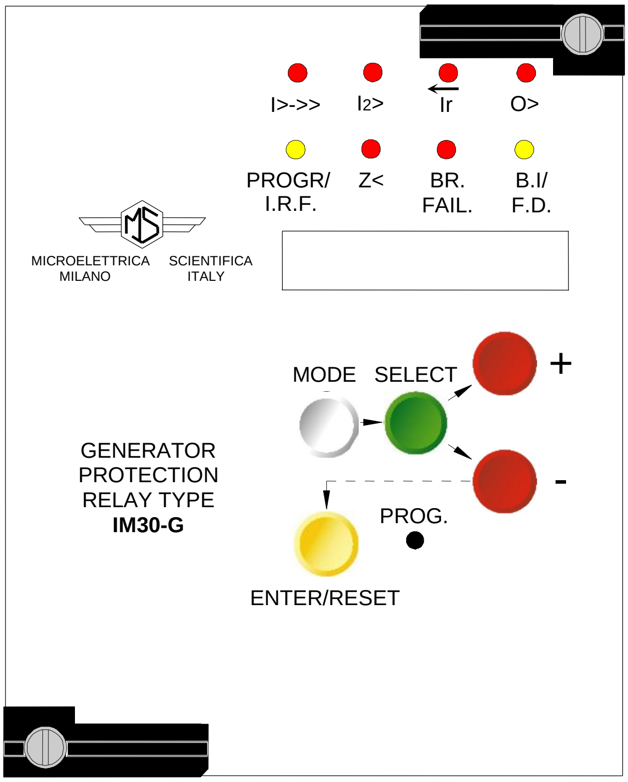
MULTIFUNCTION MICROPROCESSOR PROTECTION RELAY

TYPE IM30-GLF

OPERATION MANUAL



CE

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 effectiveness.

1.7 - Setting and Calibration

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

1.8 - Safety Protection

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

1.9 - Handling

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

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

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

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

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

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

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

1.10 - Maintenance

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

1.11 - Fault Detection And Repair

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

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

2. GENERAL

Input currents are supplied to 4 current transformers: - three measuring phase current - one measuring the earth fault zero-sequence current. Phase current input can be 1 or 5A
For zero-sequence current, taps for 1A and 5A input are provided on relay's terminal board.
Input phase to phase voltage is supplied to one voltage transformer with rated input programmable 100-125V.
The Time/current Curves, the algorithms and the ratings are herebelow reported.
This relay is derived from the version IM30-G with the addition of the possibility to work with input frequency in the range from 5 to 70 Hz taking into account the following limitation:
During the transient operation with frequency "f" different from the nominal one "fn" the functions programmed with dependent inverse time delay will compute a trip time "tf" different than that "t" corresponding to the operation at the nominal frequency : $t_f = t\frac{fn}{f}$

Example : the trip time delay at 10Hz will be five times that corresponding to 50Hz $t_{10} = t\frac{50}{10} = 5t$
There fore for low-frequency operation the function I> has to be programmed in the independent definite time mode F(I>)=D (see § 12).
On the contrary the current unbalance element F46 operates properly even at low-frequency because the heating of the rotor produced by the negative sequence component is by itself inversely proportional to the frequency.

- The Stator Earth Fault element F64S does not work when the frequency differs from the nominal value by more than ±10% due to the action of its pass-band filter.
- The functions F40 (underimpedance = loss of excitation) and F32 (Reverse Power) are automatically disactivated when frequency is less than 25Hz.
- The trip level of the overcurrent element of this version has a different setting range : I>=(0.2-2.5)Ib. At the end of the generator/motor start-up period, this element is normally disactivated via the digital input 2 (terminals 1-2 shorted) by programming “ 2=I1..... (see § 12 : Output relay’s programming).
- If has to be taken into account than that the relay computes the RMS values of the input quantities on each half-cycle whereas the frequency is detected on each full cycle. It is then clear that the computing time of the RMS values is inversely proportional to the frequency. Any trip time delay is started as soon as at least one RMS value above the set level has been detected. As already remarked the dependent time delay are affected by the frequency whereas the independent time delays are not.

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 auxiliary power is supplied by a built-in interchangeable module fully isolated an self protected.
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 - Measuring input

The relay computes the RMS value of current and voltage and the relevant phase displacement.

2.2.1 – Phase and ground

Phase and ground currents are supplied to four current transformers with 5A rated primary.
By movable jumpers on the relay card, the secondary can be switched-on to two different taps to obtain a relay rated input current In = 5 or 1 Amp (different values can be provided on request).
The measuring dynamics of the C.Ts. runs from 0.001 through 50 times In.
For the phase current the measuring range of the A/D Converters runs from 0 to 13In automatically switched to two channels one measuring from 0 to 1.3In and the second from 0.1 to 13In. The theoretical accuracy of the measurement is 0.12%In from 0 to 1.3In and 1.3%In from through 13In.

- $\varepsilon_1 = \pm 0.02$ M ± 0.002 In from 0 to 1.2 In
- $\varepsilon_2 = \pm 0.02$ M ± 0.02 In from 1.2 to 12 In

For ground current the measuring range of the A/D converter runs from 0 to 2On
The actual absolute error on each measurement M can be:

- $\varepsilon_0 = \pm 0.02$ M ± 0.004 On

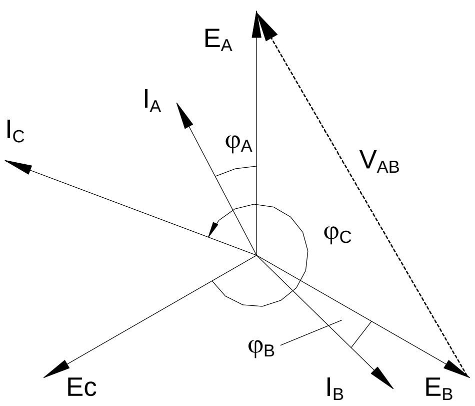
2.2.2 – Phase-to-Phase voltage

Phase-to-phase voltage U_{AB} is supplied to one Potential transformers rated 220V.
Relay's rated phase-to-phase input voltage (Uns) can be adjusted from 100 through 125V.
The ADC converter measuring range runs up to 2 x Uns.
The theoretical accuracy is 0.2%Uns.
The actual absolute error can be :

- $\varepsilon_v = \pm 0.02$ M ± 0.003 Uns

2.2.3 - Phase displacement

The relay detects the displacement between the input voltage of phase C and each phase current IA, IB, IC. The displacement angle are therefore :



$\varphi_A = (I_A \Lambda U_{AB})+30°$; $\varphi_B = (I_B \Lambda U_{AB})+150°$; $\varphi_C = (I_C \Lambda U_{AB})-90°$;

This means that the voltage system is considered to be balanced as it is normally, where as the currents can be however unbalanced. (see figure)
Angles are measured anticlockwise from 0° to 360° with accuracy ±2°.
Displacement is not measured if current or voltage are null.

2.3 - Algorithms of the different functions

2.3.1 - Setting range of the reference input quantities

- System frequency : **Fn** = (50-60)Hz
- Rated primary current of phase C.Ts. : **In** = (0-9999)A, step 1A
- Rated primary current of ground C:T. : **On** = (0-9999)A, step 1A
- Rated secondary phase-to-phase voltage of P.Ts. : **Uns** = (100-125)V, step 1V
- Relay basic current (Generator's rated current) : **Ib** = (0.5-1.1)In, step 0.1In

2.3.2 - F50/51 - Dual level 3-phase overcurrent

F1 - 50/51 : Low set overcurrent

- Pick-up (operation) level : **I>** = (1-2.5)Ib, step 0.01Ib
  Setting **I>** = Dis blocks function's operation
- Drop-out ratio : ≥0.95
- Minimum operation time of instantaneous output : 30ms
- Trip time delay in the definite time operation mode **F(I>) = D** : t = **tI>** = (0.05-30)s, step 0.01s
- Trip time delay in the inverse time operation mode **F(I>) = SI**
  $t = \frac{0.033 \cdot tI>}{(I/I>)^{0.02} - 1}$ (tI> = trip time delay at I/I> = 5)
  (see curves TU0311 Attachment. B)

F2 50/51 : High set overcurrent

- Pick-up (operation) level : **I>>** = (1-12)Ib, step 0.1Ib
  Setting **I>>** = Dis blocks function's operation
- Drop-out ratio : ≥0.95
- Minimum operation time of the instantaneous element : 30ms
- Independent trip time delay : t = **tI>>** = (0.05-3)s, step 0.01s

2.3.3 - F50/51G - Stator Ground Fault

- Pick-up (operation) level : **O>** = (0.02-0.4)On, step 0.01On
  Setting **O>** = Dis. blocks function's operation
- Drop-out ratio : ≥0.95
- Minimum operation time of the instantaneous element : 30ms
- Independent trips time delay : t = **tO>** = (0.05-30)s, step 0.01s

2.3.4 - F46 - Current unbalance : Measurement of RMS Negative Sequence Current I_2

