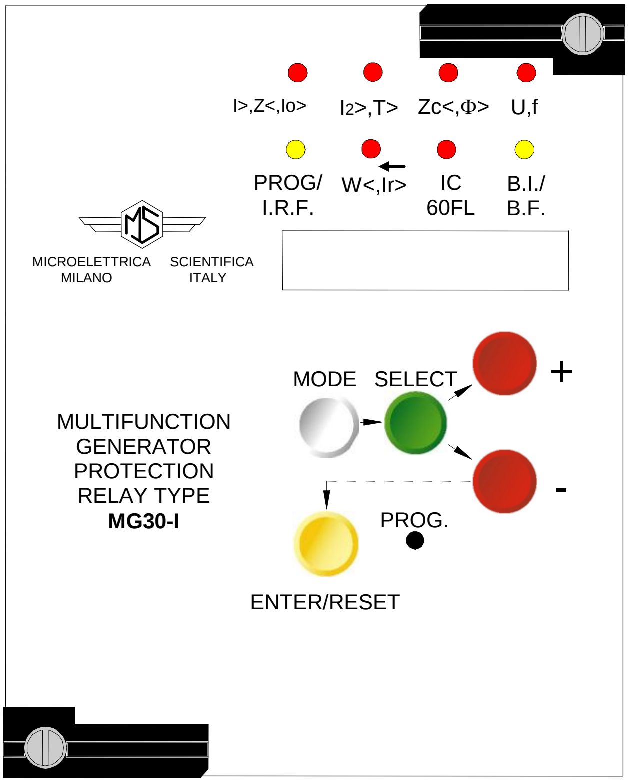
MULTIFUNCTION GENERATOR PROTECTION RELAY TYPE

MG30-I

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 produced 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 AND OPERATION

Input signals are supplied to 3 current transformers and 3 potential transformers respectively measuring phase currents and phase-to-neutral voltages plus one current transformer for measurement of zero sequence current. Phase current input can be 1 or 5A (movable jumpers on relay’s card). Rated voltage input can be programmed from 50 to 125V (phase-to-phase) 50 or 60Hz.
Make electric connection in conformity with the diagram reported on relay's enclosure.
Check that input quantities 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 energizing the unit check that supply voltage is within the allowed limits.

2.2 - Measuring Inputs

For each phase the relay computes the RMS value of current and voltage and the relevant phase displacement. It also computes the RMS value of the fundamental component of the Zero Sequence Current.

2.2.1 Phase currents are supplied to three 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 0.01 through 50 times In.
For the phase current the measuring range of the A/D Converters runs from 0 to 12In automatically switched to two channels one measuring from 0 to 1.1In and the second from 0 to 12In.

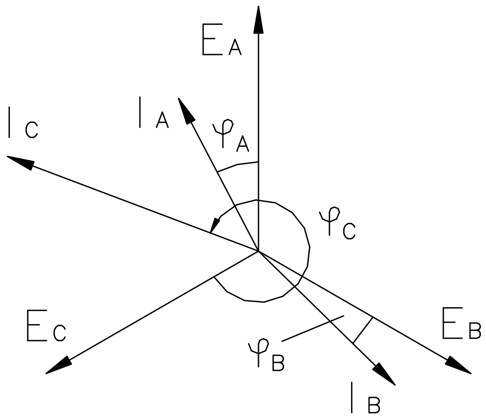
The resolution of the A/D converter is 12 bits.

2.2.2 Phase-to-neutral voltages are supplied to three Potential transformers rated 220V.
Relay's rated phase-to-phase input voltage (Un) can be matched with the System's PTs by setting their ratio kV
The ADC converter measuring range runs up to 2 x Un.

The A/D converter resolution is 12 bits.

2.2.3 Zero Sequence Current is supplied to a dedicated current transformer 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 On = 5A o 1A (different values can be provided on request).
The measuring dynamic of the CT runs from 0.002 through 2 On. For the Zero Sequence Current the measuring range of the A/D Converters runs from 0 to 2 On automatically switched to two channels, one measuring from 0 to 1.2 On and the second from 0 to 2 On; the A/D converter resolution is 12 bits. The relay computes the RMS of fundamental component of the Zero Sequence Current.

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



$\varphi_A = \varphi_{A-C} - 120°$; $\varphi_B = \varphi_{B-C} + 120°$; $\varphi_C = \varphi_{C-C}$

This means that the voltage system is considered to be balanced as it is normally, whereas 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
- Ratio of System's PTs. : **Kv** = (2-655), step 0.1
- P.Ts secondary phase-to-phase voltage : **Uns** = (50-125)V, step 1V
- Relay basic current (Generator's rated current) : **Ib** = (0.5-1.1)In, step 0.1In
- Rated primary current of neutral CT : **On** = (50-125)On, step 1V

2.3.2 - F50/51 - Dual level 3-phase overcurrent with or without voltage control

1F 50/51 : Low set overcurrent

- Voltage control activated / non activated : I>/U = ON-OFF
- Pick-up (operation) level : **I>** = (1-2.5)Ib, step 0.1Ib
  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/Ib = 5)

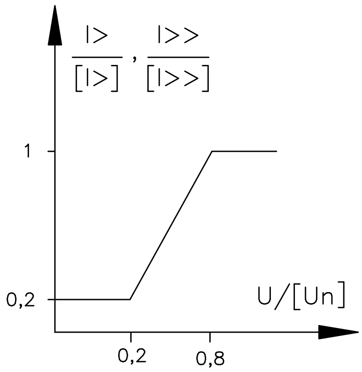
(see curves TU0311 §19)

2F 50/51 : High set overcurrent

- Voltage control activated / non activated : I>>/U = ON-OFF
- Pick-up (operation) level : **I>>** = (1-9.9)Ib, step 0.1Ib
  Setting **I>>** = Dis blocks function's operation
- Drop-out ratio : ≥0.95
- Minimum operation time : 30ms
- Independent trip time delay : t = **tI>>** = (0.05-3)s, step 0.01s

2.3.3 - Voltage controlled overcurrent

If the parameters I>/U and/or I>>/U are set to “ON” the voltage control is active respectively for the level I> and/or I>>. The actual pick-up levels (I>,I>>) vary from the programmed levels ([I>] , [I>>]) proportionally to the voltage variation according to the curve herebelow



$$\frac{I>}{[I>]},\frac{I>>}{[I>>]}=\frac{\text{Actual pick-up level}}{[\text{Set pick-up level}]}$$

$$\frac{U}{[Un]}=\frac{\text{Actual voltage}}{[\text{Rated input voltage}]}$$

The voltage ratio is measured on each phase $\left(\frac{Ex\cdot\sqrt{3}}{[Un]}\right)$ and the smallest among the values is used in the algorithm.

Practically when the input voltage drops below 0.8 [Un] the minimum pick-up level of the overcurrent elements is decreased as follow

$$\frac{I>}{[I>]}=\frac{I>>}{[I>>]}=\frac{0.8}{0.6}\cdot\left(\frac{U}{[Un]}-0.8\right)+1$$

Below 0.2 [Un] $\frac{I>}{[I>]}=\frac{I>>}{[I>>]}=0.2$

Above 0.8 [Un] $\frac{I>}{[I>]}=\frac{I>>}{[I>>]}=1$

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

1F 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

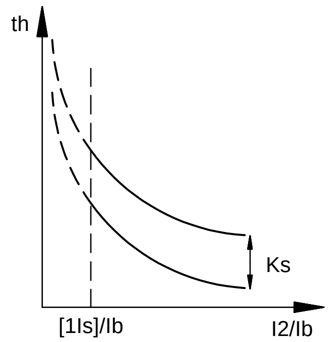
- Time multiplier : **Ks** = (5-80)s, step 1s ; **Ks** = Trip time when $I_2 = I_b$

- 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 state corresponding to the continuous operation at $I_2 = [1Is]$:
  tcs = (10-1800)s, step 1s

Cooling time $t_1 = \frac{[tcs]}{Ks}\left(\frac{I_2}{I_b}\right)^2 \cdot t$; t_1 = [tcs] 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 §20)

2F 46 : Unbalance 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

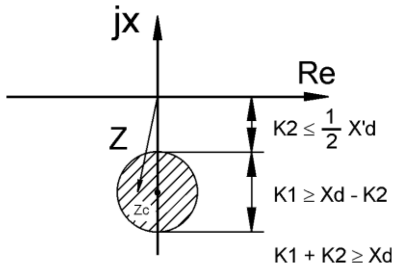
2.3.5 - F32 - Reverse power

- Current setting range : **Ir** = (0.02-0.2)Ib, step 0.01Ib

  Setting **Ir** = Dis blocks function's operation

- Operation level : I ≥ [Ir]
- Independent trip time delay : **tIr** = (0.1-60)s, step 0.01s (0.1 to 0.99),
  step 0.1s (1.0 to 60)
- Operation zone : 90°<φc<270°

2.3.6 - F40 - Loss of excitation : capacitive underimpedance Zc<



- For each phase the relay computes the impedance

$$Zc_x = \frac{E_x}{I_x \cos(\varphi_x - 90°)}$$

- Characteristics angle of the impedance α_Z = 270°

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°.

