ORION ITALIA

INSTRUCTION MANUAL

EMR-100
Electrical Multimeter and Monitoring Relay
Firmware version 1.65

C€

SAFETY STANDARDS AND GENERAL WARNINGS

①	**For a proper installation of the device 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 device 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 SPECIFICATION;
   - the rating of the device (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 device must be used EXCLUSIVELY for the purposes described in the Chapter GENERAL INFORMATION.
⚡	High-voltage live parts; disconnect the device 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 device from the panel on which it is mounted when the device 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

①	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.

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1. General Information

1.1 DESCRIPTION

The EMR-100 relay has been designed for the continuous monitoring of electrical parameters in medium or low-voltage one-phase or three-phase systems. It allows direct or remote monitoring of the system's general conditions.

Some available versions of the EMR-100, can also be used to control the production process thanks to the programmable output contacts suitable for various applications.

1.2 APPLICATIONS

- Metering of distribution feeders, transformers, generators, capacitor banks and motors
- Commercial & industrial utility
- Flexible control for demand load shedding, power factor, among others
- Power quality analysis

1.3 DIGITAL MEASUREMENT

- RMS Phase & Ground Current*
- RMS Phase+ & Line Voltage
- Energy
- Positive & negative Active power (kW) & Reactive power (kVar)
- Last & Maximum Demand readings for:
    - phase current (A)
    - active power (kW)
    - reactive power (kVar)
    - apparent power (kVA)
- Frequency (Hz)
- Voltage & Current Unbalance
- Voltage & Current Harmonic Analysis up to the 11th
- Current K-Factor

1.4 COMMUNICATION

- 1 RS485 insulated port, Modbus RTU Protocol
- Bluetooth

1.5 SIGNALLING AND PROGRAMMING

- Graphic 128x64 LCD display
- Status LED
- Indication and storage of fault conditions and their values*
- 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.	OFF = 3s ON = 0.1s
	-When it blinks, it indicates an error in discrepancy, flash memory, RAM memory, ADC or Bluetooth BLE.	OFF = 0.3s ON = 0.3s
Load	It indicates the motor status. -Starting	OFF = 0.1s ON = 0.1s
	-Running/Overload	ON = fixed
Trip	-The protection function has activated the TRIP relay with consequent motor stop.	ON = fixed
	-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.	OFF = 0.3s ON = 0.3s

In case of discrepancy, check [Troubleshooting].

1.6 OUTPUT CONTACT THRESHOLD LEVEL*

- Ground & Neutral OverCurrent
- Minimum Voltage
- Max +/- KW
- UnderVoltage
- OverVoltage
- Power Demand

*Depending on EMR-100 version [General Information: 1.8 ORDER CODE]
+Depending on Voltage, Current connection type

1.7 SPECIFICATIONS

SUPPLY VOLTAGE
120/230 Vac, -15%, +10%, 50/60 Hz

TEMPERATURE
Operational: -20 °C +55 °C
Storage temperature: -30 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: 0.01 to 4 x In
Max. continuous current: 2 x In

GROUND CT INPUT
Nominal current input: In=0.2 A
Burden: 0.2 VA @In
Frequency: 50/60 Hz
Range: 0.005 to 4 x In
Max. continuous current: 2 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 (Vn): 480/277 Vac (ph-ph/ph-N) 50/60 Hz
VT burden: 0,5 VA max.
Max. continuous: 500/300 Vac (ph-ph/ph-N)
Range: 10-300 Vac (ph-N)
System: 3 wires, 4 wires
External VT: Wye/Wye or Delta/Delta

MEASURED PARAMETERS
RMS Current: Phase A,B,C; Neutral+* and Ground+*
Current. *See Phase CT Inputs*
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 11th
Current Harmonics*: Up to 11th
Frequency: Based on Voltage Van (Vab)+
Range: 50/60Hz +/-3Hz
Active Power: Pa^+, Pb^+, Pc^+, 3ϕActive Power
Range: -999TW → 999TW
Reactive Power: Qa^+, Qb^+, Qc^+, 3ϕRective Power
Range: -999TVar → 999TVar
Apparent Power: Aa^+, Ab^+, Ac^+, 3ϕApperent 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
Power Demand: Range: -999TW → 999TW
Current Demand: Range: 0 → 2*Rated Current In

ACCURACY
Voltage: cl. 0,5% ± 1 digit
Current: cl. 0,5% ± 1 digit
3 Ph Active Power: cl. 1% ± 1 digit
3 Ph Active Energy: cl. 1% ± 1 digit

MAX. POWER CONSUMPTION
6 VA (4 W)

RELATIVE HUMIDITY
Max. 90% (non-condensing)

BURN IN

MECHANICAL
Back connections, 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: 90+1 x 90+1 mm
Weight: 700 gr.

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

UNDERVOLTAGE MONITORING*
Number of Stage: 1
Required voltage: >5% Vn, applied in all phases
Pickup level: 30% → 100% of Vn, Steps: 1%
Reset level: 31% → 100% of Vn, Steps 1%
Delay time: 0.5 s → 600.0 s, Steps: 0.5 s
Phases: Any one, any two, all three (programmable)
Minimum Operation level: 0 → 50% of Vn
Accuracy: See Voltage Inputs
Timing accuracy: ± 0.1 s or 1% setpoint (worst case)

OVERVOLTAGE MONITORING*
Number of Stages: 1
Pickup level: 101% → 155% Vn (Must be under max input V)
Steps: 1%
Reset level: 100% → 150% Vn, Steps 1%
Delay time: 0.5 s → 600.0 s, Steps: 0.5 s
Phases: Any one, any two, all three
(programmable)
Accuracy: See Voltage Inputs
Timing accuracy: ± 0.1 s or 1% setpoint (worst case)

ACTIVE POWER MONITORING*
Number of Stages: 2 (Positive and Negative)
Pickup level: 1kW → 200000kW, Steps: 1, 20, 200
Dropout Level: Fixed 98% setpoint
Delay time: 0.5 s → 600.0 s, Steps: 0.5 s
Timing accuracy: ± 0.1 s or 1% setpoint (worst case)

CURRENT DEMAND MONITORING*
Number of Stages: 3 (Phase A, B and V)
Demand Period: 1 min → 60 min, Steps: 1 min
Pickup level: 2% → 400% In, Steps: 1%
Dropout Level: Fixed 98% setpoint
Delay time: 0.5 s → 600.0 s, Steps: 0.5 s
Timing accuracy: ± 0.1 s or 1% setpoint (worst case)

POWER DEMAND MONITORING*
Number of Stages: 3 (3ϕKW, 3ϕKVar, 3ϕKVA)
Demand Period: 1 min → 60 min, Steps: 1 min
Pickup level: 1kW/kVar/kVA → 200000kW/kVar/kVA
Dropout Level: Fixed 98% setpoint
Delay time: 0.5 s → 600.0 s, Steps: 0.5 s
Timing accuracy: ± 0.1 s or 1% setpoint (worst case)

GROUND OVERCURRENT MONITORING*
Pickup level: 2% → 500% In, Steps: 1%
Reset Level: 1% → 398% In, Steps: 1%
Delay time: 0.5 s → 600.0 s, Steps: 0.5 s
Timing accuracy: ± 0.1 s or 1% setpoint (worst case)

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 EMR-100 version
+Depending on Voltage, Current connection type

