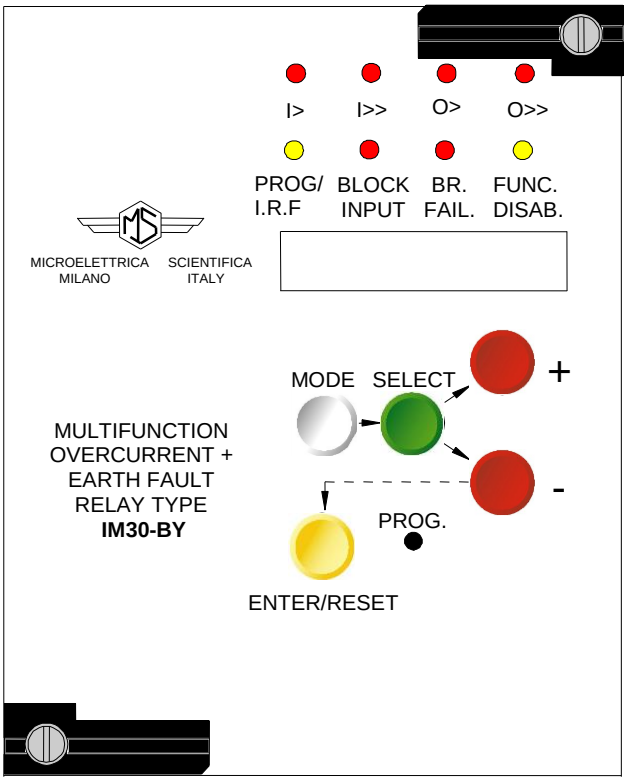
TRIPLE SINGLE PHASE MICROPROCESSOR OVERCURRENT AND EARTH FAULT PROTECTION RELAY

TYPE

IM30-BY

3.00

OPERATION MANUAL



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1. General utilization and commissioning directions

Always make reference to the specific description of the product and to the Manufacturer's instruction. Carefully observe the following warnings.

1.1 - STORAGE AND TRANSPORTATION,

must comply with the environmental conditions stated on the product's instruction or by the applicable IEC standards.

1.2 - INSTALLATION,

must be properly made and in compliance with the operational ambient conditions stated by the Manufacturer.

1.3 - ELECTRICAL CONNECTION,

must be made strictly according to the wiring diagram supplied with the Product, to its electrical characteristics and in compliance with the applicable standards particularly with reference to human safety.

1.4 - MEASURING INPUTS AND POWER SUPPLY,

carefully check that the value of input quantities and power supply voltage are proper and within the permissible variation limits.

1.5 - OUTPUTS LOADING,

must be compatible with their declared performance.

1.6 - PROTECTION EARTHING

When earthing is required, carefully check its effectiveness.

1.7 - SETTING AND CALIBRATION

Carefully check the proper setting of the different functions according to the configuration of the protected system, the safety regulations and the co-ordination with other equipment.

1.8 - SAFETY PROTECTION

Carefully check that all safety means are correctly mounted, apply proper seals where required and periodically check their integrity.

1.9 - HANDLING

Notwithstanding the highest practicable protection means used in designing M.S. electronic circuits, the electronic components and semiconductor devices mounted on the modules can be seriously damaged by electrostatic voltage discharge which can be experienced when handling the modules. The damage caused by electrostatic discharge may not be immediately apparent but the design reliability and the long life of the product will have been reduced. The electronic circuits reduced by M.S. are completely safe from electrostatic discharge (8 KV IEC 255.22.2) when housed in their case; withdrawing the modules without proper cautions expose them to the risk of damage.

a. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.

b. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit tracks or connectors.

c. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.

d. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.

e. Store or transport the module in a conductive bag.

More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 147-OF.

1.10 - MAINTENANCE

Make reference to the instruction manual of the Manufacturer ; maintenance must be carried-out by specially trained people and in strict conformity with the safety regulations.

1.11 - FAULT DETECTION AND REPAIR

Internal calibrations and components should not be altered or replaced.
For repair please ask the Manufacturer or its authorised Dealers.

Misapplication of the above warnings and instruction relieves the Manufacturer of any liability.

2. GENERAL

Input currents are supplied to 4 current transformers: - three measuring phase current - one measuring the earth fault zero-sequence current.
Phase current input can be 1 or 5A
For zero-sequence current, taps for 1A and 5A input are provided on relay's terminal board dimension drawings.
Make electric connection in conformity with the diagram reported on relay's enclosure.
Check that input currents are same as reported on the diagram and on the test certificate.
The auxiliary power is supplied by a built-in interchangeable module fully isolated an self protected.

2.1 - POWER SUPPLY

The relay can be fitted with two different types of **power supply** module :

a) - 24V(-20%) / 110V(+15%) c.a.
24V(-20%) / 125V(+20%) c.c.

b) - 80V(-20%) / 220V(+15%) c.a.
90V(-20%) / 250V(+20%) c.c.

Before energising the unit check that supply voltage is within the allowed limits.

2.2 – Operation and Algorithms

2.2.1 – Input Quantities

System Frequency

The system frequency Fn can be set to 50 or 60 Hz

Current inputs (See Connection Diagram § 17)

The relay directly displays the r.m.s. value of Phase Currents " **IA, IB, IC** " flowing in the Primary of the input Current Transformers and refers all its measurements to that value.
To make the relay properly working with any C.T., when programming the relay settings we have to load the value of the Rated Primary Current " **In** " of the phase CTs:
In = (1-9999)A, adjustable in steps of 1A.
Similarly for the Residual (Zero Sequence) Current, we have to load the value of the Rated Primary Current **On**=(1-9999)A, adjustable in steps of 1A.

If the input of the Earth Fault element is supplied by the Residual connection of the 3 phase CTs, the same value as " **In** " shall be set for " **On** ".

If the input of the Earth Fault element is supplied by a separated Core Balance CT, or by another CT, " On " set will be the Rated Primary Current of this CT, normally different from " In ".

The Rated Secondary Current of the CTs, can be either 1A of 5A.

For the Phase Current inputs, 1A or 5A configuration can be selected by moving the jumpers provided on the CT input card (see § 19).

For the Earth Fault Current input, 1A or 5A taps are provided on relay terminals board : 1A or 5A configuration is obtained by connecting the Residual Current inputs respectively to terminal 32-33 or 32-31 (see Connection Diagram § 17).

Example :

- Phase CTs 1500/5A and Core Balance CT 100/1A
- Load In = 1500A and On = 100A
- Configure CT input card with jumpers J1, J2, J3 in the 5A position.
- Connect Earth Fault input to terminals 32-33

2.2.2 – 1F50/51 – First Overcurrent element

Operation mode : **F(1I)** = D, A, B, C, MI, SI, VI, EI

The time-current operation characteristics of this element can be

- Independent definite time : F(1I) = D
- Inverse time according to different time-current curves (see § 2.2.9)

Operation level : **1I** = (0.25-4)In, adjustable in steps of 0.01In.

The value set for the variable 1I is the minimum r.m.s. value of the current flowing in at least one of the 3 phase currents " IA, IB, IC " which makes the element start functioning.

Trip time delay : **t1I** = (0.05-30)s, adjustable in steps of 0.01s.

As soon as the current of any phase (IA, IB, IC), exceeds the set value [1I] the element starts to operate:

- The led " **I>** " starts flashing.
- The timer " **t1I** " starts counting down
- Any output relay programmed to be operated by the instantaneous element "1I" (see § 12.2) gets energized and picks-up operating its contacts accordingly.

If during " t1I " count down, the current in all the 3-phases drops below 0.95 [1I] the element and the timer are reset.

In the Independent Definite Time mode " F(1I) = D " at the end of the set time [t1I] - if the current remained continuously above the reset level 0.95 [1I] – the element trips:

- The led " **I>** " is steadily illuminated.
- Any output relay programmed to be operated by the time delayed element " t1I " (see § 12.2) gets energized and picks-up operating its contacts accordingly.

In the Inverse time operation modes, the Trip Time delay is that resulting from the equations of the selected Time-Current-curve (see § 2.2.9).

Reset of the Led is operated by pressing the yellow Reset push button on relays front face or via Serial Port (see MSCom operation). Reset of the output relay takes place as explained in § 5.

Any time the time delayed element trips, the Event Recording " Last Trip " is activated (See § 10.3) and the trip counter " TRIP NUM " is increased (See § 10.4).

2.2.3 – 2F50/51 – Second Overcurrent element

The time-current operation characteristics of this element is Independent Definite Time

Operation level : **2I** = (0.5-40)In, adjustable in steps of 0.1In.

The value set for the variable " 2I " is the minimum r.m.s. value of the current flowing in at least one of the 3 phase currents " IA, IB, IC " which makes the element start functioning.

The set value [2I] of the operation level can be automatically doubled during inrush transients if the variable [2Ix2] is set to ON (See § 12).

Trip time delay : **t2I** = (0.05-3)s, adjustable in steps of 0.01s.

As soon as the current of any phase (IA, IB, IC), exceeds the set value [2I] the element starts to operate:

- The led " **I>>** " starts flashing.
- The timer " **t2I** " starts counting down
- Any output relay programmed to be operated by the instantaneous element "2I" (see § 12.2) gets energized and picks-up operating its contacts accordingly.

If during " t2I " count down, the current in all the 3-phases drops below 0.95 [2I] the element and the timer are reset.

At the end of the set time [t2I] - if the current remained continuously above the reset level 0.95 [2I] – the element trips:

- The led "**I>>**" is steadily illuminated.
- Any output relay programmed to be operated by the time delayed element " t2I " (see § 12.2) gets energized and picks-up operating its contacts accordingly.

In the Inverse time operation modes, the Trip Time delay is that resulting from the equations of the selected Time-Current-curve (see § 2.2.9).

Reset of the Led is operated by pressing the yellow Reset push button on relays front face or via Serial Port (see MSCom operation). Reset of the output relay takes place as explained in § 5.

Any time the time delayed element trips, the Event Recording " Last Trip " is activated (See § 10.3) and the trip counter " TRIP NUM " is increased (See § 10.4).

2.2.4 – 3F50/51 – Third Overcurrent element

- Instantaneous operation level : **3I** = (0.5-40)In adjustable in steps 0.1In.

It trips instantaneously as soon as the current exceeds the set level [3I], operates programmed output relays and the led " I>> " - Reset takes place at 0.95 [3I].

2.2.5 – 1F50N/51N – First Earth Fault element

Operation mode : **F(1O)** = D, A, B, C, MI, SI, VI, EI

The time-current operation characteristics of this element can be

- Independent definite time : F(1O) = D
- Inverse time according to different time-current curves (see § 2.2.9)

Operation level : **1O** = (0.02-0.4)On, adjustable in steps of 0.01On.

