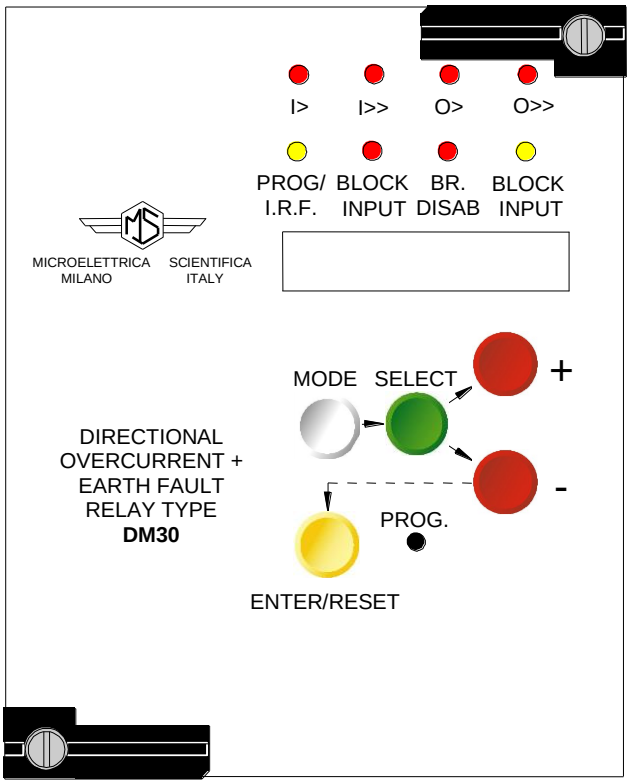
MULTIFUNCTION MICROPROCESSOR PROTECTION RELAY DIRECTIONAL 3 PHASE OVERCURRENT + DIRECTIONAL EARTH FAULT

TYPE

DM30

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.

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 CHARACTERISTICS

Input quantities are supplied to 3 Voltage Transformers and to 4 Current Transformers (- three measuring phase current - one measuring the earth fault current). Phase current inputs can be rated either 1 or 5A. The voltage input is rated 100V. The zero sequence polarizing voltage is internally reconstructed. 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%) 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 - Operation

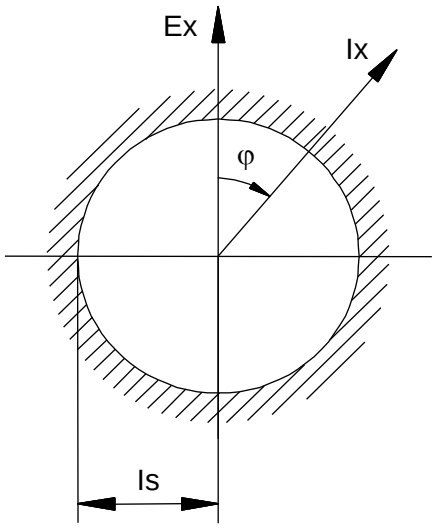
The relay performs three phase and earth fault protection. Either the Phase Fault element and the Earth Fault element can operate in three different ways according to the programming respectively of the variable Fα and Fα$_o$.

2.2.1 – Operation of the Phase Overcurrent element

It is assumed :

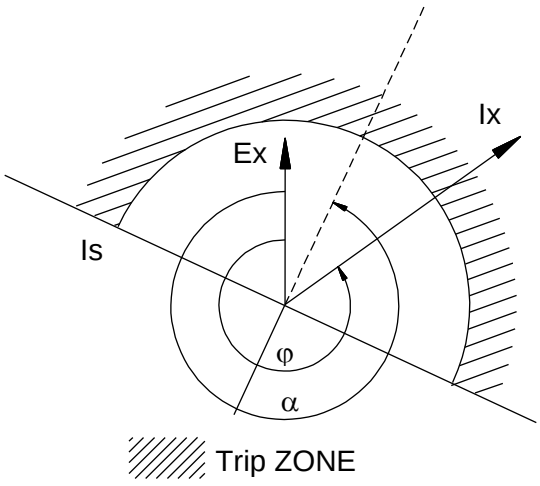
- Is = Set minimum pick-up current (I>,I>>)
- α = Set characteristic angle (max. torque angle)
- Ix = Actual relay' input current (highest among the three phase currents IA, IB, IC.)
- φ = Actual displacement of current Ix from the phase voltage Ex
- Idx = Component of Ix in the direction α

A) Programming Fα = Dis.



The element just operates as a non directional overcurrent element when Ix ≥ [Is] independently from the displacement φ

B) Programming Fα = Sup.

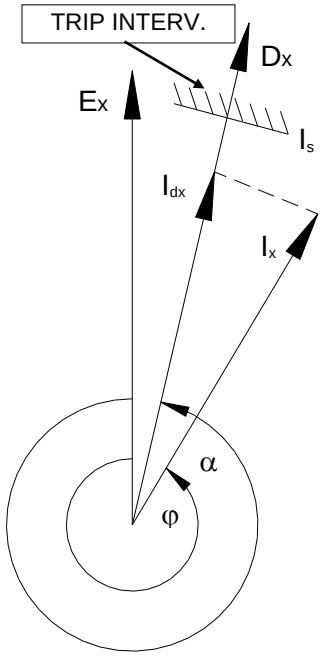


The element simply operates with supervision of the current flow direction.

The pick-up conditions are:

- The input phase-to-neutral Voltage Exceeds 1-2% of the rated input voltage Vn/√3.
- The input current exceeds the set level Is: Ix ≥ [Is]
- The displacement φ of Ix from Ex is within ±90° from the set direction α

C) Programming Fα = Dir.



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

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

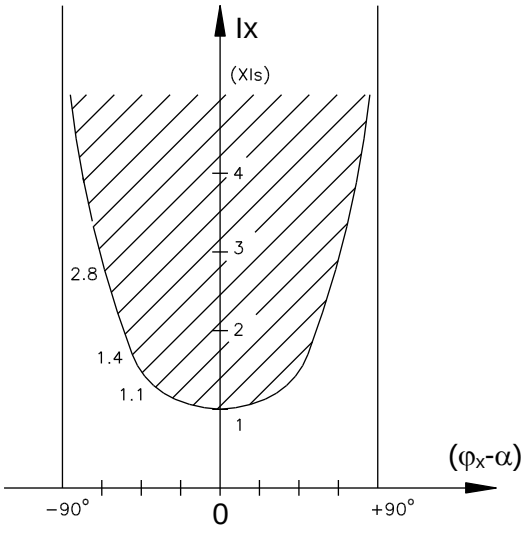
Any of the relay's phase elements initiates the operation of the overcurrent functions when the component I_{dx} of its phase current I_x in the direction Dx (vector displaced α degees from the relevant phase voltage Ex) exceeds the set pick-up level Is=[I>] or [I>>]

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

Consequently :

- When $\varphi_x = \alpha$: $I_{dx}= I_x \rightarrow$ operation when $I_x>Is$
- When $(\varphi_x-\alpha) = 90°$: $I_{dx}= 0 \rightarrow$ no operation
- When $(\varphi_x-\alpha) > 90°$: I_{dx} opposite to Dx $\rightarrow$ 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 :

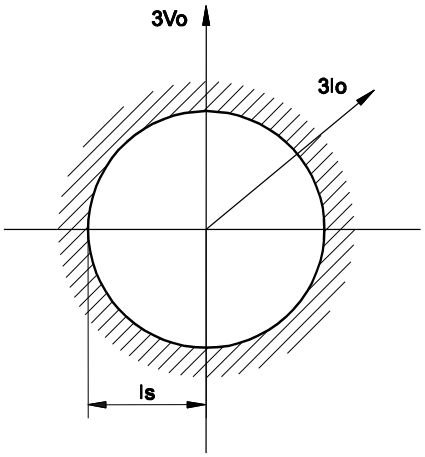
- Measurement of active current (power) :
  Forward : α = 0° - Reverse : α = 180°
- Phase fault directional overcurrent :
  Forward : α = 300°(60° lag) - Reverse : α = 120°
- Measurement of inductive reactive current :
  Forward : α = 270°(90° lag) - Reverse : α = 90°
- Measurement of capacitive reactive current:
  Forward : α = 90°(90° lead) - Reverse : α = 270°

2.3 - OPERATION OF THE DIRECTIONAL EARTH FAULT ELEMENT

It is assumed :

- **Is** = Set minimum pick-up residual current (3Io) (O>,O>>)
- **Uo** = Set minimum residual voltage (level to enable Is pick-up)
- **α_o** = Set characteristic angle (max. torque angle)
- **3Io** = Actual earth fault relay's input current
- **3Vo** = Actual earth fault relay's input voltage
- **φ_o** = Actual Io/Vo phase displacement
- **Ios** = Component of Io in the direction α

The directional earth fault element can operate in three different ways according to the programming of the variable Fα_o.



