MICROPROCESSOR OVERCURRENT AND EARTH FAULT PROTECTION RELAY

OPERATION MANUAL

REV.	DESCRIPTION	DATE	PREP.	APPR.
0	EMISSION	16-02-96	P.BRASCA	

INDEX

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 efficiency.

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 produced by M.S. are completely safe from electrostatic discharge (15 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 alterated 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

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

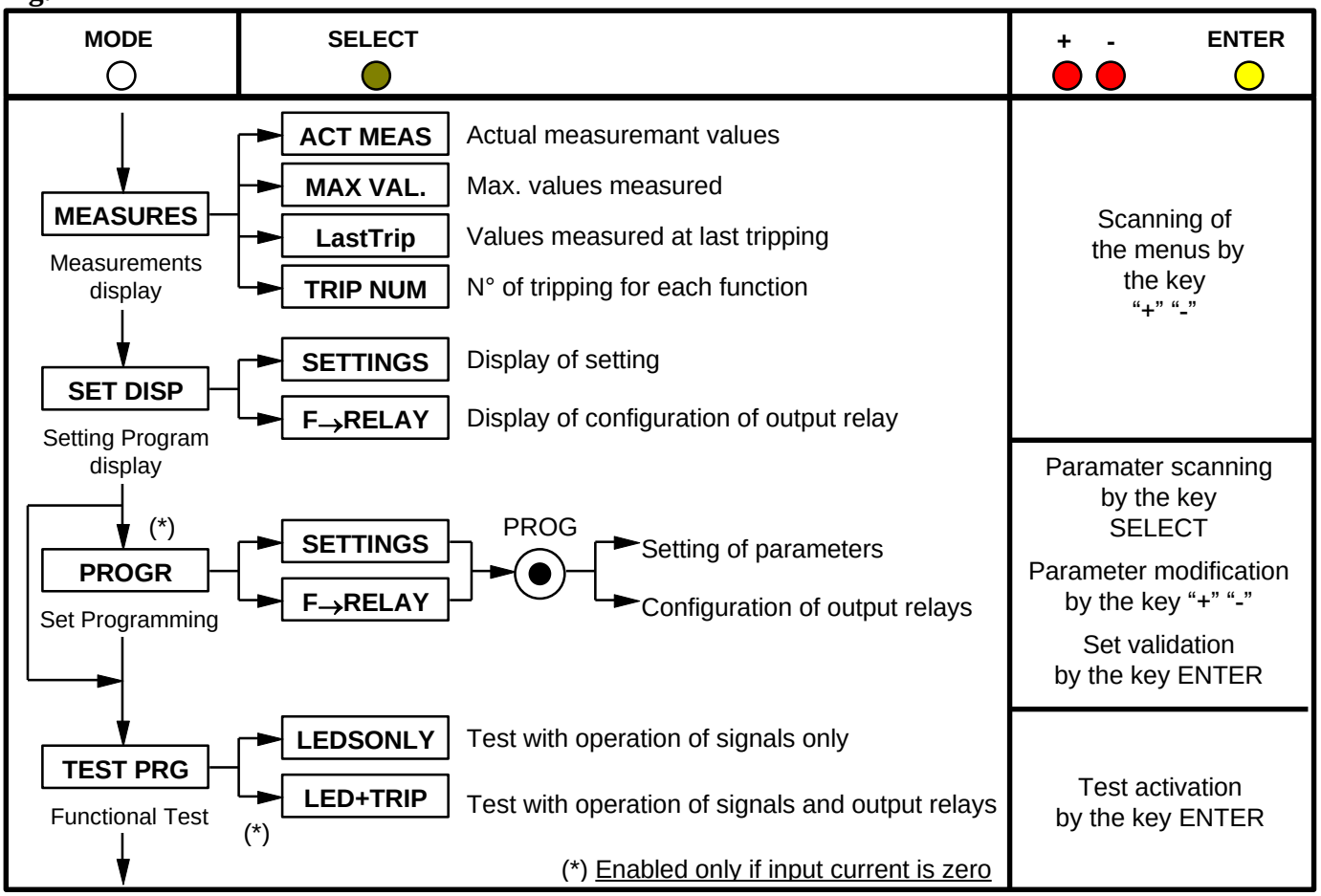
a) - { **24V(-20%) / 110V(+15%) a.c.** ; **24V(-20%) / 125V(+20%) d.c.** } **b) -** { **80V(-20%) / 220V(+15%) a.c.** ; **90V(-20%) / 250V(+20%) d.c.** }

