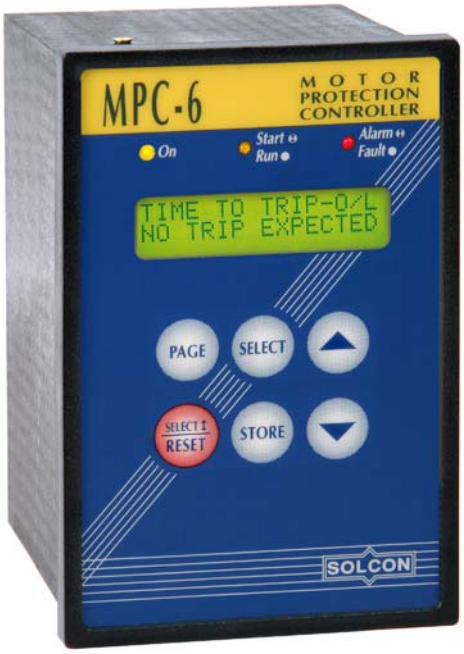
# MPC-6

## MOTOR PROTECTION & CONTROL SYSTEM




**MPC-C User's Guide**

**Ref : MPC6-AA0705**

## Safety

- Read this manual carefully before operating the equipment and follow the instructions
- Installation, operation and maintenance should be in strict accordance with this manual, national codes and good practice. Installation or operation not performed in strict accordance with these instructions will void manufacturer's warranty.
- Disconnect all power inputs before servicing the MPC-6.

## Attention

1. This product was designed in compliance with IEC 947-4-2 for class A equipment.
2. The MPC-6 is designed to meet UL requirements
3. For further information, see Technical Specification

## Warnings

- Internal components and PCB's are at mains potential when the MPC-6 is connected to mains. This voltage is extremely dangerous and will cause death or severe injury if touched.
- Unit must be grounded to ensure correct operation, safety and to prevent damage.

**The company reserves the right to make any improvements**
**Or modifications to its products without prior notice.**

# INTRODUCTION

The MPC-6 Motor Protection and Control System is a new generation of microprocessor based device designed to protect and control three phase induction motors.
The MPC-6 incorporates three main functions.

- Motor protection.
- Supervision and communication.
- Motor Control

**Motor Protection**

AC motors are very rugged and reliable when operating within their limits. However, they are usually designed to operate close to their rated limits with minimal margins for operating under abnormal conditions.

A comprehensive protection device is required to accurately create a "Thermal Model" so that the motor can run safely within its limits. This device should protect the motor from abnormal conditions in the power supply, motor and cable faults, as well as operator errors.

The MPC-6 monitors one voltage and three phase currents (true RMS line currents are measured at a sampling rate of 0.5 ms). The MPC-6 calculates the true RMS ground fault current by summing up the three phase currents. For small motors, if only ground fault is to be measured, it is possible to connect it to "I1". The MPC-6 monitors a single temperature (RTD or PTC/NTC Thermistor) input. Overall, the MPC-6 provides a comprehensive protection and control package.

**Protection Types**

- Maximum start time,
- Too many starts
- Under-current
- Load increase
- Over-current Jam / Stall
- Over-current Short circuit
- Thermal level (Overload) Alarm
- Thermal level (Overload) Trip
- Unbalance current
- Phase Sequence
- Ground fault current
- Under-voltage
- Over-voltage
- Wrong Contactor Status
- Comm. Port Failure
- External fault 1 - N.O./N.C contacts
- External fault 2 - N.O./N.C contacts
- Over Temp. Level 1&2 (using PT100 or PTC/NTC Thermistor)

**Individual Protection settings**

Protection levels and time delay settings are individually configured through the keypad on the front panel or through the communications port.

**Configurable operation**

Unique Tripping/Alarm options make it possible to designate any of the above faults as an Alarm, Trip, both or none. Furthermore, two auxiliary relays can be designated to operate with any of the supported faults.

**"Time to Trip" and "Time to Start"**

When current exceeds the overload setting a built-in unique algorithm calculates the point in time at which the motor will be tripped (when thermal capacity reaches 100%). This feature enables the operator or host computer to take corrective actions before the actual trip occurs. After the MPC-6 has tripped the motor, the MPC-6 calculates the time delay after which the motor can be restarted, once it has cooled down.

**Informative data**

Data is display on an illuminated LCD (Liquid Crystal Display) with two (2) lines and sixteen (16) characters each providing clear status and statistical information. The same information is available via the serial link.

**Actual Data**

Voltage, Phase currents, Ground fault current, PT100 / Thermistor Temp./ resistance, Motor load in % of FLC, Thermal Capacity, Time to trip, Time to start, Unbalance current.

**Statistical Data**

Motor's running hours; Total number of starts; Total number of trips; Last start time; Last start current peak,; Last Trip; Last Alarm; Pre-Trip Phase current and Ground fault current.

**Serial Link Communication**

RS485 serial link with MODBUS communication protocol, operating at a baud rate of 1200 up to 19200 bps enables monitoring of setpoints and actual parameters. Modifying the setpoint parameters through the serial link makes it very easy to enter user setpoints in place of factory default parameters. The serial link also enables remote control of the motor.
Up to 32 MPC-6 devices can be connected on the same link to the host computer. When the need for more than 32 devices arises, it is possible to use the MMI & Data highway equipment for an unlimited number of devices to be connected to the host computer.

**Easy setting and operation**

The front panel LCD together with a keypad and LEDs provides a user friendly interface, accurate digital parameters setting, actual parameters reading, and detailed trip and alarm messages display.
Unauthorized setting changes can easily be prevented by the MPR-6 software.

**Hardwired Motor Control**

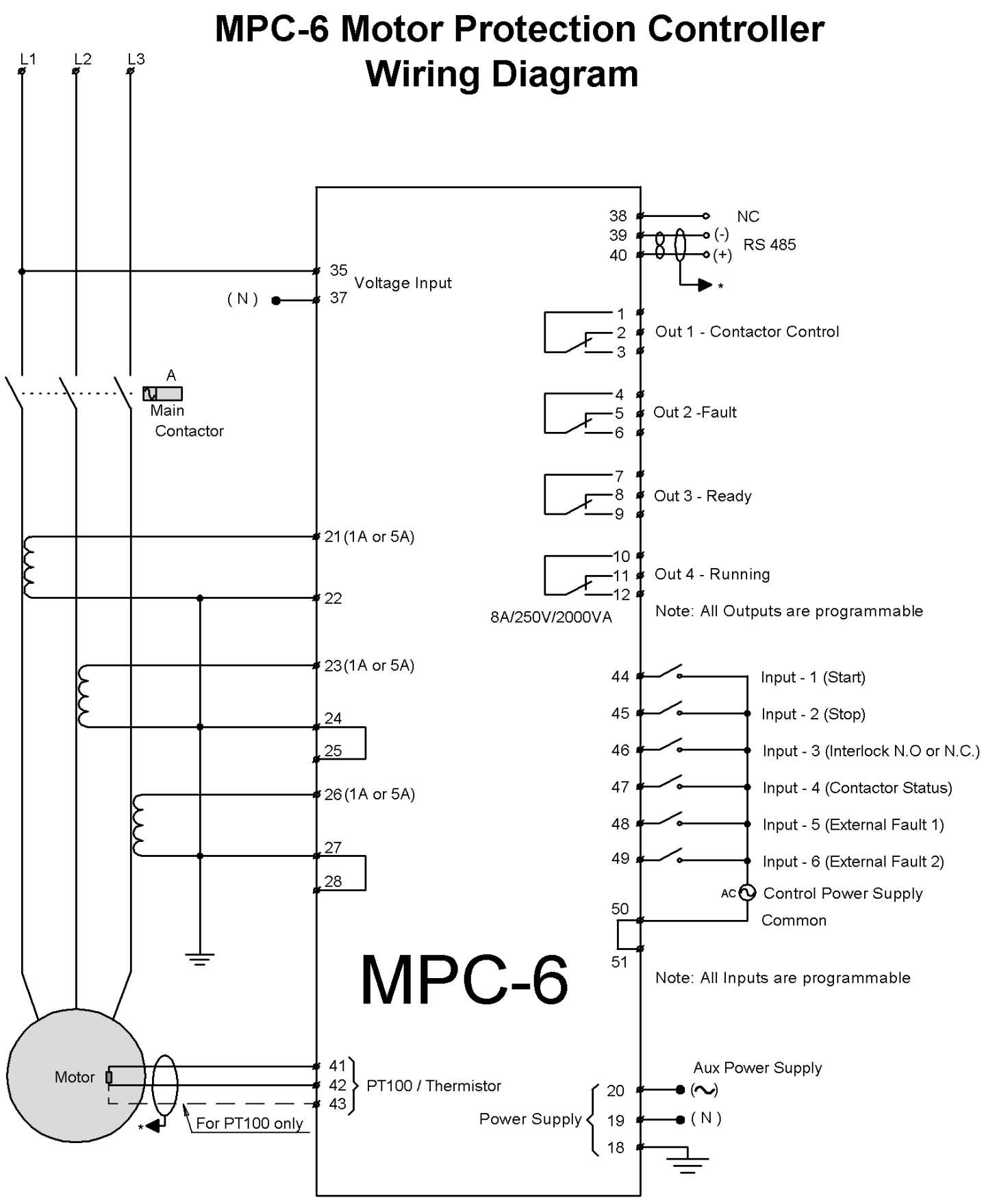
Inputs 1 & 2 are incorporated to enable two common control modes:

1. Start and Stop push-buttons.
2. Start / Stop toggle switch.

**Serial Link Motor Control**

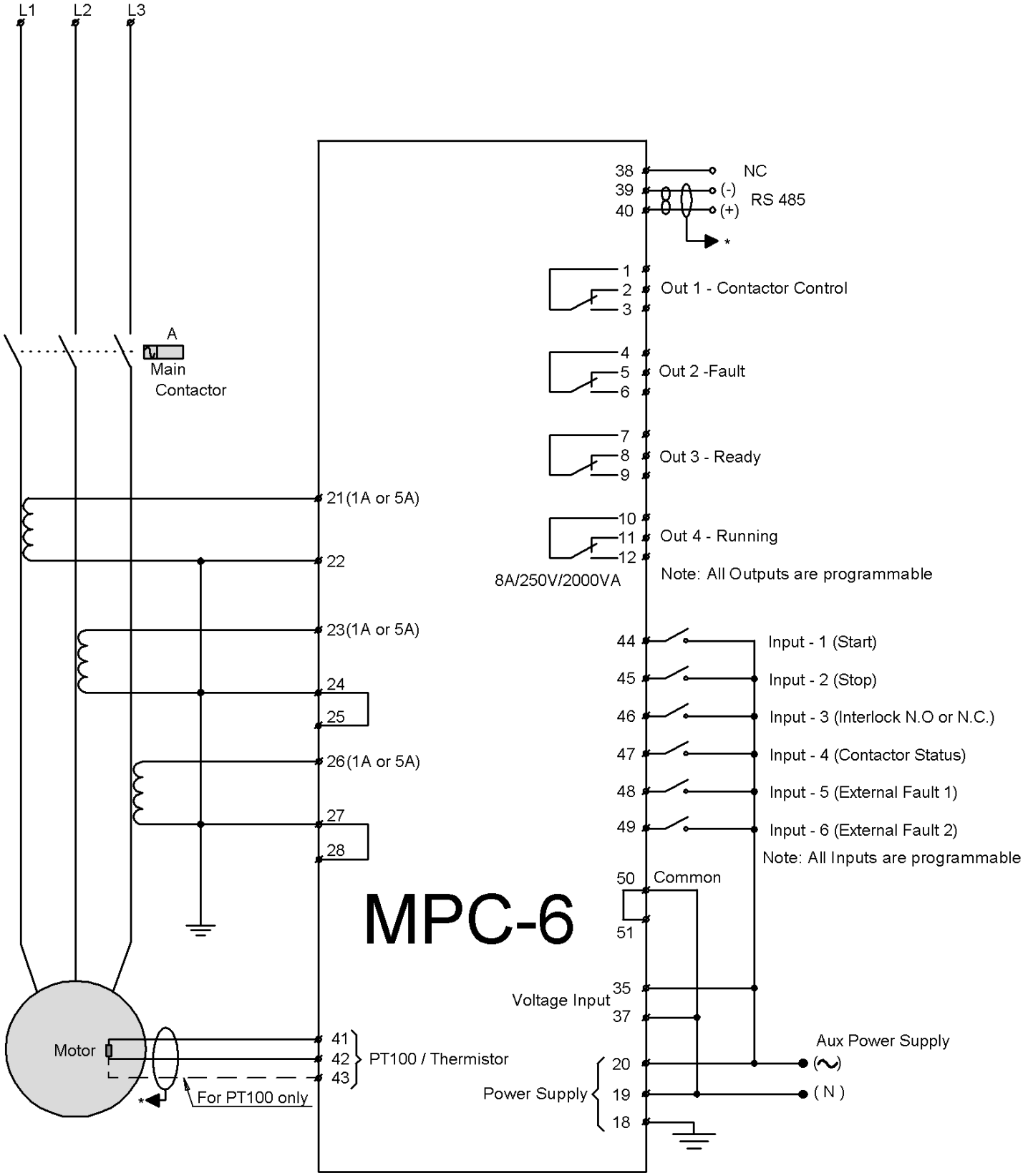
The MPC-6 communication, allows for remote control of the motor through the serial link.

