the Alarm and Trip relays (and LEDs) pickup, and the Display indicates "TRIP: GND FAULT LVL 2."

Step 12. Repeat Steps 3 and 4.

Step 13. Observe that the display indicates "unable to start - Trip".

Step 14. Remove current and voltage.

Step 15. Press Reset twice.

RESTORE SETTINGS

Step 1. Verify that operating power is still applied.

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

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

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

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

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

Step 7. Press at the same time **Data Menus** and **Reset** 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.

Basler Electric
ROUTE 143, BOX 269
HIGHLAND, IL 62249 USA
http://www.basler.com, info@basler.com
PHONE +1 618-654-2341 FAX +1 618-654-2351