Fα_o = Dis.

The element just operates as a normal overcurrent element without either residual voltage control (U_o) and zero sequence current displacement control (α_o)

- The element operates if : $3I_o \geq [I_s]$

Fα_o = Sup.

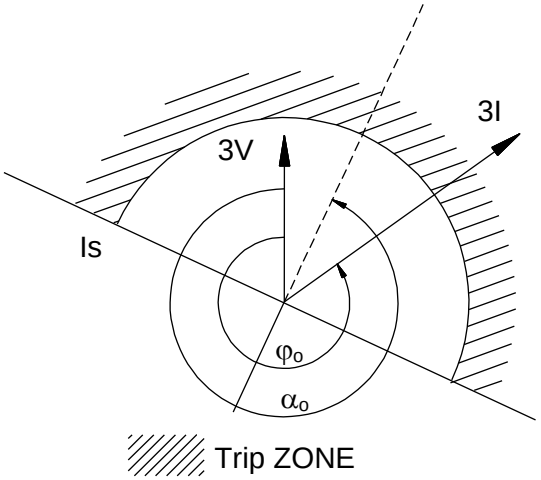
The element operates if the following 3 conditions are present :

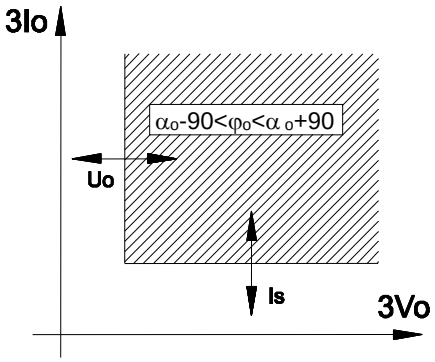
- The input residual voltage $3V_o$ exceeds the set U_o $3Vo \geq [U_o]$

- The input residual current $3I_o$ exceeds the set I_s $3I_o \geq [I_s]$

- The displacement φ_o of I_o from V_o is within ± 90° from the set direction α_o.

$$\alpha_o - 90 \leq \varphi_o \leq \alpha_o + 90$$



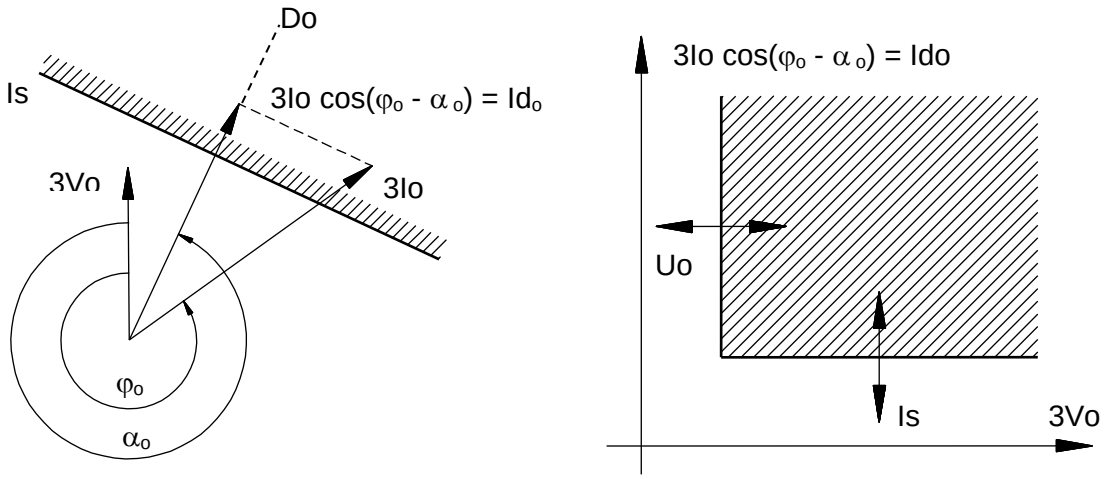


Fα_o = Dir

- The element performs a complete directional operation; pick-up takes place if the following conditions ere present.

- The input residual voltage $3V_o$ exceeds the set U_o : $3V_o \geq [U_o]$

- The component of the input residual current $3I_o$ in the direction α exceeds the set level I_s: $3I_o \cos(\varphi_o - \alpha_o) \geq [I_s]$



N.B. Angles are measured anti-clockwise from 0° to 360° (four quadrants)

Consequently :

- when $\varphi_o = \alpha_o$: $I_{do} = I_o$ → operation when $3Io \geq Is$
- when $(\varphi_o - \alpha_o)=90°$: $I_{do} = 0$ → no operation
- when $(\varphi_o - \alpha_o)>90°$: I_{do} opposite to Do → no operation

Recommended angles for different application :

- Isolated neutral : $\alpha_o = 270°$ (reverse 90° lead)
- Resistance or reactance earthed neutral : $\alpha_o = 0°$
- Solidly earthed neutral : $\alpha_o = 300°$ (60° lag)

2.4 - ALGORITHM OF THE TIME CURRENT CURVES

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

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

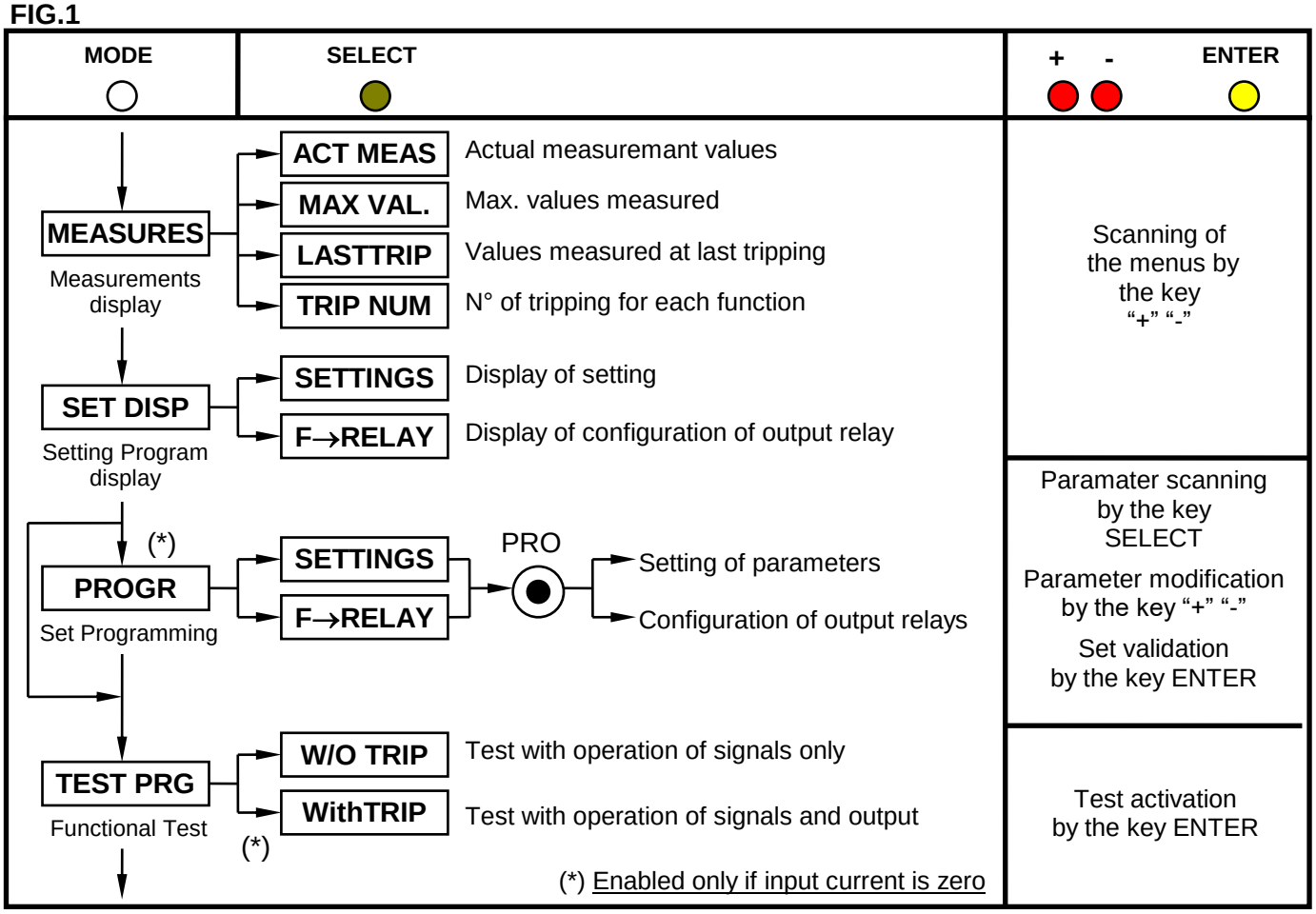
The constants **A**, **B** and **a** have different values for the different Time Current Curves.

