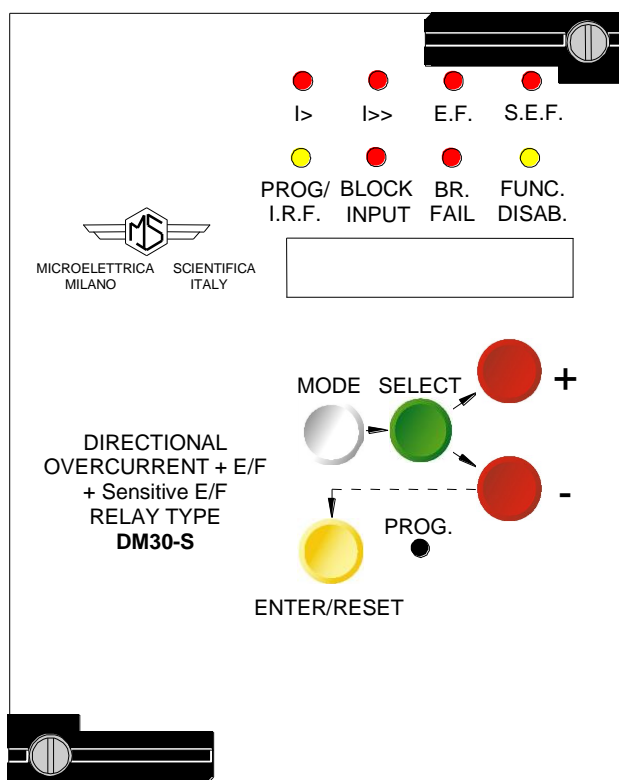


MULTIFUNCTION MICROPROCESSOR PROTECTION RELAY DIRECTIONAL 3 PHASE OVERCURRENT + EARTH FAULT AND SENSITIVE EARTH FAULT TYPE

DM30-S

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 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 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.

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- 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 CHARACTERISTICS

Input quantities are supplied to 3 Voltage Transformers and to 4 Current Transformers (- three measuring phase current - one supplying S.E.F. element).
Phase current inputs can be rated either 1 or 5A. The voltage input is rated 100V.
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 and self protected

2.1 - POWER SUPPLY

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.

2.2 - Phase Overcurrent element

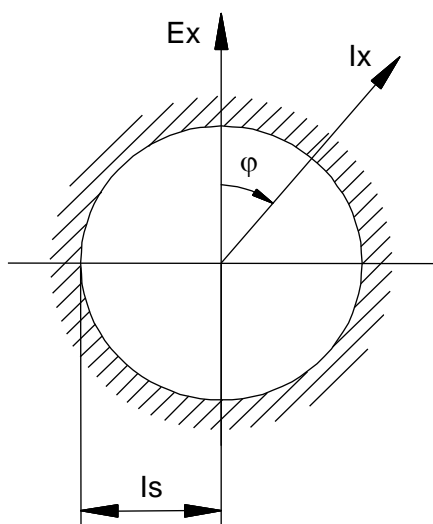
The relay performs three phase and earth fault protection. Either the Phase Fault element and the Earth Fault element can operate in three different ways according to the programming respectively of the variable F_{α} and F_{α_0} .

2.2.1 – Operation of the Phase Overcurrent element

It is assumed :

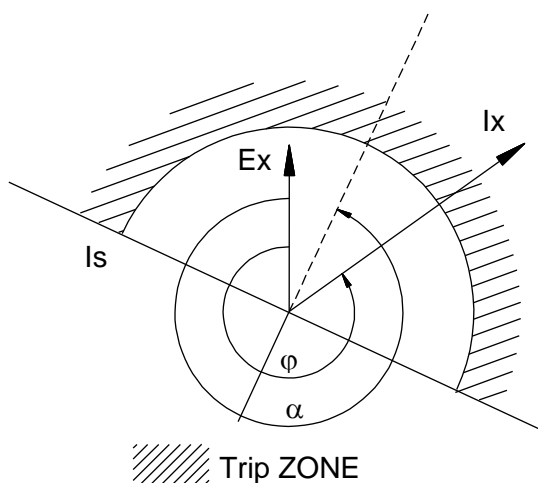
- ❑ I_s = Set minimum pick-up current ($I > I_s$)
- ❑ α = Set characteristic angle (max. torque angle)
- ❑ I_x = Actual relay' input current (highest among the three phase currents I_A, I_B, I_C .)
- ❑ φ = Actual displacement of current I_x from the phase voltage E_x
- ❑ I_{dx} = Component of I_x in the direction α

A) Programming $F_{\alpha} = \text{Dis.}$



The element just operates as a non directional overcurrent element when $I_x \geq [I_s]$ independently from the displacement φ

B) Programming $F_{\alpha} = \text{Sup.}$

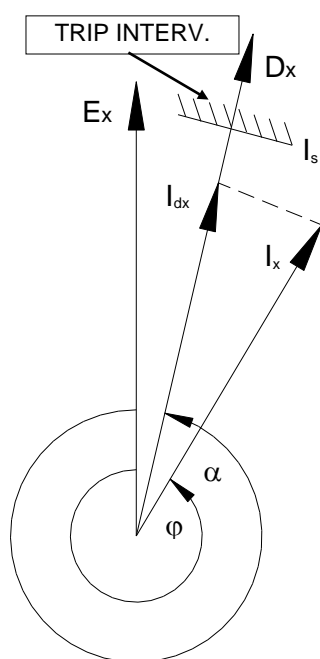


The element simply operates with supervision of the current flow direction.

The pick-up conditions are:

- ❑ The input phase-to-neutral Voltage Exceeds 1-2% of the rated input voltage $V_n/\sqrt{3}$.
- ❑ The input current exceeds the set level I_s : $I_x \geq [I_s]$
- ❑ The displacement φ of I_x from E_x is within $\pm 90^\circ$ from the set direction α

C) Programming $F_{\alpha} = \text{Dir.}$



The element operates a full directional control (wattmetric operation) measuring for each phase the current:

$$I_{\alpha A} = I_A \cos(\varphi_A - \alpha) \quad I_{\alpha B} = I_B \cos(\varphi_B - \alpha) \quad I_{\alpha C} = I_C \cos(\varphi_C - \alpha)$$

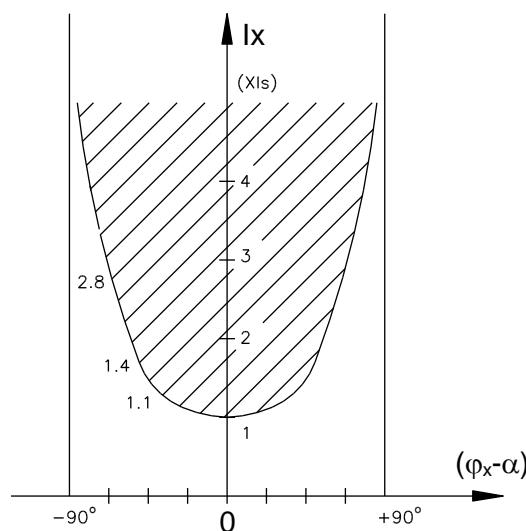
Any of the relay's phase elements initiates the operation of the overcurrent functions when the component I_{dx} of its phase current I_x in the direction D_x (vector displaced α degrees from the relevant phase voltage E_x) exceeds the set pick-up level $I_s = [I >]$ or $[I >>]$

$$I_{dx} = I_x \cos(\varphi_x - \alpha) \geq I_s$$

Consequently :

- When $\varphi_x = \alpha$: $I_{dx} = I_x \rightarrow$ operation when $I_x > I_s$
- When $(\varphi_x - \alpha) = 90^\circ$: $I_{dx} = 0 \rightarrow$ no operation
- When $(\varphi_x - \alpha) > 90^\circ$: I_{dx} opposite to $D_x \rightarrow$ no operation

Operation of the phase elements is virtually independent from the magnitude of the voltage as down as 1-2% of rated voltage.