## WIRING

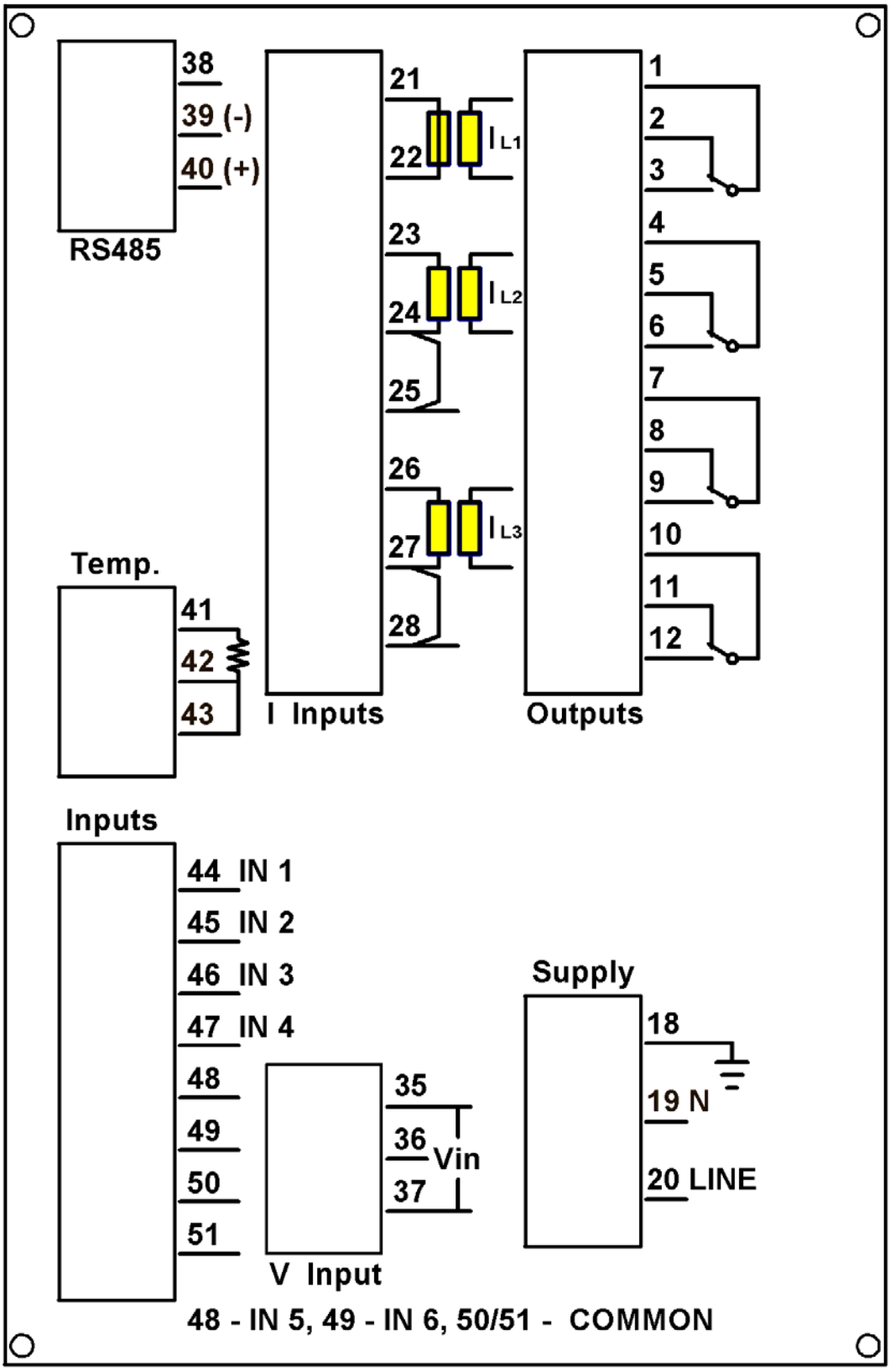

MPC-6 Motor Protection Controller
Wiring Diagram
L1
L2
L3
A
Main
Contactor
35
Voltage Input
( N )
37
21 (1A or 5A)
22
23 (1A or 5A)
24
25
26 (1A or 5A)
27
28
MPC-6
Motor
41
42
43
PT100 / Thermistor
For PT100 only
38
NC
39
(-)
40
(+)
RS 485
1
2
3
Out 1 - Contactor Control
4
5
6
Out 2 -Fault
7
8
9
Out 3 - Ready
10
11
12
Out 4 - Running
8A/250V/2000VA
Note: All Outputs are programmable
44
Input - 1 (Start)
45
Input - 2 (Stop)
46
Input - 3 (Interlock N.O or N.C.)
47
Input - 4 (Contactor Status)
48
Input - 5 (External Fault 1)
49
Input - 6 (External Fault 2)
AC
Control Power Supply
50
Common
51
Note: All Inputs are programmable
Aux Power Supply
20
(~)
Power Supply
19
( N )
18

## WIRING – ONE VOLTAGE SOURCE

# MPC-6 Motor Protection Controller Wiring Diagram Using One Voltage Source



## TERMINALS


38
39 (-)
40 (+)
RS485
21
22
I L1
23
24
I L2
25
26
27
I L3
28
I Inputs
1
2
3
4
5
6
7
8
9
10
11
12
Outputs
Temp.
41
42
43
Inputs
44 IN 1
45 IN 2
46 IN 3
47 IN 4
48
49
50
51
35
36
Vin
37
V Input
Supply
18
19 N
20 LINE
48 - IN 5, 49 - IN 6, 50/51 - COMMON

**Output Relays**
(C/O, 8A/250VAC, 2000VA)
Four Programmable Relays.

**OUTPUT 1 (Relay A)**

| Common ……..1 |
|---|

N.C 2
N.O 3
Relay can be configured (by Config. Output 1) to the following settings:

- Contactor Control. Relay is used to operate motor contactor.
- Alarm. Changes contact position upon fault which is configured as an “Alarm”.
- Alarm Fail Safe.
- Trip. Changes contact position upon fault which is configured as “Trip”.
- Trip Fail Safe.
  Fail safe logic - when the MPC-6 is energized, the relay is energized (changing contacts position). Upon fault which is designated as an "Alarm" (for Alarm Fail Safe) or as a “Trip” (for Trip Fail Safe), the relay de-energizes (contacts return to original position).

**Output 2 (Relay B)**

| Common ……..4 |
|---|

N.C 5
N.O 6
Relay can be configured (by Config. Output 2) to the following settings:

- Fault. Changes contact position upon fault which is configured as “Alarm” or as a “Trip”.
- Fault Fail Safe.
- Trip.
- Trip Fail Safe.

**Output 3 (Relay C)**

| Common ……..7 |
|---|

N.C 8
N.O 9
Relay can be configured (by Config. Relay C) to the following settings:
Ready. Relay is energized if there is no active or latched Trip, Stop input is not active and Interlock input is not active.

- Alarm.
- Alarm Fail Safe.
- Trip.
- Trip Fail Safe.

Tripping Alarm: - When set to “Tripping/Alarm” the relay can be assigned (by parameter settings) to a fault or group of faults.

**Output 4 (Relay D)**

| Common ……...10 |
|---|

N.C 11
N.O 12
Relay can be configured (by Config. Ouput 4) to the following settings:

- Running. Relay is energized if the "Contactor Status" input indicates that contactor is closed.
- Alarm
- Alarm Fail Safe.
- Trip.
- Trip Fail Safe.
- Tripping Alarm

**Discrete (Digital) inputs**
The MPC-6 has six discrete digital programmable inputs.
The internal control interface uses opto-couplers to isolate these control inputs from the micro-processor circuits. This isolation increases MPC-6 noise immunity and MTBF.
The "Control" inputs voltage level is 85 – 230VAC or VDC. Note: The Discrete input circuitry is isolated as a group from all other terminals.
Terminals 44 - 51 input voltage can be obtained from any local supply voltage.

**Hardwired Motor Control**
Inputs 1 & 2 are incorporated to enable two common hardwired motor control modes:

- Start and Stop push-buttons. Set Input 1 to "Start" and Input 2 to "Stop" (default settings).
- Start / Stop toggle switch. Set input 1 to "Start/Stop" and input 2 to any other but the "Stop" setting. If input 2 is set to "Stop", then it must be closed to enable "Start / Run".

Note: If input 2 is set to "Stop" and is open, then it is not possible to start the motor via the serial link.

**Interlocking**
Each one of the inputs 3 to 6 can be set as a normally open or normally closed Interlock. This can be used to prevent motor starting and running (hardwired or through the serial link) while an Interlock input is active.

| Input 1 ……..44 |
|---|

Input can be configured (by Config. Input 1) to the one of the following two settings:

- "Start". Designed for use with momentary "N.O." Start contacts. Close to start.
- "Start/Stop" Designed for use with maintained Start/Stop contact. Close to start, open to Stop.

| Input 2 ……..45 |
|---|

Input can be configured (by Config. Input 2) to the following settings:

- Stop. To be used with momentary "N.C." Stop contacts. The contact must be closed to enable Start / Run.
  - When open
    - Stops the motor.
    - Prevents starting through Start input or the serial link.
- Interlock "N.O." is to be used with a maintained "N.O." contact. It must be open to enable Start / Run. It stops the motor when closed.
- Interlock "N.C." is to be used with a maintained N.C. contact. It must be closed to enable Start / Run. It stops the motor when open.
- Remote Reset. Intended for momentary "N.O." contact. Close momentarily to reset.

Notes:

1. If Input 2 is set to anything other than "Stop", then Input 1 must be set to "Start/Stop" !
2. Interlock has same logic as Stop.

Input 3 ……..46

- ☞ Input can be configured (by Config. Input 3) to the following settings:
- ☞ Interlock "N.O.".
- ☞ Interlock "N.C."
- ☞ Remote Reset

Input 4 ……..47

Input can be configured (by Config. Input 4) to the following settings:

- ☞ Contactor "N.O." Status. Indicates to the MPC-6 that the motor contactor is energized (when contact is closed) or de-energized (when contact is open).
- ☞ Contactor "N.C." Status. Indicates to the MPC-6 that the motor contactor is energized (when contact is open) or de-energized (when contact is closed).
  Note: Output 4, when set to "Running" reflects the position of input 4.
- ☞ Interlock "N.O."
- ☞ Interlock "N.C."
- ☞ Remote Reset.

