ORION ITALIA

INSTRUCTION MANUAL

SMPR

Summarize measurement and protection relay

Software rev.: SMPR S1.50
Manual P/N: SMPR GBM 08/11/2021

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 SPECIFICATION;
   - 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.

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 followed. Pay attention to the information signalled by this symbol, as it refers to situations that 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.

I N D E X

1. General information

1.1 DESCRIPTION

The summarize measurement and protection relay SMPR has been designed to measure the RMS line and ground leakage currents and the line or phase voltages in normal conditions or under disturbances. The current and voltage signals are sensed through current transformers (CT) and voltage transformers (VT); after processing the data, the current protections are defined according to ANSI, IAC or IEC standard. The relay also signals the operational conditions of the breaker or disconnector.

1.2 APPLICATIONS

- Primary or secondary protection for generation and distribution systems.
- Protection of loop and radial lines in MV e LV.
- Protection of transformers, overhead lines, cables, motors and generators.

1.3 PROTECTION AND FUNCTIONALITY

Description **ANSI**

- Undervoltage **27**
- Directional power **32**
- Undercurrent **37**
- Current unbalance / Negative sequence **46**
- Phase-sequence voltage **47**
- Instantaneous phase overcurrent **50**
- Instantaneous ground overcurrent ..... **50N** / **50G**
- CT primary ratio selectable in 5 A steps (5 A ÷ 5000 A).
- Inverse-time phase overcurrent **51**
  and Inverse-time ground overcurrent ..... **51N** / **51G**
  with curve selection according to ANSI, IAC or IEC/BS142:
  - moderately inverse
  - normally inverse
  - very inverse
  - extremely inverse
  - definite time
- Power factor **55**
- Overvoltage **59**
- Blocking output **68**
- Overfrequency and underfrequency **81**
- Lockout **86**
- Breaker operation failure alarm on trip command
- KA accumulated per phase on circuit breaker interruption
- Integral relay test with or without the output contacts intervention
- Overload alarm level
- 1 trip relay
- 3 auxiliary relays that can be associated with the various functions
- 3 programmable Digital Inputs + 1 Digital Input for Breaker Status

Information

The following information concerns the use of the Actual values and the Setpoints.

CURRENT PROTECTIONS

SMPR continuously checks the 3 phase currents, negative sequence and the ground current by means of its CTs and activates an alarm and/or the circuit breaker trip when a value exceeds the set level (called *Pickup* level):

1. possibility of separately setting of the timed overcurrent, instantaneous overcurrent and alarm overcurrent;
2. separate managing of the phase and ground overcurrent setpoints;
3. phase and ground overcurrent intervention delay according to time-current curve set and to the entity of current;
4. phase undercurrent, current unbalance and negative sequence current protections
5. negative sequence phase overcurrent intervention delay according to the time current curve set and to the entity of current.

The 5 selectable time-current curve shapes are the following:
- moderately inverse
- normally inverse
- very inverse
- extremely inverse
- definite time

The 3 programmed curve types are the following:
- ANSI
- IAC
- IEC / BS142

For each curve shape 200 different curves can be used to obtain different time delays by means of Time Multiplier from 0.1 to 20.

For the 3 possible curve types and their shapes see: → Appendix A

REMARK: when selecting the curve for the circuit breaker trip, make sure the max. input current to SMPR does not exceed 100 A for more than 1 second ⇒ the wrong combination of time and current could damage the unit and consequently provoke the loss of protection.

UNDERVOLTAGE AND OVERVOLTAGE PROTECTION
SMPR continuously checks the 3 phase voltages and the 3 line voltages by means of its VTs and activates the relevant outputs when a value exceeds the set level (called *Pickup* level).

UNDERFREQUENCY AND OVERFREQUENCY PROTECTION
Thanks to the analysis of the voltage at the input A, SMPR continuously checks the system frequency and intervenes whenever the setpoints are exceeded.

PHASE REVERSAL PROTECTION
SMPR continuously monitors the sequence of the line voltages by activating the relevant outputs whenever a reversal condition occurs.

POWER PROTECTION
The relay calculates the real power, the reactive power, the apparent power and the power factor. Thanks to continuous monitoring of these elements, SMPR can perform the following protection functions:
- max. real power
- max. negative real power (Reverse power protection – ANSI 32)
- max. reactive power
- max. negative reactive power
- independent setpoints for power factor Leading or power factor Lagging
- exceeding the current "Demand" setpoint[1]
- exceeding the power "Demand" setpoint [2]

[1] Current demand = average current calculated on a specified integration period (programmable)
[2] Power demand = average power calculated on a specified integration period (programmable)

LOCKOUT FUNCTION (ANSI 86)

SMPR can execute an electrical lock for any closing of the breaker or disconnector. Set **LOCKOUT ON AUX2** = **ON** [→ **SETPOINT PAGE 2 – SYSTEM SETUP**] in order to enable this function.
It is advisable to see the example of connection shown in the following figure.

When LOCKOUT function is enabled, AUX2 output must be used (in addition to other output like for example Trip) as output contact for any protection functions that must activate the lockout after its intervention.

After activating this function, in addition to the automatic locking by SMPR in the event of a trip, one of the digital inputs can be configured (for example, Digital input 1) for remote lockout. To do this, set **INPUT # FUNCTION = LOCKOUT** (86) [→ **SETPOINT PAGE 11 – DIGITAL INPUTS**].

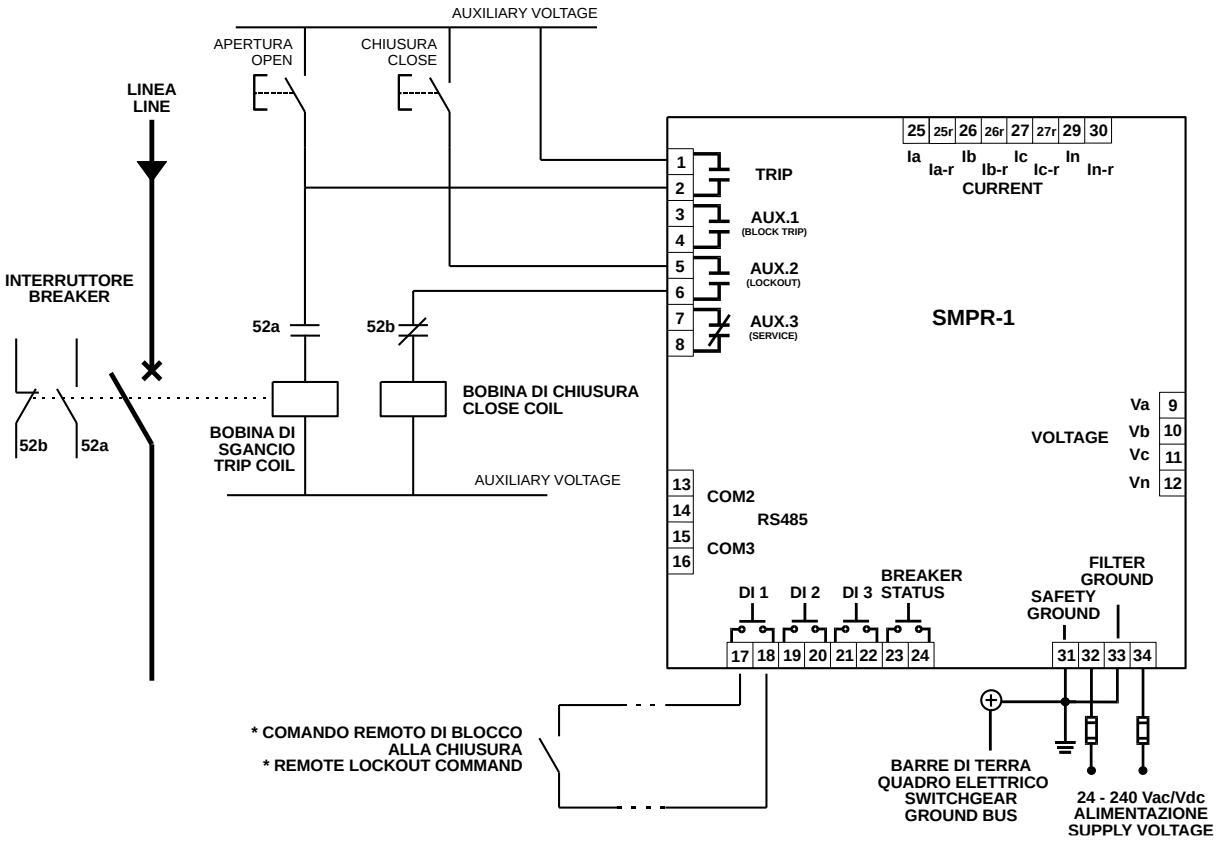


Fig. 1.1 - LOCKOUT FUNCTION – WIRING SAMPLE

LOGIC SELECTIVITY

In the event of a short circuit on the lines, SMPR can send a temporally block trip signal (function ANSI 68) to another relay or to another device in order to obtain a logic selectivity between the upstream device and the downstream device. If this function is required the following Setpoint must be set **BLOCK TRIP ON AUX1 = ON** [→ SETPOINT PAGE 2 – SYSTEM SETUP].

In cases of Ansi 50 or Ansi 50G situation (Short circuit condition) all the relay SMPR on the same feeder will see a current over the pickup level and they could trip. The SMPR, thanks to the logic selectivity function, can send a block trip command to the upstream relay at the instant it senses a higher than 50 or 50G pickup level, in order to temporally block upstream relay to trip. The downstream relay will trip after the 50 (or 50G) protection delay time and the other upstream relays will not trip.

In SETPOINT PAGE 2 – SYSTEM SETUP – **OPENING BREAKER TIME (Tob)** it is necessary to enter the time used by the opening device in order to break the circuit. After the time required for the trip of ANSI 50 protection, the relay will wait for a time equal to the one entered in **OPENING BREAKER TIME** and then it will re-open AUX1 contact, by interrupting the BLOCK TRIP command sent to the upstream relay. (This is a safety feature to avoid the upstream relay remains blocked even if the downstream breaker fails to open).

In order to complete the logic selectivity function, each of the three programmable digital inputs of SMPR upstream relay, can be set BLOCK TRIP in SETPOINT PAGE 11: **DIGITAL INPUT**. A digital input programmed in this way can receive a BLOCK TRIP command and prevent the intervention by SMPR for letting the downstream relays trip.

For safety reasons, in SMPR you can also set a maximum time for the incoming trip blocking, called **BLOCK TRIP DELAY (Tbt)**: If the downstream relay has a fault, or the wires from output to digital input are in short circuit or the SMPR digital input has a problem all the upstream SMPR will wait that maximum time **BLOCK TRIP DELAY** and then will trip.

For a correct functioning, the Tbt time in upstream relay must be > Tob + Downstream relay Ansi 50 (or 50G) delay time.

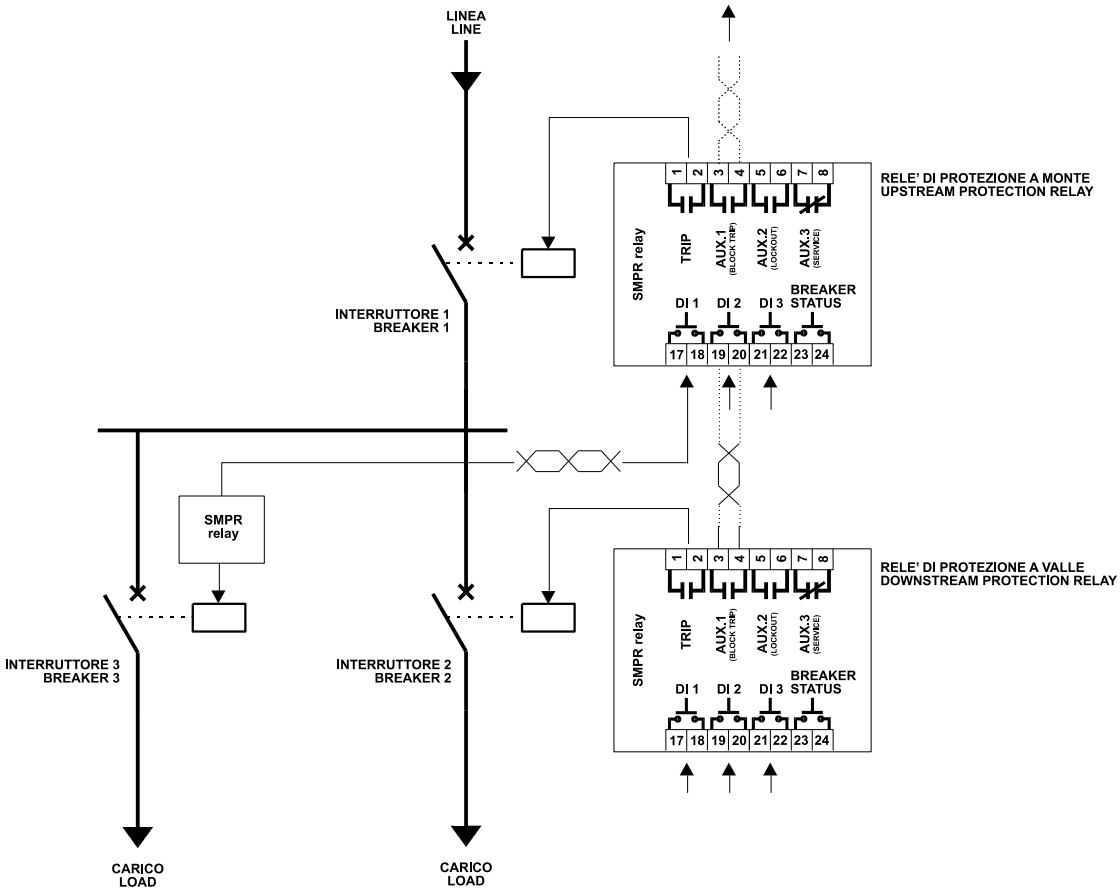


Fig. 1.2 - LOGIC SELECTIVITY – Blocking output/Blocking trip digital input – Wiring Diagram

NOTE: The upstream relay Ansi 50 delay time can not be instantaneous, because it must be greater than 1 power cycle internal relays analysis (20ms) + Digital Input Detection time (50ms); So the minimum delay time for upstream relay is 70 ms.

1.4 DIGITAL MEASUREMENT

1. True RMS Line & Ground Current
2. Average current
3. Unbalance current percentage
4. Current negative sequence
5. True RMS Phase or line voltage and average line voltage
6. System frequency
7. Positive and negative real power (kW), positive and negative reactive power (kvar) and apparent power (kVA)
8. Real energy (MWh) and reactive energy (Mvarh)
9. Power factor
10. Demand and maximum demand for:
    - current in each phase (A)
    - real power (kW)
    - reactive power (kvar)

1.5 SIGNALLING AND PROGRAMMING

- LCD & LED display indication
- Help messages
- Indication and storage of fault conditions and their values
- Indication on the **System status** [LED NAME ON SMPR]:

- circuit breaker or disconnector closed	[BREAKER CLOSED]
- circuit breaker or disconnector open	[BREAKER OPEN]
- circuit breaker or disconnector earthed	[BREAKER EARTHED]
- not used for this version of SMPR	[AUTO-RECLOSE ENABLE]
- not used for this version of SMPR	[AUTORECLOSE IN PROGRESS
- the LED is lit to indicate the relay is preventing any closing attempt	[LOCKOUT]

- Indication of the **relay status** [LED NAME ON SMPR]:

- LED “On”: the output relay has tripped to open the circuit breaker or disconnector. It stays “on” even when the output relay is programmed with PULSED mode - LED “Off”: it switches off when pressing RESET key only if the condition causing the fault is no more present	[TRIP]
- LED "On": "AUX1" output relay is energized or, if AUX1 has been set in PULSED MODE, the cause of the trip is still present	[AUX1]
- LED "On": "AUX2" output relay is energized or, if AUX2 has been set in PULSED MODE, the cause of the trip is still present	[AUX2]
- LED "On": "AUX3" output relay is energized or, if AUX3 has been set in PULSED MODE, the cause of the trip is still present	[AUX3]
- LED "On": an internal fault could compromise the functionality of the relay	[OUT OF SERVICE]

1.6 COMMUNICATION

- Remote communication using a PC or a PLC by 2 RS485 ports or 1 RS232 port (Ethernet port on request)
- Local and remote setting of the relay protections and features
- Fault and event recorder for statistical analysis
- Self-explicative program requiring no additional programming
- Remote opening or closing of the circuit breaker or disconnector

1.7 SPECIFICATIONS

SUPPLY VOLTAGE
Standard Version: 24÷310 Vdc, –15%, +10%
24÷240 Vac, –15%, +10%, 50/60 Hz
Ethernet Version: 48÷310 Vdc, –15%, +10%
48÷240 Vac, –15%, +10%, 50/60 Hz

MAX. POWER CONSUMPTION
Standard Version: 7 W or 12 VA (peak)
Ethernet Version: 8 W or 15 VA (peak)

TEMPERATURE RANGE
Operational: from 0 °C to +50 °C
Storage: from –20 °C to + 70 °C

RELATIVE HUMIDITY
Max.: 90% (non condensing)

DIELECTRIC WITHSTAND VOLTAGE
2 KV 60 s

BURN IN
48 hours at 50 °C

AMBIENT FEATURES
The relay must be installed in a room with the following features:
- indoor,
- dry, not dusty and not corrosive atmosphere.

OUTPUT CONTACT
Load: resistive (p.f. = 1)
inductive (p.f. = 0,4; L/R = 7ms)
Rated load: 250 Vac, 8 A or 30 Vdc, 8 A with p.f. =1
250 Vac, 5 A or 30 Vdc, 5 A with p.f. =0,4
Max. operating Voltage: 250 Vac, 125 Vdc
Max. operating Current: 8 A

CONSTRUCTION
In compliance with VDE, UL, CEI standards.

DIGITAL INPUT
Type: Dry contacts
Output: 24 Vdc, 10 mA (stabilized)

LED INDICATORS
Relay status: Trip, AUX1, AUX2, AUX3, Out of Service
System status: Circuit breaker closed, Circuit breaker open, Circuit breaker earthed, lockout, *auto-reclose enable, *auto-reclose in progress.
(*not used in this version)
Display (LCD): 16 x 2 digits
Display accuracy: Load current: ±1% @ 100% CT
System voltage: ±1% @ 100% VT

COMMUNICATIONS
Type: One RS232 port + two 2-wire RS485 ports, Full duplex, 1200÷19200 baud
Protocol: Modbus RTU
Functions: Reading/Writing of setpoints
Reading of actual values
Executing of commands

TERMINAL BLOCK
Fixed, for cables with section: 4 mm^2 (12 AWG).

FRAME
Auto-extinguishing ABS with frontal in polycarbonate (IP54)

ASSEMBLY
The relay has to be jointed to the structure fixing it with the help of the stirrup with screws.

DIMENSIONS
144 x 144 x 141 mm (→ Fig. 2.1 – SMPR overall dimensions)

FRONT PANEL CUTOUT
137 x 137 mm

WEIGHT
1.5 Kg

APPLICABILITY
System: Wye or delta three-phase;
Frequency: 50 and 60 Hz;
Current: max. 5000 A;
Voltage: max. 69 kV

PHASE AND GROUND CT INPUTS
Source CT: CT: 5÷5000 A.
Rated CT secondary: CT: 1 A or 5 A (specify with order).
Sampling: True RMS with 16 samples per cycle.
Bandwidth: 0÷100 Hz
CT burden: 0.25 VA per phase at rated secondary current.
Continuous: 10 A
Current withstand capac.: 1 second @100A

VOLTAGE INPUT
VT input: Secondary: 55÷254 Vac, Steps: 1 V;
Primary (Un): 0.10÷69 kV, Steps: 0.01/0.1 kV.
VT burden: 1 VA max.
Max. Continuous: 254 Vac phase-neutral.

CURRENT UNBALANCE

Pickup:	1÷99%, Steps: 1%
Delay:	0.05÷600 s, Steps: 0.01/0,1/1 s
Current accuracy:	±3% of set current at I>6%CT
Time accuracy:	±3% of trip time or ± 40ms (whichever is greater)

PHASE UNDERCURRENT (37)

Pickup:	2÷100%CT, Steps: 1%
Delay:	0.05÷600 s, Steps: 0.01/0,1/1 s
Current accuracy:	±3% of set undercurrent at I>6%CT
Time accuracy:	±3% of trip time or ± 50ms (whichever is greater).

PHASE INSTANTANEOUS OVERCURRENT (50)

Pickup level:	4÷1800% of CT, Steps: 10%
Definite time:	0÷2000 ms, Steps: 10ms
Current accuracy:	± 3% of the setting @ I<3xCT ± 6% of the setting @ I>3xCT
Time accuracy:	± 55 ms max. at I > 150% Ipk
Saturation:	18 times the CT rated current.

PHASE TIME OVERCURRENT (51)

Pickup level:	4÷300% CT, Steps: 1%
Definite time:	0.05÷600 s, Steps: 0.01/0.1/1s
Time multiplier:	0.1÷20.0; Steps: 0.1
Dropout level:	97% Ipk
Accuracy:	± 3% of the setting.
Def. Time accuracy:	included in ±3% or in ±45 ms (whichever is greater), at I >150% Ipk.

PHASE-SEQUENCE VOLTAGE (47)

Normal condition:	Sequence A-B-C = Sequenced
Fault condition:	Sequence A-C-B = Not Sequenced
Indef. condition:	Sequence NONE = the relay can not detect the voltage sequence
Delay:	0.05÷600 s, Steps: 0.01/0.1/1s

OVERVOLTAGE PROTECTION (59)

Pickup level :	1% to 150% VT; Steps: 1%
Dropout level:	1% to 150% VT; Steps: 1%
Delay:	0.0 to 600.0 s; Steps: 0.01/0.1/1 s
Pickup accuracy:	±0,5% of full scale at Vpk<200V ±1% of full scale at Vpk>200V
Reset accuracy:	±0,5% of full scale at Vpk<200V ±1% of full scale at Vpk>200V
Time accuracy:	±3% of trip time or ±30ms (whichever is greater) at 0ms time delay (no intentional delay) 70ms max at V>1.2Vpk
Operation Phases:	Any one / Any two / All three / Homopolar

UNDERVOLTAGE PROTECTION (27)

Pickup level :	15% to 100% VT; Steps: 1%
Dropout level:	15% to 100% VT; Steps: 1%
Curve:	*Inverse, Definite*
Delay:	0.0 to 600.0 s; Steps: 0.01/0.1/1 s
Pickup accuracy:	±1% of full scale (15 ≤ V ≤ 60) ±0,5% of full scale (60 < V ≤ 254)
Reset accuracy:	±1% of full scale (15 ≤ V ≤ 254)
Time accuracy:	±3% of trip time or ±40ms (whichever is greater) at 0ms time delay (no intentional delay) 90 ms max @ V < 80% Vpk
Operation Phases:	Any one / Any two / All three
Minimum oper. level:	0% to 100% VT; Steps: 1%

NEGATIVE SEQUENCE TIME OVERCURRENT (46)

Pickup level:	4÷300% CT, Steps: 1%
Time multiplier:	0.1÷20.0; Steps: 0.1
Dropout level:	97% Ipk
Accuracy:	± 3% of the setting.
Def. Time accuracy:	included in ±3% or in ±60 ms (whichever is greater), at I >150% Ipk.