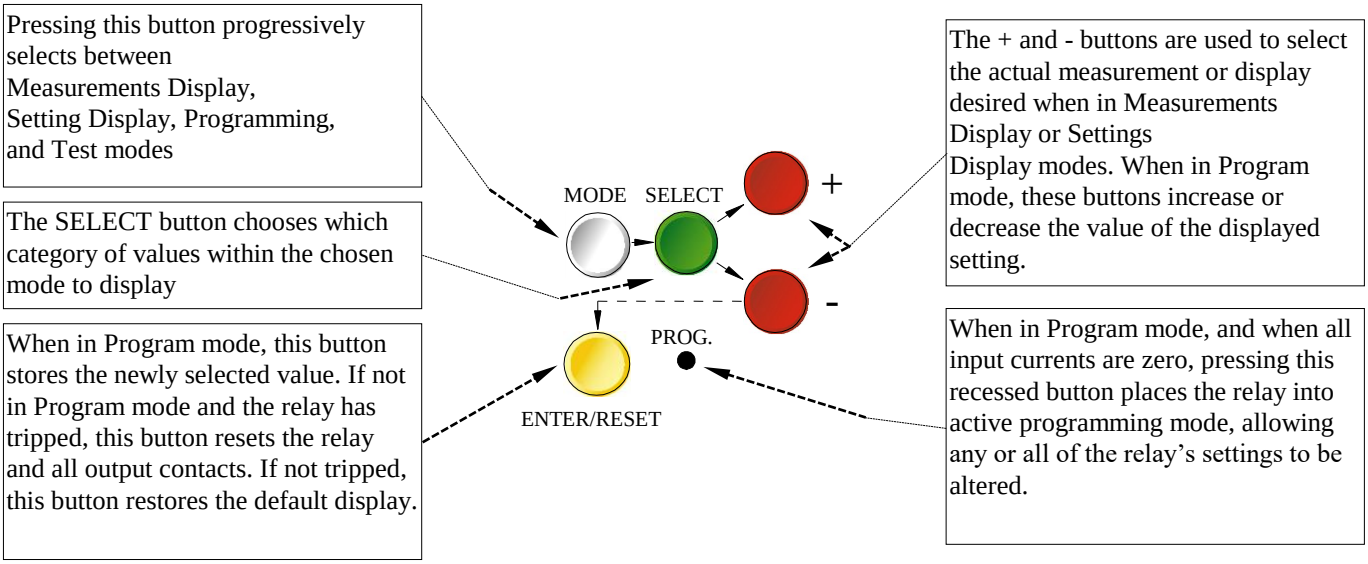
Before energising the unit check that supply voltage is within the allowed limits.

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 overcomes the set trip level [I>]. Illuminated on trip after expiry of the set trip time delay [tI>].

b) Red LED **I>>** : Same as above related to [I>>], [tI>>].

c) Red LED **O>** : Same as above related to [O>], [tO>].

d) Red LED **O>>** : Same, as above related to [O>>], [tO>>].

e) Yellow LED **PROG/IRF** : 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.

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 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): these output relays are user programmable and any of them can be associated to one of the IM30-A's functions.
One relay eventually associated to the instantaneous element of one of the functions, after pick-up normally drops-out as soon as the tripping cause disappears (current below the set trip level).
If the current remains above the trip level longer than the time delay programmed for the relevant function, the drop-out of the instantaneous relay is anyhow forced after an adjustable waiting time [tBO].(Diasactivation of the blocking output eventually used to block a relay upstream in the distribution system).
Moreover any of the relays R1,R2,R3,R4, can be programmed to be energised at the end of the delay tBF(Breaker Failure function)

Reset of the output relays associated to any time delayed function can be programmed to take place "Automatically" (tFRes= A) as soon as the tripping cause has disappeared, or "Manually" (tFRes= M) only by operating the ENTER/RESET key on relay's front or via the serial bus.
It has to be remarked that the programming structure does not allow to associate the same relay at the same time to instantaneous and delayed elements. Therefore any relay already associated to any time delayed element cannot be associated to any instantaneous element and viceversa.

b) - The relay **R5**, normally energised, is not programmable and it is deenergized on:
- internal fault
- power supply failure
- during the programming

6. SERIAL COMMUNICATION (Optional: see relevant instruction manual)

The relays fitted with the serial communication option can be connected via a cable bus or (with proper adapters) a fiber optic bus for interfacing with a Personal Computer (type IBM or compatible).
Via the communication bus all settings and commands available on relay's keyboard can be operated from the computer and viceversa all information available at relay's level can be received at computer's level.
The transmission standard is RS485 (converter 485/232 available).
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C. fitted with a WINDOWS (version 3.1 or later) program driven by the application program supplied by Microelettrica Scientifica.

7. DIGITAL INPUTS

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

- Bf (terminals 1 - 2) : it blocks the operation of the time delayed elements relevant to phase fault detection.

- Bo (terminals 1 - 3) : it blocks the operation of the time delayed elements relevant to earth fault detection.

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 (tBf=OFF; tBo=OFF) or automatically removed after the expiry of the set trip time delay of the function involved plus an additional time 2tBF (tBf=2tBO; tBo=2tBO). 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 10 ms). 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:
MEASURE = 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 PROG : 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 "-" .

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

Display	Description
I/Inxxx**%**	Highest among the 3 phase-currents displayed as % of the rated current of phase C.Ts (0-999%)
IAxxxxx**A**	True R.M.S. value of the current of phase A displayed as primary Amps.(0 - 99999)
IBxxxxx**A**	As above, phase B.
ICxxxxx**A**	As above, phase C.
Ioxxxxx**A**	As above, earth fault current.