Input 5 ……..48

Input can be configured (by Config. Input 5) to the following settings:

- ☞ External Fault 1 "N.O." Fault occurs (if enabled as "Alarm" or "Trip") when the contact is closed.
- ☞ External Fault 1 "N.C.". Fault occurs (if enabled as "Alarm" or "Trip") when contact is open.
- ☞ Interlock "N.O."
- ☞ Interlock "N.C."
- ☞ Remote Reset.

Input 6 ……..49

Input can be configured (by Config. Input 6) to the following settings:

- ☞ External Fault 2 "N.O."
- ☞ External Fault 2 "N.C."
- ☞ Interlock "N.O."
- ☞ Interlock "N.C."
- ☞ Remote Reset.

Common…….50,51

Note: The discrete Inputs circuitry (terminals 44 – 51) is isolated as a group. Voltage level should be the same as the Control Power Supply voltage level.
Note: Terminals 50 and 51 are internally connected.

Control power supply (115VAC, 230VAC 50/60 Hz, 110VDC, 220VDC).
Ground 18
Neutral (-) 19
Phase (+) 20

Analogue Inputs

(From 5A C/T, or 1A by special order)
Line Currents
Phase L1 21 ,22
Phase L2 23 ,24 ,25
Phase L3 . 26, 27, 28
Note: Leave open terminals 25 and 28.

Note: For small motors if the line currents are not connected set CT Primary to Off.

**Voltage Input**

Phase ……..35
Neutral ……37

Used for phase voltage connection. Line Voltage is calculated by multiplying the measured voltage by √ 3

**Thermistor / RTD (PT100)**

* PTC or NTC Thermistor (0.1KΩ - 25KΩ).
* PT100 (0° - 200°C)

RTD 100-240Ω ……..41-42&43
(Where 43 is for RTD compensation)
Thermistor 0.1K-30KΩ …….41-42

RTD or Thermistor selection is done by removing the rear panel to set the dip-switches **SW1.1 - SW1.2** on the microcontroller "PCB". Set the two dip switches to **ON** for Thermistor and **OFF** for RTD. Set "Temp. Sensor Type" setting parameter accordingly.

A RTD three (3) wire measurement system is used to compensate for cable resistance. See temperature table below. For Thermistors, only two wires are used (see wiring diagram).

**Disconnected Temperature Sensor**

The MPC-6 may detect a "Disconnected Temp. Sensor". In this case it detects a missing sensor and signals an "Alarm", and not a "Trip". Normally, when a sensor's temperature is very high, a typical protection device will trip due to high temperature. In the MPC-6, when temperature reading becomes very high rapidly, it will only "Alarm" and will not a "Trip". The temperature measurement will show "????" on the LCD display.

Notes:

1. Leave terminals open if no temperature sensor is connected and disable "Alarm/Trip" for temperature.
2. Maximum cable resistance allowed for RTD, must be less than 25Ω.
3. Shielded cables must be used. Connect shield to ground (earth).

| TEMP IN | Pt.100 = Platinum 100 Ω<br>Pt.100 Ω |
|---|---|
| (C) | (DIN 43760) |
| 0 | 100.00 |
| 10 | 103.90 |
| 20 | 107.79 |
| 30 | 111.67 |
| 40 | 115.54 |
| 50 | 119.40 |
| 60 | 123.24 |
| 70 | 127.07 |
| 80 | 130.89 |
| 90 | 134.70 |
| 100 | 138.50 |
| 110 | 142.29 |
| 120 | 146.06 |
| 130 | 149.82 |
| 140 | 153.58 |
| 150 | 157.32 |
| 160 | 161.04 |
| 170 | 164.76 |
| 180 | 168.46 |
| 190 | 172.16 |
| 200 | 175.84 |

**Serial Link**

Standard RS485 half duplex with MODBUS protocol. Twisted shielded pair should be used for wiring.

Serial Port (-) 39
Serial Port (+) 40
Shield – Connect to Ground

Note:
In order to match the line, connect one 120Ω resistor between (+) and (-) at the end of the line and another at the beginning of the line.

# FRONT PANEL

## LEDs and LCD

**On** - Illuminates when the control power supply is connected.

**Start /Run** - Flashes during starting, illuminates continuously after completion of starting

**Alarm /Trip** - Flashes for an "Alarm" condition, illuminates continuously for a "Trip" conditions. Turns off after resetting.

**LCD Display** – Two backlit lines of sixteen (16) characters each, presenting all data and messages.

## Operation

Push "Page" a few times until the following screen is displayed.

| System Parameters<br>***Settings*** |
|---|

In order to review the above page press the Select button.
Messages are displayed on the LCD in two lines.
The upper line shows the parameter's name.
The lower line shows its value.

To change settings, press

▲ or ▼ buttons and save the new

value by pressing the Store button.
Once data is properly stored in the non-volatile memory the LCD displays the 2 seconds flash message:

| DATA SAVED OK |
|---|

Notes:

- A new parameter setting becomes effective when set, even before being stored in non-volatile memory.


Setting a parameter without storing, and moving to another page, will return the parameter to its previously stored value.

- Any set-point parameters can be viewed, altered and stored at any point in time (provided the Parameters Lock is set to N.O.). However, it is not recommended to change and store parameters whilst the motor is starting or running.

- Any stored parameter is kept indefinitely in the non-volatile memory.

## Buttons

Page - Press to scroll through the set-point page button in positive cyclical order.

Select - Press to scroll through the parameters within a page. If the "Select" button is pressed for more than 0.5 s, the parameters will be displayed at a faster rate.

The direction of scrolling can be changed by quickly pressing the Reset button. An underline on the left-most character of the LCD indicates that the backwards scrolling mode is active.

▲ ▼ - Press to increase / decrease parameter values. Press and hold down for faster scrolling (*).

Store - Press to store the displayed parameter value in non-volatile memory (*).

Reset - Press for more then 0.5 S. to cancel the displayed Alarm or Trip (*).

Another function of the Reset button is to change the direction of the Select button scrolling. (see above)

Notes:
If "Parameters Lock" is set to Yes, parameters can only be viewed. When "Parameters lock" is set to N.O., it is possible to view, change and store any setting parameter.

## MENU NAVIGATION

**Parameter Settings**

By pressing Page button the LCD displays the following headers:

| |
|---|
| SYSTEM PARAMETER<br>***SETTINGS*** |

| |
|---|
| PROTECTION<br>***SETTINGS*** |

| |
|---|
| TRIPPING / ALARM<br>***OPTIONS*** |

### Informative Data

By pressing once more the Page button the LCD displays the following headers:

| |
|---|
| ACTUAL DATA<br>- **** - |

| |
|---|
| STATISTICAL DATA<br>- **** - |

**Service Options**

By simultaneously pressing the Page and ▼ buttons the LCD displays the following header:

| |
|---|
| SERVICE<br>*** OPTIONS *** |

**Messages**

***Flash Messages***

Flash messages are displayed as a response to an event.

For example, the flash message after storing is:

| |
|---|
| DATA SAVED OK |

***Constant Messages***

Messages which are displayed upon a fault.

For example, when the starting process is too long and MAX START TIME is enabled then after the "Trip" the following constant message would appear.

| |
|---|
| TRIP:<br>MAX START TIME |

Notes:

1.Pressing the Store button while the LCD displays an "Actual Data" parameter, will store this parameter as the default display. If no button is pressed for more than five minutes, this parameter will be constantly displayed.

2.Pressing the Store button while the LCD displays a header, will store this header as the default display. If no button is pressed for more than five minutes this header will be constantly displayed

## FACTORY DEFAULT VALUES

To return to factory default values press the Page and ▼ buttons simultaneously, the LCD will display:

| |
|---|
| SERVICE<br>***OPTIONS*** |

Press the Select button twice, the LCD will display:

| |
|---|
| STORE NOW?<br>DEFAULT SETTINGS |

Press the "Store" and "Page" buttons simultaneously, the LCD will display:

| |
|---|
| DATA SAVED OK |

Attention: Storing Default parameters erases all previously updated parameters.

## RESETTING STATISTICS

In order to clear statistical data value press the "Page" and ▼ buttons simultaneously, the LCD will display:

| |
|---|
| SERVICE<br>***OPTIONS*** |

Press the "Select" button three times and the LCD will display:

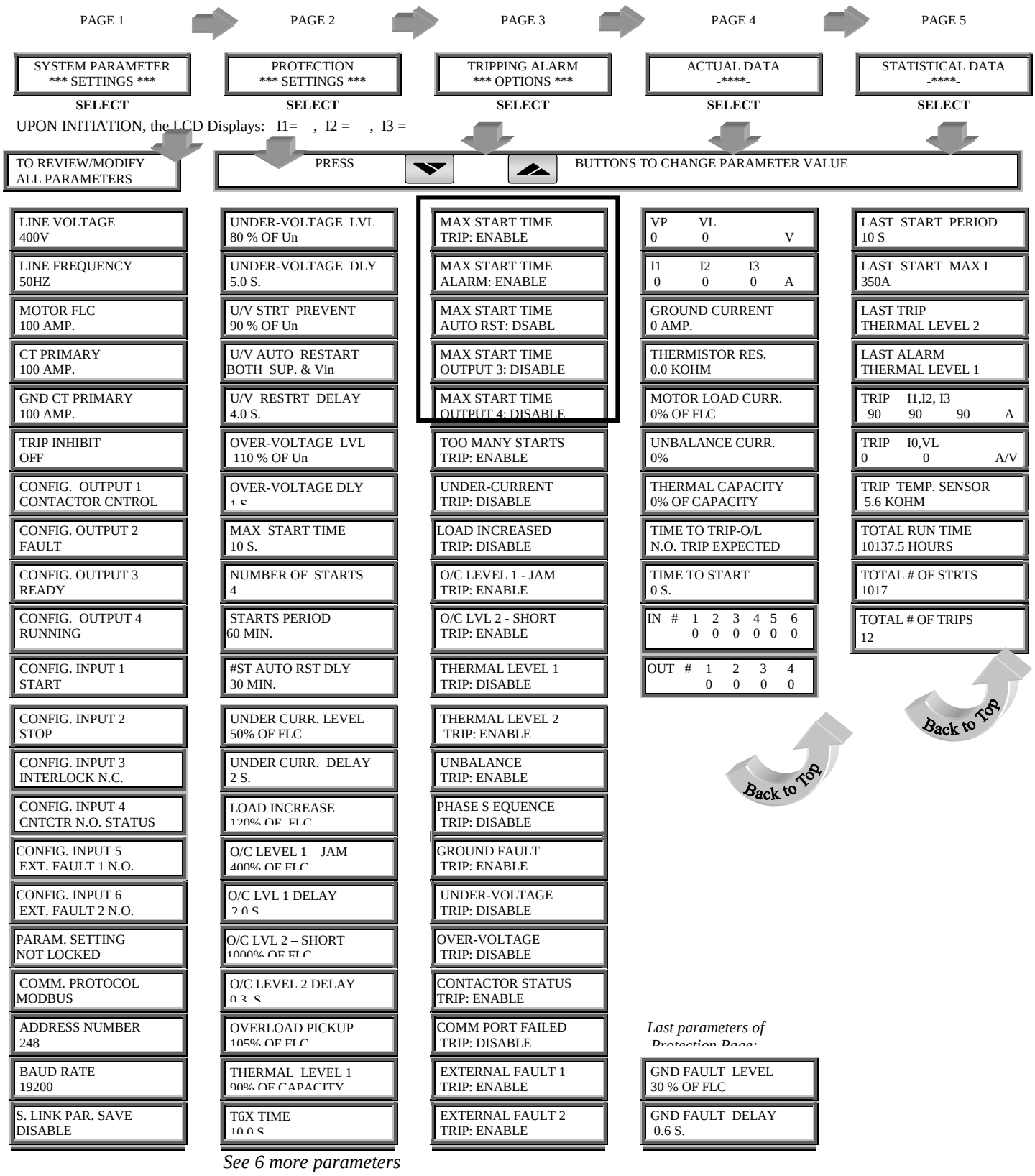
| |
|---|
| CLEAR<br>STATISTICAL DATA |

Press the "Store" and "Reset" buttons simultaneously and the LCD will display:

| |
|---|
| DATA SAVED OK |

Attention: Clearing statistical data erases all previously stored statistical data.