The value set for the variable " 1O " is the minimum r.m.s. value of the Residual Current (3Io) flowing which makes the element start functioning.

Trip time delay : **t1O** = (0.05-30)s, adjustable in steps of 0.01s.

As soon as the Residual Current exceeds the set value [1O] the element starts to operate:

- The led " **O>** " starts flashing.
- The timer" **t1O** " starts counting down
- Any output relay programmed to be operated by the instantaneous element "1O" (see § 12.2) gets energized and picks-up operating its contacts accordingly.

If during "t1O" count down, the Residual Current drops below 0.95 [1O] the element and the timer are reset.

In the Independent Definite Time mode " F(1O) = D " at the end of the set time [t1O] - if the current remained continuously above the reset level 0.95 [1O] – the element trips:

- The led " **O>** " is steadily illuminated.
- Any output relay programmed to be operated by the time delayed element "t1O" (see § 12.2) gets energized and picks-up operating its contacts accordingly.

In the Inverse time operation modes, the Trip Time delay is that resulting from the equations of the selected Time-Current-curve (see § 2.2.9).

Reset of the Led is operated by pressing the yellow Reset push button on relays front face or via Serial Port (see MSCom operation). Reset of the output relay takes place as explained in § 5.

Any time the time delayed element trips, the Event Recording " Last Trip " is activated (See § 10.3) and the trip counter " TRIP NUM " is increased (See § 10.4).

2.2.6 – 2F50N/51N – Second Earth Fault element

The time-current operation characteristics of this is Independent Definite Time

Operation level : **2O** = (0.02-4)On, adjustable in steps of 0.01On.

The value set for the variable “2O“ is the minimum r.m.s. value of the Residual Current (3Io) flowing which makes the element start functioning.

Trip time delay : **t2O** = (0.05-3)s, adjustable in steps of 0.01s.

As soon as the Residual Current exceeds the set value [2O] the element starts to operate:

- The led “ **O>>** “ starts flashing.
- The timer ” **t2O** “ starts counting down
- Any output relay programmed to be operated by the instantaneous element “2O“ (see § 12.2) gets energized and picks-up operating its contacts accordingly.

If during “t2O“ count down, the Residual Current drops below 0.95 [2O] the element and the timer are reset.

At the end of the set time [t2O] - if the current remained continuously above the reset level 0.95 [2O] – the element trips:

- The led “ **O>>** “ is steadily illuminated.
- Any output relay programmed to be operated by the time delayed element “t2O” (see § 12.2) gets energized and picks-up operating its contacts accordingly.

In the Inverse time operation modes, the Trip Time delay is that resulting from the equations of the selected Time-Current-curve (see § 2.2.9).

Reset of the Led is operated by pressing the yellow Reset push button on relays front face or via Serial Port (see MSCom operation). Reset of the output relay takes place as explained in § 5.

Any time the time delayed element trips, the Event Recording “ Last Trip “ is activated (See § 10.3) and the trip counter “ TRIP NUM “ is increased (See § 10.4).

2.2.7 – Breaker Failure

As soon as any of the output Relays R2, R3, R4 controlled by the phase overcurrent elements trips, the time “tBF” is started; if at the and of the delay “tBF” the current flowing in any of the phase elements has not drop down to zero, the Led “BR. FAIL.” is lit-on and the Relay “R1” is energized if so programmed (R1 = BF see § 12.2).

2.2.8 - ALGORITHM OF THE TIME CURRENT CURVES

The Time Current Curves are generally calculated with the following equation :

(1) $$t(I) = \left[\frac{A}{\left(\frac{I}{Is}\right)^{a} - 1} + B \right] \bullet K \bullet T_s + t_r$$ where :

t(I) = Actual trip time delay when the input current equals I

Is = Set minimum pick-up level

K = $$\left(\frac{A}{10^{a} - 1} + B \right)^{-1}$$

T_s = Set time delay : $t(I) = T_s$ when $\frac{I}{I_s} = 10$

tr = Operation time of the output relay on pick-up.

The parameters A, B and a have different values for the different Time Current Curves.

Curve Name	Curve Identifier	A	B	a
IEC A Inverse	A	0.14	0	0.02
IEC B Very Inverse	B	13.5	0	1
IEC C Extremely Inverse	C	80	0	2
IEEE Moderate Inverse	MI	0.0104	0.0226	0.02
IEEE Short Inverse	SI	0.00342	0.00262	0.02
IEEE Very Inverse	VI	3.88	0.0963	2
IEEE Inverse	I	5.95	0.18	2
IEEE Extremely Inverse	EI	5.67	0.0352	2

For the IEC curves, being B = 0, the Time/Current equation (1), becomes:

$$(1') = \frac{\left(10^{a} - 1\right)Ts}{\left(\frac{I}{Is}\right)^{a} - 1} + tr = \frac{Kt}{\left(\frac{I}{Is}\right)^{a} - 1} + tr$$

Where $Kt = (10^{a}-1)Ts$ is the time multiplier

2.3 - CLOCK AND CALENDAR

The unit features a built in clock calendar with Years, Months, Days, Hours, Minutes, Seconds, Tenths of seconds and Hundredths of seconds.

2.3.1 - Clock synchronization.

The clock can be synchronized via the serial communication interface.
The following synchronization periods can be set: 5, 10, 15, 30, 60 minutes.
Synchronization can also be disabled, in which case the relay ignores the serial broadcast signal.
In case synchronization is enabled, the unit expects to receive a sync signal at the beginning of every hour and once every T_{syn} minutes. When a sync signal is received, the clock is automatically set to the nearest expected synchronization time.
For example: if T_{syn} is 10min and a sync signal is received at 20:03:10 January the 10th, 98, then the clock is set to 20:00:00 January the 10th, 1998.
On the other hand, if the same sync signal were received at 20:06:34, the clock would be set to 20:10:00, January the 10th 98.
Note that if a sync signal is received exactly in the middle of a T_{syn} period, the clock is set to the previous expected synchronization time.

2.3.2 - Date and time setting.

When the PROG/SETTINGS menu is entered, the current date is displayed with one of the groups of digits (YY, MMM or DD) blinking.
The DOWN key operates as a cursor. It moves through the groups of digits in the sequence YY => MMM => DD => YY => …
The UP key allows the user to modify the currently blinking group of digits.
If the ENTER button is pressed the currently displayed date is set.
Pressing the SELECT button the current time is displayed which can be modified using the same procedure as for the date.
If synchronization is enabled and the date (or time) is modified, the clock is stopped until a sync signal is received via the serial port. This allows the user to manually set many units and have them to start their clocks in a synchronized fashion.
If synchronization is disabled the clock is never stopped.
Note that the setting of a new time always clears 10ths and 100ths of sec.

2.3.3 - Time resolution.

The clock has a 10ms resolution. This means that any event can be time-stamped with a 10ms accuracy, although the information concerning 10ths and 100ths of sec. can be accessed only via the serial communication interface.

2.3.4 - Operation during power off.

The unit has an on board Real Time Clock which maintains time information for at least 1 hour in case of power supply failure.

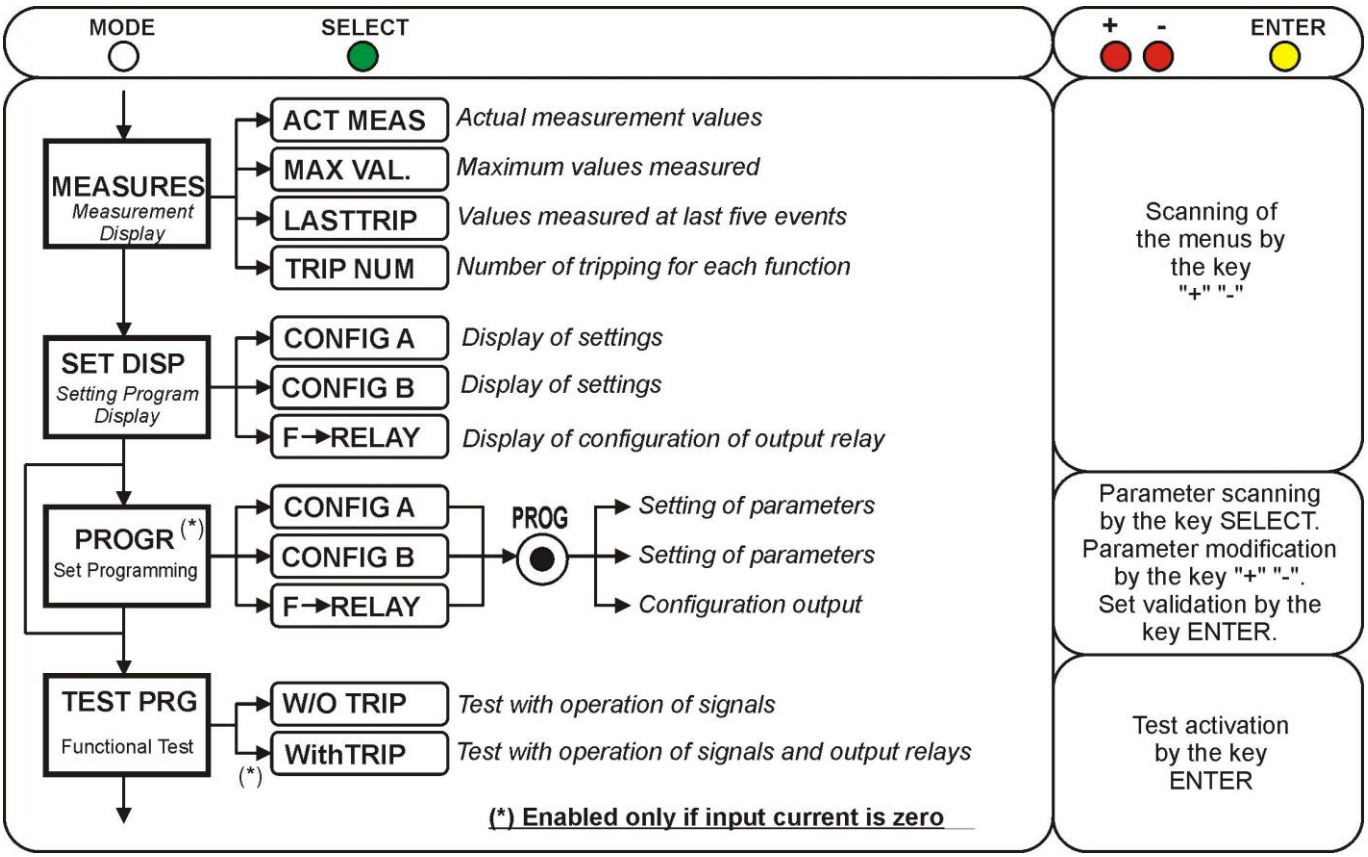
2.3.5 - Time tolerance.