Recommended angles for different applications :

- Measurement of active current (power) :
Forward : $\alpha = 0^\circ$ - Reverse : $\alpha = 180^\circ$
- Phase fault directional overcurrent :
Forward : $\alpha = 300^\circ (60^\circ \text{ lag})$ - Reverse : $\alpha = 120^\circ$
- Measurement of inductive reactive current :
Forward : $\alpha = 270^\circ (90^\circ \text{ lag})$ - Reverse : $\alpha = 90^\circ$
- Measurement of capacitive reactive current:
Forward : $\alpha = 90^\circ (90^\circ \text{ lead})$ - Reverse : $\alpha = 270^\circ$

2.3 ALGORITHM OF THE TIME CURRENT CURVES

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

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

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

I_s = Set minimum pick-up level

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

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

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

The constants **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 Extr. 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

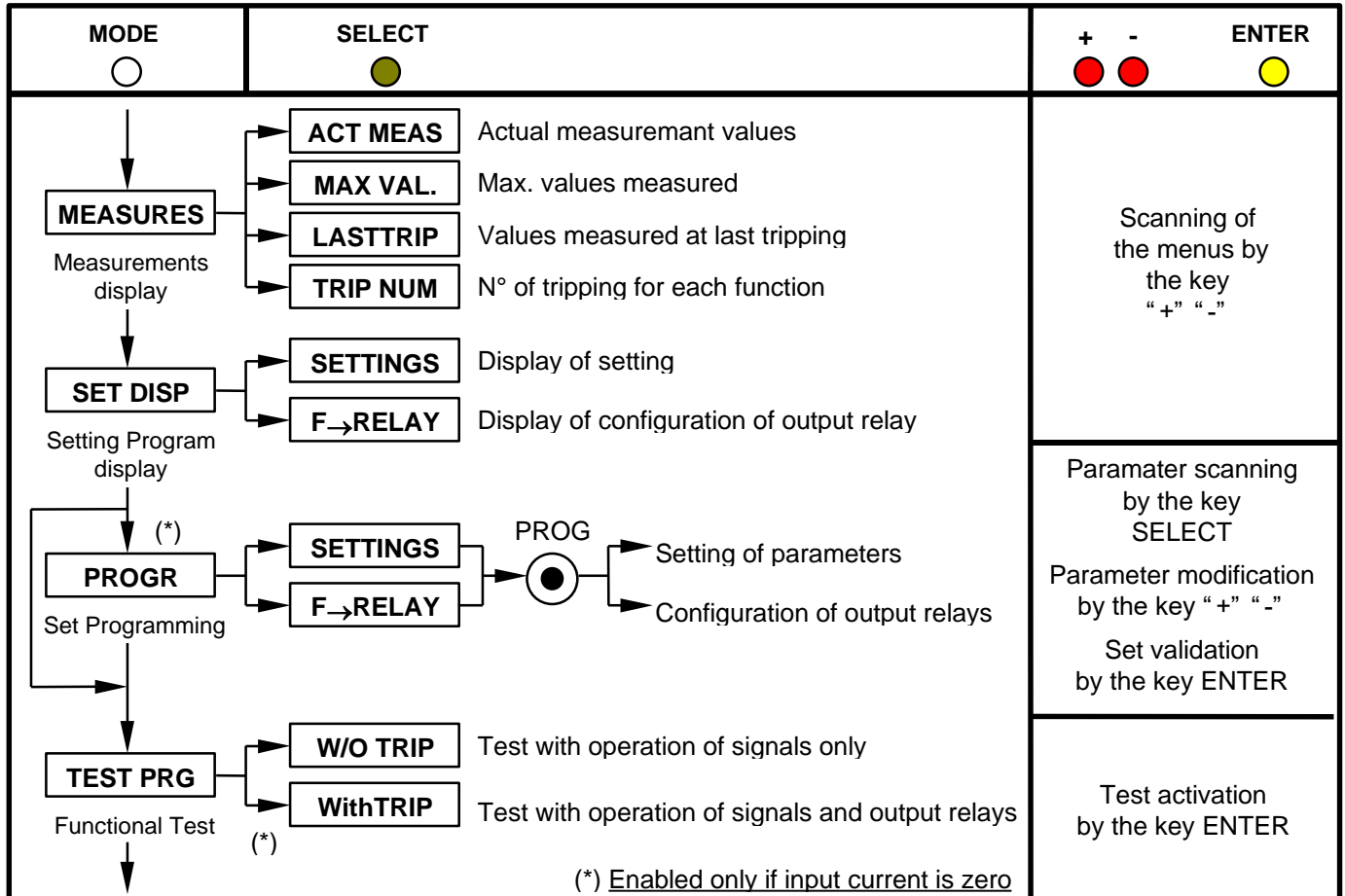
3. CONTROLS AND MEASUREMENTS

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)

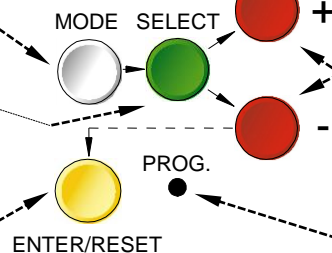
FIG.1



Pressing this button progressively selects between Measurements Display, Setting Display, Programming, and Test modes

The SELECT button chooses which category of values within the chosen mode to display

When in Program mode, this button stores the newly selected value. If not in Program mode and the relay has tripped, this button resets the relay and all output contacts. If not tripped, this button restores the default display.

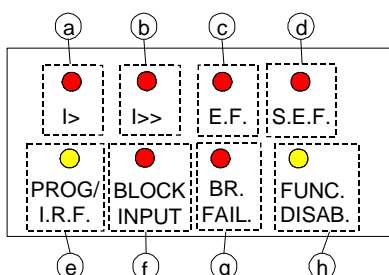


The + and - buttons are used to select the actual measurement or display desired when in Measurements Display or Settings Display modes. When in Program mode, these buttons increase or decrease the value of the displayed setting.

When in Program mode, and when all input currents are zero, pressing this recessed button places the relay into active programming mode, allowing any or all of the relay's settings to be altered.

4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a) Red LED	I>	<input type="checkbox"/> Flashing when measured current exceeds the set level I>. <input type="checkbox"/> Illuminated on trip after expiry of the set trip time delay tI>.
b) Red LED	I>>	<input type="checkbox"/> same as above related to I>> and tI>>.
c) Red LED	E.F.	<input type="checkbox"/> Flashing when E/F current exceeds the set level N> and/or N>> of the E/F element <input type="checkbox"/> Illuminated on trip after the set trip time delay tN> and/or tN>>
d) Red LED	S.E.F.	<input type="checkbox"/> Flashing when E/F current exceeds the set level O> and/or O>> of the Sensitive E/F element <input type="checkbox"/> Illuminated on trip after the expiry of the set time delay tO> and/or tO>>
e) Yellow LED	PROG/ I.R.F.	<input type="checkbox"/> Flashing during the programming of the parameters or in case of Internal Relay Fault.
f) Red LED	BLOCK INPUT	<input type="checkbox"/> Flashing when a blocking signals present at the relevant input terminals.
g) Red LED	BR.FAIL.	<input type="checkbox"/> Lit-on when the BREAKER FAILURE function is activated.
h) Yellow LED	FUNC. DISAB.	<input type="checkbox"/> 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:

<input type="checkbox"/> Leds	a,b,c,d,g	<input type="checkbox"/> From flashing to off, automatically when the lit-on cause disappears. <input type="checkbox"/> From ON to OFF, by "ENTER/RESET" push button only if the tripping cause has disappeared.
<input type="checkbox"/> Leds	e,f,h	<input type="checkbox"/> 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.

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5. OUTPUT RELAYS

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

- a) - The relays **R1,R2,R3,R4** are normally deenergized (energized on trip): these output relays are user programmable and any of them can be associated to any of the IM30-DRE's functions. Reset of the output relays after pick-up takes place automatically as soon as the tripping cause is cleared. For relays controlled by the time delayed elements of the protection functions ($t_{l>}$, $t_{l>>}$, $t_{O>}$, $t_{O>>}$, $t_{l2>}$) it is possible to select Automatic reset or Manual Reset by the front reset button (see programming of tFRes § 12.2).

The reset of the relay associated to BT (see § 2.6.2) is always automatic.

- 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

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

- | | |
|---|---|
| <input type="checkbox"/> BI (terminals 1 - 2) | : it blocks the operation of the of the time delayed elements relevant to phase fault detection. |
| <input type="checkbox"/> B0 (terminals 1 - 3) | : it blocks the operation of the time delayed elements relevant to Sensitive earth fault detection. |
| <input type="checkbox"/> BN (terminals 1 - 14) | : it blocks the operation of the time delayed elements relevant to earth fault detection. |

When a function is blocked the pick-up of its output is inhibited. Programming allows to have the inhibition either permanent as long as the blocking input is active or automatically removed with a programmable wait-time (see page 12 : tBf , tBo) after the operation of the time delayed function. By proper interconnection of the blocking inputs output among different relays it is possible to configure very efficient arrangements of logic fault discrimination as well as to feature a safe and quick breaker back-up protection.