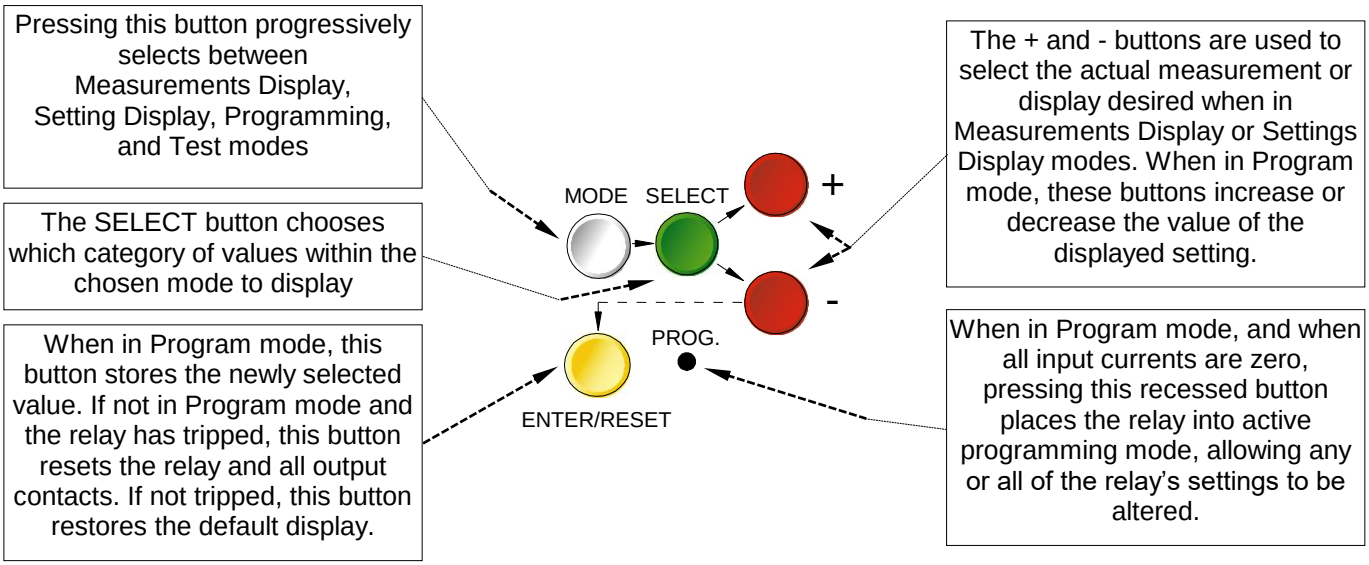
Curve Name	Curve Identifier	A	B	a
IEC A Inverse	A	0.14	0	0.02
IEC B Very Inverse	B	13.5	0	1
IEC C Extr. Inverse	C	80	0	2
IEEE Moderate Inverse	MI	0.0104	0.0226	0.02
IEEE Short Inverse	SI	0.00342	0.00262	0.02
IEEE Very Inverse	VI	3.88	0.0963	2
IEEE Inverse	I	5.95	0.18	2
IEEE Extremely Inverse	EI	5.67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

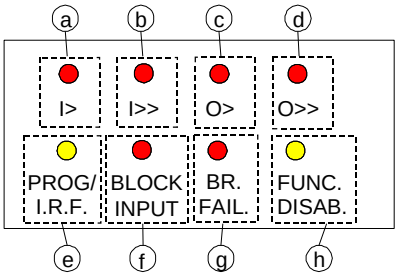
FIG.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a)	Red LED	**I>**	❑ Flashing when measured current overcomes the set level I>. ❑ Illuminated on trip after expiry of the set trip time delay tI>.
b)	Red LED	**I>>**	❑ same as above related to I>> and tI>>.
c)	Red LED	**O>**	❑ same as above related to O> and tO>.
d)	Red LED	**O>>**	❑ same, as above related to O>> and tO>>.
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 signals 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 any of the DM30's functions.
For some function both instantaneous and time delayed elements are provided.
One relay eventually controlled by the instantaneous element of one function picks up or drops out as soon as the measured input value gets respectively into the operation or the reset zone.
When the time of the delayed element of the same function has expired, another output relay is supposed to trip the circuit breaker.
If after that time the input value still remains into the operation zone (Breaker Failure to open), the relay controlled by the instantaneous element is anyhow forced to reset after a programmable wait-time [tB0], thus eliminating any interlock of the backup protection.
The reset after tripping of the relays associated to the time delayed element can be programmed as Manual or Automatic (see § 12.2 : tFRes).
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 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:

- **Bf** (terminals 1 - 2) : it blocks the operation of the 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 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 § 12.2 : 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 configurate very efficient arrangements of logic fault discrimination as well as to feature a safe and quick breaker back-up protection.

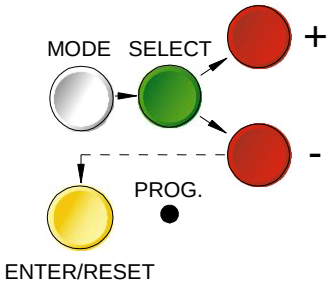
8. TEST

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 $\leq$ 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
I/Inxxx**%**	Highest among the 3 phase currents displayed as % of the rated current of 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.
Uoxxx.x**V**	True R.M.S. value of the zero sequence voltage at PT's secondary.
φoxxxxx°	Zero sequence current displacement degrees
φaxxxxx°	Phase A displacement degrees
φbxxxxx°	Phase B displacement degrees
φcxxxxx°	Phase C displacement degrees

10.2 - MAX VAL

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
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, zero sequence current
Uoxxxxx**V**	As above, zero sequence voltage
SAxx.x**In**	Max demand for phase A current during the first 100ms, displayed as p.u. of Cts rated current (0 - 99,9)
SBxx.x**In**	As above, phase B.
SCxx.x**In**	As above, phase C.
Soxx.x**On**	As above, zero sequence current.
SUoxxx**V**	As above, zero sequence voltage.

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
Causexxx	Display of the function which caused the last tripping: **I>; I>>; O>; O>>.**
IAxxx**In**	Current of phase A.
IBxxx**In**	Current of phase B.
ICxxx**In**	Current of phase C.
Ioxxx**On**	Earth fault current.
Uoxxx.x**V**	Zero sequence voltage
φoxxxxx**°**	Zero sequence displacement degrees
φaxxxxx**°**	Phase A displacement degrees
φbxxxxx**°**	Phase B displacement degrees
φcxxxxx**°**	Phase C displacement degrees

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
I> xxxx	Low set (F67) time delayed overcurrent
I>>xxxx	As above, high set (F67) time delayed overcurrent
Io>xxxx	As above, low set (F67N) time delayed earth fault
Io>>xxxx	As above, high set (F67N) time delayed earth fault

11. READING OF PROGRAMMED SETTINGS AND RELAY'S CONFIGURATION

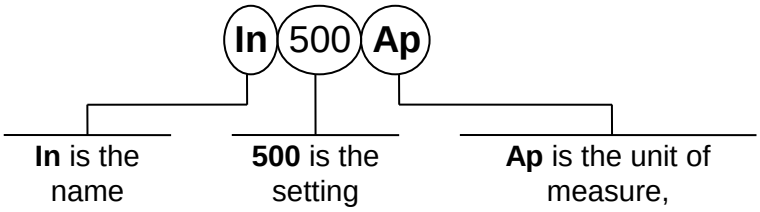
Enter the mode "SET DISP", select the menu "SETTINGS" or "F→RELAY", scroll information available in the menu by keys "+" or "-".