- Operation zone is that included in the circle having (see figure) :

  Center on the axis Jx at distance $-\left(K2 + \frac{K1}{2}\right)$ from the axes origin and Diameter= K1

- Circle offset : **K2** = (5-50)%Zb, step 1%

- Circle diameter : **K1** = (50-300)%Zb, step 1%

  Setting **K1** = Dis   blocks the function operation

- rated generator's impedance : $Zb = \frac{[Un]}{\sqrt{3}\,[Ib]}$

- 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 : $Ex < 0.3\,\frac{[Un]}{\sqrt{3}}$

- Undercurrent inhibition level : Ix < 0.2 [In]

- Operation taxes place only if all the 3 impedances of phase A, B, C are within the trip zone

- The following setting are normally used:

K2 ≤ 1/2 X'd			(X'd = transient direct axis reactance)
K1 + K2 ≥ α Xd			(Xd = synchronous reactance)
α	=	1	for salient-pole alternators and for synchronous motors
α	=	1, 2	for turbo alternators
tz	=	2s	(1s for synch. motors)
ti	=	1/4tz	

2.3.7 - F27-59 : Dual level 3-phase over-under voltage

1F 27-59 : First voltage element 1U

- Minimum Pick-up of voltage difference : **1u** = (5-50)%Un, step 1%

- Independent trip time delay : **t1u** = (0.1-60)s, step 0.1s

- Operation mode : (Un **+/-** 1u)
  The function can be programmed to operate as :

- Overvoltage (Un **+** 1u) : operates when any phase voltage E_x rises above the rated value $\frac{[Un]}{\sqrt{3}}$
  by more than [1u]%. $\frac{\sqrt{3}\cdot Ex}{[Un]}\cdot 100 \geq (100+[1u])\%$

- Undervoltage (Un **-** 1u): operates when any phase voltage E_x drops below the rated value $\frac{[Un]}{\sqrt{3}}$
  by more than [1u]%. $\frac{\sqrt{3}\cdot Ex}{[Un]}\cdot 100 \leq (100-[1u])\%$

- Voltage balance (Un **+/-** 1u) : operates when any phase voltage differs from the rated value more then [1u]%

$$(100-[1u])\% \geq \frac{\sqrt{3}\cdot Ex}{[Un]}\cdot 100 \geq (100+[1u])\%$$

- Operation blocked : (Un = Dis)

2F 27-59 : Second voltage element 2U

It operates same as the first element; the programmable parameter are :

- Pick-up level : **2u** = (5-50)%Un, step 1%
- Independent trip time delay : **t2u** = (0.1-60)s, step 0.1s
- Operation mode : (Un **+/-** 2u)

2.3.8 - F81 : Dual level over/under frequency

1F 81 : First frequency element 1f

- Minimum Pick-up of frequency difference : **1f** = (0.05-9.99)Hz, step 0.01Hz
- Independent trip time delay : **t1f** = (0.1-60)s, step 0.1s
- Operation mode : (Fn **+/-** 1f)

The function can be programmed to operate as :

- Overfrequency (Fn **+** 1f) — operates when the frequency rises above the rated value [Fn] by more than 1f Hz. $f \geq (Fn+[1f])Hz$
- Underfrequency (Fn - 1f) — operates when the frequency drops below the rated value [Fn] by more than [1f]Hz. $f \leq (Fn-[1f])Hz$
- Frequency balance (Fn **+/-**1f) — operates when frequency differs from rated value by more than [1f]Hz. $(Fn-[1f])Hz \geq f \geq (Fn+[1f])Hz$

- Operation blocked : (Fn = Dis)
- Undervoltage inhibition : U < 0.1Un
- Undercurrent inhibition : I < 0.01In

2F F81 : Second frequency element 2f

It operates same as the first element ; the programmable parameters are :

- Pick-up level : **2f** = (0.05-9.99)Hz, step 0.01Hz
- Independent trip time delay : **t2f** = (0.1-60)s, step 0.1s
- Operation mode : (Fn **+/-** 2f)

2.3.9 - F49 - Thermal overload

The relay computes a thermal image of the machine based on the ratio I/[Ib] of the RMS of the current flowing in each phase to the rated full load current of the generator :

- Warming-up time constant : **Tc** = (1 - 400)m, step 1m
- Maximum continuous overload : **Ic** = 1.05Ib (≡110%Tn)
- Rated full load (I=Ib) temperature rise : **Tn**
- Overtemperature prealarm level : **Ta** = (50-110)% Tn, step 1%

- Current corresponding to machine temperature before the overload : $Ip\left(\equiv \sqrt{Tp}\right)$

- Time to warm-up from Tp to trip temperature (110%Tn) in function of the current overload

$$t = [Tc]\ln\frac{(Tx/Tn) - (Tp/Tn)}{(Tx/Tn) - (Tb/Tn)} = [Tc]\ln\frac{(I/[Ib])^2 - (Ip/[Ib])^2}{(I/[Ib])^2 - (Ib/[Ib])^2}$$

(see curves TU0325 §20)

Cooling is computed with the same time constant (Tc) as heating.

2.3.10 - F37 - Underpower W<

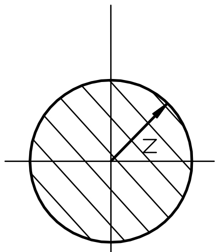
The element measures the 3-phase active power and trips when the power generated (forward) drops below the set level [W<]

- Pick-up (operation) level : **W<** = (0.05-1.00)Wb, step 0.05Wb
  Setting **W<** = Dis blocks function's operation

- Independent trip time delay : **tW<** = (0.1-60)s, step 0.1s
- Undervoltage inhibition level : U < 0.5Un
- Undercurrent inhibition level : I < 0.01In
- Overcurrent inhibition level : I> 2In

2.3.11 - F21 - Dual Level Under Impedance

The relay computes the modulus of the Impedance of each phase $Zx = \frac{Ex}{Ix}$ and compares it to the relay rated input impedance $Zn = \frac{Un}{\sqrt{3}In}$



Trip when
$Zx \leq$ [1Z], [2Z]

1F 21 : Low-set element

- Maximum pick-up level : **1Z** = (0.1 – 1.00)Zn, step 0.01Zn
- Independent trip time delay : **t1Z** = (0.05 – 9.99)s, step 0.01s
- Setting **t1Z** = inst no intentional delay
- Undercurrent inhibition : I < 0.2In
- Operation blocked : (**1Z** = Dis)

2F 21 : High-set element

- Maximum pick-up level : **2Z** = (0.1 – 1.00)Zn, step 0.01Zn
- Independent trip time delay : **t2Z** = (0.05 – 9.99)s, step 0.01s
- Setting **t2Z** = inst no intentional delay
- Undercurrent inhibition : I < 0.5In
- Operation blocked : (**2Z** = Dis)

2.3.12 F24 – Dual level Overfluxing

The relay computes the ratio $\Phi = \frac{V}{Hz}$ of the input voltage to input frequency and compares it to the relay rated value $\frac{Un}{Fn}$

1F 24 : Inverse Time element

- Minimum pick-up level : **1Φ>** = (1 – 2) $\frac{Un}{Fn}$, step 0.1pU

- Time multiplier: **K** = (0.5 – 5), step 0.1

- Trip time delay : $t = \frac{K}{\left(\frac{V}{Hz} - 1\Phi >\right)} + 0.5$ (see curve §22)

- Operation blocked : (**1Φ** = Dis)

2F 24 : Definite Time element

- Minimum pick-up level : **2Φ>** = (1 – 2) , step 0.1pU - Un/Fn
- Independent time delay : **t2Φ** = (0.1 – 60), step 0.1s
- Operation blocked : (**2Φ** = Dis)

For both levels:

- Underfrequency inhibition : f < Fn -10Hz
- Undervoltage inhibition : U < 0.5Un

2.3.13 - F64S –Stator Earth Fault element

The relay computes the fundamental (system frequency) component of the Neutral-to-Ground input current and compares it to the rated input current On of the element

1F 64 : First element

- Minimum pick-up level : **1Io** = (2 – 80)%On, step 1%On
- Independent trip time delay : **t1O** = (0.05 – 9.99)s, step 0.01s
- Setting **t1O** = inst no intentional delay
- Operation blocked : (**1Io** = Dis)

2F 64 : Second element

- Minimum pick-up level : **2Io** = (2 – 80)%On, step 1%On
- Independent trip time delay : **t2O** = (0.05 – 9.99)s, step 0.01s
- Setting **t2O** = inst no intentional delay
- Operation blocked : (**2Io** = Dis)

2.3.14 - F60FL – PT Fuse Failure

- Setting : **60FL** = ON o OFF

When set to “ ON “, the element operates as follows:

E2/E1 > 0.3 and I2/I1 < 0.8

If the ratio of the negative sequence voltage to the positive sequence voltage exceeds 0.3 and the ratio of the negative sequence current to the positive sequence current is below 0.8, the fuse failure is detected and the operation of the functions involving any voltage measurement is instantaneously blocked.
After 3 sec delay one output relay is energized for fuse failure alarm signalization.

2.3.15 - F50/27 – Inadvertent generator energization

- Setting : **IC** = ON o OFF

When set to “ ON “, the element operates as follows:

If all voltages are below 0.2Un for longer than 20s an overcurrent element is enabled; this element trips when current of any phase excees 0.2Ib for longer than 0.2s.

2.3.16 - F50BF – Breaker Failure Protection

- Setting : **tBF** = (0.05 – 0.5)s, step 0.01s

The element operates as follows:

After tripping of the output relay R1 the time tBF starts.
If at the end of tBF the current in any phase is still present the output relay associated to the Breaker Failure protection is energized.