8. TEST

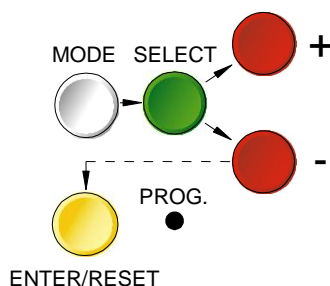
Besides the normal "WATCHDOG" and "POWERFAIL" functions, a comprehensive program of self-test and self-diagnostic provides:

- ☐ 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 ≤ 4 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. (Anyway the output relay associated to reclosing in not energized during test)

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 <ul style="list-style-type: none"> - 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 Measurement values)

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 C.Ts.(0-999)%
IAxxxxxA	True R.M.S. value of the current of phase A displayed as primary Amps.(0 - 99999)
IBxxxxxA	As above, phase B.
ICxxxxxA	As above, phase C.
OxxxxxA	As above, earth fault current measured by S.E.F. element.
NxxxxxA	As, above earth fault current calculated as $\overline{IA} + \overline{IB} + \overline{IC}$
φaxxxxx°	Phase A displacement degrees
φbxxxxx°	Phase B displacement degrees
φcxxxxx°	Phase C displacement degrees

10.2 - MAX VAL (Maximum Values measured)

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

Display	Description
IAxxxxIn	Max value of phase A current after the first 100ms, displayed as p.u. of C.Ts rated current.
IBxxxxIn	As above, phase B.
ICxxxxIn	As above, phase C.
OxxxxOn	As above, zero sequence current measured
NxxxxIn	As above, zero sequence current calculated
SAxx.xIn	Max demand for phase A current during the first 100ms, displayed as p.u. of Cts rated current (0 - 99,9)
SBxx.xIn	As above, phase B.
SCxx.xIn	As above, phase C.
S0xx.xOn	As above, zero sequence current measured.
SNxxxxIn	As above, zero sequence current calculated.

10.3 - EVENT RECORDING (LASTTRIP)

Display of the function which caused the last tripping of the relay plus values of the parameters at the moment of tripping. The memory buffer is refreshed at each new relay tripping.

Display	Description
F: xxxxx	Display of the function which caused the last tripping: I> ; I>> ; O> ; O>> ; N> ; N>> .
IAxxxIn	Current of phase A.
IBxxxIn	Current of phase B.
ICxxxIn	Current of phase C.
OxxxOn	Earth fault current measured by S.E.F. element
NxxxxxIn	Earth fault current calculated by Earth Fault element
φaxxxx°	Phase A displacement degrees
φbxxxx°	Phase B displacement degrees
φcxxxx°	Phase C displacement degrees

10.4 - TRIP NUM (N° of tripping for each function)

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	Low set (F67) time delayed overcurrent
I>>xxxx	As above, high set (F67) time delayed overcurrent
O>xxxx	As above, low set (F64) time delayed sensitive earth fault
O>>xxxx	As above, high set (F64) time delayed sensitive earth fault
N>xxxx	As above, low set (F51N) time delayed earth fault
N>>xxxx	As above, high set (F51N) time delayed earth fault

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 in the " Display " column].

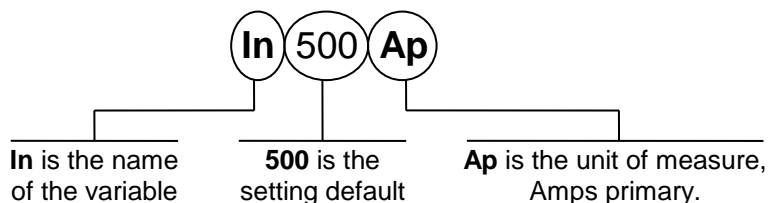
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP. **Local Programming by the front face key board is enabled only if no input current is detected (main switch open). Programming via the serial port is always enabled but a password is required to access the 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 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



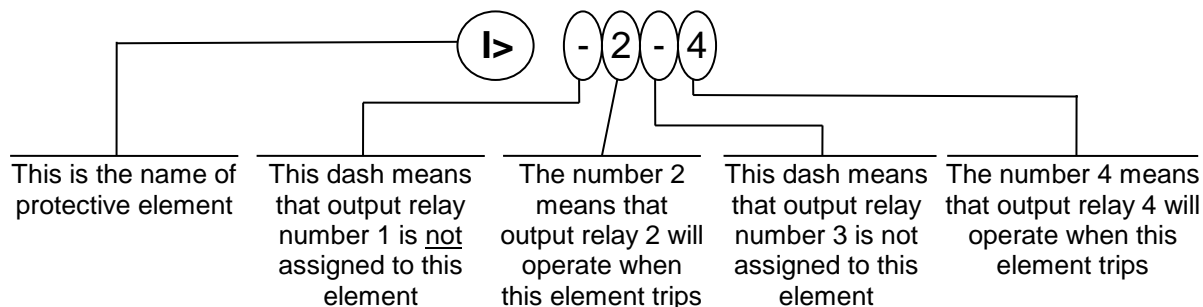
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step	Unit
Fn 50 Hz	Mains frequency	50 - 60	10	Hz
In 500Ap	Rated primary current of the phase C.Ts.	1 - 9999	1	Ap
On 500Ap	Rated primary current of the C.Ts. or of the tore C.T. supplying the zero sequence current	1 - 9999	1	Ap
Fα Dir	Operation mode of the phase O/C elements (see § 2.2.1)	Dis.–Sup.–Dir.	-	-
α= 90°	Reference direction of phase fault elements	0° - 359° - Dis	1	°
F(I>) D	Operation characteristic of the low-set 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	D A B C MI SI VI I EI	-
I> 1.0In	Trip level of low-set overcurrent element (p.u. of the rated current of the phase C.Ts.):	0.1 - 4 - Dis	0.01	In
tl> 2.0s	Trip time delay of the low-set overcurrent element: In the dependent time operation it is the trip time delay at I = 10x[I>] (see Time Current Curves)	0.05 - 30	0.01	s

Display	Description	Setting Range	Step	Unit
I>> 2In	Trip level of high-set overcurrent element in p.u. of the rated current of the phase C.Ts.:	0.5 - 40 - Dis	0.1	In
tI>> 0.1s	Trip time delay of the high-set overcurrent element	0.05 - 3	0.01	s
F(O>) D	Operation characteristic of the low-set S.E.F. element (F64): (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	D A B C MI SI VI I EI	-
O> 0.1n	Trip level of low-set S.E.F. element (F64) in p.u. of the rated current of the earth fault detection C.T.	0.02-0.4-Dis	0.01	On
tO> 30s	Trip time delay of low-set S.E.F. element: In the inverse time operation it is the trip time delay at $I_0 = 10x[O>]$ (see Time Current Curves)	0.05 - 30	0.01	s
O>>0.5On	Trip level of high-set S.E.F. element in p.u. of the rated current of the C.Ts. for unbalance detection:	0.02 - 1 - Dis	0.01	On
tO>> 2.0s	Trip time delay of the high-set earth fault element	0.05 – 9.9	0.01	s
F(N>) D	Operation characteristic of the low-set earth fault 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	D A B C MI SI VI I EI	-
N> 1.0On	Trip level of low-set earth fault element (F51N) in p.u. of the rated current of the earth fault detection C.T.	0.1 - 1 - Dis	0.01	On
tN> 1.0s	Trip time delay of low-set earth fault element: In the inverse time operation it is the trip time delay at $I_0 = 10x[N>]$ (see Time Current Curves)	0.05 - 30	0.01	s
N>>2On	Trip level of high-set earth fault element in p.u. of the rated current of the C.Ts. for unbalance detection:	0.1 – 10 - Dis	0.01	On
tN>> 0.3 s	Trip time delay of the high-set earth fault element:	0.05 - 3	0.01	s
tBO 0.1s	Max reset time delay of the instantaneous elements after tripping of the relevant delayed elements: See paragraph "Blocking Inputs"	0.05 – 0.25	0.01	s
NodAd 1	Identification number for the connection on serial communication bus	1 - 250	1	-

When Dis is programmed, the function is deactivated.