GROUND INSTANTANEOUS OVERCURRENT (50G/50N)

Pickup level:	4÷1800% of CT, Steps: 10%
Definite time:	0÷2000 ms, Steps: 10ms
Current accuracy:	± 3% of the setting @ I<3xCT ± 6% of the setting @ I>3xCT
Time accuracy:	± 55 ms max. at I > 150% Ipk
Saturation:	18 times the CT rated current.

GROUND TIME OVERCURRENT (51G/51N)

Pickup level:	4÷300% CT, Steps: 1%
Definite time:	0.05÷600 s, Steps: 0.01/0.1/1s
Time multiplier:	0.1÷20.0; Steps: 0.1
Dropout level:	97% Ipk
Accuracy:	± 3% of the setting.
Def. Time accuracy:	included in ±3% or in ±45 ms (whichever is greater), for I >150% of pickup level.

POWER FACTOR PROTECTION (55)

Alarm and trip power factor

Pickup:	0.05÷1.00 Lag, Steps: 0.01 0.05÷1.00 Lead, Steps: 0.01
Delay:	0.5÷600 s, Steps: 0.5/1s
Accuracy:	±0.015 for V<150V & PF>0.5

UNDER-/OVERFREQUENCY PROTECTION (81)

Pickup Δf:	0.05÷9.99 Hz, Steps: 0.01 Hz
Dropout Δf:	0.01÷5 Hz, Steps: 0.01 Hz
Delay:	0.1÷600 s, Steps: 0.1 ms
Accuracy:	±0.1 Hz at Δf < 8Hz
Measured:	across A-N or A-B voltage
Time Accuracy	±3% or ±50 ms (whichever is greater) at delay time > 0.5 s

OVERCURRENT CURVES

Selection of phase and ground curves according to ANSI, IAC or IEC.

- Moderately inverse
- Normally inverse
- Extremely inverse
- Definite time

The curves are valid up to 18 times the CT rated current.

DEMAND MONITORING

(*Accuracies based on values ≤ 2 x CT and 125% VT*)

Measured values:	Current	[A]
	3ϕ Real power	[kW]
	3ϕ Reactive power	[kvar]
	3ϕ Apparent power	[kVA]
Measurement type:	Programmable block interval.	
Programmable time interval:	5÷60 min, Steps: 1 min.	
Pickup levels:	Current: 5÷5000A, Steps:5 A	
	Real power: 10÷650000kW, Steps: 10 kW	
	Reactive power: 10÷650000 kvar, Steps:10 kvar	
	Apparent power: 10÷650000 kVA, Steps:10 kVA	
Accuracy:	±3%	

MEASURED PARAMETERS

(*Accuracies on 100% CT and 100% VT*)

RMS current:	Phase A, B, C, Accuracy: ± 1% (full-scale)
RMS voltage:	Phase A-N (A-B), B-N (B-C), C-N (C-A), Accuracy: ± 1% (full-scale)
Frequency:	Measuring of phase A-N or A-B. Scale: 40.0÷70.0 Hz Accuracy: ± 0.05 Hz
Accuracies for 20% full scale<V<80% full scale,	10%CT< I <200%CT, PF > 0.5
3ϕ Real power:	-1000 ÷ +1000 MW Accuracy: ±3%
3ϕ Reactive power:	-1000 ÷ +1000 Mvar Accuracy: ±3%
3ϕ Apparent power:	0÷1500 MVA Accuracy: ±3%
Power factor:	Lag: 0.00÷1.00 Lead: 0.00÷1.00 Accuracy: ± 0.01 at PF>0.5
Wh:	Total, 1 hour 0÷4200 GWh Accuracy: ±3%
Varh:	Total, 1 hour 0÷4200 Gvarh Accuracy: ±3%

EMISSIONS TEST

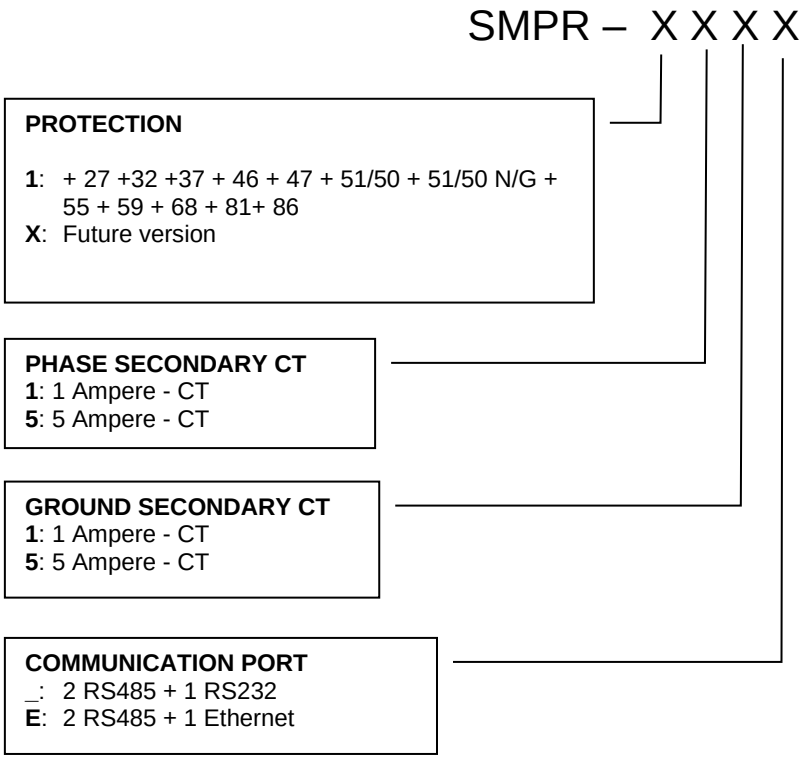
1. **Radiated emissions**
   Reference norms : EN 55011;
   Port: enclosure.
2. **Conducted emissions**
   Reference norms: EN 55011;
   Port: AC mains

IMMUNITY TESTS

1. **Conducted disturbances induced by RF field**
   Reference norms: EN 61000-4-6;
   Port: AC mains and signal lines.
2. **Radiated electromagnetic field**
   Reference norms: EN 61000-4-3; ENV 50204 ;
   Port: enclosure.
3. **Electrostatic discharge**
   Reference norms: EN 61000-4-2;
   Port: enclosure.
4. **Fast transients**
   Reference norms: EN 61000-4-4;
   Port: AC mains and signal lines.
5. **Surge**
   Reference norms: EN 61000-4-5;
   Port: AC mains.
6. **Voltage dips and short interruptions**
   Reference norms: EN 61000-4-11;
   Port: *AC mains.*

1.8 HOW TO READ THE ORDER CODE

The CT secondary must be specified when ordering (1 A or 5 A).
The meaning of the order code is the following:



2. Installing

2.1 IDENTIFICATION

On the plate in the back side of the relay SMPR you can find the following information:

ORION ITALIA	Manufacturer
PIACENZA 29100	Manufacturer's address
TEL.: 0523 – 591161	
FAX: 0523 – 593898	
www.orionitalia.com	Internet
MADE IN ITALY	
MODEL: SMPR	Model name
SERIAL No.	Serial number of the relay
MFG. DATE	Date of manufacture
CURRENT CTs (SEC)	It indicates the phase CT installed: 1 A or 5 A
GROUNG CTs (SEC)	It indicates the ground CT installed: 1 A or 5 A

2.2 UNPACKING

The shipping container contains:

- the relay SMPR
- this instruction manual
- the fixing elements
- the Test certificate (if required)

As soon as you receive the relay, inspect it 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 [→ § 1.7 – "Specification"] and away from high current conductors and sources of strong magnetic fields.
2. Put the relay inside a panel so that the keypad is easily accessible and the display is visible.
3. Make a cutout in the panelboard of: 137 x 137 mm [→ Fig. 2.1] and fix the relay by using the fixing elements provided with the relay.

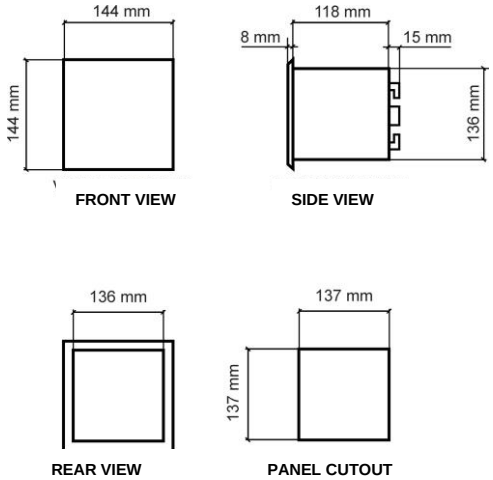


Figure 2.1 - **SMPR overall dimensions**

2.4 WIRING – OUTPUT RELAY AND DIGITAL INPUTS

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

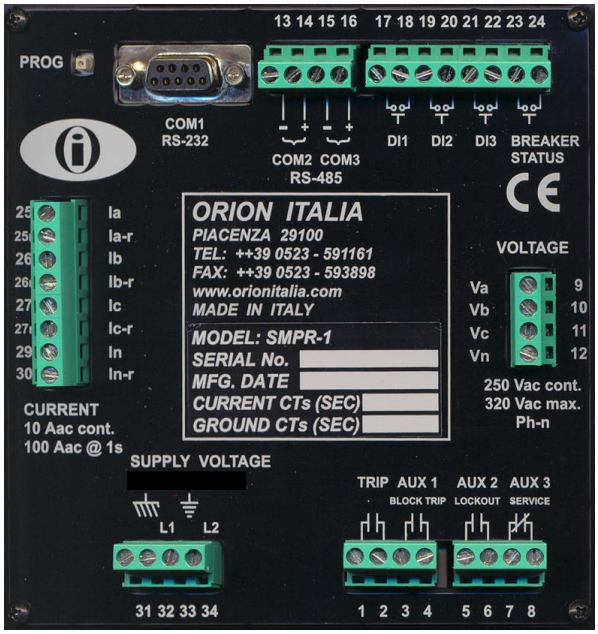


Figure 2.2 – **Rear view**

SWITCH INPUTS	TERMINALS No.
DIGITAL INPUT 1	**17 –18**
DIGITAL INPUT 2	**19 – 20**
DIGITAL INPUT 3	**21 – 22**
BREAKER STATUS	**23 – 24**

The 4 output relays on the SMPR are the following:

Relay	Type	Note	Terminals
TRIP	N.O.	Programmable: “pulsed” or “latched”	1 - 2
AUX1 (BLOCK TRIP)	N.O.	Programmable: “pulsed” or “latched” [if set as BLOCK TRIP: used for blocking trip of upstream relay during an Ansi 50 or 50G protection]	3 - 4
AUX2 (LOCKOUT)	N.O.	Programmable: “pulsed” or “latched” [if set as LOCK OUT: used for avoiding circuit breaker closing]	5 - 6
AUX 3 (SERVICE)	N.C.	Programmable: “pulsed” or “latched” [if set as SERVICE: used for signalling any control power drop or internal fault]	7 - 8

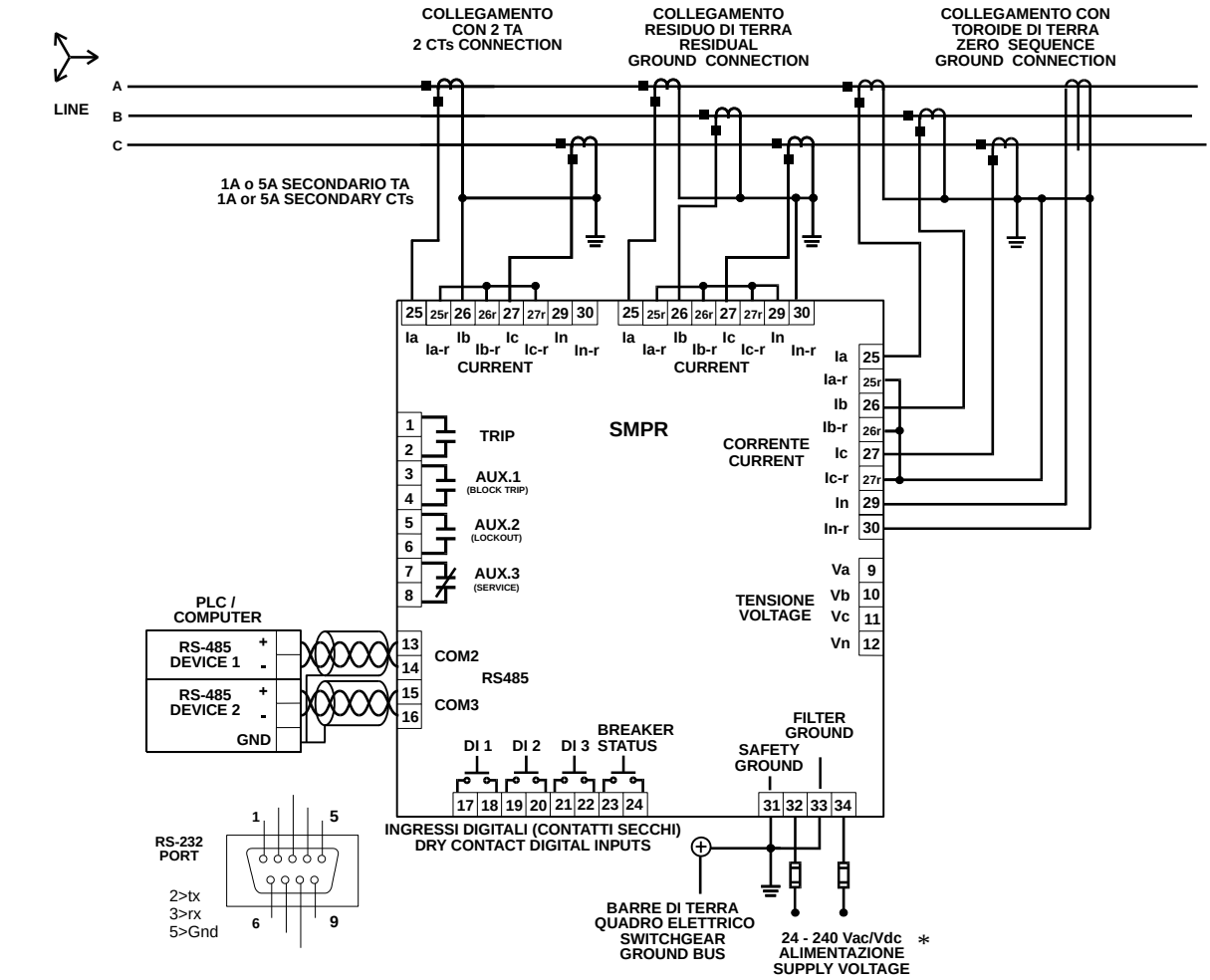
- In Fig. 2.3 the relays contacts are represented in condition of no power supply.
- Generally, the circuit breaker AUX 52a contact is connected in series to SMPR TRIP contact for cutting the current to the coil. For high-absorption trip coils an auxiliary relay is needed.
- The service contact is failsafe: it reacts in case of control power drop or of internal fault of the unit. The contact is N.C. Connect the SERVICE relay to an external alarm system. For configuring AUX3 relay as a service relay: → "Setpoint Page 2 - OUT OF SERVICE ON AUX3".

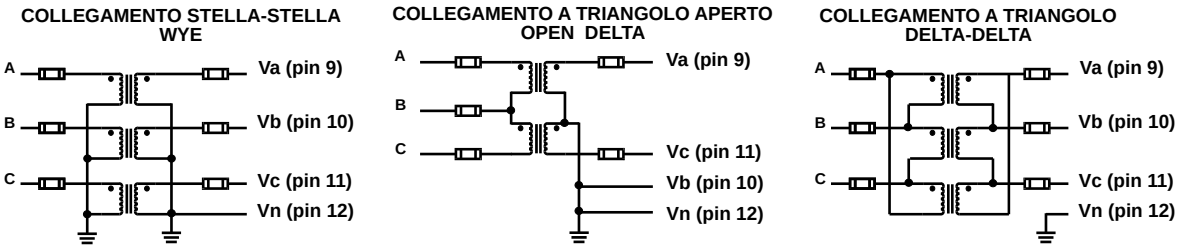
The switch inputs must be connected only to dry contact circuits so as to avoid damaging the relay SMPR.

No external voltage should be applied to the corresponding terminals as they are energized internally from the relay SMPR and opto-coupled to the sensing circuitry.
Switch outputs should be isolated from each other for correct operation. The maximum input impedance to these switches outputs is 2 kΩ.

The control power must be connected to terminals **32** and **34**.

Further information: → § 1.7 – "Specification".





* 48 – 240 Vac/Vdc for model with Ethernet

Figure 2.3 – **Wiring diagram**

2.5 CURRENT TRANSFORMERS (CT)

CTs with 1 A or 5 A secondary rated current must be used for current sensing. The choice of the CTs performances must ensure a sufficient power and the non-saturation in case of short circuit.
The 3 or 4 transformers providing a current that is proportional to the phase or ground current must be connected to terminals from no. **25** to no. **30** [→ Fig. 2.3].
Normally SMPR uses the "RESIDUAL GROUND CONNECTION" [→ Fig. 2.3] to sense ground current.
For greater accuracy, it is advisable to use the 4th CT: Zero Sequence toroid and, in this case, if the shield passes through the CT, then the conductor grounding the shield must pass again through the CT window in the opposite direction in order to nullify any contribution of the shield in the calculation of the current to ground [→ Fig. 2.4].

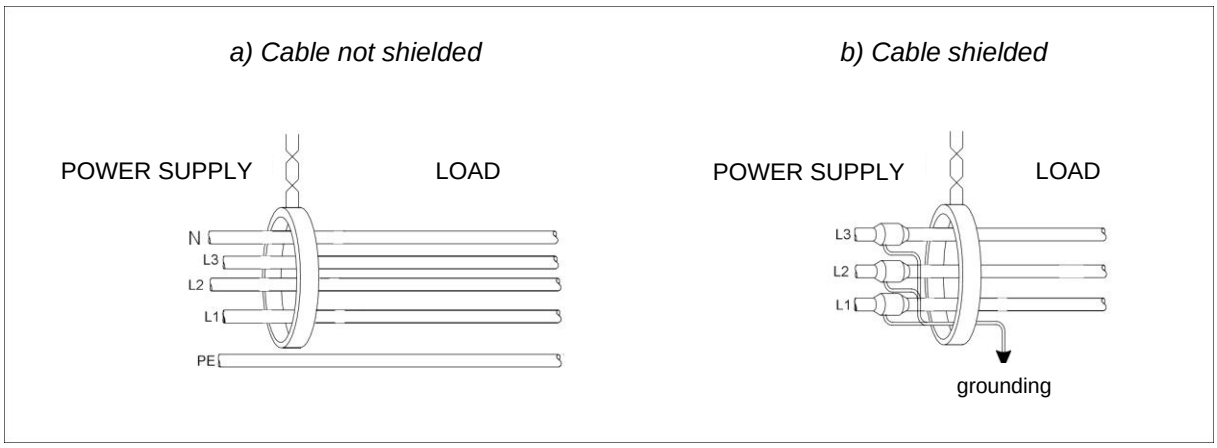


Figure 2.4 – **Cable shield**

Observe correct polarity when connecting the CTs to the relay. The CT secondary marked terminal (usually with the S1 mark on it) must be connected to the relay terminal marked with **Ia**, **Ib** or **Ic**. Each CT should have the same orientation and the points identifying the magnetic directions must be connected as shown in Fig. 2.3.

2.6 VOLTAGE TRANSFORMERS

The VTs are required to sense the system voltage and they must be connected to terminals from no. **9** to no. **12** of the relay.
The configurations of the connections can be as follows:

- wye
- delta-delta
- open delta

[→ Fig. 2.3].

If the VTs connection is:

- open delta
- delta-delta,

the zero sequence voltage cannot be sensed and thus displayed. Consequently, the ground directional protection will be deactivated.

2.7 CIRCUIT BREAKER STATUS AND CONTROL CONNECTIONS

Connect the circuit breaker AUX 52a contact to terminals **23** and **24** to display the circuit breaker status on SMPR.

2.8 DIRECTIONAL POWER

SMPR can determine the direction of the power flux:

- power with reverse direction (Negative) ⇔ the message in "ACTUAL VALUES" will show the sign "–" on the left of the number.
- power with normal direction (Positive) ⇔ no sign will be shown in the message in "ACTUAL VALUES".

2.9 COMMUNICATIONS (for Ethernet version see Annex A)

Thanks to the serial ports, a PC or PLC can make the monitoring and controlling of the relay SMPR.
For connecting directly the SMPR to a PC or PLC by RS-232 port, use a Female-Male DB-9 cable NOT CROSSED.

For connecting the SMPR by RS-485 port, see the Fig. 2.4

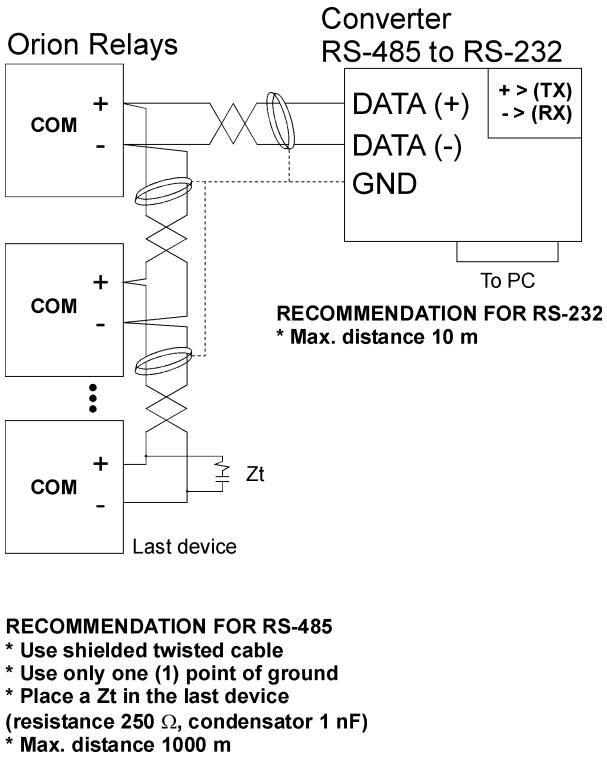


Figure 2.4– **Communications diagram**

Note: Do not connect more than 32 relays on a single RS-485 channel.
For increasing the number of relays on a single channel to more than 32 contact ORION ITALIA.