- 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 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 "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



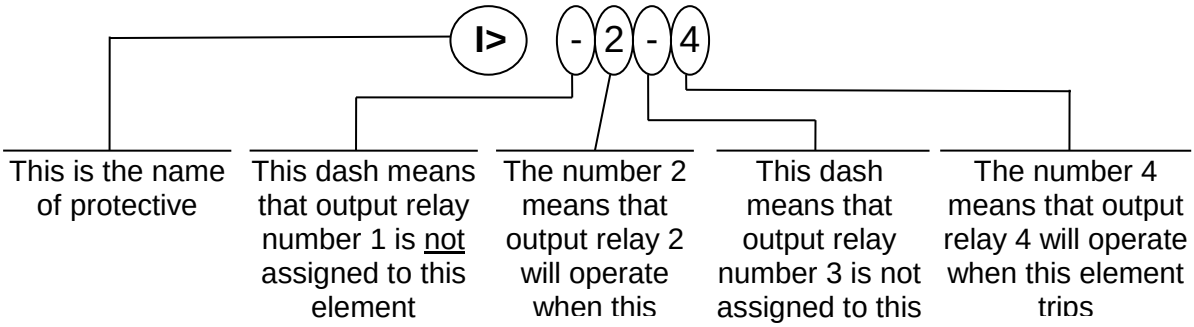
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display	Description	Setting Range	Step	Unit
Fn 50 **Hz**	Mains frequency	50 - 60	10	Hz
In 500**Ap**	Rated primary current of the phase C.Ts.	1 - 9999	1	Ap
On 500**Ap**	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°	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	-	-

Display	Description	Setting Range	Step	Unit
I> 1.0**In**	Trip level of low-set overcurrent element (p.u. of the rated current of the phase C.Ts.):	0.5 - 4 - Dis	0.01	In
tI> 2.0**s**	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
I>> 2**In**	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>> 0.1**s**	Trip time delay of the high-set overcurrent element	0.05 - 3	0.01	s
Uo> 25**V**	Minimum level of the zero-sequence polarizing input voltage for enabling operation of the earth fault element	2 - 25	1	V
Fαo= Dir	Operation mode of the Earth Fault elements (see § 2.2.2)	Dis.–Sup.–Dir.	-	-
αo= 90°	Reference direction of earth fault elements	0°- 359°	1	°
F(O>) D	Operation characteristic of the low-set earth fault element (F67): (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	-	-
O> 0.1**On**	Trip level of low-set earth fault element (F67N) in p.u. of the rated current of the earth fault detection C.T.	0.02-0.4-Dis	0.01	On
tO> 1.0**s**	Trip time delay of low-set earth fault 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>>0.1**On**	Trip level of high-set earth fault element in p.u. of the rated current of the C.Ts. for unbalance detection:	0.02 - 1 - Dis	0.01	On
tO>> 0.1**s**	Trip time delay of the high-set earth fault element:	0.05 - 3	0.01	s
tBO 0.1**s**	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 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 (F67) operates relays R1,R2,R3,R4.
tI> 1---	As above, time delayed element.
I>> --3-	Instantaneous element of high-set overcurrent (F67) operates relay R1,R2,R3,R4.
tI>> 1---	As above, time delayed element.
O> ---4	Instantaneous element of low-set earth fault element (F67N) operates relay R1,R2,R3,R4.
tO> -2--	As above, time delayed element.
O>> ---4	Instantaneous element of high-set earth fault element (F67N) 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 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 for blocking the operation of the time delayed elements relevant to earth fault (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 = 2tB0)
tBo 2tB0	As above for the earth fault functions.

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 (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.

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. ELECTRICAL CHARACTERISTICS

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		
❑ Climatic tests	IEC 68-2-1 - 68-2-2 - 68-2-33			

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

❑ Electromagnetic emission	EN55022	IND. ENV.		
❑ 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 4	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			

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 continuos
❑ Burden on current inputs	Phase : 0.01VA at In = 1A ; 0.2VA at In = 5A 0.02VA at On = 1A ; 0.4VA at On = 5A
❑ Rated Voltage	Un = 100V (different on request)
❑ Voltage overload	2 Un continuous
❑ Burden on voltage input	0,2 VA at Un
❑ 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.)
❑ Operation ambient temperature	-10°C / +55°C
❑ Storage temperature	-25°C / +70°C
❑ Humidity	IEC68-2-3 RH 93% Without Condensing at 40°C

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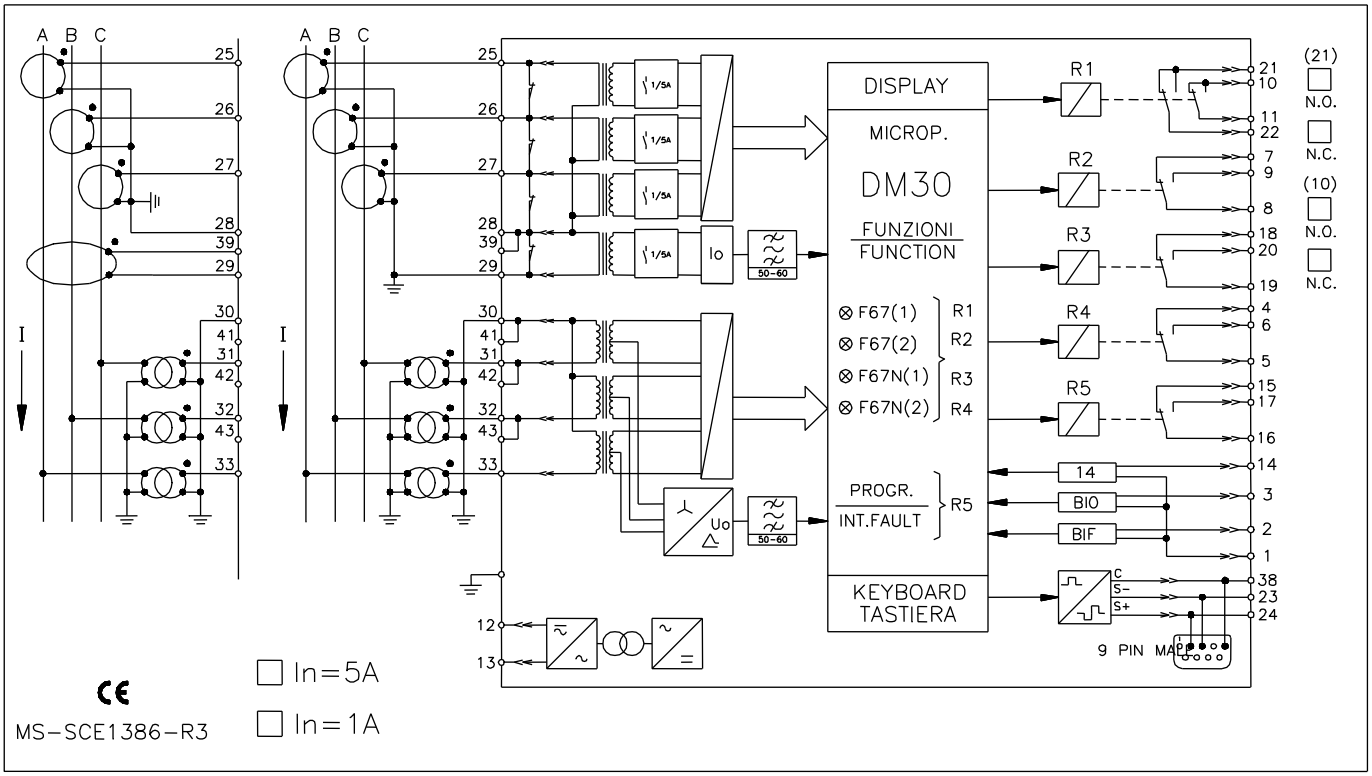
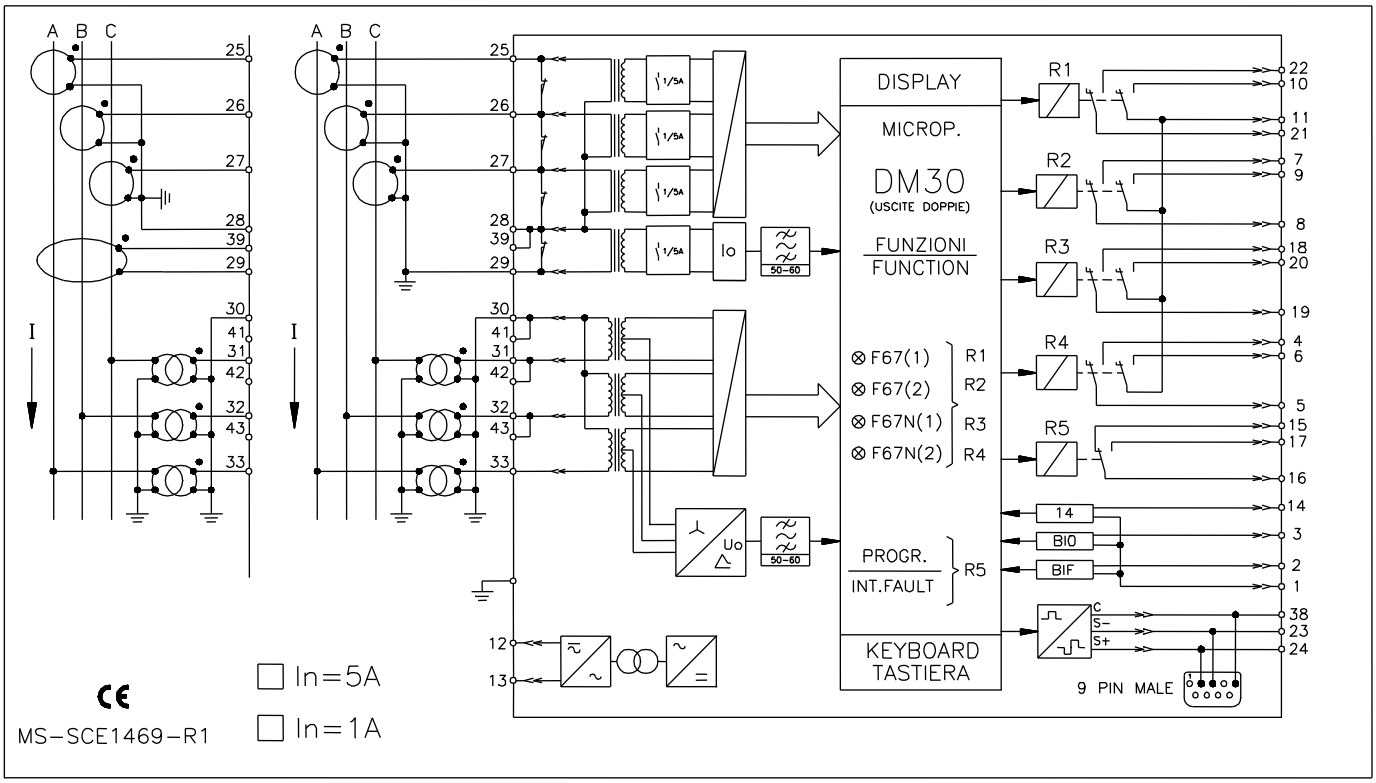
Tel. (##39) 02 575731 - Fax (##39) 02 57510940
http://www.microelettrica.com **e-mail :** ute@microelettrica.com