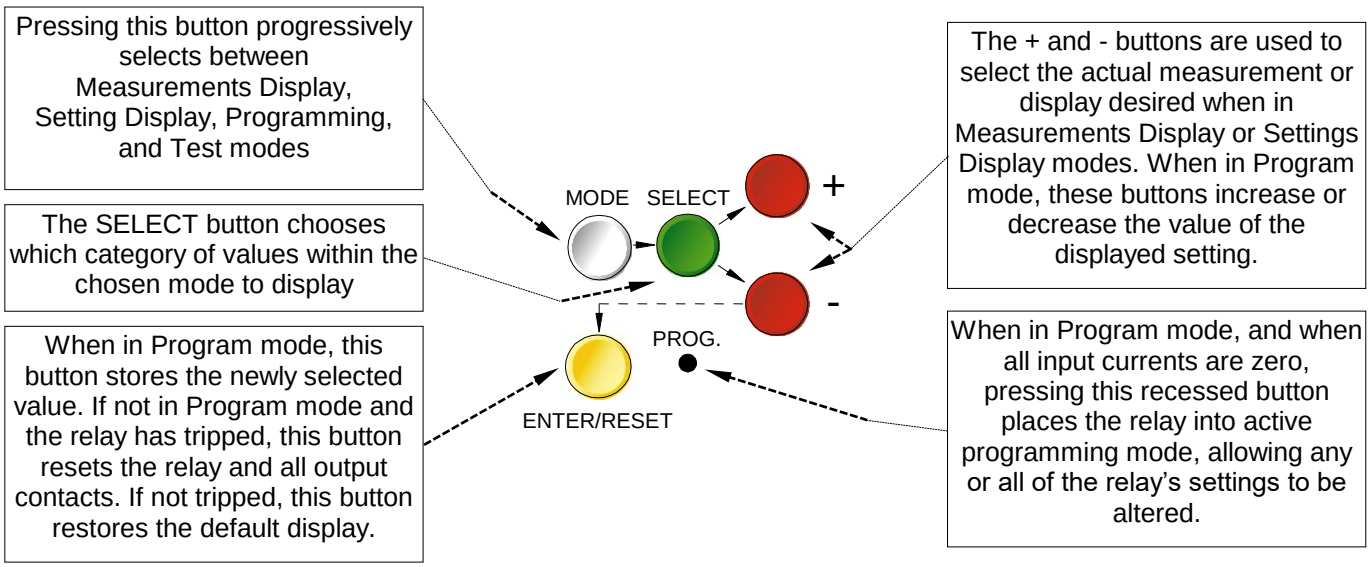
During power on, time tolerance depends on the on board crystal (+/-50ppm typ, +/-100ppm max. over full temperature range).
During power off, time tolerance depends on the RTC's oscillator (+65 /–270 ppm max over full temperature range).

3. CONTROLS AND MEASUREMENTS

Five key buttons allow for local management of all relay's functions.
A 8-digit high brightness alphanumerical display shows the relevant readings **(xxxxxxxx)**
(see synoptic table fig.1)

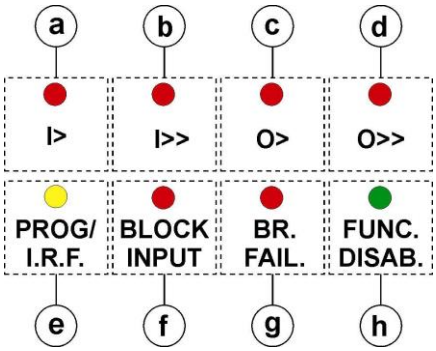
FIG.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a)	Red LED	**I>**	❑ Flashing when measured current exceeds the set trip level [1I]. ❑ Illuminated on trip after expiry of the set trip time delay [t1I].
b)	Red LED	**I>>**	❑ Same as above related to [2I], [t2I] and [3I].
c)	Red LED	**O>**	❑ Same as above related to [1O], [t1O].
d)	Red LED	**O>>**	❑ Same, as above related to [2O], [t2O].
e)	Yellow LED	**PROG/ I.R.F.**	❑ Flashing during the programming of the parameters or in case of Internal Relay Fault.
f)	Red LED	**BLOCK INPUT**	❑ Flashing when a blocking signal is present at the relevant input terminals.
g)	Red LED	**BR.FAIL.**	❑ Lit-on when the BREAKER FAILURE function is activated.(see § 5)
h)	Yellow LED	**FUNC. DISAB.**	❑ Lit-on when the operation of one or more of the relay functions has been disactivated in the programming.

The reset of the leds takes place as follows:

❑ Leds a,b,c,d,g	:	❑ From flashing to off, automatically when the lit-on cause disappears. ❑ From ON to OFF, by "ENTER/RESET" push button or via serial communication only if the tripping cause has disappeared.
❑ Leds e,f,h	:	❑ From ON to OFF, automatically when the lit-on cause disappears.

In case of auxiliary power supply failure the status of the leds is recorded and reproduced when power supply is restored.

5. OUTPUT RELAYS

Five output relays are available (R1, R2, R3, R4, R5)

a) - The relays **R1,R2,R3,R4** are normally deenergized (energised on trip of the time delayed elements):

R2 : t1I, t2I, t3I - Phase A
R3 : t1I, t2I, t3I - Phase B
R4 : t1I, t2I, t3I - Phase C

R1 : According to programming as follows:
R1 = tIo : 1O, 2O (Earth Fault any phase)
R1 = BF : Breaker Failure (See § 2.2.7)

b) - The relay **R5**, normally energized, is not programmable and it is deenergized on:

- internal fault
- power supply failure
- during the programming

6. SERIAL COMMUNICATION

The relays fitted with the serial communication option can be connected via a cable bus a fiber optic bus for interfacing with a Personal Computer (type IBM or compatible).
All the functionalities that can be operated locally (for example reading of input measurement and changing of relay's settings) are also possible via the serial communication interface.
Furthermore the serial port allows the user to read event recording and stored data.
The unit has a RS232 / RS485 interface and can be connected either directly to a P.C. via a dedicated cable or to a RS485 serial bus, allowing having many relays to exchange data with a single master P.C. using the same physical serial line. A RS485/232 converter is available on request.
The communication protocol is MODBUS RTU (only functions 3, 4 and 16 are implemented).
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCOM) for Windows 95/98/NT4 SP3 (or later) is available.
Please refer to the MSCOM instruction manual for more information Microelettrica Scientifica.

7. DIGITAL INPUTS

Three digital inputs are provided: they are active when the relevant terminals are shorted

- **B2** (terminals 1 - 2) : it blocks the operation of the phase overcurrent elements

- **B3** (terminals 1 - 3) : it blocks the operation of the earth fault elements.

- **B4** (terminals 1 - 14) : The relay allows to independently program two complete banks of setting.

  Switching-over from “CONFIG A” to “CONFIG B”

  - Terminals 1 – 14 Open = “CONFIG A” active
  - Terminals 1 – 14 Shorted = “CONFIG B” active

  The input B4 can also be activated via the serial communication port (leave 1-14 open).
  In this case Switching-back from “CONFIG B” to “CONFIG A” can only be made via serial port.
  Note: if the terminals 1 – 14 are shorted, switching-back from “CONFIG B” to “CONFIG A” cannot be made via the serial port.

1-14	Serial communication	Active Setting
Open	No Set	CONFIG A
Open	Set	CONFIG B
Shorted	No Set	CONFIG B
Shorted	Set	CONFIG B

When a function is blocked the pick-up of its time delayed output is inhibited. Programming allows to have the inhibition either permanent as long as the blocking input is active (tB2=Dis; tB3=Dis) or automatically removed after the expiry of the set trip time delay of the function involved plus an additional time 2tBF (tB2=2tBF; tB3=2tBF). By proper interconnection of the blocking inputs and outputs of different relays it is possible to configurate very efficient arrangements of logic fault discrimination as well as to feature a safe and quick breaker back-up protection.

8. TEST

Besides the normal "WATCHDOG" and "POWERFAIL" functions, a comprehensive program of self-test and self-diagnostic provides:

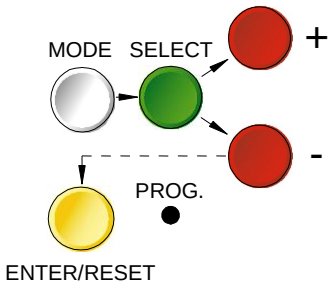
- Diagnostic and functional test, with checking of program routines and memory's content, run every time the aux. power is switched-on: the display shows the type of relay and its version number.

- Dynamic functional test run during normal operation every 15 min. (relay's operation is suspended for less than ≤4ms). If any internal fault is detected, the display shows a fault message, the Led "PROG/IRF" illuminates and the relay R5 is deenergized.

- Complete test activated by the keyboard or via the communication bus either with or without tripping of the output relays.

9. KEYBOARD AND DISPLAY OPERATION

All controls can be operated from relay's front or via serial communication bus.
The keyboard includes five hand operable buttons **(MODE) - (SELECT) - (+) - (-) - (ENTER/RESET)** plus one indirect operable key **(PROG)** (see synoptic table a fig.1):



a) - White key	**MODE**	:	when operated it enters one of the following operation modes indicated on the display :
	MEASURES	=	Reading of all the parameters measured and of those recorded in the memory
	SET DISP	=	Reading of the settings and of the configuration of the output relays as programmed.
	PROG	=	Access to the programming of the settings and of relay configuration.
	TEST PROG	=	Access to the manual test routines.
b) - Green key	**SELECT**	:	When operated it selects one of the menus available in the actual operation MODE
c) - Red key	"**+**" AND "**-**"	:	When operated they allow to scroll the different information available in the menu entered by the key SELECT
d) - Yellow key	**ENTER/RESET**	:	It allows the validation of the programmed settings - the actuation of test programs - the forcing of the default display indication - the reset of signal Leds.
e) - Indirect key	●	:	Enables access to the programming.

10. READING OF MEASUREMENTS AND RECORDED PARAMETERS

Enter the MODE "MEASURE", SELECT the menus "ACT.MEAS"-"MAX VAL"-"LASTTRIP"--"TRIP NUM", scroll available information by key "+" or "-" .

10.1 - ACT.MEAS

Actual values as measured during the normal operation.
The values displayed are continuously refreshed.

Display			Description
xxXXXxx			Date : Day, Month, Year
xx:xx:xx			Hour : Hours, Minutes, Seconds
I/In	xxx	**%**	Highest among the 3 phase-currents displayed as % of the rated current of phase C.Ts (0-999%)
IA	xxxxx	**A**	True R.M.S. value of the current of phase A displayed as primary Amps.(0 - 99999)
IB	xxxxx	**A**	As above, phase B.
IC	xxxxx	**A**	As above, phase C.
Io	xxxxx	**A**	As above, earth fault current.