2.10 CONTROL POWER

- Voltage ranges for SMPR Standard ..... **20 ÷ 341 Vdc**
  20 ÷ 264 Vac
  SMPR with Ethernet ..... **41 ÷ 341 Vdc**
  41 ÷ 264 Vac

- Power supply connection terminals ..... **32** and **34**.

No internal or external adjustments are required to use any of the voltages included in the two indicated intervals.
For the external protection, SMPR has no internal fuses.

2.11 SYSTEM GROUNDING

On the rear side of the relay there are two separate grounds [→ Fig. 2.2]:

- Internal metal chassis parts and external shield safety ground terminal **31**

- Surge suppression components ground terminal (grounded to separate filter ground) **33**

For reliable operation both grounds must be connected directly to the ground bus bars of the switchgear. Do not connect the ground connection to the switchgear metal frame because low impedance to ground cannot be guaranteed.

2.12 HIPOT TESTING

Hipot testing carried out by the Manufacturer:

- Voltage ..... **2000 Vac, 50 Hz**
- Time (under voltage) ..... **1 minute**

Disconnect the communication terminals and filter ground during dielectric strength testing (hipot) or damages to the internal surge protection devices may occur.

If hipot testing is to be performed on an installed relay for insulation verification, all remaining terminals except for:

- Safety ground terminal + external shield **31**
- Surge suppression components ground terminal (grounded to separate filter ground) **33**

should be connected in parallel.

3. How to use the menu

3.1 MENU STRUCTURE

SMPR menu is a tree-structure type, consisting of:

- **PAGE** → subsequent for function access;
- **LINE** → for each PAGE.

3.2 MENU ACCESS

You can have access to the menu by pressing one of the following keys:

□ **SET POINTS** ⇒ *It activates the menu for setting functions and variables*.

□ **ACTUAL VALUES** ⇒ *It activates the menu for selecting the actual values to be displayed*.

3.3 MENU SURFING

For menu surfing, use one of the following keys:

▲PAGE ⇒ *Next PAGE*.

▼PAGE ⇒ *Previous PAGE.*

□ **LINE** ⇒ *Next LINE in the actual PAGE*.

3.4 SELECTING AND STORING KEYS

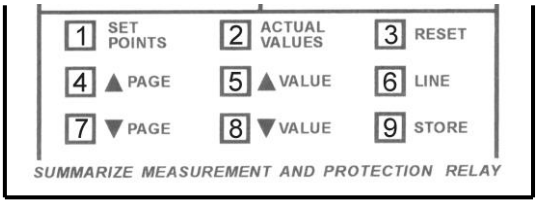
Use the following keys for selecting and storing data:

▲VALUE ⇒ *For scrolling the values or the options to the end of the actual range.*

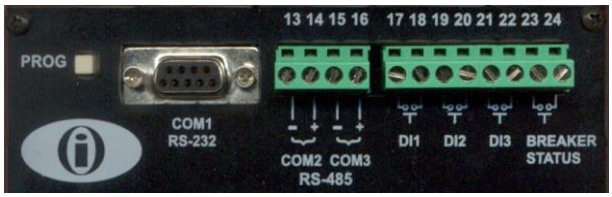
▼VALUE ⇒ *For scrolling the values or the options to the beginning of the actual range*.

□ **STORE** ⇒

- *For storing the newly entered data*.
- *It requires the entering of the access code* (111).
- *It switches the keypad operation mode for entering the digits (1 to 9) positioned as shown in the figure*.



PROG key is positioned on the back of the relay. It can be used to enter new data in SETPOINTS or ACTUAL VALUES menu (range: YES/NO) without entering the access code.



Press **PROG** key instead of: **ENTER ACCESS CODE +** □ **STORE** Key

3.5 QUICK SURFING GUIDE

The operation mode of the **PAGE, LINE**, **VALUE** and **STORE** keys is described in details only in the description of the PAGE 1 of the SETPOINT Menu. As the mode for surfing is the same in the other pages, the use of these keys, starting from the second PAGE of the Menu, will not be repeated.

The following summary is intended to be a QUICK SURFING GUIDE:

PAGE: these two keys allow going from one PAGE to the next one [▲] or to the previous one [▼].

LINE: this key allows going from one LINE to the next inside the same PAGE. At the last LINE of the PAGE, it allows to go to the next PAGE.

VALUE: these two keys allow to select range values, decreasing [▼] or increasing [▲], or to select two or more options [for example NO and YES].

STORE: this key allows to store the data and to enter the access code.
Any modifying not confirmed by **STORE** will be ignored.

3.6 SYMBOLS USED IN THE TEXT

The SMPR display is represented by this figure.

Next to each Line, on the right side of the display, “RANGE:” will be displayed and followed by digits or options separated by the following symbols:

Symbol	Meaning
;	You can select only among the elements of the list that are all clearly listed and separated by the “semi-colon”.
÷	**You can select among all values included in the limits indicated.**

FOR EXAMPLE:

RANGE: 2; 3; 6 ⇒ you can select only one of the three digits: **2**, or **3,** or **6**

RANGE: 2 ÷ 6 ⇒ you can select **2**, or **3**, or **4**, or **5**, or **6**.

In the SETPOINT Pages (except for PAGE 1), the value indicated in this manual in the 2nd line of the display has been set by the Manufacturer of the relay.

This symbol indicates the key that must be pressed.

3.7 MENU STRUCTURE

The following page includes the complete structure of the SMPR Menu Pages.

The following keys can activate the two menus represented:

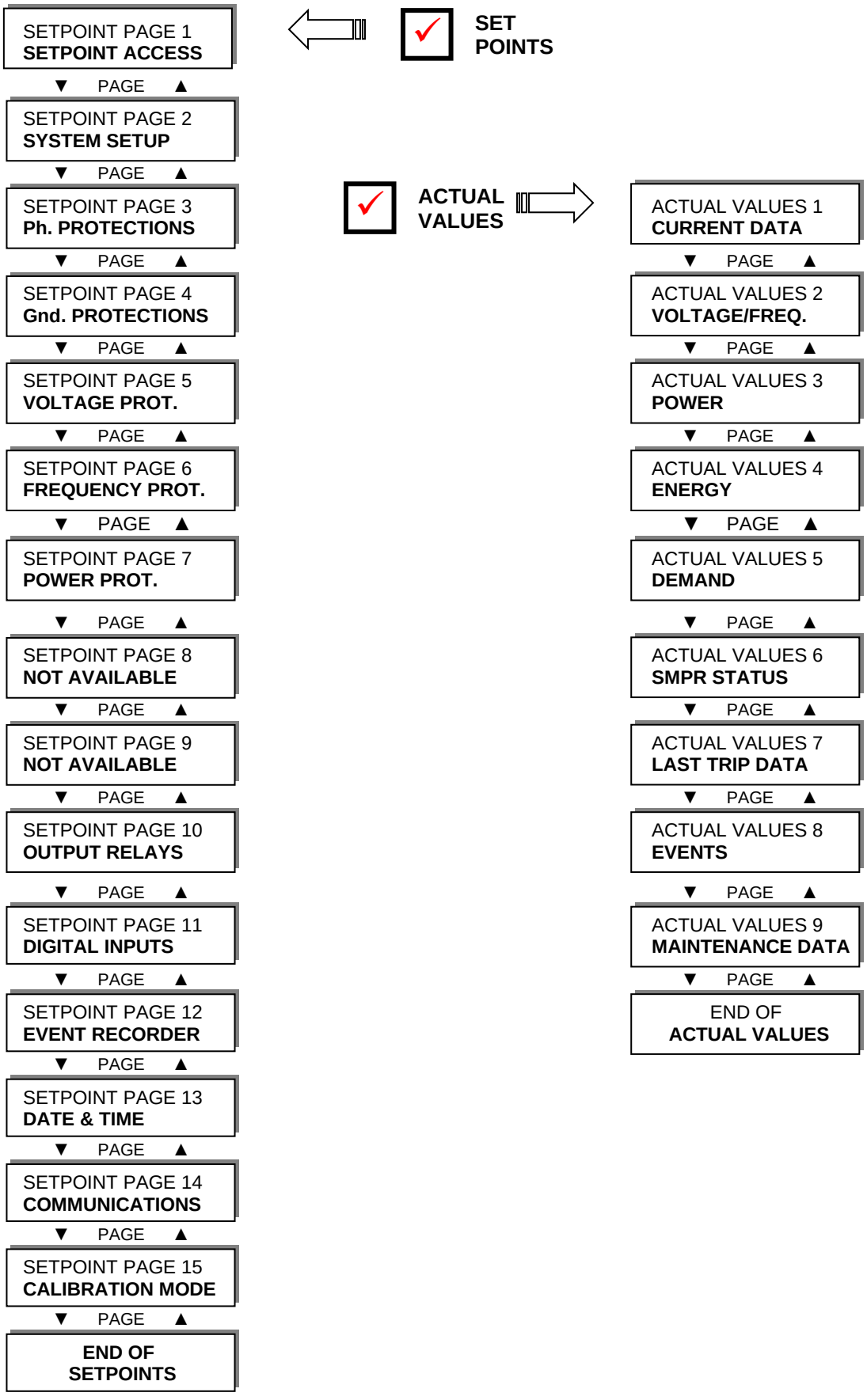
SET POINTS

⇒ It allows programming the relay by setting the parameters and the electrical variables values.

ACTUAL VALUES

⇒ This menu allows displaying or clearing some of the parameters monitored or calculated by the relay.

Before reading the map, study carefully the information in the previous paragraphs 3.1; 3.2; 3.3; 3.4; 3.5 and 3.6.


SETPOINT PAGE 1
SETPOINT ACCESS
▼ PAGE ▲
SETPOINT PAGE 2
SYSTEM SETUP
▼ PAGE ▲
SETPOINT PAGE 3
Ph. PROTECTIONS
▼ PAGE ▲
SETPOINT PAGE 4
Gnd. PROTECTIONS
▼ PAGE ▲
SETPOINT PAGE 5
VOLTAGE PROT.
▼ PAGE ▲
SETPOINT PAGE 6
FREQUENCY PROT.
▼ PAGE ▲
SETPOINT PAGE 7
POWER PROT.
▼ PAGE ▲
SETPOINT PAGE 8
NOT AVAILABLE
▼ PAGE ▲
SETPOINT PAGE 9
NOT AVAILABLE
▼ PAGE ▲
SETPOINT PAGE 10
OUTPUT RELAYS
▼ PAGE ▲
SETPOINT PAGE 11
DIGITAL INPUTS
▼ PAGE ▲
SETPOINT PAGE 12
EVENT RECORDER
▼ PAGE ▲
SETPOINT PAGE 13
DATE & TIME
▼ PAGE ▲
SETPOINT PAGE 14
COMMUNICATIONS
▼ PAGE ▲
SETPOINT PAGE 15
CALIBRATION MODE
▼ PAGE ▲
END OF
SETPOINTS
SET
POINTS
ACTUAL
VALUES
ACTUAL VALUES 1
CURRENT DATA
▼ PAGE ▲
ACTUAL VALUES 2
VOLTAGE/FREQ.
▼ PAGE ▲
ACTUAL VALUES 3
POWER
▼ PAGE ▲
ACTUAL VALUES 4
ENERGY
▼ PAGE ▲
ACTUAL VALUES 5
DEMAND
▼ PAGE ▲
ACTUAL VALUES 6
SMPR STATUS
▼ PAGE ▲
ACTUAL VALUES 7
LAST TRIP DATA
▼ PAGE ▲
ACTUAL VALUES 8
EVENTS
▼ PAGE ▲
ACTUAL VALUES 9
MAINTENANCE DATA
▼ PAGE ▲
END OF
ACTUAL VALUES

3.8 HOW TO USE SETPOINTS AND ACTUAL VALUES KEYS

SET POINTS

SETPOINT PAGE 1
SETPOINT ACCESS

LINE ⇨ ENTER ACCESS CODE: **X X X**

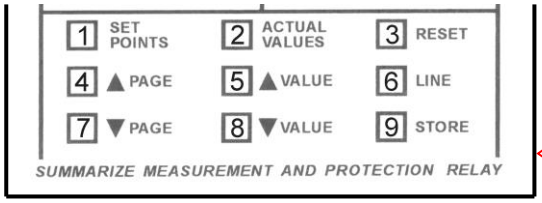
⇩

SETPOINT ACCESS ENABLED

LINE

ENTER NEW ACCESS CODE: **Y/N** ⇨ Select: **NO** or **YES** → **▲VALUE** or **▼VALUE** ⇩

ENTER NEW ACCESS CODE: **X X X** ⇦ **STORE** (*)



PAY ATTENTION to position of digits!

LINE

FIRMWARE: SMPR – FIRMWARE

LINE

END OF PAGE SETPOINT ACCESS

(*) If YES has been selected, by pressing **STORE** key, all the nine keys on the front panelboard modify their functions and allow to enter the digits from 1 to 9, according to the correspondence represented in the diagram.

4. "SETPOINTS" menu

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

4.1 Setpoints page 1: SETPOINT ACCESS

SETPOINTS PAGE 1 **SETPOINT ACCESS**	*This PAGE contains messages for SETPOINT access.* *Press **LINE** key to pass to next LINE.*
ENTER ACCESS CODE: 111	*Enter the THREE-DIGIT access code using the digits from 1 to 9.* [→ § 3.8 -]. **Manufacturer code: 111.**
SETPOINT ACCESS ENABLED	*It indicates that the SETPOINT values can be modified (ACCESS CODE entered is correct)*
SETPOINT ACCESS ONLY VIEW	*It indicates that the SETPOINT values cannot be modified (ACCESS CODE entered is not correct)*
ENTER NEW ACCESS CODE? NO	RANGE:.....NO; YES *The user can enter his customized access code.* • *to confirm the code programmed by the Constructor:* 1. *press **LINE** key to pass to **FIRMWARE: SMPR – S X.XX*** • *to replace the code programmed by the Constructor with the customized one:* 1. *press **▲VALUE** key→ **YES** will be displayed;* 2. *press **STORE** key;* 3. *enter the new code that is automatically confirmed after entering;* 4. *press **LINE** key to pass to the following line.*
ENTER NEW ACCESS CODE: XXX	*Enter the THREE-DIGIT access code using the digits from 1 to 9.* [→ § 3.8 -]. **Manufacturer code: 111.**
NEW ACCESS CODE STORED = XXX	*It indicates that the new access code has been stored.*
FIRMWARE SMPR-S X.XX	*It indicates the SMPR firmware version.*
END OF PAGE **SETPOINT ACCESS**	*Last LINE of PAGE 1.* *Press **LINE** or **▲PAGE** to pass to the first line of PAGE 2.*

4.1.1 Relationship between Function and Output Relay

In the following pages the output relays must be selected for each protection function. Carry out the following procedure for selection:
(For explaining purposes reference is made to the function: PHASE TIMED O/C).

PHASE TIMED O/C **RELAY**: – – – –

The 4 symbols "– – – –" are displayed and by **VALUE** ▲ and **VALUE** ▼ keys:
the 1st symbol can be changed in **T = TRIP**
the 2nd symbol can be changed in **1 = AUX1**
the 3rd symbol can be changed in **2 = AUX2**
the 4th symbol can be changed in **3 = AUX3**

PROCEDURE

1. As soon as the selection of the outputs is required, the first symbol available starts blinking.

2. Commutation of the 1st symbol:
   Press **VALUE** ▲ or **VALUE** ▼ and confirm by **STORE + ACCESS CODE** (if required). The cursor will blink in correspondence of the 1st symbol. Modify the selection, if necessary, or press **LINE** to pass to the second symbol.

   Passage to the 2nd symbol without commuting the 1st one:
   Press **LINE**.

3. Repeat the procedure for all 4 symbols: "– – – –".

Example: For selecting **T – 2 –**

PHASE TIMED O/C **RELAY**: ∗ – – –	The first cursor blinks ⇒ Press **VALUE** ▲ and **T** will be displayed. Press **STORE + ACCESS CODE** (if required) ⇒ **T** is confirmed and **T** will blink.
PHASE TIMED O/C **RELAY**: **T** ∗ – –	Press **LINE**: the second cursor will blink.
PHASE TIMED O/C **RELAY**: **T** – ∗ –	Press **LINE** to pass to the third cursor that will start blinking: press **VALUE** ▲ and **2** will be displayed. Press **STORE** + **ACCESS CODE** (if required) ⇒ **2** is confirmed and **T** will blink.
PHASE TIMED O/C **RELAY**: **T** – 2 ∗	Press **LINE** for 3 times⇒ the fourth cursor will blink.
PHASE TIMED O/C **RELAY**: **T** – 2 –	Press **LINE**: the selection: **T – 2 –** has been completed and you pass to the following Line of the active Setpoint.

4.2 Setpoints page 2: SYSTEM SETUP

SETPOINTS PAGE 2
SYSTEM SETUP

This page allows entering the SMPR parameter values for the system in which it will operate.

SAMPLING FREQUENCY: 50 Hz

RANGE: .....50 Hz; 60 Hz
Enter the system frequency.

PHASE CT RATING PRIMARY: 50 A

RANGE: .....5÷5000 A
STEPS: .....5 A
Enter the primary current rating of the phase current transformers being used. This value is on the transformer plate. In case your transformer has a rating not included in this range, please contact ORION ITALIA.
All three current transformers must have the same rating.

GROUND SENSING RESIDUAL

RANGE: ..... RESIDUAL; ZERO SEQUENCE
It asks if your system uses a separate zero sequence CT or if the CTs are connected in a residual sensing configuration to detect ground current.

GROUND CT RATING PRIMARY: 50 A

If GROUND SENSING = ZERO SEQUENCE

RANGE: .....5÷5000 A
STEPS: .....5 A
Enter the primary current rating of the ground CT being used.

VT CONNECTION WYE

RANGE: ..... WYE; DELTA-DELTA; OPEN DELTA
Enter the type of VT connection.

VT NOMINAL SEC 100 V

RANGE: .....55÷254 V
STEPS: .....1 V
Enter the voltage nominal value of the secondary of the VT.

VT PRIMARY VOLTS 10.00 KV

RANGE: ..... 0.10÷69.00 kV
STEPS: ..... 0.01; 0.10 kV
Enter the voltage nominal value of the primary of the VT.

OUT OF SERVICE ON AUX3: YES

RANGE: .....NO; YES
When selecting **YES** *AUX3 relay will perform the* **SERVICE** *function: once the power is applied, the relay will make AUX3 react and the related contact will be opened. In case of fault of the relay (OUT OF SERVICE led "On") or of loss of power supply, AUX3 will pass to stand-by position and close its contact.*
When selecting **NO** *AUX 3 will be managed as AUX1, AUX2 and TRIP; remark that, unlike these last ones, AUX3 contact is normally closed.*

LOCKOUT (86) ON AUX2: NO

RANGE: .....NO; YES
[→ Fig. 1.1 - "Lockout Function"].

BLOCK TRIP. DELAY: 0.15 Sec

RANGE: .....0.05÷1 s
STEPS: .....0.01 s
Enter the time of TRIP intervention blocking.
For enabling BLOCK TRIP function a digital input must be configured as BLOCK TRIP (see setpoint page 6 DIGITAL INPUT). After receiving a BLOCK TRIP command, the relay will forbid the trip for a maximum time equal to the one specified in this line; then, if the fault is still present, the relay will trip. Use this function to obtain the logic selectivity between 2 or more relays [→ Fig. 1.2 - Diagram "Logic selectivity"].

BLOCK TRIP OUT ON AUX1: NO

RANGE: .....NO; YES
The relay can send a signal for the presence of "fault condition" to an upstream relay. The logic selectivity can then be obtained between 2 or more relays. [→ Fig. 1.2 - Diagram "Logic selectivity"].

OPENING BREAKER TIME: 100 ms

RANGE:..... 10÷500 ms
STEPS:..... 10 ms
Enter the time required by the breaker to perform the opening function. This time is used in the logic selectivity as safety time before enabling the trip of the upstream relay.

If "BLOCK TRIP OUT ON AUX1" = YES

AMPS DEMAND PERIOD: 15 min.

RANGE..... 5÷60 min.
STEPS..... 1 min.
This message allows the user to specify Amps Demand time period. It is the amplitude of the time interval (integration interval) of which the Current Demand is calculated (average current on the period indicated).
REMARK*: the period can be initialized at any time by "closing" a Digital Input already programmed* [→**Setpoint Page 11**: **DIGITAL INPUTS**].

POWER DEMAND PERIOD: 15 min.

RANGE:..... 5÷60 min.
STEPS:..... 1 min.
This message allows the user to specify Power Demand time period. . It is the amplitude of the time interval (integration interval) of which the Power Demand is calculated (average power on the period indicated).
REMARK*: the period can be initialized at any time by "closing" a Digital Input already programmed* [→**Setpoint Page 11**: **DIGITAL INPUTS**].

BREAKER DISCREP. RELAYS: ----

RANGE:..... Any combination of AUX1, AUX2 and AUX3 relays
It allows selecting the output signalling the discrepancy between the trip command sent by the protection relay and the signal received at the BREAKER STATUS input from the circuit breaker or disconnector auxiliary contact.
This error information signals that the trip command has not provoked the opening or that the auxiliary contact (52a) does not operate properly.
Disable this function in case of no connection between 52a auxiliary contact and BREAKER STATUS input.
For disabling the function ⇒ select "– – – –".

REMARK: The procedure for selection is described at page 4.2.

BREAKER DISCREP. DELAY: 1000 ms

RANGE:..... 10÷2500 ms
STEPS:..... 10 ms
Delay for the circuit breaker auxiliary contacts to signal the opening. If a correct reply is not obtained in this delay, an event for circuit breaker discrepancy will be displayed and the selected contact will activate.

If any BREAKER DISCREP. RELAYS is selected

MECH. OPERATIONS RELAYS: ----

RANGE:.....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays
Select the relays to be activated when reaching the max. number of mechanical operations set in the next Line.

REMARK: The procedure for selection is described at page 4.2.

MECH. OPERATIONS MAXIMUM: 3000

RANGE:..... 5÷9995
STEPS:..... 5
Enter the max. number of mechanical operations.
This value represents the granted quantity of mechanical operations carried out by the circuit breaker and the event indicates that maintenance is required.

If any MECH. OPERATIONS RELAYS is selected

ACCUMULATED AMP RELAYS: ----

RANGE.....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays
It allows selecting the outputs signalling the accumulated kA set in ACCUMULATED AMP LEVEL have been reached.
The accumulated kA are measured for each of the three phases and they result from the summation of the current ratings interrupted by the circuit breaker (pre-trip data) at each trip command.
For disabling the function ⇒ select: "– – – –".

