ORION ITALIA

INSTRUCTION MANUAL

MPR-100

Metering and Protection for Asynchronous Motors

Firmware version 1.68

CE

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SAFETY STANDARDS AND GENERAL WARNINGS

	For a proper installation of the unit the technicians must read carefully and understand the instructions provided by the Constructor. All the installation operations must be carried out by suitably qualified technicians with adequate knowledge of the unit and of the content of this manual.

1. Check that the installation room (spaces, segregations and ambient) are suitable for the electrical and electronic apparatus and in particular that:
   - the room conditions are in compliance with the information contained in *[General Information: 1.8 SPECIFICATIONS]*;
   - the rating of the unit (voltages, frequencies, and so on) are coherent with the features of the electric system.

2. Make sure that the Standard and Legal requirements are followed during installation, service and maintenance, in order to construct installations according to good technical and safety working practices.

	The unit must be used EXCLUSIVELY for the purposes described in the Chapter *[General Information]*.
	High-voltage live parts; disconnect the unit before carrying out any insulation tests on the installation.
	Do not carry out any installation/maintenance operations requiring the disassembling and the removal of the unit from the panel on which it is mounted when the unit is live: make sure it has been disconnected.

For any requests, please contact:
ORION ITALIA ASSISTANCE SERVICE

WEB: www.orionitalia.com

SYMBOLS IN THE TEXT AND THEIR MEANINGS

	It indicates an OBLIGATION, an operation that must be obligatory. Pay attention to the information signalled by this symbol, as it refers to situations which require CAUTION AND WARNING: any operations not in compliance with what is indicated could provoke damages to objects or people.
	Pay particular ATTENTION to the parts indicated by this symbol: they are live.
	It indicates a DANGER, a situation or operation requiring the MAXIMUM ATTENTION: any actions not in compliance with what is indicated could provoke really serious damages to objects and even mortal injuries to people.
	It indicates INFORMATION or REMARKS that must be read with particular attention.

INDEX

1. General Information

(*) The following options are available depending on the MPR-100 model version [*General Information: 1.9 ORDER CODE*].

1.1 DESCRIPTION

The device has been designed for continuous monitoring and protection of electrical three-phase motors in heavy-duty industrial applications such as minery, oil & gas and water treatment plants.
It allows direct, close-distance or remote monitoring via RS-485 and Bluetooth connectivity.

MPR-100 permits the activation of additional specific protection functions for motor industrial applications. Its versatility makes it the perfect solution for oil & gas, minery and all heavy-duty environments.

1.2 APPLICATIONS

- Metering & protection of 3P asynchronous motors
- Commercial & industrial utility
- Flexible control for demand load shedding, power factor (*)
- Power quality analysis (*)

1.3 DIGITAL MEASUREMENT

- True RMS Phase Currents
- RMS Line Voltage
- Active Power (kW)
  Reactive Power (kVAR)
  Apparent Power (kVA)
- Power Factor (PF)
- Voltage and Current THD
- Frequency (Hz)
- Voltage and Current Harmonics (up to 11th)
- Vectorial/Homopolar Ground Current
- Energy
- Phase Sequence
- Counters (running time, thermal capacity counter, starts)

1.4 APPLICABILITY

- Systems: Wye or Delta three-phase
- Frequency: 50/60 Hz
- Current: up to 6000 A max (or up to 600 A max with Orion Italia standard CTs for MPR)
- Voltage: up to 277/480Vac (direct measure) or external VT

1.5 COMMUNICATION

- RS485 port, Modbus RTU Protocol
- Bluetooth

1.6 SIGNALLING AND PROGRAMMING

- Graphic LCD & LED based HMI
- Indication of fault conditions
- Indication of the relay status
- Indication of motor status
- Available leds:

Led	Description	Duty Cycle
Status (keep alive)	-It indicates that the device is switched on and the self-diagnosis has not encountered any problems. -When it blinks, it indicates an error in discrepancy, flash memory, RAM memory, ADC or Bluetooth BLE.	OFF = 3s ON = 0.1s OFF = 0.3s ON = 0.3s
Load	It indicates the motor status. -Starting -Running/Overload	 OFF = 0.1s ON = 0.1s ON = fixed
Trip	-The protection function has activated the TRIP relay with consequent motor stop. -A power contactor failure has occurred. A protection has activated the TRIP relay, but the power contactor did not interrupt the circuit and therefore the motor continues to absorb current.	ON = fixed OFF = 0.3s ON = 0.3s

In case of discrepancy, check [*Troubleshooting*].

1.7 PROTECTION AND FUNCTIONALITY (*)

- Phase Under & Over Voltage
- Phase Reversal
- Mechanical Jam
- Thermal Capacity Protection
- Acceleration Time
- Current Unbalance
- Ground Fault (Vectorial, Zero Sequence)
- Load Increase
- Undercurrent
- Multiple Starts

1.8 SPECIFICATIONS

SUPPLY VOLTAGE
Options: *(See Section 1.9 Order Code)*
Model A: 120/230 Vac, -15%, +10%, 50/60 Hz
Model W: 85V (115V) ÷ 264V (300V) Vac (Vdc)
Model B: 24Vdc -15%, +10%,
Model C: 48Vdc -15%, +10%

TEMPERATURE
Operational: -20°C +55°C
Storage temp.: -30°C to +70 °C

DIELECTRIC WITHSTAND VOLTAGE
2 kVac, 60s from all circuits and enclosure
2 kVac, 60s between HLV and LV circuit

ELECTRICAL INSULATION CONSTRUCTION
OverVoltage category: III
Pollution degree: 2
Altitude: 2000m (AMSL)

PHASE CT INPUTS
Nominal current input: In=0,2 A
Burden: 0,2 VA @In
Frequency: 50/60 Hz
Range: 0.05 to 8 x In
CT Primary Range:
1.6-3.2-6.4 A; 25 A; 600 A;
100-200-300-400 A (MPR standard CTs);
Custom
Custom Phase CT Rating: 5 A → 6000 A
Steps: 1 A (from 5 A to 10 A); 5 A (from 10 A to 500 A); 50 A (from 500 A to 6000 A)

GROUND CT INPUT
Nominal current input: In=0,2 A
Burden: 0,4 VA @In
Frequency: 50/60 Hz
Range: 0.005 to 4 x In
Ground CT Ratio: 50 → 5000
Steps: 5 (from 50 to 500); 10 (from 500 to 1000); 50 (from 1000 to 5000)

VOLTAGE INPUTS
Rated Input: 480/277 Vac (ph-ph/ph-N) 50/60 Hz
VT burden: 0,5 VA max.
Max. Continuous: 300 Vac phase-neutral
System: 3 wires, 4 wires
External VT: Wye/Wye or Delta/Delta

MEASURED PARAMETERS
RMS Current: Phase A,B,C; Vectorial and Zero Sequence* Ground Current. For ratings: *See Phase CT Input and Ground CT Input.*
RMS Voltage*: AN, BN, CN; AB^+, BC^+, CA^+. For ratings: *See Voltage Inputs.*
Voltage Unbalance*: Range 0→100%
Current Unbalance: Range 0→100%
Voltage Harmonics*: Up to 11^{th}
Current Harmonics: Up to 11^{th}
Frequency*: Based on Voltage Van $(Vab)^+$ Range: 50/60Hz +/-3Hz
Active Power*: Pa^+,Pb^+,Pc^+, 3Φ Active Power Range: -999TW → 999TW
Reactive Power*: Qa^+,Qb^+,Qc^+, 3Φ Reactive Power Range: -999TVar → 999TVar
Apparent Power*: Aa^+,Ab^+,Ac^+, 3Φ Apparent Power Range: -999TVA → 999TVA
Pos. Active Energy: Range: 0 → 999.9TWh
Neg. Active Energy: Range: 0 → 999.9TWh
Pos. Reactive Energy: Range: 0 → 999.9TVARh
Neg. Reactive Energy: Range: 0 → 999.9TVARh
Power Factor: Range: 1.00 LAG → 1.00 LEAD

ACCURACY
Voltage*: cl. 1% ± 1 digit
Current: cl. 1% ± 1 digit
3 Ph Active Power*: cl. 2% ± 1 digit

MECHANICAL
Back connection, section 2,5 mm² or 14 AWG
Frame: Noryl auto-extinguish
IP40 Front (up to IP54 front, on request)
Dimension: 96 x 96 x 146 mm.
Front panel cutout: $91^{-0,5}$x $91^{-0,5}$ mm
Weight: 700 gr.

COMMUNICATION
RS-485 serial port
Protocol: Modbus RTU-Slave
Insulation: 1,5 kVdc
Bluetooth: 4.2

UNDERVOLTAGE MONITORING*
Number of Stage: 1
Required voltage: >5% Vn, applied in all phases
Pickup level: 30% → 99% of Vn, Steps: 1%
Reset level: 31% → 100% of Vn, Steps: 1%
Delay time: 0.5s → 600s,
Steps: 0.1s (from 0.5s to 10s); 1s (from 10s to 600s)
Phases: Any one, any two, all three (programmable)
Minimum Operation level: 0 → 50% of Vn
Accuracy: *See Voltage Inputs*
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

OVERVOLTAGE MONITORING*
Number of Stages: 1
Pickup level: 101%→150%Vn (Must be under max input V) Steps: 1%
Reset level: 100% → 149% Vn, Steps: 1%
Delay time: 0.5s → 600s,
Steps: 0.1s (from 0.5s to 10s); 1s (from 10s to 600s)
Phases: Any one, any two, all three (programmable)
Accuracy: *See Voltage Inputs*
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

PHASE REVERSAL MONITORING*
Delay time: Fixed 0.5s
Timing accuracy: ± 0.1s

GROUND VECTORIAL OVERCURRENT MONITORING
Pickup level: 10% → 300% of Phase CT, Steps: 1%
Dropout Level: Fixed 98% setpoint
Delay time on Start/Run: 0.1s → 100s,
Steps: 0.1s (from 0.1s to 10s); 1s (from 10s to 100s)
Accuracy: *See Current Inputs*
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

GROUND ZERO SEQUENCE OVERCURRENT MONITORING*
Pickup level: 0.5% → 100% of In,
Steps: 0.5% (from 0.5% to 10%); 1% (from 10% to 600%)
Dropout Level: Fixed 98% setpoint
Delay time on Start/Run: 0.1s → 100s,
Steps: 0.1s (from 0.1s to 10s); 1s (from 10s to 100s)
Accuracy: *See Current Inputs*
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

THERMAL CAPACITY MONITORING
Pickup level: 16% → 100%, Steps: 1%
Reset level: 1% → 90% Steps: 1% or LEARNED

MECHANICAL JAM MONITORING
Pickup level: 110% → 500% of FLC, Steps: 1%
Dropout Level: Fixed 98% setpoint
Delay time: 0.5s → 600s,
Steps: 0.1s (from 0.5s to 10s); 1s (from 10s to 600s)
Accuracy: *See Current Inputs*
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

CURRENT UNBALANCE MONITORING
Pickup level: 1% → 99%, Steps: 1%
Dropout Level: Fixed 98% setpoint
Delay time: 0.5s → 600s,
Steps: 0.1s (from 0.5s to 10s); 1s (from 10s to 600s)
Accuracy: 2%
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

MAX. POWER CONSUMPTION
6 VA (4 W)

RELATIVE HUMIDITY
Max. 90% (non-condensing)

BURN IN
48 hours at 50 °C

OUTPUT CONTACT *(See Section 1.9 Order Code)*
Rated load: 8A@ 240Vac Resistive
8A@ 24Vdc Resistive (0,2 A @125 Vdc)
Max Switching Voltage: 400 Vac / 150 Vdc
Max Continuous current: 5 A

PHASE UNDERCURRENT MONITORING*
Pickup level: 2% → 100% of FLC, Steps: 1%
Dropout Level: Fixed 102% setpoint
Delay time: 0.5s → 600s,
Steps: 0.1s (from 0.5s to 10s); 1s (from 10s to 600s)
Accuracy: *See Current Inputs*
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

LOAD INCREASE MONITORING*
Pickup level: *[see 6.4 Setpoints: MOTOR SETUP: Overload* Pickup Level] 10% → 150% of FLC, Steps: 1%
Dropout Level: Fixed 98% setpoint
Delay time: Fixed 0.5s
Accuracy: *See Current Inputs*
Timing accuracy: ± 0.1s

ACCELERATION TIME MONITORING
Pickup level: 1.0s → 300s,
Steps: 0.1s (from 1.0s to 10s); 1s (from 10s to 300s)
Timing accuracy: ± 0.1s or 1% setpoint (worst case)

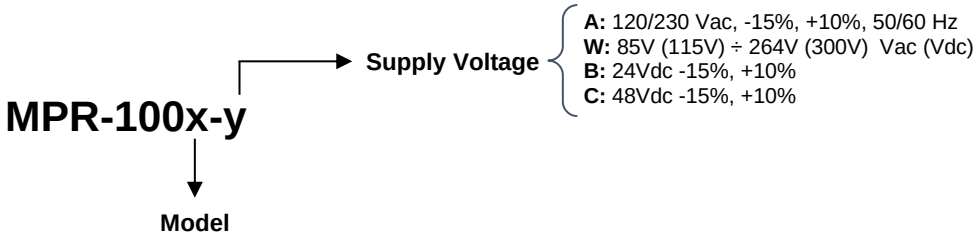
MULTIPLE STARTS MONITORING
Pickup level: 1 → 6000
Time Period: Hour/Day/Month
Accuracy: 2min if time period = HOUR
1 hr if time period = DAY
1 day if time period = MONTH (30 days)

STANDARDS
Low voltage directive: IEC 60255-27, IEC 60255-5
EMC directive: IEC 60255-26

FIRMWARE UPGRADE
via RS-485 Serial Port
OTA via Bluetooth

*Depending on MPR-100 version
+Depending on Voltage, Current connection type

1.9 ORDER CODE



	Metering										Protections (ANSI)											Events	Communication Port
Model	RMS Amp	RMS Volt	Freq.	KW, KVA, KVAR	KWh	Power Factor	Phase Sequence	Currents Harmonics	Voltage Harmonics	THD (Volt, Amp)	27	37	59	49	46i	47	50LR	51R	51GV	51GS (sef)	66		
MPR-1000	o							o						o	o		o	o	o		o	o	Modbus RTU & Bluetooth
MPR-1001	o							o						o	o		o	o	o	o	o	o	
MPR-1002	o	o	o				o	o	o	o	o	o	o	o	o	o	o	o	o		o	o	
MPR-1003	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	

2. Installation

2.1 DESCRIPTION

The back panel label of the relay details the following information:

ORION ITALIA
TEL: 0523 591161
FAX: 0523 593898
www.orionitalia.com
MADE IN ITALY
POWER SUPPLY
PHASE, GROUND, CURRENT INPUTS RATINGS
VOLTAGE INPUTS RATING
MODEL: MPR-100
SERIAL No.