48 hours at 50 °C

OUTPUT CONTACT *(See Section 1.8 Order Code)*
Rated load: 8 A@240 Vac Resistive
             8 A@24 Vdc Resistive (0,2 A @125 Vdc)
Max. switching voltage: 400 Vac / 150 Vdc
Max. continuous current: 5 A

1.8 ORDER CODE

Model	RMS Volt Amp	Freq.	KW, KVA, KVAR, demand	KWh	Power Factor	Phase Sequence	Currents Voltage Harmonics	THD Voltage Current	Ground OverCurrent	Max +/- KW Under/Over Volt. KW demand	Events	Communication Port	Cloud Ready**
			Metering						**Output Contact Threshold Level**			**Communication & Smart Functions**	
EMR-1000	o	o	o	o	o	o							
EMR-1001	o	o	o	o	o	o	o	o				Modbus RTU & Bluetooth	YES
EMR-1002	o	o	o	o	o	o			o		o		
EMR-1003	o	o	o	o	o	o				o	o		
EMR-1004	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:

COMPANY NAME AND CONTACTS
MADE IN ITALY
POWER SUPPLY
PHASE, GROUND, CURRENT INPUTS RATINGS
VOLTAGE INPUTS RATING
MODEL
SERIAL No.
CE Marking

2.2 UNPACKING

The shipping container includes:

- Product model ordered
- Instruction manual (if required)
- (3) Current Transformers (if required)

- Fixing elements
- Test Report (if required)

Inspect the device 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: 1.7 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.
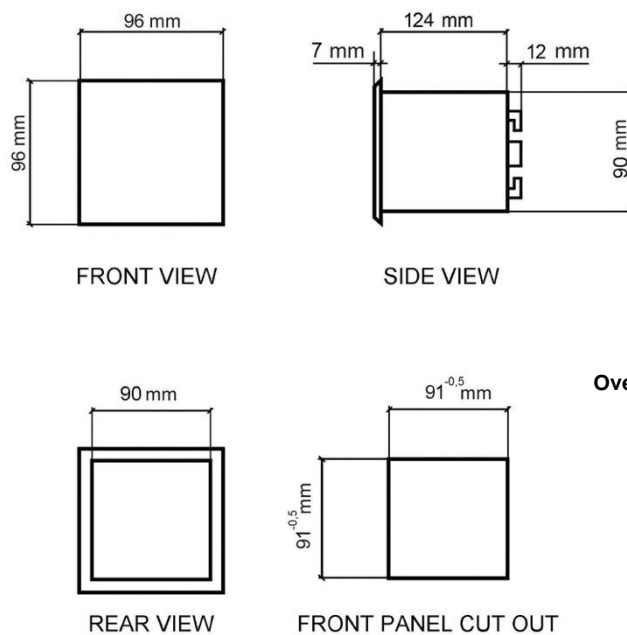
Figure 2.1
Overall dimensions

2.4 WIRING

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

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 device, 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 device and of the content of this manual.
ⓘ	The digital input must be connected only to dry contact circuits to avoid damaging the *Electrical Multimeter & Monitoring Relay.* No external voltage should be applied to the corresponding terminals as they are energized internally from the relay and opto-coupled to the sensing circuitry.
⚡	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: → 1.7 Specifications
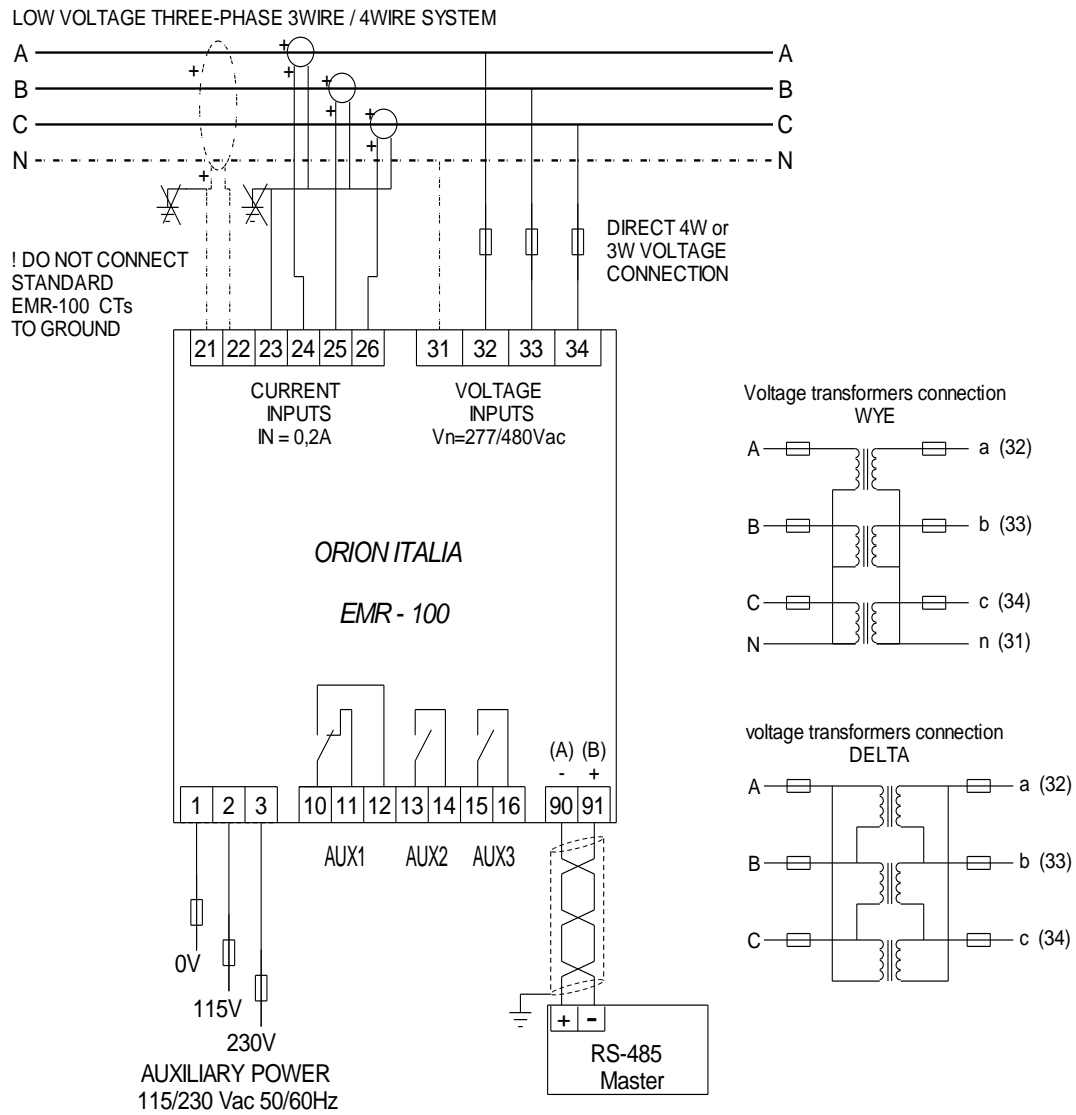
Figure 2.3 – **Wiring diagram**

(!)	Do not connect CTs to ground.
(!)	When VTs are used, their primary and secondary must be grounded or not depending on local standards or regulations.