# MENUS OVERVIEW



| | | | |
|---|---|---|---|
| SER. LINK CONTROL<br>DISABLE | HOT/COLD RATIO<br>50% | TEMP. LEVEL 1<br>TRIP: DISABLE | G/F DURING START<br>100 % OF FLC |
| | COOL TIME FACTOR<br>5 | TEMP. LEVEL 2<br>TRIP: DISABLE | TEMP. SENSOR TYPE<br>PTC THERMISTOR |
| | UNBALANCE LEVEL<br>25% OF FLC | | TEMP. SENSOR LVL 1<br>3.0 KOHM |
| | UNBAL. MIN. TIME<br>5 S. | | TEMP. SENSOR LVL 2<br>4.0 KOHM |
| | UNBAL. MAX. TIME<br>30 S | | |

**Press** Page + ▼ **Button to enter Service Options mod**

Service
*** Options ***

Select **Button to select the required paramet**

Program Version
MC6281204-

Store Now ?
Default Settings **Press** Page + Store **Button to Store Default Settings**

Clear
Statistical Data **Press** Reset Store **Button to Clear statistical Data**

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Back to Top

| | SYSTEM PARAMETERS | | |
|---|---|---|---|

| PARAMETER & DEFAULT VALUE | Description | RANGE | Increments |
|---|---|---|---|
| LINE VOLTAGE<br>400 VOLT | Rated mains Line Voltage | 110 – 690 V | 1V |
| LINE FREQUENCY<br>50 HZ | Rated mains Frequency | 50 / 60 Hz | 10 HZ |
| MOTOR FLC<br>100 Amps | Motor Full Load (name plate) Current. | 1 - 1000A | 1A |
| CT PRIMARY<br>100 Amps | Primary rated current of the Current Transformer. Set to Off, if phase currents are not connected. Core Balance can be connected to I1 for Ground Fault detection.<br><br>Note :<br>For all MPC-6 models except the "Z" option model (see Model Number, pg 36) the following applies :<br>If the CT Primary is set to less or equal to 100 Amps and the actual current is less than 100 Amps the display of Line currents will use a format with one decima point.<br>Eg. 45.1 43.0 46.3 | Off,<br>1 - 1500A | 1A<br>0.1 if CT primary < 100V |
| GND CT PRIMARY<br>100 AMP. | Primary rated current of the Ground Fault Current Transformer. This parameter is in effect, only if the CT Primary is set to Off. Set here the Core Balance primary current. | 1 – 1500A | 0.1 |
| TRIP INHIBIT<br>OFF | Inhibits the Trip command thus preventing opening of motor contactor when current exceeds a set value, in order to prevent contactor's damage. The fault must be cleared by an upstream circuit breaker or fuses. When contactors are not used (circuit breaker application) set it to OFF.<br>Note: Thermal Level 2 Trip overrides trip inhibit setting. | 400-1000% of Motor FLC, OFF | 10% |
| WARNING<br>The MPC-6 will not protect the motor against high current above the current inhibit setting. It is the customer's responsibility to ensure that the motor is protected against fault current, above "Current Inhibit" by external protection. | | | |
| CONFIG. OUTPUT 1<br>Contactor Control | Output 1 (Relay A) configuration. | Contactor Control, Alarm, Alarm Fail Safe, Trip, Trip Fail Safe.<br>See wiring Diagram and terminals review for all output and input configurations. | |
| CONFIG. OUTPUT 2<br>Fault | Output 2 (Relay B) configuration. | Fault, Fault Fail Safe, Trip, Trip Fail Safe.<br>Note: Fault is an “OR” function of Alarm and Trip. | |
| CONFIG. OUTPUT 3<br>Ready | Output 3 (Relay C) configuration. | Ready, Alarm, Alarm Fail Safe, Trip, Trip Fail Safe, Tripping / Alarm. | |
| CONFIG. OUTPUT 4<br>Running | Output 4 (Relay D) configuration. | Running, Alarm, Alarm Fail Safe, Trip, Trip Fail Safe, Tripping / Alarm. | |
| CONFIG. INPUT 1<br>Start | Configuration of Input -1 as: | Start, Start / Stop. See wiring Diagram and MPC-6 Terminals. | |
| CONFIG. INPUT 2<br>Stop | Configuration of Input -2 as: | Stop, Interlock N.O., Interlock N.C. Remote Reset. | |
| CONFIG. INPUT 3<br>Interlock N.C. | Configuration of Input -3 as: | Interlock N.O., Interlock N.C., Remote Reset. | |

| PARAMETER & DEFAULT VALUE | Description | RANGE | Increments |
|---|---|---|---|
| CONFIG. INPUT 4<br>Contactor N.O. Status | Configuration of Input -4 as: | Contactor N.O. Status, Contactor N.C. Status, Interlock N.O., Interlock N.C., Remote Reset. | |
| CONFIG. INPUT 5<br>Ext. Fault 1 N.O. | Configuration of Input -5 as: | External Fault 1 NOa, External Fault 1 N.C., Interlock N.O., Interlock N.C., Remote Reset. | |
| CONFIG. INPUT 6<br>Ext. Fault 2 N.O. | Configuration of Input -6 as: | External Fault 2 N.O. , External Fault 2 N.C. , Interlock N.O. , Interlock N.C., Remote Reset | |
| PARAM SETTING<br>Not Locked | Set to Enable (Not Locked) / Disable (Locked Out) change of setting parameters through the front panel keyboard. | Not Locked (Enable), Locked Out (Disable) | |
| COMM. PROTOCOL<br>MODBUS | Comm. Protocol, fixed by firmware. | | |
| ADDRESS NUMBER<br>OFF | MPC-6 Address on Serial Link. RS485 Allows a maximum of 32 MPC-6 on a twisted pair. For user convenience, the number of serial links is extended to 3 digits. Cycle the control supply after any change of address number. | 1-247, 248 = Off | 1 |
| BAUD RATE<br>19200 | Serial Link communication speed in bps. Cycle the control supply after any change of baud rate. | 1200, 2400, 4800, 9600, 19200 | |
| SER. LINK PAR. SAVE<br>Disable | Set to Enable / Disable change of setting parameters through the serial link. | Disable, Enable | |
| SER. LINK CONTROL<br>Disable | Set to Enable / Disable Start, Stop and Reset control functions through the serial link. | Disable, Enable | |
| | **PROTECTION SETTINGS** | | |
| UNDER-VOLTAGE LEVEL<br>80 % of Vn | Under-voltage level. (in % of nominal voltage). Fault occurs when voltage is below set value for more than Under-voltage delay. | 50 - 95 % of rated voltage | 1 %0 |
| UNDER-VOLTAGE DELAY<br>5.0 S. | Under-voltage time delay. | 0.2 - 24 S. | 0.1 S. |
| U/V START PREVENT<br>90 % of Vn | Prevents starting if mains voltage is lower than set by Under-voltage Start Prevent. | Off, 51-95% of rated voltage | 1 % |
| U/V AUTO RESTART<br>BOTH SUP. & Vin | Enables / Disables the auto Restart features.<br><br>Set to “Measured Voltage”, if the control power supply (19-20) is stable during mains failure (powered from UPS or DC). Mains failure is detected and causes the motor to stop, when the voltage decreases below 65% of the rated voltage. Mains restoration is detected when voltage increases to above 85% of rated voltage.<br><br>Set to “Both Sup & Vin” for normal AC mains (both measured voltage (35,37) and control power supply (19,20) turn off during mains failure.<br><br>Note:<br>Setting as “Auxiliary Supply” may not cause restart, for mains failure duration of less than 0.5sec.<br>Restart occurs only if:<br>Motor was Starting/Running before mains failure<br>Turn off time is 0.1 - 4 s. (±25%)<br>0Normal start conditions are met (Stop and Interlock are not active).<br>Voltage level is enough for starting (restored to above “U/V Start Prevent”). | Disable, Auxiliary Supply, Measured Voltage, Both Sup. & Vin | |

| PARAMETER & DEFAULT VALUE | Description | RANGE | Increments |
|---|---|---|---|
| U/V RESTART DELAY<br>4.0 S. | Time delay for the auto Restart feature, counted from mains (auxiliary supply or measured voltage, as set on "U/V Start Prevent) restoration. | 0.4 – 25 S. | 0.1 S. |
| OVER-VOLTAGE LEVEL<br>110% Of Vn | Over-voltage (in % of nominal voltage). Fault occurs when voltage is above set value for more than Over-voltage LEVEL 2 Delay. | 100 – 120% of rated voltage. | 1 % |
| OVER-VOLTAGE DLY<br>1.0 S. | Over-voltage time delay. | 0.2 - 24 S. | 0.1 S. |
| MAX. START TIME<br>10 s. | Maximum permitted starting time. End of starting is assumed when motor's current decreases below 110% of Overload Pickup value. | 1 - 250 s. | 1 s. |
| NUMBER OF STARTS<br>4<br>At fault LCD displays:<br>TOO MANY STARTS | Maximum Permitted number of starts during "Starts Period".<br>Auto Reset, when Enabled, occurs after "#St Auto Reset Delay" time has elapsed. | 1 - 10 | 1 |
| STARTS PERIOD<br>60 min. | Time period during which the number of starts is counted. | 1 - 60 min. | 1 min. |
| #ST AUTO RST DLY<br>30 min | Auto-reset delay used when a "Too many starts" fault occurs. Auto-reset needs to be enabled for the "Too many starts" protection. | 1 - 60 min. | 1 min. |
| UNDER CURR. LEVEL<br>50% of FLC | Under-current level for a running motor. Fault occurs when current decreases below the set value for more than Under-current delay. | 10 - 90 % of Motor FLC. | 1% |
| UNDER CURR. DELAY<br>2 s. | Under-current delay. | 1 - 60 s. | 1 s. |
| LOAD INCREASE<br>120% of FLC | Load Increase Alarm. Enabled after start process ended (after current decreased below 110% of Overload pickup). Fault occurs when the motor average current increases above the set value for more than 5 s. | 60 - 150% of Motor FLC | 1% |
| O/C LEVEL 1 - JAM<br>400% of FLC | Over-current Level-1. Stall / Jam protection, Enabled after end of starting process. Fault occurs when motors average current increases above set value for more than O/C Level 1 Delay. | 100 - 500 % of Motor FLC. | 10% |
| O/C LEVEL 1 DELAY<br>2.0 s. | Time delay for Over-current level-1. | 0.5 - 10 s. | 0.1 s. |
| O/C LVL 2- SHORT<br>1000% of FLC | Over-current level-2. Short circuit protection, operative during starting and running. Indicates that current exceeded set value for more than Over-current delay.<br>Note: The Over-current Level 2 Trip is blocked when the highest of any of the line currents exceeds "Trip Inhibit" setting.<br>It is designed to prevent the opening of motor contactor under a high short circuit condition. This is done in order to protect it's contacts from being damaged. | 400 - 1200 % of Motor FLC. | 10% |
| O/C LVL 2 DELAY<br>0.3sec. | Time delay for Over-current level -2.<br>Note: When set to 0 the actual delay is less than 90 ms. | 0 – 4 s. | 0.1 s. |
| OVERLOAD PICKUP<br>105% of FLC | Lower threshold for Thermal Level 1 / 2 protection. Thermal trip is not possible as long as current is below the set value. When current increases above the set value a trip will occur after a time delay that depends on the present value of the current level, the “Thermal Capacity” and on the t6x setting | 60 – 130 % of Motor FLC. | 1% |
| THERMAL LEVEL 1<br>90% of Capacity | Simulation of motor’s thermal condition, stored in a thermal register. The “heating” of the thermal register (i.e. it’s increment) is related to the square of the current (the highest of the three line currents). The rate of “cooling” of the thermal register is directly related to motor’s present Thermal condition.<br>Thermal capacity of 100% is equivalent to a motor running at the maximum allowed temperature. At this point the motor must be tripped (Thermal level 2).<br>“Thermal Level 1” is adjustable from 50-99% of | 50 – 99 % of max. thermal capacity. | 1% |