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
Imxxxx**In**	Highest among the 3 phase-currents displayed as p.u. of Cts rated current.(0-99,9)%
IAxxxx**In**	Max. value of phase A current after the first 100ms, displayed as p.u. of C.Ts rated current.
IBxxxx**In**	As above, phase B.
ICxxxx**In**	As above, phase C.
Ioxxxx**On**	As above, earth fault current.
SAxxxx**In**	Max. current of phase A during the first 100ms.
SBxxxx**In**	As above, phase B.
SCxxxx**In**	As above, phase C.
Soxxxx**On**	As above, earth fault current.

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...
F:xxxxxx	Function which produced the event being displayed and faulty phase in case of phase current element's trip **I> ph A,B,C; I>> ph A,B,C; O>; O>>.**
IAxxxx**In**	Current of phase A. (value recorded at the moment of tipping)
IBxxxx**In**	Current of phase B. (as above)
ICxxxx**In**	Current of phase C. (as above)
Ioxxxx**On**	Earth fault current. (as above)

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
I> xxxx	Trip number of Low set overcurrent time delayed element [tI>].
I>>xxxx	Trip number of High set overcurrent time delayed element [tI>>].
Io> xxxx	Trip number of Low set earth fault time delayed element [tO>].
Io>>xxxx	Trip number of High set earth fault time delayed element [tO>>].

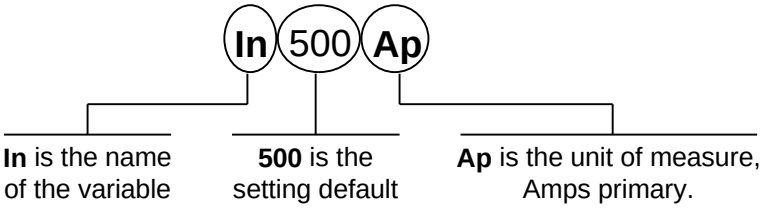
11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

Enter the mode "SET DISP", select the menu "SETTINGS" or "F→RELAY", scroll information available in the menu by keys "+" or "-".
SETTINGS= 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 **(-----)**].
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP
Programming is enabled only if no input current is detected (main circuit breakers open).
As soon as programming is enabled, the Led PRG/IRF flashes and the reclosing lock-out relay R5 is deenergized..
Enter MODE "PROG" and SELECT either "SETTINGS" 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



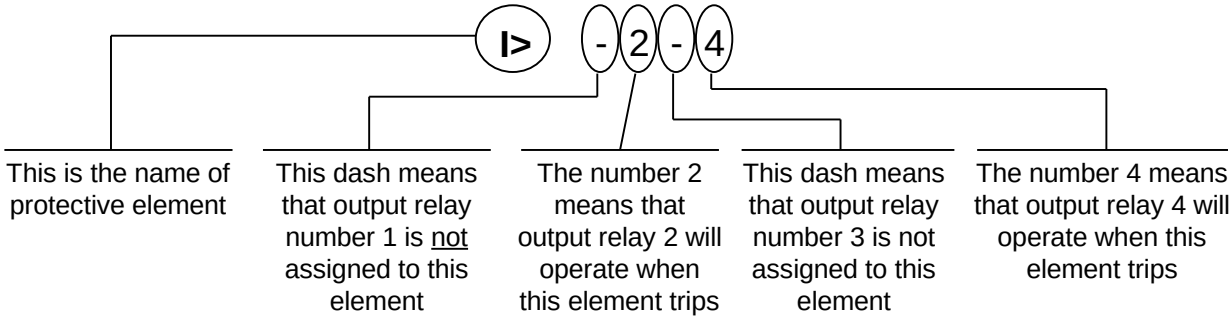
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step
Fn 50 **Hz**	Mains frequency	50 - 60 Hz	-
In 500**Ap**	Rated primary current of the phase C.Ts.	(1 - 9999)A	1A
On 500**Ap**	Rated primary current of the C.Ts. or of the tore C.T. supplying the zero sequence current	(1 - 9999)A	1A
F(I>) D	Operation characteristic of the low-set overcurrent element: (D) = Independent definite time. (SI) = Dependent normal inverse time. (VI) = Dependent very inverse time. (EI) = Dependent extremely inverse time.	D SI VI EI	-
I> .5**In**	Trip level of low-set overcurrent element (p.u. of the rated current of the phase C.Ts.)	(0.5 - 4 - Dis)In	0.01In