ACCUMULATED AMP
LEVEL: 300 KA

If any ACCUMULATED AMP RELAYS is selected and BREAKER TYPE = CIRCUIT BREAKER

RANGE ..... 10÷5000 kA
STEP..... 1 kA
Enter the KA accumulated alarm level.
This function informs about the wear of the circuit breaker pole; the alarm can be used to indicate that an inspection is required.

END OF PAGE
SYSTEM SETUP

Last LINE of PAGE 2.
*Press **LINE** or **▲PAGE** to pass to the first line of PAGE 3.*

4.3 Setpoints page 3: Ph. PROTECTIONS

SETPOINTS PAGE 3
Ph. PROTECTIONS

This PAGE allows setting the phase overcurrent protection.

PHASE TIMED O/C
RELAYS: T---

RANGE ..... Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays
Select the outputs to be activated by the phase timed overcurrent protection (ANSI 51).
For disabling the function ⇒ select "– – – –".

REMARK: The procedure for selection is described at page 4.2.

PHASE TIMED O/C
PICKUP: 4% CT

If any PHASE TIMED O/C RELAYS is selected

RANGE ..... 4÷300% of CT
STEP..... 1% of CT
Enter the overcurrents pickup level in percentage of the transformer primary current. This level determines the current level at which the relay will start counting the overcurrent protection delay according to the protection curve selected.
Example: if entering 50% as percentage value, the relay starts counting the intervention delay of the selected relay when at least one of the phase currents arrives at 50% of the value entered in **PHASE CT RATING PRIMARY** of **SETPOINT PAGE 2: SYSTEM SETUP**.

PHASE O/C CURVE
ANSI MOD INV

If any PHASE TIMED O/C RELAYS is selected

RANGE: ..... DEFINITE TIME; ANSI MOD INV; ANSI NORMAL INV; ANSI VERY INV; ANSI EXTREM INV; IAC SHORT TIME; IAC INVERSE; IAC VERY INV; IAC EXTREM INV; IEC SHORT TIME; IEC-A NORMAL INV; IEC-B VERY INV; IEC-C EXTREM INV

Enter the phase overcurrent protection curve shape required.

PHASE TIMED O/C
DELAY: 1.0 Sec

If any PHASE TIMED O/C RELAYS is selected and PHASE O/C CURVE = DEFINITE TIME

RANGE: ..... 0.05÷600 s
STEP:..... 0.01; 0.1; 1 s
Enter the overcurrent protection (ANSI 51) pickup delay value. The delay allows avoiding false alarms caused by intense temporary currents like the ones generated during the operation of very powerful devices.
If:
current increases above the intervention value set for a time < time delay selected,
⇒ *no intervention will be activated.*

Ph. O/C CURVE
MULTIPLIER: 1.0

If any PHASE TIMED O/C RELAYS is selected and PHASE O/C CURVE ≠ DEFINITE TIME

RANGE: ..... 0.1÷20.0
STEP:..... 0.1
Enter the phase overcurrent multiplier to select the curve required.
[→ Appendix A].

PHASE INST. O/C
RELAYS: T---

If BREAKER TYPE = CIRCUIT BREAKER

RANGE: ..... Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays (Trip is always selected)

Select the outputs to be activated by the phase instantaneous overcurrent protection (ANSI 50).

REMARK: The procedure for selection is described at page 4.2.

PHASE INST. O/C
PICKUP: 40% CT

If any PHASE INST: O/C RELAYS is selected and BREAKER TYPE = CIRCUIT BREAKER

RANGE:.....4÷1800% of CT
STEP:.....1; 10% of CT
Enter the phase overcurrents pickup level in percentage of the transformer primary current. This level determines the current level at which the relay will start counting the overcurrent protection delay.
Example: if entering 50% as percentage value, the relay starts counting the intervention delay of the selected output when at least one of the phase currents arrives at 50% of the value entered in **PHASE CT RATING PRIMARY** of **SETPOINT PAGE 2: SYSTEM SETUP.**

PHASE INST. O/C
DELAY: 0 ms

If any PHASE INST: O/C RELAYS is selected and BREAKER TYPE = CIRCUIT BREAKER

RANGE:.....0÷2000 ms
STEP:.....10 ms
Enter the phase instantaneous overcurrent protection intervention delay. The time delay allows avoiding false alarms caused by intense temporary currents like the ones generated during the operation of very powerful devices.
If:
current increases above the intervention value set for a time < time delay selected,
⇒ no intervention will be activated.

PHASE O/C ALARM
RELAYS: ----

RANGE:.....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays
Select the outputs to be activated by the phase overcurrent alarm.
REMARK: The procedure for selection is described at page 4.2.

PHASE O/C ALARM
PICKUP: 4% CT

If any PHASE O/C ALARM RELAYS is selected

RANGE:.....4÷300% of CT
STEP:.....1% of CT
Enter the phase overcurrent alarm level in percentage of the transformer primary current. This level determines the current level at which the relay will activate the overcurrent alarm.
Example: if entering 50% as percentage value, the relay starts counting the alarm delay when at least one of the phase currents arrives at 50% of the value entered in **PHASE CT RATING PRIMARY** of **SETPOINT PAGE 2: SYSTEM SETUP.**

PHASE O/C ALARM
DELAY: 1.0 Sec

If any PHASE O/C ALARM RELAYS is selected

RANGE:.....0.05÷600 s
STEP:.....0.01 / 0.1 / 1 s
Enter the phase overcurrent alarm delay. The time delay allows avoiding false alarms caused by intense temporary currents like the ones generated during the operation of very powerful devices.
If:
current increases above the alarm level set for a time < time delay selected,
⇒ no intervention will be activated.

AMP. UNBALANCE
RELAYS: ------

RANGE:.....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays
Select the output to be activated by phase current unbalance protection.
REMARK: The procedure for selection is described at page 4.2.

AMP. UNBALANCE
PICKUP: 10%

If any AMP. UNBALANCE RELAYS is selected

RANGE:..... 1÷99 %
STEP:..... 1%
Enter the unbalance level. Amp. unbalance value is calculated as the maximum deviation of the phase currents from the three-phase average current divided by the three-phase average current value.

AMP. UNBALANCE
DELAY: 1.0 Sec

If any AMP. UNBALANCE RELAYS is selected

RANGE:.....0.05÷600 s
STEP:.....0.01; 0.1; 1 s
If:
1. *maximum current unbalance ≥ **AMP. UNBALANCE LEVEL** setpoint value,*
2. *this condition remains in this way for the time delay programmed in this setpoint,*

⇒ a current unbalance condition will occur.

Ph. UNDERCURRENT
RELAYS: ------

RANGE:.....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays
Select the output to be activated by phase undercurrent protection.
REMARK: The procedure for selection is described at page 4.2.

Ph. UNDERCURRENT
PICKUP: 4% CT

If any Ph. UNDERCURRENT RELAYS is selected

RANGE:.....2÷100 % of CT
STEP:.....1% of CT
Enter the minimum phase current intervention value in percentage of the CT value.

Ph. UNDERCURRENT DELAY: 1.0 Sec If any Ph. UNDERCURRENT RELAYS is selected	RANGE: ..... 0.05÷600 s STEP:..... 0.01; 0.1; 1 s *If:* *phase current ≤ Ph. UNDERCURRENT PICKUP setpoint value for a time < Ph UNDERCURRENT DELAY,* *⇒ no intervention will be activated.*
NEG SEQ TIME O/C RELAYS: ----	RANGE .....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays *Select the outputs to be activated by the timed negative sequence overcurrent protection (ANSI 46).* *For disabling the function ⇒ select "– – – –".* **REMARK:** The procedure for selection is described at page 4.2.
NEG SEQ TIME O/C PICKUP: 4% CT If any NEG SEQ TIMED O/C RELAYS is selected	RANGE ..... 4÷300% of CT STEP..... 1% of CT *Enter the negative sequence overcurrents pickup level in percentage of the transformer primary current. This level determines the inverse current level at which the relay will start counting the negative sequence delay according to the protection curve selected.* **Example**: if entering 50% as percentage value, the relay starts counting the intervention delay of the selected relay when the inverse current arrives at 50% of the value entered in **PHASE CT RATING PRIMARY** of **SETPOINT PAGE 2: SYSTEM SETUP**.
NEG SEQ CURVE ANSI MOD INV If any NEG SEQ TIMED O/C RELAYS is selected	RANGE: ..... DEFINITE TIME; ANSI MOD INV; ANSI NORMAL INV; ANSI VERY INV; ANSI EXTREM INV; IAC SHORT TIME; IAC INVERSE; IAC VERY INV; IAC EXTREM INV; IEC SHORT TIME; IEC-A NORMAL INV; IEC-B VERY INV; IEC-C EXTREM INV *Enter the negative sequence overcurrent protection curve shape required.*
NEG SEQ TIME O/C DELAY: 1.0 Sec If any NEG SEQ TIMED O/C RELAYS is selected and PHASE O/C CURVE = DEFINITE TIME	RANGE: ..... 0.05÷600 s STEP:..... 0.01; 0.1; 1 s *Enter the negative sequence overcurrent protection (ANSI 46) pickup delay value. The delay allows avoiding false alarms caused by intense temporary currents like the ones generated during the operation of very powerful devices.* *If:* *current increases above the intervention value set for a time < time delay selected,* *⇒ no intervention will be activated.*
Ph. O/C CURVE MULTIPLIER: 1.0 If any NEG SEQ TIMED O/C RELAYS is selected and NEG SEQ O/C CURVE ≠ DEFINITE TIME	RANGE: .....0.1÷20.0 STEP:.....0.1 *Enter the phase overcurrent multiplier to select the curve required.* [→ Appendix A].
END OF PAGE Ph. PROTECTIONS	*Last LINE of PAGE 3.* *Press **LINE** or **▲PAGE** to pass to the first line of PAGE 4.*

4.4 Setpoints page 4: Gnd. PROTECTIONS

SETPOINTS PAGE 4 Gnd. PROTECTIONS	*This PAGE allows setting the ground current protections.*
GROUND TIMED O/C RELAYS: T ---	RANGE: .....Any combination of TRIP (T) and AUX1, AUX2, AUX3 relays *Select the outputs to be activated by the ground timed overcurrent protection (ANSI 51 N/G).* • *If "– – – –" is selected, the two following lines displayed when pressing **LINE** key are **GROUND INST. O/C RELAY** and **GROUND O/C ALARM RELAY**.* **REMARK:** The procedure for selection is described at page 4.2.

GROUND TIMED O/C
PICKUP: 12% CT

If any GROUND TIMED O/C RELAYS is selected

RANGE:.....4÷300% of CT
STEP:.....1% of CT
Enter the ground overcurrent pickup level. This level determines the current level at which the relay will start counting the circuit breaker/disconnector trip time according to the protection curve selected in the following line: ***GROUND O/C CURVE***.

GROUND O/C CURVE
ANSI MOD INV

If any GROUND TIMED O/C RELAYS is selected

RANGE:..... DEFINITE TIME; ANSI MOD INV; ANSI NORMAL INV; ANSI VERY INV; ANSI EXTREM INV; IAC SHORT TIME; IAC INVERSE; IAC VERY INV; IAC EXTREM INV; IEC SHORT TIME; IEC-A NORMAL INV; IEC-B VERY INV; IEC-C EXTREM INV
Enter the ground overcurrent protection curve shape required:
- If ***DEFINITE TIME*** *is selected, the following line displayed when pressing* ***LINE*** *key is:* ***GROUND TIMED O/C DELAY***.

GROUND TIMED O/C
DELAY: 1.0 Sec

If
GROUND TIMED O/C RELAYS
≠
"– – – –"
and
GROUND O/C CURVE
=
DEFINITE TIME

RANGE:.....0.05 ÷ 600 s
STEPS:..... 0.01; 0.1; 1 s
Enter the ground alarm delay. The related output will activate if the current rating is superior to "GROUND TIMED O/C PICKUP" for a longer time than the set one.

GROUND O/C CURVE
MULTIPLIER: 1.0

If
GROUND TIMED O/C RELAYS
≠
"– – – –"
and
GROUND O/C CURVE
=
DEFINITE TIME

RANGE:.....0.1 ÷ 20.0
STEPS:.....0.1
Set the ground overcurrent multiplier to select the curve required.
[→ Appendix A]

GROUND INST. O/C
RELAYS: T ---

If
BREAKER TYPE
=
CIRCUIT BREAKER

Select the outputs to be activated by the ground instantaneous overcurrent protection (ANSI 51N). Select "– – – –" for disabling the protection.
REMARK: The procedure for selection is described at page 4.2.

GROUND INST. O/C
PICKUP: 120% CT

If
GROUND INST. O/C RELAY
≠
"– – – –"
and
BREAKER TYPE
=
CIRCUIT BREAKER

RANGE:.....**4**% ÷ 1800% CT
STEPS:.....1%; 10% CT
Enter the instantaneous overcurrent pickup level. This level determines the current level at which the relay will start counting the time for the activation of the related output.

GROUND INST. O/C
DELAY: 0 ms

If
GROUND INST. O/C RELAY
≠
"– – – –"
and
BREAKER TYPE
=
CIRCUIT BREAKER

RANGE:.....0÷2000 ms
STEPS:.....10 ms
Enter the intervention delay for ground instantaneous overcurrent protection.
If:
the ground current increases above the value entered in "GROUND INST. O/C PICKUP" for a time > delay time selected,
⇒ *the output will activate*.

GROUND O/C ALARM
RELAYS: ----

RANGE:.....
Select the outputs to be activated by the ground overcurrent alarm. Select "– – – –" for disabling the alarm.

REMARK: The procedure for selection is described at page 4.2.

GROUND O/C ALARM
PICKUP: 12% CT

RANGE:..... 4% ÷ 300% CT
STEPS:.....1% CT
Enter the ground overcurrent alarm level. This level determines the current level at which the relay will start counting the time for the activation of the alarm.

GROUND O/C ALARM
DELAY: 1.0 Sec

RANGE:..... 0.05÷600 s
STEPS:.....0.01; 0.1; 1 s
Enter the delay for the ground overcurrent alarm activation.
If:
the ground current increases above the value entered in "GROUND O/C ALARM DELAY" for a time > delay time selected,
⇒ *the output will activate.*

END OF PAGE
Gnd. PROTECTIONS

Last LINE of PAGE 4.
*Press **LINE** or **▲PAGE** to pass to the first line of PAGE 5.*

4.5 Setpoint page 5: VOLTAGE PROT.

SETPOINT PAGE 5
VOLTAGE PROT.

This page allows settings the voltage protection.

UNDERVOLTAGE 1
RELAYS: ------

RANGE:.....any combination of Trip (T), AUX 1, AUX 2 and AUX 3 Relays
Select the outputs to be activated by the UNDERVOLTAGE 1 protection.
Select at least one of TRIP, AUX1, AUX 2, AUX3 to enable the UNDERVOLTAGE 1 protection.

REMARK: The procedure for selection is described at page 4.2

UNDERVOLTAGE 1
PICKUP: 95% VT

If
"UNDERVOLTAGE 1 RELAYS
≠
"----"

RANGE: 15% ÷ 100% VT
STEPS: 1% VT
Enter the UNDERVOLTAGE 1 LEVEL in percentage of the rated value of VT for the activation of the UNDERVOLTAGE 1 protection.

UNDERVOLTAGE 1
DROPOUT: 97% VT

If
"UNDERVOLTAGE 1 RELAYS
≠
"----"

RANGE:..... 15% ÷ 100% VT
STEPS:.....1% VT
Enter the percentage value at which the faulty condition for UNDERVOLTAGE 1 drops out.

UNDERVOLTAGE 1
DELAY: 1.0 Sec

If
"UNDERVOLTAGE 1 RELAYS
≠
"----"

RANGE:..... 0.00÷600 s
STEPS:.....0.01; 0.1; 1 s
Enter the UNDERVOLTAGE 1 protection intervention delay.
If:
voltage decreases under the set level for a time < undervoltage 1 delay time selected
⇒ *no intervention will be activated.*

UNDERVOLTAGE 1
CURVE: DEFINITE

If
"UNDERVOLTAGE 1 RELAYS
≠
"----"

RANGE:..... DEFINITE; INVERSE
Enter the UNDERVOLTAGE 1 protection curve shape required:
- *DEFINITE TIME: definite-time curve; the pick-up delay is the one defined in UNDERVOLTAGE 1 DELAY*
- *INVERSE: inverse-time curve, the pick-up delay is $T= D/(1 - V/V_{lev})$ where:*
  V = measured voltage
  V_{lev} = pick up level selected in UNDERVOLTAGE 1 LEVEL
  D = delay time selected in UNDERVOLTAGE 1 DELAY.

PHASES FOR U/V 1 OPER.: ANY ONE
If "UNDERVOLTAGE 1 RELAYS ≠ "----"

RANGE: ..... ANY ONE; ANY TWO; ALL THREE
Select the min. number of phases on which the faulty condition has to occur for UNDERVOLTAGE 1 intervention.

MINIMUM OPER. LEVEL: 0% VT
If "UNDERVOLTAGE 1 RELAYS ≠ "----"

RANGE: ..... 0% ÷ 100% VT
STEPS: .....1% VT
Enter the limit voltage value under which the UNDERVOLTAGE 1 protection is disabled.

OVERVOLTAGE 1 RELAYS: ------

RANGE: .....any combination of Trip (T) and AUX 1 ÷ AUX 3 relays
Select the outputs to be activated by the OVERVOLTAGE 1 protection.
Select at least one of TRIP, AUX1, AUX2, AUX3 to enable the OVERVOLTAGE 1 protection.

REMARK: The procedure for selection is described at page 4.2

OVERVOLTAGE 1 PICKUP: 105% VT
If "OVERVOLTAGE 1 RELAYS" ≠ "----"

RANGE: .....15% ÷ 150% VT
STEPS: ..... 1% VT
Enter the OVERVOLTAGE 1 LEVEL in percentage of the rated value of VT for the activation of the OVERVOLTAGE 1 protection.

OVERVOLTAGE 1 DROPOUT: 103% VT
If "OVERVOLTAGE 1 RELAYS" ≠ "----"

RANGE: .....15% ÷ 150% VT
STEPS: ..... 1% VT
Enter the percentage value at which the faulty condition for OVERVOLTAGE 1 drops out.

OVERVOLTAGE 1 DELAY: 1.0 Sec
If "OVERVOLTAGE 1 RELAYS" ≠ "----"

RANGE: .....0.00÷600 s
STEPS: ..... 0.01; 0.1; 1 s
Enter the OVERVOLTAGE 1 protection intervention delay.
If:
voltage increases above the set intervention value for a time < delay time selected,
⇒ *no intervention will be activated.*

PHASES FOR O/V OPER.: ANY ONE
If "OVERVOLTAGE 1 RELAYS" ≠ "----"

RANGE: ..... ANY ONE; ANY TWO; ALL THREE
Select the min. number of phases on which the faulty condition has to occur for OVERVOLTAGE 1 intervention.

PHASES REVERSAL RELAYS: ------

RANGE: .....any combination of Trip (T) and AUX 1 ÷ AUX 3 relays
Select the outputs to be activated by the PHASE REVERSAL protection.
Select at least one of TRIP, AUX1, AUX2, AUX3 to enable the PHASE REVERSAL protection.

REMARK: The procedure for selection is described at page 4.2

PHASES REVERSAL DELAY: 1.0 Sec
If "PHASE REVERSAL RELAYS" ≠ "----"

RANGE: .....0.05÷600 s
STEPS: ..... 0.01; 0.1; 1 s
Enter the PHASE REVERSAL protection intervention delay.
If:
PHASE REVERSAL condition occurs for a time < delay time selected,
⇒ *no intervention will be activated.*

END OF PAGE VOLTAGE PROT.

Last LINE of PAGE 5.
*Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 6.*

4.6 Setpoint page 6: FREQUENCY

SETPOINT PAGE 6
FREQUENCY

This PAGE allows setting the underfrequency and the overfrequency protections.

FREQUENCY 1
RELAYS: ------

RANGE: ..... any combination of Trip (T) and AUX 1 ÷ AUX 3 relays
Select the outputs to be activated by the FREQUENCY 1 protection.
Select at least one of TRIP, AUX1, AUX2, AUX3 to enable the FREQUENCY 1 protection.

REMARK: The procedure for selection is described at page 4.2.

FREQUENCY 1
MODE: O/F + U/F

If
"FREQUENCY 1 RELAYS"
≠
"----"

RANGE: ..... O/F+U/F; O/F; U/F
Select the FREQUENCY 1 protection mode.
O/F → OVERFREQUENCY
U/F → UNDERFREQUENCY
O/F+U/F → OVERFREQUENCY + UNDERFREQUENCY.

FREQUENCY 1
PICKUP: 1.00 Hz

If
"FREQUENCY 1 RELAYS"
≠
"----"

RANGE: ..... 0.05÷9.99 Hz
STEPS: ..... 0.01 Hz
Enter the absolute value of the maximum variation of the frequency beyond which the FREQUENCY 1 (overfrequency 1 or underfrequency 1) protection is activated.

FREQUENCY 1
DROPOUT: 0.50 Hz

If
"FREQUENCY 1 RELAYS"
≠
"----"

RANGE: ..... 0.01÷5.00 Hz
STEPS: ..... 0.01 Hz
Enter the absolute value of the frequency variation (in relation to the rated frequency) at which the condition of overfrequency 1 or underfrequency 1 drops out.

FREQUENCY 1
DELAY: 1.0 Sec

If
"FREQUENCY 1 RELAYS"
≠
"----"

RANGE: ..... 0.1÷600 s
STEPS: ..... 0.1; 1 s
Enter the FREQUENCY 1 protection intervention delay.
If:
frequency is different from the rated value, by exceeding the set variation, for a time < frequency 1 delay time selected,
⇒ *no intervention will be activated.*

FREQUENCY 2
RELAYS: ------

RANGE: ..... any combination of Trip (T) and AUX 1 ÷ AUX 3 relays
Select the outputs to be activated by the FREQUENCY 2 protection.
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the FREQUENCY 2 protection.

REMARK: The procedure for selection is described at page 4.2

FREQUENCY 2
MODE: O/F + U/F

If
"FREQUENCY 2 RELAYS"
≠
"----"

RANGE: ..... O/F+U/F; O/F; U/F
Select the FREQUENCY 2 protection mode.
O/F → OVERFREQUENCY
U/F → UNDERFREQUENCY
O/F+U/F → OVERFREQUENCY + UNDERFREQUENCY

FREQUENCY 2
PICKUP: 1.00 Hz

If
"FREQUENCY 2 RELAYS"
≠
"----"

RANGE: ..... 0.05÷9.99 Hz
STEPS: ..... 0.01 Hz
Enter the absolute value of the maximum variation of the frequency beyond which the FREQUENCY 2 (overfrequency 2 or underfrequency 2) protection is activated.