2.4 CLOCK AND CALENDAR

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

2.4.1 Clock synchronization.

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

2.4.2 Date and time setting.

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

2.4.3 Time resolution.

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

2.4.4 Operation during power off.

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

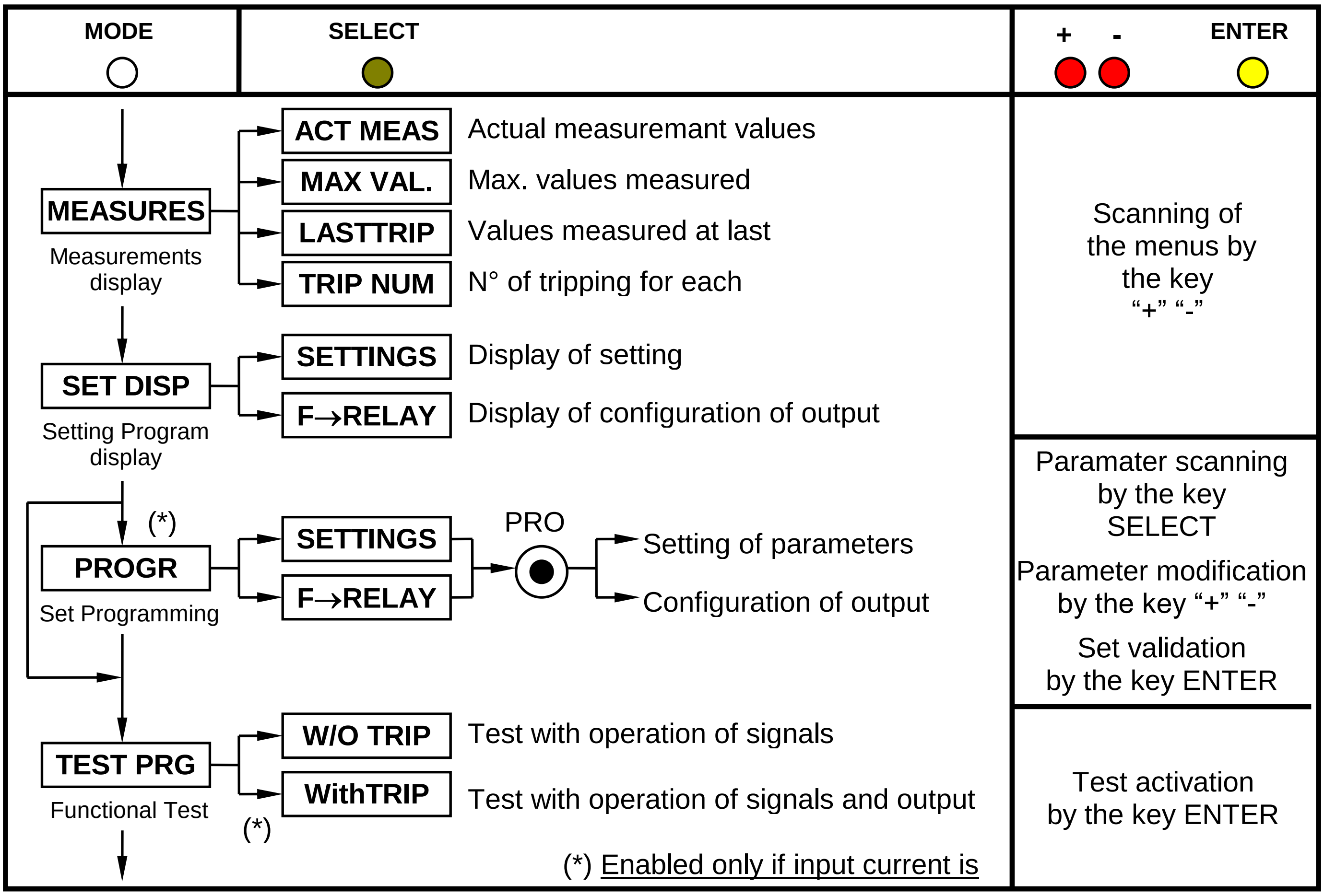
2.4.5 Time tolerance.

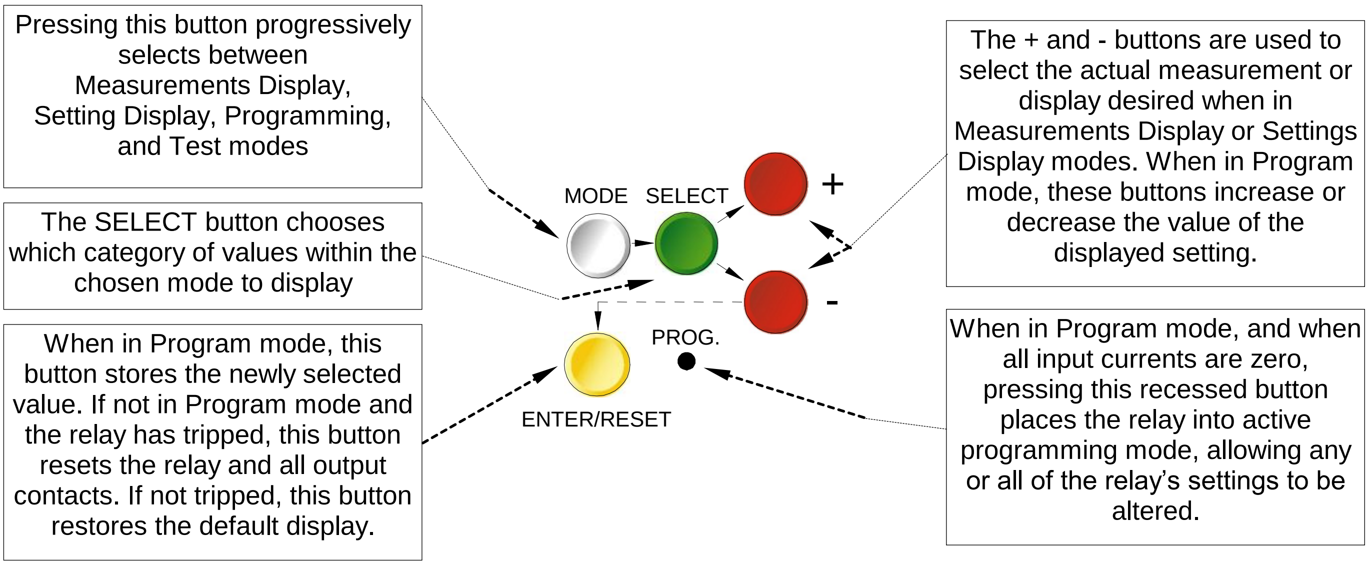
During power on, time tolerance depends on the on board crystal (+/-50ppm typ, +/-100ppm max. over full temperature range).
During power off, time tolerance depends on the RTC's oscillator (+65 –270 ppm max over full temperature range).

3. CONTROLS AND MEASUREMENTS

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

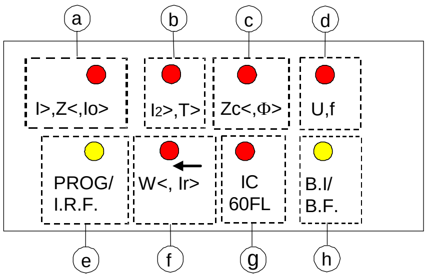
Fig.1





4. SIGNALIZATIONS

Eight signal leds (normally off) are provided:



a)	Red LED	**I>,Z<,Io>**	❑ Flashing during the trip time delay of any of the following elements: I>, I>>,1Z, 2Z, 1Io, 2Io. ❑ Illuminated on trip after expiry of the set trip time delay of any of the above elements: tI>, tI>>, t1Z, t2Z, t1Io, t2Io.
b)	Red LED	**I_2>, T>**	❑ Flashing during the trip time delay of the 1Is, 2Is elements or when the thermal image's temperature exceeds the prealarm temperature [Ta]. ❑ Illuminated on trip after expiry of the set trip time delay of the 1Is, 2Is elements or when temperature exceeds the trip level.
c)	Red LED	**Z_c<, ϕ>**	❑ Flashing during the trip time delay of any of the following elements: Z_c, 1ϕ>, 2ϕ>. ❑ Illuminated on trip after expiry of the set trip time delay of any of the above elements: tZ_c, t1ϕ>, t2ϕ>.
d)	Red LED	**U,f**	❑ Flashing during the trip time delay of any over/under voltage elements 1U, 2U or over/under frequency elements 1f,2f. ❑ Illuminated on trip at the end of time delay.
e)	Yellow LED	**PROG/ I.R.F.**	❑ Flashing during the programming of the parameters. ❑ Illuminated in case of Internal Relay Fault.
f)	Red LED	**W<, Ir>**	❑ Same as d), related to W<, Ir>.
g)	Red LED	**IC 60FL**	❑ Illuminated in case of trip of the I>/V< or 60FL functions.
h)	Yellow LED	**B.I./B.F.**	❑ Lit-on when the Breaker Failure function operateds ❑ Flashing when a blocking signal is present at the relevant input terminals.

The reset of the leds takes place as follows:

- From flashing to off, automatically when the lit-on cause disappears.
- From ON to OFF, by "ENTER/RESET" push button via serial bus command only if the tripping cause has disappeared.