Display	Description	Setting Range	Step
tI> .05**s**	Trip time delay of the low-set overcurrent element In the inverse time operation [tI>] is the trip time delay at I = 10x[I>].	(0.05 - 30)s	0.01s
I>> .5**In**	Trip level of high-set overcurrent element (p.u. of the rated current of the phase C.Ts.):	(0.5 - 40 - Dis)In	0.1In
tI>> .05**s**	Trip time delay of the high-set overcurrent element	(0.05 - 3)s	0.01s
F(O>) D	Operation characteristic of the low-set earth fault element: (D) = Independent definite time. (SI) = Dependent normal inverse time. (VI) = Dependent very inverse time. (EI) = Dependent extremely inverse time.	D SI VI EI	-
O> .02**On**	Trip level of low-set earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection)	(0.02 - 0.4 - Dis)On	0.01On
tO> .05**s**	Trip time delay of low-set earth fault element In the inverse time operation [tO>] is the trip time delay at I = 10x[O>].	(0.05 - 30)s	0.01s
O>> .02**On**	Trip level of high-set earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection)	(0.02 - 4 - Dis)On	0.01On
tO>> .05**s**	Trip time delay of the high-set earth fault element	(0.05 - 3)s	0.01s
tBO .05**s**	Max. reset time delay of the instantaneous elements after tripping of the time delayed elements and time delay for activation of the output relay associated to the Breaker Failure function	(0.05-0.25)s	0.01s
2I>> OFF	Automatic doubling of high set overcurrent level When set to ON the level I>> is automatically doubled (from I>> to 2I>>) 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 I>> comes back to its normal set value (from 2I>> to I>>).	(ON - OFF)	-
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



Mode PROG menu F→RELAY (Production standard settings here under shown).
The key "+" operates as cursor; it moves through the digits corresponding to the four programmable relays in the sequence 1,2,3,4,(1= relay R1, etc.) and makes start flashing the information actually present in the digit. The information present in the digit can be either the number of the relay (if this was already associated to the function actually on programming) or a dot (-) if the relay was not yet addressed.

The key "-" changes the existing status from the dot to the relay number or viceversa.

Display	Description
I> --3-	Instantaneous element of low-set overcurrent operates relays R1,R2,R3,R4. (only one or more, whatever combination)
tI> 1---	As above, time delayed element.
I>> --3-	Instantaneous element of high-set overcurrent operates relay R1,R2,R3,R4.
tI>> 1---	As above, time delayed element.
O> ---4	Instantaneous element of low-set earth fault element operates relay R1,R2,R3,R4.
tO> -2--	As above, time delayed element.
O>> ---4	Instantaneous element of high-set earth fault element operates relay R1,R2,R3,R4.
tO>> -2--	As above, time delayed element.
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.
Bf I>>I>	The input (Bf) for blocking the operation of the time delayed elements relevant to phase faults (I>, I>>) can act on the function (I>) only or (I>>) only, or on both
BoO>>O>	The input (Bo) for blocking the operation of the time delayed elements relevant to earth faults (O>, O>>) can act on the function (O>) only or (O>>) only, or on both.
tBf 2tB0	The blocking of the phase fault elements can be programmed so that it lasts as long the blocking input signal is present (tBf 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 2xtBO (tBf 2xtBO).
tBo 2tB0	As above, for the earth fault elements (tBo Dis) or (tBo 2tBO).

13. MANUAL AND AUTOMATIC TEST OPERATION

- 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 (I/Inxxx%)
  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.

- 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.

CAUTION

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.