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 (F67) operates relays R1,R2,R3,R4.
tl> 1---	As above, time delayed element. operates relay R1,R2,R3,R4.
I>> --3-	Instantaneous element of high-set overcurrent (F67) operates relay R1,R2,R3,R4.
tl>> 1---	As above, time delayed element. operates relay R1,R2,R3,R4.
O> ---4	Instantaneous element of low-set S.E.F. element operates relay R1,R2,R3,R4.
tO> -2--	As above, time delayed element. operates relay R1,R2,R3,R4.
O>> ---4	Instantaneous element of high-set S.E.F. element operates relay R1,R2,R3,R4.
tO>> -2--	As above, time delayed element. operates relay R1,R2,R3,R4.
N> ---4	Instantaneous element of low-set earth fault element (F67) operates relay R1,R2,R3,R4.
tN> -2--	As above, time delayed element. operates relay R1,R2,R3,R4.
N>> ---4	Instantaneous element of high-set earth fault element (F67) operates relay R1,R2,R3,R4.
tN>> -2--	As above, time delayed element. operates relay R1,R2,R3,R4.
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.
BI I>>I>	The input 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 (I>>I>).
BO O>>O>	The input for blocking the operation of the time delayed elements relevant to S.E.F. (O>>, O>) can act on the function (O>) only or (O>>) only, or on both (O>>O>).
BN N>>N>	The input for blocking the operation of the time delayed elements relevant to earth fault (N>>, N>) can act on the function (N>) only or (N>>) only, or on both (N>>N>).
MBI 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 = 2tB0)
MB0 2tB0	The blocking of the S.E.F. 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 = 2tB0)
MBN 2tB0	The blocking of the earth 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 = 2tB0)

13. MANUAL AND AUTOMATIC 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 ≤ 10 ms). 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 2 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 taking 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

REFERENCE STANDARDS IEC 60255 - EN50263 - CE Directive - EN/IEC61000 - IEEE C37

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

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

<input type="checkbox"/> Operation ambient temperature	-10°C / +55°C
<input type="checkbox"/> Storage temperature	-25°C / +70°C
<input type="checkbox"/> Humidity	IEC68-2-3 RH 93% Without Condensing AT 40°C

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

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

CHARACTERISTICS

<input type="checkbox"/> Accuracy at reference value of influencing factors	2% Rated Input for measure 0,2% On 2% +/- 10ms for times
<input type="checkbox"/> Rated Current	In = 1 or 5A - On = 1 or 5A
<input type="checkbox"/> Current overload	200 A for 1 sec; 10A continuous
<input type="checkbox"/> Burden on current inputs	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A 0.02VA at On = 1A
<input type="checkbox"/> Rated Voltage	Un = 100V (different on request)
<input type="checkbox"/> Voltage overload	2 Un continuous
<input type="checkbox"/> Burden on voltage input	0,2 VA at Un
<input type="checkbox"/> Average power supply consumption	8.5 VA
<input type="checkbox"/> 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.)

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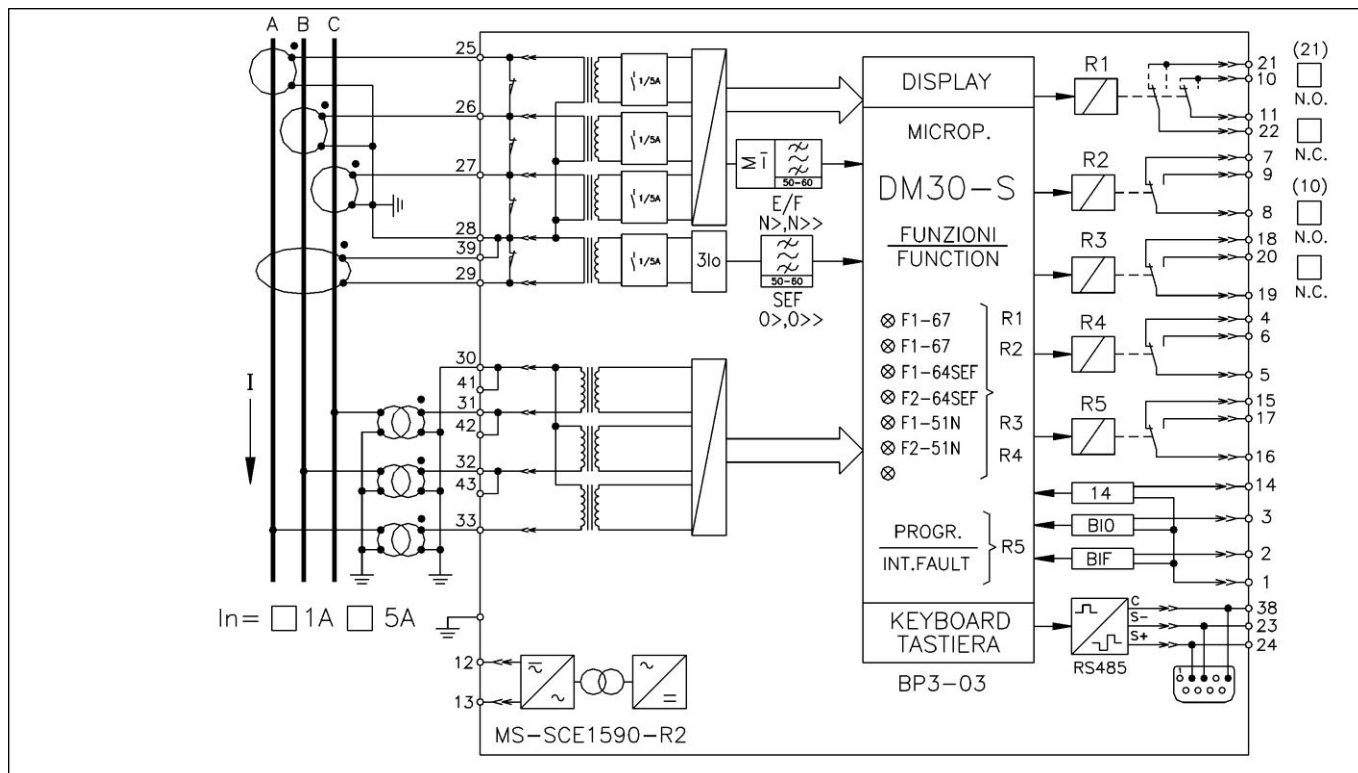
Tel. (##39) 02 575731 - Fax (##39) 02 57510940

<http://www.microelettrica.com> e-mail : ute@microelettrica.com

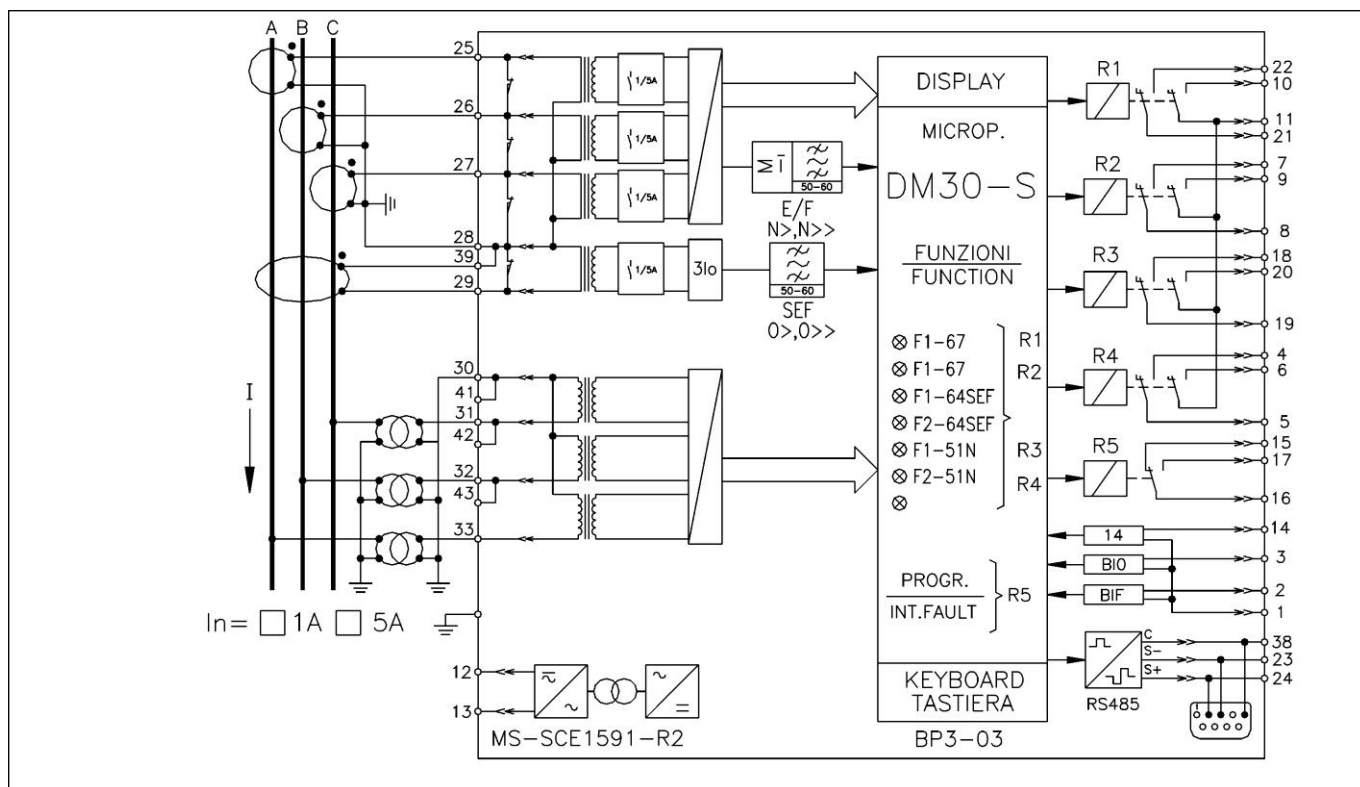
The performances and the characteristics reported in this manual are not binding and can be modified at any moment without notice