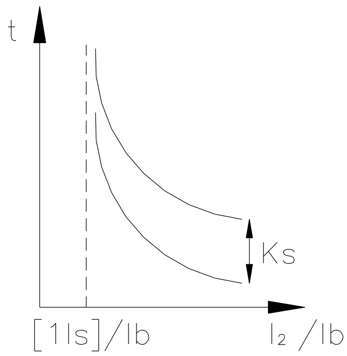
F1 46 : $I_2^2 \ t = K$ (adiabatic heating)

- Generator's continuous I_2 rating : **1Is** = (0.05-0.5)Ib, step 0.01Ib
  Setting **1Is** = Dis blocks function's operation
- Time multiplier : **Ks** = (5-80)s, step 1s
  Trip time when $I_2 = I_b$
- Trip time delay $t_h = \frac{Ks}{(I_2/I_b)^2}$
  Heat accumulation only operates if $I_2 \geq [1Is]$
- Cooling time from trip level to the status corresponding to the operation at $I_2=[1Is]$: **tc** = (10-1800)s, step 1s

Cooling time $t_l = \frac{[tc]}{Ks}\left(\frac{I_2}{I_b}\right)^2 \cdot t$: t_l = [tc] when $\left(\frac{I_2}{I_b}\right)^2 \cdot t = Ks$

Cooling only takes places if $\frac{I_2}{I_b} < 1Is$

(see curves TU0312 Attachment. B)



F2 46 : Alarm

- Alarm level : **2Is** = (0.03-1)Ib, step 0.01Ib
  Setting **2Is** = Dis blocks function's operation
- Independent trip time delay : **t2Is** = (1-100)s, step 1s

2.3.5 - F32 - Reverse active power

- Active current setting range : **Ir>** = (0.02-0.2)In, step 0.01In
  Setting **Ir>** = Dis blocks function's operation
- Operation level : = Ic cos (φc-180°) ≥ [Ir]
- Independent trip time delay : **tIr>** = (0.1-60)s, step 0.1s
- Operation zone : (-90°+180°)<φc<(90°+180°)

2.3.6 - F21/40 - Directional Underimpedance / Loss of excitation

- The relay computes the impedance

$$Z\alpha = \frac{E}{I\cos(\varphi - \alpha°)}$$

- Characteristics angle of the impedance α = (0°-330°), step 30°

Setting of impedance angle	Max sensitivity current angle	Current components
α = 0° R	φ = 0° (360°)	Forward Resistive
α = 330° R+C	φ = +30°	Forward Resistive + Forward Capacitive
α = 300° R+C	φ = +60°	Forward Resistive + Forward Capacitive
α = 270° C	φ = +90°	Forward Capacitive (Loss of Field)
α = 240° C-R	φ = +120°	Forward Capacitive + Reverse Resistive
α = 210° C-R	φ = +150°	Forward Capacitive + Reverse Resistive
α = 180° -R	φ = +180°	Reverse Resistive
α = 150° R-R	φ = +210° (-150°)	Forward Inductive + Reverse Resistive
α = 120° L-R	φ = +240° (-120°)	Forward Inductive + Reverse Resistive
α = 90° L	φ = +270° (-90°)	Forward Inductive
α = 60° L+R	φ = +300° (-60°)	Forward Inductive + Forward Resistive
α = 30° L+R	φ = +330° (-30°)	Forward Inductive + Forward Resistive

The direction α is that of the axle where the center of the circle is located.

N.B. By definition the relation between current displacement φ and impedance displacement α is :
α = 360°- φ
Angles are counted anticlockwise from 0° (real axis = direction of phase-to-neutral voltage E) through 360°.
For example : the displacement of a totally capacitive current is φ = 90°; the angle of a totally capacitive impedance is α = 270°. (see figure)

- Operation zone is that included in the circle having (see figure) :
- Center on the axle displaced by α at distance $K2 + \frac{K1}{2}$ from the origin Diameter = K1
- Circle offset : **K2** = (5-50)%Zb, step 1%
- Circle diameter : **K1** = (50-300)%Zb, step 1%
  Setting **K1** = Dis blocks the function's operation
- $Zb = \frac{Uns}{\sqrt{3}\,Ib}$

- Independent trip time delay : **tz** = (0.2-60)s, step 0.1s
- Integration time : **ti** = (0-10)s, step 0.1s
  In case of impedance oscillation reset of the timer tz only takes place if Z remains outside the trip area for at least [ti].
- Undervoltage inhibition level : $Ex<0.3\frac{Uns}{\sqrt{3}}$
- Undercurrent inhibition level : Ix<0.2Ib
- Testing :

For testing the Field loss protection operate as follows :

- Impedance characteristic angle set to α_Z = 270° capacitive
  (this corresponds to current leading voltage by 90°).
- Circle off-set to any value (recommended value for testing K2 = 50%)
- Circle diameter to any value (recommended value for testing K1 = 200%)
- Time delay **tz** to any value (recommended value for testing tz = 0.2s)

<u>Using a single phase apparatus</u>

- Voltage input at rated value to terminals 32-33
- Current input to phase A terminals 25-26
- Phase displacement of input current on input voltage φ = 90° (current leading voltage)

  See attached table.

  The trip area is that inside the circle $Z_n = \frac{U_{ns}}{\sqrt{3}\, I_b}$ we can individuate the two intersection point between circle and the impedance axle when the impedance values are :

  ZA = K2%Zb; ZB = (K1+K2)%Zb

  If input = Uns the currents corresponding to ZA and ZB are :

$$I_A = \frac{\sqrt{3}\, Ib\, 100}{K_2} \quad ; \qquad I_B = \frac{\sqrt{3}\, Ib\, 100}{K_1 + K_2}$$

with Ib = 2A, K1 = 200%, K2 = 50% $\Rightarrow$ currents are

$IA = (2 \cdot \sqrt{3} \cdot 2) = 6{,}93A$; $IB = (0{,}4 \cdot \sqrt{3} \cdot 2) = 1{,}39A$

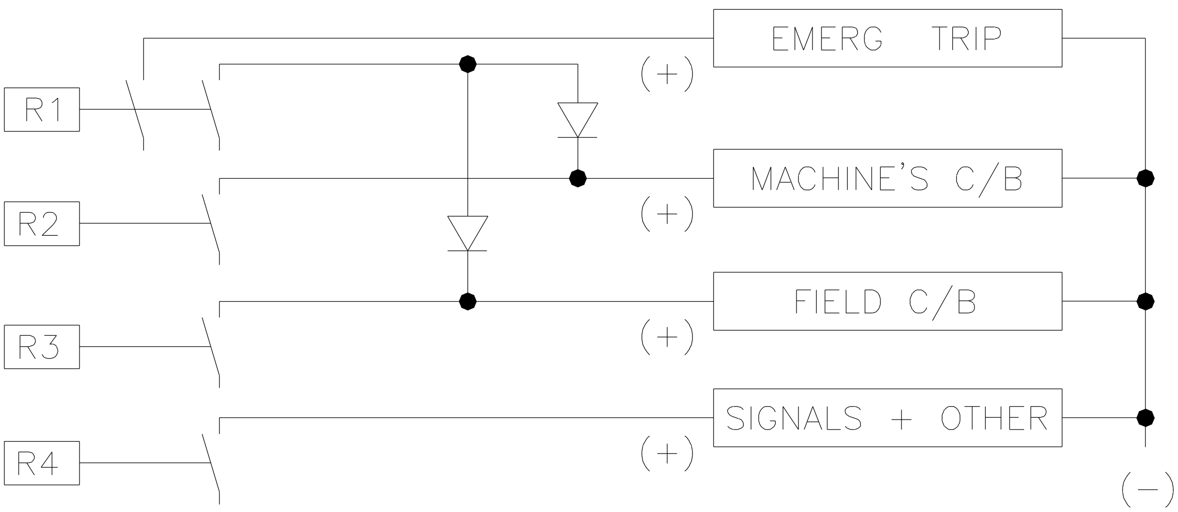
Trip must take place for : 1,39A<I<6,93A

2.4 - Configuration of the output relays (see § 5)

The different functions of the relay can be programmed to operate any of the output relays as explained in § 5.
The functions are more than the available output relays but some of then can be grouped to operate the same relay according to the protection system.
For generator protection the different functions normally operate the trippings shown in the tabel here below.