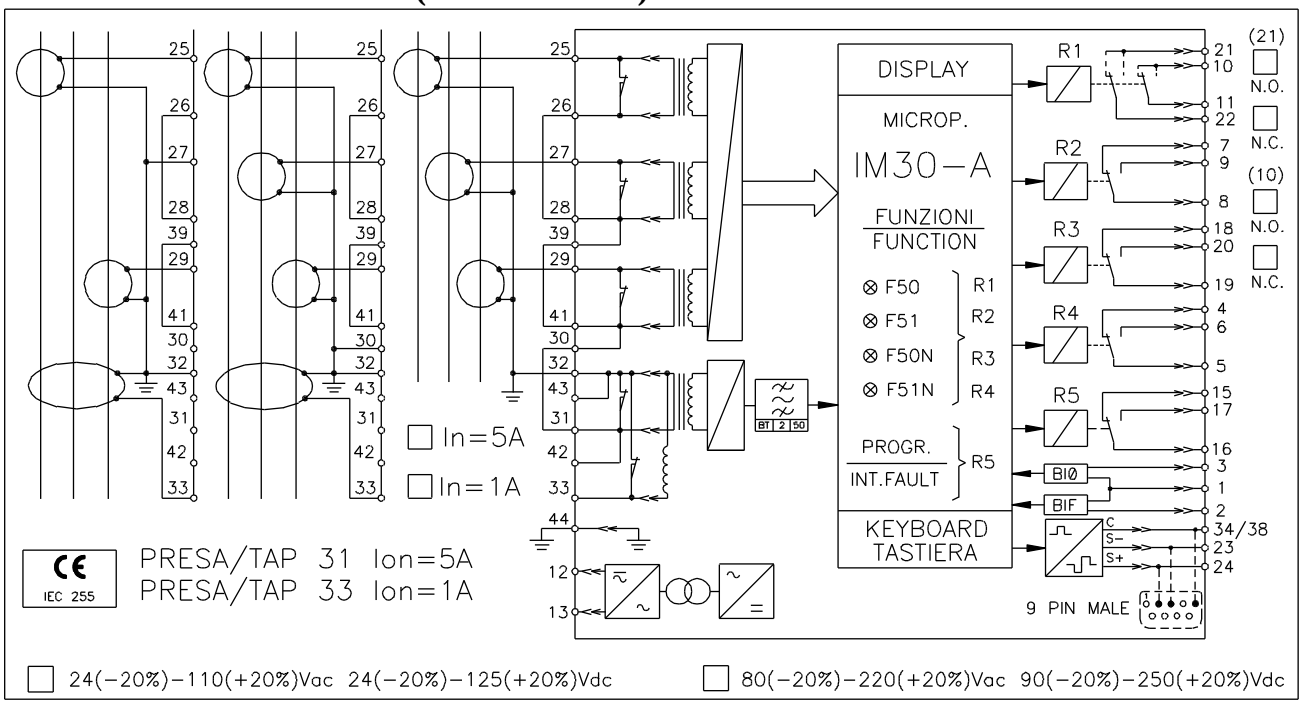
14. MAINTENANCE

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.