| PARAMETER & DEFAULT VALUE | Description | RANGE | Increments |
|---|---|---|---|
| | "Thermal Trip".<br>The following three parameters are used to calculate the "Thermal Capacity". | | |
| t6X TIME<br>10.0 s | Overload trip time of cold motor at 6 times Motor FLC. (The time required to heat Thermal Capacity from 0 to 100% at 6 x FLC). | 0.5 – 120 s. | 0.5 |
| HOT/COLD RATIO<br>50% | The ratio between thermal Capacity available for a hot motor and thermal capacity available for a cold motor. (A higher setting allows for a longer time before tripping a hot motor due to high current). | 20- 100% of Thermal Capacity. | 1%. |
| COOL TIME FACTOR 5 | The Ratio between cooling time constant of stopped motor to the heating/cooling time constant of running motor. | 1 – 15 | 1 |
| UNBALANCE LEVEL<br>25% of FLC | Unbalance-current Level is the difference between maximum and minimum values of the motor's three line currents; divided by motor's maximum current or motor's FLC (this method prevents nuisance alarms at low currents).<br>Fault occurs only if actual "Unbalance-current" is greater than the set value. See figure 6 for the time delay. | 10 – 40%<br><br>see curve on page XX LV | 1% |
| UNBAL. MIN. TIME<br>5 S. | Prevents an unbalance-current fault within less than the set unbalance-current minimum time, regardless of the unbalance-current actual level. | 1 – 24 s | 1 s. |
| UNBAL. MAX. TIME<br>30 S. | Unbalance curve selection. Time delay at 10 % of Unbalance. Fault time inversely relates to the actual unbalance (See page ??). | 20 – 120 s | 1 s. |
| GND FAULT LEVEL<br>30 % OF FLC | Ground Fault current initiating Fault (in % of Motor FLC),after G/F Level 2 Delay. This setting has no influence during starting. See G/F During Start parameter | 1 – 100 % of FLC | 1% |
| GND FAULT DELAY<br>0.6 S. | Ground Fault Delay. | 0– 10.0 S. | 0.1 S. |
| G/F DURING START<br>100 % OF FLC | Ground Fault Level Alarm / Trip During start period. Intended to be used when core balance CT is not used, to prevent nuisance tripping with high currents of start process. | 1 – 100 % of FLC | 1% |
| TEMP. SENSOR TYPE<br>PTC Thermistor | Select desired temperature sensor (selection must be accompanied by internal dip switch settings) | NTC Thermistor, PTC Thermistor, PT100 | |
| TEMP. LEVEL 1<br>3.0 KOhm (NTC or PTC)<br>30°C (pt100) | Choose the desired Resistance (for thermistor) temperature (for pt100) set point for Fault | 0.1-25Kohm,<br>1-250°C, | 0.1KOhm<br>1°C |
| TEMP. LEVEL 2<br>4.0 KOhm (NTC or PTC)<br>40°C (pt100) | Choose the desired Resistance (for NTC or PTC thermistor) or temperature (for pt100) set point for Fault | 0.1-25K ohm,<br>1-250°C, | 0.1KOhm<br>1°C |

Note:

**Once parameters have been set it is strongly recommend to perform a "parameter setting" lock. This is of particular importance in order to avoid unwanted changes via the front panel or more importantly via the serial link where by accident a host can send setting commands to the wrong address.**

Figure 1 - Overload Protection - Cold Motor

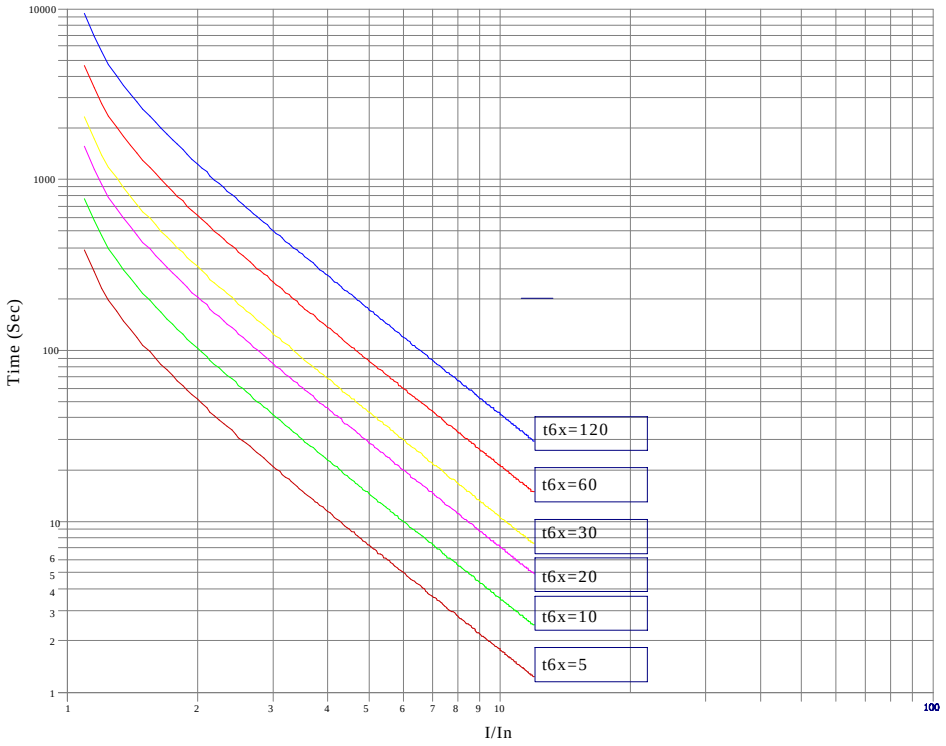



Figure 2 - Overload Protection - Hot Motor (hot/cold ratio = 0.5)

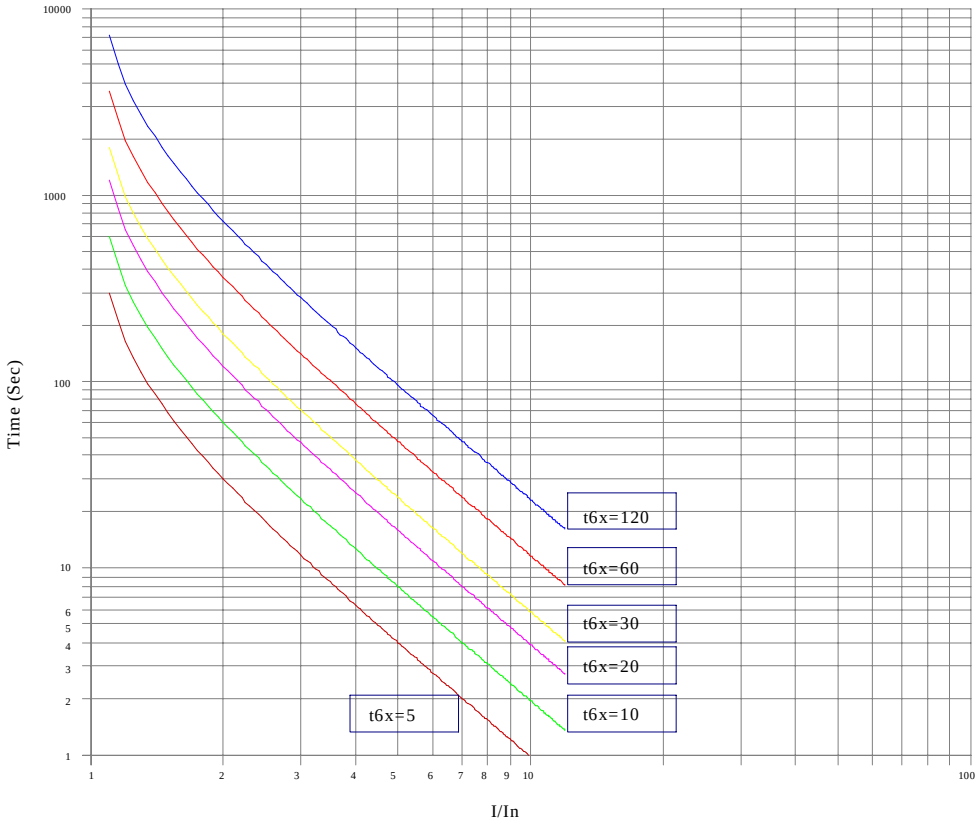
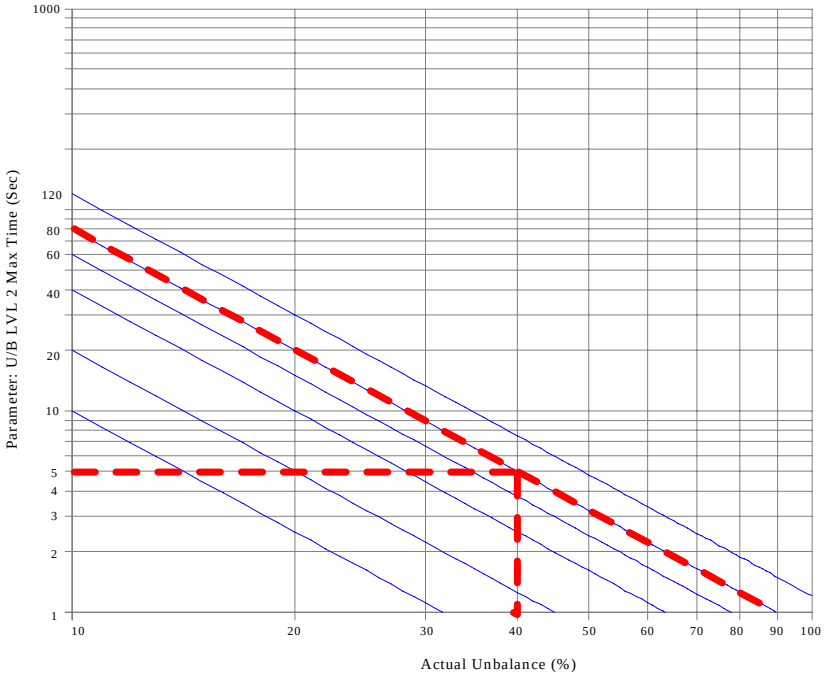


Figure 6 - Unbalance Protection




Unbalance Level Value Selection:

The selected diagonal line intersects with the vertical axis at "UNBAL. MAX. TIME", as set on the Protection Settings page.

Unbalance greater then "UNBALANCE LEVEL" will Alarm / Trip after a delay that depends on the severity of the unbalance and the selected curve.

Note:
The delay is always greater than " UNBAL. MIN. TIME" setting.

Example:

Assume that the user requires the MPC-6 to trip the motor at 40% Unbalance current after a delay of 5 sec.

The intersection point of 5 sec and 40 % is on a diagonal line which intersects the X axis at 80 sec. Hence, set "UNBAL. MAX. TIME" should be set to 80 sec. Please note that at 60 % unbalance the MPC-6 will trip after approximately 2.5 sec.

# TRIP/ALARM & RESET OPTIONS

**Protection function**

Each one of the MPC-6's protections has five possible settings:

- Trip
- Alarm
- Auto Reset
- Output 3 (effective only if set as Tripping/Alarm at System Parameters page).
- Output 4 (effective only if set as Tripping/Alarm at System Parameters page).

For each of these five settings any the MPC-6 protections can be assigned to each of the following functions :

- Trip only
- Alarm only
- Alarm and Trip
- Disabled
- Enabling Auto Resetting
- Operating Aux Output 3 (relay C)
- Operating Output 4 (relay D )

Trip only usage:
Set Trip: Enable, Alarm: Disable. Upon fault:
Trip LED illuminates.
Trip relay: if designated as "Trip", energizes. if designated as "Trip-Fail Safe", de-energizes.
Relays C and/or D, if assigned to function on this fault, energize.