2.5 CURRENT TRANSFORMERS (CT)

See [APPENDIX A].

2.6 COMMUNICATIONS

Thanks to the three-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.
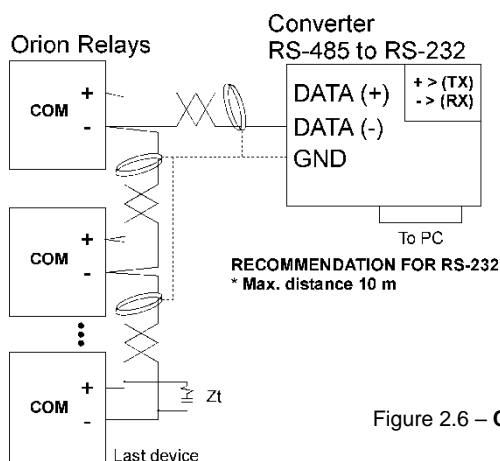
Figure 2.6 – **Communications**

2.7 POWER SUPPLY

Voltage ranges for the relay → *[General Information: 1.7 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 device. 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	→	product reset

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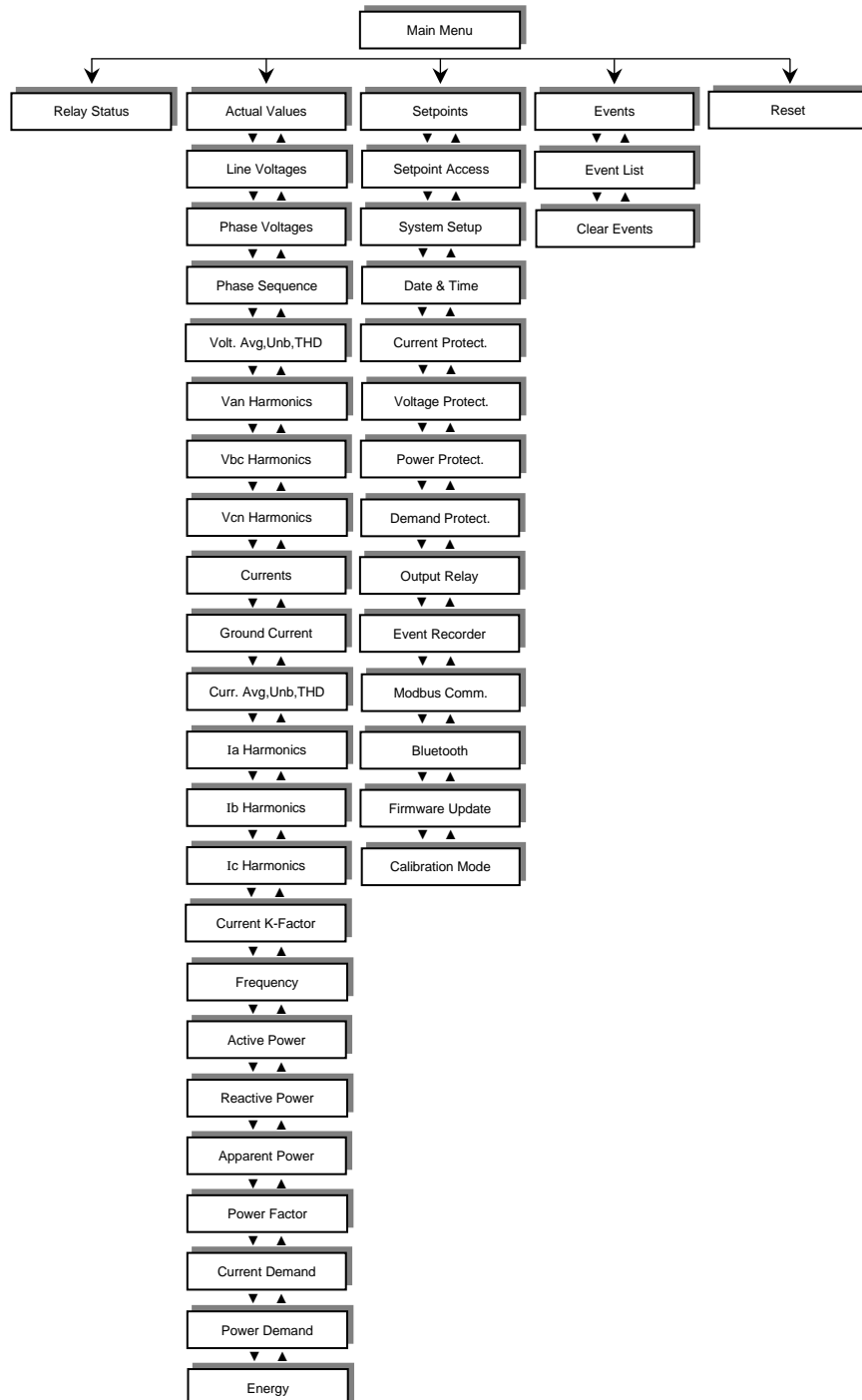
3.2 AUTOSCROLL FUNCTION

When turned ON, the device will cyclically show the following screens from the Actual Values Menu:
Line Voltages, Phase Voltages+, Currents, Ground Current, 3 Phase Power, Power Factor, Power Demand, Frequency.
The Autoscroll mode will also be activated five (5) minutes after complete inactivity.
Press any key to return to the Main Menu.

+Depending on Voltage, Current connection type

3.3 POP-UP FUNCTION

Whenever the device trips, the display will immediately show a POP-UP screen with the cause of the last trip 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

There are 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
         EMR-100  F.V. X.XX

```

To modify the First-Level password, press **ENTER**.

```
          Setpoint Access
           ORION ITALIA
         EMR-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 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

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

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

To modify the Phase CT Rating value, press **ENTER** and 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 Enabled
Password incorrect >> Setpoint Access Disabled

This screen does not appear if the user has previously inserted the correct password.

```
           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
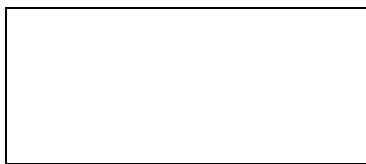
This figure on the left represents the relay display.

[*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 tripped protections, internal faults and/or setpoint discrepancies.
The maximum number of alerts present on the screen is four (4), additional alerts will not be shown.
Normal conditions >> No Active Protection

[APPENDIX C] for all possible status.

5. Menu *ACTUAL VALUES*

Actual Values	Line Voltages	Phase Voltages	Phase Sequence	Volt. Avg,Unb,THD
Ground Current	Currents	Vcn Harmonics	Vbn Harmonics	Van Harmonics
Curr. Avg,Unb,THD	Ia Harmonics	Ib Harmonics	Ic Harmonics	Current K-Factor
Power Factor	Apparent Power	Reactive Power	Active Power	Frequency
Current Demand	Power Demand	Energy		
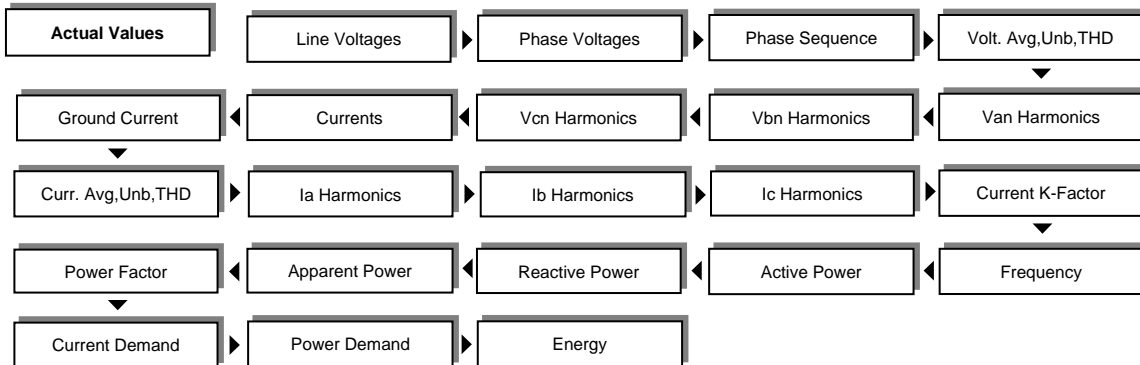
5.1 Actual values: LINE VOLTAGES

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

RMS value of Line Voltages.

5.2 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

5.3 Actual values: PHASE SEQUENCES