PROTEC. FUNCTION	**DEVICE OPERATED**				**OUTPUT RELAY CONTROLLED**			
	EMERG. TRIP	MACHINE C/B	FIELD C/B	SIGNALS OR OTHER	R1	R2	R3	R4
32 = Ir>		X	X			X	X	
40 = Zc<		X				X		
46-1 = 1Is		X		X		X		
46-2 = 2Is		(X)						X
50-1 = I>				(X)				(X)
50-2 = I>>				(X)				(X)
51-1 = tI>	X	X	X		X			
51-2 = tI>>	X	X	X		X			
50G = O>				(X)				
51G = tO>	(X)	X	X	(X)	(X)	X	X	(X)

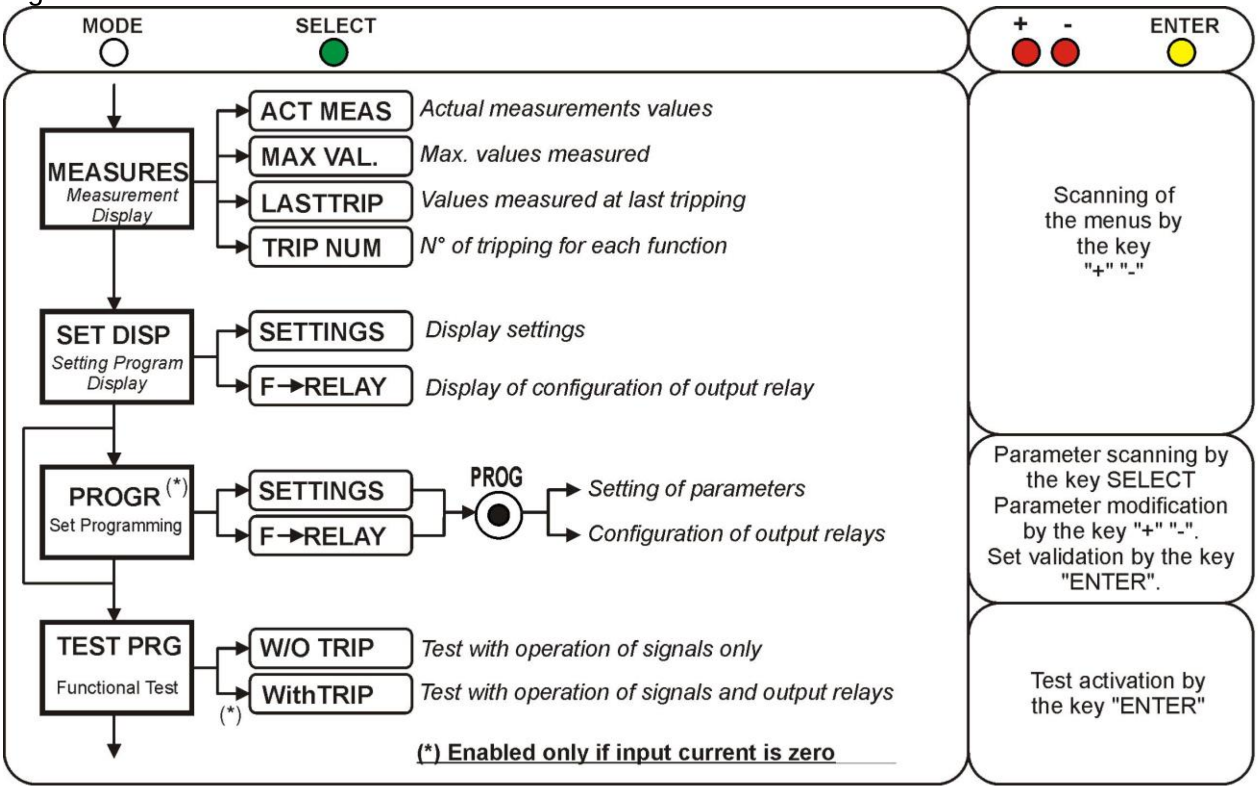
(X) = if required ; X = needed



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)

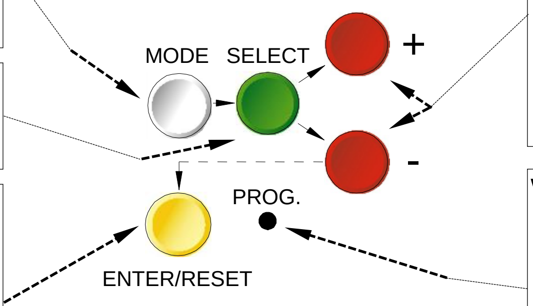
Fig. 1



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.

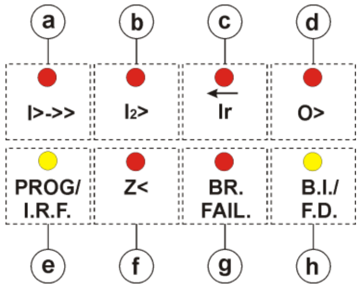


The + and - buttons are used to select the actual measurement or display desired when in Measurements Display or Settings Display modes. When in Program mode, these buttons increase or decrease the value of the displayed setting.

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>->>**	❑ Flashing when measured current overcomes the set trip level [I>],[I>>] ❑ Illuminated on trip after expiry of the set trip time delay [tI>],[tI>>].
b)	Red LED	**I_2>->>**	❑ same as above related to [1Is], [2Is].
c)	Red LED	**Ir**	❑ same as above related to [Ir>], [tIr>].
d)	Red LED	**O>**	❑ same as above related to [O>], [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	**Z<**	❑ same as above related to [Z<], [tz].
g)	Red LED	**BR. FAIL.**	❑ Lit-on when the BREAKER FAILURE function is activated.
h)	Yellow LED	**B.I./ F.D.**	❑ Lit-on when the operation of one or more of the relay functions has been disactivated in the programming ❑ Flashing when a blocking signal is present at the relevant input terminals.

The reset of the leds takes place as follows:

❑ Leds a,b,c,d,e :	❑ 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 f,g,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-GLF'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 [tBF].(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

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 are provided: they are active when the relevant terminals are shorted

❑	**2**	(terminals 1 - 2)	:	it blocks the operation of the time delayed elements relevant to phase or ground fault protection; programming allows to block the operation of the functions I>(Il) or I>>(Ih) or O>(Io).
❑	**3**	(terminals 1 - 3)	:	it blocks the operation of the time delayed elements relevant to Under Impedance or Reverse Power protection; programming allows to block the operation of the function (Z<) only or (Ir) only or both.

When a function is blocked the pick-up of its output is inhibited. For input -2- programming allows to have the inhibition either permanent as long as the blocking input is active (t_2=OFF) or automatically removed after the expiry of the set trip time delay of the function involved plus additional time 2tBF (t_2=2tBF). By proper interconnection of the blocking inputs and blocking 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:

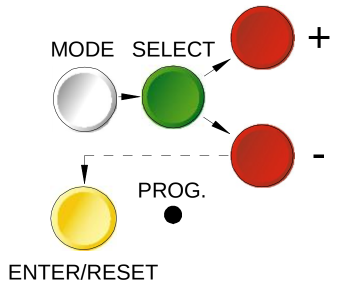
- Diagnostic and functional test, with checking of program routines and memory's content, run every time the aux. power is switched-on: the display shows the type of relay and its version number.

- Dynamic functional test run during normal operation every 15 min. (relay's operation is suspended for less than ≤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.

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
IA	xxxxx	**A**	True R.M.S. value of the current of phase A displayed as primary Amps. (0 - 99999)
IB	xxxxx	**A**	As above, phase B
IC	xxxxx	**A**	As above, phase C.
Io	xxxxx	**A**	As above, earth fault current
Us	xxxxx	**%**	R.M.S. voltage as % of rated VTs secondary
I2	xxx	**%Ib**	R.M.S. Negative sequence current as % of basic setting Ib
φ	xxxxx	**°**	Symmetric phase displacement (IΛE).

N.B:If no key is operated within 60 sec. the display is automatically switched to the default indication (IAxxxxxA)

10.2 - MAX VAL

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

Display			Description
IA	xxxx	**In**	Max. value of phase A current after the first 100ms, displayed as p.u. of C.Ts rated current
IB	xxxx	**In**	As above, phase B
IC	xxxx	**In**	As above, phase C.
Io	xxxx	**On**	As above, earth fault current
I2	xxx	**%Ib**	As above, negative sequence current
Us	xxxx	**%**	Max. val. of input voltage after the first 100ms, as % of rated input.
SA	xxxx	**In**	Max. current of phase A during the first 100ms.
SB	xxxx	**In**	As above, phase B.
SC	xxxx	**In**	As above, phase C.
So	xxxx	**On**	As above, earth fault current.
SU	xxxx	**%**	Max. input voltage during the first 100ms

10.3 - LASTTRIP

Display of the function which caused the tripping of the relay plus values of the parameters at the moment of tripping.

Display			Description
F:xxxxxx			Function which produced the last event being displayed and faulty phase in case of phase current element's trip **I>, I>>, Io>, 1Is, 2Is, Ir>, Z<.**
IA	xxxx	**In**	Current of phase A. (value recorded at the moment of tipping)
IB	xxxx	**In**	Current of phase B. (as above)
IC	xxxx	**In**	Current of phase C. (as above)
Io	xxxx	**On**	Earth fault current. (as above)
I2	xxxx	**%Ib**	Negative sequence current. (as above)
Us	xxxx	**%**	Input voltage. (as above)

10.4 - TRIP NUM

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

Display		Description
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 earth fault time delayed element [tO>].
1Is	xxxx	Trip number of Low set unbalance time delayed element.
2Is	xxxx	Trip number of High set unbalance time delayed element.
Ir>	xxxx	Trip number of Reverse Power time delayed element.
Z<	xxxx	Trip number of Under Impedance time delayed element.

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 "-".
SETTING= values of relay's operation parameters as programmed; the setting program actually active is displayed with steady light whereas the stand-by program is displayed with flashing light.
F→RELAY= output relay associated to the different functions as programmed.