10.2 - MAX VAL

Maximum demand values recorded starting from 100ms after closing of main Circuit Breaker plus highest inrush values recorded within the first 100ms from Breaker closing, (updated any time the breaker closes).

Display			Description
IA	xxxx	**In**	Max. value of phase A current after the first 100ms, displayed as p.u. of C.Ts rated current.
IB	xxxx	**In**	As above, phase B.
IC	xxxx	**In**	As above, phase C.
Io	xxxx	**On**	As above, earth fault current.
SA	xxxx	**In**	Max. current of phase A during the first 100ms.
SB	xxxx	**In**	As above, phase B.
SC	xxxx	**In**	As above, phase C.
SO	xxxx	**On**	As above, earth fault current.

10.3 - LASTTRIP

Display of the function which caused the tripping of the relay plus values of the parameters at the moment of tripping. The last five events are recorded
The memory buffer is refreshed at each new relay tripping with a decreasing numbering (FIFO logic).

Display	Description
LastTr-x	Indication of the recorded event (x= 0 to 4) Example: Last event (LastTr -0) Last but one event (LastTr-1) etc...
xxXXXxx	Date : Day, Month, Year
xx:xx:xx	Hour : Hours, Minutes, Seconds
F: xxxxxx	Function which produced the event being displayed and faulty phase in case of phase current element's trip **1I ph A,B,C; 2I ph A,B,C; 3I ph A,B,C; 1O; 2O**
IA xxxx **In**	Current of phase A. (value recorded at the moment of tipping)
IB xxxx **In**	Current of phase B. (as above)
IC xxxx **In**	Current of phase C. (as above)
Io xxxx **On**	Earth fault current. (as above)

10.4 - TRIP NUM

Counters of the number of operations for each of the relay functions.
The memory is non-volatile and can be cancelled only with a secret procedure.

Display	Description	
1IA xxxx	Trip number of Low set overcurrent time delayed element	1I phase A
1IB xxxx	Trip number of Low set overcurrent time delayed element	1I phase B
1IC xxxx	Trip number of Low set overcurrent time delayed element	1I phase C
2IA xxxx	Trip number of High set overcurrent time delayed element	2I phase A
2IB xxxx	Trip number of High set overcurrent time delayed element	2I phase B
2IC xxxx	Trip number of High set overcurrent time delayed element	2I phase C
3IA xxxx	Trip number of Instantaneous overcurrent element.	3I phase A
3IB xxxx	Trip number of Instantaneous overcurrent element.	3I phase B
3IC xxxx	Trip number of Instantaneous overcurrent element.	3I phase C
1O xxxx	Trip number of Low set earth fault time delayed element	
2O xxxx	Trip number of High set earth fault time delayed element	

11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

Enter the mode "SET DISP", select the menu "CONFIG A" or "CONFIG B" or "F→RELAY", scroll information available in the menu by keys "+" or "-".

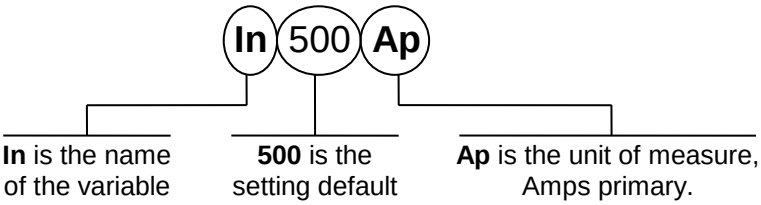
CONFIG = values of relay's operation parameters as programmed

F→RELAY = output relays associated to the different functions as programmed.

12. PROGRAMMING

The relay is supplied with the standard default programming used for factory test.
[Values here below reported in the " Display " column].
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP
Local Programming by the front face key board is enabled only if no input current is detected (main switch open). Programming via the serial port is always enabled but a password is required to access the programming mode. The default password is the null string; in the standard application program for communication "MS-COM" it is also provided an emergency password which can be disclosed on request only.
As soon as programming is enabled, the Led PRG/IRF flashes and the alarm relay R5 is deenergized..
Enter MODE "PROG" and SELECT either "CONFIG A" or "CONFIG B" for programming of parameters or "F→RELAY" for programming of output relays configuration; enable programming by the indirect operation key PROG.
The key SELECT now scrolls the available parameters. By the key (+) , (-) the displayed values can be modified; to speed up parameter's variation press the key SELECT while "+" or "-" are pressed.
Press key "ENTER/RESET" to validate the set values.

12.1 - PROGRAMMING OF FUNCTIONS SETTINGS



Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display			Description	Setting Range	Step	Unit
xxxxxxx			Current date	DDMMMYY	-	-
xx:xx:xx			Current time	HH:MM:SS	-	-
Fn	50	**Hz**	Mains frequency	50 - 60	10	Hz
In	500	**Ap**	Rated primary current of the phase C.Ts.	1 - 9999	1	A
On	500	**Ap**	Rated primary current of the C.Ts. or of the tore C.T. supplying the zero sequence current	1 - 9999	1	A
F(1I)	D		Operation characteristic of the first overcurrent element: (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C (MI) = IEEE Moderate Inverse Curve (SI) = IEEE Short Inverse Curve (VI) = IEEE Very Inverse Curve (I) = IEEE Inverse Curve (EI) = IEEE Extremely Inverse Curve	D A B C MI SI VI I EI	-	-

Display			Description	Setting Range	Step	Unit
1I	0.5	**In**	Trip level of first overcurrent element (p.u. of the rated current of the phase C.Ts.) 1F50	0.25 - 4 - Dis	0.01	In
t1I	0.05	**s**	Trip time delay of the first overcurrent element In the inverse time operation [t1I] is the trip time delay at I = 10x[1I]. 1F51	0.05 - 30	0.01	s
2I	0.5	**In**	Trip level of second overcurrent element (p.u. of the rated current of the phase C.Ts.) 2F50	0.5 - 40 - Dis	0.1	In
t2I	0.05	**s**	Trip time delay of the second overcurrent element 2F51	0.05 - 3	0.01	s
3I	0.5	**In**	Trip level of instantaneous overcurrent element (1I) 3F50	0.5 – 40 - Dis	0.1	In
F(1O)	D		Operation characteristic of the first earth fault element: (D) = Independent definite time (A) = IEC Inverse Time Curve type A (B) = IEC Very Inverse Time Curve type B (C) = IEC Extremely Inverse Time Curve type C (MI) = IEEE Moderate Inverse Curve (SI) = IEEE Short Inverse Curve (VI) = IEEE Very Inverse Curve (I) = IEEE Inverse Curve (EI) = IEEE Extremely Inverse Curve	D A B C MI SI VI I EI	-	-
1O	0.02	**On**	Trip level of first earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection) 1F50N	0.02 - 0.4 - Dis	0.01	On
t1O	0.05	**s**	Trip time delay of first earth fault element. In the inverse time operation [t1O] is the trip time delay at 1O=10x[1O]. 1F51N	0.05 - 30	0.01	s
2O	0.02	**On**	Trip level of second earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection) 2F50N	0.02 - 4 - Dis	0.01	On
t2O	0.05	**s**	Trip time delay of the second earth fault element 2F51N	0.05 - 3	0.01	s
tBF	0.05	**s**	Time delay for Breaker Failure alarm	0.05 - 0.75	0.01	s
2Ix2	OFF		Automatic doubling of second overcurrent level. When set to ON the level 2I is automatically doubled (from 2I to 2Ix2) If within the first 60ms from switch-on, the inrush current gets higher than 1,5 In. As soon as the current drops below 1,25 In the level 2I comes back to its normal set value (from 2Ix2 to 2I).	ON / OFF	ON / OFF	-
Tsyn	Dis	**m**	Synchronization Time Expected time interval between sync. pulses.	5 - 60 - Dis	5-10 15-30 60-Dis	m
NodAd	1		Identification number for connection on serial communication bus	1 - 250	1	-

The setting Dis indicates that the function is disactivated.

12.2 - PROGRAMMING THE CONFIGURATION OF OUTPUT RELAYS

With refer to Fig.1 §3 operate as follows:

		Push-button	
1	-	**Mode**	PROG
2	-	**Select**	F→RELAY
3	-	**Prog. (hidden button)**	

4 - Select to individuate the variable to be programmed (R1, tFRes, B2, B3, tB2, tB3)
5 - Operate “+” / “-“ Keys to set the function needed
6 - **Enter** to validate at each individual step “4”

Display		Description
R1	tIo	**R1 = tIo** - 1O, 2O (Earth Fault any phase) **R1 = BF -** Breaker Failure
tFRes:	A	The reset after tripping of the relays associated to the time delayed elements can take place: **(A)** automatically when current drops below the trip level. **(M)** manually by the operation of the "ENTER/RESET" key.
B2	2I 1I	The input (B2) for blocking the operation of the time delayed elements relevant to phase faults (1I, 2I) can act on the function (1I) only or (2I) only, or on both
B3	2O 1O	The input (B3) for blocking the operation of the time delayed elements relevant to earth faults (1O, 2O) can act on the function (1O) only or (2O) only, or on both.
tB2	2tBF	The blocking of the phase fault elements can be programmed so that it lasts as long the blocking input signal is present (tB2 = Dis) or so that, even with the blocking input still present, it only lasts for the set trip time delay of the function plus an additional time 2xtBF (tB2 = 2xtBF).
tB3	2tBF	As above, for the earth fault elements (tB3 = Dis) or (tB3 = 2tBF).

13. MANUAL TEST OPERATION

13.1 - Mode "TESTPROG" subprogram "W/O TRIP"

Operation of the yellow key activates a complete test of the electronics and the process routines. All the leds are lit-on and the display shows (TEST RUN). If the test routine is successfully completed the display switches-over to the default reading (xx:xx:xx).
If an internal fault is detected, the display shows the fault identification code and the relay R5 is deenergized. This test can be carried-out even during the operation of the relay without affecting the relay tripping in case a fault takes place during the test itself.

13.2 - Mode "TESTPROG" subprogram "WithTRIP"

Access to this program is enabled only if the current detected is zero (breaker open).
Pressing the yellow key the display shows "TEST RUN?". A second operation of the yellow key starts a complete test which also includes the activation of all the output relays.
The display shows (TEST RUN) with the same procedure as for the test with W/O TRIP.
Every 15 min during the normal operation the relay automatically initiates an auto test procedure (duration ≤ 10ms). If any internal fault is detected during the auto test, the relay R5 is deenergized, the relevant led is activated and the fault code is displayed.

WARNING

Running the **WithTRIP** test will operate all of the output relays. Care must be taken to ensure that no unexpected or harmful equipment operations will occur as a result of running this test.
It is generally recommended that this test be run only in a bench test environment or after all dangerous output connections are removed.