2.2 UNPACKING

The shipping container includes:

- the MPR-100 Relay
- this instruction manual
- three MPR-family Standard CTs (if required)
- the fixing elements
- the Test Report (if required)

Inspect the unit and inform ORION ITALIA of any damage.
If reshipment is required, the original container and packing should be used.

2.3 MOUNTING

The mounting should be carried out as follows:

1. Install the relay in a place where the humidity and temperature are those for which it has been designed *[General Information: 1.8 SPECIFICATIONS]* and away from high current conductors and sources of strong magnetic fields.
2. Put the relay on a panel so that the keypad is easily accessible, and the display is visible.
3. Make a cutout in the panelboard *[Figure 2.1]* and fix the relay by using the fixing elements provided.

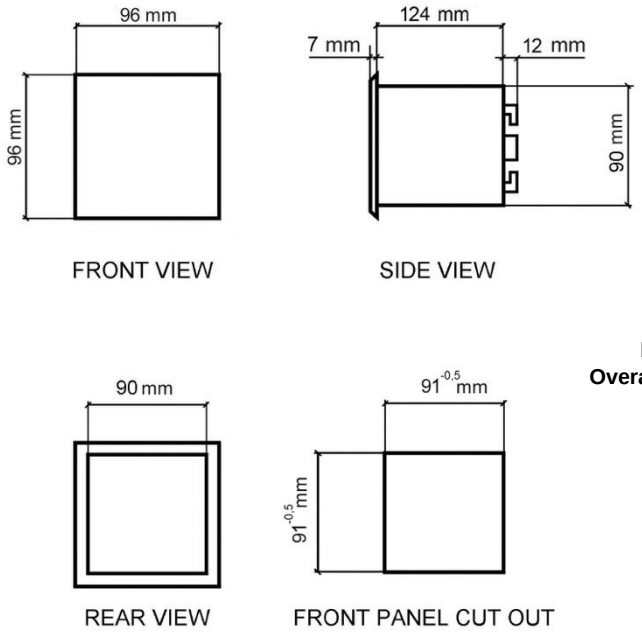


Figure 2.1
Overall dimensions

2.4 WIRING

The electrical connections are made by terminal blocks on the back side of the unit.

CONNECTIONS	TERMINALS No.
Power Supply	**1-2-3**
Relays: **AUX1** **AUX2** **AUX3**	 **10-11-12** **13-14** **15-16**
Voltage Inputs	**31-32-33-34**
Current Inputs	**21-22-23-24-25-26**

Figure 2.2 – **Rear view**

	Before carrying out the installation of the unit, it is necessary to read and understand the indications provided by the Constructor. All the installation operations must be carried out by qualified personnel with adequate knowledge of the functioning of the unit and of the content of this manual.
	The control power, current/voltage input and output contacts must be connected according to the supply voltage connection diagram included in the present manual. Ensure applied currents/voltages abide by the MPR-100 ratings indicated on the relay label.
	Further information: → 1.8 Specifications

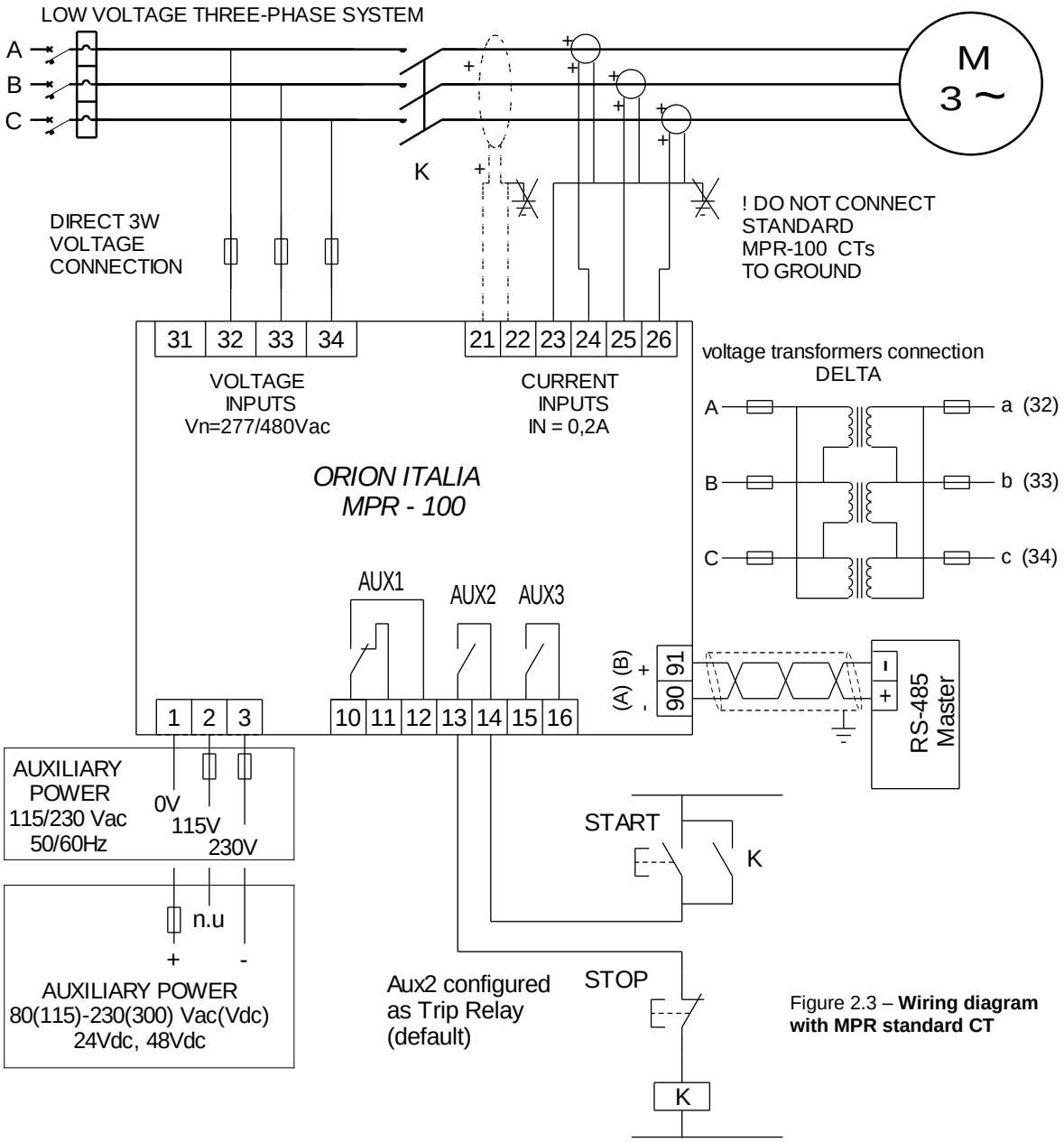


Figure 2.3 – **Wiring diagram with MPR standard CT**

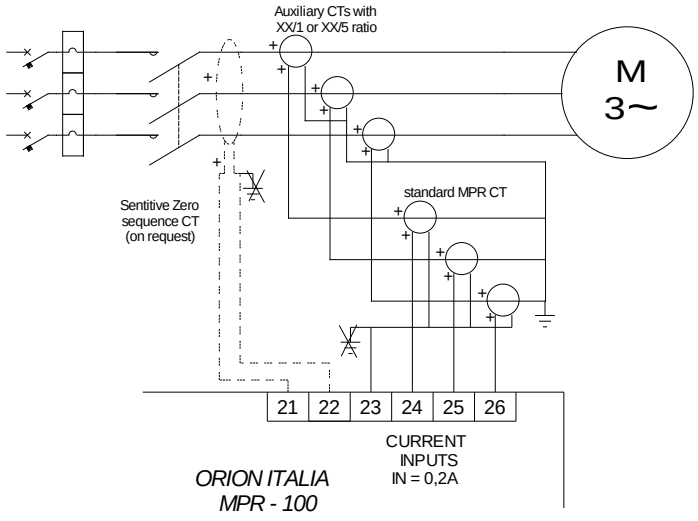


Figure 2.4 – **Wiring diagram with additional auxiliary CT**

Note: for Direct 4W or connection using VTs, contact ORION ITALIA.

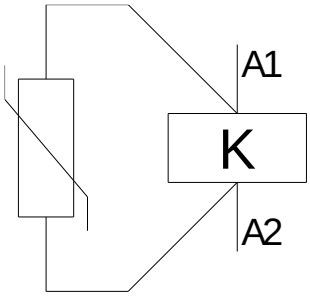


Figure 2.5 – **Surge suppressors on contactor coils**

Note: precautions must be taken in system designs to avoid potential high electromagnetic disturbance which may result in unstable network and malfunction of the relays.

2.5 CURRENT TRANSFORMERS (CT)

See [APPENDIX A].

2.6 COMMUNICATIONS

Thanks to the serial port, the monitoring and control of the relay can be made by a SCADA system, a PC or PLC device.

The ports provided are:

1 two-wire RS-485 port	→	1 twisted pair which transmits and receives alternatively, is used for the data TX and RX
Bluetooth connectivity	→	BLE 4.2 standard

For the RS-485 port use shielded & twisted pair wire to minimize communication errors from noise.
A suitable type of wire is: **BELDEN#9841**, **AWG 24** which is shielded and with a characteristic impedance of **120 Ω**.

Ground the shield only at one point *[Figure 2.6]*
For the RS-485 port a maximum of 35 relays can be daisy chained together in parallel mode on a communication channel for a MAXIMUM DISTANCE OF 1000 METERS.
For larger systems, additional RS-485 channels must be added.

To increase the number of relays over 35 on single channel, consult the relay constructor.

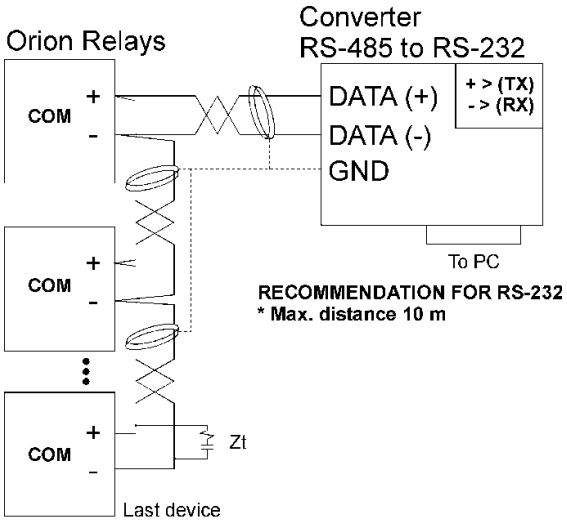


Figure 2.6 – **Communications**

RECOMMENDATION FOR RS-485
*** Use shielded twisted cable**
*** Use only one (1) point of ground**
*** Place a Zt in the last device**
(resistance 250 Ω, condensator 1 nF)
*** Max. distance 1000 m**

2.7 POWER SUPPLY

Voltage ranges for the relay → *[General Information: 1.8 SPECIFICATIONS]*
Power supply connection terminals → *[Installation: 2.4 WIRING]*

The relay has no internal fuses, external protection should be applied.
Orion Italia advices the use of 1 A timed external fuse.