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

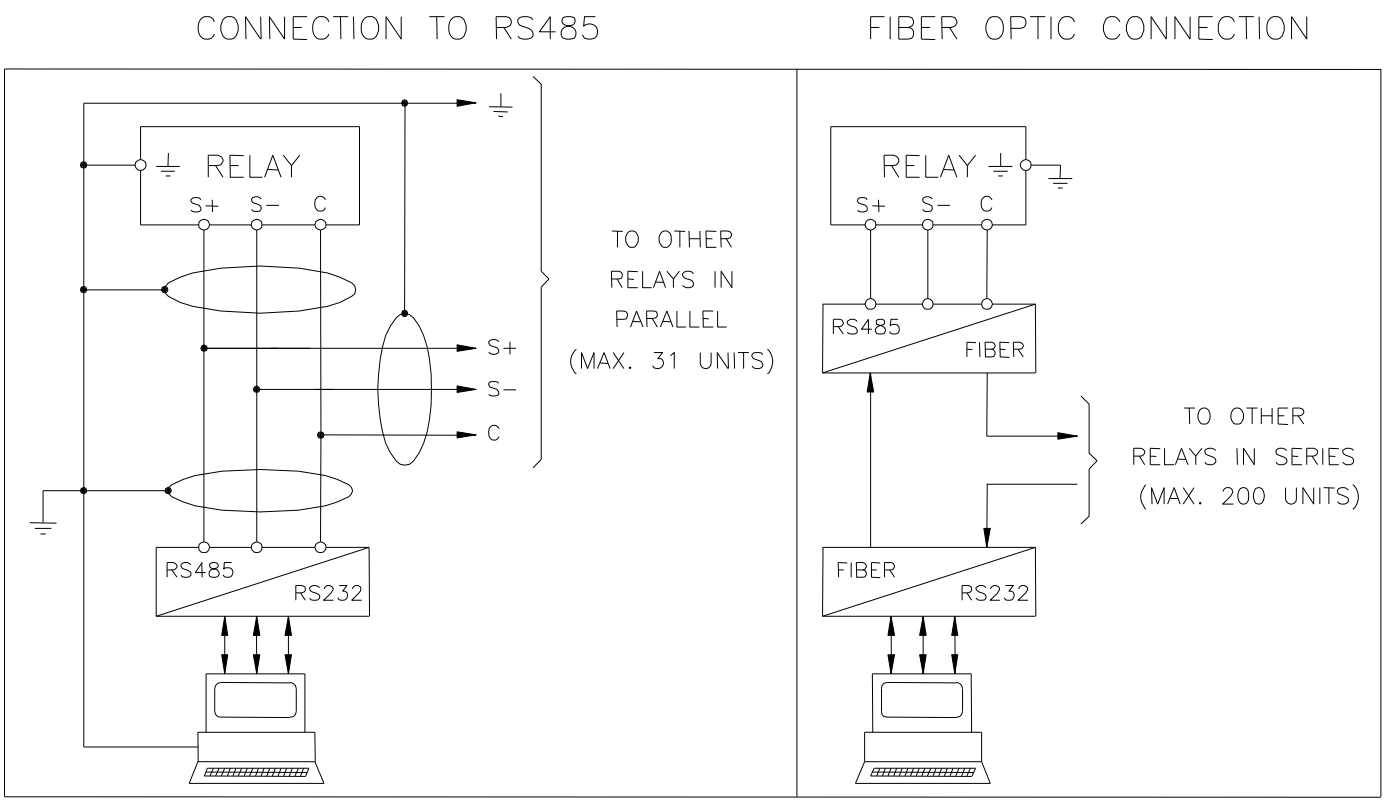
16. CONNECTION DIAGRAM (SCE1386 Rev.3 Standard Output)



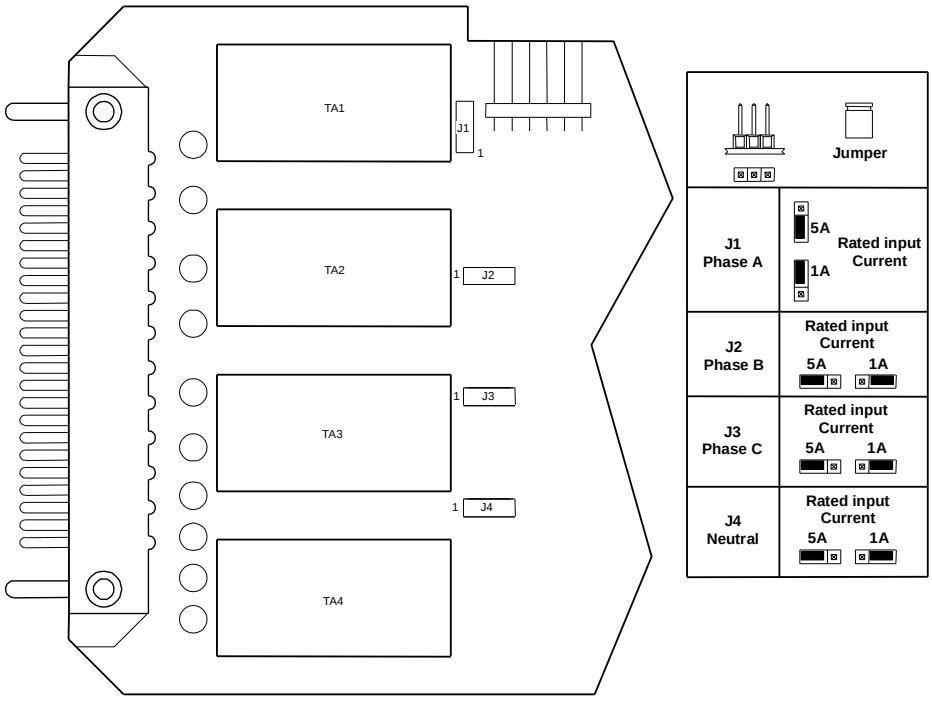
16.1 - CONNECTION DIAGRAM (SCE1469 Rev.1 Double Output)