FREQUENCY 2
DROPOUT: 0.50 Hz

If
"FREQUENCY 2 RELAYS"
≠
"----"

RANGE: ..... 0.01÷5.00 Hz
STEPS: ..... 0.01 Hz
Enter the absolute value of the frequency variation (in relation to the rated frequency) at which the condition of overfrequency 2 or underfrequency 2 drops out.

FREQUENCY 2 DELAY: 1.0 Sec

If "FREQUENCY 2 RELAYS" ≠ "----"

RANGE: ..... 0.1÷600 s
STEPS: ..... 0.1; 1 s
Enter the FREQUENCY 2 protection intervention delay.
If:
frequency is different from the rated value, by exceeding the set variation, for a time < FREQUENCY 2 delay time selected,
⇒ *no intervention will be activated.*

END OF PAGE FREQUENCY

Last LINE of PAGE 6.
*Press **LINE** or **▲PAGE** to pass to the first line of PAGE 7.*

4.7 Setpoint page 7: POWER PROT.

SETPOINT PAGE 7 POWER PROT.

This page allows settings the power protection.

P.F. LEADING RELAYS: ------

RANGE: ..... TRIP, AUX1, AUX2, AUX 3
Select the outputs to be activated by power factor leading protection.
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the power factor leading protection.

P.F. LEADING PICKUP: 0.80

If P. F. LEADING RELAYS ≠ "----"

RANGE: ..... 0.00÷1.00
STEP: 0.01
Enter the power factor level at which the relay will start counting the time for the activation of power factor leading.

P.F. LEADING DROPOUT: 0.80

If P. F. LEADING RELAYS ≠ "----"

RANGE: ..... 0.00÷1.00
STEP: 0.01
Enter the power factor value at which the faulty condition for power factor leading drops out.

P.F. LEADING DELAY: 1.0 Sec

If P. F. LEADING RELAYS ≠ "----"

RANGE: ..... 0.5÷650 s
STEP: ..... 0.5 s; 1 s
Enter the power factor leading protection intervention delay and drop out delay.
If:
1) *power factor decrease under the set level for a time < power factor leading delay time selected,*
   ⇒ *no intervention will be activated*
2) *after intervention, if the cause of the fault has disappeared, the relay waits for a time = set time, before returning to normal status condition,*
   ⇒ *no intervention will be activated*

P.F. LAGGING RELAYS: ------

RANGE: ..... TRIP, AUX1, AUX2, AUX 3
Select the outputs to be activated by power factor lagging protection.
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the power factor lagging protection.

P.F. LAGGING PICKUP: 0.80

If P. F. LAGGING RELAYS ≠ "----"

RANGE: ..... 0.00÷1.00
STEP: 0.01
Enter the power factor level at which the relay will start counting the time for the activation of power factor lagging.

P.F. LAGGING
DROPOUT: 0.80

If
P. F. LAGGING RELAYS
≠
"----"

RANGE: ..... 0.00÷1.00
STEP: 0.01
Enter the power factor value at which the faulty condition for power factor lagging drops out.

P.F. LAGGING
DELAY: 1.0 Sec

If
P. F. LAGGING RELAYS
≠
"----"

RANGE: ..... 0.5÷650 s
STEP: ..... 0.5 s; 1 s
Enter the power factor lagging protection intervention delay and drop out delay.
If:
1) *power factor decrease under the set level for a time < power factor lagging delay time selected,*
   ⇒ *no intervention will be activated*
2) *after intervention, if the cause of the fault has disappeared, the relay waits for a time = set time, before returning to normal status condition,*
   ⇒ *no intervention will be activated*

REVERSE POWER
RELAYS: ------

RANGE: ..... any combination of Trip (T) and AUX 1÷AUX3 relay
Select the output to be activated by the Reverse Power protection (Negative kW).
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the REVERSE POWER protection.
REMARK: The procedure for selection is described at page 4.2

REVERSE POWER
PICKUP: 100 KW

RANGE: ..... 10 kW ÷ 650 MW
STEPS: ..... 10 kW; 0,1 MW; 1 MW
Enter the negative real power intervention value.

REVERSE POWER
DELAY: 1.0 Sec

RANGE: ..... 0.5÷600 s
STEPS: ..... 0.5 s
If:
1. *|negative real power| ≥ |**REVERSE POWER PICKUP**|,*
2. *this condition remains in this way for the time delay programmed in this setpoint,*

⇒ *a reverse power condition will occur.*

FORWARD POWER
RELAYS: ------

RANGE: ..... any combination of Trip (T) and AUX 1÷AUX3 relay
Select the output to be activated by the Forward Power protection (Positive kW).
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the FORWARD POWER protection.
REMARK: The procedure for selection is described at page 4.2

FORWARD POWER
PICKUP: 100 KW

RANGE: ..... 10 kW ÷ 650 MW
STEPS: ..... 10 kW; 0,1 MW; 1 MW
Enter the positive real power intervention value.

FORWARD POWER
DELAY: 1.0 Sec

RANGE: ..... 0.5÷600 s
STEPS: ..... 0.5 s
If:
1. *positive real power ≥ **FORWARD POWER PICKUP** setpoint value,*
2. *this condition remains in this way for the time delay programmed in this setpoint,*

⇒ *an excess positive real power condition will occur.*

AMPS DEMAND
RELAYS: ------

RANGE: ..... any combination of Trip (T), AUX 1, AUX 2, AUX 3 relay
Select the output to be activated by the Amps Demand.
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the AMPS DEMAND.
REMARK: The procedure for selection is described at page 4.2

AMPS DEMAND
PICKUP: 100 A

RANGE: ..... 5÷5000 A
STEPS: ..... 5 A
Enter the three-phase current intervention relay.
In Setpoint page 2: "SYSTEM SETUP" the period of time can be defined on which the Demand of current and of power can be calculated.

KW DEMAND RELAYS: ------

RANGE: .....any combination of Trip (T), AUX 1, AUX 2, AUX3 relay
Select the output to be activated by the KW DEMAND.
Select at least one of TRIP, AUX 1, AUX2, AUX3 to enable the KW DEMAND.
REMARK: The procedure for selection is described at page 4.2

KW DEMAND PICKUP: 1.00 MW

RANGE: .....10 kW ÷ 650 MW
STEPS: .....10 kW; 0,1 MW; 1 MW
Enter the three-phase real power intervention value.
In Setpoint page 2: "SYSTEM SETUP" the period of time can be defined on which the Demand of current and of power can be calculated.

KVAR DEMAND RELAYS: ------

RANGE: .....any combination of Trip (T), AUX 1, AUX 2, AUX3 relay

REMARK: The procedure for selection is described at page 4.2

KVAR DEMAND PICKUP: 1.00 MVAR

RANGE: .....10 kVAR ÷ 650 MVAR
STEPS: ..... 10 kVAR; 0.1 MVAR; 1 MVAR
Enter the three-phase reactive power intervention value.
In Setpoint page 2: "SYSTEM SETUP" the period of time can be defined on which the Demand of current "AMPS DEMAND PERIOD" and of power "POWER DEMAND PERIOD" can be calculated.

END OF PAGE **POWER PROT.**

Last LINE of PAGE 7.
*Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 8.*

4.8 Setpoint page 8: NOT AVAILABLE

SETPOINT PAGE 8 **NOT AVAILABLE**

*This page is not available for this SMPR version. Press ▲**PAGE** to pass to next page.*

4.9 Setpoint page 9: NOT AVAILABLE

SETPOINT PAGE 9 **NOT AVAILABLE**

*This page is not available for this SMPR version. Press ▲**PAGE** to pass to next page.*

4.10 Setpoint page 10: OUTPUT RELAYS

SETPOINT PAGE 10 **OUTPUT RELAYS**

This PAGE allows setting the features of the relay output contacts.

TRIP OUTPUT RELAY: LATCHED

RANGE: .....LATCHED; PULSED

- PULSED operation:
  *In case of fault condition due to which the related output must activate, this output will be energized for a time as the one set in **TRIP RELAY PULSE TIME**; after this time the output relay will de-energize and the contact will return to the stand-by condition. The output will repeat this operation every 3 seconds in case the fault condition is still present.*

- LATCHED operation:
  In case of fault condition due to which the related output must activate, this output will be energized for an indefinite time. The output relay will de-energize only when the fault condition is no more present and the unit is RESET.

TRIP RELAY PULSE TIME: 0.2 Sec

If "TRIP OUTPUT RELAY" = PULSED

RANGE: ..... 0.1÷2.0 s
STEPS: ..... 0.1 s
Enter the delay for the trip relay de-energizing.

AUX1 OUTPUT RELAY: LATCHED

If "BLOCK TRIP ON AUX1" = OFF

RANGE: ..... LATCHED; PULSED

- PULSED operation:
  *In case of fault condition due to which the related output must activate, this output will be energized for a time as the one set in **AUX1 RELAY PULSE TIME**; after this time the output relay will de-energize and the contact will return to the stand-by condition.*
- LATCHED operation:
  In case of fault condition due to which the related output must activate, this output will be energized for an indefinite time. The output relay will de-energize only when the fault condition is no more present and the unit is RESET.

AUX1 RELAY PULSE TIME: 0.2 Sec

If "BLOCK TRIP ON AUX1" = OFF AND AUX 1 RELAY = PULSED

RANGE: ..... 0.1÷2.0 s
STEPS: ..... 0.1 s
Enter the delay for AUX 1 relay de-energizing.

AUX2 OUTPUT RELAY: LATCHED

If LOCKOUT ON AUX 2 = OFF

RANGE: ..... LATCHED; PULSED

- PULSED operation:
  *In case of fault condition due to which the related output must activate, this output will be energized for a time as the one set in **AUX2 RELAY PULSE TIME**; after this time the output relay will de-energize and the contact will return to the stand-by condition.*
- LATCHED operation:
  In case of fault condition due to which the related output must activate, this output will be energized for an indefinite time. The output relay will de-energize only when the fault condition is no more present and the unit is RESET.

AUX2 RELAY PULSE TIME: 0.2 Sec

If "LOCKOUT ON AUX 2" = OFF AND "AUX2 OUTPUT RELAY=PULSED

RANGE: ..... 0.1÷2.0 s
STEPS: ..... 0.1 s
Enter the delay for AUX 2 relay de-energizing.

AUX3 OUTPUT RELAY: LATCHED

If OUT OF SERVICE ON AUX 3 = OFF

RANGE: ..... LATCHED; PULSED

- PULSED operation:
  *In case of fault condition due to which the related output must activate, this output will be energized for a time as the one set in **AUX3 RELAY PULSE TIME**; after this time the output relay will de-energize and the contact will return to the stand-by condition.*
- LATCHED operation:
  In case of fault condition due to which the related output must activate, this output will be energized for an indefinite time. The output relay will de-energize only when the fault condition is no more present and the unit is RESET.

AUX3 RELAY PULSE TIME: 0.2 Sec

If "OUT OF SERVICE ON AUX 3" = OFF AND "AUX 3 OUTPUT RELAY" = PULSED

RANGE: ..... 0.1÷2.0
STEPS: ..... 0.1 s
Enter the delay for AUX 3 relay de-energizing.

END OF PAGE OUTPUT RELAYS

Last LINE of PAGE 10.
*Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 11.*

4.11 Setpoint page 11: DIGITAL INPUTS

SETPOINT PAGE 11
DIGITAL INPUTS

This PAGE allows setting the digital inputs.

INPUT 1 FUNCTION
NONE

RANGE: .....NONE; BREAKER EARTHED; EXTERNAL RESET; REMOTE TRIP; BLOCK TRIP; ACTIVATE AUX1; ACTIVATE AUX2; ACTIVATE AUX3; LOCKOUT (86); NEW DMD PERIOD

Select the function to be associated with INPUT 1.

INPUT 1 ACTIVE
WHEN: CLOSED

RANGE: ..... CLOSED; OPENED

Configure digital input INPUT 1:
CLOSED ⇒ *INPUT 1 will be active when the related contacts are closed.*
OPENED ⇒ *INPUT 1 will be active when the related contacts are open.*

INPUT 2 FUNCTION
EXTERNAL RESET

RANGE: .....NONE; BREAKER EARTHED; EXTERNAL RESET; REMOTE TRIP; BLOCK TRIP; ACTIVATE AUX1; ACTIVATE AUX2; ACTIVATE AUX3; LOCKOUT (86); NEW DMD PERIOD

Select the function to be associated with INPUT 2.

INPUT 2 ACTIVE
WHEN: CLOSED

RANGE: ..... CLOSED; OPENED

Configure digital input INPUT 2:
CLOSED ⇒ *INPUT 2 will be active when the related contacts are closed.*
OPENED ⇒ *INPUT 2 will be active when the related contacts are open.*

INPUT 3 FUNCTION
BREAKER EARTHED

RANGE: ..... NONE; BREAKER EARTHED; EXTERNAL RESET; REMOTE TRIP; BLOCK TRIP; ACTIVATE AUX1; ACTIVATE AUX2; ACTIVATE AUX3; LOCKOUT (86); NEW DMD PERIOD

Select the function to be associated with INPUT 3.

INPUT 3 ACTIVE
WHEN: CLOSED

RANGE: ..... CLOSED; OPENED

Configure digital input INPUT 3:
CLOSED ⇒ *INPUT 3 will be active when the related contacts are closed.*
OPENED ⇒ *INPUT 3 will be active when the related contacts are open.*

END OF PAGE
DIGITAL INPUTS

Last LINE of PAGE 11.
*Press **LINE** or **▲PAGE,** to pass to the first line of PAGE 12.*

4.12 Setpoint page 12: EVENT RECORDER

SETPOINT PAGE 12
EVENT RECORDER

This PAGE allows to enable/disable the recording of the events, up to 10 max., according to FIFO (First-In, First-Out) mode. Once 10 events are stored, the oldest event is cleared by the new one occurred.

Ph. PROTECTIONS
EVENTS: ON

RANGE: ..... OFF; ON

It enables/disables phase current protection events recording.

Gnd. PROTECTIONS
EVENTS: ON

RANGE: ..... OFF; ON

It enables/disables ground current protection events recording

VOLTAGE PROT.
EVENTS: ON

RANGE: ..... OFF; ON

It enables/disables voltage protection events recording.

FREQUENCY PROT.
EVENTS: ON

RANGE: ..... OFF; ON

It enables/disables frequency protection events recording.

POWER PROT.
EVENTS: ON

RANGE: ..... OFF; ON

It enables/disables power protection events recording.

SYSTEM EVENTS: ON	RANGE: ..... OFF; ON *It enables/disables system protection events recording.*
OUTPUT RELAYS EVENTS: OFF	RANGE: ..... OFF; ON *It enables/disables output contacts events recording.*
DIGITAL INPUTS EVENTS: OFF	RANGE: ..... OFF; ON *It enables/disables digital inputs events recording.*
END OF PAGE **EVENT RECORDER**	*Last LINE of PAGE 12.* *Press **LINE** or **▲PAGE,** to pass to the first line of PAGE 13.*

4.13 Setpoint page 13: DATE & TIME

SETPOINT PAGE 13 **DATE & TIME**	*This PAGE allows setting date and time.*
Jun 9, 2001 16:54:02.10	*Actual date and time are displayed.*
SET DATE & TIME? NO	RANGE: ..... YES; NO *It asks if you want to modify date and time:* • *<u>to confirm the actual data:</u>* 1. *Press **LINE** to pass to **END OF PAGE – SETPOINT VALUES*** • *<u>to modify date and time</u>:* 1. *Press **▲VALUE → YES** will be displayed;* 2. *Press **STORE** and enter access code (if required)* 3. *Modify the blinking data by using **▲VALUE** and **▼VALUE**;* 4. *Press **LINE** to pass to next lines;* 5. *Press **STORE** after modifying.*
Jun 9, 2001 16:54:02.10	RANGE: ..... JAN÷DEC.
Jun **9**, 2001 16:54:02.10	RANGE: ..... 1÷31
Jun 9, **2001** 16:54:02.10	RANGE: ..... 2000÷2099
Jun 9, 2001 **16**:54:02.10	RANGE: ..... 0÷23
Jun 9, 2001 16:**54**:02.10	RANGE: ..... 0÷59
Jun 9, 2001 16:54:**02**.10	RANGE: ..... 0÷59
END OF PAGE **DATE & TIME**	*Last LINE of PAGE 13.* *Press **LINE** or **▲PAGE** to pass to the first line of PAGE 14.*

4.14 Setpoint page 14: COMMUNICATIONS

SETPOINT PAGE 14 COMMUNICATIONS	*This PAGE allows setting the features for the communications between SMPR and other devices.*
MODBUS ADDRESS 1	RANGE: ..... 1÷247 *Assign its own address to the relay in order to differentiate it from other relays connected to the same communication network.*
COM1 RS-232 BAUDRATE 9600	RANGE: ..... 1200; 2400; 4800; 9600; 19200 *Select the Baud rate for COM1 RS-232 port. (Do not change this value in Ethernet model)*
COM2 RS-485 BAUDRATE 9600	RANGE: ..... 1200; 2400; 4800; 9600; 19200 *Select the Baud rate COM2 RS-485 port.*
COM3 RS-485 BAUDRATE 9600	RANGE: ..... 1200; 2400; 4800; 9600; 19200 *Select the Baud rate COM3 RS-485 port.*
END OF PAGE COMMUNICATIONS	*Last LINE of PAGE 14.* *Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 15.*

4.15 Setpoint page 15: CALIBRATION MODE

SETPOINT PAGE 15 CALIBRATION MODE	*This PAGE allows testing the operation of the inputs and the output relays.*
RELAYS TEST NONE	RANGE: ..... NONE; TRIP; AUX1; AUX2; AUX 3; ALL *Select the involved output for testing the correct operation of the output relays by using VALUE ▲ and* VALUE ▼ *and press* STORE. *Press RESET to return to the normal condition.*
DIGITAL INPUT 1 DEACTIVATED	RANGE: ..... ACTIVATED; DEACTIVATED *This message allows controlling the status (DEACTIVATED or ACTIVATED) of external contact DIGITAL INPUT 1.*
DIGITAL INPUT 2 DEACTIVATED	RANGE: ..... ACTIVATED; DEACTIVATED *This message allows controlling the status (DEACTIVATED or ACTIVATED) of external contact DIGITAL INPUT 2.*
DIGITAL INPUT 3 DEACTIVATED	RANGE: ..... ACTIVATED; DEACTIVATED *This message allows controlling the status (DEACTIVATED or ACTIVATED) of external contact DIGITAL INPUT 3.*
UPDATE FIRMWARE? NO	RANGE: YES; NO *By selecting YES the relay firmware can be updated by serial port RS-232. Before confirm YES, read the Upgrading Instruction. The instruction will be given by Orion Italia for each available upgrade*
END OF PAGE CALIBRATION MODE	*Last LINE of PAGE 15.*

5. "ACTUAL VALUES" menu

5.1 Actual values 1: CURRENT DATA

ACTUAL VALUES 1 CURRENT DATA	*This page shows information on the feeder phase and ground currents being monitored by the SMPR relay.*
A: 0.00 B: 0.00 C: 0.00 Amp	*It displays true RMS of each phase current.*
GROUND CURRENT 0.00 Amp	*It displays true RMS of ground current.*
CURRENT AVERAGE 0.00 Amp	*It displays the average current calculated as* $I_{avg} = (\|I_a\| + \|I_b\| + \|I_c\|)/3$.
A: 00.0 B: 00.0 C: 00.0 A %UNB	*It displays the % unbalance of I_a, I_b, I_c currents. Each values is calculated by dividing the deviation from the average value by the average value.*
NEG. SEQ. CURRENT 00.0 Amp	*It displays the measured value of the negative sequence current.*
ACTUAL VALUES 1 END OF PAGE	*Last LINE of PAGE 1.* *Press **LINE** or **▲PAGE** to pass to the first line of PAGE 2.*

5.2 Actual values 2: VOLTAGE / FREQ.

ACTUAL VALUES 2 VOLTAGE / FREQ.	*This page displays information on values of the voltage and frequency of the three-phase feeder being monitored by the SMPR relay.*
AB: 00.0 BC: 00.0 CA: 00.0 V	*It displays the RMS value of line voltages.*
AN: 00.0 BN: 00.0 CN: 00.0 V	*It displays the RMS value of phase voltages.*
If VT CONNECTION in Setpoint page 2 = WYE	
VOLTAGE AVERAGE 0.00 V	*It displays the average of the 3 RMS values of the line voltages* $V_{avg}=(\|V_{AB}\| + \|V_{BC}\| + \|V_{CA}\|/3$.
FREQUENCY 50.0 Hz	*It displays the value of the frequency.*
PHASE SEQUENCE A-B-C	RANGE: .....A-B-C, A-C-B, NONE *A-B-C* ⇒ *right phase sequence* *A-C-B* ⇒ *phase reversal* *NONE* ⇒ *the relay cannot detect the sequence due to its wrong insertion or to one or more voltages with too low value.*
ACTUAL VALUES 2 END OF PAGE	*Last LINE of PAGE 2.* *Press **LINE** or **▲PAGE** to pass to the first line of PAGE 3.*

5.3 Actual values 3: POWER

ACTUAL VALUES 3 POWER

This page displays information on the real, reactive, apparent power and power factor of the system.

REAL POWER
+0 KW

It displays the three phase real power. SMPR inform you about the direction flow of the real power according to the following keys:
+ → FORWARD
- → REVERSE

REACTIVE POWER
+0 KVAR

It displays the three phase reactive power. The SMPR shows direction flow by displaying the signed value of kVAR.
+ → LAGGING
- → LEADING

APPARENT POWER
0 KVA

It displays the three phase apparent power.

POWER FACTOR
0.00 LEAD

It displays the three-phase power factor as lagging or leading one.

A: +0 B: +0
C: +0 KW

It displays the real power value of each phase.

If
VT CONNECTION
=
WYE
In Setpoint Page 2

A: +0 B: +0
C: +0 KVAR

It displays the reactive power value of each phase.

If
VT CONNECTION
=
WYE
In Setpoint Page 2

A: +0 B: +0
C: +0 KVA

It displays the apparent power value of each phase.

If
VT CONNECTION
=
WYE
In Setpoint Page 2

ACTUAL VALUES 3 END OF PAGE

Last LINE of PAGE 3.
*Press **LINE** or **▲PAGE** to pass to the first line of PAGE 4.*

5.4 Actual values 4: ENERGY

ACTUAL VALUES 4 ENERGY

This page displays information on the real energy and reactive energy.

POS REAL ENERGY
0 KWh

It displays the positive real energy in kWh starting from the latest energy data clearing.

NEG REAL ENERGY
0 KWh

It displays the negative real energy in kWh starting from the latest energy data clearing.