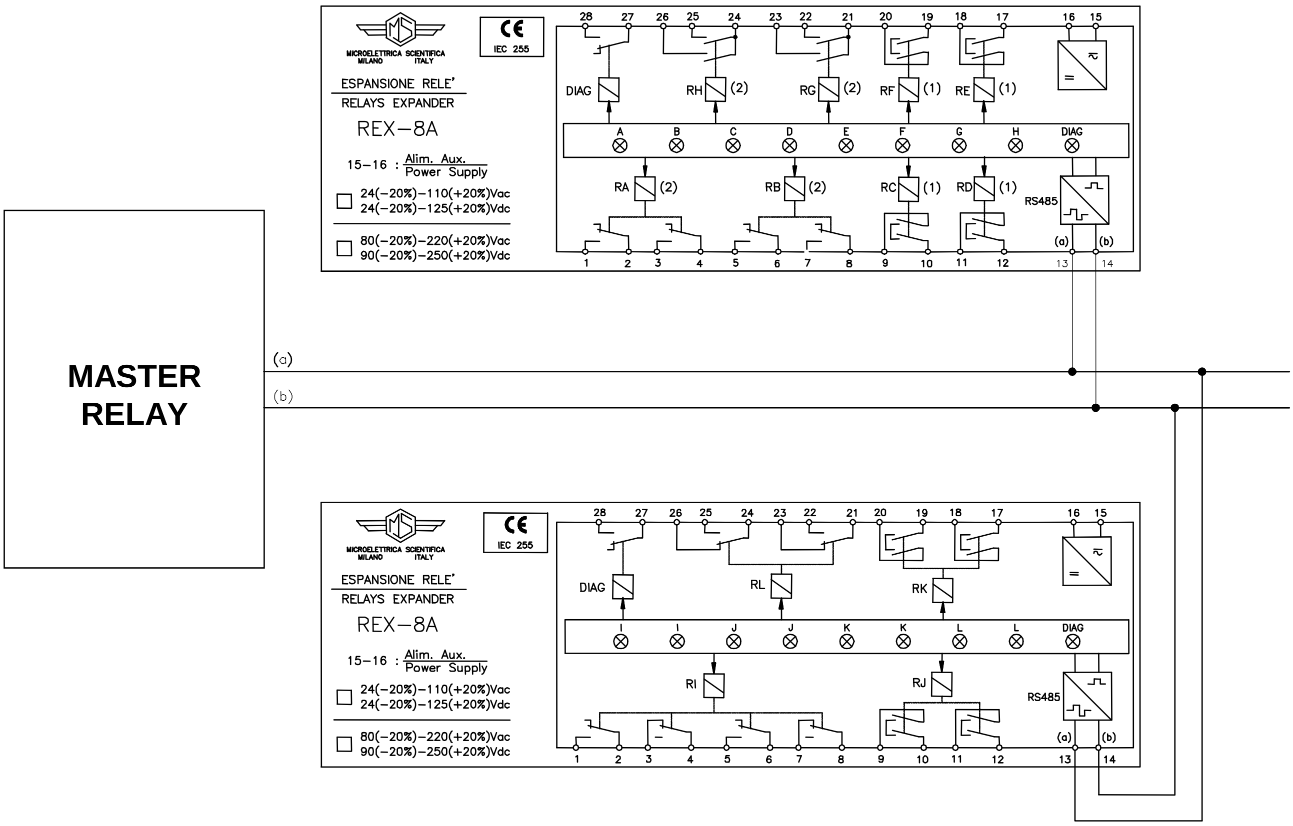
In case of auxiliary power supply failure the status of the leds is recorded and reproduced when power supply is restored.

5. OUTPUT RELAYS

The unit MG30-X includes four (R1, R2, R3, R4) user programmable plus one diagnostic (R5) output relays.
The number of output relays can be increased by the addition of one or two optional Relay Expansion modules REX-8.
The modules REX-8 are for protruding mounting and are controlled by the master module MG30-X via a screened twisted pairs of cables connecting dedicated RS485 serial ports (see diagram herebelow).
The module REX-8 includes eight (RA, RB, RC, RD, RE, RF, RG, RH) user programmable plus one (R-Diag) diagnostic output relays
The master module MG30-X can control all-together up to sixteen output relays

- 4 internal R1 – R2 – R3 – R4
- 8 from the first optional REX-8 module RA – RB – RC – RD – RE – RF – RG – RH
- 4 from a second optional REX-8 module RI(RA+RB) – RJ(RC+RD) – RK(RE+RF) – RL(RG+RH)

This second unit REX-8 is configured (by internal Dip-Switch) to operate the eight relays two by two in parallel (only four user programmable outputs with double number of available contacts)
<u>Any of the functions featured by the MG30-X can be programmed to control up to four</u> out of the sixteen user programmable output relays



a) - The user programmable relays (All except R5 and RDIAG) are normally deenergized (energised on trip). One relay eventually associated to the instantaneous element of one of the functions I>, I>>, 1Z, 2Z after pick-up normally drops-out as soon as the tripping cause disappears.
If the cause remains longer than the time delay programmed for the delayed element of the same function, the drop-out of the instantaneous relay is anyhow forced after an adjustable waiting time [tBF].(Disactivation of the blocking output eventually used to block a relay upstream in the distribution system).
Moreover any of the programmable relays 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) by operating the ENTER/RESET key on relay's front or via the serial bus.

b) - The relays R5, R DIAG, are not user programmable; they are normally energized and get deenergized on :

R5
- internal fault of MG30-X
- MG30-X power supply failure
- during the programming

R DIAG
- Internal fault of REX-8
- REX-8 power supply failure
- Interruption/fault on the serial control communication

6. SERIAL COMMUNICATION

Besides the serial port used for driving the Relay Expansion REX-8, the relays fitted with the serial communication option can be connected via a cable bus or (with proper adapters) a fiber optic bus for interfacing with a Personal Computer (type IBM or compatible).
All the operations which can be performed locally (for example reading of measured data and changing of relay's settings) are also possible via the serial communication interface.
Furthermore the serial port allows the user to read the demand recording 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, thus having many relays to exchange data with a single master P.C. using the same physical serial line. A RS485/232 converter is available on request.
The communication protocol is MODBUS RTU (only functions 3, 4 and 16 are implemented).
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCOM) for Windows 95/98/NT4 SP3 (or later) is available.
Please refer to the MSCOM instruction manual for more information Microelettrica Scientifica.

7. DIGITAL INPUTS

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

❑	**2**	(terminals 1 - 2)	:	it blocks the operation of the relays associated to one or more of the time delayed elements of the functions I>, I>>, 1Z, 2Z in any possible combination as programmed.
❑	**3**	(terminals 1 - 3)	:	it blocks the operation of the relays associated to one or more of the time delayed elements of the functions Ir>, Zc<, 1Io>, 2Io> in any possible combination as programmed.
❑	**4**	(terminals 1 - 14)	:	It blocks the operation of the relays associated to one or more of the functions 1U, 2U, 1f, 2f in any possible combination.

When a function is blocked the pick-up of its time delayed element 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 configure very efficient arrangements of logic fault discrimination as well as to feature a safe and quick breaker back-up protection.

8. TEST

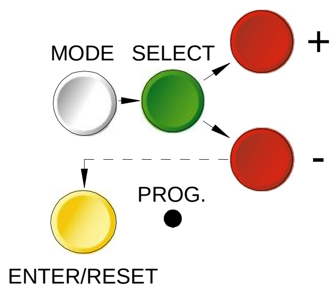
Besides the normal "WATCHDOG" and "POWERFAIL" functions, a comprehensive program of self-test and self-diagnostic provides:

- 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.

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			Descrizione
xxXXXxx			Date : Day, Month, Year
xx:xx:xx			Hour : Hours, Minutes, Seconds
T	xxxx	**%Tn**	Actual thermal state as % of the steady full load state Tn : (0-999)%
IA	xxxxx	**A**	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
UA	xxxxx	**V**	R.M.S. value of phase-to-phase voltage U_{AB} : (0-65535)V
UB	xxxxx	**V**	As above, phase U_{BC}
UC	xxxxx	**V**	As above, phase U_{CA}
φa	xxxxx	**°**	Phase displacement of IA on EA : (0-360° anticlockwise)
φb	xxxxx	**°**	Phase displacement of IB on EB : (0-360° anticlockwise)
φc	xxxxx	**°**	Phase displacement of IC on EC : (0-360° anticlockwise)
W	xxxx	**%Wb**	Three phase active power as % of generator's rated power: (0-999)% (Wb=√3•Un•Ib)
f	xxxxx	**Hz**	System frequency : (40.00-70.00)Hz
I2	xxxx	**%Ib**	R.M.S. Negative sequence current as % of generator's rated current Ib
Io	xxxx	**A**	System Frequency component of Earth Fault Current displayed as primary Amps: (0-99999)

10.2 - MAX VAL

Maximum demand values recorded starting from 100ms after closing of main Circuit Breaker (updated any time the C/B closes)

Display			Descrizione
T	xxxx	**%Tn**	Thermal image state as % of full load temperature
IA	xx.x	**In**	Phase A current displayed as p.u. of C.Ts rated current
IB	xx.x	**In**	As above, phase B
IC	xx.x	**In**	As above, phase C
I2	xxxx	**%Ib**	Negative sequence current as % of generator's rated current
W	xxxx	**%Wb**	Active power as % of generator's rated power
Io	xxxx	**On**	System Frequency component of Earth Faul Current as p.u. of Neutral CT rared Current

10.3 - LASTTRIP

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

Display			Descrizione
LastTr-x			Indication of the recorded event (x= 0 to 4) Example: Last event (LastTr -0) Last but one event (LastTr-1) etc...
xxXXXxx			Date : Day, Month, Year
xx:xx:xx			Hour : Hours, Minutes, Seconds
F:	xxxxxx		Function which produced the event being displayed : **I>, I>>, 1Is, 2Is, Ir, FL, 1U, 2U, 1f, 2f, W<, T>, 1Z, 2Z, 1Φ, 2Φ, 1Io, 2Io, 60FL, IC.**
T	xxxx	**%Tn**	Temperature of thermal image.
IA	xx.x	**In**	Current phase A.
IB	xx.x	**In**	Current phase B.
IC	xx.x	**In**	Current phase C.
EA	xxx	**%En**	Phase-to-Neutral voltage phase A
EB	xxx	**%En**	Phase-to-Neutral voltage phase B
EC	xxx	**%En**	Phase-to-Neutral voltage phase C
φa	xxxxx	**°**	Phase displacement of current phase A
φb	xxxxx	**°**	Phase displacement of current phase B
φc	xxxxx	**°**	Phase displacement of current phase C
W	xxxx	**%Wb**	Three phase active power
f	xx.xx	**Hz**	Frequency
I2	xxxx	**%Ib**	Negative sequence current
Io	xxxx	**On**	System Frequency component of Earth Faul Current as p.u. of Neutral CT rared Current

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		Descrizione
T>	xxxxxx	Thermal overload
I>	xxxxxx	Time delayed trip of 1st O/C element [tI>].
I>>	xxxxx	As above, 2nd O/C element [tI>>].
1Is	xxxxx	As above, 1st negative sequence O/C element
2Is	xxxxx	As above, 2nd negative sequence O/C element
Ir>	xxxxx	As above, reverse current element
1u	xxxxxx	As above, element 1U
2u	xxxxxx	As above, element 2U
1f	xxxxxx	As above, element 1f
2f	xxxxxx	As above, element 2f
FL	xxxxxx	As above, loss of field element
W<	xxxxxx	As above, under power element
1Z	xxxxxx	As above, Underimpedance element 1Z
2Z	xxxxxx	As above, Underimpedance element 2Z
1Φ	xxxxxx	As above, Overfluxing element 1Φ
2Φ	xxxxxx	As above, Overfluxing element 2Φ
1Io	xxxxx	As above, Stator Ground Fault element 1Io
2Io	xxxxx	As above, Stator Ground Fault element 2Io
60FL	xxxx	As above, PT’s Fuse Failure element
IC	xxxxxx	As above, Inadvertent generator’s energization 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;
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 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

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).