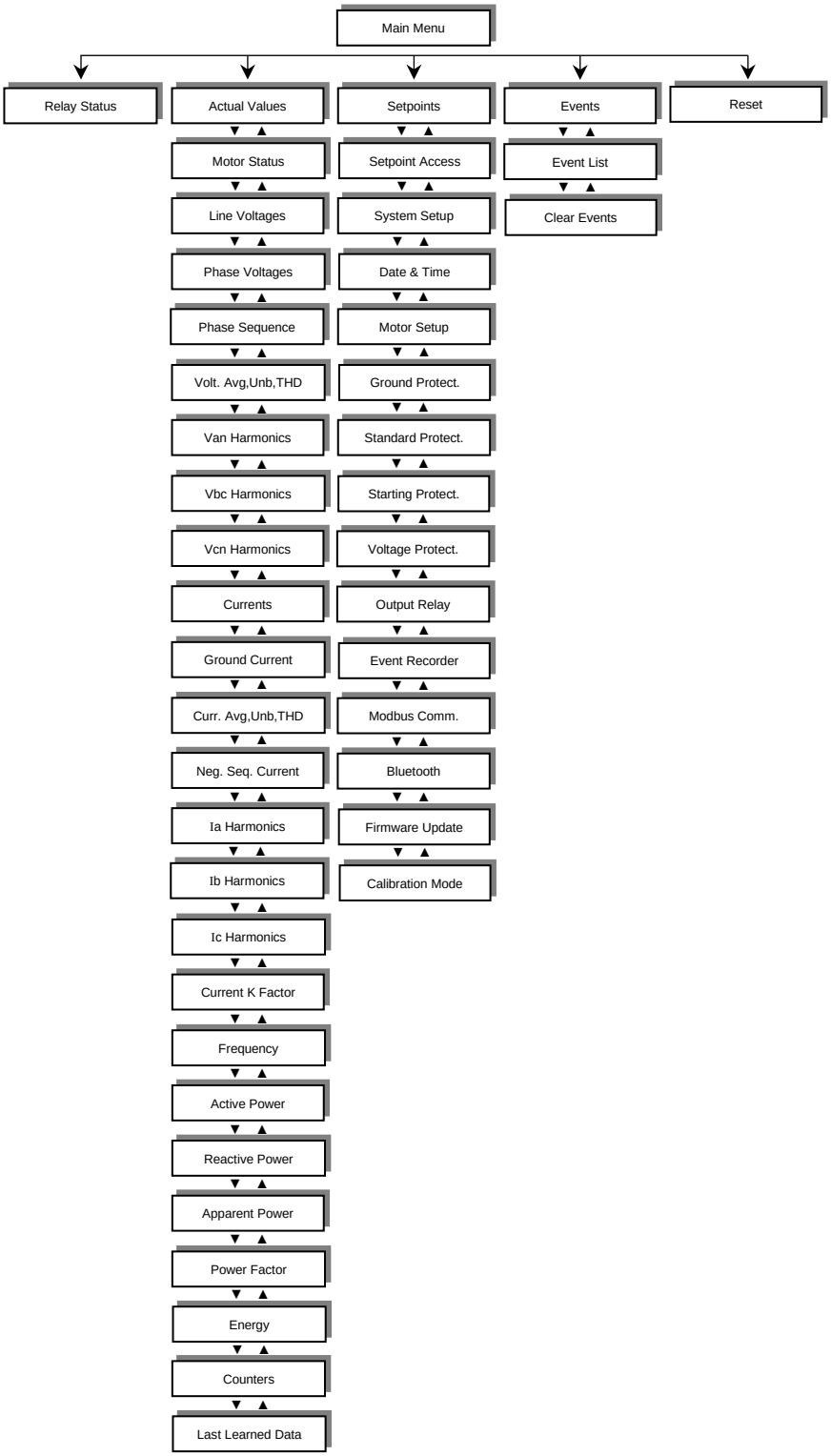
3. Main Menu, Autoscroll and Pop-Up Functions

3.1 MENU STRUCTURE

You can have access to the Main Menu by turning on the unit. The display shows the following options:

RELAY STATUS	→	status of the relay
ACTUAL VALUES	→	display of metering values
SETPOINTS	→	set up the general system and functions
EVENTS	→	visualize the last events stored and possibly clear them all
RESET	→	reset the MPR-100

Below, you can find the representation of the complete structure consisting of the Relay Main Menu and sub-menus.



3.2 AUTOSCROLL FUNCTION

When the user turns on the MPR-100, the unit will cyclically show the following screens:
Line Voltages, Phase Voltages[+], Currents, Ground Current[+], 3 Phase Power, Power Factor, Frequency, Motor Status, Relay Status.

The Autoscroll mode will also be activated five (5) minutes after complete inactivity.
To exit, press any key on the MPR-100 to return to the Main Menu.

[+]Depending on Voltage, Current connection type

3.3 POP-UP FUNCTION

Whenever there is a fault condition, the MPR-100 display will immediately show a POP-UP screen with the cause of the last protection intervention and the corresponding time stamp. To exit, press ⮌ **ESC**.

3.4 MENU SURFING

To surf the menus, use one of the following keys:

▲	**UP**	→	move through the previous options of each menu
▼	**DOWN**	→	move through the next options of each menu
↲	**ENTER**	→	access the selected option
⮌	**ESC**	→	go back to the previous menu

3.5 PASSWORD MANAGEMENT

The MPR-100 has three levels of password-granted authorizations:

FIRST LEVEL	→	view Actual Values and modify Setpoints. A First-Level password cannot clear the values of accumulated energy and cannot navigate through some of the options in the Calibration Mode menu *[APPENDIX B].*

How to Set or Modify a First-Level password
DEFAULT FIRST-LEVEL PASSWORD: 1111

Setpoint Access ORION ITALIA MPR-100 F.V. X.XX	To modify the First-Level password, press **ENTER**.
Setpoint Access **ORION ITALIA** **MPR-100 F.V. X.XX** Enter Password - - - -	Insert the current First-Level password and press **ENTER**. To edit and store the password, *see [Main Menu, Autoscroll and Pop-Up Functions: 3.6 EDITING AND STORING KEYS]*. Password correct >> Setpoint Enabled. *This screen does not appear if the user has previously entered the correct password.*
Setpoint Access **Press Enter to Modify the Password** Otherwise press ▲▼ or Esc	Press **ENTER** and insert a new First-Level password. Insert new password >> New Password Stored.

By changing the First-Level password, the Second-Level password will automatically change.

SECOND LEVEL	→	access every option on the First Level, some options on the Calibration Mode menu and clear the accumulated energy *[APPENDIX B].* This password is obtained by adding 1 *(to the first digit)*, 2 *(to the second digit)*, 3 *(to the third digit)* and 4 *(to the fourth digit)* of the First-Level password. No digit in the resulting password can equal zero (0). If the sum of the two digits is greater than ten (10), only the unit will be considered. If the sum equals ten (10), the digit will become one (1)

For example: PSW1 = 9896 (new user password)
PSW1 = 1111 (**factory default**)

PSW1	9	8	9	6
+	1	2	3	4
=	**10**	**10**	**12**	**10**
PSW2	**1**	**1**	**2**	**1**

DEFAULT PSW1	1	1	1	1
+	1	2	3	4
=	**2**	**3**	**4**	**5**
PSW2	**2**	**3**	**4**	**5**

THIRD LEVEL	→	in this case, the user must contact Orion Italia to obtain the code. It allows access to every option on the Second Level and the ability to alter the MPR-100 calibration settings *[APPENDIX B].*

3.6 EDITING AND STORING KEYS

To edit and store data, use the following keys:

▲	**UP**	→	increase the value
▼	**DOWN**	→	decrease the value
↲	**ENTER**	→	highlight the option and press **ENTER** to modify. Change the value, press **ENTER** to store

For example:
How to Change Phase CT Rating

Scroll ▲ or ▼and highlight the desired option, as shown in the following representation.
On the Main Menu, the user must select *[6.2 Setpoints: SYSTEM SETUP*]

System Setup
Phase CT Rating
100A/0.2A
Number of Turns
1

To modify the Phase CT Rating value, press **ENTER**.
The MPR-100 will ask the user to insert the password.

System Setup
Phase CT Rating
100A/0.2A
Enter Password
- - - -

Press ▲ or ▼ to select the first digit of the password, press **ENTER**.
Repeat for the second, third and fourth digit.
Password correct >> Setpoint Access Enabled
Password incorrect >> Setpoint Access Disabled

This screen does not appear if the user has previously inserted the correct password and if the MPR-100 has not entered Autoscroll mode.

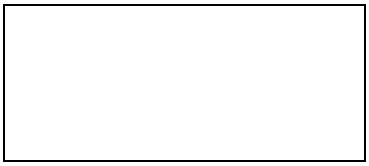
System Setup
Phase CT Rating
Value
100A/0.2A

Password correct >> when the value blinks, press ▲ or ▼ to modify.
Press **ENTER** to store the new setpoint >> Setpoint Stored.

3.7 FUNCTION KEY

F	→	On the Main Menu or in Autoscroll mode, press **F** >> QR Code. Scan with a cell phone or tablet equipped with internet, access the website to download the technical information or register an email address.

3.8 SYMBOLS USED IN THE TEXT



This figure on the left represents the relay display.

[*Main Menu option: SECTION*]
If x = x

This screen only appears if the statement on the left is applied.

Symbol

; → Select among the elements on the list
÷ → Select any value within the indicated parameters

For example:
RANGE: 2; 3; 6 → select **2**, or **3**, or **6**.
RANGE: 2 ÷ 6 → select **2**, or **3**, or **4**, or **5**, or **6**.

FRONT PANEL

4. Menu *RELAY STATUS*

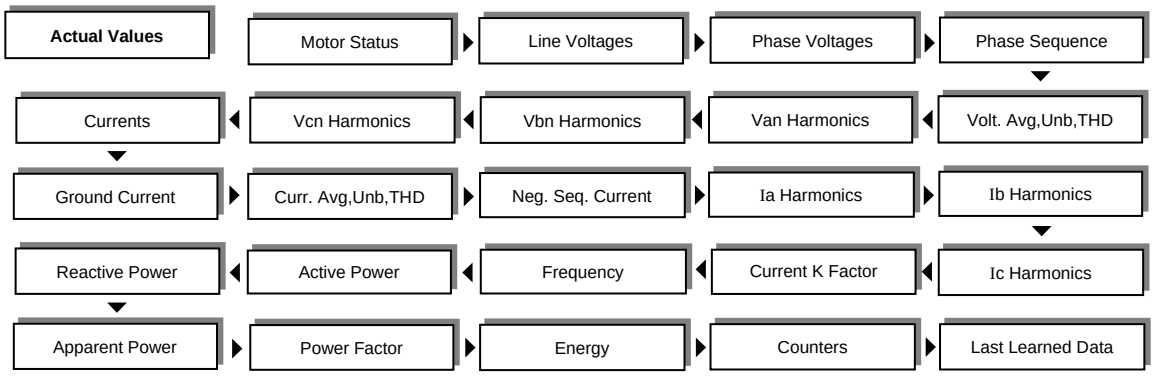
4.1 RELAY STATUS

Relay Status No Active Protection

This section provides information on the Relay Status.
For example, the display could indicate protection interventions, internal faults and/or setpoint discrepancies.
In the presence of more than four (4) alerts, navigate the list with the help of ▲ or ▼.
Normal conditions >> No Active Protection

[APPENDIX C] for all possible status.

5. Menu *ACTUAL VALUES*



(*) The following options are available depending on the MPR-100 model version [*General Information: 1.9 ORDER CODE*].

5.1 Actual values: MOTOR STATUS

Motor Status
Motor Status
STOPPED
Motor TC
Used 0%

RANGE: STOPPED, STARTING, RUNNING, OVERLOADED, TRIPPED.
- Stopped: when *Avg. motor load* < *5%*, the trip relay is in Non-Operating State and there are *No Active Trip Conditions*.
- Starting: when the motor was previously stopped, *Avg. motor load* >= *Overload Pickup and all phase currents are* >= *5%.*
- Running: from Starting status, when Avg. motor load < Overload Pickup. From Stopped status, when Avg. motor load >= 5% for a time >= 5sec and all phase currents >= 5%. From Overloaded status, when Avg. motor load < Overload Pickup.
- Overloaded: from Running, when Avg. Motor Load > Overload Pickup.
- Tripped: when there is an active protection on trip output contact, this contact will enter Operating State and consequently, the Avg. Motor Load will be < 5%.
Note: if motor status is TRIPPED, Motor Starts Counter and Starts Data Counter will not increase.

Following the Motor Status Condition, the screen shows Motor TC Used:
Motor Thermal Capacity accumulated according to motor I²t history and chosen overload curve. When a thermal capacity value reaches the setpoint (Thermal Capacity Level), this will cause the protection to intervene.

5.2 Actual values: LINE VOLTAGES

Line Voltages
Vab= 0.00 V
Vbc= 0.00 V
Vca= 0.00 V

(*) RMS value of Line Voltages.

5.3 Actual values: PHASE VOLTAGES

Phase Voltages
Van= 0.00 V
Vbn= 0.00 V
Vcn= 0.00 V

(*) RMS value of Phase Voltages.

[6.2 *Setpoints: SYSTEM SETUP*]
If VT Connection = Wye or Direct 4W

5.4 Actual values: PHASE SEQUENCE

Phase Sequence None	(*)	RANGE: NONE; ABC; ACB NONE: when the MPR-100 is not capable of detecting the Phase Sequence. For instance, in case of phase loss or insufficient voltage. ABC: Direct sequence ACB: Inverse sequence

5.5 Actual values: VOLTAGE AVG,UNB,THD

Voltage Avg,Unb,THD Voltage Avg= 0.00 V Voltage Unb= 0.0 % THD= 0.0%	(*)	- Average of the 3 RMS values of line voltages Vavg=(|VAB| + |VBC| + |VCA|)/3. - Unbalance line voltages percentage (maximum of the three unbalance values). - Voltage THD value (Voltage Total Harmonic Distortion).

5.6 Actual values: Van (Vab) HARMONICS

View the 11 Harmonics related to the phase voltage or line voltage if Direct 3W or Delta were selected in *[6.2 Setpoints: SYSTEM SETUP: VT Connection]*.

Van Harmonics Van2nd= 0.0 % … Van11th= 0.0 %	(*)	Van Harmonics percentage values. Press ▲ or ▼ to visualize all values. If Direct 3W or Delta VT Connection, Harmonics of Vab will be shown.

5.7 Actual values: Vbn (Vbc) HARMONICS

View the 11 Harmonics related to the phase voltage or line voltage if Direct 3W or Delta were selected in *[6.2 Setpoints: SYSTEM SETUP: VT Connection]*.

Vbn Harmonics Vbn2nd= 0.0 % … Vbn11th= 0.0 %	(*)	Vbn Harmonics percentage values. Press ▲ or ▼ to visualize all values. If Direct 3W or Delta VT Connection, Harmonics of Vbc will be shown.

5.8 Actual values: Vcn (Vca) HARMONICS

View the 11 Harmonics related to the phase voltage or line voltage if Direct 3W or Delta were selected in *[6.2 Setpoints: SYSTEM SETUP: VT Connection]*.

Vcn Harmonics Vcn2nd= 0.0 % … Vcn11th= 0.0 %	(*)	Vcn Harmonics percentage values. Press ▲ or ▼ in order to visualize all values. If Direct 3W or Delta VT Connection, Harmonics of Vca will be shown.