POS REACT ENERGY
0 KVARh

It displays the positive reactive energy in kVARh starting from the latest energy data clearing.

NEG REACT ENERGY
0 KVARh

It displays the negative reactive energy in kVARh starting from the latest energy data clearing.

LAST ENERGY CLR.
Date & Time

STORE ..... Mar 9, 2000
22:01:00.0

It displays date and time of the latest data clearing.

CLEAR ALL ENERGY
VALUES? NO

*It allows to clear the stored energy data. After having selected YES by the ▲ **VALUE** key, press the **STORE** key and enter the access codeif required.*

ACTUAL VALUE 4
END OF PAGE

Last LINE of PAGE 3.
*Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 4.*

5.5 Actual values 5: DEMAND

ACTUAL VALUE 5
DEMAND

This page displays the demand metering and the max. demand metering for current, real and reactive power.

LAST AMPS DEMAND
0 A

It displays the phase current demand (in Amps) over the most recent time interval.
→ *Setpoint page 2: "SYSTEM SETUP" – **AMPS DEMAND PERIOD** to define the current integration time.*
→ *Setpoint page to configure a Digital Input for starting the integration time*

LAST KW DEMAND
0 KW

It displays the real power (in kW) over the most recent time interval.
→ *Setpoint page 2: "SYSTEM SETUP" – **POWER DEMAND PERIOD** to define the power integration time.*
→ *Setpoint page to configure a Digital Input for starting the integration time*

LAST KVAR DEMAND
0 KVAR

It displays the reactive power (in kVAR) over the most recent time interval.
→ *Setpoint page 2: "SYSTEM SETUP" – **POWER DEMAND PERIOD** to define the power integration time*
→ *Setpoint page to configure a Digital Input for the integration time*

MAX. AMPS DEMAND
0 A

It displays the maximum Amps demand value since the last clearing of the demand data [→ CLEAR MAX DEMAND VALUES]
Press STORE to display date and time of the maximum demand.
STORE ..... Mar 9, 2000
22:01:00.0

MAX. KW DEMAND
0 KW

It displays the maximum kW demand value since the last clearing of the demand data.
[→ CLEAR MAX DEMAND VALUES]
Press STORE to display date and time of the maximum demand.
STORE ..... Mar 9, 2000
22:01:00.0

MAX. KVAR DEMAND
0 KVAR

It displays the maximum kVAR demand value since the last clearing of the demand data.
[→ CLEAR MAX DEMAND VALUES]
Press STORE to display date and time of the maximum demand.
STORE ..... Mar 9, 2000
22:01:00.0

CLEAR MAX DEMAND
VALUES? NO

It allows to reset all max. demand data

ACTUAL VALUE 5
END OF PAGE

Last LINE of PAGE 5.
*Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 6.*

5.6 Actual values 6: SMPR STATUS

ACTUAL VALUES **SMPR STATUS**	*This page shows the status of Digital Inputs, outputs, of Breaker or Disconnector and the status of LOCKOUT logic function.*
ACTIVE OUTPUTS T123	*It displays the active outputs.* ***T** = Trip, **1** = AUX.1, **2** = AUX.2, **3** = AUX.3, **–** = Output not active*
LOCKOUT (86) DEACTIVATED	*It indicates if the relay is performing the function ANSI 86 (LOCKOUT).* *ACTIVATED ⇒ the lockout preventing the reclosing is active.* *DEACTIVATED ⇒ the relay does not forbid any reclosing.*
DIGITAL INPUT 1 DEACTIVATED	*It displays the status of Digital input 1.*
DIGITAL INPUT 2 DEACTIVATED	*It displays the status of Digital Input 2.*
DIGITAL INPUT 3 DEACTIVATED	*It displays the status of Digital Input 3.*
ACTUAL VALUES 6 **END OF PAGE**	*Last LINE of PAGE 6.* *Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 7.*

5.7 Actual values 7: LAST TRIP DATA

ACTUAL VALUES 7 **LAST TRIP DATA**	*This PAGE includes the electrical variables values at the latest trip made by SMPR; these variables can be displayed immediately after the trip.* ***For example:*** *After the overcurrent trip, the phase currents can be displayed to check the phase/s that have/s caused the problem.* *The data are stored even in case of no control power to the relay.*
LAST TRIP CAUSE NO TRIP DATA	*It displays the cause of the latest trip. If "NO TRIP DATA" is displayed, no trip occurred.* **STORE** ⇒ *It displays date and time of the latest trip.*
A: 0.00 B: 0.00 C: 0.00 Amp	*It displays phase currents when the trip occurred.*
GROUND CURRENT 0.00 Amp	*It displays ground current when the trip occurred.*
NEG. SEQ. CURRENT 0.00 Amp	*It displays the value when the last trip occurred.*
AB: 00.0 BC: 00.0 CA: 00.0 V	*It displays line voltages when the trip occurred.*
FREQUENCY 50.0 Hz	*It displays frequency when the trip occurred.*
POWER FACTOR 0.00 LEAD	*It displays power factory when the trip occurred.*
ACTUAL VALUES 7 **END OF PAGE**	*Last LINE of PAGE 7.* *Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 8.*

5.8 Actual values 8: EVENTS

ACTUAL VALUES 8 **EVENTS**	*It displays the events. In case of no control power supply, the cause, the electrical variables values related to each event and the moment of the fault [future function] would not be lost.*
EVENT 10 EVENT CAUSE	*It indicates the number of the event and its cause.*

VALUE ▲ or **VALUE** ▼ ⇒ *It displays the latest events or previous ones.*

STORE ⇒ *It displays date and time*

LINE Each time you press **LINE**, the following messages will be displayed step by step:

A: 0.00 B: 0.00 C: 0.00 Amp	*It displays the phase current RMS value related to the event previously indicated.*
GROUND CURRENT 0.00 Amp	*It displays the ground current RMS value related to the event previously indicated.*
NEG. SEQ. CURRENT 0.00 Amp	*It displays the negative sequence current RMS value related to the event previously indicated.*
AB: 00.0 BC: 00.0 CA: 00.0 V	*It displays the line voltage RMS value related to the event previously indicated.*
FREQUENCY 50.0 Hz	*It displays the frequency value related to the event previously indicated.*
POWER FACTOR 0.00 LEAD	*It displays the power factor value related to the event previously indicated.*
CLEAR ALL EVENTS NO	*Confirm any clearing of events.* *YES* ⇒ events clearing *LINE* ⇒ events are not cleared *STORE* ⇒ to confirm the selection
ACTUAL VALUES 8 **EVENTS**	*Last LINE of PAGE 8.* *Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 9.*

5.9 Actual values 9: MAINTENANCE DATA

ACTUAL VALUES 9 **MAINTENANCE DATA**	*This PAGE includes:* *1. the number of trips (due to intervention by protections) or openings carried out* *2. KA accumulated in each phase,* *stored for managing the maintenance.*
TRIPS COUNTER 0	*It indicates the number of trips caused by the intervention of the protections.*
ACCUMULATED AMP Ph. A 0 KA	*It indicates the kA accumulated in phase A during the trips by SMPR.* *The total measuring resulting from the addition of the value detected when the trip has occurred to the previous total value gives an indication about the wear of the opening device.*

ACCUMULATED AMP Ph. B 0 KA	*It indicates the kA accumulated in phase B during the trips by SMPR.* *The total measuring resulting from the addition of the value detected when the trip has occurred to the previous total value gives an indication about the wear of the opening device.*
ACCUMULATED AMP Ph. C 0 KA	*It indicates the kA accumulated in phase C during the trips by SMPR.* *The total measuring resulting from the addition of the value detected when the trip has occurred to the previous total value gives an indication about the wear of the opening device.*
PHASE O/C TRIPS 0	*It counts the times the circuit breaker or disconnector controlled by SMPR has tripped due to the intervention of ⇒ phase overcurrent protection.*
GROUND O/C TRIPS 0	*It counts the times the circuit breaker or disconnector controlled by SMPR has tripped due to the intervention of ⇒ ground overcurrent protection.*
OPENING COUNTER 0	*It counts the breaker or disconnector openings.*
MAINTENANCE DATA CLEAR? NO	*It allows the clearing of the maintenance data.* *Use VALUE UP key or VALUE DOWN key to select the answers: YES or NO and press STORE to confirm the selection.*
ACTUAL VALUES 9 **END OF PAGE**	*Last LINE of PAGE 9.* *Press **LINE** or ▲**PAGE** to pass to the first line of PAGE 10.*

6. AUTOMATIC OPERATION

6.1 AUTOMATIC OPERATION CONDITION

When starting the SMPR or after 5 minutes from the last operation carried out on the front keyboard, the relay cyclically displays the following information:

- current of each phase
- ground current
- line voltages
- frequency
- power factor
- cause of the latest intervention.

When supplying the power to the SMPR, the following message is displayed:

ORION ITALIA **SMPR RELAY**

and then these messages will be displayed:

A: 0.00 B: 0.00 C: 0.00 Amp	*It indicates the actual current true RMS in phase A, phase B, phase C.*
GROUND CURRENT Amp	*It indicates the actual ground current true RMS.*
AB: 00.0 BC: 00.0 CA: 00.0 V	*It indicates the line voltage.*

If any fault has caused the TRIP relay intervention and consequently the device turning off due to voltage loss, when the power supply is restored the relay will activate and make the following leds blink: TRIP led.
This indication does not signal that TRIP contact is active but signals that the device has switched off due to a trip caused by a fault.
Press RESET to stop the signalling.

7. Events recorder

Press ACTUAL VALUE and select the page: EVENT [→ Actual value 8: EVENTS] to display the last 10 events.

7.1 DEFINITION OF "EVENT" AND STORING

SMPR is equipped with an Event recorder in which the following data are stored:

- intervention of protection or alarm due to phase overcurrent,
- intervention of protection or alarm due to ground overcurrent,
- changing of status of an output contact,
- changing of status of a digital input,
- system status (circuit breaker status, discrepancy signalling, reaching of the limit of mechanical operations or kA accumulated, remote trip commands, block trip and other events non included in the previous points)

during the operation of the relay.

All events, up to 10 max., will be stored in a memory buffer operating in FIFO (First-In, First-Out) mode. Once 10 events are stored, the oldest event is cleared by the new one occurred.

7.2 EVENTS FORMAT

Each event is characterized by the line parameters values when the event is occurring. The stored parameters are the following:

- description of the event,
- each of the 3 phase currents,
- ground current,
- negative sequence current,
- line voltages
- frequency
- power factor
- event date and time.

8. Troubleshooting

PROBLEM	SOLUTION	REFERENCE
The display does not turn on.	1. Check the power supply to the auxiliary terminals. 2. Check the power supply voltage is the same as the one indicated on the plate (on the back of the relay).	*Wiring diagram*
The display is “On” but no message is displayed.	1. Check the power supply voltage is the same as the one indicated on the plate (on the back of the relay).	*Wiring diagram*
The phase current is not displayed.	1. Check the current reading is enabled. 2. Check the wiring of phase CT.	*Actual values 1* *Wiring diagram*
Wrong displaying of the phase current reading.	1. Measure the current input in the terminals of SMPR by using a clamp meter. 2. Check the CT primary current has been correctly entered and stored in Setpoint Page 2.	*Page 2 of Setpoint*
The ground current is not displayed.	1. Check the active ACTUAL VALUES PAGE is the right one. 2. Check the ground CT primary current has been correctly entered, ZERO SEQUENCE has been set in Setpoint 2 and the ground CT connections. 3. Check the CTs right connection according to "Residual" entering if RESIDUAL has been set in Setpoint 2.	*Actual values 1* *Page 2 of Setpoint* *Wiring diagram* *Page 2 of Setpoint* *Wiring diagram*
Wrong displaying of the voltages read or of the phases sequence.	1. Verify the settings in “SETPOINT PAGE 2 – SYSTEM SETUP” [→ Chapter 4]: the VTs used, the type of connection and the system frequency. 2. Measure the voltages at the input terminals Va, Vb, Vc and Vn.	

9. Warranty

ORION ITALIA warrants that the materials and the labouring of every product have no faults with normal use and working conditions for a period of 12 months starting from the date of shipping from the manufacturer.

In case of fault included in the warranty conditions, ORION ITALIA takes full responsibility for repairing or replacing the product without any extra fees for the buyer. The warranty is always considered free-port to our head office in Piacenza.

The costs for the Buyer are the following:

- the round-trip shipping for the repairing or the overhauling of the relay;
- the travelling expenses for the technician in charge of the repairing and the overhauling.

These charges are calculated according to ANIMA, Col. C charges. In case of controversy, the place of jurisdiction is the one of Piacenza.

This warranty is not valid for any device that has been subject to incorrect use, negligence, accidents, incorrect installation or that has not been used in accordance with the instructions, or for any device tampered outside the factory. ORION ITALIA will not be responsible for the consequences of any damages, even indirect, for the loss of gain or for the eventual costs deriving from any malfunctioning or from any incorrect use or setting of our devices.

ORION ITALIA reserves the right to modify the device and/or replace the content of this manual without previous notice.

APPENDIX A

TABLES AND TIME-CURRENT CURVES

This appendix includes the 3 curve types and their related shapes.

ANSI CURVES
Moderately inverse
Normally inverse
Very inverse
Extremely inverse

IAC CURVES
IAC Short time
IAC Normally inverse
IAC Very inverse
IAC Extremely inverse

IEC/BS 142 CURVES
IEC Short time
IEC A Normally inverse
IEC B Very inverse
IEC C Extremely inverse

ANSI CURVES

$$T = M * \left(A + \frac{B}{\left(\frac{I}{Ipu} - C\right)} + \frac{D}{\left(\frac{I}{Ipu} - C\right)^2} + \frac{E}{\left(\frac{I}{Ipu} - C\right)^3} \right)$$

ANSI CURVE CONSTANTS	A	B	C	D	E
Moderately Inverse	0.1735	0.6791	0.8	-0.08	0.1271
Normally Inverse	0.0274	2.2614	0.3	-4.19	9.1272
Very Inverse	0.0615	0.7989	0.34	-0.284	4.0505
Extremely Inverse	0.0399	0.2294	0.5	3.0094	0.7222

TRIP TIME (SEC)	T
CURVE MULTIPLIER SETPOINT	M
INPUT CURRENT	I
PICKUP CURRENT SETPOINT	Ipu

MULT.	I/Ipu												
(M)	1.0	1.5	2	3	4	5	6	7	8	9	10	15	20
ANSI - MODERATELY INVERSE													
0.5	8.728	0.675	0.379	0.239	0.191	0.166	0.151	0.141	0.133	0.128	0.123	0.110	0.104
0.8	13.965	1.081	0.606	0.382	0.305	0.266	0.242	0.225	0.213	0.204	0.197	0.177	0.167
1	17.457	1.351	0.757	0.478	0.382	0.332	0.302	0.281	0.267	0.255	0.247	0.221	0.209
1.2	20.948	1.621	0.909	0.573	0.458	0.399	0.362	0.338	0.320	0.306	0.296	0.265	0.250
1.5	26.185	2.026	1.136	0.716	0.573	0.499	0.453	0.422	0.400	0.383	0.370	0.331	0.313
2	34.913	2.702	1.515	0.955	0.764	0.665	0.604	0.563	0.533	0.511	0.493	0.442	0.417
3	52.370	4.053	2.272	1.433	1.145	0.997	0.906	0.844	0.800	0.766	0.740	0.663	0.626
4	69.826	5.404	3.030	1.910	1.527	1.329	1.208	1.126	1.066	1.021	0.986	0.884	0.835
6	104.74	8.106	4.544	2.866	2.291	1.994	1.812	1.689	1.600	1.532	1.479	1.326	1.252
8	139.65	10.807	6.059	3.821	3.054	2.659	2.416	2.252	2.133	2.043	1.972	1.768	1.669
10	174.57	13.509	7.574	4.776	3.818	3.324	3.020	2.815	2.666	2.554	2.465	2.210	2.087
15	261.85	20.264	11.361	7.164	5.727	4.986	4.531	4.222	3.999	3.830	3.698	3.315	3.130
20	349.13	27.019	15.148	9.552	7.636	6.647	6.041	5.630	5.332	5.107	4.931	4.419	4.173
ANSI - NORMALLY INVERSE													
0.5	10.659	2.142	0.883	0.377	0.256	0.203	0.172	0.151	0.135	0.123	0.113	0.082	0.066
0.8	17.054	3.427	1.412	0.603	0.410	0.325	0.276	0.242	0.216	0.197	0.181	0.132	0.106
1	21.317	4.284	1.766	0.754	0.513	0.407	0.344	0.302	0.270	0.246	0.226	0.165	0.133
1.2	25.580	5.141	2.119	0.905	0.615	0.488	0.413	0.362	0.324	0.295	0.271	0.198	0.159
1.5	31.976	6.426	2.648	1.131	0.769	0.610	0.517	0.453	0.406	0.369	0.339	0.247	0.199
2	42.634	8.568	3.531	1.508	1.025	0.814	0.689	0.604	0.541	0.492	0.452	0.329	0.265
3	63.951	12.853	5.297	2.262	1.538	1.220	1.033	0.906	0.811	0.738	0.678	0.494	0.398
4	85.268	17.137	7.062	3.016	2.051	1.627	1.378	1.208	1.082	0.983	0.904	0.659	0.530
6	127.90	25.705	10.594	4.524	3.076	2.441	2.067	1.812	1.622	1.475	1.356	0.988	0.796
8	170.54	34.274	14.125	6.031	4.102	3.254	2.756	2.415	2.163	1.967	1.808	1.318	1.061
10	213.17	42.842	17.656	7.539	5.127	4.068	3.445	3.019	2.704	2.458	2.260	1.647	1.326
15	319.76	64.263	26.484	11.309	7.691	6.102	5.167	4.529	4.056	3.688	3.390	2.471	1.989
20	426.34	85.684	35.312	15.078	10.254	8.136	6.889	6.039	5.408	4.917	4.520	3.294	2.652
ANSI - VERY INVERSE													
0.5	7.354	1.567	0.663	0.268	0.171	0.130	0.108	0.094	0.085	0.078	0.073	0.058	0.051
0.8	11.767	2.507	1.060	0.430	0.273	0.208	0.173	0.151	0.136	0.125	0.117	0.093	0.082
1	14.709	3.134	1.325	0.537	0.341	0.260	0.216	0.189	0.170	0.156	0.146	0.116	0.102
1.2	17.651	3.761	1.590	0.644	0.409	0.312	0.259	0.227	0.204	0.187	0.175	0.139	0.122
1.5	22.063	4.701	1.988	0.805	0.512	0.390	0.324	0.283	0.255	0.234	0.218	0.174	0.153
2	29.418	6.268	2.650	1.074	0.682	0.520	0.432	0.378	0.340	0.312	0.291	0.232	0.204
3	44.127	9.402	3.976	1.611	1.024	0.780	0.648	0.566	0.510	0.469	0.437	0.348	0.306
4	58.835	12.537	5.301	2.148	1.365	1.040	0.864	0.755	0.680	0.625	0.583	0.464	0.408
6	88.253	18.805	7.951	3.221	2.047	1.559	1.297	1.133	1.020	0.937	0.874	0.696	0.612
8	117.67	25.073	10.602	4.295	2.730	2.079	1.729	1.510	1.360	1.250	1.165	0.928	0.815
10	147.09	31.341	13.252	5.369	3.412	2.599	2.161	1.888	1.700	1.562	1.457	1.160	1.019
15	220.63	47.012	19.878	8.054	5.118	3.898	3.242	2.831	2.550	2.343	2.185	1.739	1.529
20	294.18	62.683	26.504	10.738	6.824	5.198	4.322	3.775	3.399	3.124	2.913	2.319	2.039
ANSI - EXTREMELY INVERSE													
0.5	9.157	2.000	0.872	0.330	0.184	0.124	0.093	0.075	0.063	0.055	0.049	0.035	0.030
0.8	14.651	3.201	1.395	0.528	0.294	0.198	0.148	0.119	0.101	0.088	0.079	0.056	0.048
1	18.314	4.001	1.744	0.659	0.368	0.247	0.185	0.149	0.126	0.110	0.098	0.070	0.060
1.2	21.977	4.801	2.093	0.791	0.442	0.297	0.223	0.179	0.151	0.132	0.118	0.084	0.072
1.5	27.471	6.001	2.616	0.989	0.552	0.371	0.278	0.224	0.189	0.165	0.147	0.105	0.090
2	36.628	8.002	3.489	1.319	0.736	0.495	0.371	0.298	0.251	0.219	0.196	0.141	0.119
3	54.942	12.003	5.233	1.978	1.104	0.742	0.556	0.447	0.377	0.329	0.295	0.211	0.179
4	73.256	16.004	6.977	2.638	1.472	0.990	0.742	0.596	0.503	0.439	0.393	0.281	0.239
6	109.88	24.005	10.466	3.956	2.208	1.484	1.113	0.894	0.754	0.658	0.589	0.422	0.358
8	146.51	32.007	13.955	5.275	2.944	1.979	1.483	1.192	1.006	0.878	0.786	0.562	0.477
10	183.14	40.009	17.443	6.594	3.680	2.474	1.854	1.491	1.257	1.097	0.982	0.703	0.597
15	274.71	60.014	26.165	9.891	5.519	3.711	2.782	2.236	1.885	1.646	1.474	1.054	0.895
20	366.28	80.018	34.887	13.188	7.359	4.948	3.709	2.981	2.514	2.194	1.965	1.405	1.194

IAC CURVES

$$T = M * \left(A + \frac{B}{\left(\frac{I}{Ipu} - C\right)} + \frac{D}{\left(\frac{I}{Ipu} - C\right)^2} + \frac{E}{\left(\frac{I}{Ipu} - C\right)^3} \right)$$

IAC CURVE CONSTANTS	A	B	C	D	E
Short Inverse	0.0428	0.0609	0.62	-0.001	0.0221
Normally Inverse	0.2078	0.863	0.8	-0.418	0.1947
Very Inverse	0.09	0.7955	0.1	-1.289	7.9586
Extremely Inverse	0.004	0.638	0.62	1.787	0.246