17. CONNECTION DIAGRAM (SCE1590 Rev.1 Standard Output)

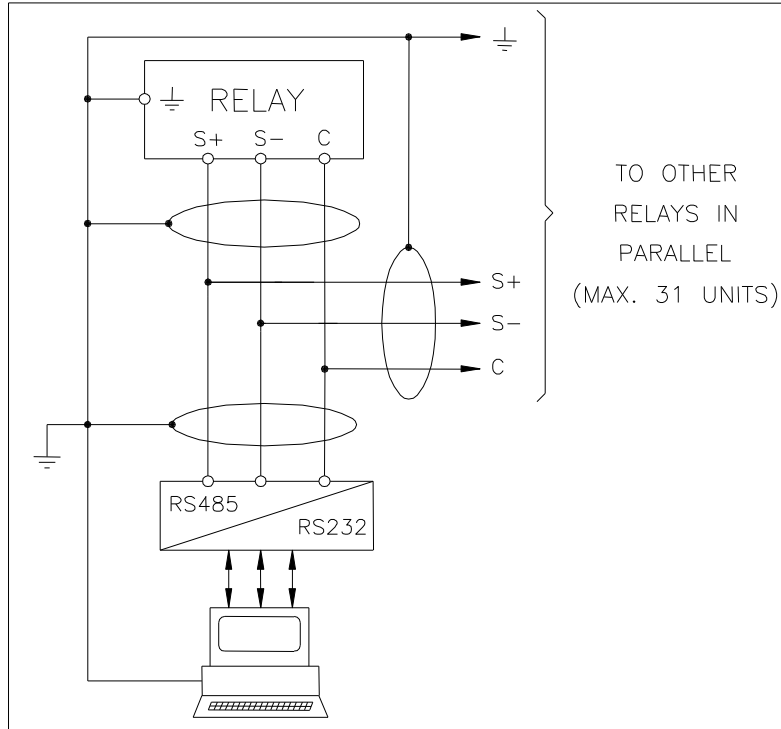


17.1 CONNECTION DIAGRAM (SCE1591 Rev.1 Double Output)

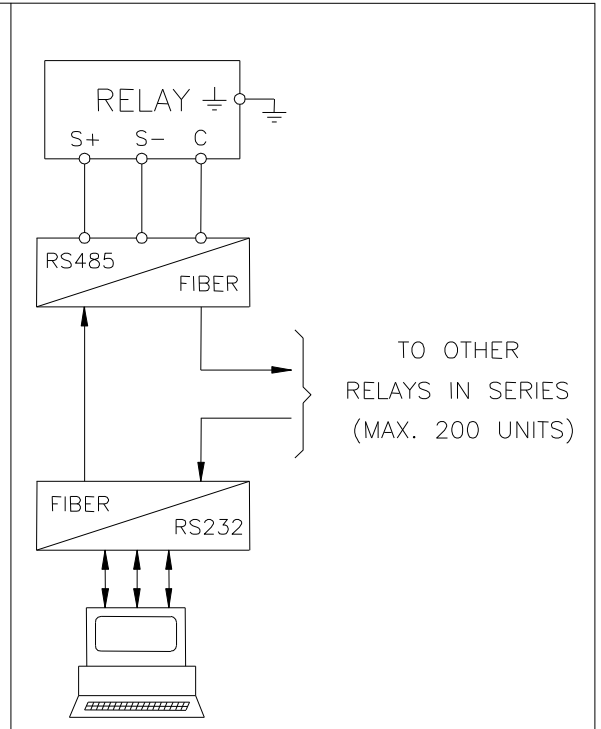


18. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)