5.9 Actual values: CURRENTS

Currents Ia= 0.00 A Ib= 0.00 A Ic= 0.00 A IgV= 0.00 A	True RMS current value of phase *a*, *b*, *c* and RMS value of ground vectorial *gV*. Ground vectorial current IgV is the vectorial sum of Ia, Ib and Ic.

5.10 Actual values: GROUND CURRENT

Ground Current
Ig0= 0.00 A

(*) RMS Ground Current measured by Zero Sequence (homopolar) CT.

[6.2 *Setpoints: SYSTEM SETUP*]
If Ground Sensing = ENABLED

5.11 Actual values: CURRENT AVG,UNB,THD

Current Avg,Unb,THD
Current Avg= 0.00 A
Current Unb= 0.0 %
Current THD= 0.0%

- Average of the 3 True RMS values of the phase currents
  Current avg=(|Ia| + |Ib| + |Ic|)/3
- Unbalance current percentage (max. of the three unbalance values)
- Current THD value (Total Harmonic Distortion) (*)

5.12 Actual values: NEGATIVE SEQUENCE CURRENT

Neg. Sequence Current
INeg= 0.00 A

RMS value of the negative sequence current.

5.13 Actual values: Ia HARMONICS

Ia Harmonics
Ia2nd= 0.00 %
…
Ia11th= 0.00 %

Ia Harmonics percentage values.
Press ▲ or ▼ to visualize all values.

5.14 Actual values: Ib HARMONICS

Ib Harmonics
Ib2nd= 0.00 %
…
Ib11th= 0.00 %

Ib Harmonics percentage values.
Press ▲ or ▼ to visualize all values.

5.15 Actual values: Ic HARMONICS

Ic Harmonics
Ic2nd= 0.00 %
…
Ic11th= 0.00 %

Ic Harmonics percentage values.
Press ▲ or ▼ to visualize all values.

5.16 Actual values: CURRENT K-FACTOR

Current K-Factor
KF – Ia= 0.00
KF – Ib= 0.00
KF – Ic= 0.00

K-Factor of Ia, Ib and Ic currents (over-dimension factor due to the distortions).

5.17 Actual values: FREQUENCY

Frequency
Frequency= 0.00 Hz

(*) System Frequency value (Hz).
The MPR-100 calculates frequency from voltage input *terminal 31-32* (A-N voltage in case of Direct 4W or Wye connection, A-B voltage in case of Direct 3W or Delta connection).

5.18 Actual values: ACTIVE POWER

Active Power
Pa= 0 W
Pb= 0 W
Pc= 0 W
3P= 0 W

(*) Total RMS three-phase Active Power and individual-phase Active Power.
The individual-phase Active Power will only be shown if Direct 4W or Wye system *[6.2 Setpoints: SYSTEM SETUP: VT Connection]*.

For sign conventions of Power and Power Factor, *see [APPENDIX D].*

5.19 Actual values: REACTIVE POWER

Reactive Power
Qa= 0 VAR
Qb= 0 VAR
Qc= 0 VAR
3Q= 0 VAR

(*) Total RMS three-phase Reactive Power and individual-phase Reactive Power.
The individual-phase Reactive Power will only be shown if Direct 4W or Wye system *[6.2 Setpoints: SYSTEM SETUP: VT Connection].*

For sign conventions of Power and Power Factor, *see [APPENDIX D].*

5.20 Actual values: APPARENT POWER

Apparent Power
Aa= 0 VA
Ab= 0 VA
Ac= 0 VA
3A= 0 VA

(*) Total RMS three-phase Apparent Power and individual-phase Apparent Power.
The individual-phase Apparent Power will only be shown if Direct 4W or Wye system *[6.2 Setpoints: SYSTEM SETUP: VT Connection].*

For sign conventions of Power and Power Factor, *see [APPENDIX D].*

5.21 Actual values: POWER FACTOR

Power Factor
Pf= 0.00

(*) Three-phase Power Factor.
The value could vary from 1.00 LAGGING up to 1.00 LEADING.
In case of insufficient current or insufficient voltage, the MPR-100 will not be able to calculate the Power Factor >> the value shown will be 0.00 n.a.

For sign conventions of Power and Power Factor, *see [APPENDIX D].*

5.22 Actual values: ENERGY

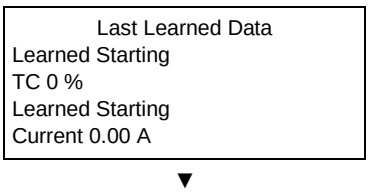
Energy Act+= 0 Wh Act- = 0 Wh React+= 0 VARh React- = 0 VARh	(*)	- Total amount of positive and negative Active Energy accumulated from the Last Energy Clear (Wh, kWh, MWh, GWh or TWh) - Total amount of positive and negative Reactive Energy accumulated from the Last Energy Clear (kVARh, MVARh, GVARh, VARh or TVARh)
▼		
Energy Last Energy Clear DD-MM-YY hh:mm:ss	(*)	Date and time in which the energy value was last cleared.
▲ ▼		
Energy Clear Energy Data? No	(*)	If it is necessary to reset the energy data, press **ENTER,** insert the Second-Level password (PSW2), scroll ▲ ▼ and select YES. *This type of clearing requires at least the Second-Level password (PSW2).*
▲		

5.23 Actual values: COUNTERS

Counters Motor Running Time 0 h Motor Starts Counters 0	The first counter displays the motor running time in hours. When this timer reaches 999999, it will reset to 0. The second counter displays the total number of motor starts. Note: if motor status is TRIPPED, Motor Starts Counter will not increase.
▼	
Counters Thermal Capacity Counter 0	This value increases every time there is a thermal capacity protection intervention.
▲ ▼	
Counters Timer & Counters Reset No	RANGE: NO; YES Select YES to reset all Timers & Counters. Insert the Second-Level password (PSW2) to authorize the reset.
▲ ▼	
Counters Motor Starts Rate 0/D Max Starts Rate 0/D	The first counter represents the number of starts that occurred in the predefined time period *[6.7 Setpoints: STARTING PROTECT.*: Multiple Starts Time Period]. Max Starts Rate represents the maximum number of starts that occurred in the predefined period of time; or the maximum value assumed in Motor Starts Rate. Note: if motor status is TRIPPED, Starts Data Counter will not increase. *See Note [6.7 Setpoints: STARTING PROTECT.*]
▲ ▼	
Counters Starts Data Reset No	RANGE: NO; YES Select YES to reset all Starts Data. Insert the First or Second-Level password (PSW1 or PSW2) to authorize the reset.
▲	

5.24 Actual values: LAST LEARNED DATA

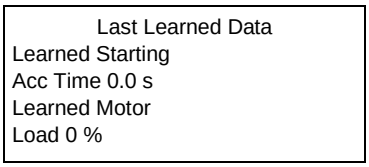
The MPR-100 learns the acceleration time, the starting current, as well as, the thermal capacity required during motor starts. This data is accumulated based on the last four starts.



▼

The first value refers to the average of thermal capacity from the last four starts**. The thermal capacity accumulated during a start is the difference between the thermal capacity reached at the transition point Starting-Running and the thermal capacity reached at the transition point Stopped-Starting.

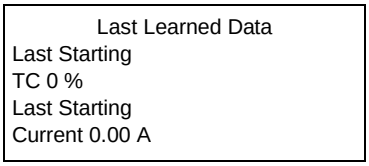
The Learned Starting Current is the average of four current values.
These four current values are the starting average current of the last four successful starts**.
The starting average current is measured 100 ms after the instant in which the motor current goes from zero to greater than overload pickup. This should ensure that the measured current is symmetrical.



▲▼

The Learned Starting Acceleration Time may be used to fine tune the acceleration time protection. The starting acceleration time is measured from the instant in which the motor current goes from zero to greater than overload pickup, to the instant in which the current falls below the overload pickup level.
Learned Starting Acceleration Time is the longest starting acceleration time of the last four successful starts**.

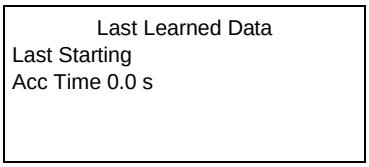
The Learned Motor Load is the average motor current in a time period defined *Motor Load Period [6.4 Setpoints: MOTOR SETUP: Motor Load Learn Period]*.
A reliable value is obtained after a time equal to at least 5 times *Motor Load Period*.



▲▼

The Last Starting Thermal Capacity refers to the TC accumulated during the last successful start.

The Last Starting Current refers to the starting current during the last start, even if it was not successful.



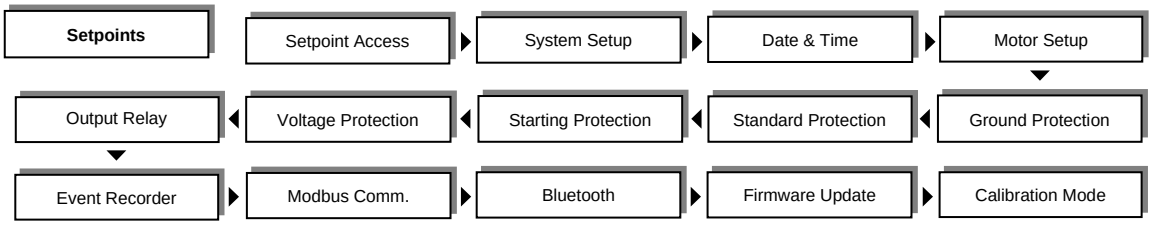
▲

The Last Starting Acceleration Time refers to the acceleration time from the last successful start.

**When there is no start history, this value will be reliable only after having successfully achieved *four* starts.

6. Menu *SETPOINTS*

Before carrying out the programming of the unit, it is necessary to read and understand the indications provided by the Constructor. All the programming must be carried out by qualified personnel with adequate knowledge of the operation of the unit and of the content of this manual.



(*) The following options are available depending on the MPR-100 model version [*General Information: 1.9 ORDER CODE*].

6.1 Setpoints: SETPOINT ACCESS

Setpoint Access ORION ITALIA MPR-100X F.V. X.XX

MPR-100 model and the firmware version.
Press **ENTER**, insert and/or modify the First-Level password (PSW1).
See [Main Menu, Autoscroll and Pop-Up Functions: 3.5 PASSWORD MANAGEMENT].

6.2 Setpoints: SYSTEM SETUP

This section indicates the parameters for system setup.

System Setup **System Frequency** Value 50 Hz

RANGE: 50; 60 Hz
Enter the nominal power system frequency. This value will set the optimal digital sampling rate.

System Setup **Phase CT Rating** Value 100A/0.2A

RANGE: 1.6A/0.2A; 3.2A/0.2A; 6.4A/0.2A; 25A/0.2A; 100A/0.2A; 200A/0.2A; 300A/0.2A; 400A/0.2A; 600A/0.2A; Cust/0.2A
This value is found on the transformer nameplate.
Choose Cust/0.2A (Custom CT) if the CT is not an Orion Italia MPR standard CTs.
All phase current transformers must have the same rating.

System Setup **Custom Phase CT Rating** Value 100A/0.2A

[6.2 Setpoints: SYSTEM SETUP]
If Phase CT Rating = Cust/0.2

RANGE: 5/0.2 ÷ 6000/0.2
STEPS: 1, 5, 50
Specify the rating of the Custom Phase CT.

System Setup **Number of Turns** Value 1

RANGE: 1; 2; 3; 4; 5
Enter the Number of Turns of the power cable through the current transformer.

System Setup
Ground Sensing
Value
ENABLED

(*) RANGE: ENABLED; DISABLED
ENABLED >> the MPR-100 will measure the ground current through the homopolar CT connected to the fourth current input.

System Setup
Ground CT Ratio
Value
500

(*) RANGE: 50 ÷ 5000
STEPS: 5, 10, 50
Enter the ratio (*the result of primary rating/secondary rating*) of the ground current transformer (Zero Sequence CT).

[6.2 Setpoints: SYSTEM SETUP]
If Ground Sensing = ENABLED

System Setup
VT Connection
Value
Direct 4W

(*) RANGE: Direct 3W; Direct 4W; Wye; Delta
Direct 3W: the power cable of a 3-wire system is directly connected to the voltage input (without voltage transformers).
Direct 4W: the power cable of a 4-wire system is directly connected to the voltage input (without voltage transformers).
Wye: connection with VT in Wye configuration.
Delta: connection with VT in Delta configuration.
See Figure 2.3

System Setup
VT Rated Secondary
Value
100 V

(*) RANGE: 80 ÷ 480
STEPS: 1
Enter the voltage nominal value of the secondary of the VT.
Only if *[6.2 Setpoints: SYSTEM SETUP: VT Connection: Wye]* this screen will show the VT Rated Secondary Rating as **value/√3**.

[6.2 Setpoints: SYSTEM SETUP]
If VT Connection = Delta or Wye

System Setup
VT Rated Primary
Value
1.0 kV

(*) RANGE: 80 V ÷ 10.0 kV
STEPS: 5 V, 50 V; 0.5 kV
Enter the voltage nominal value of the primary of the VT.
Only if *[6.2 Setpoints: SYSTEM SETUP: VT Connection: Wye]* this screen will show the VT Rated Primary Rating as **value/√3**.

[6.2 Setpoints: SYSTEM SETUP]
If VT Connection = Delta or Wye

System Setup
Command
Value
REMOTE BLE+485

RANGE: Local; Remote 485; Remote BLE; Remote BLE+485
Choose the enabled command source and with this, disable all communication commands from the rest of the options.
The local HMI always remains enabled.

System Setup
Trip Relay
Value
Aux2

RANGE: Aux1; Aux2; Aux3
Choose the output relay that will manage the power contactor.

To connect the contactor to the MPR output relay, see Figure 2.5 and its note.