```
       Phase Sequence
             None
```

RMS value of Phase Sequence.

5.4 Actual values: VOLTAGE AVG,UNB,THD

```
     Voltage Avg,Unb,THD
Voltage Avg= 0.00 V
Voltage Unb= 0.00 %
THD= 0.0%
```

- Average of the 3 RMS values of line voltages
  Vavg=(|VAB| + |VBC| + |VCA|)/3.
- Unbalance voltage percentage (maximum of the three unbalance values).
- Voltage THD value (Total Harmonic Distortion).

5.5 Actual values: Van (Vab) HARMONICS

You can 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

5.6 Actual values: Vbn (Vbc) HARMONICS

You can 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.

5.7 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.

5.8 Actual values: CURRENTS

```
           Currents
Ia= 0.00 A
Ib= 0.00 A
Ic= 0.00 A
In= 0.00 A
```

RMS current value of phase *a*, *b*, *c* and neutral *n*.

Neutral current In is the vector sum of Ia, Ib and Ic.
It will only be displayed if [*6.2 Setpoints: SYSTEM SETUP*] is Direct 4W or Wye.
In case of ground fault, the In value might be affected by the ground current.

5.9 Actual values: GROUND CURRENT

```
        Ground Current
Ig= 0.00 A
```

Ground Current measured by Zero Sequence (homopolar) CT.

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

5.10   Actual values: CURRENT AVG,UNB,THD

```
   Current Avg,Unb,THD
Current Avg= 0.00 V
Current Unb= 0.00 %
THD= 0.0%
```

- Average of the 3 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).

5.11   Actual values: Ia HARMONICS

```
        Ia Harmonics
Ia2nd= 0.00 %
…
Ia11th= 0.00 %
```

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

5.12   Actual values: Ib HARMONICS

```
        Ib Harmonics
Ib2nd= 0.00 %
…
Ib11th= 0.00 %
```

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

5.13   Actual values: Ic HARMONICS

```
        Ic Harmonics
Ic2nd= 0.00 %
…
Ic11th= 0.00 %
```

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

5.14   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).

5.15   Actual values: FREQUENCY

```
         Frequency
Frequency= 0.0 Hz
```

System Frequency value (Hz). The frequency is calculated from VT input (A-N voltage in case of Direct 4W or Wye connection, A-B voltage in case of Direct 3W or Delta connection).

5.16   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]*.

5.17   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]*.

5.18   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]*.

5.19   Actual values: POWER FACTOR

```
        Power Factor
Pf= 0.00
```

Three-phase Power Factor.
The value could vary from 0.00 LAGGING up to 0.00 LEADING.
In case of insufficient current or voltage, the value shown will be 0.00 N.A.

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

5.20   Actual values: CURRENT DEMAND

```
            Demand
Ia= 0.00 A
Ib= 0.00 A
Ic= 0.00 A
```
▼

Phase A, B and C Current Demand.

```
            Demand
Max Ia= 0.00 A

        DD-MM-YY  hh:mm:ss
```
▲ ▼

Maximum Demand Ia registered with the relative date and time.

```
            Demand
Max Ib= 0.00 A

        DD-MM-YY  hh:mm:ss
```
▲ ▼

Maximum Demand I$_b$ registered with the relative date and time.

```
            Demand
Max Ic= 0.00 A

        DD-MM-YY  hh:mm:ss
```
▲ ▼

Maximum Demand Ic registered with the relative date and time.

```
            Demand
Clear Current Max
Demand?
            No
```
▲

Press **ENTER**, insert the First-Level (PSW1) or Second-Level password (PSW2) and scroll ▲ ▼.
Select YES to clear the Demands.

5.21   Actual values: POWER DEMAND

```
        Demand
3P= 0 W
3Q= 0 VAR
3A= 0 VA

```
▼

Three-phase Active, Reactive and Apparent Power Demand.

```
        Demand
Max 3P= 0.00 W

    DD-MM-YY  hh:mm:ss

```
▲ ▼

Maximum Demand 3P registered with the relative date and time.

```
        Demand
Max 3Q= 0.00 VAR

    DD-MM-YY  hh:mm:ss

```
▲ ▼

Maximum Demand 3Q registered with the relative date and time.

```
        Demand
Max 3A= 0.00 VA

    DD-MM-YY  hh:mm:ss

```
▲ ▼

Maximum Demand 3A registered with the relative date and time.

```
        Demand
Clear Power Max
Demand?
            No

```
▲

Press **ENTER**, insert the First-Level (PSW1) or Second-Level password (PSW2) and scroll ▲ ▼.
Select YES to clear the Demands.

5.22   Actual values: ENERGY

```
        Energy
Act+= 0 Th
Act- = 0 Th
React+= 0 Th
React- = 0 Th
```
▼

- Total amount of positive and negative Active Energy accumulated from the Last Energy Clear (kWh, MWh, GWh or TWh)
- Total amount of positive and negative Reactive Energy accumulated from the Last Energy Clear (kVArh, MVArh, GVArh 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?
            No

```
▲

Press **ENTER,** insert the Second-Level password (PSW2) and scroll ▲ ▼.
Select YES to clear the stored energy data.

This type of clearing requires at least a Second-Level password (PSW2).

6. Menu *SETPOINTS*

> ⓘ Before carrying out the programming of the device, 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 device and of the content of this manual.

Setpoints	→	Setpoint Access	▶	System Setup	▶	Date & Time	▶	Current Protection

▼

Event Recorder	◀	Output Relay	◀	Demand Protection	◀	Power Protection	◀	Voltage Protection

▼

Modbus Comm.	▶	Bluetooth	▶	Firmware Update	▶	Calibration Mode
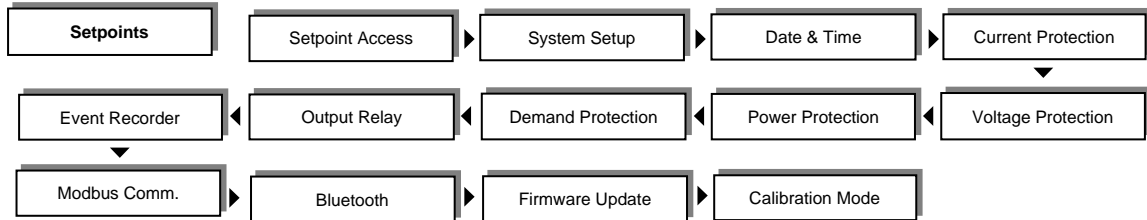
6.1 Setpoints: SETPOINT ACCESS

```
        Setpoint Access
          ORION ITALIA
      EMR-100X  F.V. X.XX
```

Device 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

```
        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
This value is found on the transformer nameplate.
Choose Cust/0.2A (Custom CT) if the transformer has a rating outside the range.
All three-phase current transformers must have the same rating.

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

RANGE: 5A/0.2A ÷ 6000/0.2A
STEPS: 1, 5, 50
All three-phase current transformers must have the same rating.