Alarm only usage:
Set Trip: Disable, Alarm: Enable. Upon fault:
Alarm LED illuminates.
Alarm relay: De-energizes (fail-safe operation)
Aux output 3 and/or output 4 (if assigned to function in this fault), energize.

Alarm and Trip usage:
Set Trip: Enable, Alarm: Enable. Upon fault:
Trip and Alarm LEDs illuminate.
Trip relay: if designated "Trip", energizes. if designated to "Trip-Fail Safe", de-energizes.
Alarm relay: de-energizes (fail-safe operation)
Aux relays C and/or D, if assigned to function on this fault , energize.

Disable:
Set Trip: Disable, Alarm: Disable

**Operating Output 3 (Relay C)**

The relay can be assigned for one or more of the 20 faults. It will operates for a certain fault only if Trip or Alarm are enabled and if set as Tripping / Alarm at System Parameters page.

**Operating Output 4 (Relay D)**

The relay can be assigned for one or more of the 20 faults. It will operates for a certain fault only if Trip or Alarm are enabled and if set as Tripping / Alarm at System Parameters page.

**External Faults**

External Fault 1

Occurs when input 5 is set as “Ext. Fault 1 N.O.” and the MPC-6 detects a control voltage between Input 5 and common input terminals.

If config. input 5 is set to Ext. Fault 1 N/O then Fault occurs when Input 5 and common input terminal contact closes.
If config. input 5 is set to Ext. Fault 1 N/C then Fault occurs when Programmable Input-1 contact opens.

External fault 2
Occurs when Input 6 is set as “Ext. Fault 2 N.C.” and the MPC-6 detects no voltage between the Input 6 and the “Common” input terminals.

If config. input 6 is set to Ext. Fault 2 N/O then Fault occurs when Programmable Input-1 contact closes.
If config. input 6 is set to Ext. Fault 2 N/C then Fault occurs when Programmable Input-1 contact opens

**Phase Sequence**

Fault occurs when the phase sequence is reversed. Phase sequence is tested only for short period after starting. Detection of wrong phase sequence accomplished in less then 0.5 s.
Note:
The phase sequence is designed to operate properly only in DOL starting. If for example motor is started by electronic soft starter, VFD, etc. Phase Sequence protection must be set to Off.

**Communication Port Failed**

At fault LCD displays
COMM FAILURE
Fault occurs when the MPC-6 detects three consecutive transmissions from the host computer, in which a parity bit, and/or the CRC word are wrong.
Auto reset, when Enabled, occurs when a transmission from the host computer is received properly.

**More than One Alarm or Trip.**

The MPC-6 is designed to accept and store the first Alarm it detects. If this alarm has not been reset and an additional alarm occurs, the MPC-6 will not display the second alarm on the LCD nor assign it to the Fault Data page.

Example: If "Load Increased" occurs and then a "Thermal Level 1" occurs, the MPC-6 will continue displaying "Load Increased" message on both LCD and Statistical Data page. This is to assist the user in establishing the cause of the alarm.

In case a trip occurs after an alarm, then the trip message will override the alarm message.

## RESET OPTIONS

Resetting after a fault can be done either through the Reset button on the front panel or remotely through any the Inputs 2 to 6, when designated as Remote Reset, or through the serial link.
The MPC-6 can also be assigned to have Auto Reset

Auto Reset
When required set "Auto Rst: Enable"
If not required set "Auto Rst: Disable"

The MPC-6 resets itself automatically when the fault cause disappears. The Auto Reset is activated after a 2 second delay.

Note:
It is recommended to avoid unnecessary Autoreset

On some faults, when Auto Reset is enabled, the MPC-6 trips and after a 2 s. delay resets itself automatically. The fault message on the LCD disappears after 2 s
Example:
On "Under-current", when Auto Reset function is enabled, the contactor opens and the motor stops.
After a 2 second delay automatic reset occurs.
and the "Under-current" message disappears (hence it was only displayed for 2 seconds).

Thermal Capacity Reset method
(to enable emergency restart)
Due to the importance of the Thermal protection a different reset method is used.
Thermal Capacity fault can be reset only from the front panel Reset button. It is not possible to reset this fault through Input-1 or Input-2 and or even through the serial link.

It is impossible to reset a "Thermal Level 2" condition until "Thermal Capacity " has reduced bellow 50%.
If urgent starting is needed, (while parameters lock=N0), before thermal capacity has reduced below 50%, press Reset button.

The LCD will display: "Reset Thermal Capacity???
Pressing Reset button again after 1 second resets the Thermal Capacity.

# SETTINGS SUMMARY

**Parameter Setting**

The following table summarizes the ranges and factory default settings for each of the parameters. New settings can be marked in the empty spaces ( ). For this table, (+) stands for "Enabled", (-) for "Disabled" and - to not applicable.

Motor Number (_____) Application Name (_____)

| | Parameter No. | Function Name | Range | Default Settings | Field Settings |
|---|---|---|---|---|---|
| System Parameters Settings | 1 | Line Voltage | 119 – 690V | 400V | |
| | 2 | Line frequency | 50-60Hz | 50HZ | |
| | 3 | Motor FLC | 1-1000A | 100A | |
| | 4 | C/T Primary | 1-1500A | 100A | |
| | 5 | GND CT Primary | 1-1500A | 100A | |
| | 6 | Trip Inhibit | 400-1000% FLC, Off | Off | |
| | 7 | Config. Output 1 | Contactor Control, Alarm, Alarm Fail Safe, Trip, Trip Fail Safe. | Contactor Control | |
| | 8 | Config. Output 2 | Fault, Fault Fail Safe, Trip, Trip Fail Safe. | Fault | |
| | 9 | Config. Output 3 | Ready, Alarm, Alarm Fail Safe, Trip, Trip Fail Safe, Tripping / Alarm. | Ready | |
| | 10 | Config. Output 4 | Running, Alarm, Alarm Fail Safe, Trip, Trip Fail Safe, Tripping / Alarm. | Running | |
| | 11 | Config. Input 1 | Start, Start / Stop | Start | |
| | 12 | Config. Input 2 | Stop, Interlock N.O., Interlock N.C., Remote Reset. | Stop | |
| | 13 | Config. Input 3 | Interlock N.O. , Interlock N.C., Remote Reset. | Interlock N.C. | |
| | 13 | Config. Input 4 | Contactor N.O. Status, Contactor N.C. Status, Interlock N.O. , Interlock N.C., Remote Reset. | Contactor N.O. Status | |
| | 15 | Config. Input 5 | External Fault 1 N.O. , External Fault 1 N.C. , Interlock N.O. , Interlock N.C., Remote Reset. | External Fault 1 N.O. | |
| | 16 | Config. Input 6 | External Fault 2 N.O. , External Fault 2 N.C. , Interlock N.O. , Interlock N.C., Remote Reset | External Fault 2 N.O. | |
| | 17 | Param. Setting | Not Locked (Enable), Locked Out (Disable) | Not Locked | |
| | 18 | Address No | 1-247, 248=Off | 248 | |
| | 19 | Baud Rate | 1200-19200 | 19200 | |
| | 20 | S. Link Par. Save | Disable, Enable | Disable | |
| | 21 | S. Link Control | Disable, Enable | Disable | |
| Protection Settings | 28 | Under-voltage Level | 50 - 95 % of rated voltage | 80 % | |
| | 29 | Under-voltage Dly | 0.2 - 25 S. | 5.0 S. | |
| | 30 | U/V Start Prevent | Off, 51-95% of rated voltage | 90 % | |
| | 31 | U/V Auto Restart | Disable, Auxiliary Supply, Measured Voltage, Both Sup. & Vin | Both Sup. & Vin | |
| | 32 | U/V Restart Delay | 0.4 – 25 S | 4.0 S | . |
| | 33 | Over-voltage Level | 100– 120% of rated voltage. | 110 % | |
| | 34 | Over-voltage Dly | 1 – 250 S. | 1 S. | |
| | 35 | Max Start Time | 1-250 s | 10 s | |
| | 36 | No of Starts | 1-10 | 4 | |

| | Parameter No. | Function Name | Range | Default Settings | Field Settings |
|---|---|---|---|---|---|
| | 37 | Starts period | 1-60 min | 60 min | |
| | 38 | #St Auto Rst Dly | 1-60 min | 30 min | |
| | 39 | Under Curr. Level | 10-90% FLC | 50 % | |
| | 40 | Under Curr. Delay | 1-60 s | 2 s | |
| | 41 | Load Increase | 60-150% FLC | 120 % | |
| | 42 | O/C Level 1- (Jam) | 100-500% FLC | 400 % | |
| | 43 | O/C Level 1 delay | 0.5-10 s | 2 s | |
| | 44 | O/C Level 2 - Short | 400-1200% FLC | 1000% | |
| | 45 | O/C Level 2 delay | 0-4 s | 0.3 s | |
| | 46 | Overload pickup | 60-130% FLC | 105 % | |
| | 77 | Thermal Level 1 | 50-99% FLC | 90 % | |
| | 48 | t6x (curve selection) | 0.5-120 s | 10 s | |
| | 49 | Hot to Cold Ratio | 20-100% | 50 % | |
| | 50 | Cool Time Factor | 1-15 | 5 | |
| | 51 | Unbalance Level | 10-40% of FLC | 25% | |
| | 52 | Unbal. Min. Time | 1 – 30 s. | 5 S. | |
| | 53 | Unbal. Max. Time | 20-120 S | 30 s | |
| | 54 | GND Fault Level | 1 – 100 % of FLC | 30 % | |
| | 55 | GND Fault Delay | 0.1 – 10.0 S. | 0.6 S. | |
| | 56 | G/F During Start | 1 – 100 % of FLC | 100 % | |
| | 57 | Temp. Sensor Type | RTD / Thermistor | Thermistor | |
| | 58 | Temp. Level 1 | 0.1-25Kohm, 0-250°C | 3.0 Kohm | |
| | 59 | Temp. Level 2 | 0.1-25Kohm, 0-250°C | 4.0 Kohm | |

**Protection Setting**

| | Protection Description | Trip | | Alarm | | Auto Reset | | Relay 3 | | Relay 4 | | ANSI Code Standards |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dflt | New | Dflt | New | Dflt | New | Dflt | New | Dflt | New | |
| 1 | Max Start Time | + | | + | | - | | - | | - | | 48 |
| 2 | Too Many Starts | + | | + | | + | | - | | - | | 66 |
| 3 | Under-current | - | | - | | - | | - | | - | | 37 |
| 4 | Load Increased | - | | + | | - | | - | | - | | 51L |
| 5 | O/C Level 1-Jam | + | | + | | - | | - | | - | | 51R |
| 6 | O/C Level 2 - Short | + | | + | | - | | - | | - | | 50 |
| 7 | Thermal Level 1 | - | | + | | - | | - | | - | | 49S/51 |
| 8 | Thermal Level 2 | + | | + | | - | | - | | - | | 49S/51 |
| 9 | Unbalance | + | | + | | - | | - | | - | | 46 |
| 10 | Phase Sequence 1 | - | | - | | - | | - | | - | | 47 |
| 11 | GND Fault | + | | + | | - | | - | | - | | 67 |
| 12 | Under-voltage | - | | + | | - | | - | | - | | 27 |
| 13 | Over-voltage | - | | + | | - | | - | | - | | 59 |
| 14 | Contactor Status | + | | + | | - | | - | | - | | 74 |
| 15 | Comm. Port Failed | - | | + | | + | | - | | - | | 3 |
| 16 | External Fault 1 1 | + | | + | | - | | - | | - | | 86,94 |
| 17 | External Fault 2 | + | | + | | - | | - | | - | | 86,94 |
| 18 | Temp. Level 1 | - | | - | | - | | - | | - | | 49R |
| 19 | Temp. Level 2 | - | | - | | - | | - | | - | | 49R |

Note:
Disable = "-", Enable = "+"
(*) - Does not require any additional parameters and hence does not have an entry in the Parameters Page.