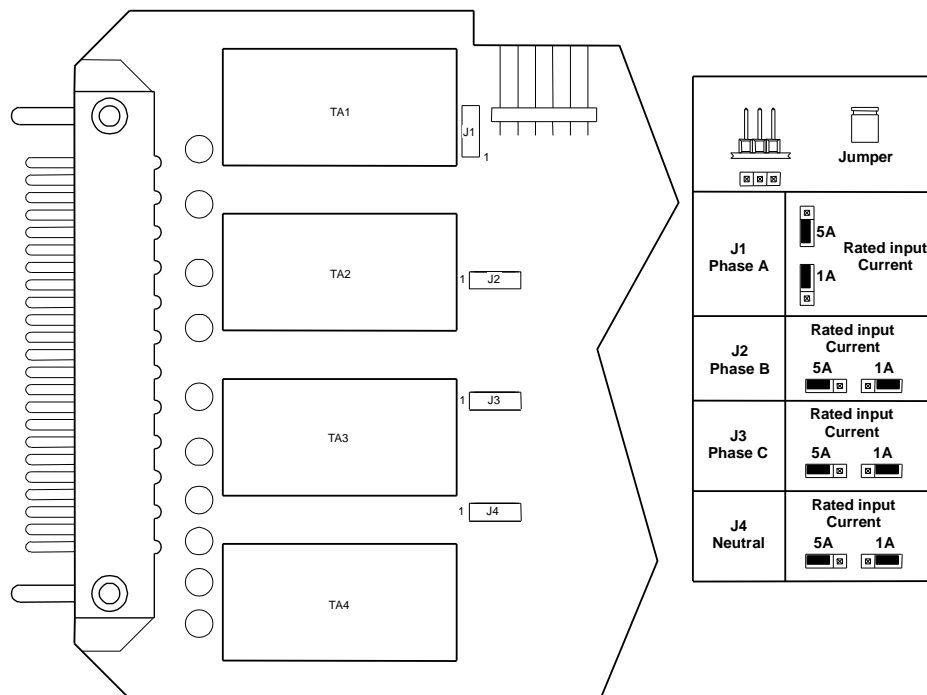
CONNECTION TO RS485



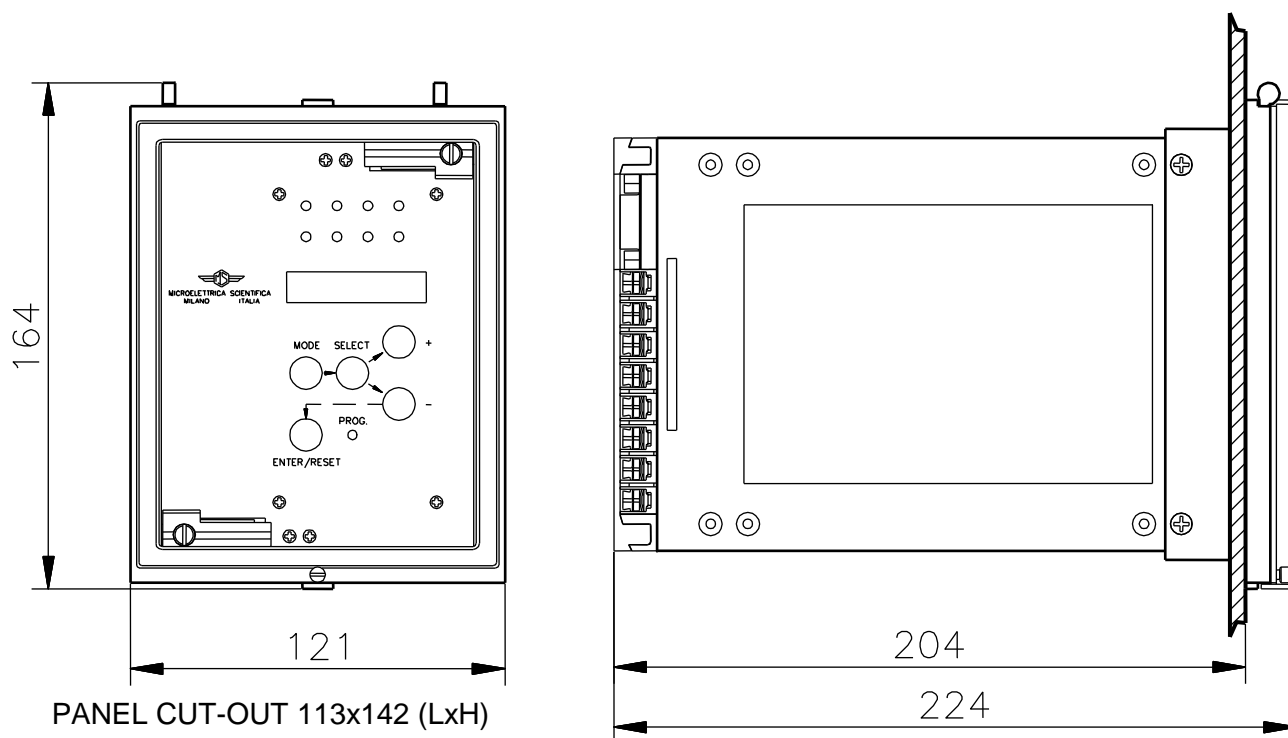
FIBER OPTIC CONNECTION



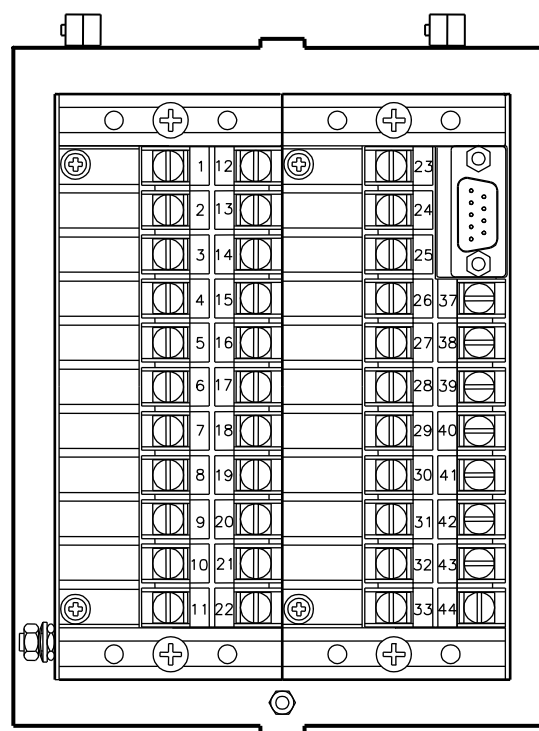
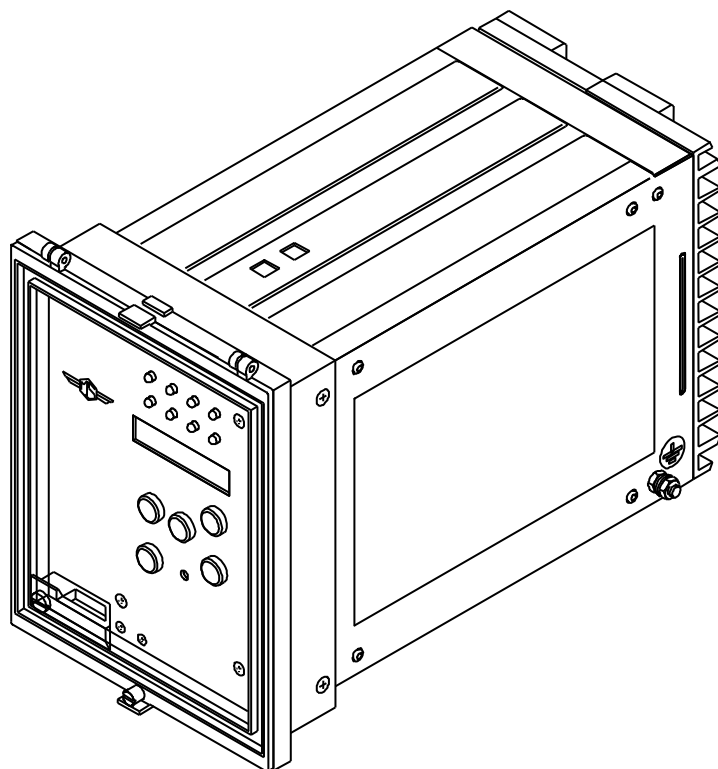
19. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A



20. OVERALL DIMENSIONS / MOUNTING

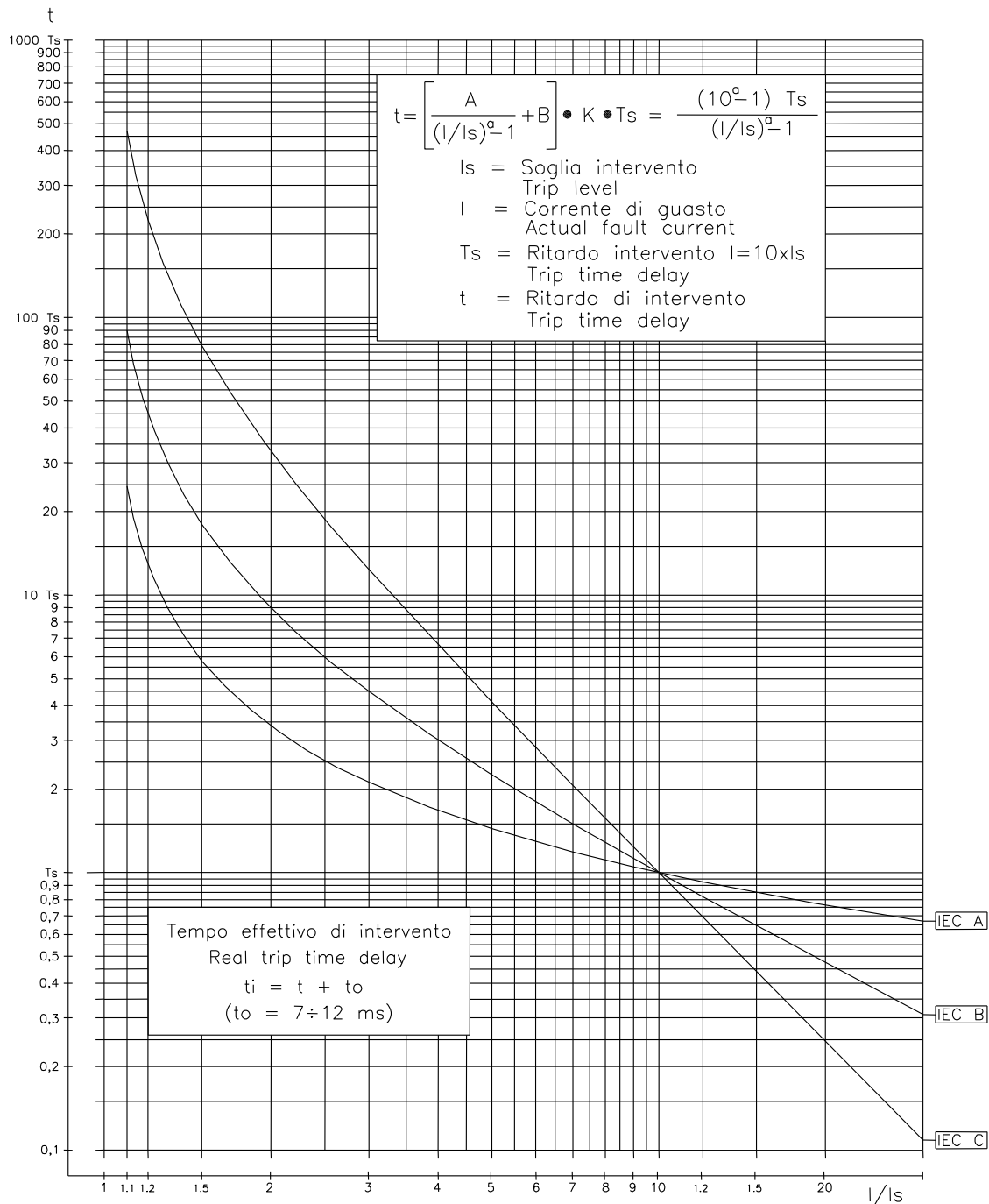


**View of Rear
Terminal Connection**





21. TIME CURRENT CURVES (TU0353 Rev.0) 1/2



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

$$F51 \begin{cases} I_s = I > = (0.5-4)I_n \\ T_s = t_i > = (0.05-30)s \end{cases}$$