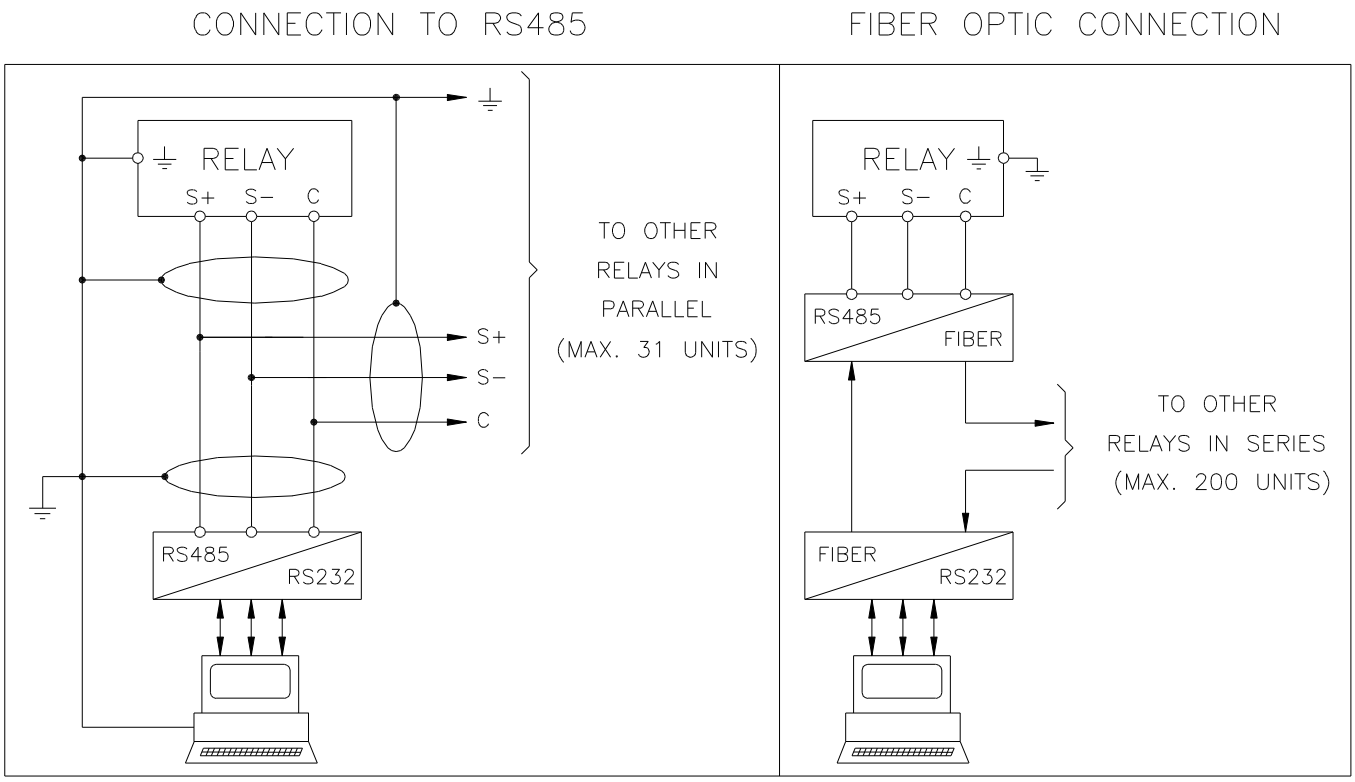
15. ELECTRICAL CHARACTERISTICS

Reference standards	IEC 255, 801; CEI 41-1; IEEE C37; CE
Dielectric test voltage	2000 V, 50 Hz, 1 min.
Impulse test voltage	5kV (MC), 2kV (MD) - 1,2/50μμs
Immunity to high frequency burst	1 kV (MC), 0,5 kV (MD) - 0,1 MHz 2,5 kV (MC), 1 kV (MD) - 1 MHz
Immunity to electrostatic discharge	15 kV
Immunity to sinusoidal wave burst	100 V - (0,01-1) MHz
Immunity to radiated E.M. field	10 V/m - (20-1000) MHz
Immunity to high energy burst	4 kV (MC), 2 kV (MD) - (IEC 805-5)
Immunity to 50-60 Hz magnetic field	1000 A/m
Immunity to impulse magnetic field	1000 A/m - 8/20μs
Immunity to magnetic burst	100A/m - (0,1-1) MHz
Resistance to vibration and shocks	10-500 Hz - 1 g - 0,075 mm
Rated current	In = 1 or 5 A On = 1 or 5 A
Current overload	200 a for 1 sec; 10 A continuos
Burden on current inputs	0,2 VA/phase at In; 0,06 VA at On
Average power supply consumption	8,5 VA
Output relays	rating 5 A; Vn = 380 V A.C. resistive switching = 1100 W (380 V max) make = 30 A (peak) 0,5 sec. break = 0,3 A, 110 Vcc, L/R = 40 ms (100.000 op.)
Operation ambient temperature	-20°C / +60°C
Storage temperature	-30°C / +80°C

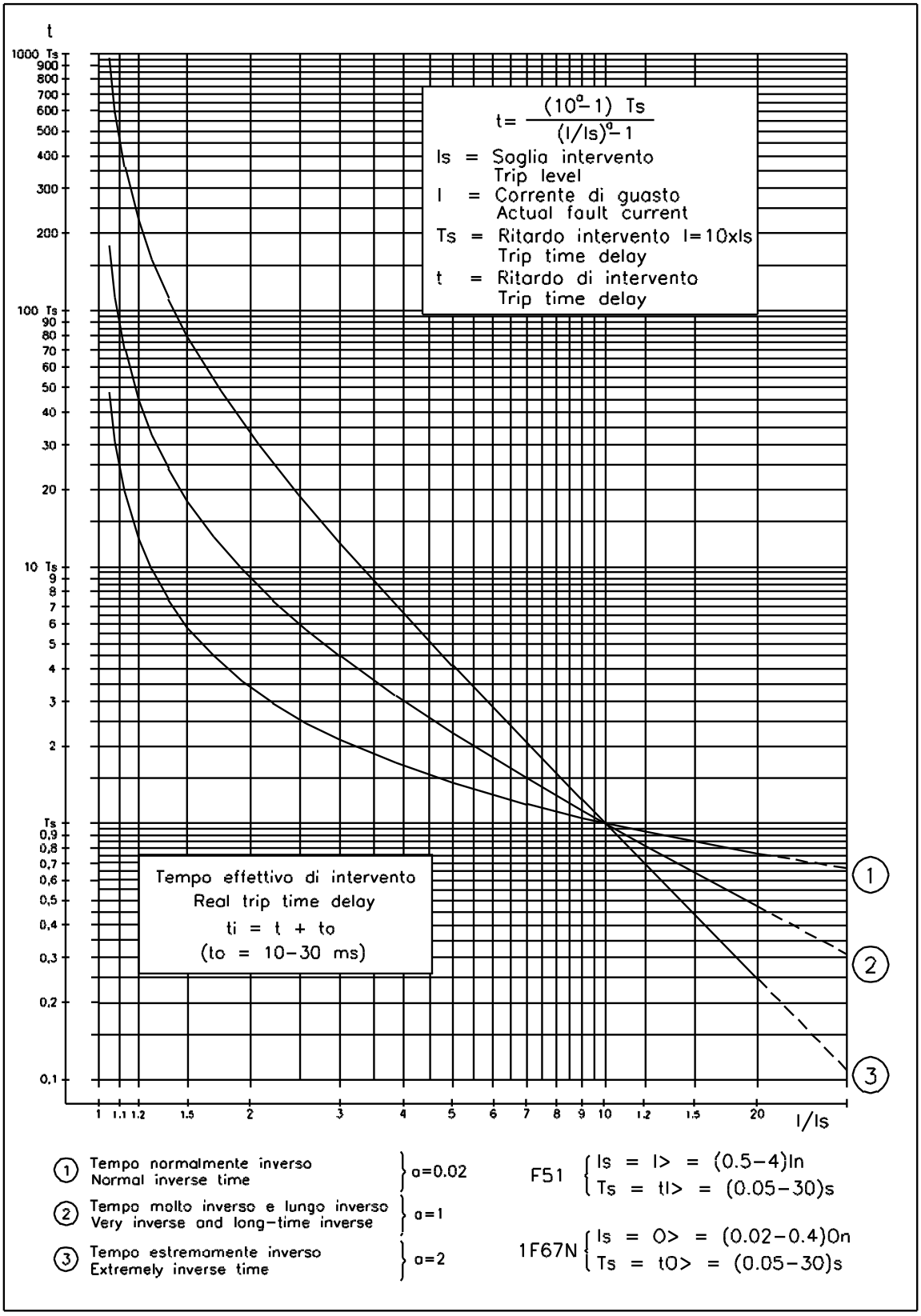
16. CONNECTION DIAGRAM (SCE1209 Rev.7)