12. PROGRAMMING

The relay is supplied with the standard default programming used for factory test. [Values here below reported in the " Display " column].
All parameters can be modified as needed in the mode PROG and displayed in the mode SET DISP
Local Programming by the front face key board is enabled only if no input current is detected (main switch open). Programming via the serial port is always enabled but a password is required to access the programming mode. The default password is the null string; in the standard application program for communication "MS-COM" it is also provided an emergency password which can be disclosed on request only.
As soon as programming is enabled, the Led PRG/IRF flashes and the alarm relay R5 is deenergized..
Enter MODE "PROG" and SELECT either "SETTING1" or "SETTING2" 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

In 500 **Ap**

In is the name of the variable

500 is the setting default

Ap is the unit of measure, Amps primary.

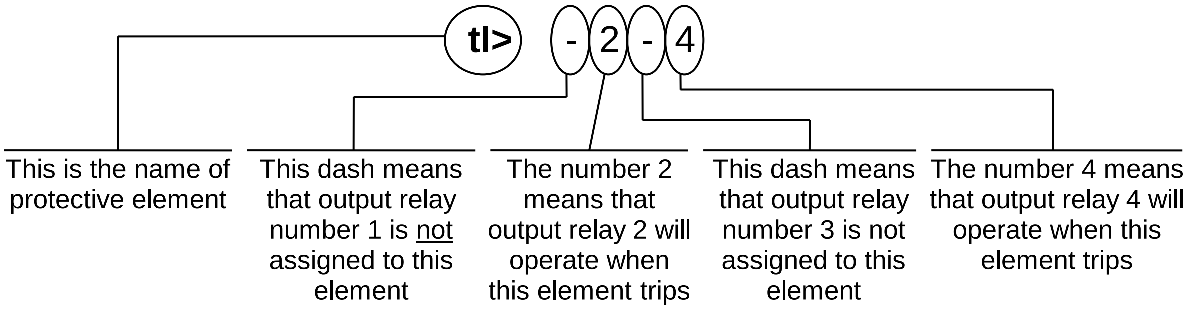
Mode PROG menu SETTINGS. (Production standard settings here under shown).

Display			Description	Setting Range	Step	Unit
NodAd	1	**-**	Identification number for connection on serial communication bus	1 - 250	1	-
Fn	50	**Hz**	Mains frequency: setting range	50 - 60		Hz
In	500	**Ap**	Rated primary current of the phase C.Ts.	1 - 9999	1	A
On	500	**Ap**	Rated primary current of the C.Ts. or of the tore C.T. supplying the zero sequence current	1 - 9999	1	A
Uns	100	**V**	Rated secondary voltage of V.Ts (phase to phase)	100 - 125	1	V
Ib	0.5	**In**	Generator's rated current as p.u. of C.Ts rated current	0.5 - 1.1	0.1	In
F(I>)	D		Operation characteristic of the low-set overcurrent element (D) = Independent definite time. (SI) = Dependent normal inverse time.	D SI	D SI	-
I>	1.0	**Ib**	Trip level of low-set overcurrent element (p.u. of Ib)	1 - 2.5 - Dis	0.01	Ib
tI>	0.05	**s**	Trip time delay of the low-set overcurrent element. In the inverse time operation [tI>] is the trip time delay at I = 5x[I>].	0.05 - 30	0.01	s
I>>	1	**Ib**	Trip level of high-set overcurrent element (p.u. of Ib)	1 – 12 - Dis	0.1	Ib
tI>>	0.05	**s**	Trip time delay of the high-set overcurrent element	0.05 - 3	0.01	s
O>	0.02	**On**	Trip level of earth fault element (p.u. of the rated current of the C.Ts. for zero sequence detection) **The Earth Fault element does not work when frequency is outside the range 45-65Hz due to the action of the input band-pass filter**	0.02 - 0.4 - Dis	0.01	On
tO>	0.05	**s**	Trip time delay of low-set earth fault element	0.05 - 30	0.01	s
1Is	0.05	**Ib**	Generator's max. continuous negative sequence current rating (p.u. of Ib)	0.05 - 0.5 - Dis	0.01	Ib
Ks	5	**s**	Time multiplier of the I^2t time-current curve	5 - 80	1	s
tc	10	**s**	Cooling time from trip level to cold state	10 - 1800	1	s
2Is	0.03	**Ib**	Negative sequence current alarm level	0.03 - 1 - Dis	0.01	Ib
t2Is	1	**s**	Independent trip time delay of alarm element	1 - 100	1	s
Ir>	0.02	**In**	Trip level of the reverse power element (Active component of current as p.u. of In). **The Reverse Power function disactivated when frequency ≤36Hz**	0.02 - 0.2 - Dis	0.01	In

Display			Description	Setting Range	Step	Unit
tIr>	0.1	**s**	Independent trip time delay of reverse power element	0.1 - 60	0.01	s
α=	270	**C**	Impedance characteristic angle (Max. sensitivity direction)	0 - 330	30	°
K_1	300	**%Zb**	Diameter of the circle	50 - 300	1	%
K_2	50	**%Zb**	Offset of the circle including the underimpedance tripping zone (% of Zb=Vn/(√3 Ib) **Underimpedance trip is inhibited on undervoltage U<0,3Un and undercurrent I<0,2Ib and frequency ≤36Hz**	5 - 50	1	%
tz	0.2	**s**	Trip time delay of the underimpedance element	0.2 - 60	0,1	s
ti	0	**s**	Integration time of underimpedance element. To avoid non operation in case of impedance swinging the reset of the trip time delay "tz" only takes place if the measured impedance remains outside the tripping zone for at least "ti". **N.B**. "**ti" must be always shorter than "tz"**	0 - 10	0.1	s
tBF	0.05	**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 - 0.5	0.01	s

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 (only one or more, whatever combination)	operates relays R1,R2,R3,R4.
tI>	1	-	-	-	As above, time delayed element	operates relay R1,R2,R3,R4
I>>	-	-	3	-	Instantaneous element of high-set overcurrent	operates relay R1,R2,R3,R4
tI>>	1	-	-	-	As above, time delayed element	operates relay R1,R2,R3,R4
O>	-	-	3	-	Instantaneous element of low-set earth fault element	operates relay R1,R2,R3,R4.
tO>	1	-	-	-	As above, time delayed element	operates relay R1,R2,R3,R4
1Is	1	-	-	-	First unbalance element (time delayed)	operates relay R1,R2,R3,R4
2Is	-	2	-	-	As above, second unbalance element	operates relay R1,R2,R3,R4
Ir>	1	-	-	-	Reverse power time delayed element	operates relay R1,R2,R3,R4
Z<	1	-	-	-	Underimpedance time delayed element	operates relay R1,R2,R3,R4
tBF	-	-	-	4	Breaker Failure function operates	output 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.	
2:	--Ih--				The input (2) for blocking the time delayed elements relevant to phase and ground faults operate on I>(Il) or I>>(Ih) or O>(Io) as programmed	
t_2	OFF				The operation of the blocking input (2) can be programmed so that it lasts as long the blocking input signal is present (t_2=OFF) or so that, even with the blocking input still present, it only lasts for the set trip time delay of the function plus an additional time 2xtBF (t_2=2xtBF).	
3:	--Ir				The blocking input (3) operate on function Z< or IR> as programmed	

13. MANUAL TEST OPERATION

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

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

13.2 - Mode "TESTPROG" subprogram "WithTRIP"

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

WARNING

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

14. MAINTENANCE

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

WARNING

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

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

15. POWER FREQUENCY INSULATION TEST

Every relay individually undergoes a factory insulation test according to IEC255-5 standard at 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 tacking place in other parts or components of the board can severely damage the relays or cause damages, not immediately evident to the electronic components.