System Setup
Out of Service Relay
Value
None

RANGE: None; Aux1
Enable or disable the Out of Service function on Aux1.
Note: if [*6.2 Setpoints: SYSTEM SETUP:* Out of Service Relay = AUX1], *[6.9 Setpoints: OUTPUT RELAY:* Aux1 Output Relay] will be forced as Autoreset and [*6.9 Setpoints: OUTPUT RELAY:* Aux1 Non-Operating State = Energized].

System Setup
Power Contact Failure
Value
None

RANGE: None; Aux1; Aux2; Aux3
Whenever there is a Power Contact Failure condition, the chosen output relay will operate.
By choosing None, the Power Contact Failure function will be disabled.

6.3 Setpoints: DATE & TIME

Date & Time
2018. Jan. 9
16:54:02:0

Press **ENTER** to modify.

Date & Time
2018. Jan. 9
16:54:02:0
Enter Password
- - - -

Insert the First-Level password (PSW1) to set or modify Date and Time.
To store new Date and Time:

1. Insert the correct password, if required, using ▲ and ▼
2. If the password is correct, the year will blink.

Date & Time
2018. Jan. 9
16:54:02:0
Value
2018. Jan. 9
16:54:02:0

3. Select the year using ▲ and ▼ and press **ENTER**.
4. Repeat steps 2 and 3 for month, day, hour, minutes, and seconds.
5. Press **ENTER** to store the new date and time.
   Note: press **ENTER**, the decimals of the seconds will begin from zero (0).
   Note2: by changing Date & Time, Starts Data will be cleared.

6.4 Setpoints: MOTOR SETUP

Motor Setup
Motor Full Load Current
Value
100 A

RANGE: 0,5 ÷ 5000
STEPS: 0,1; 1; 10
Enter the motor rated full load current.
Note: it is necessary to choose the correct CT ratio and dimension in order to detect the FLC and the Starting Current.

Motor Setup
TC. Curve Class
Value
2

RANGE: CLASS 1; CLASS 2; CLASS 3; CLASS 4; CLASS 5; CLASS 6; CLASS 7; CLASS 8; CLASS 9; CLASS 10; CLASS 15; CLASS 20; CLASS 30
Enter the motor thermal class.

Motor Setup
Overload Pickup Level
Value
101 %

RANGE: 10 ÷ 150
STEPS: 1
This setpoint dictates where the overload curve begins as the motor enters overload condition.

Motor Setup
Hot/Cold Ratio
Value
90 %

RANGE: 1 ÷ 100
STEPS: 1
This Setpoint defines the ratio of motor *hot* thermal characteristic to the motor *cold* characteristic. The motor manufacturer should provide thermal limit information for a hot/cold motor.
When the motor is running at a level that is below the Overload Pickup Level, the Thermal Capacity Used will rise or fall based on the average phase current and the Hot/Cold Ratio setpoint.
The Thermal Capacity Used will either rise at a fixed rate of 5% per minute or fall depending on the running cool time constant.

$$TC_{used\_end} = I_{avg} \times (100 - \text{Hot/Cold Ratio}) / \text{Motor FLC}$$

where:

TC_{used_end} = steady state thermal capacity (after the motor has been running at a constant current below the thermal pickup level for some time).
I_{avg} = average current.
Hot/Cold Ratio = The Hot/Cold Stall Time Ratio setting applied to the relay.
Motor FLC = Motor Full Load Current.

The Hot/Cold Ratio may be determined by dividing the COLD LOCKED ROTOR TIME and HOT LOCKED ROTOR TIME provided by the motor manufacturer. In case these thermal ratings are not available, read the hot safe stall time and the cold safe stall time on the Motor Overload Curves (Hot and Cold) in correspondence to the locked rotor current (LRC). If there is no differentiation between the Hot and Cold curve, the ratio should be entered as 100%.

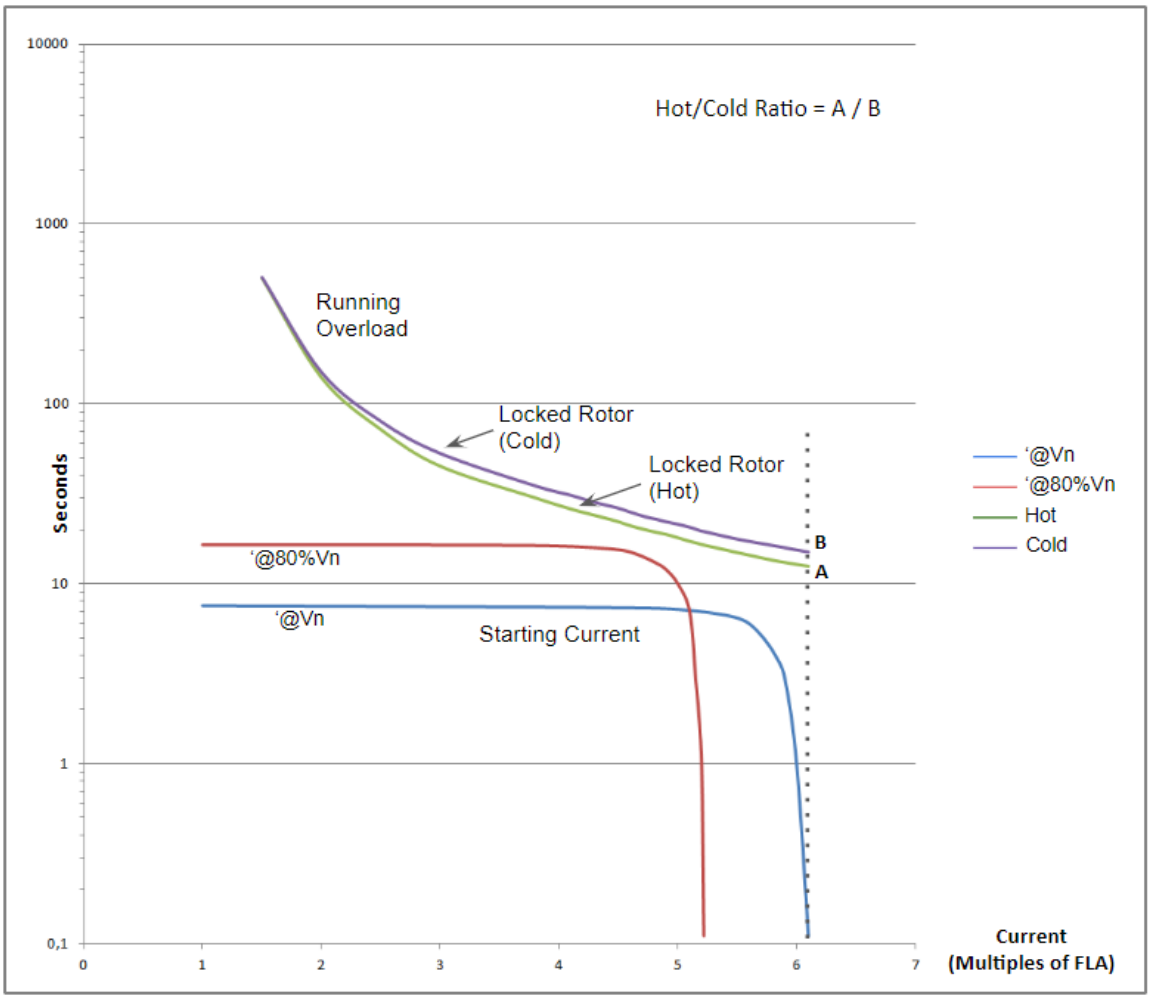


Figure 6.1 – **Motor Overload Curves (Hot/Cold Ratio)**

Motor Setup **Negative Sequence Factor** Value 0

RANGE: 0 ÷ 12
STEPS: 1
If a Negative Sequence Factor also named *k* value is different from 0, the equivalent motor load is incremented proportionally to the Negative Sequence Current present on the motor phase currents, resulting on a motor class derating. The formula applied to calculate equivalent motor heating current equation, including current negative sequence contribution.

$$I_{eq} = \sqrt{i^2 \times \left(1 + k \times \left(\frac{I_2}{I_1}\right)^2\right)}$$

Where: I_{eq} = equivalent motor heating current
i = per unit current based on FLC
I_2 = negative sequence current
I_1 = positive sequence current
k = Negative Sequence Factor

The *k* constant can be calculated as described:
$k = 175/I_{LR}^2$ (typical estimation) & $k = 230/I_{LR}^2$ (conservative estimation)
I_{LR}: locked rotor current per unit

Motor Setup **Cooling Time Stopped** Value 30 min

RANGE: 0 ÷ 720
STEPS: 1
Enter the Cooling Time constant applied when the motor is Stopped.
Note: when the MPR-100 is turned off, the relay assumes the Motor is Stopped.

Motor Setup **Cooling Time Running** Value 30 min

RANGE: 0 ÷ 720
STEPS: 1
Enter the Cooling Time constant applied when the motor is Running.
Note: when the MPR-100 is turned off, the relay assumes the motor is Stopped.

Motor Setup **Motor Load Learn Period** Value 15 min

RANGE: 1 ÷ 120
STEPS: 1
Select the period of time over which the Average Motor Load is calculated.
Set a *Motor Load Learn Period* value that is much greater than the motor cycle time.

6.5 Setpoints: GROUND PROTECTION

The following protections have a dropout at 98% of the relative setpoint.
Below the dropout level, it is possible to reset the MPR-100 manually by pressing the Reset button or automatically if the output relay is programmed as Autoreset.

Ground Protect. **Gnd OVC. Vect Relay** Value - - -

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Ground OverCurrent Vectorial will be disabled.

Ground Protect. **Gnd OVC. Vectorial Level** Value 10 %

[6.5 Setpoints: GROUND PROTECT.]
If Gnd. OVC. Vect Relay ≠ NONE

RANGE: 10 ÷ 300
STEPS: 1
Ground vectorial current is calculated as a vectorial sum of the three phase currents.
The protection will activate when the ground vectorial current exceeds this level for a period >= the Ground OverCurrent Vectorial on Run Delay (on motor Running) or >= the Ground OverCurrent Vectorial on Start Delay (on motor Starting).

Ground Protect.
Gnd OVC. Vect on Run
Delay
Value
0.5 s

[6.5 Setpoints: GROUND PROTECT.]
If Gnd. OVC. Vect Relay ≠ NONE

RANGE: 0.1 ÷ 100
STEPS: 0.1; 1
Enter the Delay time for the Ground OverCurrent Vectorial protection (on motor Running).

Ground Protect.
Gnd OVC. Vect on Start
Delay
Value
0.5 s

[*6.5 Setpoints: GROUND PROTECT.]*
If Gnd. OVC. Vect Relay ≠ NONE

RANGE: 0.1 ÷ 100
STEPS: 0.1; 1
Enter the Delay time for the Ground OverCurrent Vectorial protection (on motor Starting).

Ground Protect.
Gnd OVC. ZS
Relay
Value
- - -

[6.2 Setpoints: SYSTEM SETUP]
If Ground Sensing ≠ DISABLED

(*) RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Ground OverCurrent Zero Sequence will be disabled.

Ground Protect.
Gnd OVC. ZS
Level
Value
6,0 % In

[6.2 Setpoints: SYSTEM SETUP]
If Ground Sensing ≠ DISABLED
[6.5 Setpoints: GROUND PROTECT.]
If Gnd. OVC. ZS Relay ≠ NONE

(*) RANGE: 0,5 ÷ 100
STEPS: 0,5; 1
Ground vectorial current is calculated through the homopolar current transformer (Zero Sequence CT).
The protection will activate when the zero sequence current exceeds this level for a period >= the Ground OverCurrent Zero Sequence on Run Delay (on motor Running) or >= the Ground OverCurrent Zero Sequence on Start Delay (on motor Starting).

Ground Protect.
Gnd OVC. ZS on Run
Delay
Value
0.5 s

[6.2 Setpoints: SYSTEM SETUP]
If Ground Sensing ≠ DISABLED
[6.5 Setpoints: GROUND PROTECT.]
If Gnd. OVC. ZS Relay ≠ NONE

(*) RANGE: 0,1 ÷ 100
STEPS: 0.1; 1
Enter the Delay time for the Ground OverCurrent Zero Sequence protection (on motor Running).

Ground Protect.
Gnd OVC. ZS on Start
Delay
Value
0.5 s

[6.2 Setpoints: SYSTEM SETUP]
If Ground Sensing ≠ DISABLED
[6.5 Setpoints: GROUND PROTECT.]
If Gnd. OVC. ZS Relay ≠ NONE

(*) RANGE: 0,1 ÷ 100
STEPS: 0.1; 1
Enter the Delay time for the Ground OverCurrent Zero Sequence protection (on motor Starting).

6.6 Setpoints: STANDARD PROTECTION

Standard Protect.
Load Increase
Relay
Value
- - -

(*)

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Load Increase Relay will be disabled.
When the motor is in Running status, the Load Increase protection will act when the motor current exceeds the value set in *[Setpoints 6.4: MOTOR SETUP: Overload Pickup Level] for a period > 0,5 sec*.

Standard Protect.
Thermal Capacity
Relay
Value
- - -

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Thermal Capacity will be disabled.

Standard Protect.
Thermal Capacity
Level
Value
70 %

[6.6 Setpoints: STANDARD PROTECT.]
If Thermal Capacity Relay ≠ NONE

RANGE: 16 ÷ 100
STEPS: 1
Enter the Thermal capacity intervention value.

Standard Protect.
Reset TC Mode
Value
LEARN

[6.6 Setpoints: STANDARD PROTECT.]
If Thermal Capacity Relay ≠ NONE

RANGE: LEARN; LEVEL
Select LEARN, to allow the MPR-100 to automatically calculate the reset level, or select LEVEL to specify a value below which the TC protection will reset.

In case of LEARN:

Reset TC = 98% - Learned Starting TC

Where: Learned Starting TC = *See [5.24 Actual Values: LAST LEARNED DATA]*.

Note: if the result is < 15% or the Learned Starting Capacity = 0%, the value will be automatically brought to 15%.
If the result is > 90%, the value will be automatically brought to 90%.