## ACTUAL DATA

To enter Actual Data press Page button until the "ACTUAL DATA" header is displayed
Note: Values given below are examples only.

ACTUAL DATA
- **** -

| PARAMETER & SAMPLE VALUES | DESCRIPTION | RANGE |
|---|---|---|
| VP VL<br>231 400 V | Phase (measured) and Line (*√3) voltages. | 50V – 750V. |
| I1 I2 I3<br>345 343 346 A | Line (motor) currents.<br>Note:<br>For all MPC-6 models except the "Z" option model (see Model Number, pg 36) the following applies :<br>If the CT Primary is set to less or equal to 100 Amps and the actual current is less than 100 Amps the display of Line currents will use a format with one decima point.<br>Eg. 45.1 43.0 46.3 | 1A – 12KA. |
| GROUND CURRENT<br>0 AMP. | Ground Current is calculated by adding up the three phase currents. If CT Primary is set to OFF then a Core Balance CT should be used and connected to I1 input. | |
| THERMISTOR RES.<br>9.5 KOHM | Thermistor measured resistance / RTD Measured °C.<br>Note: if Thermistor/RTD is not connected the LCD display shows: ????? | RTD 1-250°C<br>Thermistor 0.1- 30K |
| MOTOR LOAD CURRENT<br>90 % of FLC | Motor current as a percentage of Motor FLC. | 0 - 1200% FLC |
| UNBALANCE CURR.<br>1% | Unbalance current, the difference between max. and min. of motor's three line currents, related to the larger between motor's max. line current and Motor FLC. | 0 - 100% |
| THERMAL CAPACITY<br>20% of Capacity | Thermal register capacity. Trip level = 100% | 0-250% of max. Thermal Capacity |
| TIME TO TRIP- O/L<br>No Trip Expected | Expected time to trip, by reaching 100% Thermal Capacity, the present current value being kept. | No trip expected,<br>0 - 4 hours |
| TIME TO START<br>0 s. | Expected time to restart is displayed on the LCD in the following cases:<br>☞ After a "Thermal Trip" - in this case it is the expected time for the Thermal Capacity to decay by 50% of its the maximum full "Thermal Capacity" of 100%<br>☞ After "Too Many Starts" Trip - it is the time until Auto Reset, if enabled, will be performed | After "Thermal Trip":<br>0 - ... minutes<br>After "Too Many Starts" : 1 - few hours. |
| IN # 1 2 3 4 5 6<br>0 1 0 0 0 0 | Status of the discrete digital Inputs 1 to 6. | 0 – Open contact.<br>1 – Closed contact. |
| OUT # 1 2 3 4<br>0 0 1 0 | Status of Relays A to D. (Output 1 to 4) | 0 – Open contact.<br>1 – Closed contact. |

## STATISTICAL DATA

To enter Statistical Data press Page button until the "STATISTICAL DATA" header is displayed
Note: Values given below are examples only.

STATISTICAL DATA
- **** -

| Parameter & Sample Value | Description | Range |
|---|---|---|
| LAST STRT PERIOD<br>5 s. | Last start time duration. | 0-255 seconds. |
| LAST START MAX I<br>350 amp. | RMS maximum current , highest of three phases, during the last start. | 0-24000 amp. |
| LAST TRIP<br>Temp. Level 2 | Last active fault that was enabled as a Trip. | all 19 faults |
| LAST ALARM<br>Temp. Level 1 | Last active fault that was enabled as an Alarm. | all 19 faults. |
| Trip I1, I2, I3<br>110 112 109 A | Values of three line motor-currents before the last trip. | 0-12000 amp. |
| TRIP I0,VL<br>0 0 A,V | Values of Ground Fault Current and Line Voltage, just before last trip. | 0 – 30V, 0-1000mA |
| TRIP TEMP. SENSOR<br>0.0 KOHM | Reading of the thermal sensor before last trip. R for Thermistors and T for RTDs. | RTD 1-250°C<br>Thermistor 0.1- 30K |
| TOTAL RUN TIME<br>10137.5 hours | Total run time since commissioning. | 0-60,000 hours. |
| TOTAL # OF START<br>1017 | Total number of starts since commissioning. | 0-65535 |
| TOTAL # OF TRIPS<br>12 | Total number of trips since commissioning. | 0-65535 |

## SERVICE OPTIONS

To enter Statistical Data press Page button until the "SERVICE OPTIONS" header is displayed
Note: Values given below are examples only.

SERVICE
***OPTIONS***

| Parameter & Example Value | Description |
|---|---|
| PROGRAM VERSION<br>MC6281204-MODBUS | Program version. |
| STORE NOW ?<br>Default settings | Stores all factory default parameters in the non-volatile memory. Press the Store and Set Page buttons simultaneously, to store. A "Data Saved Ok" confirmation message is displayed for about two seconds |
| CLEAR<br>Statistical Data | Resets and stores "0" for all the statistical data.<br>Press the "Reset" and "Store" buttons simultaneously, to reset and store zero values in the non-volatile memory.<br>The parameters cleared are:<br>☞ Total run time ,<br>☞ Total # of starts,<br>☞ Total # of trips,<br>☞ Last start period,<br>☞ Last start peak I,<br>☞ Trip I1, I2, I3,<br>☞ Trip GND current,<br>☞ Trip T1,T2,T3 and<br>☞ Thermal capacity<br><br>A confirmation " Data Saved OK" message is displayed for about two seconds. |

Warning
Resetting Statistical Data resets all previous statistical data values ! ! !
The last two actions (default storing and resetting statistical data ) should be done with care, since retrieving previous set-point parameters or statistical data is impossible.

# MESSAGES

## Flash Messages

These messages are displayed for a short while only. The display than returns to the previous message. Flash messages are usually displayed as a response to an operator action.
It is used either to confirm activation of the requested operation, or to indicate the reason for not doing so.

| Parameter & Example Value | Description |
|---|---|
| DATA SAVED OK | Displayed after pressing Store button. If an error is found during the store process, then the next message is shown. |
| STORAGE ERROR | Displayed when an error is found in the store process. |
| WRONG PARAMETERS | Displayed after power-up, if the non-volatile parameter check sum is found to be corrupt. |
| UNAUTHORIZED ACCESS | Displayed when the Parameters lock is set to yes, and a parameter change is attempted. Also displayed after an Unauthorized Store action. |
| RESET THERMAL CAPACITY ??? | Displayed as a response to pressing the "Reset button while "Parameters Lock" is set to NO. It indicates that next time the "Reset" button, after one (1) second interval ,that it will reset the "Thermal Capacity" to 0.<br>Note : This should be done with care !! Resetting the Thermal Capacity may prevent the MPC-6 from tripping on Thermal Overload under a justifiable circumstance. |
| THERMAL CAPACITY RESET PERFORMED | Displayed after the second time the "Reset" Button is pressed, as explained previously. |

## Constant Messages

These messages are displayed, as a response to an event and not as a result of an operator action.

| Parameter & Example Value | Description |
|---|---|
| ALARM<br>THERMAL LEVEL 1 | Displayed when the Alarm LED illuminates. The second line displays the fault name. |
| TRIP<br>THERMAL LEVEL | Displayed when the Trip LED illuminates. The second line displays the fault name. |

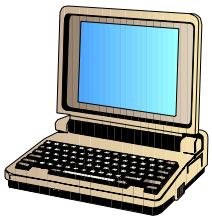
## COMMUNICATIONS

The MPC-6 incorporates a RS485 serial link and uses the MODBUS RTU protocol [2] to provide high-speed data acquisition to supervisory computers.
Data formats have been carefully structured to provide fast notification of alarms and continuous updates of performance parameters. Load control can be performed from host computers or by PLCs.
The following can be performed through the communication.

- ☞ Read and modify all MPC-6 Settings
- ☞ Read all Actual and Statistical Data parameters
- ☞ Start / Stop / Reset control functions

The system reliability is exceptionally high, meeting the highest industry standards for reliable communication Included in each message is a 16 bit CRC.

RS-232 to RS-485 Converter is available for programming and supervision of single units via an IBM-PC or compatible.



Up to 32 MPC-6 can be connected to the PLC or host computer via a twisted shielded pair.

Note:
Terminate serial link cable with 120-Ohm resistors at both ends. The MPC-6 system is user expandable. No special engineering skills or tools are required.

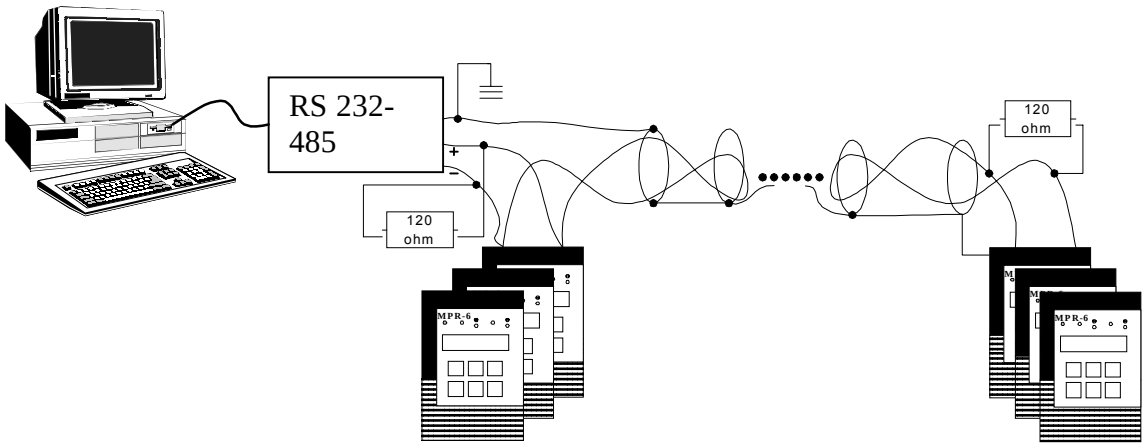
For larger systems a Data Highway enables multiple MPC-6 connection.

The system also performs high-speed data acquisition
Users therefore have a simple and friendly means of building a fully integrated monitoring and control systems

An optional basic communication package is available.
The package includes:
1. Windows (3.11 & 95) based package
2. Two meter cable with RS-232 to RS-485 Converter
3. Communications Manual



[2]Protocol specs are not included in this document and are part of the MPC-6 communications manual, which can be obtained upon request.