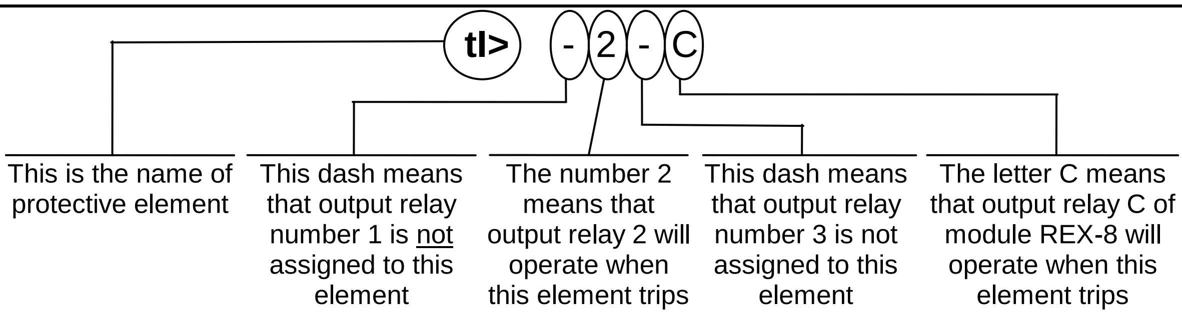
Display	Description	Setting Range	Step	Unit
xxxxxxx	Current date	DDMMMYY	-	-
xx:xx:xx	Current time	HH:MM:SS	-	-
Tsyn Dis **m**	Synchronisation Time Expected time interval between sync. signal.	5 - 60 - Dis	5-10 15-30 60-Dis	m
NodAd 1	Identification number for connection on serial communication bus	1 - 250	1	-
Fn 50 **Hz**	System frequency	50 - 60	10	Hz
In 500 **Ap**	Rated primary current of the phase C.Ts.	1 - 9999	1	A
Kv 3.8	Ratio of system PTs	2.0 - 655	0.1	-
UnS 100 **V**	P.Ts. rated secondary phase-to-phase voltage	50 – 125	1	V
On 100 **V**	Rated secondary current of neutral-to-ground PT	50 – 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	-
U/I> ON	Voltage control on level I>	ON - OFF	ON-OFF	-
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
U/I>> ON	Voltage control on level I>>	ON - OFF	ON-OFF	-
I>> 3 **Ib**	Trip level of high-set overcurrent element (p.u. of Ib)	1 - 9.9 - Dis	0.1	Ib
tI>> 0.05 **s**	Trip time delay of the high-set overcurrent element	0.05 - 3	0.01	s

Display			Descrizione	Regolazione	Passo	Unità
1Is	0.05	**Ib**	Generator's max. continuos negative sequence current rating (p.u. of Ib)	0.05-0.5-Dis	0.01	p.u.Ib
Ks	5	**s**	Time multiplier of the I_2^2t time-current curve	5 - 80	1	s
tcs	10	**s**	Cooling time from trip level to the state corresponding to I2=1Is	10 - 1800	1	s
2Is	0.03	**Ib**	Negative sequence current alarm level	0.03-0.5-Dis	0.01	Ib
t2Is	1	**s**	Independent trip time delay of alarm element	1 - 100	1	s
Ir>	0.02	**Ib**	Trip level of the reverse power element	0.02 - 0.2 - Dis	0.01	Ib
tIr>	0.1	**s**	Independent trip time delay of reverse power element	0.1 - 60	0.01	s
K1	300	**%Zb**	Diameter of the circle including the underimpedance tripping zone (Loss of Field element)	50 - 300 - Dis	1	%Zb
K2	50	**%Zb**	Offset of the circle (% of Zb=Vn/(√3 Ib) **Underimpedance trip is inhibited on undervoltage U<0,3Un and undercurrent I<0,2Ib**	5 - 50	1	%Zb
tz	0.2	**s**	Trip time delay of the Loss of Field element	0.2 - 60	0.1	s
ti	0.0	**s**	Integration time of Loss of Field 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
Un	+/-	**1u**	Operation mode of first voltage element **-** = undervoltage **+** = overvoltage **+/-** = over/under voltage Dis = disactivated	**-** **+** **+/-** Dis	**-** **+** **+/-** Dis	-
1u	15	%En	Pick-up level of the first voltage element	1 - 50	1	% En
t1u	1.00	**s**	Trip time delay of the first voltage element	0.10 - 60	0.1	s
Un	+	**2u**	Operation mode of second voltage element **-** = undervoltage **+** = overvoltage **+/-** = over/under voltage Dis = disactivated	**-** **+** **+/-** Dis	**-** **+** **+/-** Dis	-
2u	10	%En	Pick-up level of the second voltage element	1 - 50	1	% En
t2u	3	**s**	Trip time delay of the second voltage element	0.10 - 60	0.1	s
Fn	+/-	**1f**	Operation mode of first frequency element **-** = underfrequency **+** = overfrequency **+/-** = over/under frequency Dis = disactivated	**-** **+** **+/-** Dis	**-** **+** **+/-** Dis	-
1f	0.5	**Hz**	Pick-up level of the first frequency element	0.05 - 9.99	0.01	Hz
t1f	3	**s**	Trip time delay of the first frequency element	0.1 - 60	0.1	s
Fn	+	**2f**	Operation mode of second frequency element **-** = underfrequency **+** = overfrequency **+/-** = over/under frequency Dis = disactivated	**-** **+** **+/-** Dis	**-** **+** **+/-** Dis	-
2f	1	**Hz**	Pick-up level of the second frequency element	0.05 - 9.99	0.01	Hz
t2f	0.5	**s**	Trip time delay of the second frequency element	0.1 - 60	0.1	s
Tc	60	**m**	Thermal time constant of the alternator	1 - 400	1	m
Ta/n	100	**%**	Prealarm level of the thermal image	50 - 110	1	%Tn
W<	0.05	**Wb**	Pick-up level of the active underpower element	0.05-1.00-Dis	0.05	Wb
tW<	0.1	**s**	Trip time delay	0.1 - 60	0.1	s

Display			Descrizione	Regolazione	Passo	Unità
1Z	0.5	**Zn**	Pick-up level of the 1st underimpedance element	0.1 – 1 - Dis	0.01	p.u. Zn
t1Z	1	**s**	Trip time delay of 1Z element	ist - 0.05 – 9.99	0.01	s
2Z	1	**Zn**	Pick-up level of the 2nd underimpedance element	0.1 – 1 - Dis	0.01	p.u. Zn
t2Z	2	**s**	Trip time delay of 2Z element	ist - 0.05 – 9.99	0.01	s
1Φ>	1.2	**pU**	Pick-up level of the V/Hz inverse time element	1 – 2 - Dis	0.1	p.u.
K	0.5		Time multiplier of the V/Hz T.C.C.	0.5 – 5	0.1	-
2Φ>	1.2	**pU**	Pick-up level of the V/Hz definite time element	1 – 2 - Dis	0.1	p.u.
t2Φ	5.0	**s**	Trip time delay of the 2Φ element	0.1 – 60	0.1	s
1Io	5	**%On**	Pick-up level of the 1st 64S element	2 – 80 – Dis	1	%On
t1O	2	**s**	Trip time delay of the element 1Io	ist - 0.05 – 9.99	0.01	s
2Io	10	**%On**	Pick-up level of the 2nd 64S element	2 – 80 – Dis	1	%On
t2O	3	**s**	Trip time delay of the element 2Io	ist - 0.05 – 9.99	0.01	s
60FL	ON		PTs' Fuse Failure element	ON – OFF	-	-
IC	ON		Inadvertent generator energization element	ON – OFF	-	-
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 (Settings out of production are here under shown).
The key "**+**" operates as cursor; it moves through the digits corresponding to the four relays programmable for any functions in the sequence 4-3-2-1-L-K-J-I-H-G-F-E-D-C-B-A (4=Relay R4 etc.) and makes start flashing the information actually present in the digit. The information present in the digit can be either the number/letter of the relay (if this was already associated to the function actually on programming) or a dot (-) if this place was not yet addressed.
The key "**-**" changes the existing status from the dot to the relay number/letter or viceversa.