Standard Protect.
Reset TC Level
Value
50 %

[6.6 Setpoints: STANDARD PROTECT.]
If Reset TC Mode = LEVEL
If Thermal Capacity Relay ≠ NONE

RANGE: 1 ÷ 90 %
STEPS: 1 %
The protection for Thermal Capacity will be restored below this value.

Standard Protect.
Mechanical Jam
Relay
Value
- - -

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Mechanical Jam Relay will be disabled.

Standard Protect.
Mechanical Jam
Level
Value
110 %FLC

[6.6 Setpoints: STANDARD PROTECT.]
If Mechanical Jam Relay ≠ NONE

RANGE: 110 ÷ 500
STEPS: 1
Enter the Mechanical Jam intervention level.
After a motor start, the protection will activate once the magnitude of Ia, Ib, or Ic exceeds this threshold for a time >= Mechanical Jam Delay.
This feature may be used to indicate a stall condition *only* when running, because it is *disabled* during the starting condition.

The dropout level is at 98%, below which it is possible to reset the MPR-100 manually by pressing the Reset button or automatically if the output relay is programmed as Autoreset.

Standard Protect.
Mechanical Jam
Delay
Value
0.5 s

[6.6 Setpoints: STANDARD PROTECT.]
If Mechanical Jam Relay ≠ NONE

RANGE: 0.5 ÷ 600
STEPS: 0.1; 1
Enter the Delay time for the Mechanical Jam protection.

Standard Protect.
Current Unbalance
Relay
Value
- - -

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Current Unbalance will be disabled.

Standard Protect.
Current Unbalance
Level
Value
10 %

[6.6 Setpoints: STANDARD PROTECT.]
If Current Unbalance Relay ≠ NONE

RANGE: 1 ÷ 99
STEPS: 1
Enter the Current Unbalance intervention level.
The protection will activate once the current unbalance exceeds this threshold for a time >= Current Unbalance Delay.

The dropout level is at 98%, below which it is possible to reset the MPR-100 manually by pressing the Reset button or automatically if the output relay is programmed as Autoreset.

Standard Protect.
Current Unbalance
Delay
Value
0.5 s

[6.6 Setpoints: STANDARD PROTECT.]
If Current Unbalance Relay ≠ NONE

RANGE: 0.5 ÷ 600
STEPS: 0.1; 1
Enter the Delay time for the Current Unbalance protection.

Standard Protect.
UnderCurrent
Relay
Value
- - -

(*) RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection UnderCurrent will be disabled.

Standard Protect.
UnderCurrent
Level
Value
10 %FLC

[6.6 Setpoints: STANDARD PROTECT.]
If UnderCurrent Relay ≠ NONE

(*) RANGE: 2 ÷ 100
STEPS: 1
Enter the UnderCurrent intervention level.
The protection will activate once the magnitude of at least one Ia, Ib, or Ic falls below this threshold for a time >= UnderCurrent Delay.

The dropout level is at 102%, above which it is possible to reset the MPR-100 manually by pressing the Reset button or automatically if the output relay is programmed as Autoreset.

Standard Protect.
UnderCurrent
Delay
Value
0.5 s

[6.6 Setpoints: STANDARD PROTECT.]
If UnderCurrent Relay ≠ NONE

(*) RANGE: 0.5 ÷ 600
STEPS: 0.1; 1
Enter the Delay time for the UnderCurrent protection.

6.7 Setpoints: STARTING PROTECTION

Standard Protect.
Acceleration Time
Relay
Value
- - -

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Acceleration Time will be disabled.

Standard Protect.
Max Acceleration
Time
Value
10 s

[6.7 Setpoints: STARTING PROTECT.]
If Acceleration Time Relay ≠ NONE

RANGE: 1.0 ÷ 300
STEPS: 0.1; 1
This value determines the maximum time that the motor will employ to start.
If the acceleration period goes beyond this time, the protection will act.

Note: the statistics related to the Multiple Starts Relay section are obtained from a circular buffer that stores all the departures considering the moment in which they occurred. The buffer consists of 30 cells in the case of Time Period = HOUR or MONTH and 24 cells in the case of Time Period = DAY.

Standard Protect.
Multiple Starts
Relay
Value
- - -

RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Multiple Starts Relay will be disabled.

Standard Protect.
Multiple Starts Time
Period
Value
HOUR

[6.7 Setpoints: STARTING PROTECT.]
If Multiple Starts Relay ≠ NONE

RANGE: HOUR; DAY; MONTH
The selected value represents the period of time over which the starts statistics are calculated.

When the value is changed, the starts statistics for the selected time period, max starts for the selected time period, and the data on the circular buffer will be reset.

Standard Protect.
Max Starting Rate
Value
10/H

[6.7 Setpoints: STARTING PROTECT.]
If Multiple Starts Relay ≠ NONE

RANGE: 1 ÷ 6000
STEPS: 1
Depending on the option selected on the screen Multiple Starts Time Period, the value will show /H for HOUR, /D for DAY and /M for MONTH.

6.8 Setpoints: VOLTAGE PROTECTION

The voltage thresholds in the following setpoints, are expressed in percentage of Rated VT.
Delta >> Rated VT = phase-phase Primary Rating.
Wye >> Rated VT = phase-ground Primary Rating.
Direct 3W >> Rated VT = the MPR-100 phase-phase rated voltage input (480 V).
Direct 4W >> Rated VT = the MPR-100 phase-neutral rated voltage input (277 V).

Voltage Protect.
UnderVoltage1
Relay
Value
- - -

(*) RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection UnderVoltage will be disabled.

Voltage Protect.
UnderVoltage1 Level
Value
80 %VT

[6.8 Setpoints: VOLTAGE PROTECT.]
If UnderVoltage1 Relay ≠ NONE

(*) RANGE: 30 ÷ 99
STEPS: 1
Enter the UnderVoltage intervention level.
The protection will activate when the voltages drop down this level for a period >= UnderVoltage1 Delay value.

Voltage Protect.
UnderVoltage1 Reset
Value
85 %VT

[6.8 Setpoints: VOLTAGE PROTECT.]
If UnderVoltage1 Relay ≠ NONE

(*) RANGE: 31 ÷ 100
STEPS: 1
Enter the percentage value at which the faulty condition for UnderVoltage1 drops out. At this point, it is possible to reset the MPR-100 manually by pressing the Reset button or automatically if the output relay is programmed as Autoreset.

Voltage Protect.
UnderVoltage1 Delay
Value
0.5 s

[6.8 Setpoints: VOLTAGE PROTECT.]
If UnderVoltage1 Relay ≠ NONE

(*) RANGE: 0.5 ÷ 600
STEPS: 0.1; 1
Enter the UnderVoltage1 protection intervention delay.

Voltage Protect.
UnderVoltage1 Phase Operat.
Value
ANY ONE

[*6.8 Setpoints: VOLTAGE PROTECT.*]
If UnderVoltage1 Relay ≠ NONE

(*) RANGE: ANY ONE; ANY TWO; ALL THREE
Select the minimum number of phases on which the faulty condition has to occur for UnderVoltage1 intervention.

Voltage Protect.
UnderVoltage1 min. op. level
Value
15 %VT

[6.8 Setpoints: VOLTAGE PROTECT.]
If UnderVoltage1 Relay ≠ NONE

(*) RANGE: 0 ÷ 50
STEPS: 1
Enter the limit voltage value under which the UnderVoltage1 protection is disabled.

Voltage Protect.
OverVoltage1
Relay
Value
- - -

(*) RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection OverVoltage will be disabled.

Voltage Protect.
OverVoltage1 Level
Value
115 %VT

[6.8 Setpoints: VOLTAGE PROTECT.]
If OverVoltage1 Relay ≠ NONE

(*) RANGE: 101 ÷ 150
STEPS: 1
Enter the OverVoltage intervention level.
The protection will activate when the voltages exceed this level for a period >= OverVoltage1 Delay value.

Voltage Protect.
OverVoltage1 Reset
Value
110 %VT

[6.8 Setpoints: VOLTAGE PROTECT.]
If OverVoltage1 Relay ≠ NONE

(*) RANGE: 100 ÷ 149
STEPS: 1
Enter the percentage value at which the faulty condition for OverVoltage1 drops out. At this point, it is possible to reset the MPR-100 manually by pressing the Reset button or automatically if the output relay is programmed as Autoreset.

Voltage Protect.
OverVoltage1 Delay
Value
0.5 s

[6.8 Setpoints: VOLTAGE PROTECT.]
If OverVoltage1 Relay ≠ NONE

(*) RANGE: 0.5 ÷ 600
STEPS: 0.1; 1
Enter the OverVoltage1 protection intervention delay.

Voltage Protect.
OverVoltage1 Phase Operat.
Value
ANY ONE

[6.8 Setpoints: VOLTAGE PROTECT.]
If OverVoltage1 Relay ≠ NONE

(*) RANGE: ANY ONE; ANY TWO; ALL THREE
Select the minimum number of phases on which the faulty condition has to occur for OverVoltage1 intervention.

Voltage Protect.
Phase Reversal Relay
Value
- - -

(*) RANGE: NONE; ANY COMBINATION OF AUX1, AUX2 OR AUX3
When NONE is selected, the protection Phase Reversal will be disabled.
The protection will activate when the relay detects the voltage sequence as inverse.

6.9 Setpoints: OUTPUT RELAY

In case of fault condition, the output relay associated to the active protection function will act (it will go from a Non-Operating State to an Operating State). If the output relay is configured as a Trip Relay [6.2 *Setpoints: SYSTEM SETUP: Trip Relay*], the protection intervention will cause the Trip led to turn ON.

Output Relay
Aux1 Output Relay
Value
LATCHED

RANGE: LATCHED; AUTORESET

- LATCHED: once the associated protection has intervened, the Aux1 output relay will function in Operating State.
  When the fault condition ceases, it is necessary to manually RESET.
- AUTORESET: once the associated protection has intervened, the output relay will function in Operating State.
  When the fault condition ceases, the Aux1 output relay will automatically RESET.

Note: if [*6.2 Setpoints: SYSTEM SETUP:* Out of Service Relay = AUX1], *[6.9 Setpoints: OUTPUT RELAY:* Aux1 Output Relay] will be forced as Autoreset and [*6.9 Setpoints: OUTPUT RELAY:* Aux1 Non-Operating State = Energized].

Output Relay
Aux2 Output Relay
Value
LATCHED

RANGE: LATCHED; AUTORESET
- LATCHED: once the associated protection has intervened, the Aux2 output relay will function in Operating State.
  When the fault condition ceases, it is necessary to manually RESET.
- AUTORESET: once the associated protection has intervened, the output relay will function in Operating State.
  When the fault condition ceases, the Aux2 output relay will automatically RESET.

Output Relay
Aux3 Output Relay
Value
LATCHED

RANGE: LATCHED; AUTORESET
- LATCHED: once the associated protection has intervened, the Aux3 output relay will function in Operating State.
  When the fault condition ceases, it is necessary to manually RESET.
- AUTORESET: once the associated protection has intervened, the output relay will function in Operating State.
  When the fault condition ceases, the Aux3 output relay will automatically RESET.

Output Relay
Aux1 Non-Operating State
Value
DE-ENERG.

RANGE: DE-ENERGIZED; ENERGIZED
- DE-ENERGIZED: when the Aux1 output relay is in Non-Operating State, the coil is turned OFF (Safe State).
- ENERGIZED: when the Aux1 output relay is in Non-Operating State, the coil is turned ON.

Output Relay
Aux2 Non-Operating State
Value
DE-ENERG.

RANGE: DE-ENERGIZED; ENERGIZED
- DE-ENERGIZED: when the Aux2 output relay is in Non-Operating State, the coil is turned OFF (Safe State) and its contact is open.
- ENERGIZED: when the Aux2 output relay is in Non-Operating State, the coil is turned ON and its contact is closed.

Output Relay
Aux3 Non-Operating State
Value
DE-ENERG.

RANGE: DE-ENERGIZED; ENERGIZED
- DE-ENERGIZED: when the Aux3 output relay is in Non-Operating State, the coil is turned OFF (Safe State) and its contact is open.
- ENERGIZED: when the Aux3 output relay is in Non-Operating State, the coil is turned ON and its contact is closed.

To connect the output relays on the above section, please refer to *Figure 2.5* and its note.

6.10 Setpoints: EVENT RECORDER

You can enable/disable the recording of each type of event. All events, up to 100 maximum, will be stored in a memory buffer operating in FIFO (First-In, First-Out) mode. Once 100 events are stored, the new event will push out the oldest one from the Event List.

Event Recorder
System Events
Value
ENABLED

RANGE: ENABLED; DISABLED

Event Recorder
Output Relays Events
Value
ENABLED

RANGE: ENABLED; DISABLED

Event Recorder **Voltage Protect.** **Events** Value ENABLED	(*)	RANGE: ENABLED; DISABLED
Event Recorder **Gnd Current Protect.** **Events** Value ENABLED		RANGE: ENABLED; DISABLED
Event Recorder **Standard Protect.** **Events** Value ENABLED		RANGE: ENABLED; DISABLED
Event Recorder **Starting Protect.** **Events** Value ENABLED		RANGE: ENABLED; DISABLED

6.11 Setpoints: MODBUS COMMUNICATION

This section contains the settings that allow the MPR-100 communication with other devices.

Modbus Comm. **Modbus** **Address 1** Value 1	RANGE: 1 ÷ 247 STEPS: 1 Modify the Modbus ID.
Modbus Comm. **RS-485** **Baudrate** Value 9600	RANGE: 9600; 19200; 38400; 57600; 115200 Select the Baud rate.
Modbus Comm. **RS-485** **Config.** Value 8N1	RANGE: 8N1; 8N2; 8E1; 8E2; 8O1; 8O2 Specify the parity and the Stop-bit.