16. ELECTRICAL CHARACTERISTICS

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

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

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

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

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

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

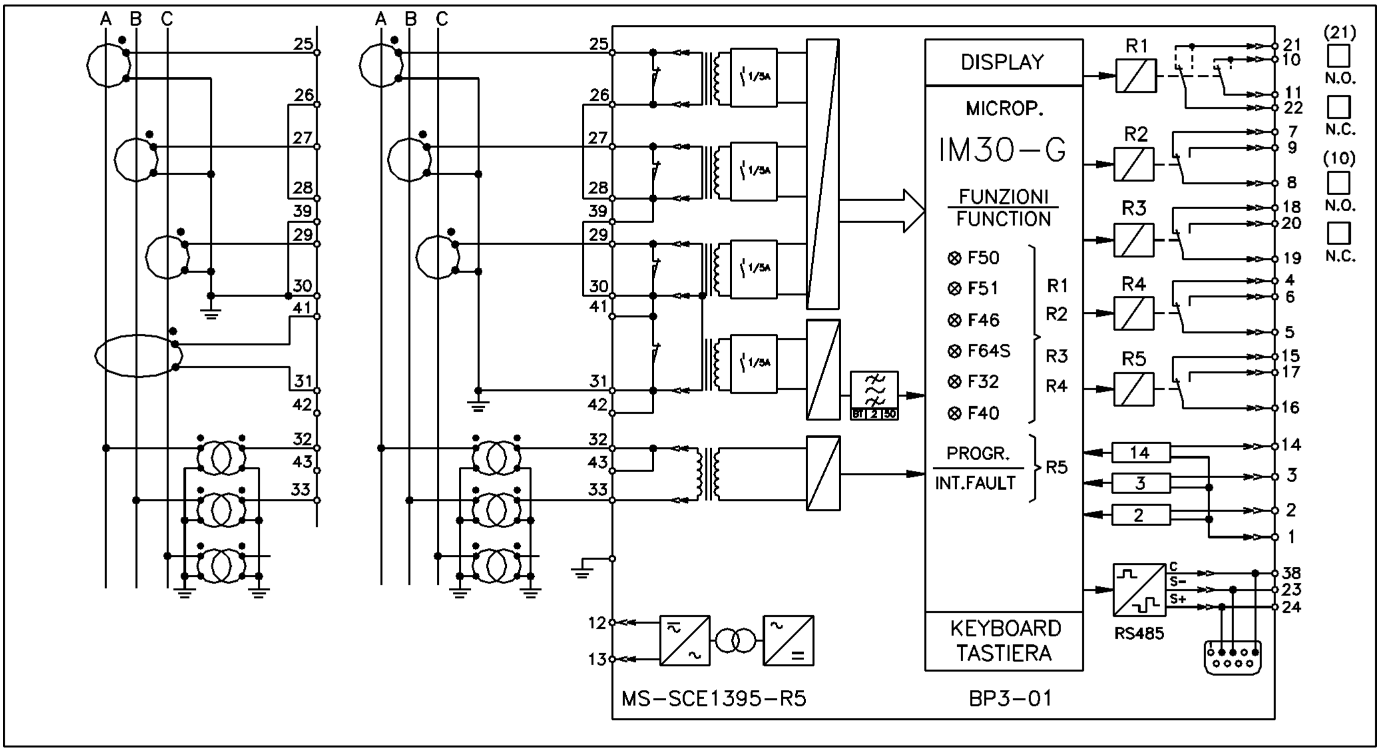
CHARACTERISTICS

❑ Accuracy at reference value of influencing factors	2% In for measure 2% +/- 10ms for times
❑ Rated current	In = 1 or 5 A - On = 1 or 5 A
❑ Current overload	200 a for 1 sec; 10 A continuous
❑ Burden on current inputs	0,01 VA/phase at In=1A ; 0,015 VA at On=1A 0,2 VA/phase at In=5A ; 0,4 VA at On=5A
❑ Rated voltage	Un=100V (different on request)
❑ Voltage overload	2 Un continuous
❑ Burden on voltage inputs	0,04 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.)
❑ Protection degree	IP44 (IP54 on request)

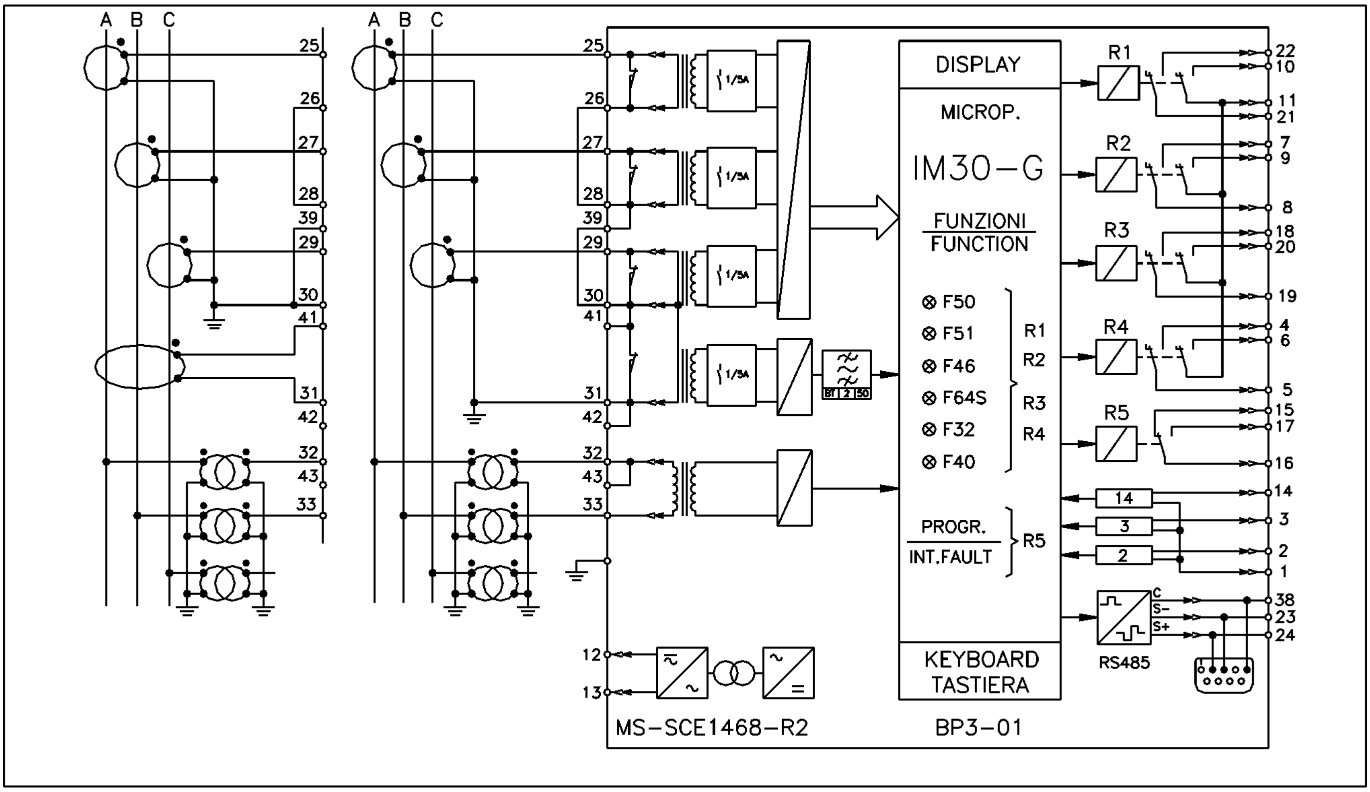
Microelettrica Scientifica S.p.A. - 20089 Rozzano (MI) - Italy - Via Alberelle, 56/68
Tel. (+39) 02 575731 - Fax (+39) 02 57510940
http://www.microelettrica.com **e-mail :** ute@microelettrica.com

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

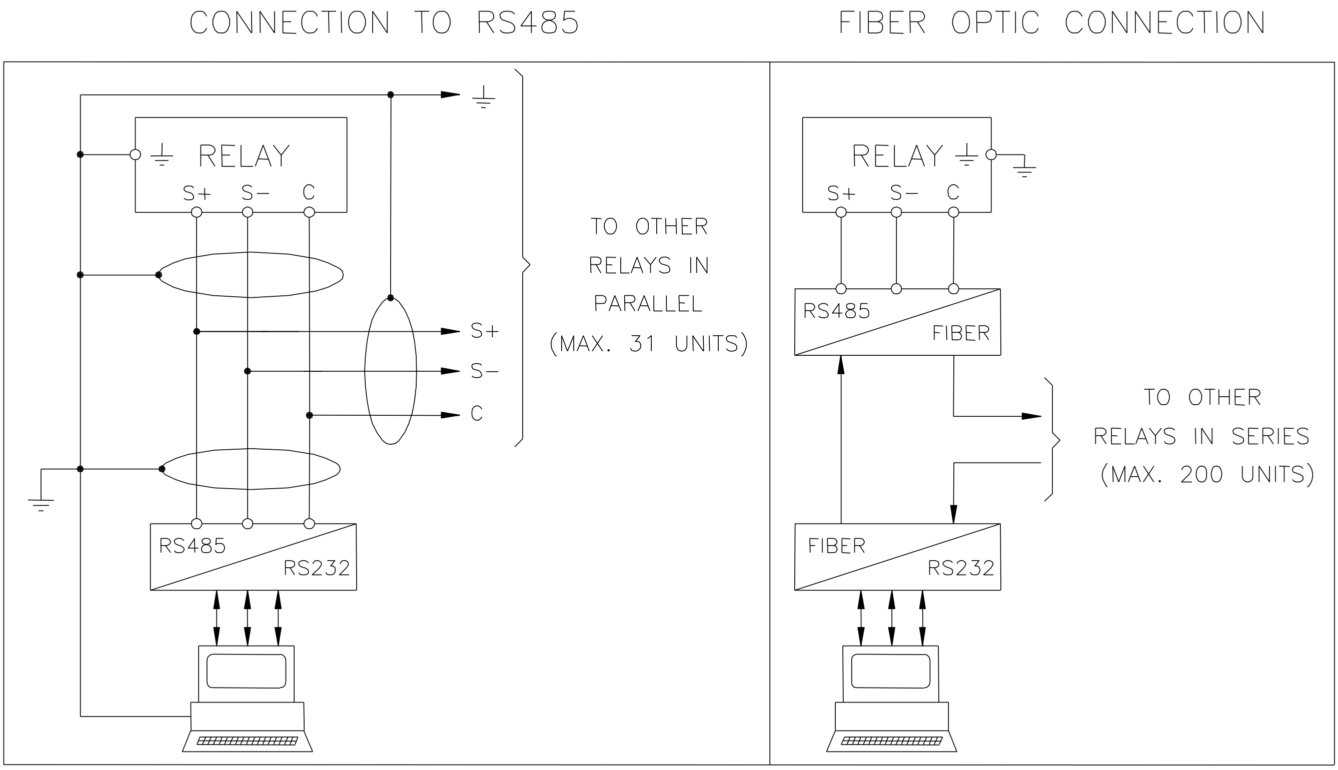
17. CONNECTION DIAGRAM (SCE1395 Rev.5 - Standard Output)