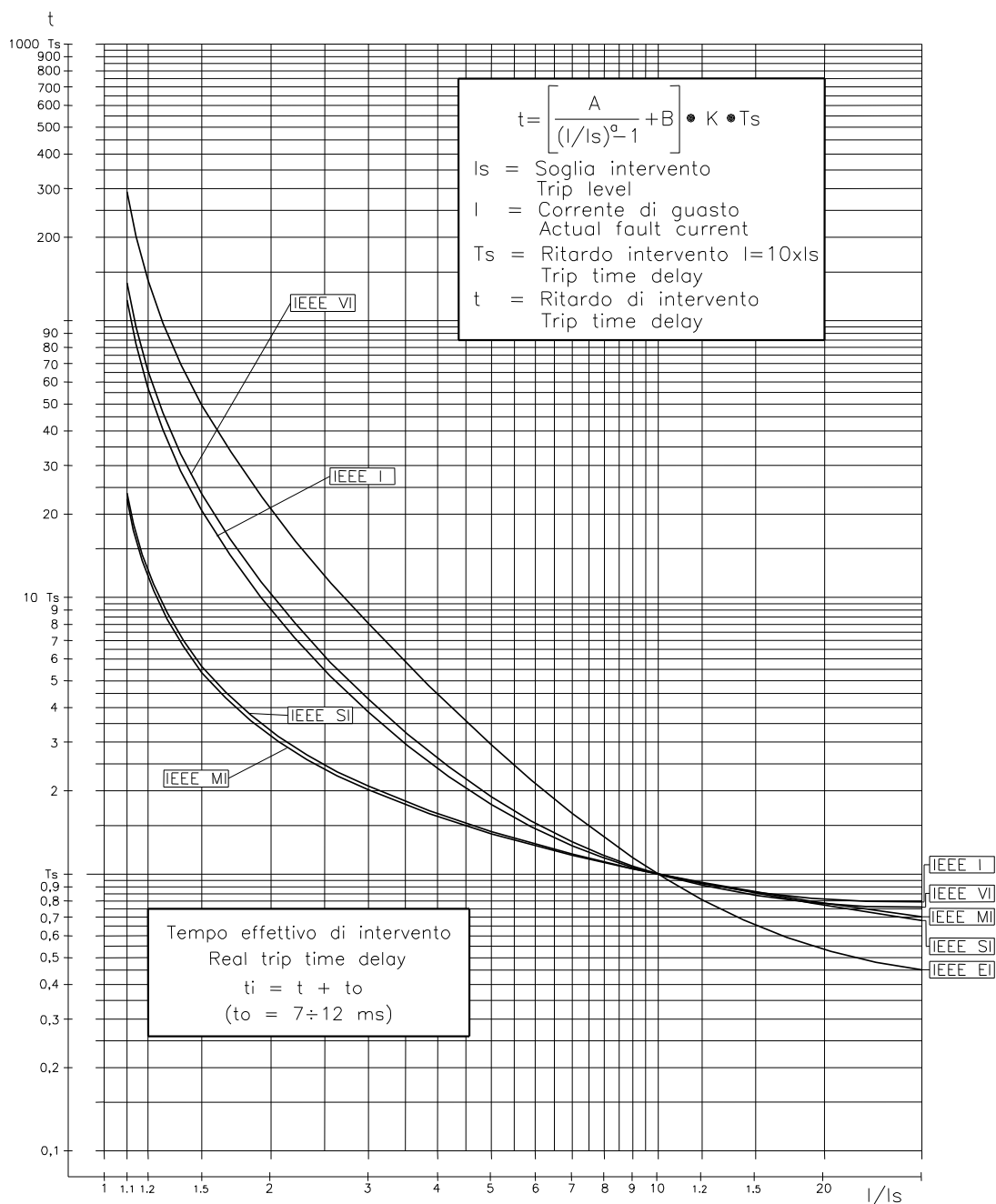
$$F51N \begin{cases} I_s = 0 > = (0.02-0.4)O_n \\ T_s = t_o > = (0.05-30)s \end{cases}$$

For F51 saturation at $I > 50 I_n$

For F51N saturation at $O > 2 O_n - N > 10 I_n$



22. TIME CURRENT CURVES (TU0353 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

$$\begin{aligned}
 &F51 \quad \begin{cases} I_s = I > = (0.5-4)I_n \\ T_s = t_i > = (0.05-30)s \end{cases} \\
 &F51N \quad \begin{cases} I_s = 0 > = (0.02-0.4)0_n \\ T_s = t_o > = (0.05-30)s \end{cases}
 \end{aligned}$$

For F51 saturation at $I > 50 I_n$

For F51N saturation at $O > 2 O_n$ - $N > 10 I_n$

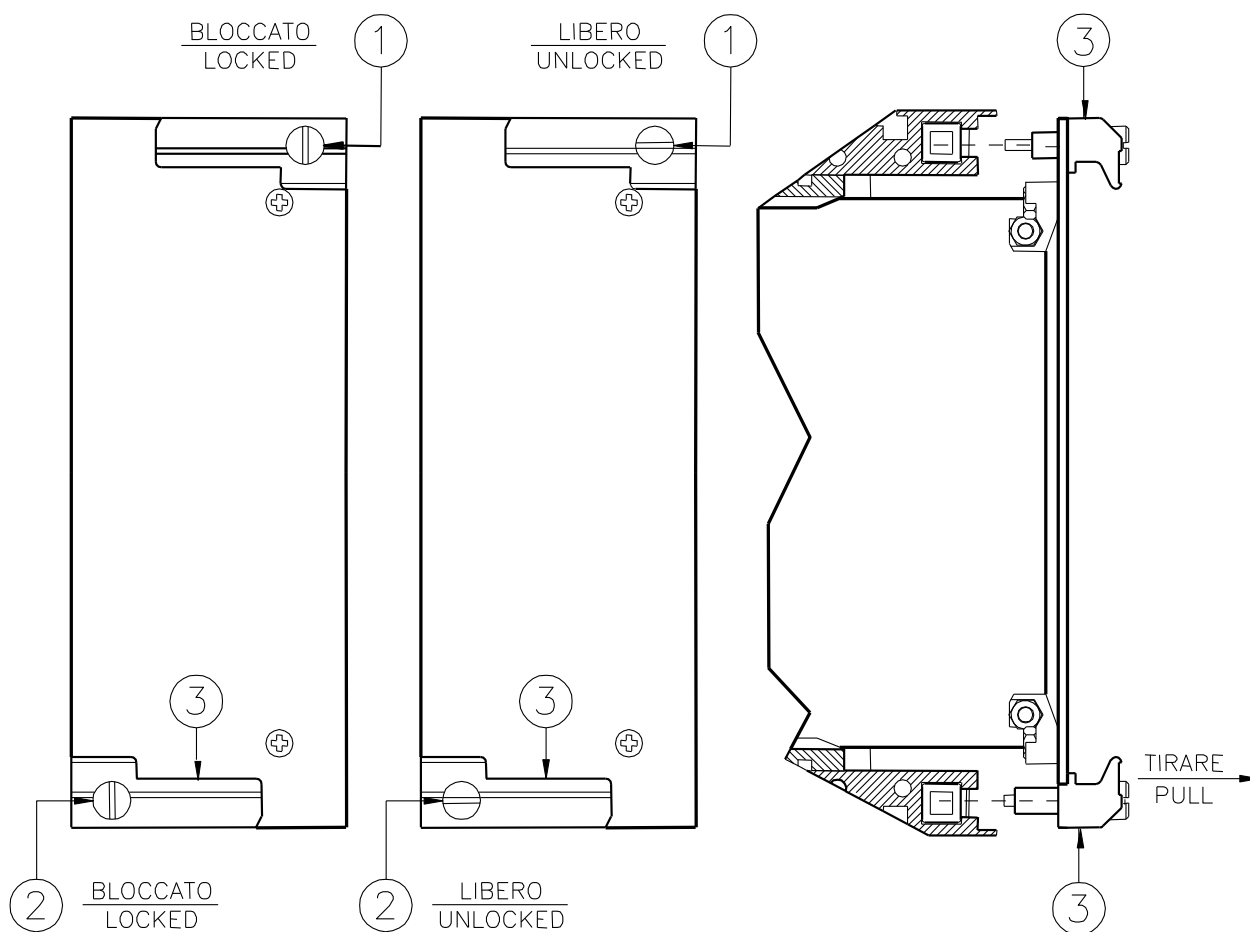
23. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