Display					Descrizione			
I>	-	-	-	-	Instantaneous element of low-set overcurrent	operates relays R1, →R4	Only for Ver. MG30-I -X	RA,RB→RL
tI>	1	-	-	-	As above, time delayed element	operates relays R1, →R4		RA,RB→RL
I>>	-	-	-	-	Instantaneous element of high-set overcurrent	operates relays R1, →R4		RA,RB→RL
tI>>	1	-	-	-	As above, time delayed element	operates relays R1, →R4		RA,RB→RL
1Is	-	2	-	-	First unbalance element (time delayed)	operates relays R1, →R4		RA,RB→RL
2Is	-	-	-	4	As above, second unbalance element	operates relays R1, →R4		RA,RB→RL
tIr>	-	2	3	-	Reverse power time delayed element	operates relays R1, →R4		RA,RB→RL
FL	-	2	-	-	Field Loss Underimpedance time delayed element	operates relays R1, →R4		RA,RB→RL
tW<	-	-	-	4	Underpower time delayed element	operates relays R1, →R4		RA,RB→RL

Display					Descrizione			
1U	-	-	-	4	Time delayed element 1U	operates relays R1, →R4	Only for Ver. MG30-I-X	RA,RB→RL
2U	-	2	3	-	Time delayed element 2U	operates relays R1, →R4		RA,RB→RL
1f	-	-	-	4	Time delayed element 1f	operates relays R1, →R4		RA,RB→RL
2f	-	-	-	4	Time delayed element 1f	operates relays R1, →R4		RA,RB→RL
T>	-	2	-	-	Overtemperature element	operates relays R1, →R4		RA,RB→RL
Ta/n	-	-	-	4	Thermal prealarm	operates relays R1, →R4		RA,RB→RL
1Z	-	-	-	-	Instantaneous element 1Z	operates relays R1, →R4		RA,RB→RL
t1Z	1	-	-	-	Delayed element t1Z	operates relays R1, →R4		RA,RB→RL
2Z	-	-	-	-	Instantaneous element 2Z	operates relays R1, →R4		RA,RB→RL
t2Z	1	-	-	-	Delayed element t2Z	operates relays R1, →R4		RA,RB→RL
1ϕ	-	-	-	-	Instantaneous element 1ϕ	operates relays R1, →R4		RA,RB→RL
t1ϕ	1	-	-	-	Delayed element t1ϕ	operates relays R1, →R4		RA,RB→RL
2ϕ	-	-	-	-	Instantaneous element 2ϕ	operates relays R1, →R4		RA,RB→RL
t2ϕ	1	-	-	-	Delayed element t2ϕ	operates relays R1, →R4		RA,RB→RL
1Io	-	-	-	-	Instantaneous element 1Io	operates relays R1, →R4		RA,RB→RL
t1O	1	-	-	-	Delayed element t1O	operates relays R1, →R4		RA,RB→RL
2Io	-	-	-	-	Instantaneous element 2Io	operates relays R1, →R4		RA,RB→RL
t2O	1	-	-	-	Delayed element t2O	operates relays R1, →R4		RA,RB→RL
60FL	-	-	-	4	Function 60FL	operates relays R1, →R4		RA,RB→RL
IC	1	-	-	-	Function IC	operates relays R1, →R4		RA,RB→RL
tBF	-	-	-	-	Breaker Failure function (N.B. tBF cannot operate relay R1)	R2, R3, R4		RA,RB→RL
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.			
2A	I>>				The input (2) for blocking the time delayed elements relevant to phase and ground faults operate on (I>) or (I>>) or (I>+I>>)			
t2	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).			
3A	Ir				The blocking input (3) operate on function (FL) or (Ir>) or (FL+Ir>)			
4A	-				The blocking input (4) blocks the operation of the delayed elements of functions (1f) or (2f) or (1f+2f).			
2B	-				The blocking input (2) blocks the operation of the delayed elements of functions (1Z) or (2Z) or (1Z+2Z)			
3B	-				The blocking input (3) blocks the operation of the delayed elements of functions (1Io) or (2Io) in any possibl combination			
4B	-				The blocking input (2) blocks the operation of the delayed elements of functions (1u) or (2u) or (1u+2u)			

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

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

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

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

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

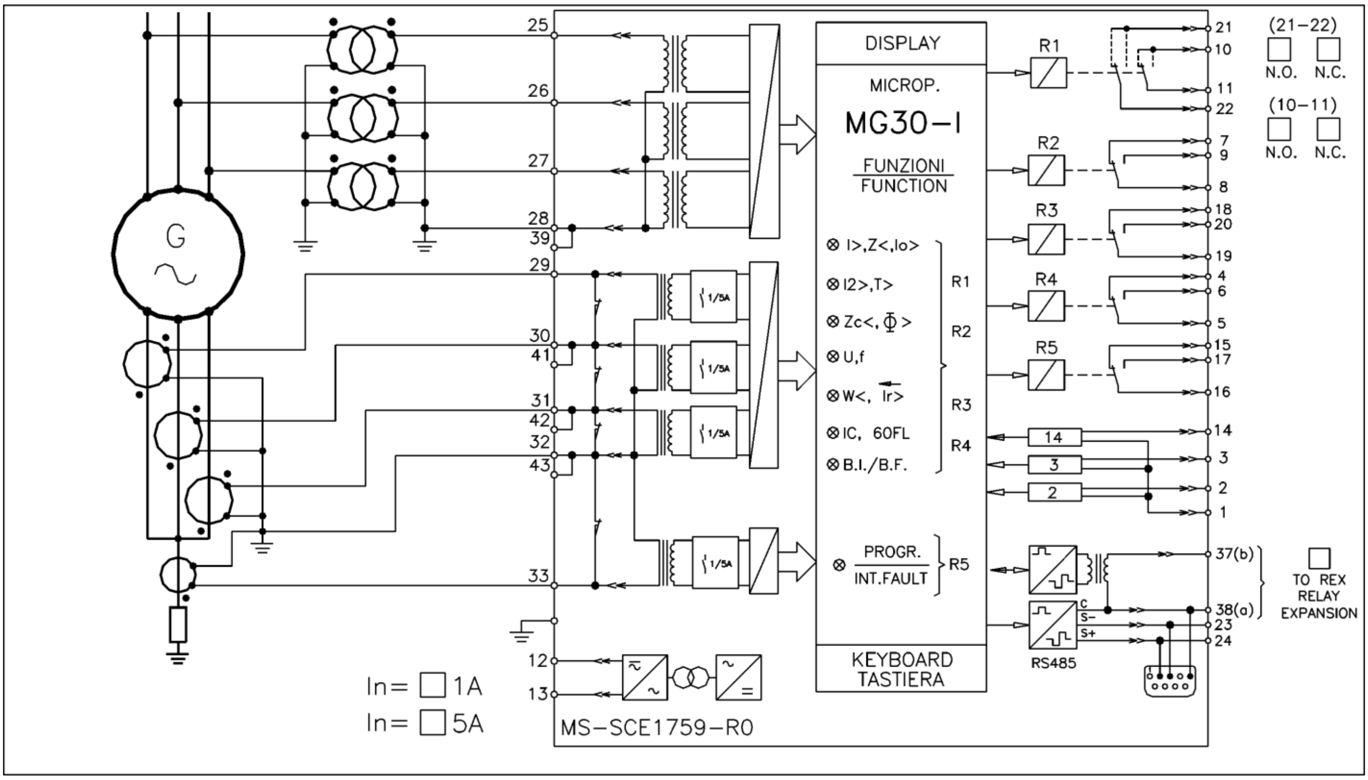
❑ Electromagnetic emission	EN55022 industrial environment			
❑ Radiated electromagnetic field immunity test	IEC61000-4-3 ENV50204	level 3	80-1000MHz 900MHz/200Hz	10V/m 10V/m
❑ Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
❑ Electrostatic discharge test	IEC61000-4-2	level 4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

CHARACTERISTICS

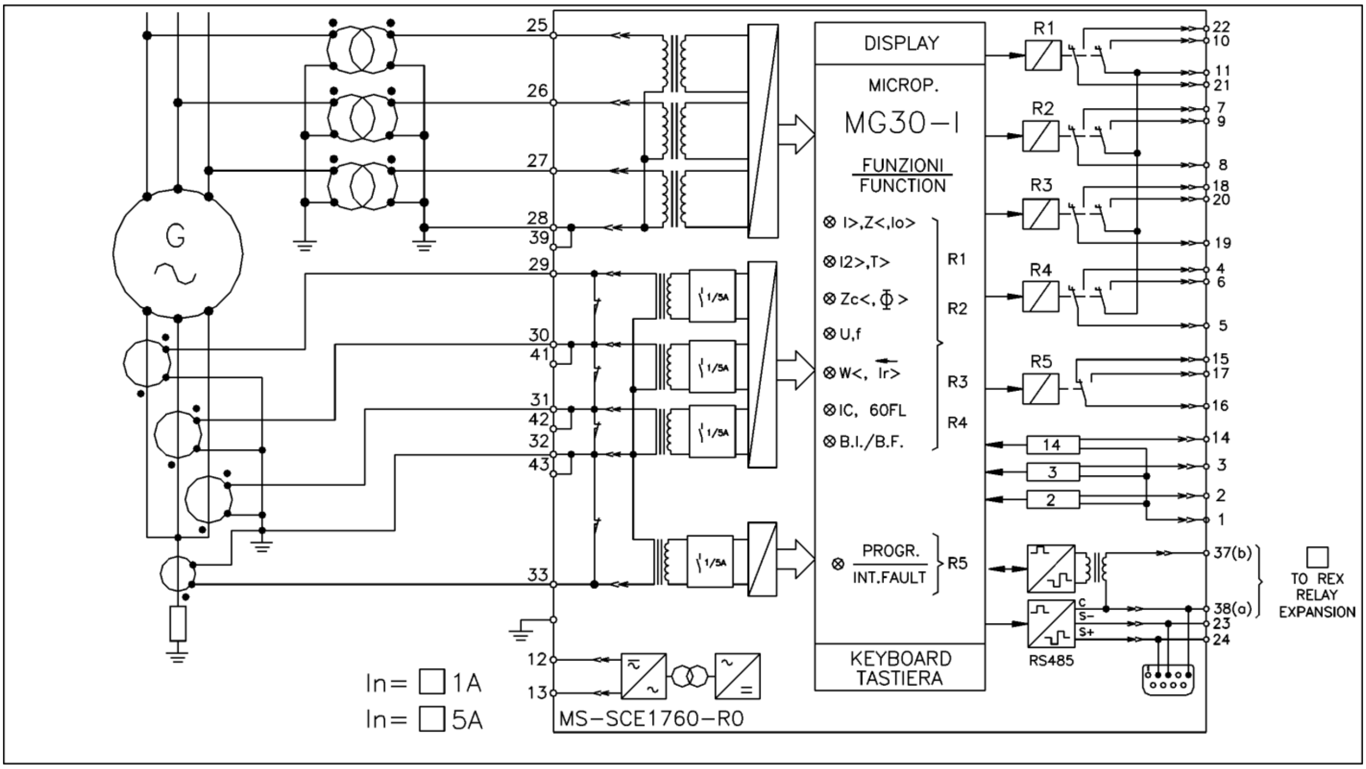
❑ Accuracy at reference value of influencing factors	2% 2% +/- 10ms	for measure for times
❑ Rated Current	In = 1 or 5A	
❑ Current overload	200 A for 1 sec; 10A continuous	
❑ Burden on current inputs	Phase : 0.01VA at In = 1A; 0.25VA at In = 5A	
❑ Rated Voltage	Un = 100V (different on request)	
❑ Voltage overload	2 Un continuous	
❑ Burden on voltage input	0,05 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.)	