For further information, download *Modbus Memory Map* from the Orion Italia website.

6.12 Setpoints: BLUETOOTH

This section contains information regarding the MPR-100 Bluetooth connectivity.

Bluetooth **Device Name** Value MPR–XXX–XXXXXX	Modify the Bluetooth ID. If an external device carries out a Bluetooth scan, the MPR-100 will appear with the Device Name specified on the screen.

6.13 Setpoints: FIRMWARE UPDATE

Before proceeding with the upgrade, the user must make sure to not have any issues regarding the power supply.
DO NOT DISCONNECT POWER SUPPLY during the firmware upgrade, the device could remain unusable.
Orion Italia cannot be held responsible for any damage that may incur following the incorrect firmware upgrade procedure.

The MPR-100 firmware can be updated by Bluetooth or by serial RS-485 port.

Firmware Update **RS485 Update** BLE Update	To initialize the upgrade, select the method and press **ENTER**. To authorize the update, please insert the Second-Level Password (PSW2).

Firmware Update Ready to be Updated	The MPR-100 is waiting to receive the update. Once the upgrade has been successfully installed, verify the firmware version in *[6.1 Setpoints: SETPOINT ACCESS].*

6.14 Setpoints: CALIBRATION MODE

When the user is operating the setpoints on this menu, the MPR-100 does not guarantee the correct performance of the protection and storage of Events, as well as the correct execution of the measuring functions.

For security purposes, it is therefore highly suggested that the user take the necessary precautions before operating in this section.

Calibration Mode **Display Brightness** Value 5	RANGE: 0 ÷ 10 Choose the Display Brightness to be applied when the MPR-100 is not in Autoscroll mode.

Calibration Mode **Display Contrast** Value 5	RANGE: 1 ÷ 10

Calibration Mode **Test HMI** Value No	RANGE: Yes; No Choose YES and press **ENTER**, to carry out a test of the display and the leds. The display will show only dots and the leds will turn on for a couple of seconds.

Calibration Mode **Test BLE** Value No	RANGE: Yes; No Choose YES and press **ENTER**, to carry out a test.

Calibration Mode **Test Relays** Value None	RANGE: NONE; AUX1; AUX2; AUX3; ALL Energize one or more output relays. During the test, the chosen relay(s) will remain energized for five (5) seconds and the navigation will be disabled throughout this time.

Calibration Mode **Device ID** Value 63aDedRt2f4=	A code like the example on the screen uniquely identifies the MPR-100. It is useful in case the password gets lost or in case Orion Italia requires it for technical support.

The following screens will only be visible if the system is accessed with the Second-Level Password (PSW2):
See [APPENDIX B]

Any modification applied to the following settings, can affect metering and protection functions.

Calibration Mode **K TA** Value 1.000	RANGE: 0.800 ÷ 1.200 Correction factor for CT ratio.

Calibration Mode **K TV** Value 1.000	RANGE: 0.800 ÷ 1.200 Correction factor for TV ratio.

Calibration Mode **Comp Phi TA/TV** Value 0.00	RANGE: -5.00 ÷ 5.00 Correction factor for TA/TV phase displacement.

7. Menu *EVENTS*

7.1 EVENT LIST

The MPR-100 is capable of storing up to one hundred (100) events.
Certain types of Events could be registered or not, depending on the settings stored in the section *[6.10 Setpoints: EVENT RECORDER].*

Event List Event *X* *Type of event* DD-MM-YY hh:mm:ss

- Event ID
- Event description
- Time stamp

Press **ENTER** to view the electrical values at the time of the Event.

Event X Van= 0.00 V Vbn= 0.00 V Vcn= 0.00 V

▼

In case of Direct 4W or Wye, Phase Voltages values will be shown.
In case of Direct 3W or Delta, Line Voltages values will be shown.

Certain models of MPR-100 don't carry all options of metering and protection. In these cases, the values will show N.A.

Event X Ia= 0.00 A Ib= 0.00 A Ic= 0.00 A Ig= 0.00 A

▲ ▼

Phase and Ground Current values.
If *[6.2 Setpoints: SYSTEM SETUP: Ground Sensing: ENABLED]* and the version of MPR-100 offers this option, Ground Current (Ig0) will appear. In any other circumstance, the value will be *N.A.*

If the event refers to Ground OverCurrent Vectorial, the display will show IgV instead of Ig0.

Event X 3P= 0 W Pf= 0.00 Frequency= 0.00 Hz Motor TC: 0%

▲

- Three-phase Active Power
- Three-phase Power Factor
- System Frequency
- Motor Thermal Capacity

Certain models of MPR-100 don't carry all options of metering and protection. In these cases, the values will show *N.A.*

7.2 CLEAR EVENTS

Events Clear All Events? No

Select the desired option and press **ENTER**.
Insert the First-Level (PSW1) or Second-Level password (PSW2) - unless there has been a previous log in.
Press **ENTER** to Clear All Events or press ⮌ **ESC** to abort.
The unit will confirm the clearing by showing Events Data Cleared.

8. Menu *RESET*

All the programming must be carried out by qualified personnel with adequate knowledge of the operation of the unit and of the content of this manual.

8.1 RESET

This Main Menu option allows the user to execute a RESET of the MPR-100.
The Reset command does not cancel any acquired data (Events, Energy…), instead, it resets a fault condition (including Trip) if it is no longer present; and/or eliminates the notification of a previously stored fault condition.

Reset
Reset Relays?
No

RANGE: NO; YES
Scroll ▲ ▼ to select YES and press **ENTER** to proceed >> Reset Sent.
To abort, press ⮌ **ESC**.

This Menu can be accessed by a Shortcut:
Press **ENTER** and ⮌ **ESC** contemporarily for more than two seconds.

Another way to proceed with the RESET is through Modbus RS485, only if [6.2 *Setpoints: SYSTEM SETUP: Command*] REMOTE 485 or REMOTE BLE+485.

9. Troubleshooting

RELAY CANNOT TURN ON

- Check the connections and the control power fuses.

VOLTAGES ARE NOT DISPLAYED

- Check the connections and fuses of voltage inputs.

CURRENTS ARE NOT DISPLAYED

- Check the CTs wiring.
- Check the terminal for short-circuiting.

OUTPUT RELAYS (TERMINALS N. 10 to 16) MALFUNCTIONING

- Check for proper operating following *[6.14 Setpoints: CALIBRATION MODE]* instructions.
- Check for proper wiring connection.

DISCREPANCY (led STATUS blinking 0.3s ON – 0.3s OFF)

- Check that all setpoints are not out of range with respect to the memory map.
- Check that UnderVoltage Reset is not <= UnderVoltage Level
- Check that OverVoltage Reset is not >= OverVoltage Level
- Only if *[6.6 Setpoints: STANDARD PROTECT.*: Reset TC Mode = LEVEL]; check that TC Reset is not >= TC Level
- Only if = *[6.6 Setpoints: STANDARD PROTECT.*: Reset TC Mode = LEARN]; check that the calculated LEARN value found in *[6.6 Setpoints: STANDARD PROTECT.*: Reset TC Mode] is not >= TC Level
    - Reset TC = 98% - Learned Starting TC
      Where: Learned Starting TC = *See [5.24 Actual Values: LAST LEARNED DATA]*.
- Only if *[6.2 Setpoints: SYSTEM SETUP*: Out of Service Relay = AUX1]; check that no protection is enabled on Out of Service Relay
- Only if *[6.2 Setpoints: SYSTEM SETUP*: Out of Service Relay = AUX1]; check that *[6.2 Setpoints: SYSTEM SETUP*: Trip Relay ≠ AUX1]
- Check that the output associated with Trip Relay is not the same as the one associated with Power Contact Failure Relay
- Check that the output associated with Power Contact Failure Relay is not the same as the one associated with Out of Service Relay.

APPENDIX A

CURRENT TRANSFORMERS (CT)

STANDARD APPLICATION

Standard Phase CTs “MPR-100 CT” are used for current sensing on MPR-100 relay; these standard CTs are designed with four different ratios in order to have a very high range of nominal currents.
Three of these CTs are normally supplied with the relay (unless particular request).

The standard MPR-100 CT has 4 terminals; the table shown below allows to select the correct ratio:

Ip/Is	n	OUTPUTS	ACCURACY	ORDER CODE
100/0.2 A	n2 - 3 = 500	$2^+ – 3$	1%	KITCT01
200/0.2 A	n1 - 2 = 1000	$1^+ – 2$	1%	
300/0.2 A	n1 - 3 = 1500	$1^+ – 3$	0.7%	
400/0.2 A	n1 - 4 = 2000	$1^+ – 4$	0.5%	

$^+$Positive terminal

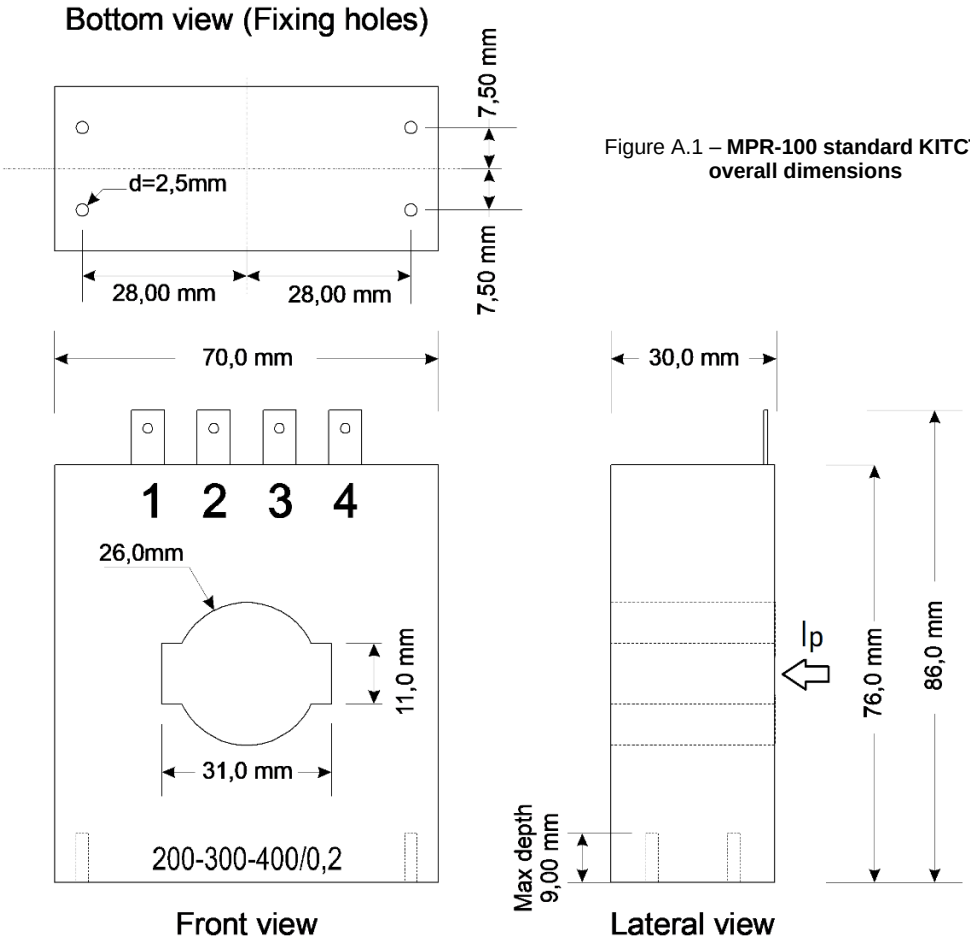


Figure A.1 – **MPR-100 standard KITCT01 overall dimensions**

Figure A.2 – **MPR-100 CT technical data**

Ip/Is	n	OUTPUTS	ACCURACY	ORDER CODE
25/0.2 A	n1 - 4 = 125	1^{+} – 4	2%	KITCT02

[+]Positive terminal

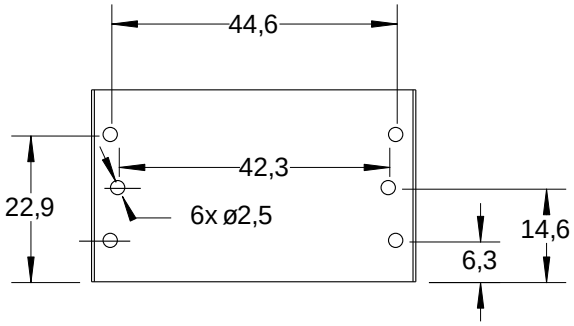
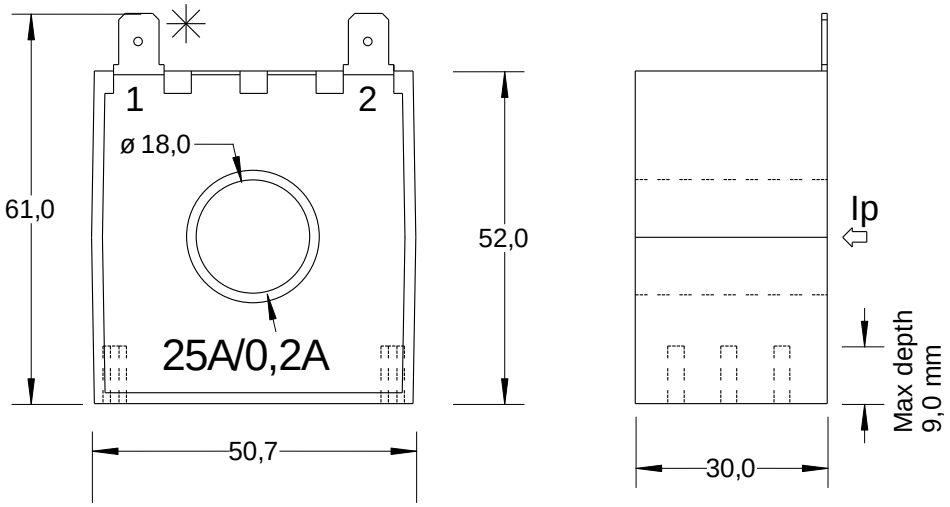


Figure A.3 – **MPR-100 standard KITCT02 overall dimensions**



Observe correct polarity during the connection of the CT *[Figure 2.3 and Figure 2.4]*

If higher than 400 A nominal currents or different specifications regarding the CTs are needed, contact Orion Italia.