TRIP TIME (SEC)	T
CURVE MULTIPLIER SETPOINT	M
INPUT CURRENT	I
PICKUP CURRENT SETPOINT	Ipu

MULT.	I/Ipu												
(M)	1.0	1.5	2	3	4	5	6	7	8	9	10	15	20
IAC SHORT INVERSE													
0.5	0.299	0.072	0.047	0.035	0.031	0.028	0.027	0.026	0.026	0.025	0.025	0.024	0.023
0.8	0.479	0.115	0.076	0.056	0.049	0.046	0.043	0.042	0.041	0.040	0.039	0.038	0.037
1	0.599	0.143	0.095	0.070	0.061	0.057	0.054	0.052	0.051	0.050	0.049	0.047	0.046
1.2	0.719	0.172	0.114	0.084	0.074	0.068	0.065	0.063	0.061	0.060	0.059	0.056	0.055
1.5	0.898	0.215	0.142	0.105	0.092	0.085	0.081	0.079	0.077	0.075	0.074	0.071	0.069
2	1.198	0.286	0.190	0.140	0.123	0.114	0.108	0.105	0.102	0.100	0.099	0.094	0.092
3	1.797	0.429	0.284	0.210	0.184	0.171	0.163	0.157	0.153	0.150	0.148	0.141	0.138
4	2.396	0.573	0.379	0.279	0.245	0.228	0.217	0.210	0.204	0.200	0.197	0.188	0.184
6	3.593	0.859	0.569	0.419	0.368	0.341	0.325	0.314	0.307	0.301	0.296	0.282	0.276
8	4.791	1.145	0.759	0.559	0.490	0.455	0.434	0.419	0.409	0.401	0.394	0.376	0.368
10	5.989	1.431	0.948	0.699	0.613	0.569	0.542	0.524	0.511	0.501	0.493	0.470	0.459
15	8.983	2.147	1.422	1.048	0.920	0.854	0.813	0.786	0.766	0.751	0.740	0.706	0.689
20	11.978	2.863	1.896	1.397	1.226	1.138	1.085	1.048	1.022	1.002	0.986	0.941	0.919
IAC NORMALLY INVERSE													
0.5	9.205	0.578	0.375	0.266	0.221	0.196	0.180	0.168	0.160	0.154	0.148	0.133	0.126
0.8	14.728	0.924	0.599	0.426	0.354	0.314	0.288	0.270	0.256	0.246	0.238	0.213	0.201
1	18.410	1.155	0.749	0.532	0.443	0.392	0.360	0.337	0.320	0.307	0.297	0.267	0.252
1.2	22.092	1.386	0.899	0.638	0.531	0.471	0.432	0.404	0.384	0.369	0.356	0.320	0.302
1.5	27.615	1.733	1.124	0.798	0.664	0.588	0.540	0.505	0.480	0.461	0.445	0.400	0.377
2	36.821	2.310	1.499	1.064	0.885	0.784	0.719	0.674	0.640	0.614	0.594	0.533	0.503
3	55.231	3.466	2.248	1.596	1.328	1.177	1.079	1.011	0.960	0.922	0.891	0.800	0.755
4	73.641	4.621	2.997	2.128	1.770	1.569	1.439	1.348	1.280	1.229	1.188	1.066	1.007
6	110.46	6.931	4.496	3.192	2.656	2.353	2.158	2.022	1.921	1.843	1.781	1.599	1.510
8	147.28	9.242	5.995	4.256	3.541	3.138	2.878	2.695	2.561	2.457	2.375	2.133	2.013
10	184.10	11.552	7.494	5.320	4.426	3.922	3.597	3.369	3.201	3.072	2.969	2.666	2.516
15	276.15	17.329	11.240	7.980	6.639	5.883	5.395	5.054	4.802	4.608	4.454	3.999	3.775
20	368.21	23.105	14.987	10.640	8.852	7.844	7.194	6.739	6.402	6.144	5.938	5.331	5.033
IAC VERY INVERSE													
0.5	5.150	1.451	0.656	0.269	0.172	0.133	0.113	0.101	0.093	0.087	0.083	0.070	0.064
0.8	8.240	2.321	1.050	0.430	0.275	0.213	0.181	0.162	0.149	0.140	0.132	0.112	0.102
1	10.300	2.901	1.312	0.537	0.343	0.266	0.227	0.202	0.186	0.174	0.165	0.140	0.128
1.2	12.360	3.481	1.574	0.645	0.412	0.320	0.272	0.243	0.223	0.209	0.198	0.168	0.153
1.5	15.450	4.352	1.968	0.806	0.515	0.399	0.340	0.304	0.279	0.262	0.248	0.210	0.192
2	20.601	5.802	2.624	1.075	0.687	0.533	0.453	0.405	0.372	0.349	0.331	0.280	0.255
3	30.901	8.704	3.936	1.612	1.030	0.799	0.680	0.607	0.559	0.523	0.496	0.420	0.383
4	41.201	11.605	5.248	2.150	1.374	1.065	0.906	0.810	0.745	0.698	0.662	0.560	0.511
6	61.802	17.407	7.872	3.225	2.061	1.598	1.359	1.215	1.117	1.046	0.992	0.840	0.766
8	82.402	23.209	10.497	4.299	2.747	2.131	1.813	1.620	1.490	1.395	1.323	1.120	1.022
10	103.00	29.012	13.121	5.374	3.434	2.663	2.266	2.025	1.862	1.744	1.654	1.400	1.277
15	154.50	43.518	19.681	8.061	5.151	3.995	3.398	3.037	2.793	2.616	2.481	2.100	1.916
20	206.01	58.024	26.241	10.748	6.869	5.327	4.531	4.049	3.724	3.488	3.308	2.800	2.555
IAC EXTREMELY INVERSE													
0.5	9.271	1.699	0.749	0.303	0.178	0.123	0.093	0.074	0.062	0.053	0.046	0.029	0.021
0.8	14.833	2.718	1.199	0.485	0.284	0.197	0.149	0.119	0.099	0.085	0.074	0.046	0.033
1	18.541	3.398	1.498	0.606	0.356	0.246	0.186	0.149	0.124	0.106	0.093	0.057	0.042
1.2	22.250	4.077	1.798	0.727	0.427	0.295	0.223	0.179	0.149	0.127	0.111	0.069	0.050
1.5	27.812	5.096	2.247	0.909	0.533	0.369	0.279	0.223	0.186	0.159	0.139	0.086	0.063
2	37.083	6.795	2.997	1.212	0.711	0.491	0.372	0.298	0.248	0.212	0.185	0.114	0.083
3	55.624	10.193	4.495	1.817	1.067	0.737	0.558	0.447	0.372	0.318	0.278	0.171	0.125
4	74.166	13.590	5.993	2.423	1.422	0.983	0.744	0.595	0.495	0.424	0.371	0.228	0.167
6	111.25	20.385	8.990	3.635	2.133	1.474	1.115	0.893	0.743	0.636	0.556	0.343	0.250
8	148.33	27.181	11.986	4.846	2.844	1.966	1.487	1.191	0.991	0.848	0.741	0.457	0.334
10	185.41	33.976	14.983	6.058	3.555	2.457	1.859	1.488	1.239	1.060	0.926	0.571	0.417
15	278.12	50.964	22.474	9.087	5.333	3.686	2.789	2.233	1.858	1.590	1.389	0.856	0.626
20	370.83	67.952	29.966	12.116	7.111	4.915	3.718	2.977	2.477	2.120	1.853	1.142	0.834

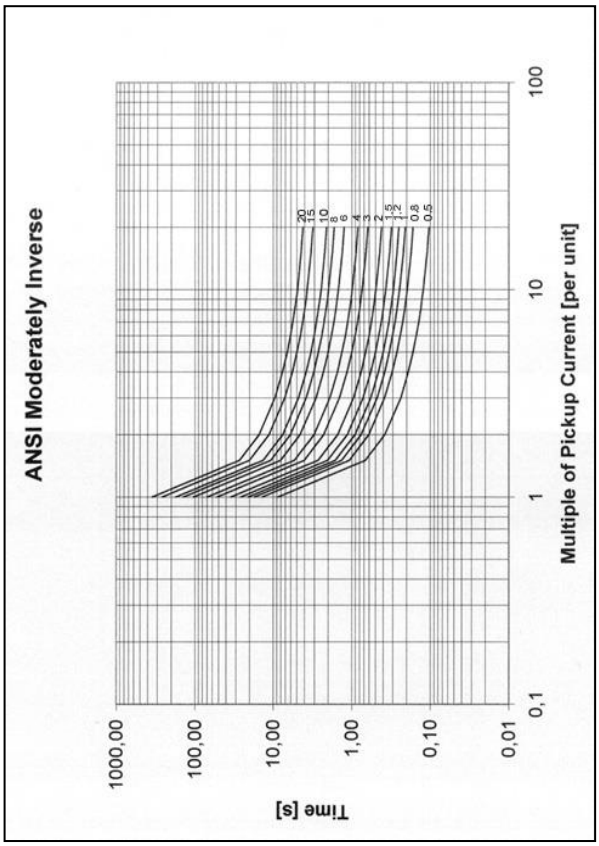
IEC CURVES

$$T = \frac{M}{10} * \left(\frac{K}{\left(\frac{I}{Ipu} \right)^{E} - 1} \right)$$

IEC CURVE CONSTANTS	K	E
Short Time	0.05	0.04
Curve A	0.14	0.02
Curve B	13.5	1
Curve C	80	2

TRIP TIME (SEC)	T
CURVE MULTIPLIER SETPOINT	M
INPUT CURRENT	I
PICKUP CURRENT SETPOINT	Ipu

MULT.	I/Ipu												
(M)	1.1	1.5	2	3	4	5	6	7	8	9	10	15	20
IEC SHORT TIME													
0.5	0.655	0.153	0.089	0.056	0.044	0.038	0.034	0.031	0.029	0.027	0.026	0.022	0.020
0.8	1.047	0.245	0.142	0.089	0.070	0.060	0.054	0.049	0.046	0.044	0.041	0.035	0.031
1	1.309	0.306	0.178	0.111	0.088	0.075	0.067	0.062	0.058	0.054	0.052	0.044	0.039
1.2	1.571	0.367	0.213	0.134	0.105	0.090	0.081	0.074	0.069	0.065	0.062	0.052	0.047
1.5	1.964	0.459	0.267	0.167	0.132	0.113	0.101	0.093	0.086	0.082	0.078	0.066	0.059
2	2.618	0.612	0.356	0.223	0.175	0.150	0.135	0.124	0.115	0.109	0.104	0.087	0.079
3	3.927	0.917	0.534	0.334	0.263	0.226	0.202	0.185	0.173	0.163	0.155	0.131	0.118
4	5.236	1.223	0.711	0.445	0.351	0.301	0.269	0.247	0.231	0.218	0.207	0.175	0.157
6	7.854	1.835	1.067	0.668	0.526	0.451	0.404	0.371	0.346	0.327	0.311	0.262	0.236
8	10.472	2.446	1.423	0.890	0.702	0.602	0.538	0.494	0.461	0.435	0.415	0.350	0.314
10	13.090	3.058	1.778	1.113	0.877	0.752	0.673	0.618	0.576	0.544	0.518	0.437	0.393
15	19.635	4.587	2.668	1.669	1.315	1.128	1.009	0.927	0.865	0.816	0.777	0.656	0.589
20	26.180	6.116	3.557	2.226	1.754	1.504	1.346	1.235	1.153	1.089	1.037	0.874	0.786
IEC CURVE A (NORMALLY INVERSE)													
0.5	3.669	0.860	0.501	0.315	0.249	0.214	0.192	0.176	0.165	0.156	0.149	0.126	0.113
0.8	5.870	1.376	0.802	0.504	0.398	0.342	0.307	0.282	0.264	0.249	0.238	0.201	0.181
1	7.337	1.719	1.003	0.630	0.498	0.428	0.384	0.353	0.330	0.312	0.297	0.252	0.227
1.2	8.805	2.063	1.203	0.756	0.598	0.514	0.460	0.423	0.396	0.374	0.356	0.302	0.272
1.5	11.006	2.579	1.504	0.945	0.747	0.642	0.576	0.529	0.495	0.467	0.446	0.377	0.340
2	14.675	3.439	2.006	1.260	0.996	0.856	0.767	0.706	0.659	0.623	0.594	0.503	0.453
3	22.012	5.158	3.009	1.891	1.494	1.284	1.151	1.058	0.989	0.935	0.891	0.755	0.680
4	29.350	6.878	4.012	2.521	1.992	1.712	1.535	1.411	1.319	1.247	1.188	1.006	0.907
6	44.025	10.317	6.017	3.781	2.988	2.568	2.302	2.117	1.978	1.870	1.782	1.509	1.360
8	58.700	13.755	8.023	5.042	3.984	3.424	3.070	2.822	2.637	2.493	2.376	2.012	1.814
10	73.374	17.194	10.029	6.302	4.980	4.280	3.837	3.528	3.297	3.116	2.971	2.516	2.267
15	110.06	25.791	15.044	9.453	7.470	6.420	5.756	5.292	4.945	4.675	4.456	3.773	3.401
20	146.75	34.388	20.058	12.604	9.960	8.559	7.674	7.055	6.594	6.233	5.941	5.031	4.535
IEC CURVE B (VERY INVERSE)													
0.5	6.750	1.350	0.675	0.338	0.225	0.169	0.135	0.113	0.096	0.084	0.075	0.048	0.036
0.8	10.800	2.160	1.080	0.540	0.360	0.270	0.216	0.180	0.154	0.135	0.120	0.077	0.057
1	13.500	2.700	1.350	0.675	0.450	0.338	0.270	0.225	0.193	0.169	0.150	0.096	0.071
1.2	16.200	3.240	1.620	0.810	0.540	0.405	0.324	0.270	0.231	0.203	0.180	0.116	0.085
1.5	20.250	4.050	2.025	1.013	0.675	0.506	0.405	0.338	0.289	0.253	0.225	0.145	0.107
2	27.000	5.400	2.700	1.350	0.900	0.675	0.540	0.450	0.386	0.338	0.300	0.193	0.142
3	40.500	8.100	4.050	2.025	1.350	1.013	0.810	0.675	0.579	0.506	0.450	0.289	0.213
4	54.000	10.800	5.400	2.700	1.800	1.350	1.080	0.900	0.771	0.675	0.600	0.386	0.284
6	81.000	16.200	8.100	4.050	2.700	2.025	1.620	1.350	1.157	1.013	0.900	0.579	0.426
8	108.00	21.600	10.800	5.400	3.600	2.700	2.160	1.800	1.543	1.350	1.200	0.771	0.568
10	135.00	27.000	13.500	6.750	4.500	3.375	2.700	2.250	1.929	1.688	1.500	0.964	0.711
15	202.50	40.500	20.250	10.125	6.750	5.063	4.050	3.375	2.893	2.531	2.250	1.446	1.066
20	270.00	54.000	27.000	13.500	9.000	6.750	5.400	4.500	3.857	3.375	3.000	1.929	1.421
IEC CURVE C (EXTREMELY INVERSE)													
0.5	19.048	3.200	1.333	0.500	0.267	0.167	0.114	0.083	0.063	0.050	0.040	0.018	0.010
0.8	30.476	5.120	2.133	0.800	0.427	0.267	0.183	0.133	0.102	0.080	0.065	0.029	0.016
1	38.095	6.400	2.667	1.000	0.533	0.333	0.229	0.167	0.127	0.100	0.081	0.036	0.020
1.2	45.714	7.680	3.200	1.200	0.640	0.400	0.274	0.200	0.152	0.120	0.097	0.043	0.024
1.5	57.143	9.600	4.000	1.500	0.800	0.500	0.343	0.250	0.190	0.150	0.121	0.054	0.030
2	76.190	12.800	5.333	2.000	1.067	0.667	0.457	0.333	0.254	0.200	0.162	0.071	0.040
3	114.29	19.200	8.000	3.000	1.600	1.000	0.686	0.500	0.381	0.300	0.242	0.107	0.060
4	152.38	25.600	10.667	4.000	2.133	1.333	0.914	0.667	0.508	0.400	0.323	0.143	0.080
6	228.57	38.400	16.000	6.000	3.200	2.000	1.371	1.000	0.762	0.600	0.485	0.214	0.120
8	304.76	51.200	21.333	8.000	4.267	2.667	1.829	1.333	1.016	0.800	0.646	0.286	0.160
10	380.95	64.000	26.667	10.000	5.333	3.333	2.286	1.667	1.270	1.000	0.808	0.357	0.201
15	571.43	96.000	40.000	15.000	8.000	5.000	3.429	2.500	1.905	1.500	1.212	0.536	0.301
20	761.90	128.00	53.333	20.000	10.667	6.667	4.571	3.333	2.540	2.000	1.616	0.714	0.401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Time [s]
1000,00
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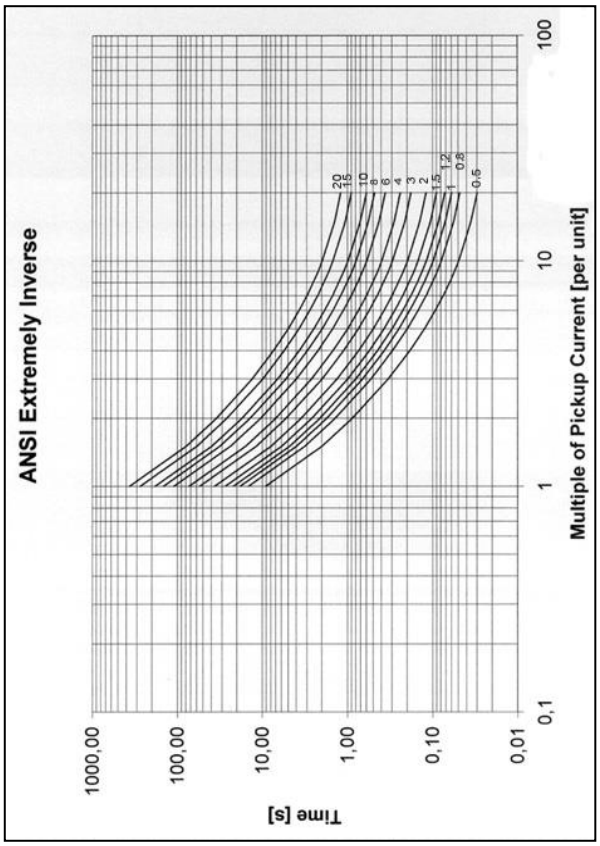
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
1
0,8
0,5


ANSI Extremely Inverse
Time [s]
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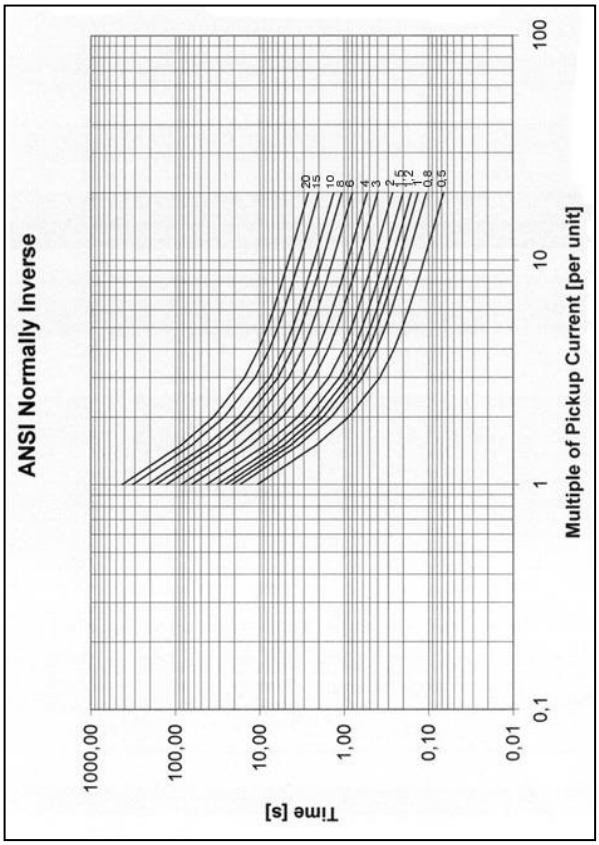
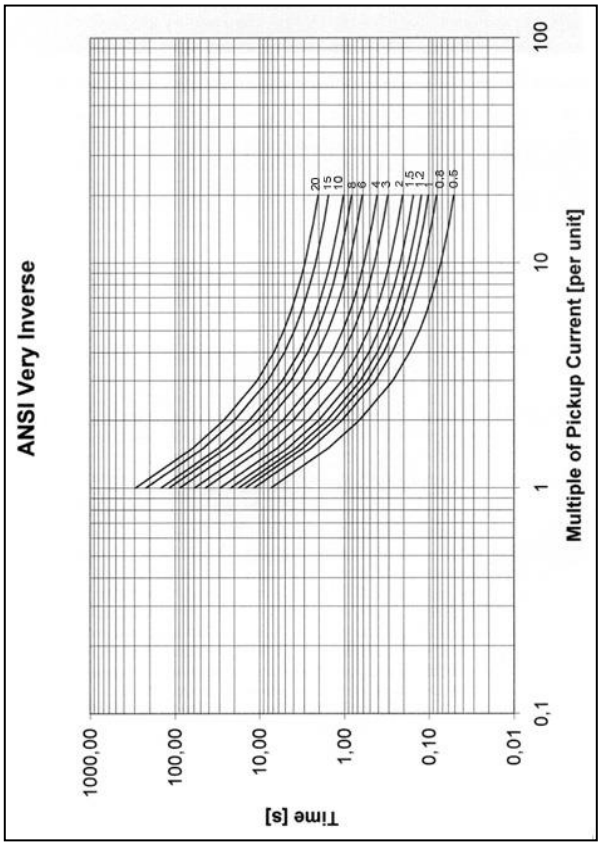
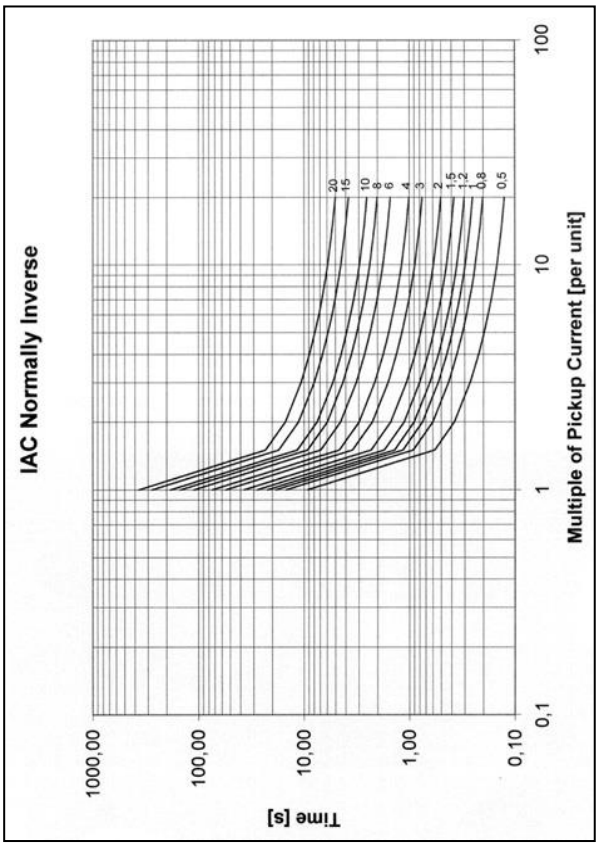
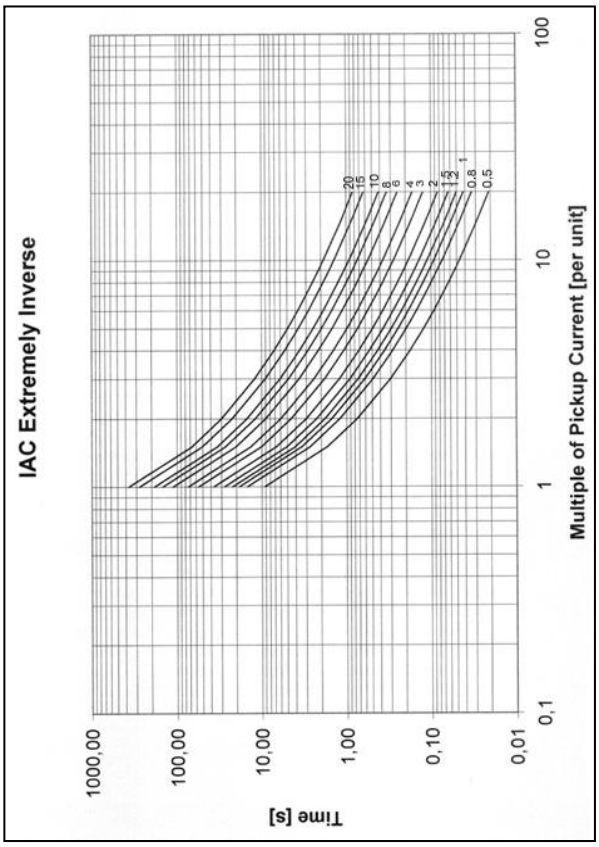
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
1
0,8
0,6