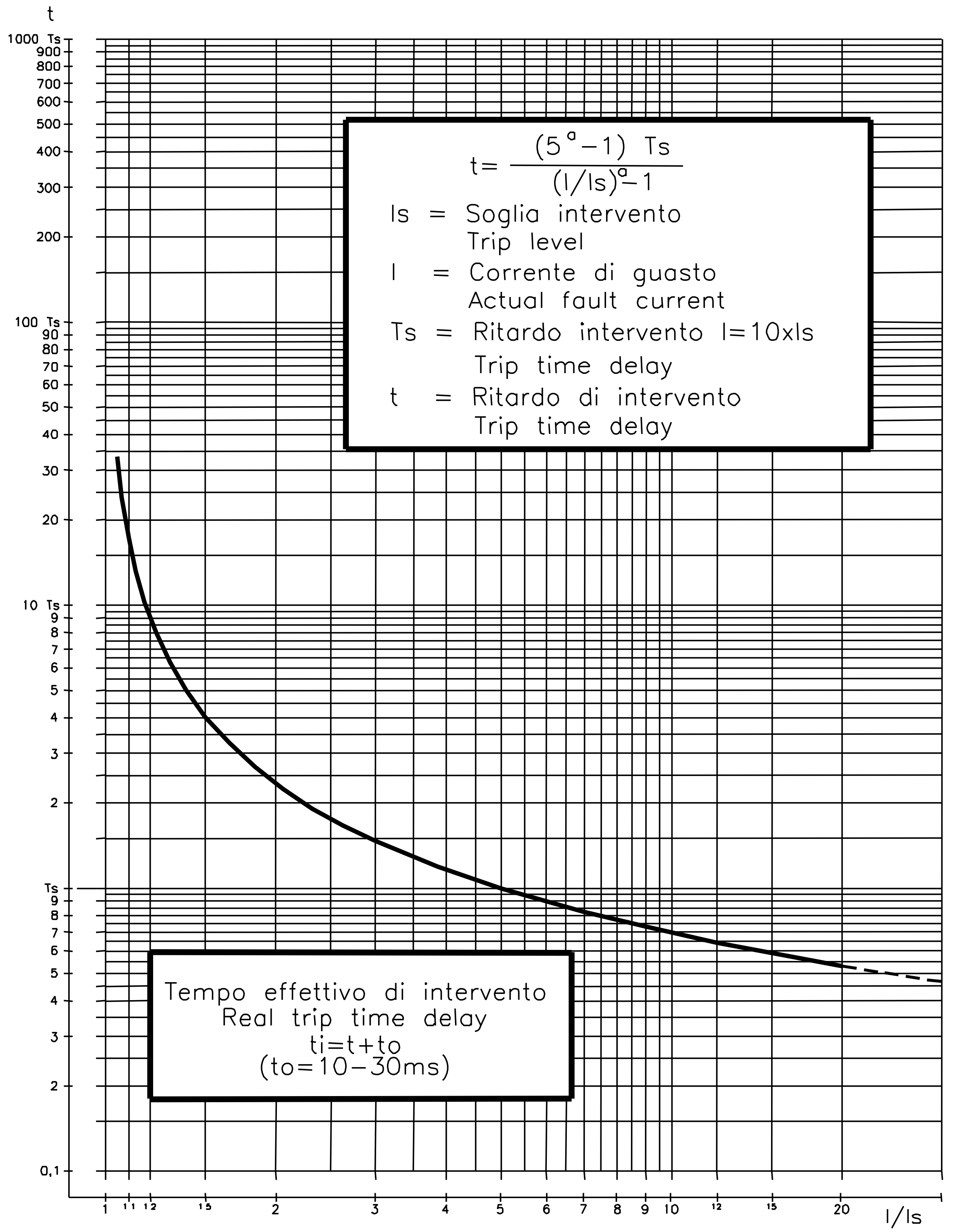
17.1 - CONNECTION DIAGRAM (SCE1468 Rev.2 - Double Output)



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



19. TIME CURRENT CURVES F51 - IM30-G (TU0311 Rev.0)



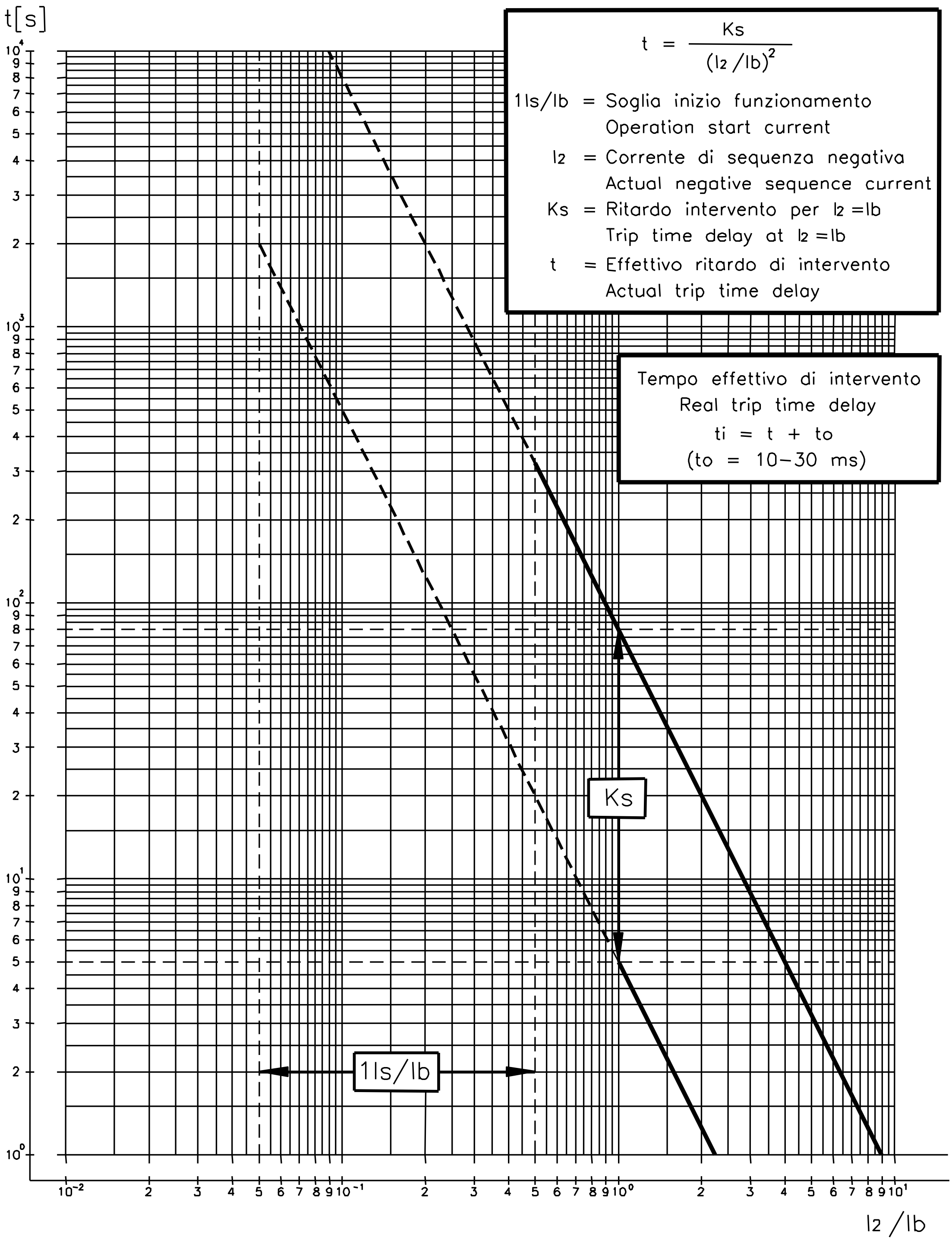
Tempo normalmente inverso
Normal inverse time

a=0.02

F51

Is = I> = (1 − 2,5)Ib
Ts = tI> = (0.05−30)s

20. I^2t = constant element F46 - IM30-G (TU0312 Rev.0)



I_2 = (0.05 – 0.5)Ib step 0.01In

Ks = (5 – 80)sec. @ I_2 = Ib step 1sec.