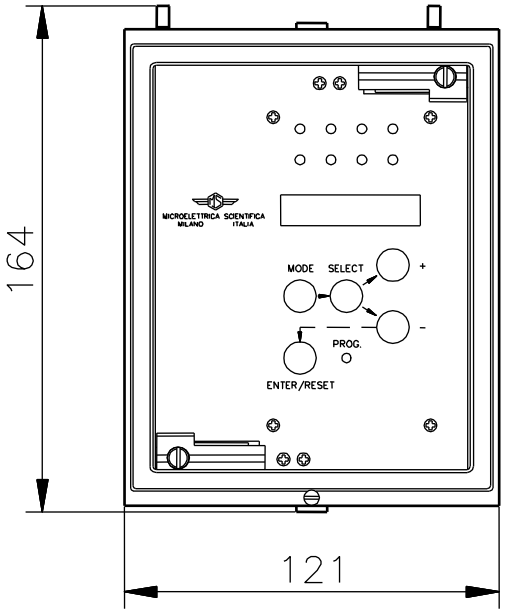
17. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)



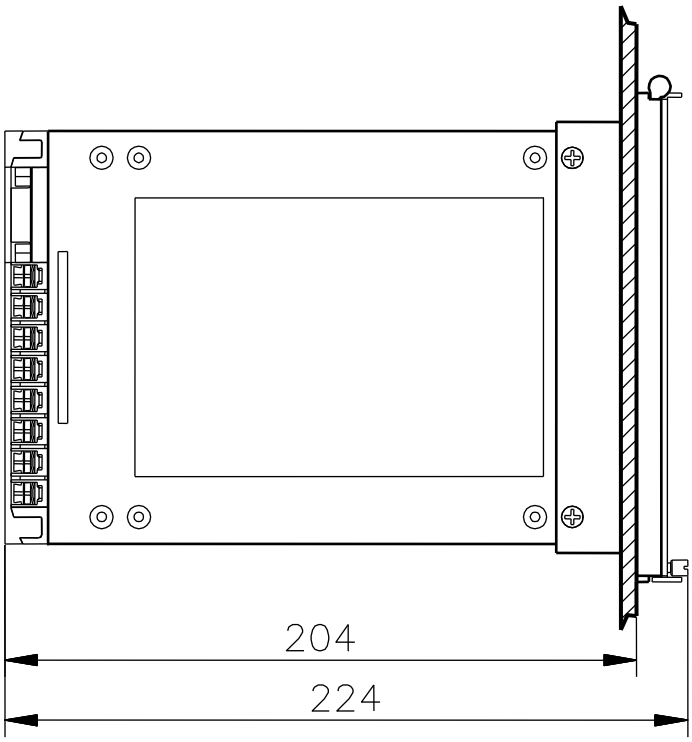
18. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A

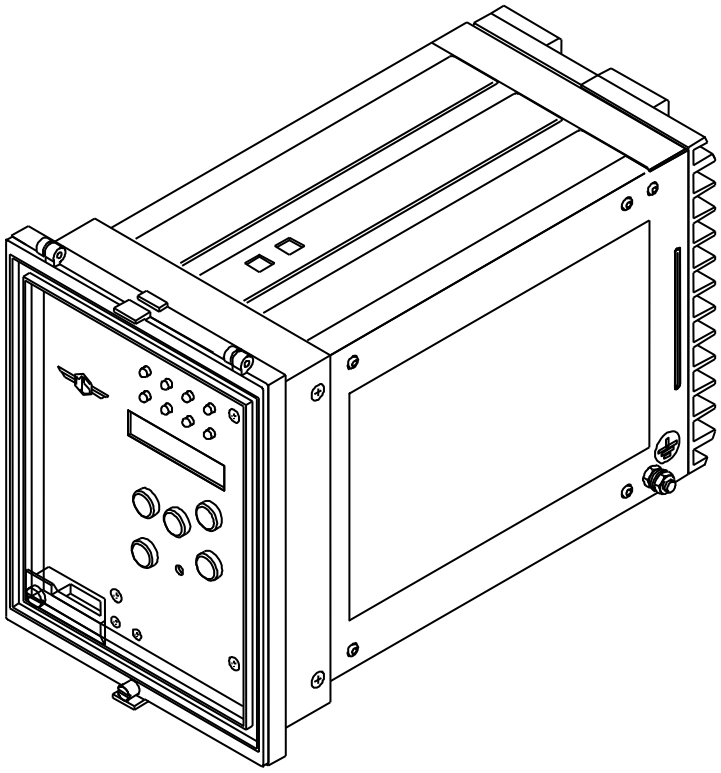


19. OVERALL DIMENSIONS / MOUNTING

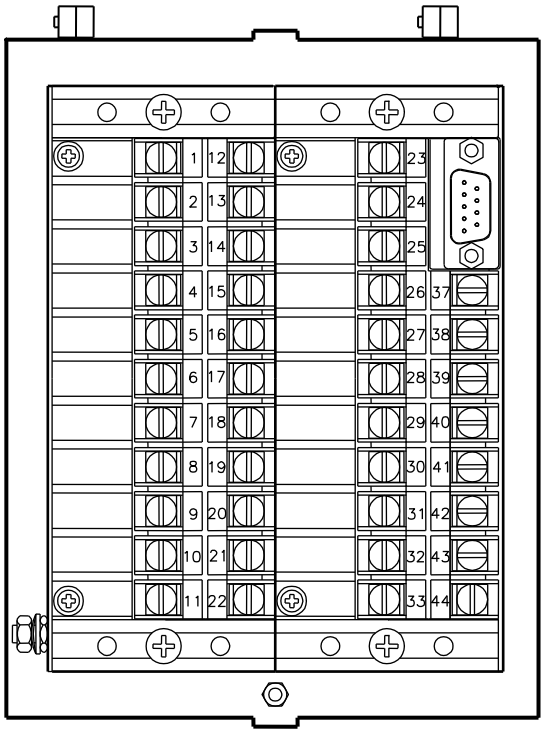


PANEL CUT-OUT 113x142 (LxH)