14. MAINTENANCE

No maintenance is required. Periodically a functional check-out can be made with the test procedures described under MANUAL TEST chapter. In case of malfunctioning please contact Microelettrica Scientifica Service or the local Authorised Dealer mentioning the relay's Serial No reported in the label on relays enclosure.

WARNING

In case of Internal Relay Fault detection, proceed as here-below indicated :

- If the error message displayed is one of the following “DSP Err”, “ALU Err” ,”KBD Err” ,”ADC Err”, switch off power supply and switch-on again. If the message does not disappear send the relay to Microelettrica Scientifica (or its local dealer) for repair.
- If the error message displayed is “E2P Err”, try to program any parameter and then run “W/OTRIP”.
- If message disappear please check all the parameters.
- If message remains send the relay to Microelettrica Scientifica (or its local dealer) for repair.

15. POWER FREQUENCY INSULATION TEST

Every relay individually undergoes a factory insulation test according to IEC255-5 standard at
 kV, 50 Hz 1min. Insulation test should not be repeated as it unusefully stresses the dielectrics.
When doing the insulation test, the terminals relevant to serial output must always be short circuited to ground. When relays are mounted in switchboards or relay boards that have to undergo the insulation tests, the relay modules must be drawn-out of their enclosures and the test must only include the fixed part of the relay with its terminals and the relevant connections.
This is extremely important as discharges eventually tacking place in other parts or components of the board can severely damage the relays or cause damages, not immediately evident to the electronic components.

16. ELECTRICAL CHARACTERISTICS

APPROVAL: CE – RINA – UL and CSA approval File : E202083
REFERENCE STANDARDS IEC 60255 - EN50263 - CE Directive - EN/IEC61000 - IEEE C37

❑	Dielectric test voltage	IEC 60255-5	2kV, 50/60Hz, 1 min.
❑	Impulse test voltage	IEC 60255-5	5kV (c.m.), 2kV (d.m.) – 1,2/50μs
❑	Insulation resistance	> 100MΩ	

Environmental Std. Ref. (IEC 68-2-1 - 68-2-2 - 68-2-33)

❑	Operation ambient temperature	-10°C / +55°C
❑	Storage temperature	-25°C / +70°C
❑	Humidity	IEC68-2-3 RH 93% Without Condensing AT 40°C

CE EMC Compatibility (EN50081-2 - EN50082-2 - EN50263)

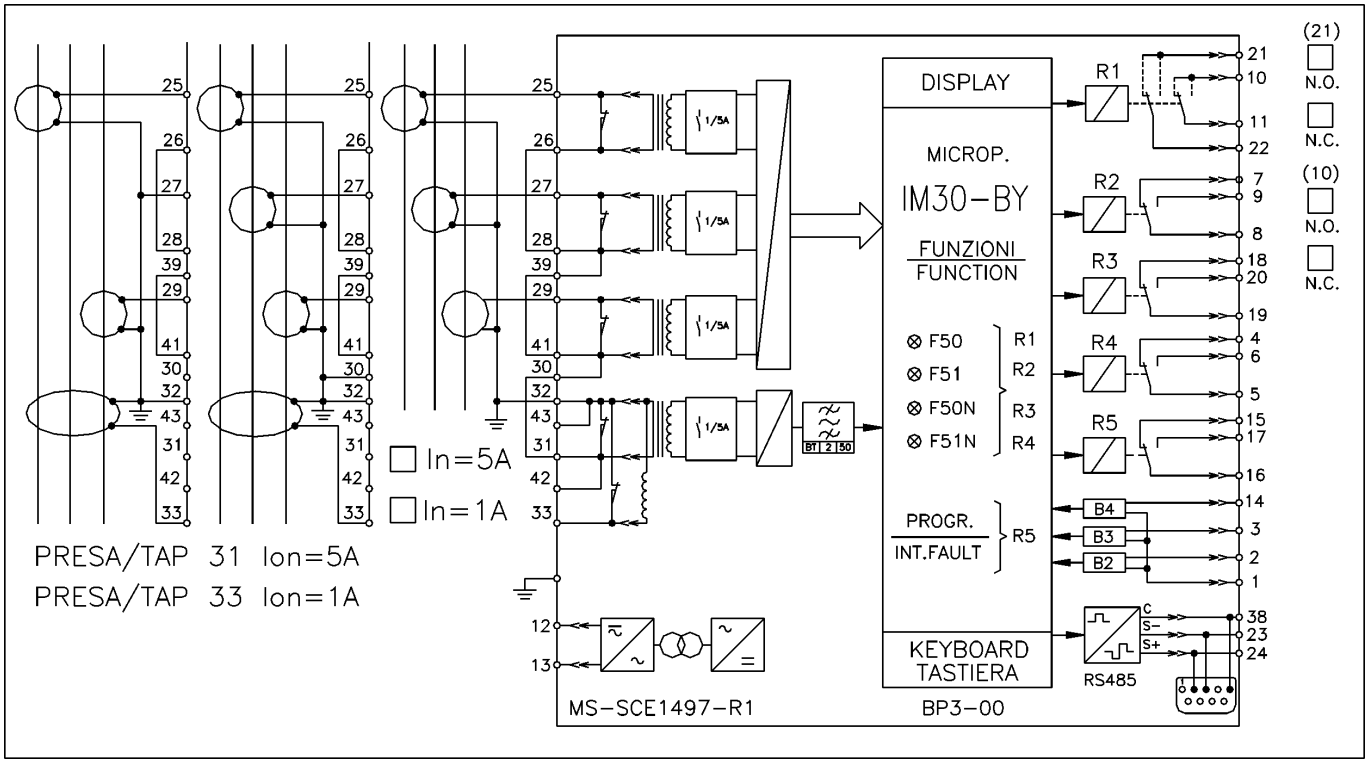
❑	Electromagnetic emission	EN55022 industrial environment			
❑	Radiated electromagnetic field immunity test	IEC61000-4-3 ENV50204	level 3	80-1000MHz 900MHz/200Hz	10V/m 10V/m
❑	Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
❑	Electrostatic discharge test	IEC61000-4-2	level 4	6kV contact / 8kV air	
❑	Power frequency magnetic test	IEC61000-4-8		1000A/m	50/60Hz
❑	Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs	
❑	Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz	
❑	Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz	
❑	HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)	
❑	Oscillatory waves (Ring waves)	IEC61000-4-12	level 4	4kV(c.m.), 2kV(d.m.)	
❑	Surge immunity test	IEC61000-4-5	level 4	2kV(c.m.), 1kV(d.m.)	
❑	Voltage interruptions	IEC60255-4-11			
❑	Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 10-500Hz 1g			

CHARACTERISTICS

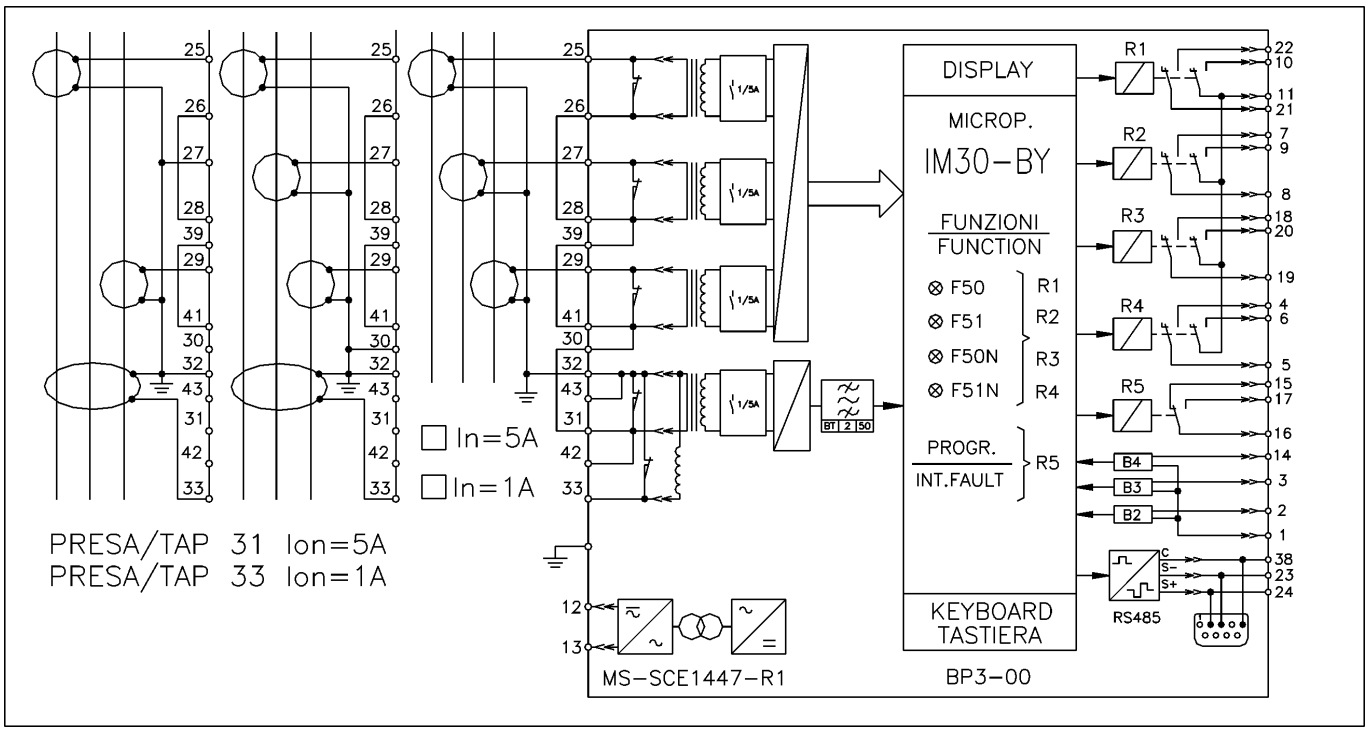
❑	Accuracy at reference value of influencing factors	2% In for measure 0,2% On 2% +/- 10ms for times
❑	Rated Current	In = 1 or 5A - On = 1 or 5A
❑	Current overload	200 A for 1 sec; 10A continuous
❑	Burden on current inputs	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A Neutral : 0.03VA at In = 1A ; 0.2VA at In = 5A
❑	Average power supply consumption	8.5 VA
❑	Output relays	rating 5 A; Vn = 380 V A.C. resistive switching = 1100W (380V max) make = 30 A (peak) 0,5 sec. break = 0.3 A, 110 Vcc, L/R = 40 ms (100.000 op.)