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

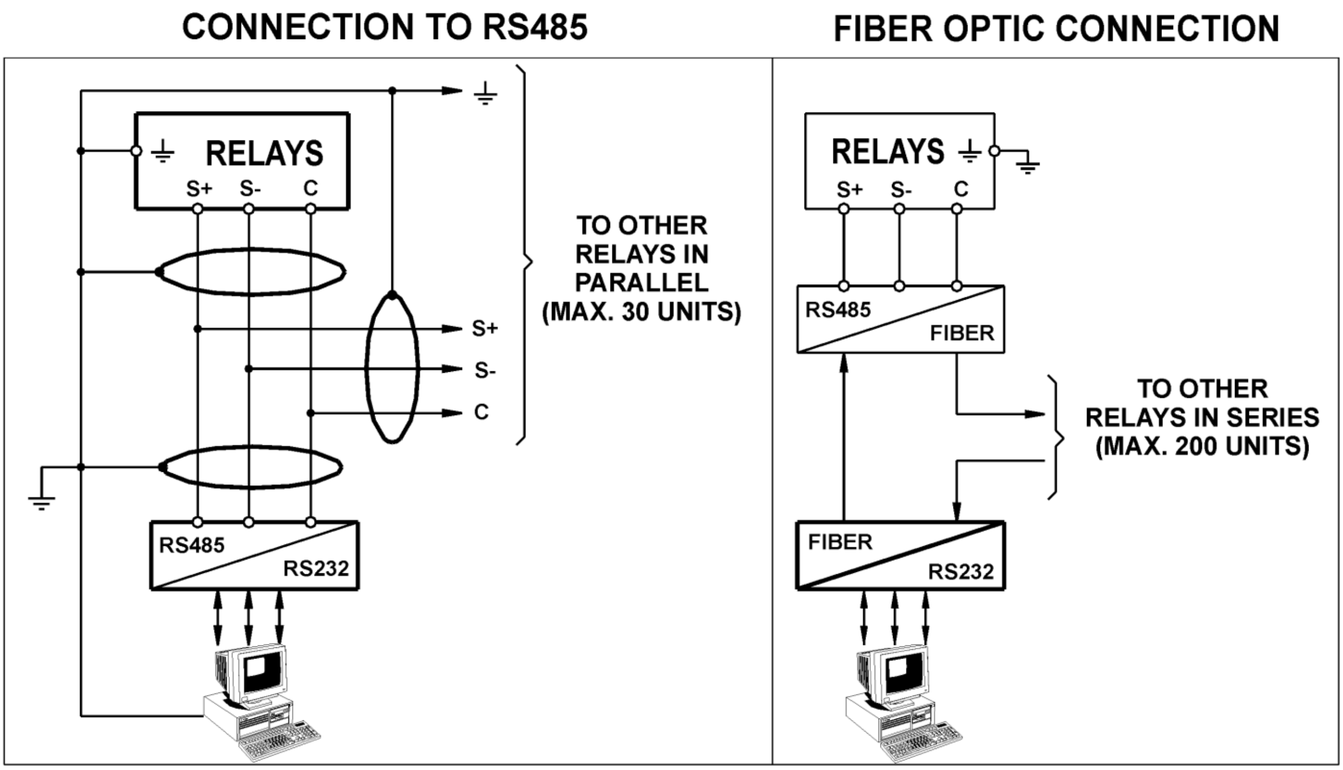
17. CONNECTION DIAGRAM (SCE1759 Rev.0 Standard Output)



17.1 - CONNECTION DIAGRAM (SCE1760 Rev.0 Double Output)