```
        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 EMR-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: direct connection of phase CT input to the power cable (without voltage transformers) of a 3-wire system.
Direct 4W: direct connection of phase CT input to the power cable (without voltage transformers) of a 4-wire system.
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 /√3 V
```

RANGE: 80 ÷ 480
STEPS: 1
Only if *[6.2 Setpoints: SYSTEM SETUP: VT Connection: Direct 4W]* this screen will show the VT Rated Secondary Rating as **value/√3**.

```
            System Setup
VT Rated Primary
Value
                      10.0 /√3 kV
```

RANGE: 80 ÷ 130 kV
STEPS: 5 V, 50 V; 0.5 kV
Only if *[6.2 Setpoints: SYSTEM SETUP: VT Connection: Direct 4W]* this screen will show the VT Rated Primary Rating as **value/√3**.

6.3 Setpoints: DATE & TIME

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

Press **ENTER** to modify.

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

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.
6.   Note: press **ENTER**, the decimals of the seconds will begin from zero (0).

6.4 Setpoints: CURRENT PROTECTION

The voltage thresholds in the following setpoints are expressed in percentage of rated current of ground current transformer (Zero Sequence CT).
Setpoints 6.4 will only appear if *[6.2 Setpoints: SYSTEM SETUP: Ground Sensing: ENABLED]*.

```
        Current Protect.
GND OverCurrent
Relay - - -
```

RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3
Select the output relay that will be set in motion when the ground current exceeds the GND OverCurrent threshold for the defined delay time.
If no relay is selected, the function will not be active.

```
        Current Protect.
GND OverCurrent
Level
Value
                        10 %CT
```

RANGE: 2 %CT ÷ 400 %CT
STEPS: 1
This value represents the ground overcurrent threshold.
If the ground current exceeds this threshold for a time ≥ the GND OverCurrent Delay, the ground overcurrent condition will occur.

```
        Current Protect.
GND OverCurrent
Reset
Value
                        8 %CT
```

RANGE: 1 %CT ÷ 398 %CT
STEPS: 1
Enter the percentage at which the faulty condition GND OverCurrent drops out and the EMR-100 can be reset.
Output relay = Latched >> manual reset.
Output relay = Autoreset >> automatic reset.
See [6.8 Setpoints: OUTPUT RELAY]

```
        Current Protect.
GND OverCurrent
Delay
Value
                        0.5 s
```

RANGE: 0.5 s ÷ 600 s
STEPS: 0.1, 1
If the ground current ≥ GND OverCurrent Level for the amount of time programmed on this screen, a ground overcurrent condition will occur.

6.5 Setpoints: VOLTAGE PROTECTION

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

```
        Voltage Protect.
UnderVoltage1 Protect.
                        - - -
```

RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3
Select the output relay that will be set in motion when the voltage drops below UnderVoltage1 threshold for the programmed time.
If no relay is selected, the function will not be active.

```
        Voltage Protect.
UnderVoltage1 Level
Value
                        80 %VT
```

RANGE: 30 %VT ÷ 100 %VT
STEPS: 1
This value represents the UnderVoltage1 threshold.
If the voltage drops below this threshold for a time ≥ to the UnderVoltage1 Delay, the UnderVoltage1 condition will occur.

```
        Voltage Protect.
UnderVoltage1 Reset
Value
                        85 %VT
```

RANGE: 31 %VT ÷ 100 %VT
STEPS: 1
Enter the percentage at which the faulty condition UnderVoltage1 drops out >> the EMR-100 can be reset.
Output relay = Latched >> manual reset.
Output relay = Autoreset >> automatic reset.
See [6.8 Setpoints: OUTPUT RELAY]

```
        Voltage Protect.
UnderVoltage1 Delay
Value
                      0.5 s
```

RANGE: 0.5 s ÷ 600 s
STEPS: 0.1, 1
If the voltage ≤ UNDERVOLTAGE1 LEVEL for the time programmed in this setpoint, an under voltage condition will occur.

```
        Voltage Protect.
UnderVoltage1 Phase
Operat.
Value
                   ANY ONE
```

RANGE: ALL THREE; ANY TWO; ANY ONE
Select the minimum number of phases on which the faulty condition has to occur before UnderVoltage1 intervenes.

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

RANGE: 0 %VT ÷ 50 %VT
STEPS: 1
Enter the voltage limit value under which the UnderVoltage1 protection is disabled.

```
        Voltage Protect.
OverVoltage1 Protect.
                   - - -
```

RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3
Select the output relay that will be set in motion when the voltage exceeds the OverVoltage1 threshold for the programmed time.
If no relay is selected, the function will not be active.

```
        Voltage Protect.
OverVoltage1 Level
Value
                  115 %VT
```

RANGE: 101 %VT ÷ 150 %VT
STEPS: 1
If the voltage exceeds this threshold for a time ≥ the OverVoltage1 Delay, the OverVoltage1 condition will occur.

```
        Voltage Protect.
OverVoltage1 Reset
Value
                  110 %VT
```

RANGE: 100 %VT ÷ 150 %VT
STEPS: 1
Enter the percentage at which the faulty condition OverVoltage1 drops out >> reset the EMR-100.
Output relay = Latched >> manual reset.
Output relay = Autoreset >> automatic reset.
See [6.8 Setpoints: OUTPUT RELAY]

```
        Voltage Protect.
OverVoltage1 Delay
Value
                      0.5 s
```

RANGE: 0.5 s ÷ 600 s
STEPS: 0.1, 1
If the voltage ≥ OVERVOLTAGE1 LEVEL for the time programmed in this setpoint, an over voltage condition will occur.