Microelettrica Scientifica S.p.A. - 20089 Rozzano (MI) - Italy - Via Alberelle, 56/68
Tel. (##39) 02 575731 - Fax (##39) 02 57510940
http://www.microelettrica.com **e-mail :** ute@microelettrica.com

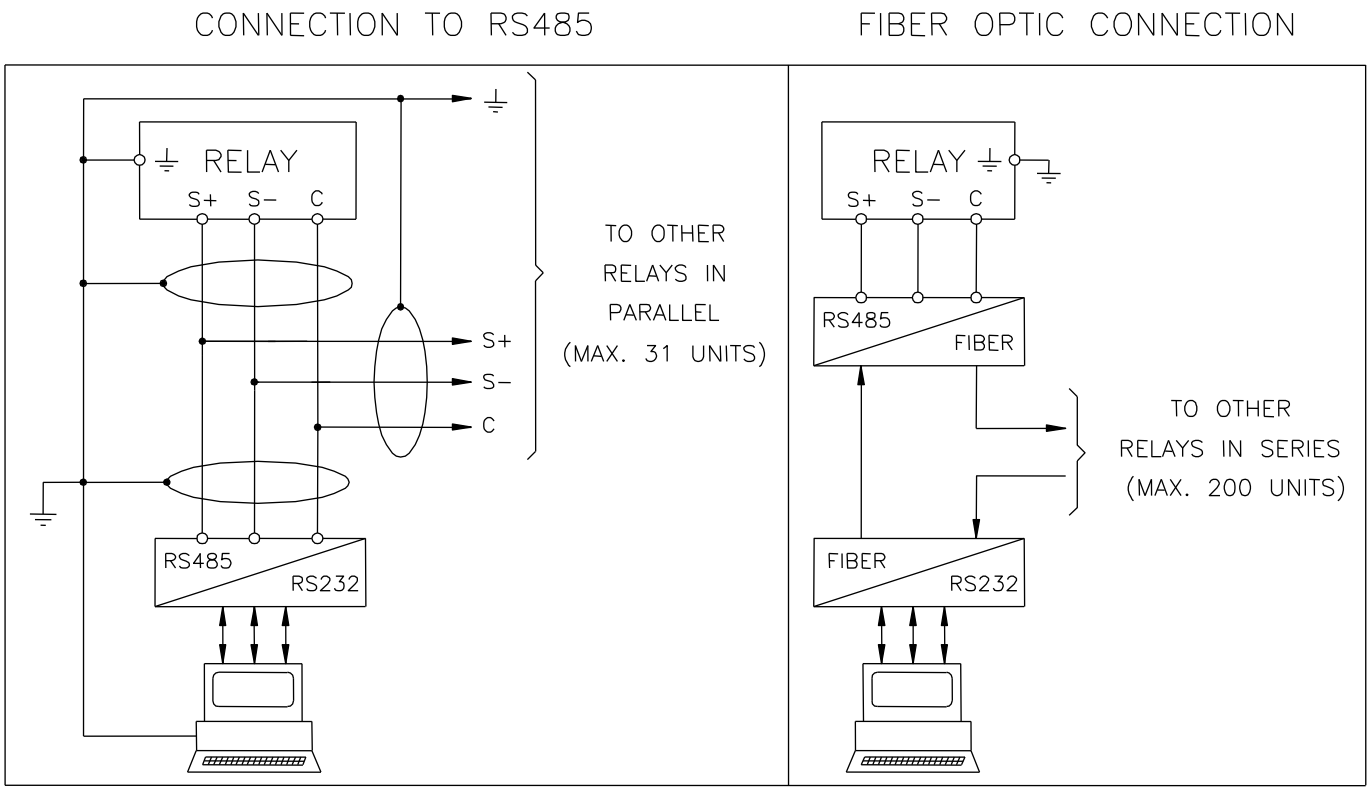
17. CONNECTION DIAGRAM (SCE1497 Rev.1 Standard Output)



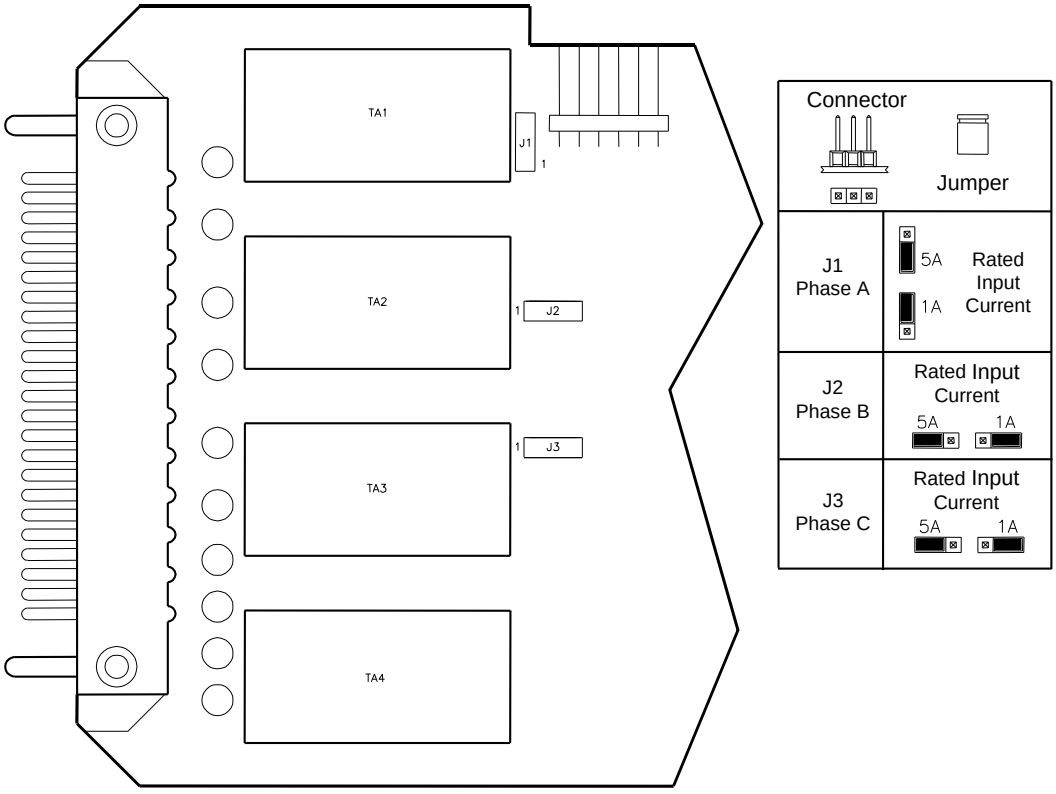
17.1 - CONNECTION DIAGRAM (SCE1447 Rev.1 Double Output)



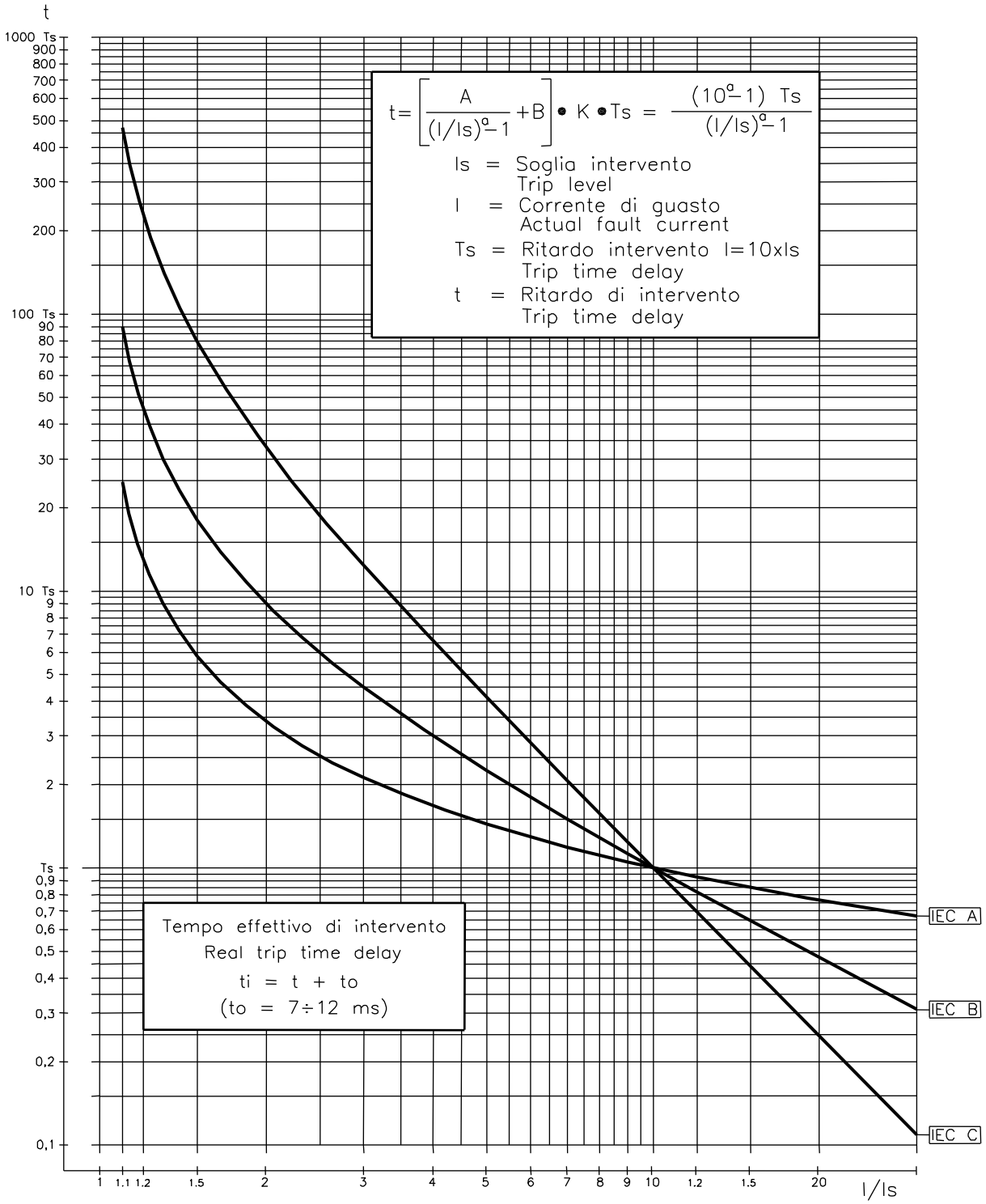
18. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)



19. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A



20. TIME CURRENT CURVES IEC (TU0388 Rev.0 1/2)

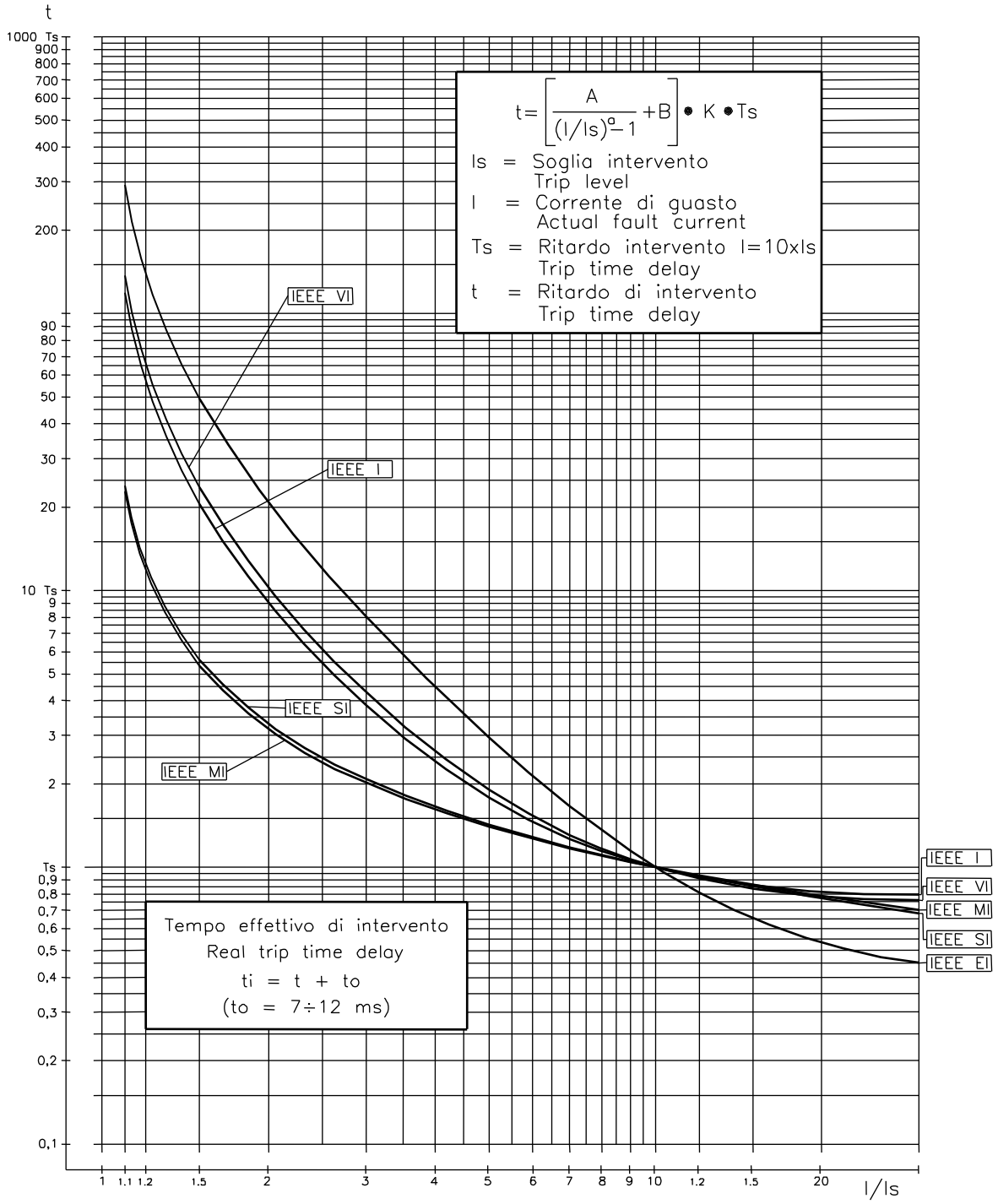


Curve Type	A	B	K	a
IEC A	0.14	0	0.336632	0.02
IEC B	13.5	0	0.666667	1
IEC C	80	0	1.2375	2

F51 { Is = I> = (0.25−4)In
Ts = tI> = (0.05−30)s

F51N { Is = O> = (0.02−0.4)On
Ts = tO> = (0.05−30)s

21. TIME CURRENT CURVES IEEE (TU0388 Rev.0 2/2)



Curve Type	A	B	K	a
MI= IEEE Moderate Inv.	0.0104	0.0226	4.110608	0.02
SI= IEEE Short Inv.	0.00342	0.00262	13.30009	0.02
VI= IEEE Very Inv.	3.88	0.0963	7.380514	2
I= IEEE Inverse	5.95	0.18	4.164914	2
EI= IEEE Extremely Inv.	5.67	0.0352	10.814	2

F51 { Is = I> = (0.25−4)In ; Ts = tI> = (0.05−30)s }

F51N { Is = O> = (0.02−0.4)On ; Ts = tO> = (0.05−30)s }

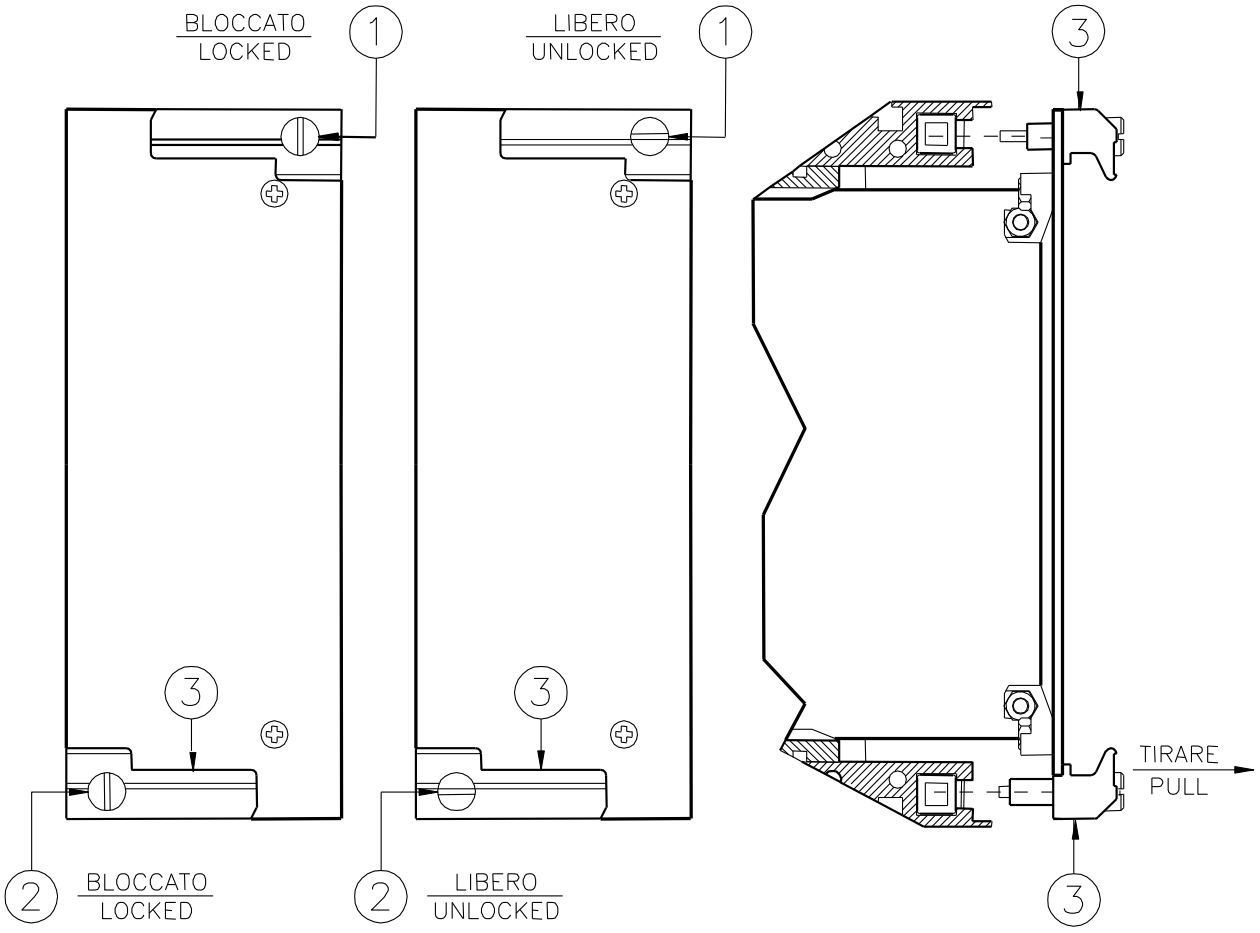
22. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

22.1 Draw-out

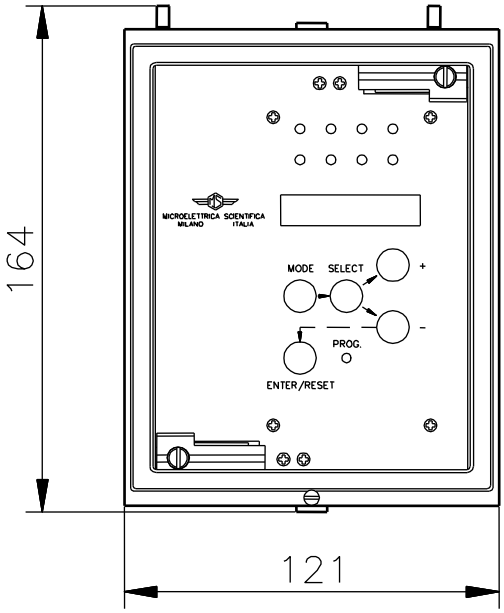
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

22.2 Plug-in

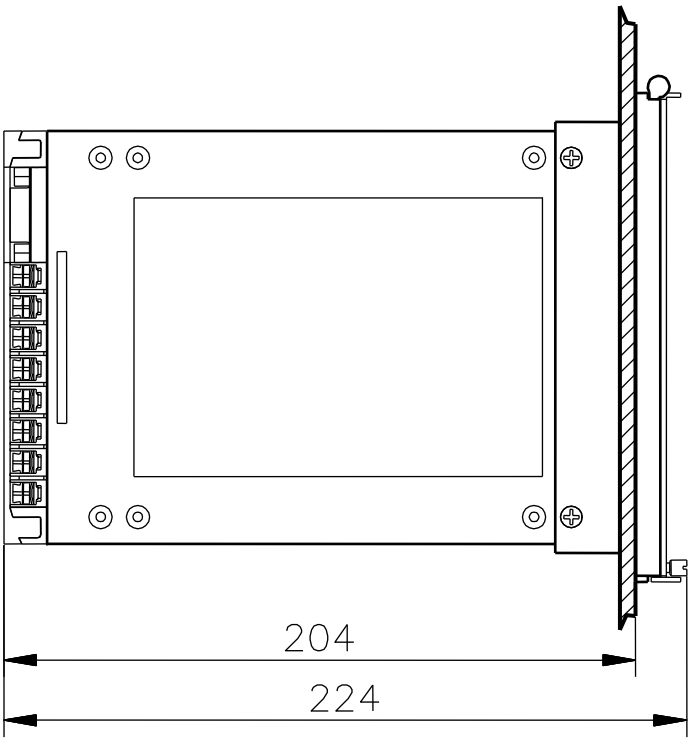
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position (locked).