If the MPR-100 version contemplates it, sensitive ground current detection can be achieved using a Zero Sequence detection method as shown in *Figure A.3*. For this configuration, the three-phase cables must pass through the window of a separate CT which senses the Zero Sequence component of the three currents.

CUSTOM CT

Using a CT that is different from the MPR-family standards:

Please take note, all CTs must have a secondary rated current 0.2 A.
The unit will be damaged if these precautions are not followed.
Orion Italia cannot be held responsible for any damage that may incur following the use of non-indicated CTs.

Do not connect the secondaries of CTs to ground.

Whenever Custom CTs are used, the relay should be set as follows:

[Setpoints 2: SYSTEM SETUP]
Phase CT Rating → select “Cust/0.2 A”
Custom Phase CT Rating → insert the phase primary nominal current of the CT
Number of Turns → select the number of turns of the wire on the CT primary side

APPENDIX B

PASSWORD MANAGEMENT

Function/Level PSW	No PSW	First Level (PSW1)	Second Level (PSW2)	Third Level (PSW3) *Contact Orion Italia*	Notes
Reset Relay	X	X	X	X	
Clear Events		X	X	X	
Reset Counters			X	X	
Reset Starts Data Counters		X	X	X	
Reset Energy			X	X	
Factory Default				X	K-Calibration, K-TA TV, Energy, Events, Counters and Last Learned Data will remain the same.
Auto-Calibration				X	
K-Calibration (relay)				X	
K-Calibration (TA-TV)			X	X	
Upgrade Firmware			X	X	
Update BLE Stack				X	
Info Stack BLE			X	X	
Device ID			X	X	
BLE Name		X	X	X	

See [Main Menu, Autoscroll and Pop-Up Functions: 3.5 PASSWORD MANAGEMENT].

APPENDIX C

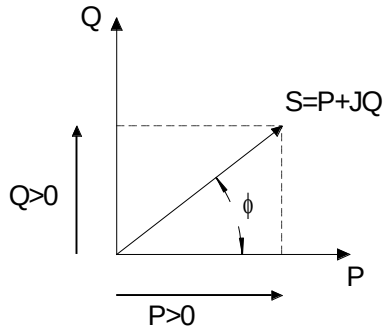
STATUS LIST

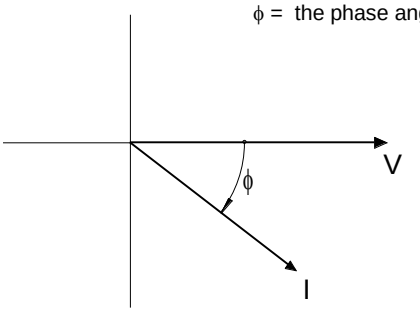
Status	Description
No Active Protection	Normal status, no faulty conditions present.
Undervoltage1	Active protection for undervoltage threshold reached.
Overvoltage1	Active protection for overvoltage threshold reached.
Phase Reversal	Active protection for phase reversal conditions.
Ground Vect OVC.	Active protection for ground vectorial overcurrent threshold reached.
Ground ZS OVC.	Active protection for ground zero sequence overcurrent threshold reached.
Current Unbalance	Active protection for current unbalance threshold reached.
Undercurrent	Active protection for phase undercurrent threshold reached.
Mechanical Jam	Active protection for mechanical jam threshold reached.
Load Increased	Active protection for load increased conditions.
Motor Thermal Prot.	Active protection for thermal capacity threshold reached.
Multiple Starts Prot.	Active protection for max. starting rate reached.
Setpoint Discrepancy	A discrepancy was found in the stored setpoints.
Flash Busy	The internal flash memory is not available during the reading/writing operations.
ADC Failure	Analog to digital converter internal failure.
BLE Failure	Bluetooth low energy internal failure.
RAM Failure	Ram internal failure.
Check Events	A protection occurred. For details, see *[Events: 7.1 EVENT LIST].*
Acc. Timer Protect.	Active protection for acceleration timer threshold reached.
Out Of Service	MPR is *out of service*. MPR functions are not guaranteed.
Power Contact Failure	The *Power Contact Failure* output relay acts (in case of trip, the motor continues to run).

APPENDIX D

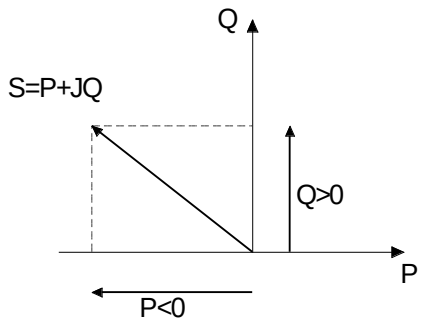
POWER FACTOR CONVENTION (IEEE)

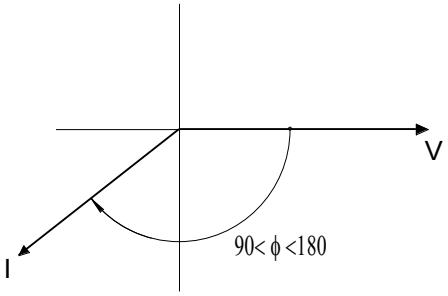
S = P+jQ
S= apparent power
P= active power = VIcosϕ
Q= reactive power = VIsenϕ
ϕ = the phase angle by which I lags V



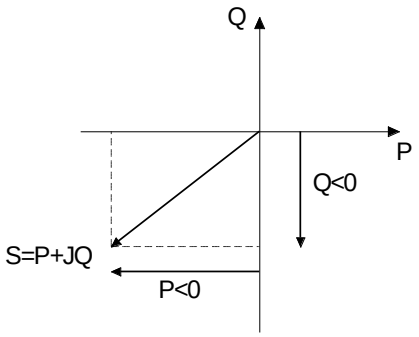


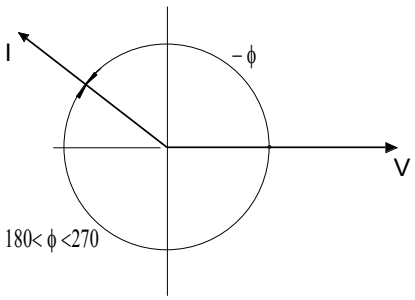
Power factor lagging (-) : **P (Watt)**: is being absorbed by the load **Q (Var)**: is being absorbed by the load.



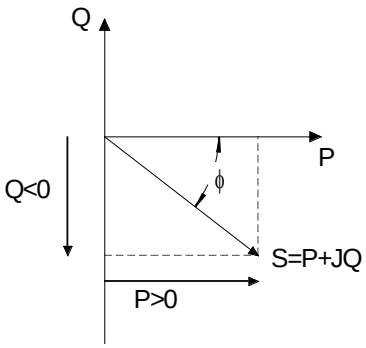


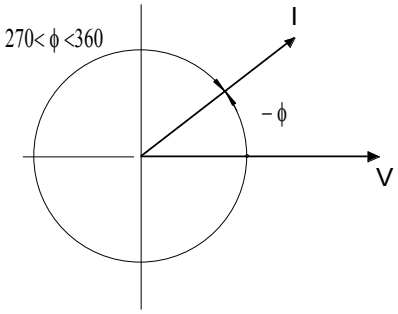
Power factor leading (+): **P (Watt)**: is being supplied by the load. **Q (Var)**: is being absorbed by the load.





Power factor lagging (-): **P (Watt)**: is being supplied by the load. **Q (Var)**: is being supplied by the load.





Power factor leading (+): **P (Watt)**: is being absorbed by the load. **Q (Var)**: is being supplied by the load.

APPENDIX E

EVENT LIST

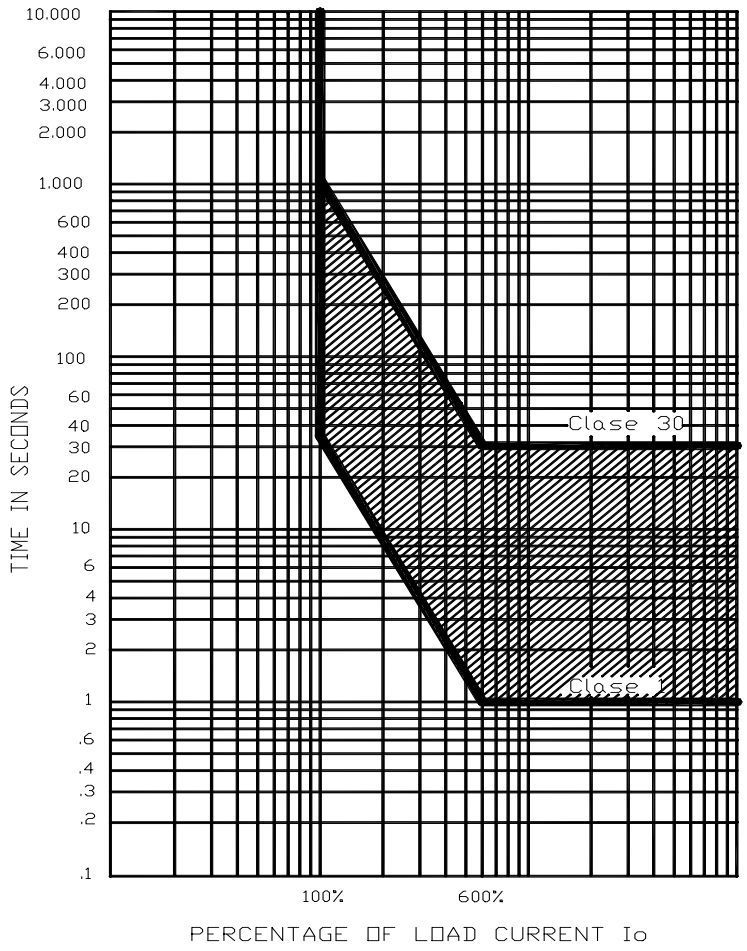
Event	Description
No Events	
Clear Events	It indicates events were cleared.
Undervoltage1	Undervoltage1 protection occurred.
Overvoltage1	Overvoltage1 protection occurred.
Phase Reversal	Phase reversal protection occurred.
Gnd Vect OVC.	Ground vectorial overcurrent protection occurred.
Gnd ZS OVC.	Ground zero sequence protection occurred.
Current Unbalance	Current unbalance protection occurred.
Undercurrent	Phase undercurrent protection occurred.
Mechanical Jam	Mechanical jam protection occurred.
Load Increased	Load increased protection occurred.
Thermal Capacity	Thermal capacity protection occurred.
Acceleration Timer	Acceleration timer protection occurred.
Multiple Starts	Multiple Starts protection occurred.
Aux1 De-Energized	The output Aux1 status was changed from energized to de-energized.
Aux2 De-Energized	The output Aux2 status was changed from energized to de-energized.
Aux3 De-Energized	The output Aux3 status was changed from energized to de-energized.
Aux1 Energized	The output Aux1 status was changed from de-energized to energized.
Aux2 Energized	The output Aux2 status was changed from de-energized to energized.
Aux3 Energized	The output Aux3 status was changed from de-energized to energized.
Aux1 Remote De-Energ.	The output Aux1 status was changed from energized to de-energized through a remote command.
Aux2 Remote De-Energ.	The output Aux2 status was changed from energized to de-energized through a remote command.
Aux3 Remote De-Energ.	The output Aux3 status was changed from energized to de-energized through a remote command.
Aux1 Remote Energ.	The output Aux1 status was changed from de-energized to energized through a remote command.
Aux2 Remote Energ.	The output Aux2 status was changed from de-energized to energized through a remote command.
Aux3 Remote Energ.	The output Aux3 status was changed from de-energized to energized through a remote command.
Default Sp. Loaded	In case of internal fault, the MPR-100 has been reset back to default setpoint values.
Setpoint Stored	A setpoint modification took place. Consecutive changes in the Setpoint section are stored under the same event. Following a minute after the last modification, a new event will be generated.
Setpoint Discrepancy	The values set by the user in the Setpoint section, generated a discrepancy (e.g.: verify the values of Threshold and Reset that could generate a protection malfunction – Reset Level > Threshold Level in Overvoltage1 or Reset Level < Threshold Level in Undervoltage1). **See *[Troubleshooting]***
BLE Failure	Internal fault occurred in the Bluetooth module.
BLE Module Tested	The BLE test was executed by the user.
Password Changed	The user changed the password.
Model Changed	The version model of the MPR-100 was upgraded.
Energy Clear	The user deleted the Energy value.
Energy Data Lost	It indicates there was an error in the memorized Energy value.
Energy Restored	The MPR-100 is not capable of reading the Energy value in RAM and it recovers it from the internal EPROM. This could have generated a loss of Energy.
Motor Data Lost	The MPR-100 has lost the Motor data values.

Starts Data Clear	The Starts counter was cleared or the Multiple Starts Time Period was modified or a manual change of Date & Time occurred.
Starts Data Lost	The MPR-100 has lost the Starts data values.
Calibration Data Lost	The MPR-100 has lost the Calibration data values.
Memory Status Lost	Following a restart of the MPR-100, the unit is not capable of reaching the same status present before it was restarted.
Aux Power Lost	The MPR-100 was powered off.
Aux Power Restored	The MPR-100 was powered on.
ADC Failure	Internal fault occurred in the digital analogic converter.
Flash Busy	The internal flash memory was not available during the reading/writing operations.
Out Of Service	*Out of service* conditions occurred.
Power Contact Failure	*Power contact failure* conditions occurred.

APPENDIX F

MOTOR THERMAL CURVES

Formula k = (I^2)* t



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