```
        Voltage Protect.
OverVoltage1 Phase
Operat.
Value
                   ANY ONE
```

RANGE: ALL THREE; ANY TWO; ANY ONE
Select the minimum number of phases on which the faulty condition has to occur before OverVoltage1 intervenes.

6.6 Setpoints: POWER PROTECTION

```
        Power Protect.
Positive KW Protect.
                   - - -
```

RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3
Select the output relay that will be set in motion when the power exceeds the Positive kW threshold for the programmed time.
If no relay is selected, the function will not be active.

Power Protect. **Positive KW Level** Value 10 kW	RANGE: 1 kW ÷ 200000 kW STEPS: 1, 20, 200 Enter the Positive Active Power intervention value.

Power Protect. **Positive KW Delay** Value 0.5 s	RANGE: 0.5 s ÷ 100 s STEPS: 0.1, 1 If the Positive Active Power ≥ POSITIVE KW LEVEL for the time programmed in this setpoint, an excess positive active power condition will occur.

Power Protect. Negative KW Protect. - - -	RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3 Select the output relay that will be set in motion when the power exceeds the Negative kW threshold for the programmed time. If no relay is selected, the function will not be active.

Power Protect. **Negative KW Level** Value 10 kW	RANGE: 1 kW ÷ 200000 kW STEPS: 1, 20, 200 Enter the Negative Active Power intervention value.

Power Protect. **Negative KW Delay** Value 0.5 s	RANGE: 0.5 s ÷ 100 s STEPS: 0.1, 1 If the Negative Active Power ≥ NEGATIVE KW LEVEL for the time programmed in this setpoint, an excess negative active power condition will occur.

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

6.7 Setpoints: DEMAND PROTECTION

Demand Time Period
Once Demand Period, or Phase CT Rating Primary *[6.2 Setpoints: SYSTEM SETUP]*, or VT Primary and Secondary, etc., has been set up, the relay will begin sampling kWs, kvars, kVA and current every five (5) seconds.

Demand Calculation
The Current and Voltage Demands are calculated on the basis of the values read in the related time intervals which are set in Demand Time Period. This method calculates a linear average of the RMS current, the active power, the reactive power or the apparent power over the programmed Demand Time Period. Each new value of demand becomes available at the end of each time period.

$$\bar{M} = \frac{\int_{t_1}^{t_2} f(t)dt}{t_2 - t_1} \qquad \textit{Demand calculation in } [t_1; t_2]$$

Demand Protect. **Amps Demand Time Period** Value 5 min	RANGE: 1 min ÷ 60 min STEPS: 1 Specify AMPS Demand Time Period. This value is the integration time used to determine the current demand.

Demand Protect. Ph-A Amps Demand Relay - - -	RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3 Phase A Current Demand condition can be associated with the activation of the AUX 1; AUX 2; AUX 3 contact or disabled. If no relay is selected, the function will not be active.

Demand Protect. **Ph-A Amps Demand** **Level** Value 100 %CT	RANGE: 2 %CT ÷ 400 %CT STEPS: 1 Enter the Phase A Current Demand threshold.

Demand Protect. Ph-B Amps Demand Relay - - -	RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3 Phase B Current Demand condition can be associated with the activation of the AUX 1; AUX 2; AUX 3 contact or disabled. If no relay is selected, the function will not be active.

Demand Protect. **Ph-B Amps Demand** **Level** Value 100 %CT	RANGE: 2 %CT ÷ 400 %CT STEPS: 1 Enter the Phase B Current Demand threshold.

Demand Protect. Ph-C Amps Demand Relay - - -	RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3 Phase C Current Demand condition can be associated with the activation of the AUX 1; AUX 2; AUX 3 contact or disabled. If no relay is selected, the function will not be active.

Demand Protect. **Ph-C Amps Demand** **Level** Value 100 %CT	RANGE: 2 %CT ÷ 400 %CT STEPS: 1 Enter the Phase C Current Demand threshold.

Demand Protect. **Power Demand Time** **Period** Value 5 min	RANGE: 5 min ÷ 60 min STEPS: 1 Specify the Power Demand Time Period. This value is the integration time used to determine the power demand.

Demand Protect. KW Demand Relay - - -	RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3 Active Power Demand condition can be associated with the activation of the AUX 1; AUX 2; AUX 3 contact or disabled. If no relay is selected, the function will not be active.

Demand Protect. **KW Demand** **Level** Value 10 kW	RANGE: 1 kW ÷ 200000 kW STEPS: 1, 20, 200 Enter the Active Power Demand threshold.

Demand Protect. KVAR Demand Relay - - -	RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3 Reactive Power Demand condition can be associated with the activation of the AUX 1; AUX 2; AUX 3 contact or disabled. If no relay is selected, the function will not be active.

```
            Demand Protect.
KVAR Demand
Level
Value
                    10 kVAR
```

RANGE: 1 kW ÷ 200000 kW
STEPS: 1, 20, 200
Enter the Reactive Power Demand threshold.

```
            Demand Protect.
KVA Demand
Relay - - -
```

RANGE: ANY COMBINATION OF AUX 1; AUX 2; AUX 3
Apparent Power Demand condition can be associated with the activation of the AUX 1; AUX 2; AUX 3 contact or disabled.
If no relay is selected, the function will not be active.

```
            Demand Protect.
KVA Demand
Level
Value
                    10 kVAR
```

RANGE: 1 kW ÷ 200000 kW
STEPS: 1, 20, 200
Enter the Apparent Power Demand threshold.

6.8 Setpoints: OUTPUT RELAY

```
            Output Relay
Aux1 Output Relay
Value
                    LATCHED
```

RANGE: LATCHED; AUTORESET
-    LATCHED: a fault condition will cause the AUX1 Output to energize indefinitely and the TRIP led to turn on.
     If fault conditions are no longer present, press RESET to de-energize and consequently, the TRIP led will turn off.
-    AUTORESET: a fault condition will cause the AUX1 Output Relay to energize and the TRIP led to turn on.
     If fault conditions are no longer present, the AUX1 Output Relay and the TRIP led will automatically de-energize.

```
            Output Relay
Aux2 Output Relay
Value
                    LATCHED
```

RANGE: LATCHED; AUTORESET
-    LATCHED: a fault condition will cause the AUX2 Output to energize indefinitely and the TRIP led to turn on.
     If fault conditions are no longer present, press RESET to de-energize and consequently, the TRIP led will turn off.
-    AUTORESET: a fault condition will cause the AUX2 Output Relay to energize and the TRIP led to turn on.
     If fault conditions are no longer present, the AUX2 Output Relay and the TRIP led will automatically de-energize.

```
            Output Relay
Aux3 Output Relay
Value
                    LATCHED
```

RANGE: LATCHED; AUTORESET
-    LATCHED: a fault condition will cause the AUX3 Output to energize indefinitely and the TRIP led to turn on.
     If fault conditions are no longer present, press RESET to de-energize and consequently, the TRIP led will turn off.
-    AUTORESET: a fault condition will cause the AUX3 Output Relay to energize and the TRIP led to turn on.
     If fault conditions are no longer present, the AUX3 Output Relay and the TRIP led will automatically de-energize.

6.9 Setpoints: EVENT RECORDER

You can enable/disable the recording of selected events. 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

<table>
<tr><td>
Event Recorder
Output Relays
Events
Value
ENABLED
</td><td>RANGE: ENABLED; DISABLED</td></tr>
</table>

<table>
<tr><td>
Event Recorder
Voltage Protect.
Events
Value
ENABLED
</td><td>RANGE: ENABLED; DISABLED</td></tr>
</table>

<table>
<tr><td>
Event Recorder
Current Protect.
Events
Value
ENABLED
</td><td>RANGE: ENABLED; DISABLED</td></tr>
</table>

<table>
<tr><td>
Event Recorder
Power Protect.
Events
Value
ENABLED
</td><td>RANGE: ENABLED; DISABLED</td></tr>
</table>

<table>
<tr><td>
Event Recorder
Demand Protect.
Events
Value
ENABLED
</td><td>RANGE: ENABLED; DISABLED</td></tr>
</table>

6.10 Setpoints: MODBUS COMMUNICATION

This section contains setpoints that control the EMR-100 communication with other devices.

<table>
<tr><td>
Modbus Comm.
Modbus
Address 1
Value
1
</td><td>RANGE: 1 ÷ 247
STEPS: 1
Modify the Modbus ID.</td></tr>
</table>

<table>
<tr><td>
Modbus Comm.
RS-485
Baudrate
Value
9600
</td><td>RANGE: 9600; 19200; 38400; 57600; 115200
Select the Baud rate.</td></tr>
</table>

<table>
<tr><td>
Modbus Comm.
RS-485
Config.
Value
8N1
</td><td>RANGE: 8N1; 8N2; 8E1; 8E2; 8O1; 8O2
Specify the parity and the Stop-bit.</td></tr>
</table>

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

6.11 Setpoints: BLUETOOTH

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

```
            Bluetooth
Device Name
Value
        EMR–XXXX–XXXXXX
```

Modify the Bluetooth ID.
If an external device carries out a Bluetooth scan, the EMR-100 will appear with the Device Name specified on the screen.

6.12 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 EMR-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**.