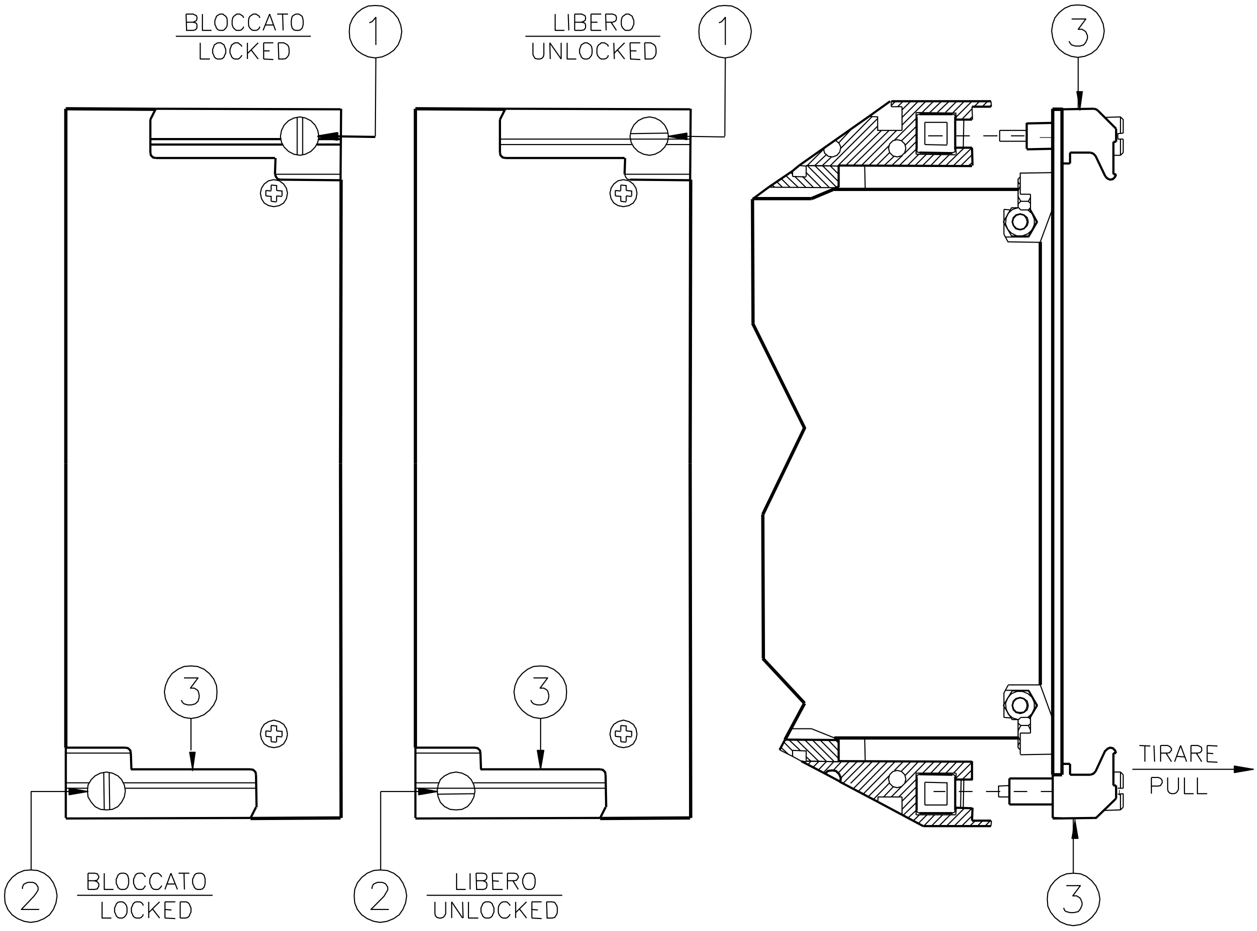
21. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

21.1 - Draw-out

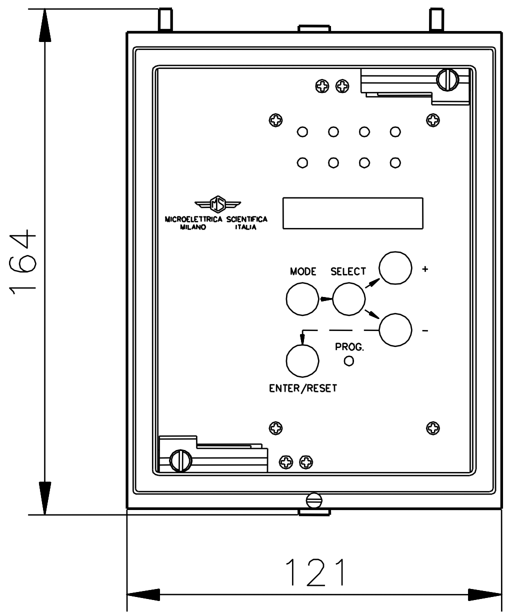
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

21.2 - Plug-in

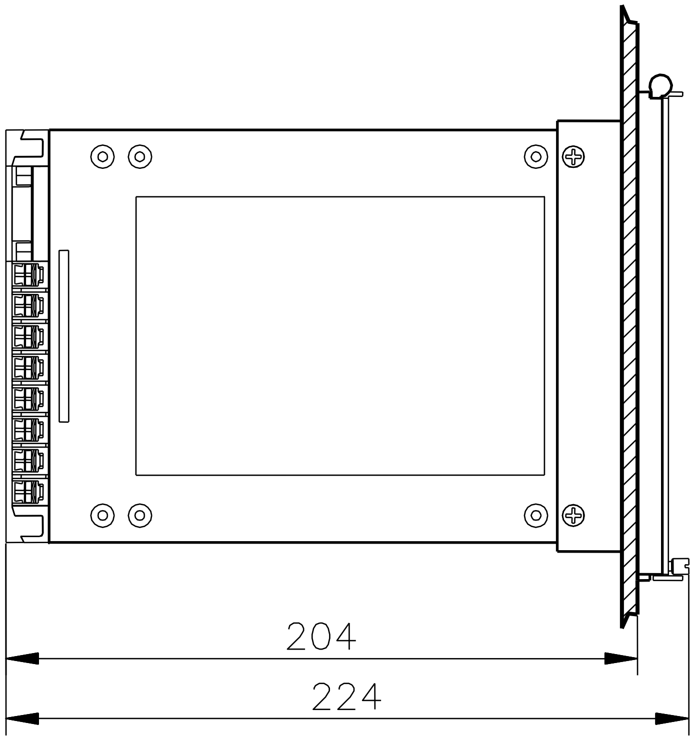
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position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

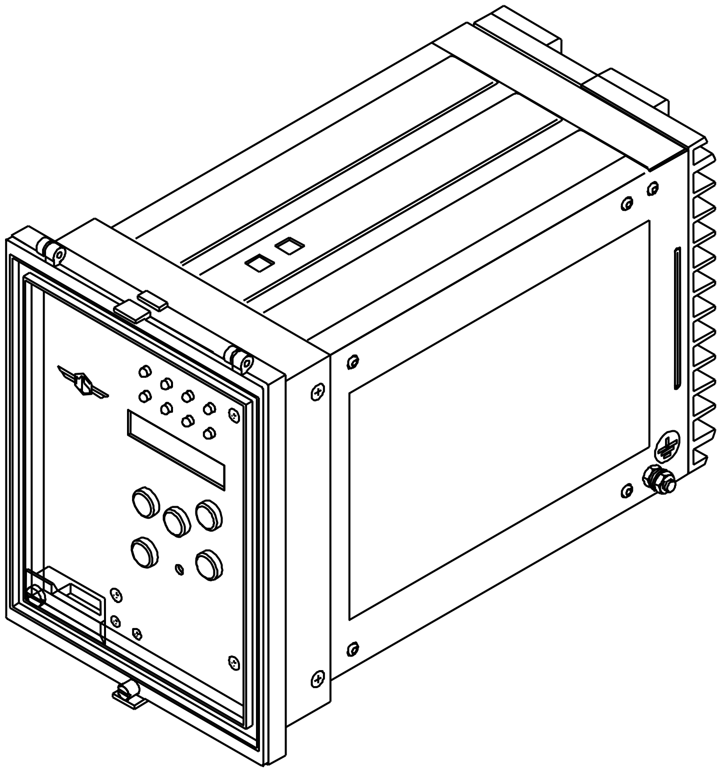


22. MOUNTING

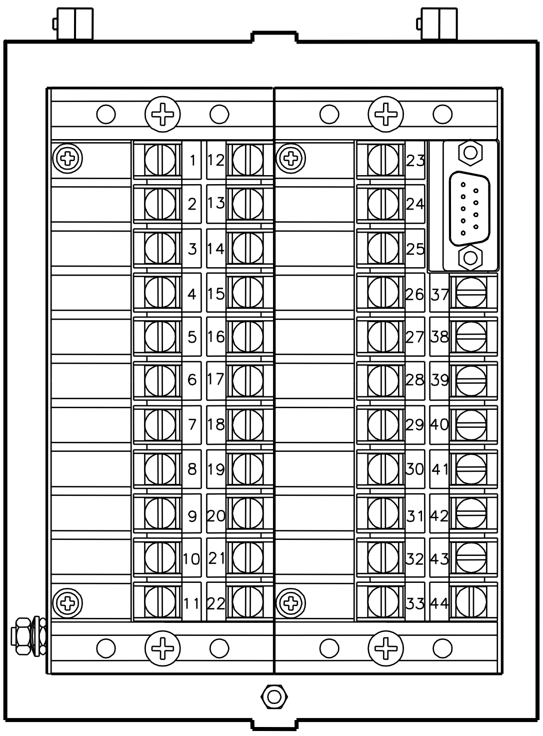


PANEL CUT-OUT 113x142 (LxH)