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



18. TIME CURRENT CURVES (TU0228 Rev.0)



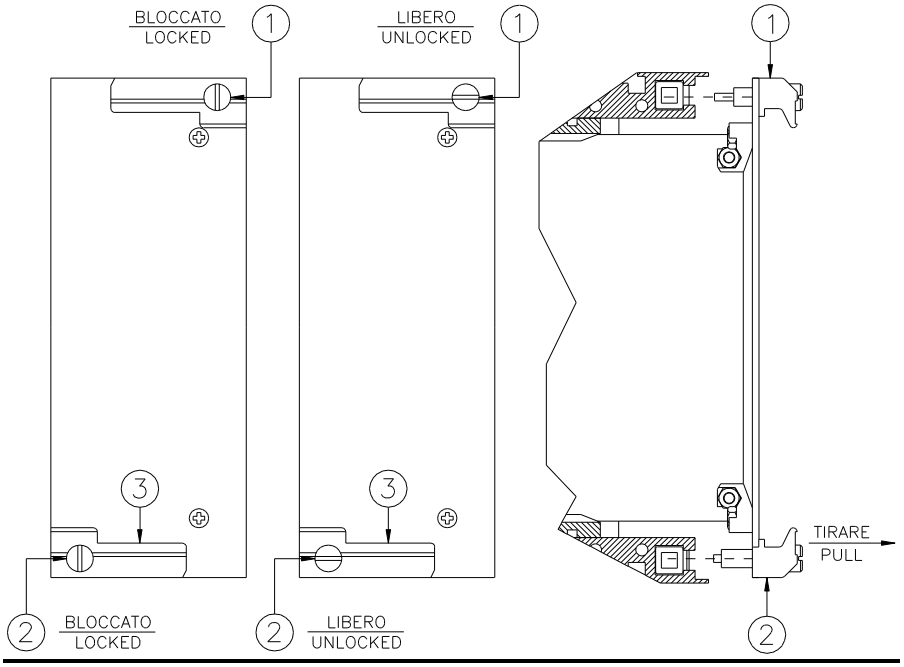
19. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

DRAW-OUT

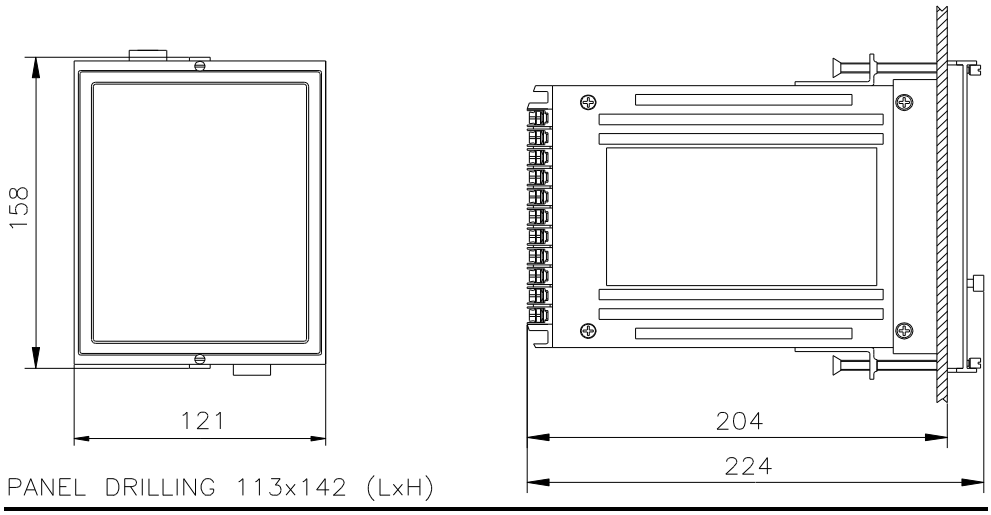
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