RS 232-
485
+
-
120
ohm
120
ohm
MPR-6
MPR-6

# TECHNICAL SPECIFICATIONS

| AREA | DESCRIPTION |
|---|---|
| **Auxiliary Power Supply:** | |
| ☞ Type: | 115V/230V Universal AC (50Hz/60Hz) /DC power supply. |
| ☞ Power Consumption: | ≤ 10VA |
| **Current Measurement (three currents)** | |
| ☞ Method : | True RMS. |
| ☞ Range | 0.05 to 12 * phase CT Primary amps setting.<br><br>Note:<br>I1 is used to measure mains frequency. Lower (< 0.05) current may cause wrong frequency measurement which may cause inaccurate currents and voltage measurements. |
| ☞ Full scale: | 12 * phase CT Primary amps setting. |
| ☞ Accuracy : | ± 1.5% , for 0.9 to 1.5 * CT Primary amps setting.<br>± 5% above 1.5 * CT Primary<br>± (3% + 0.02 * CT Primary) below 0.9 * CT Primary |
| ☞ Power consumption: | ≤ 0.1VA per 1A at 1Amp. input, (Input impedance ≤ 100mΩ)<br>≤ 0.5VA per 5A at 5Amp. input, (Input impedance ≤ 20mΩ) |
| **Voltage Input** | |
| ☞ Method: | True RMS, sample rate 0.5 ms. |
| ☞ Power consumption: | ≤ 0.2 VA |
| ☞ Range | 50 – 750 / √3 volts. |
| ☞ Full scale: | 750 / √3 volts. |
| ☞ Accuracy: | ± 1.0% of full scale. |
| **Ground Fault Current measurement** | |
| *With CT Primary is not set to OFF* | |
| ☞ *Method:* | ☞ *True RMS.*<br>☞ *"Ground current" is calculated by summing sampled values of the three phase currents;* |
| ☞ *Full scale:* | *12 * CT Primary amps setting* |
| ☞ *Accuracy :* | ☞ *± 1.5% , for 0.9 to 1.5 * CT Primary amps setting.*<br>☞ *± 5% above 1.5 * CT Primary*<br>☞ *± (3% + 0.02 * CT Primary) below 0.9 * CT Primary* |
| With CT Primary is set to OFF | |
| ☞ Method: | ☞ True RMS.<br>☞ Ground current should be measured using Core Balance CT, connected to I1 inputs |
| ☞ Full scale: | 12 * GND CT Primary amps setting |
| ☞ Accuracy : | ☞ *± 1.5% , for 0.9 to 1.5 * CT Primary amps setting.*<br>☞ *± 5% above 1.5 * GND CT Primary*<br>☞ *± (3% + 0.02 * GND CT Primary) below 0.9 * GND CT Primary* |

**Thermistor Input** **RTD Input**

| AREA | | DESCRIPTION | |
|---|---|---|---|
| Range: | 0.1 - 30KΩ | Range: | 100 - 240Ω or 0□C - 250□C |
| Accuracy: | ± 0.1KΩ up to 5KΩ, ± 3% above 5KΩ. | Accuracy: | ± 3% of resistance |
| Time Delay: | Two (2) seconds | Time Delay: | two (2) seconds |
| | | Max. wire resistance: | 25Ω. |

**Overload Alarm and Trip Curves**
(both heating and cooling**)**

Fault time accuracy:
- ± 1 Second up to 10 seconds.
- ± 1 second ± 2% above 10 seconds.

Threshold current level : OVERLOAD PICKUP ± 1.5%.

**Total Run Timing**
Accuracy: ±2%.

**Mains Failure Timing**
Accuracy: ±25%.

**Current Unbalance Alarm and Trip**
Method: *Unbalance = 100 * (Imax - Imin) / Ir [%]*

Where:
- *Imax* is the maximum of the three phase currents.
- *Imin* is the minimum of the three phase currents.
- *Ir* is the maximum of *Imax* and "Motor FLC" setting. (to prevent nuisance tripping at low current levels)

Alarm:

Threshold unbalance alarm level:
- 50% of Unbalance Current setting ± 2%.

Alarm (fixed) time delay:
- 5.0 ± 0.5 Sec.

Trip Curves:

Threshold unbalance trip Level:
- Unbalance Current setting ± 2%.

Trip time accuracy:
- ± 1 Second up to 10 seconds.
- ± 1 second ± 2% above 10 seconds.

**Fault Time Delays**
Accuracy: ±0.5 S. or ±2% of time, which ever is greater, for all but the above faults with the following exceptions:

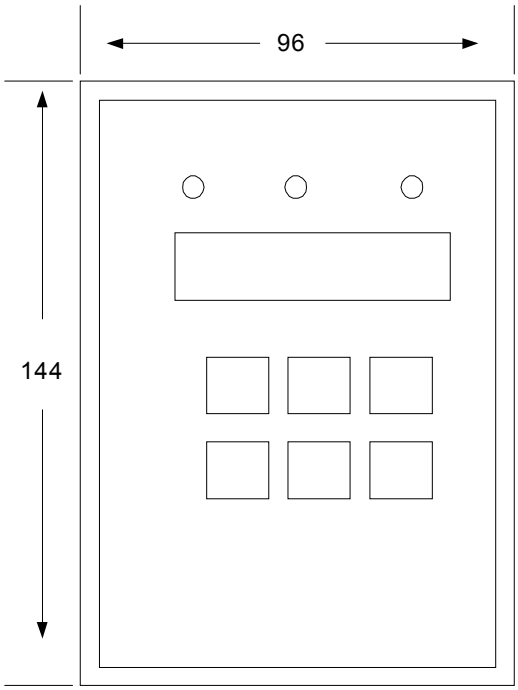
- O/C Level 2: -0.1/+0.2 s for less than 1 s delay.*
- Ground Fault Level 2: -0.1/+0.2 s for less than 1 s delay.*
- Mains OFF for Auto Restart: 4 s±20%

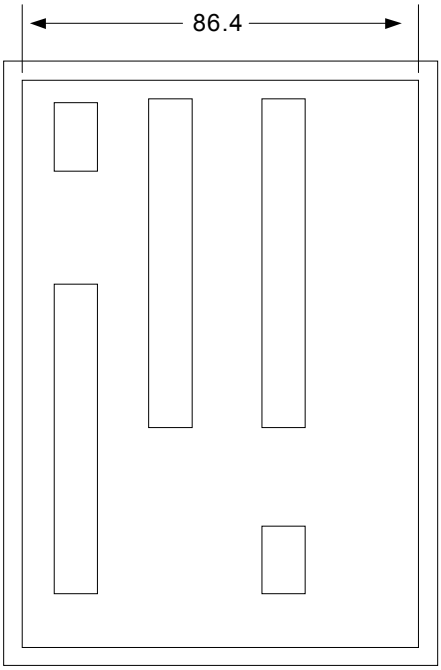
*When adjusted to 0..60 ms ±30ms.

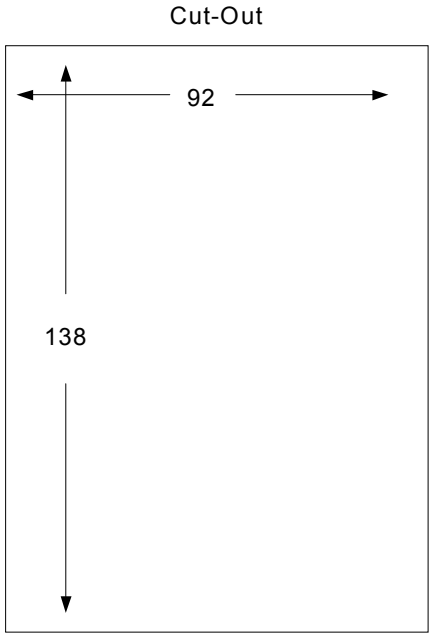
**Relays Contacts**
Rated load:
- 8A/250VAC 1800VA.
- 48Vdc, 0.25A Inductive

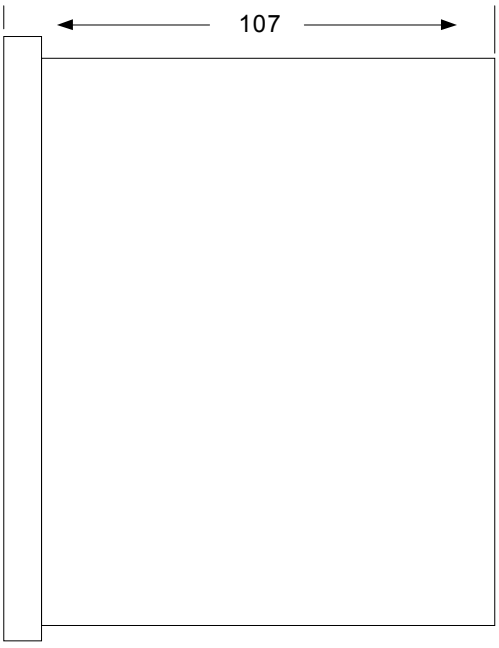
| AREA | DESCRIPTION |
|---|---|
| | ☞ 48Vdc, 1.0A Resistive |
| Maximum voltage: | ☞ 250VAC.<br>☞ 125Vdc, 0.15A Inductive<br>☞ 125Vdc, 0.4A Resistive |
| **Dielectric Strength** | 1500VAC, for 1 minute, between Ground (terminal 18) and:<br>☞ Current inputs.<br>☞ Auxiliary power supply inputs<br>☞ Control terminals |
| **Temperature Range** | 0°C to +50°C (default - all units),<br>-10°C to +60°C (by special order) |
| **Standards**<br>(designed to meet following standards) | |
| Impulse : | ☞ IEC 255-4 (1976) & Amend #1 (1979)<br>☞ IEC 255-5 (1977)<br>☞ 5 kV common-mode test<br>☞ 5 kV transverse-mode test |
| Surge withstand : | ☞ Oscillatory 2.5 kV peak<br>☞ Fast transient 4 kV crest voltage<br>☞ In accordance with: ANSI C37.90.1 (1990), IEC 55-4 (1976) & Amend #1 (1979) Class III, IEC 255-22-2 (1988) Class III |
| Radio Frequency Interference (RFI) : | In accordance with EMI standard ANSI C37.90.2 |

## DIMENSIONS

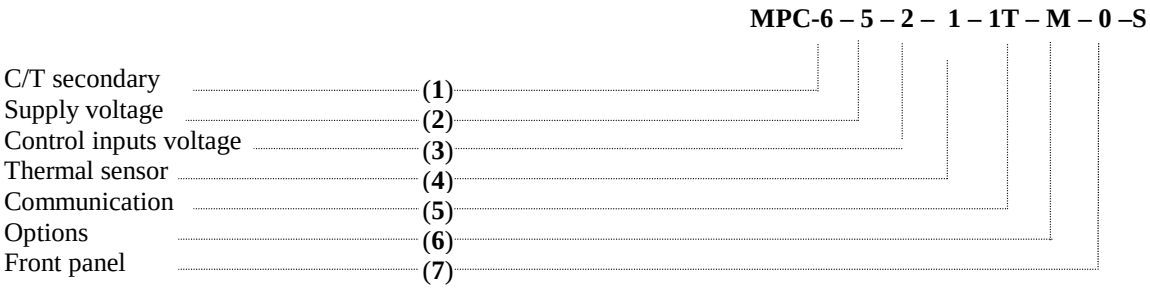


## Model Number




| (**1**) C/T secondary | Specify | For |
|---|---|---|
| | 1 | 1A |
| | 5 | 5A |

| (**2**) Supply Voltage | Specify | For |
|---|---|---|
| | 2 | 110/220 Vac/dc |

| (**3**) Control inputs Voltage | Specify | For |
|---|---|---|
| | 0 | 220 Vac |
| | 1 | 110 Vac |
| | 2 | 220 Vdc |
| | 3 | 110 Vdc |

| (**4**) Thermal sensor | Specify | For |
|---|---|---|
| | 1T | 1 Thermistor |
| | 1R | 1 RTD (Pt100) |

| (**5**) Communication | Specify | For |
|---|---|---|
| | M | RS485 with MODBUS protocol |

| (**6**) Required options. | Specify | For |
|---|---|---|
| | 0 | No options. |
| | Z | Bazan |
| | M | Marine approval (Consult factory) |

| (**7**) Front panel | Specify | For |
|---|---|---|
| | S | Standard |

# TABLE OF ACRONYMS

| Acronyms | Description |
|---|---|
| O/V | Over Voltage |
| U/V | Under Voltage |
| RTU | Remote Terminal Unit |
| I1 | Phase 1 line current |
| I2\ | Phase 2 line current |
| I3 | Phase 3 line current |
| I0 | Ground current in Amps |
| FLC | Full Motor Load Current in Amps. |
| Trips | Fault condition that causes a motor stop |
| T/C | Thermal capacity |
| U/C | Under current. Current which is below minimum… |
| T/L | Thermal Level |
| G/F | Ground Fault |
| C/T | Current Transformer |
| Unbalance | Unbalance current |
| U/B | Unbalance current |
| Ph/S | Phase Sequence |
| Gnd | Ground |
| NO | Normally Open relay contact |
| NC | Normally closed relay contact |
| PCB | Printed Circuit Board |
| Vin | ?????????? |
| ms | Mili-seconds |

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