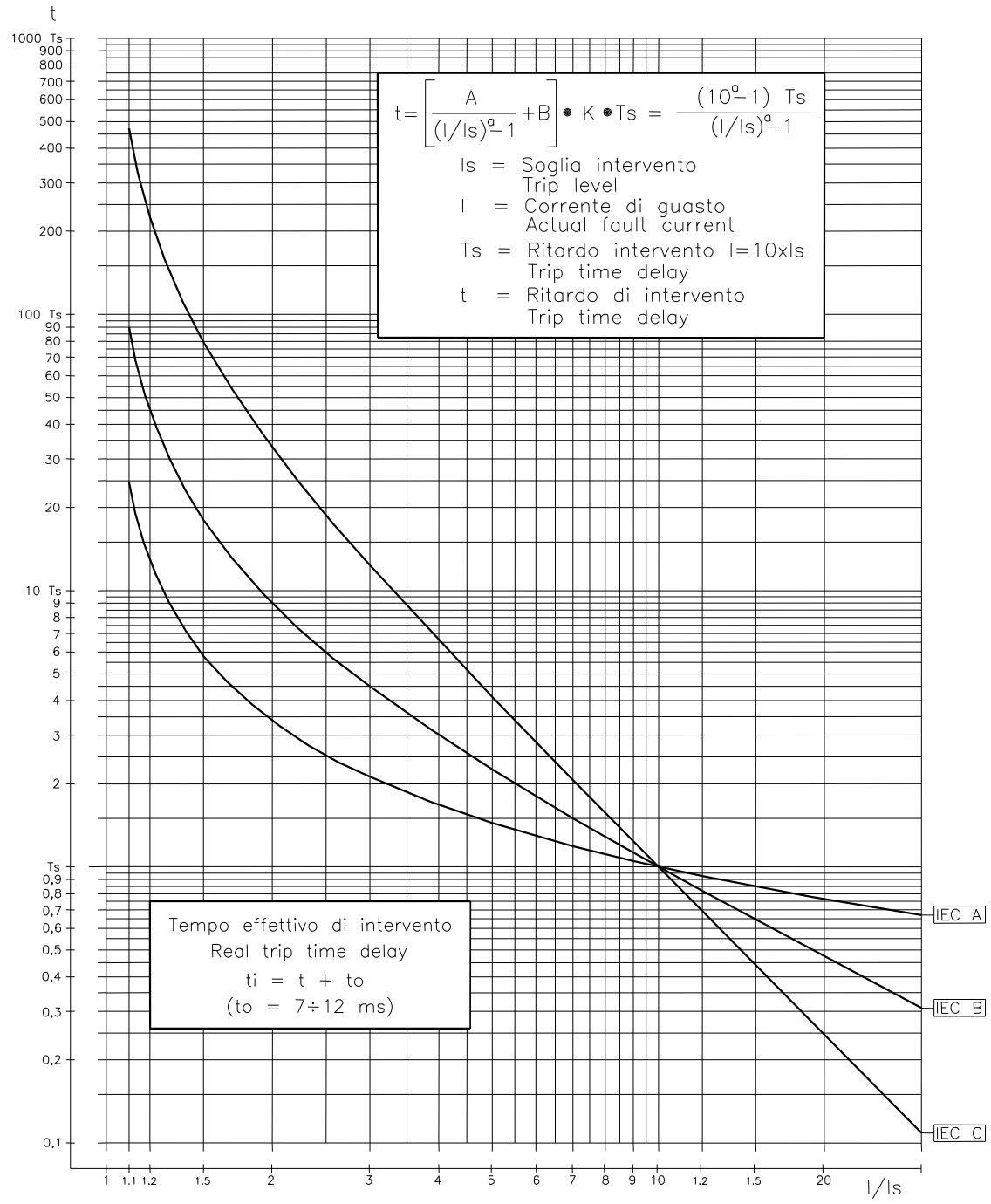




View of Rear Terminal Connection



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



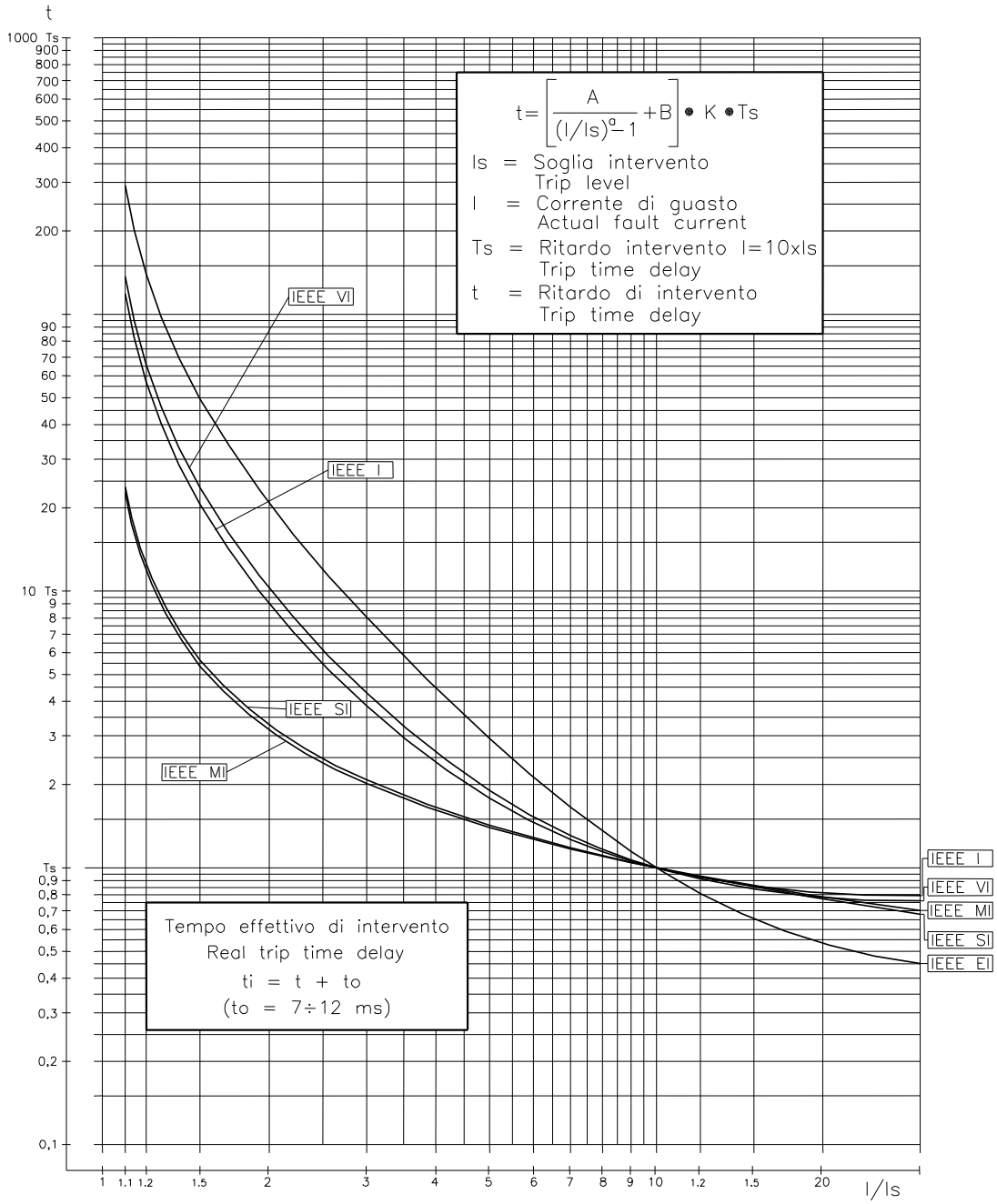
Curve Type	A	B	K	a
IEC A	0.14	0	0.336632	0.02
IEC B	13.5	0	0.666667	1
IEC C	80	0	1.2375	2

F51 { Is = I> = (0.5−4)In
Ts = tI> = (0.05−30)s

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

For F51 saturation at I> 50 In
For F51N saturation at Io> 4 On

21. 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

F51 { Is = I> = (0.5−4)In
Ts = tI> = (0.05−30)s

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

For F51 saturation at I> 50 In
For F51N saturation at Io> 4 On

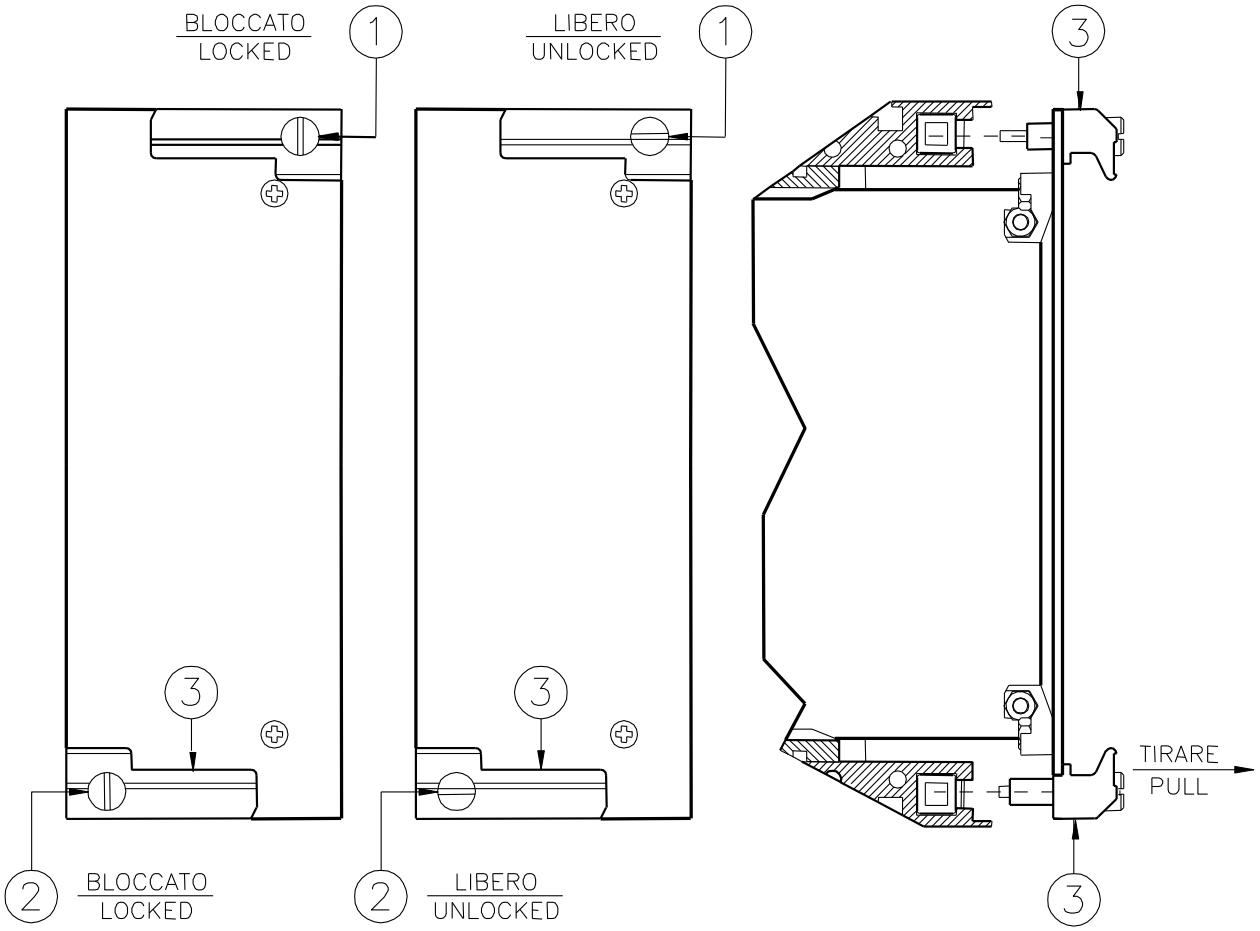
22. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