ANSI Normally Inverse
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
1
0,8
0,5


ANSI Very Inverse
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
1
0,8
0,5


IAC Normally Inverse
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
0,8
0,5


IAC Extremely Inverse
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
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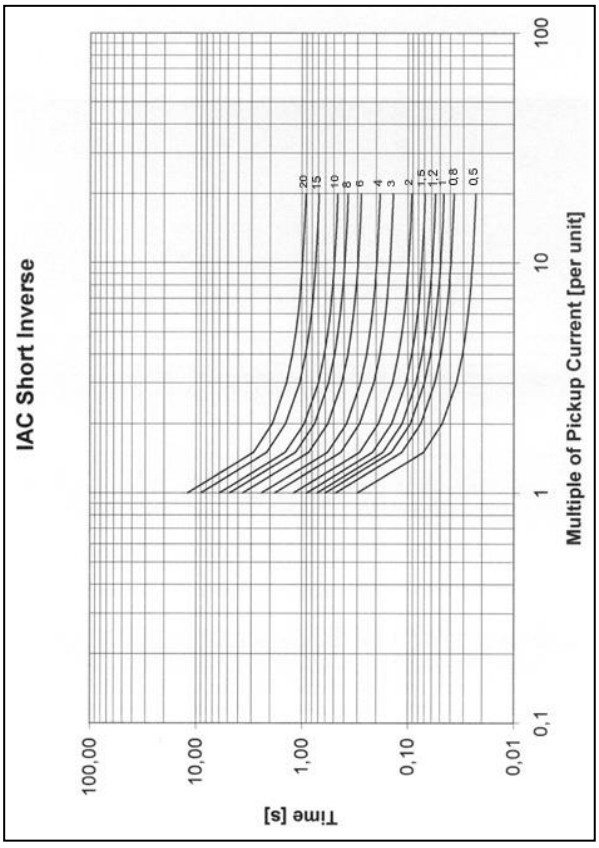
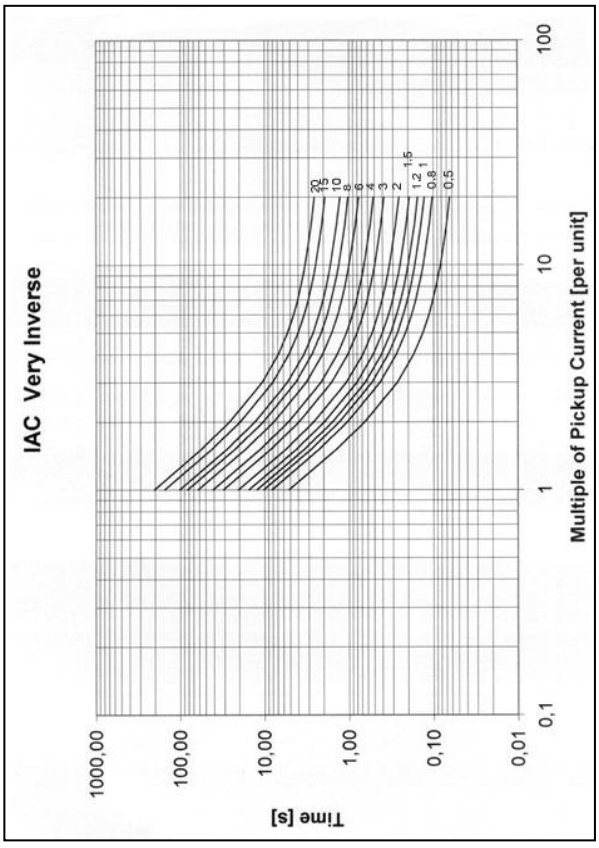
0,8
0,5


IAC Short Inverse
Time [s]
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
0,8
0,5


IAC Very Inverse
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
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1,5
1,2
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0,8
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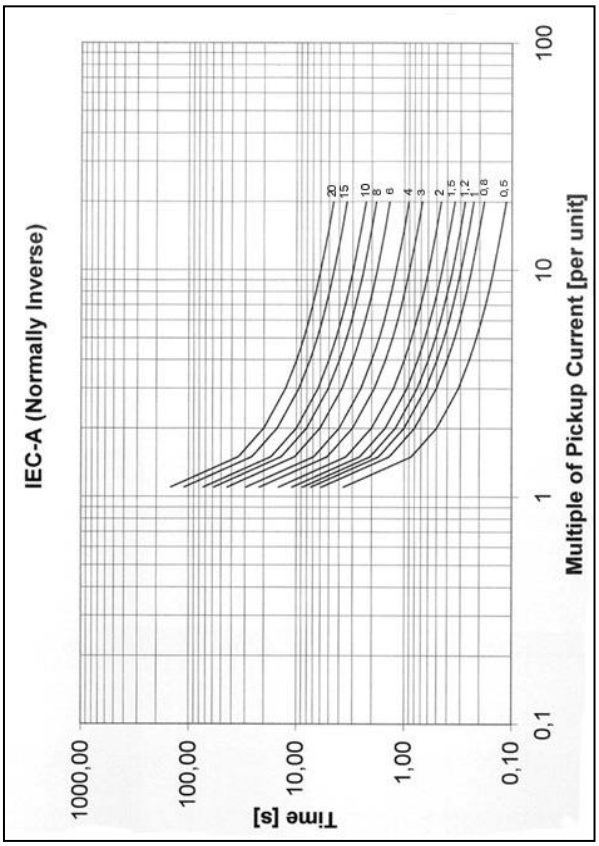
IEC-A (Normally Inverse)
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
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3
2
1,5
1,2
1
0,8
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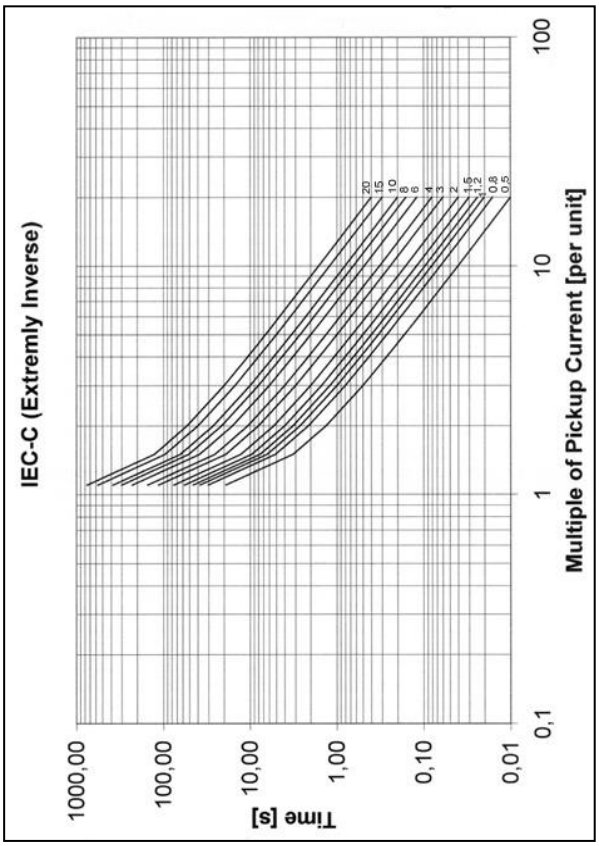
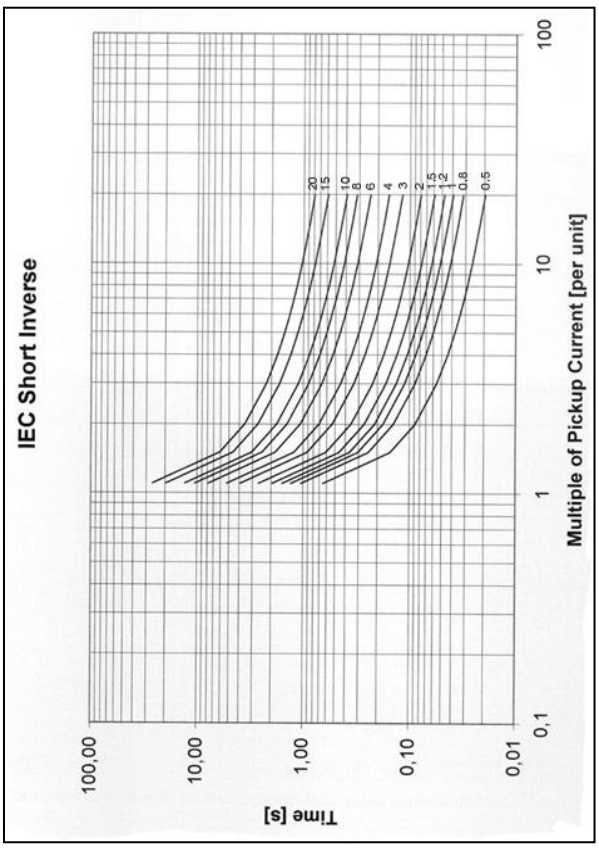
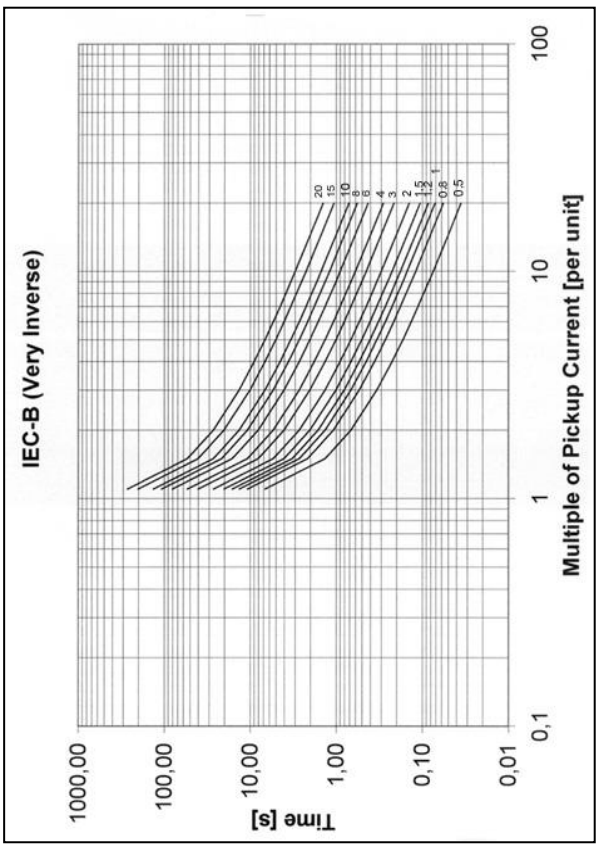

IEC-C (Extremly Inverse)
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
0,8
0,5


IEC Short Inverse
Time [s]
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
10
8
6
4
3
2
1,5
1,2
0,8
0,5


IEC-B (Very Inverse)
Time [s]
1000,00
100,00
10,00
1,00
0,10
0,01
0,1
1
10
100
Multiple of Pickup Current [per unit]
20
15
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1,5
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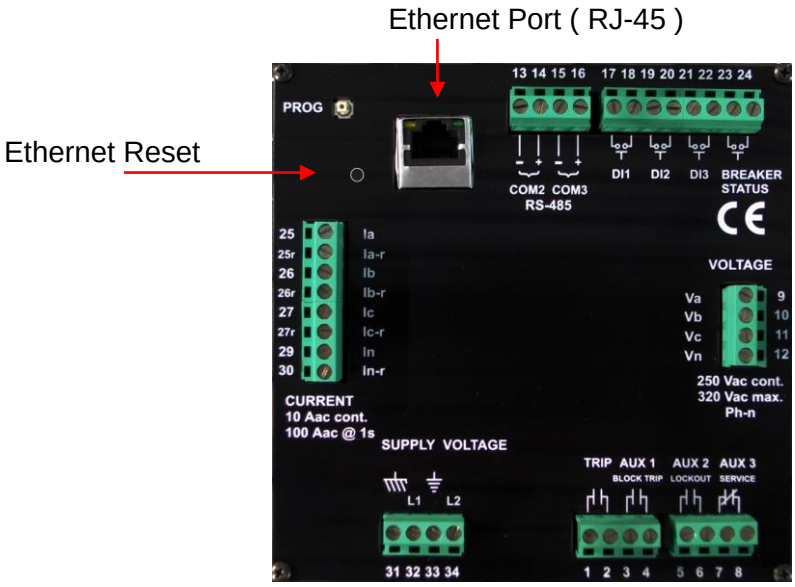
0,8
0,5

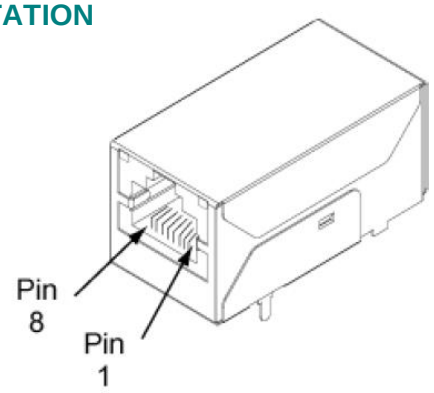
APPENDIX B: ETHERNET INTERFACE
(for Ethernet version only)

B1. General information



*Note: Depending on the model, the protection relay represented in the photo could be different.

ETHERNET INTERFACE PIN ORIENTATION



Ethernet Interface Pin Assignments							
Pin 1	**Pin 2**	**Pin 3**	**Pin 4**	**Pin 5**	**Pin 6**	**Pin 7**	**Pin 8**
TXD+	TXD-	RXD+	N.U.	N.U.	RXD-	N.U.	N.U.
Transmit Data +	Transmit Data -	Receive Data +			Receive Data -		

CONNECTIONS

Use an Ethernet cable STP (cat-5 or cat-5e, shielded) with shielded RJ-45 terminal connectors. Connect the relay to an industrial Hub or Switch that guarantees the grounding of the shield.
Keep the Ethernet network away from power cables or sources that generate electromagnetic disturbances (like contactors, fluorescent lamp ballast, high power motor, circuit breaker …..).

LED DESCRIPTION

The module has two LEDs that are located near the upper corners of the Ethernet port (see the figure). The following table describes the LED operation:

LED Behaviors	
Yellow	Network link status: Off = no link has been detected On = a link has been detected
Green	Network activity: Off = the channel is in idle state Blinking = data is transmitted or received

Ethernet RESET

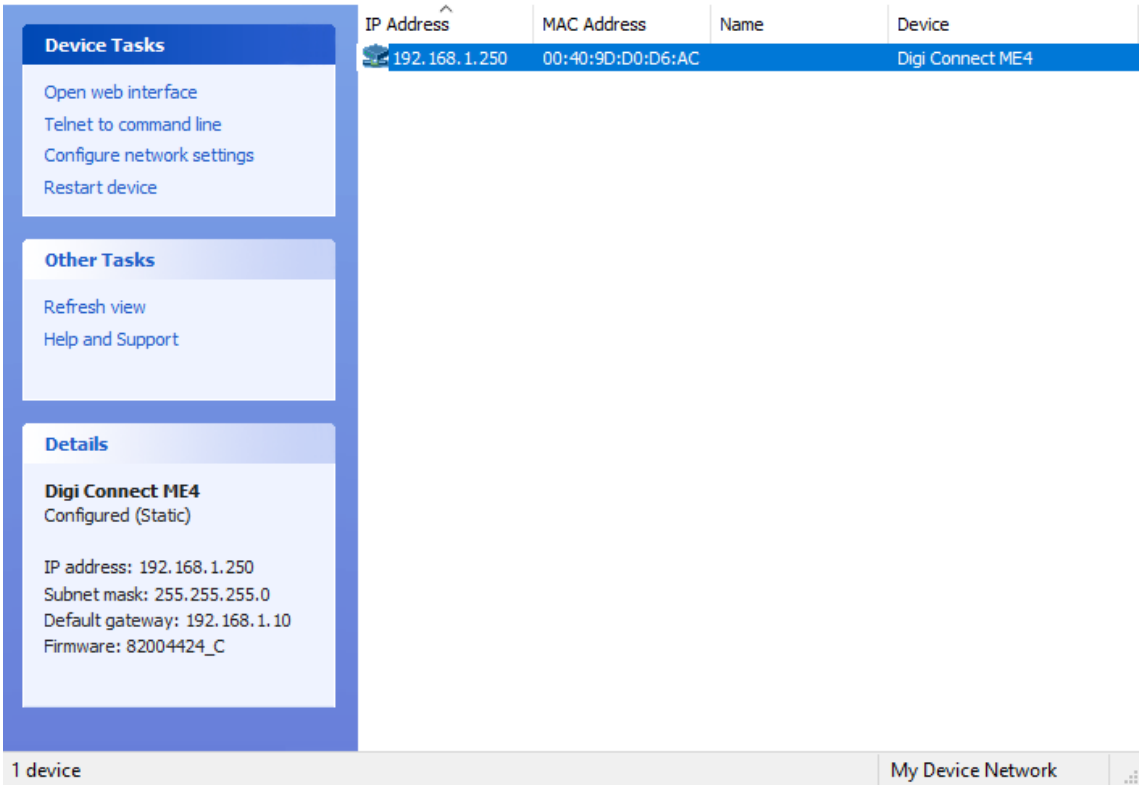
On the back panel of relay there is a small hole. By this it is possible to reach the ETHERNET RESET BUTTON.
Use this button only after following the troubleshooting paragraph of this guide.
In any case, this button do not reset to the factory defaults.

B2. Software Tools

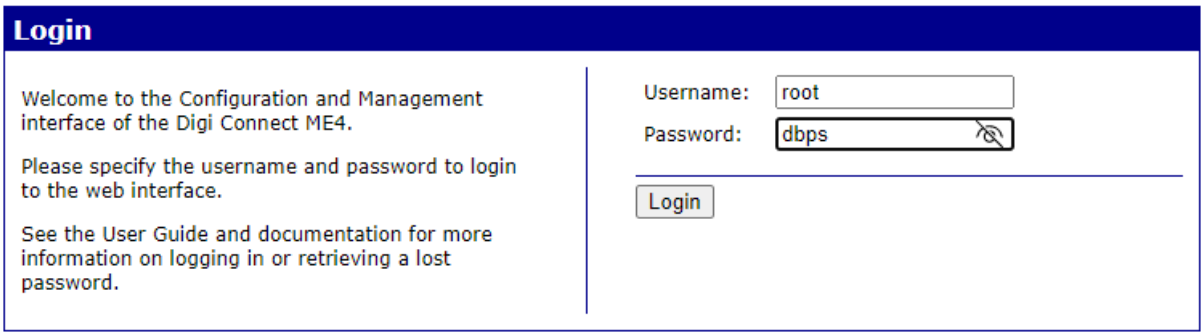
All the necessary setup/configuration tools are available in a “zip” file downloadable from Orion Italia web site.
The “zip” file contains:

- 40002256_H.exe

that allows you to find the Orion Italia protection relay on the LAN.
Launch the file, highlight the device and click on Open Web Interface.
In case of a problem, Orion Italia suggests to momentarily disable the Windows Firewall.



Insert username and password.
Username: root
Password: dbps



B3. IP Address and Subnet Mask

The protection relay is set with a default address so the customers have to change it.
During the configuration of the IP Address of many relays on the same lan, in order to avoid address conflicts, connect only one relay at the same time and change its default IP address:
- Once connected the LAN to the protection relay by the RJ-45 connector, be sure to have the Yellow led = ON (this may require in some cases up to 2 minutes).

To change the IP address and the Subnet Mask, select the Network tab on the left menu of the Web Interface, enter the desired parameters, click Apply and then click Apply once more on the next window. The device will reboot and the IP address will be changed.

B4. Serial communication port

In order to establish a correct communication, it is necessary to leave the standard configuration as follows:

Ethernet port settings: Baud Rate = 9600
Data Bits = 8
Parity = None
Stop Bits = 1
Flow control = None (suggested)
These settings are visible in the Serial Ports tab on the left menu of the Web Interface.

Protection Relay settings:
Setpoint *COMMUNICATIONS* , line *COM1 RS-232 Baudrate* =9600

In case of issues, contact Orion Italia.

B5. Electrical Insulation

The insulation voltage of the Ethernet port is 2000 Vdc

B6. Ethernet Interface Troubleshooting

PROBLEM	SOLUTION	REFERENCE
The Yellow Led on the Ethernet port is OFF	1. Check the connection of the Ethernet cable. 2. Check the connections of RJ-45 connector according to the “Ethernet Interface pin orientation”.	Chapter 1: General Information - ETHERNET INTERFACE PIN ORIENTATION
The OI_DISCOVER or the CFGWIZ application can not find the device.	1. Check the yellow LED on the Ethernet port 2. Check the addresses of each relay on the LAN in order to avoid conflict problems.	Chapter 3: IP Address and Subnet Mask
The Ethernet port seems to work properly but the Orion Italia relay does not communicate	1. Check the Serial port RS232 COM1 configuration on the Orion Italia HMI at SETPOINT “COMMUNICATIONS” 2. Check the serial communication settings of the Ethernet port by the cfgwiz.exe tools.	Chapter 4: Serial communication port
The Ethernet port stops to work after a modification of the settings or a power supply problems	1. Press the ETHERNET RESET button.	Chapter 1: General Information - RESET