23.1 Draw-out

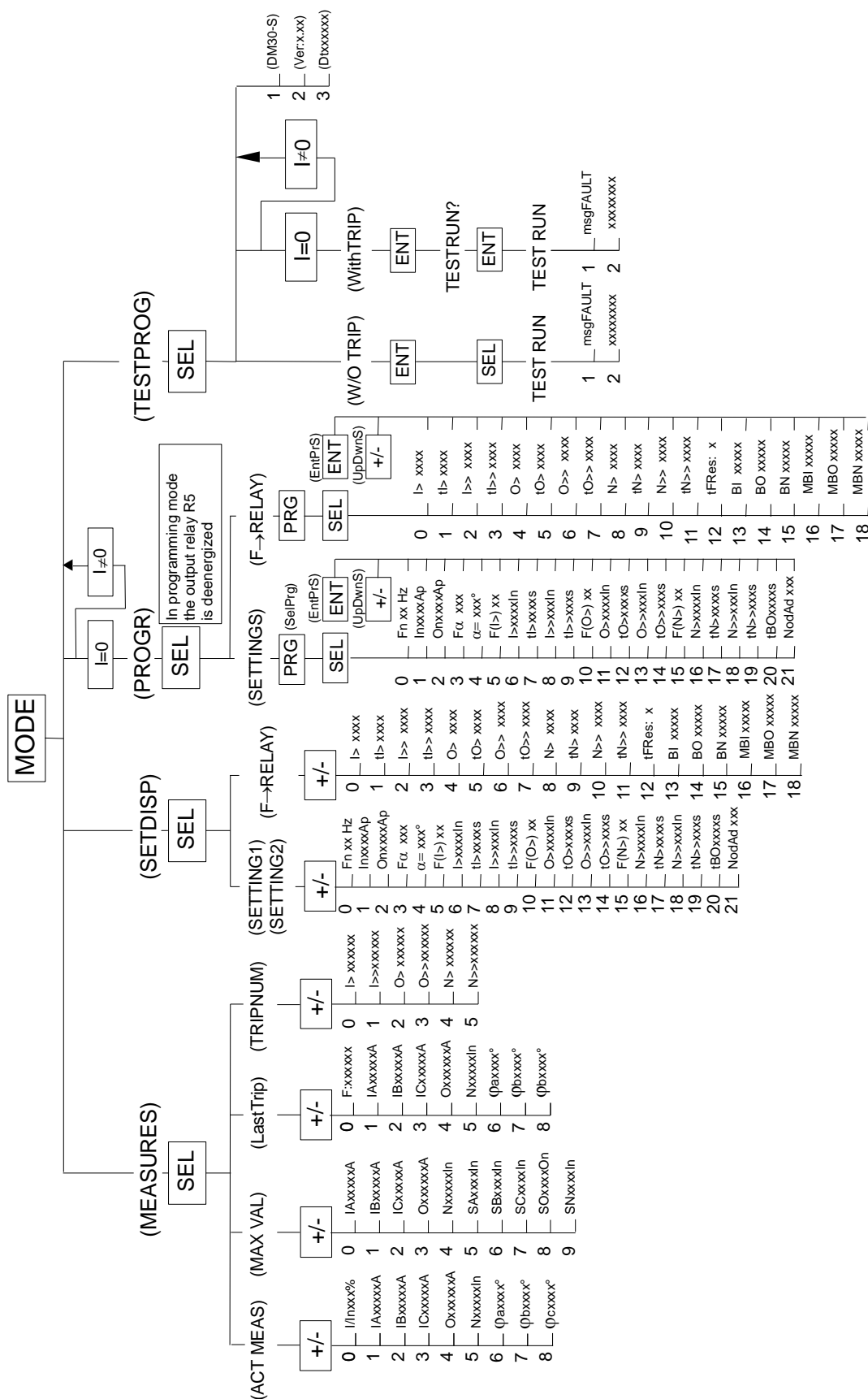
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
 Draw-out the PCB by pulling on the handle ③

23.2 Plug-in

Rotate clockwise the screws ① and ② in 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).



24. KEYBOARD OPERATIONAL DIAGRAM



 Microelettrica Scientifica	<h1 style="margin: 0;">DM30-S</h1>	Doc. N° MO-0095-ING Rev. 2 Pag. 27 of 27
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25. SETTINGS' FORM

Relay Type	DM30-S	Station :	FW Version:	Circuit :	
Date :	/ /			Relay Serial Number :	
Power Supply	<input type="checkbox"/> 24V(-20%) / 110V(+15%) a.c. <input type="checkbox"/> 80V(-20%) / 220V(+15%) a.c.	<input type="checkbox"/> 24V(-20%) / 125V(+20%) d.c. <input type="checkbox"/> 90V(-20%) / 250V(+20%) d.c.	Rated Current :	<input type="checkbox"/> 1A <input type="checkbox"/> 5A	
			Rated Voltage :	100V	

RELAY PROGRAMMING							
Variable	Description	Setting Range	Default Setting	Actual Setting	Test Result		
					Pick-up	Reset	
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				
Fα	Operation mode of the phase O/C elements	Dis-Sup-Dir	-	Dir			
α=	Reference direction of phase fault elements	0 - 359 - Dis	°	90			
F(I>)	Operation characteristic of the low-set overcurrent element	D,A,B,C,MI SI,VI,I,El	-	D			
I>	Trip level of low-set overcurrent element	0.1 - 4 - Dis	In	1.0			
tl>	Trip time delay of the low-set overcurrent element	0.05 - 30	s	2.0			
I>>	Trip level of high-set overcurrent element in p.u. of the rated current of the phase C.Ts.:	0.5 - 40 - Dis	In	2			
tl>>	Trip time delay of the high-set overcurrent element	0.05 - 3	s	0.1			
F(O>)	Operation characteristic of the low-set S.E.F. element (F64)	D,A,B,C,MI SI,VI,I,El	-	D			
O>	Trip level of low-set S.E.F. element (F64)	0.02-0.4-Dis	On	0.1			
tO>	Trip time delay of low-set S.E.F. element	0.05 - 30	s	30			
O>>	Trip level of high-set S.E.F. element	0.02 - 1 - Dis	On	0.5			
tO>>	Trip time delay of the high-set earth fault element	0.05 - 9.9	s	2.0			
F(N>)	Operation characteristic of the low-set earth fault element	D,A,B,C,MI SI,VI,I,El	-	D			
N>	Trip level of low-set earth fault element (F51N)	0.1 - 1 - Dis	On	1.0			
tN>	Trip time delay of low-set earth fault element	0.05 - 30	s	1.0			
N>>	Trip level of high-set earth fault element	0.1 - 10 - Dis	On	2			
tN>>	Trip time delay of the high-set earth fault element	0.05 - 3	s	0.3			
tBO	Max reset time delay of the instantaneous elements	0.05 - 0.25	s	0.1			
NodAd	Identification number for the serial communication	1 - 250	-	1			

CONFIGURATION OF OUTPUT RELAYS										
Default Setting					Actual Setting					
Protective Element	Output Relays				Description	Protective Element	Output Relays			
I>	-	-	3	-	Low-set phase overcurrent pick-up	I>				
tl>	1	-	-	-	Time delayed low-set phase overcurrent	tl>				
I>>	-	-	3	-	High-set phase overcurrent pick-up	I>>				
tl>>	1	-	-	-	Time delayed high-set phase overcurrent	tl>>				
O>	-	-	-	4	Low-set S.E.F. pick-up	O>				
tO>	-	2	-	-	Time delayed low-set S.E.F.	tO>				
O>>	-	-	-	4	High-set S.E.F. pick-up	O>>				
tO>>	-	2	-	-	Time delayed high-set S.E.F.	tO>>				
N>	-	-	-	4	Low-set ground overcurrent pick-up	N>				
tN>	-	2	-	-	Time delayed low-set ground overcurrent	tN>				
N>>	-	-	-	4	High-set ground overcurrent pick-up	N>>				
tN>>	-	2	-	-	Time delayed high-set ground overcurrent	tN>>				
BT	-	-	-	-	Breaker Trip relay	BT				
tFRes:	A				Relay reset mode A=Automatic, M=Manual (*)	tFRes:				
BI	I>>I>				The input for blocking	BI				
B0	O>>O>				The input for blocking	B0				
BN	N>>N>				The input for blocking	BN				
MBI	2tB0				The blocking of the fase fault elements	MBI				
MB0	2tB0				The blocking of the S.E.F. elements	MB0				
MBN	2tB0				The blocking of the earth fault elements	MBN				

Commissioning Engineer : _____ Date : _____

Customer Witness : _____ Date : _____