22.1 - Draw-out

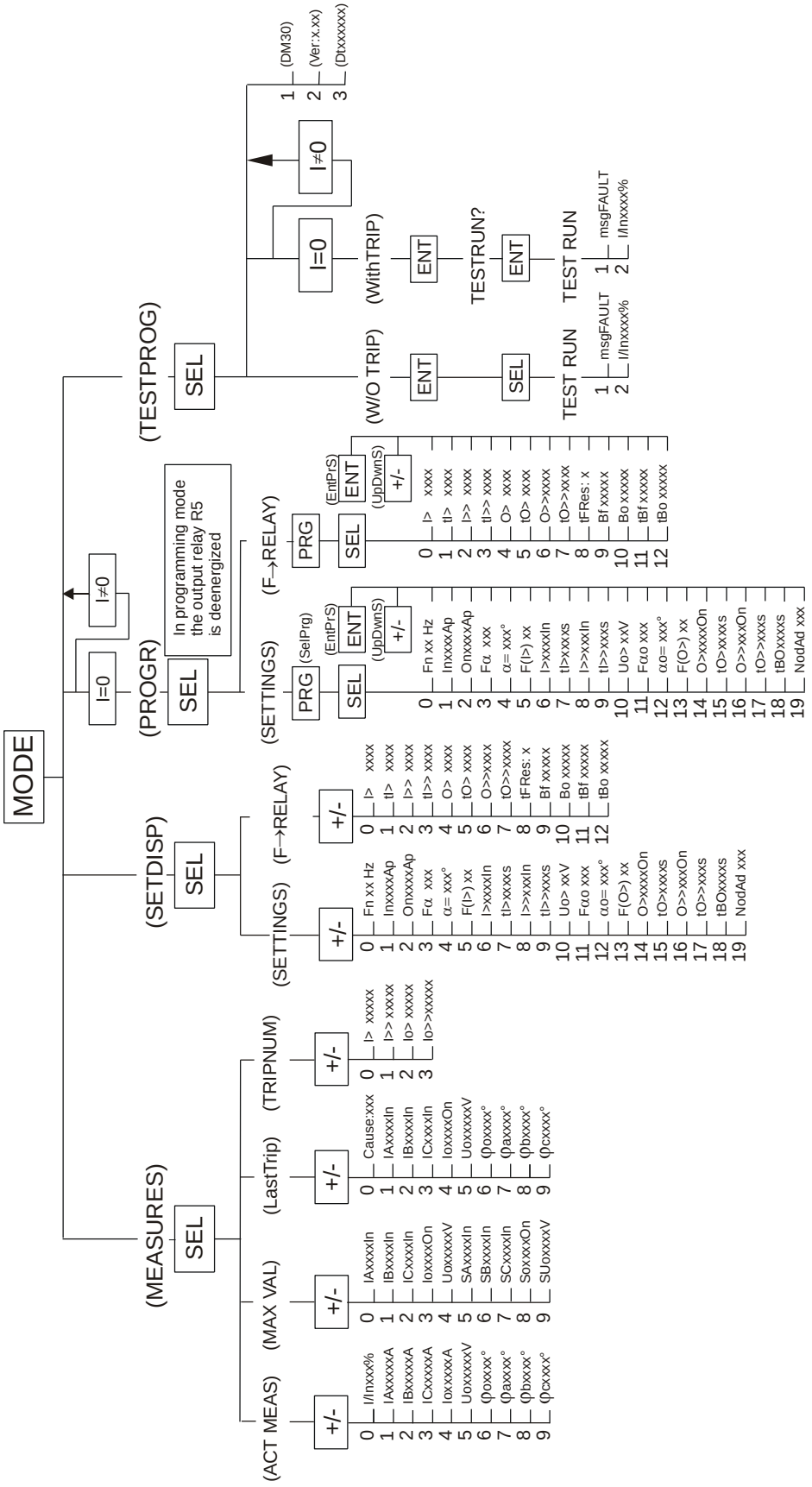
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

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. KEYBOARD OPERATIONAL DIAGRAM



24. SETTINGS' FORM – Commissioning Test Record

Relay Type	**DM30**	**Station :**	**Circuit :**
Date :	**/ /**		**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 Current :** **Rated Voltage :**	☐ **1A** ☐ **5A**

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	**°**	90			
F(I>)	Operation characteristic of the low-set overcurrent element	D-A-B-C-MI SI-VI-I-EI	**-**	D			
I>	Trip level of low-set overcurrent element	0.5 - 4 - Dis	**In**	1.0			
tI>	Trip time delay of the low-set overcurrent element	0.05 – 30	**s**	2.0			
I>>	Trip level of high-set overcurrent element	0.5 - 40 - Dis	**In**	2			
tI>>	Trip time delay of the high-set overcurrent element	0.05 - 3	**s**	0.1			
Uo>	Minimum level of the zero-sequence polarizing input	2 – 25	**V**	25			
Fαo=	Operation mode of the Earth Fault elements	Dis–Sup–Dir	**-**	Dir			
αo=	Reference direction of earth fault elements	0- 359	**°**	90			
F(O>)	Operation characteristic of the low-set earth fault element	D-A-B-C-MI SI-VI-I-EI	**-**	D			
O>	Trip level of low-set earth fault element (F67N)	0.02-0.4-Dis	**On**	0.1			
tO>	Trip time delay of low-set earth fault element	0.05 - 30	**s**	1.0			
O>>	Trip level of high-set earth fault element	0.02 - 1 - Dis	**On**	0.1			
tO>>	Trip time delay of the high-set earth fault element:	0.05 - 3	**s**	0.1			
tBO	Max reset time delay of the instantaneous elements	0.05 – 0.25	**s**	0.1			
NodAd	Identification number for the connection on serial communication bus	1 - 250	**-**	1			

CONFIGURATION OF OUTPUT RELAYS

Default Setting						Actual Setting					
Protect. Element	**Output Relays**				**Description**	**Protect. Element**	**Output Relays**				
I>	-	-	3	-	Low-set phase overcurrent pick-up	**I>**					
tI>	1	-	-	-	Time delayed low-set phase overcurrent	**tI>**					
I>>	-	-	3	-	High-set phase overcurrent pick-up	**I>>**					
tI>>	1	-	-	-	Time delayed high-set phase overcurrent	**tI>>**					
O>	-	-	-	4	Low-set ground overcurrent pick-up	**O>**					
tO>	-	2	-	-	Time delayed low-set ground overcurrent	**tO>**					
O>>	-	-	-	4	High-set ground overcurrent pick-up	**O>>**					
tO>>	-	2	-	-	Time delayed high-set ground overcurrent	**tO>>**					
tFRes:	A				Relay reset mode A = Automatic, M = Manual	**tFRes:**					
Bf	I>>I>				The input for blocking	**Bf**					
Bo	O>>O>				The input for blocking	**Bo**					
tBf	2tB0				The blocking of the phase fault elements	**tBf**					
tBo	2tB0				The blocking of the earth fault elements	**tBo**					

Commissioning Engineer : _____ **Date :** _____

Customer Witness : _____ **Date :** _____