```
        Firmware Update
      Ready to be Updated
```

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

6.13 Setpoints: CALIBRATION MODE

When the user is operating the setpoints on this menu, the EMR-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

```
        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 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
        ZCeDJEDMBTM=
```

A code similar to the example on the screen uniquely identifies the EMR-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.

```
          Calibration Mode
K Time
Value
              0.00
```

RANGE: -116 ☐ 116
Internal clock calibration value.
DO NOT MODIFY.
This setpoint is factory calibrated.
If modified, contact Orion Italia.

7.   Menu *EVENTS*

7.1 EVENT LIST

The EMR-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 *[6.9 Setpoints: EVENT RECORDER]*.

<table>
<tr><td>
Events
Event List
Clear Events
</td><td>
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 device will confirm the clearing by showing Events Data Cleared.
</td></tr>
</table>

<table>
<tr><td>
Event List
Event *X*
Type of event
DD-MM-YY hh:mm:ss
</td><td>
-    Event ID
-    Event description
-    Time stamp
Press **ENTER** to view the electrical values at the time of the Event.
</td></tr>
</table>

<table>
<tr><td>
Event X
Van= 0.00 V
Vbn= 0.00 V
Vcn= 0.00 V
▼
</td><td>
In case of Direct 4W or Wye, Phase Voltage values will be shown.
In case of Direct 3W or Delta, Line Voltage values will be shown.
</td></tr>
</table>

<table>
<tr><td>
Event X
Ia= 0.00 A
Ib= 0.00 A
Ic= 0.00 A
Ig= 0.00 A
▲ ▼
</td><td>
Phase and Ground Current values.
Ground Current (Ig) will appear only if [*6.2 Setpoints: SYSTEM SETUP:* Ground Sensing: ENABLED].
</td></tr>
</table>

<table>
<tr><td>
Event X
3P= 0 W
Pf= 0.00
Frequency= 0.0 Hz
▲
</td><td>
-    Three-phase Active Power
-    Three-phase Power Factor
-    System Frequency
</td></tr>
</table>

7.2 CLEAR EVENTS

<table>
<tr><td>
Events
Clear All Events?
No
</td><td>
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 device will confirm the clearing by showing Events Data Cleared.
</td></tr>
</table>

8. Menu *RESET*

> (!) All the programming must be carried out by qualified personnel with adequate knowledge of the operation of the device and of the content of this manual.

8.1 RESET

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

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 down ENT and ESC contemporarily for more than two seconds.

9. Troubleshooting

RELAY CANNOT TURN ON
- Check 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.

SWITCH INPUTS MALFUNCTIONING
- Check for proper operating following *[6.13 Setpoints: CALIBRATION MODE]* instructions.

OUTPUT RELAYS (TERMINALS N. 10 to 16) MALFUNCTIONING
- Check for proper operating following *[6.13 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.
  - o Check that UnderVoltage Reset is not <= UnderVoltage Level
  - o Check that OverVoltage Reset is not >= OverVoltage Level
  - o Only if *[6.6 Setpoints: STANDARD PROTECT.*: Reset TC Mode = LEVEL]; check that TC Reset is not >= TC Level
  - o Only if *[6.2 Setpoints: SYSTEM SETUP*: Out of Service Relay = AUX1]; check that no protection is enabled on Out of Service Relay
  - o Only if *[6.2 Setpoints: SYSTEM SETUP*: Out of Service Relay = AUX1]; check that *[6.2 Setpoints: SYSTEM SETUP*: Trip Relay ≠ AUX1]
  - o Check that the output associated with Trip Relay **is not** the same as the one associated with Power Contact Failure Relay
  - o 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 "EMR-100 CT" are used for current sensing on EMR-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 EMR-100 CT has 4 terminals; the table shown below allows to select the correct ratio:

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

$^+$Positive terminal
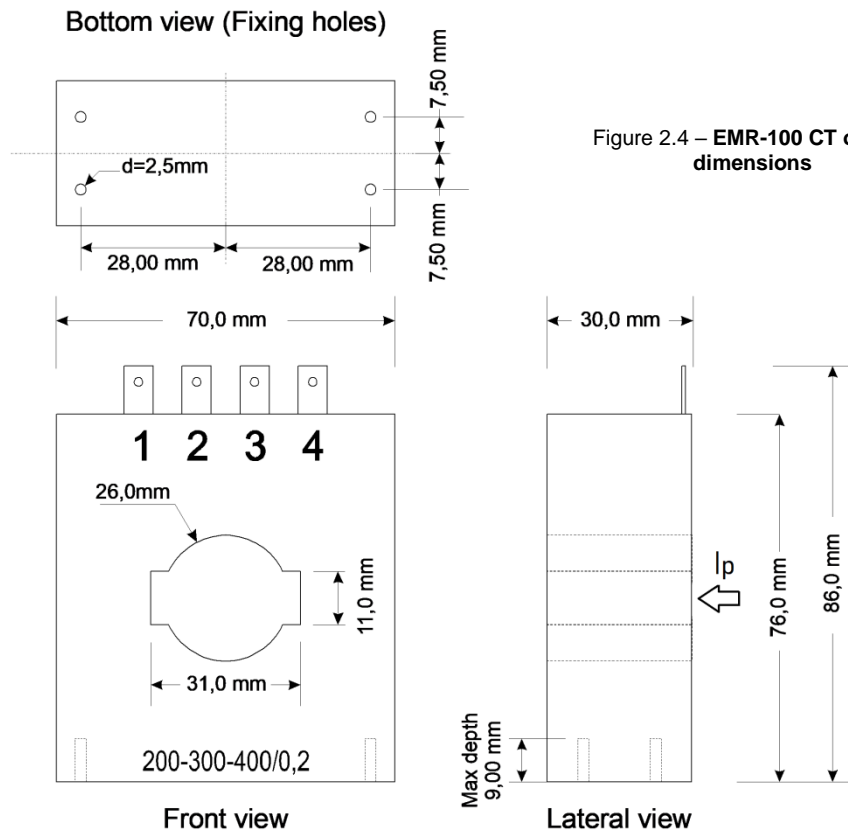
Figure 2.4 – **EMR-100 CT overall dimensions**

Figure 2.5 – **EMR-100 CT technical data**

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

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

Sensitive ground current detection can be achieved using a Zero Sequence detection method as shown in *Figure 2.3*. 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

<u>Using a CT that is different from the EMR-family standards</u>:

Please take note, all CTs must have a secondary rated current 0.2 A.
The device 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:

[6.2 Setpoints: SYSTEM SETUP]

Phase CT Rating	→	select "Cust/0.2 A"
Custom Phase CT Rating	→	insert the phase primary nominal current of the C
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 Current Max. Demand		X	X	X	
Reset Power Max. Demand		X	X	X	
Reset Energy			X	X	