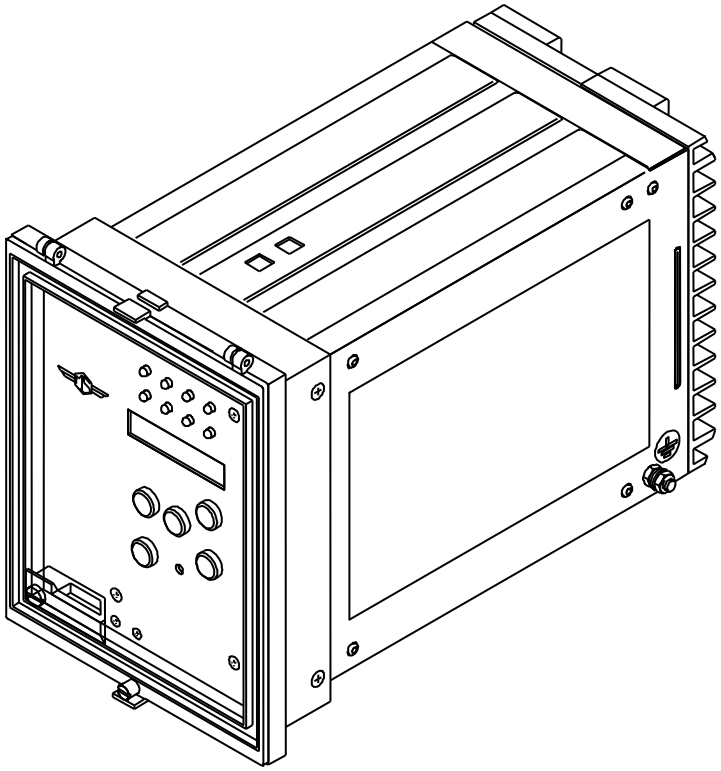


23. MOUNTING

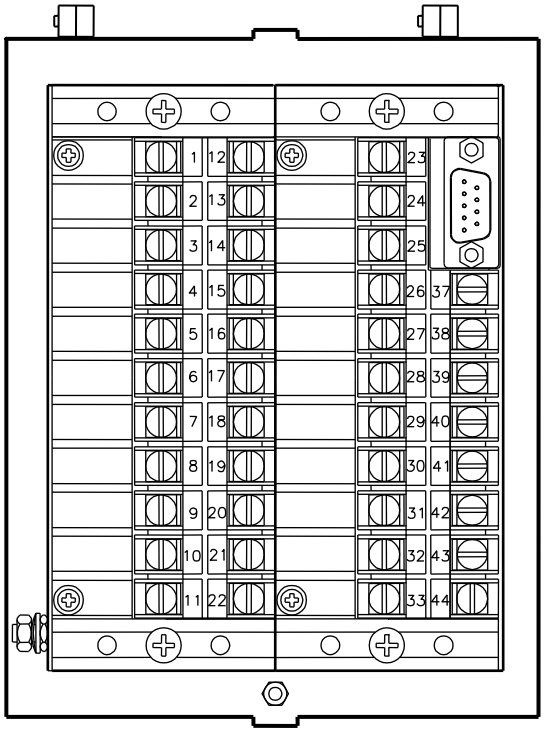


PANEL CUT-OUT 113x142 (LxH)

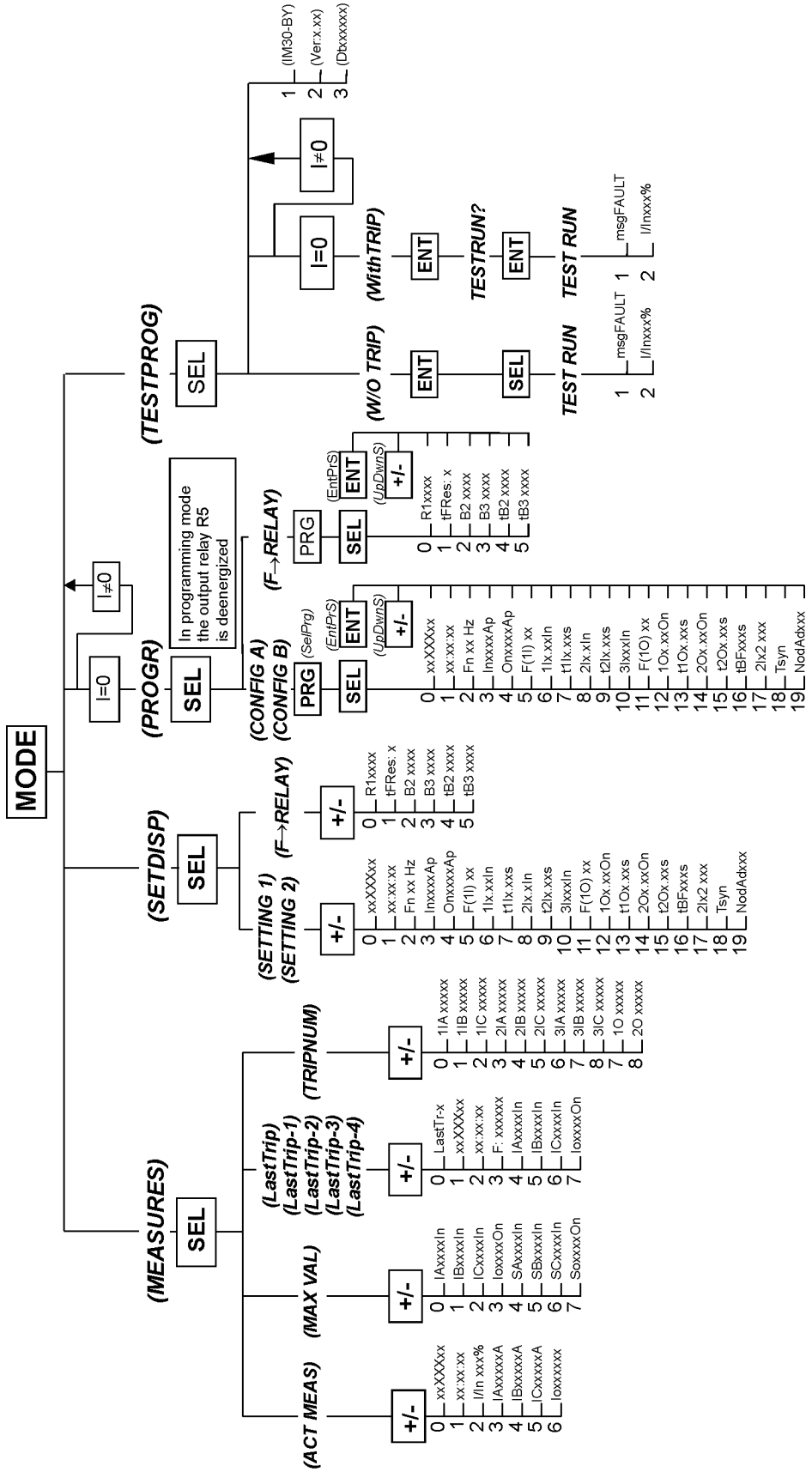




View of Rear
Terminal Connection



24. KEYBOARD OPERATIONAL DIAGRAM



25. Setting Form – Commissioning Test Record

Relay Type	**IM30-BY**	**Station :**		**Circuit :**	
Date :	**/ /**	**FW Version:**		**Relay Serial Number :**	
Power Supply	☐ 24V(-20%) / 110V(+15%) a.c. 24V(-20%) / 125V(+20%) d.c. ☐ 80V(-20%) / 220V(+15%) a.c. 90V(-20%) / 250V(+20%) d.c.			**Rated Voltage :**	

RELAY PROGRAMMING

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result	
						Pick-up	Reset
xxxxxxx	Current date	DDMMMYY	**-**	Random			
xx:xx:xx	Current time	HH:MM:SS	**-**	Random			
Fn	Mains frequency	50 - 60	**Hz**	50			
In	Rated primary current of the phase C.Ts.	1 - 9999	**Ap**	500			
On	Rated primary current of the C.Ts.	1 - 9999	**Ap**	500			
F(1I)	Operation characteristic of the first overcurrent element:	D,A,B,C,MI SI,VI,I,EI	-	D			
1I	Trip level of first overcurrent element	0.25 - 4 - Dis	**In**	0.5			
t1I	Trip time delay of the first overcurrent element	0.05 - 30	**s**	0.05			
2I	Trip level of second overcurrent element	0.5 - 40 - Dis	**In**	0.5			
t2I	Trip time delay of the second overcurrent element	0.05 - 3	**s**	0.05			
3I	Trip level of instantaneous overcurrent element (1I)	0.5 – 40 - Dis	**In**	0.5			
F(1O)	Operation characteristic of the first earth fault element:	D,A,B,C,MI SI,VI,I,EI	-	D			
1O	Trip level of first earth fault element	0.02-0.4 - Dis	**On**	0.02			
t1O	Trip time delay of first earth fault element.	0.05 - 30	**s**	0.05			
2O	Trip level of second earth fault element	0.02 - 4 - Dis	**On**	0.02			
t2O	Trip time delay of the second earth fault element	0.05 - 3	**s**	0.05			
tBF	Time delay for Breaker Failure alarm	0.05 - 0.75	**s**	0.05			
2Ix2	Automatic doubling of second overcurrent level.	ON / OFF		OFF			
Tsyn	Synchronisation Time	5 - 60 - Dis	**m**	Dis			
NodAd	Identification number for connection on serial communication bus	1 - 250		1			

CONFIGURATION OF OUTPUT RELAYS

Default Setting			Actual Setting	
Prot Elem.	**Output Relays**	**Description**	**Prot. Elem.**	**Output Relays**
R1	tIo	**R1 = tIo** - 1O, 2O (Earth Fault any phase) **R1 = BF -** Breaker Failure	**R1**	
tFRes:	A	The reset after tripping of the relays associated to the time delayed elements can take place: **(A)** automatically **(M)** manually	**tFRes**:	
B2	2I 1I	The input (B2) for blocking the operation of the time delayed elements relevant to phase faults	**B2**	
B3	2O 1O	The input (B3) for blocking the operation of the time delayed elements relevant to earth faults	**B3**	
tB2	2tBF	The blocking of the phase fault elements	**tB2**	
tB3	2tBF	As above, for the earth fault elements	**tB3**	

Commissioning Engineer : _____ **Date :** _____

Customer Witness : _____ **Date :** _____