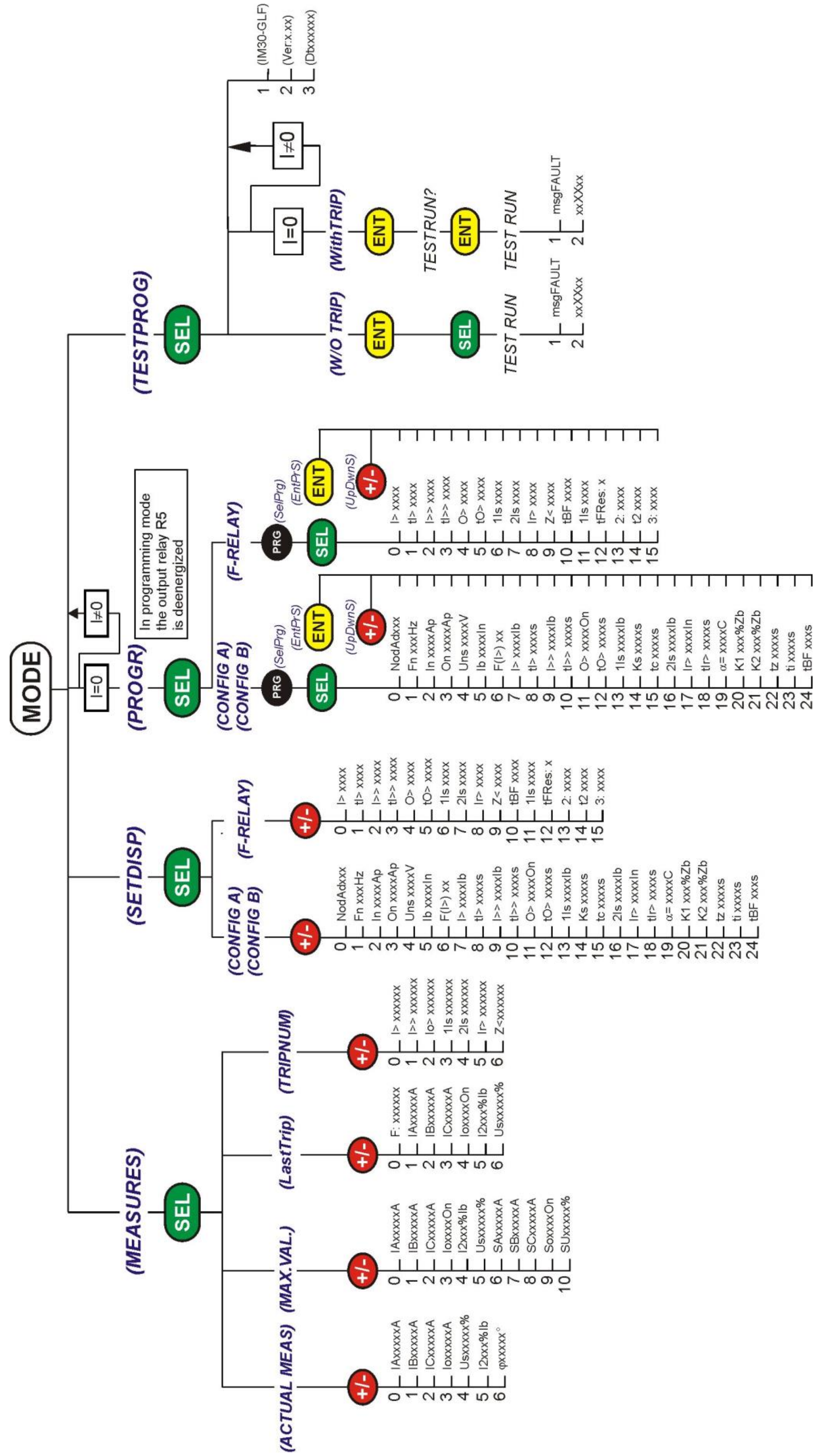




View of Rear
Terminal Connection



23. KEYBOARD OPERATIONAL DIAGRAM



24. SETTING'S FORM

Relay Type	**IM30-GLF**	**Station :**			**Circuit :**			
Date :	/ /	**Firmware Ver.**			**Relay Serial Number :**			
Power Supply	☐ 24V(-20%) / 110V(+15%) a.c. 24V(-20%) / 125V(+20%) d.c.				**In**	☐ **1A**	☐ **5A**	
	☐ 80V(-20%) / 220V(+15%) a.c. 90V(-20%) / 250V(+20%) d.c.				**Ion**	☐ **1A**	☐ **5A**	

RELAY PROGRAMMING

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result	
						Pick-up	Reset
NodAd	Identification number for serial connection	1 - 250	**-**	1			
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			
Uns	Rated secondary voltage of Vts (phase to phase)	100 - 125	**V**	100			
Ib	Generator's rated current as p.u. of Cts rated current	0.5 - 1.1	**In**	0.5			
F(I>)	Oper. charact. of the low-set overcurrent element	D, SI		D			
I>	Trip level of low-set overcurrent element	1 - 2.5 - Dis	**Ib**	1.0			
tI>	Trip time delay of the low-set overcurrent element	0.05 - 30	**s**	0.05			
I>>	Trip level of high-set overcurrent element	1 – 12 - Dis	**Ib**	1			
tI>>	Trip time delay of the high-set overcurrent element	0.05 - 3	**s**	0.05			
O>	Trip level of earth fault element	0.02-0.4-Dis	**On**	0.02			
tO>	Trip time delay of low-set earth fault element	0.05 - 30	**s**	0.05			
1Is	Generator's max. continuos negative sequence current rating	0.05-0.5-Dis	**Ib**	0.05			
Ks	Time multiplier of the I^2t time-current curve	5 - 80	**s**	5			
tc	Cooling time from trip level to cold state	10 - 1800	**s**	10			
2Is	Negative sequence current alarm level	0.03 - 1 - Dis	**Ib**	0.03			
t2Is	Independent trip time delay of alarm element	1 - 100	**s**	1			
Ir>	Trip level of the reverse power element	0.02-0.2-Dis	**In**	0.02			
tIr>	Indep. trip time delay of reverse power element	0.1 - 60	**s**	0.1			
α=	Impedance characteristic angle	0 - 330	**C**	270			
K_1	Diameter of the circle	50 - 300	**%Zb**	300			
K_2	Offset of the circle including the underimpedance tripping zone	5 - 50	**%Zb**	50			
tz	Trip time delay of the underimpedance element	0.2 - 60	**s**	0.2			
ti	Integration time of underimpedance element.	0 - 10	**s**	0			
tBF	Max. reset time delay of the instantaneous elements after tripping	0.05 - 0.5	**s**	0.05			

CONFIGURATION OF OUTPUT RELAYS												
Default Setting							**Actual Setting**					
Protect. Element	**Output Relays**				**Description**		**Protect. Element**	**Output Relays**				
I>	-	-	3	-	Instantaneous element of low-set overcurrent		**I>**					
tI>	1	-	-	-	As above, time delayed element		**tI>**					
I>>	-	-	3	-	Instantaneous element of high-set overcurrent		**I>>**					
tI>>	1	-	-	-	As above, time delayed element		**tI>>**					
O>	-	-	3	-	Instantaneous element of low-set earth fault element		**O>**					
tO>	1	-	-	-	As above, time delayed element		**tO>**					
1Is	1	-	-	-	First unbalance element (time delayed)		**1Is**					
2Is	-	2	-	-	As above, second unbalance element		**2Is**					
Ir>	1	-	-	-	Reverse power time delayed element		**Ir>**					
Z<	1	-	-	-	Underimpedance time delayed element		**Z<**					
tBF	-	-	-	4	Breaker Failure function operates		**tBF**					
tFRes:	A				The reset after tripping: **(A)** automatically **(M)** manually		**tFRes:**					
2:	--Ih--				The input (2) for blocking the time delayed elements relevant to phase and ground		**2:**					
t_2	OFF				The operation of the blocking input (2) can be programmed so that it lasts as long the blocking input signal is present (t_2=OFF) or so that, even with the blocking input still present, it only lasts for the set trip time delay of the function plus an additional time 2xtBF (t_2=2xtBF).		**t_2**					
3:	--Ir				The blocking input (3) operate on function Z< or IR> as programmed		**3:**					

Commissioning Engineer: ______________________________ **Date :** ________________

Customer Witness: ______________________________ **Date :** ________________