Factory Default			X	X	Calibration values, Energy and Events will remain the same. The passwords and the Max. Demands (Current and Voltage) will be reset.
Calibration Values				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.
Setpoint Discrepancy	A discrepancy was found in the stored setpoints.
Trip Memory	A trip occurred and it is no longer present. The EMR-100 will indicate this phrase on the status and will activate the corresponding Memory led.
ADC Failure	Analog to digital converter internal failure.
Flash Failure	Flash internal failure.
BLE Failure	Bluetooth low energy internal failure.
RAM Failure	Ram internal failure.
OverVoltage1	Trip for over voltage threshold, reached.
UnderVoltage1	Trip for under voltage threshold, reached.
Ground Overcurrent	Trip for ground overcurrent threshold, reached.
Ph-A Current Demand	Trip for phase A current demand threshold, reached.
Ph-B Current Demand	Trip for phase B current demand threshold, reached.
Ph-C Current Demand	Trip for phase C current demand threshold, reached.
Positive Power	Trip for positive active power threshold, reached.
Negative Power	Trip for negative active power threshold, reached.
Active Power Demand	Trip for active power demand threshold, reached.
Reactive Power Demand	Trip for reactive power demand threshold, reached.
Apparent Power Demand	Trip for apparent power demand threshold, reached.

APPENDIX D

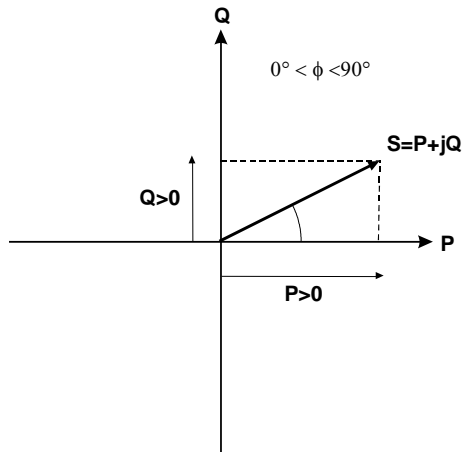The following is an explanation of power flow designation used in the EMR-100.

S = P+jQ

S = Apparent Power
P = Active Power = VIcosϕ
Q = Reactive Power = VIsenϕ
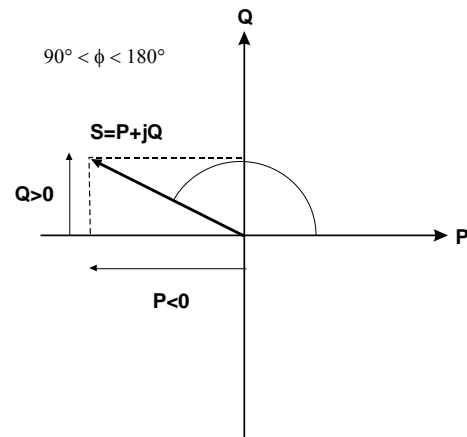ϕ = the phase angle by which I lags V

$0° < \phi < 90°$

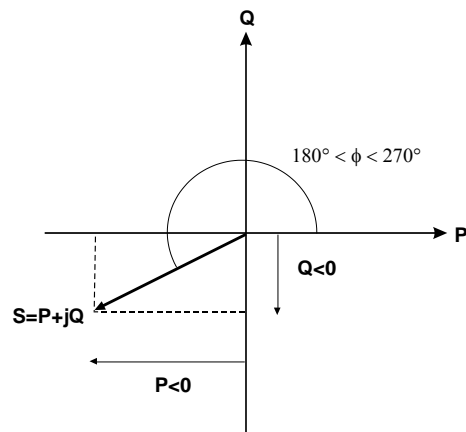Power Factor lagging
P (Watt): is being absorbed by the load.
Q (Var): is being absorbed by the load.

$90° < \phi < 180°$

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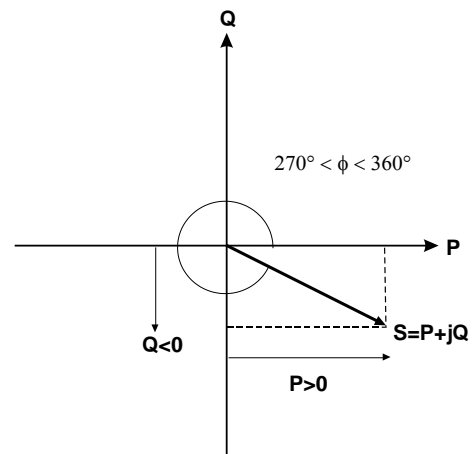**P (Watt)**: is being supplied by the load.
Q (Var): is being absorbed by the load.

$180° < \phi < 270°$

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

$270° < \phi < 360°$

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	
Events Clear	It indicates there was a clearing of events.
Undervoltage1	There was an Undervoltage1 trip.
Gnd Overcurrent	There was a Gnd Overcurrent trip.
Overvoltage1	There was an Overvoltage1 trip.
Aux1 Reset	The condition that kept the output energized was reset and the corresponding output relay status went from energized to de-energized.
Aux2 Reset	The condition that kept the output energized was reset and the corresponding output relay status went from energized to de-energized.
Aux3 Reset	The condition that kept the output energized was reset and the corresponding output relay status went from energized to de-energized.
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.
Aux Power Loss	Auxiliary power supply interaction or power off.
Aux Power Restored	EMR-100 power supply was restored.
ADC Failure	Internal fault occurred in the digital analogic converter.
Flash Failure	Internal fault occurred in the flash.
BLE Failure	Internal fault occurred in the Bluetooth module.
Energy Data Lost	It indicates there was an error in the memorized Energy value.
Current Demand Lost	It indicates there was an error in the Current Demand value.
Power Demand Lost	It indicates there was an error in the Power Demand value.
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).*
Default Sp. Loaded	In case of internal fault, the EMR-100 has been reset back to default setpoint values.
Positive Power	There was a Positive Power trip.
Negative Power	There was a Negative Power trip.
Energy Clear	The user deleted the Energy value.
Current Demand Clear	There was a Current Demand trip.
Power Demand Clear	There was a Power Demand trip.
New Period Curr. Dem.	The corresponding demand period has been initialized by a Modbus command or due to a modification of the setpoint Time Period.
New Period Pow. Dem.	The corresponding demand period has been initialized by a Modbus command or due to a modification of the setpoint Time Period.
Phase-A Current Demand	There was a Phase-A Current Demand trip.
Phase-B Current Demand	There was a Phase-B Current Demand trip.
Phase-C Current Demand	There was a Phase-C Current Demand trip.
Active Power Demand	There was an Active Power Demand trip.
Reactive Power Demand	There was a Reactive Power Demand trip.
Apparent Power Demand	There was an Apparent Power Demand trip.
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.
Calibration Data Lost	The EMR-100 has lost the Calibration data values.
Memory Status Lost	Following a restart of the EMR-100, the device is not capable of reaching the same status present before it was restarted.
Energy Restored	The EMR-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.