PLUG-IN

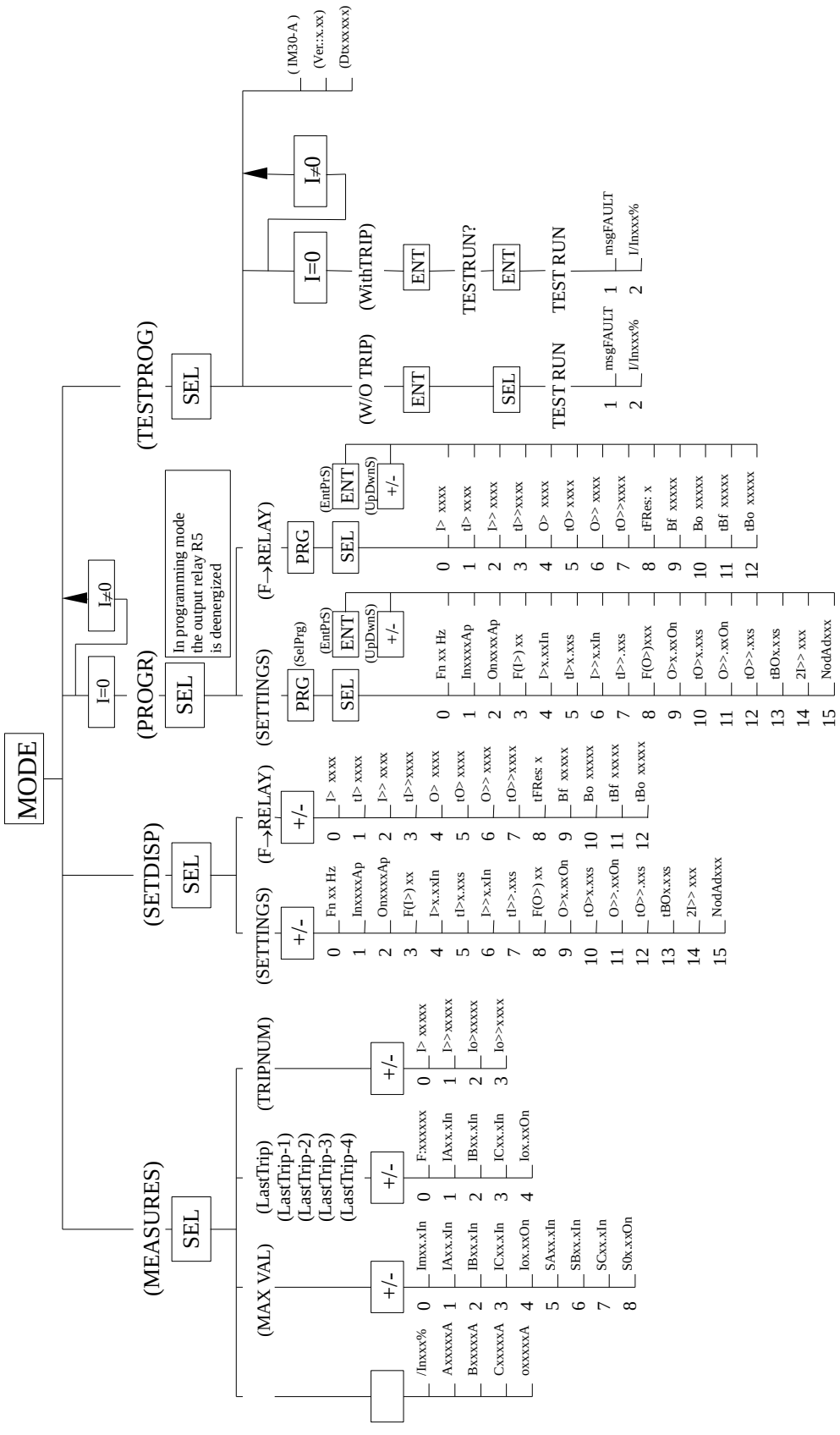
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position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



20. OVERALL DIMENSIONS



21. KEYBOARD OPERATIONAL DIAGRAM (D46299 Rev.2)



22. SETTING'S FORM

Date :		**Number Relay:**	

RELAY PROGRAMMING

Default Setting			**Actual Setting**		
Variable	**Value**	**Measurement Unit**	**Variable**	**Value**	**Measurement Unit**
Fn	50	**Hz**	**Fn**		**Hz**
In	500	**Ap**	**In**		**Ap**
On	500	**Ap**	**On**		**Ap**
F(I>)	D	----------	**F(I>)**		----------
I>	.5	**In**	**I>**		**In**
tI>	.05	**s**	**tI>**		**s**
I>>	.5	**In**	**I>>**		**In**
tI>>	.05	**s**	**tI>>**		**s**
F(O>)	D	----------	**F(O>)**		----------
O>	.02	**On**	**O>**		**On**
tO>	.05	**s**	**tO>**		**s**
O>>	.02	**On**	**O>>**		**On**
tO>>	.05	**s**	**tO>>**		**s**
tBO	.05	**s**	**tBO**		**s**
2I>>	OFF	----------	**2I>>**		----------
NodAd	1	----------	**NodAd**		----------

CONFIGURATION OF OUTPUT RELAYS

Default Setting					**Actual Setting**				
Protecive Elem.	**Output Relays**				**Protecive Elem.**	**Output Relays**			
I>	-	-	3	-	**I>**				
tI>	1	-	-	-	**tI>**				
I>>	-	-	3	-	**I>>**				
tI>>	1	-	-	-	**tI>>**				
O>	-	-	-	4	**O>**				
tO>	-	2	-	-	**tO>**				
O>>	-		-	4	**O>>**				
tO>>	-	2	-	-	**tO>>**				
tFRes:	A				**tFRes**:				
Bf	I>>I>				**Bf**				
Bo	O>>O>				**Bo**				
tBf	2tB0				**tBf**				
tBo	2tB0				**tBo**				