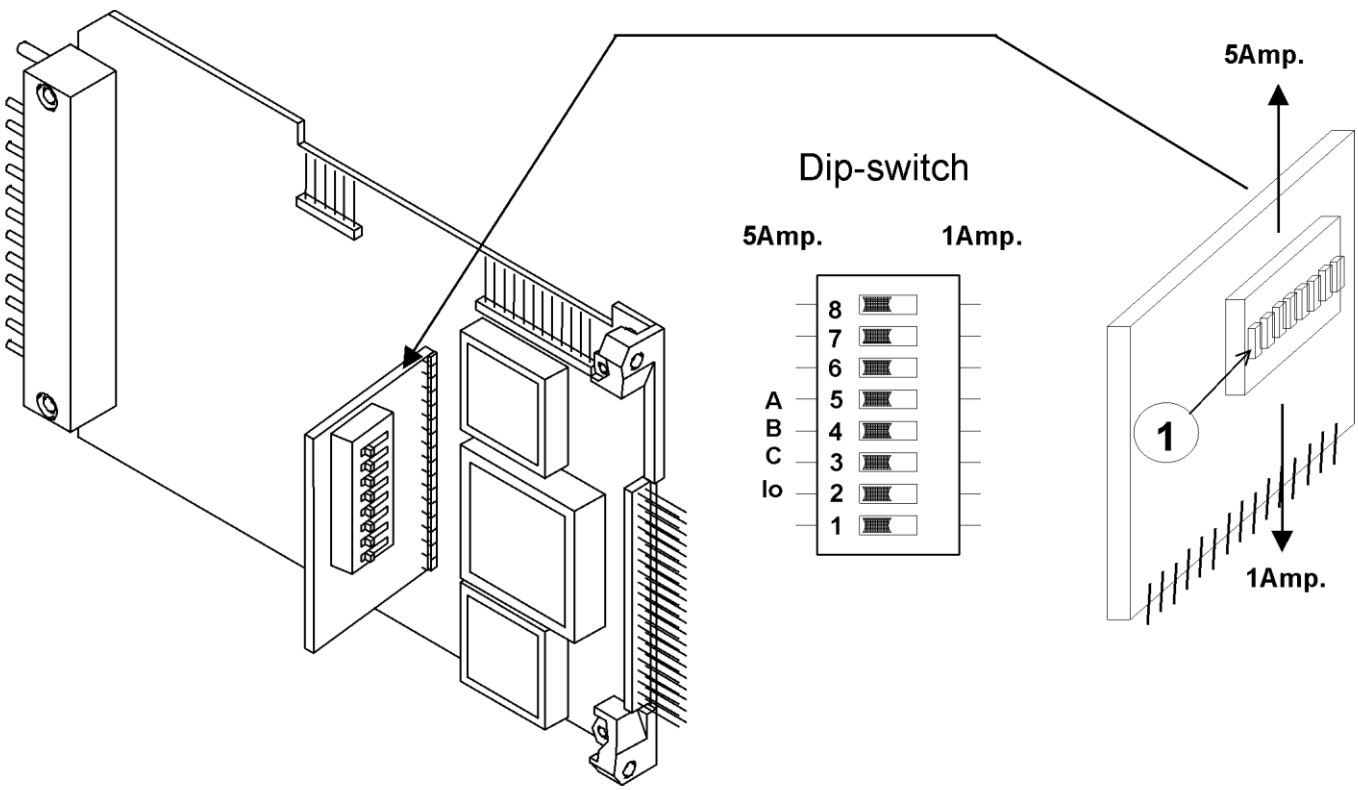


18. WIRING THE SERIAL COMMUNICATION BUS (SCE1309 Rev.0)

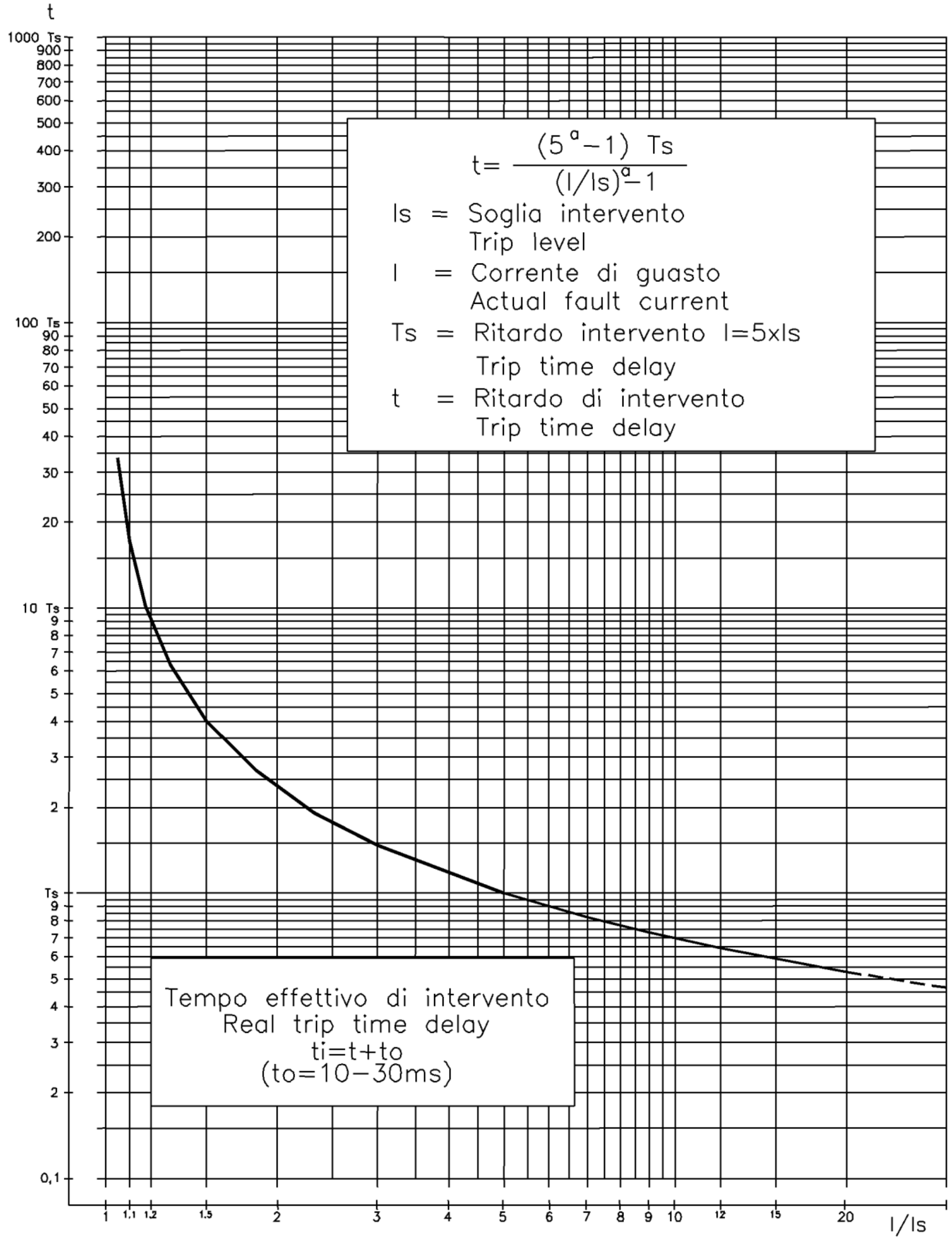


19. CHANGE PHASE CURRENT RATED INPUT 1 OR 5A

Phase current input can be 1 or 5A (movable jumpers on relay's card).



20. TIME CURRENT CURVES F51 (TU0311 Rev.0)

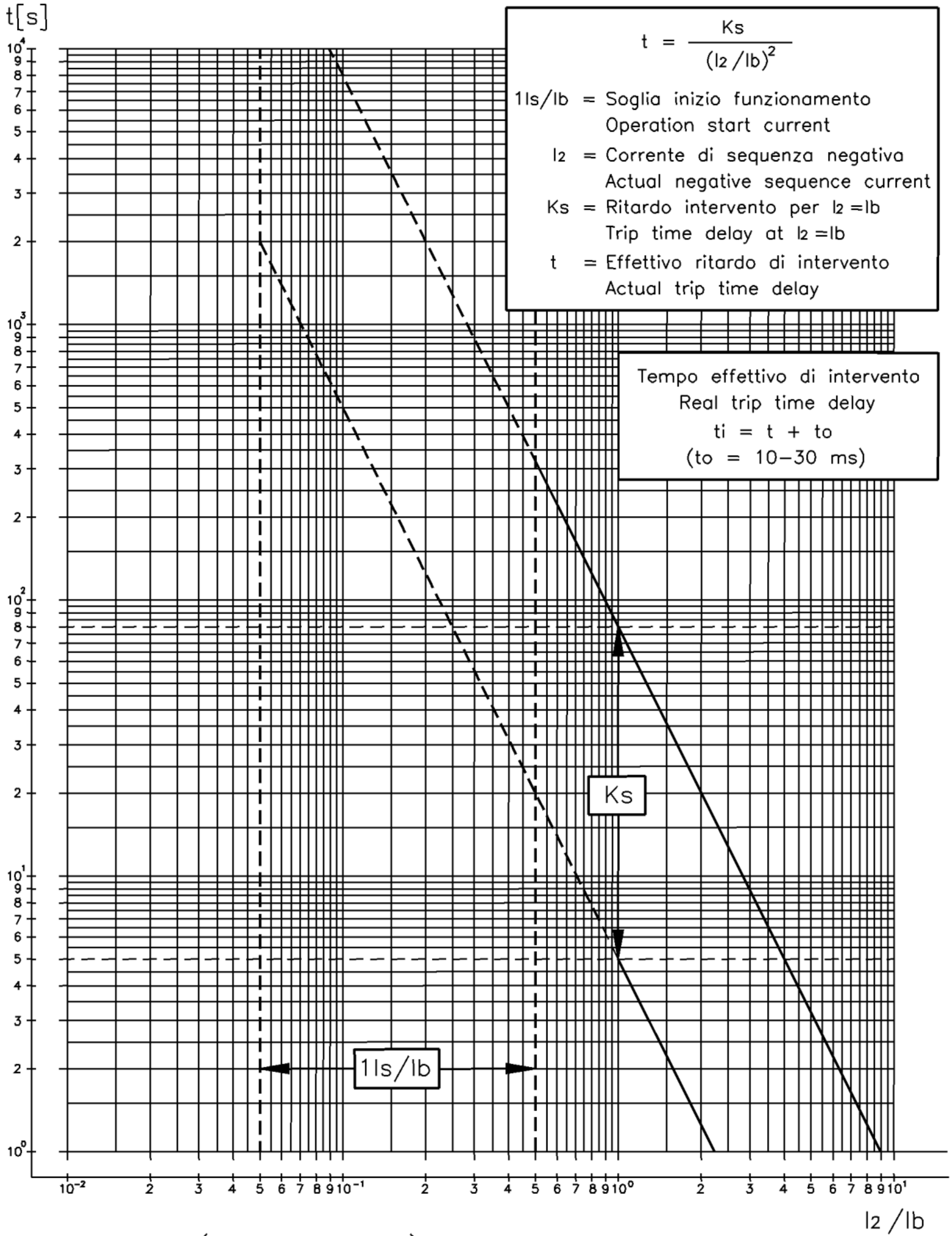


Tempo normalmente inverso
Normal inverse time

a=0.02

F51
Is = I> = (1 − 2,5)Ib
Ts = tI> = (0.05−30)s

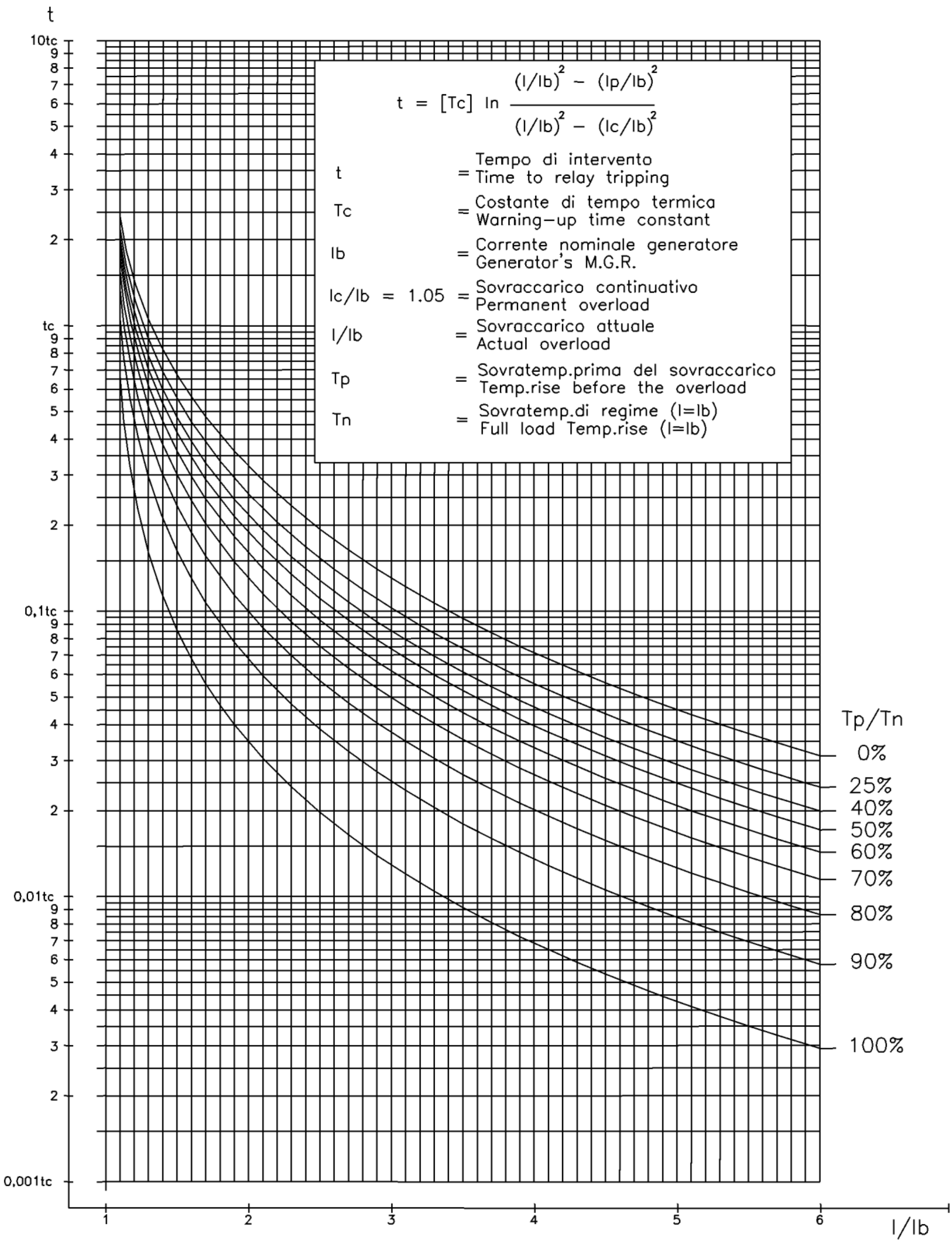
21. I^2t = CONSTANT ELEMENT F46 (TU0312 Rev.0)



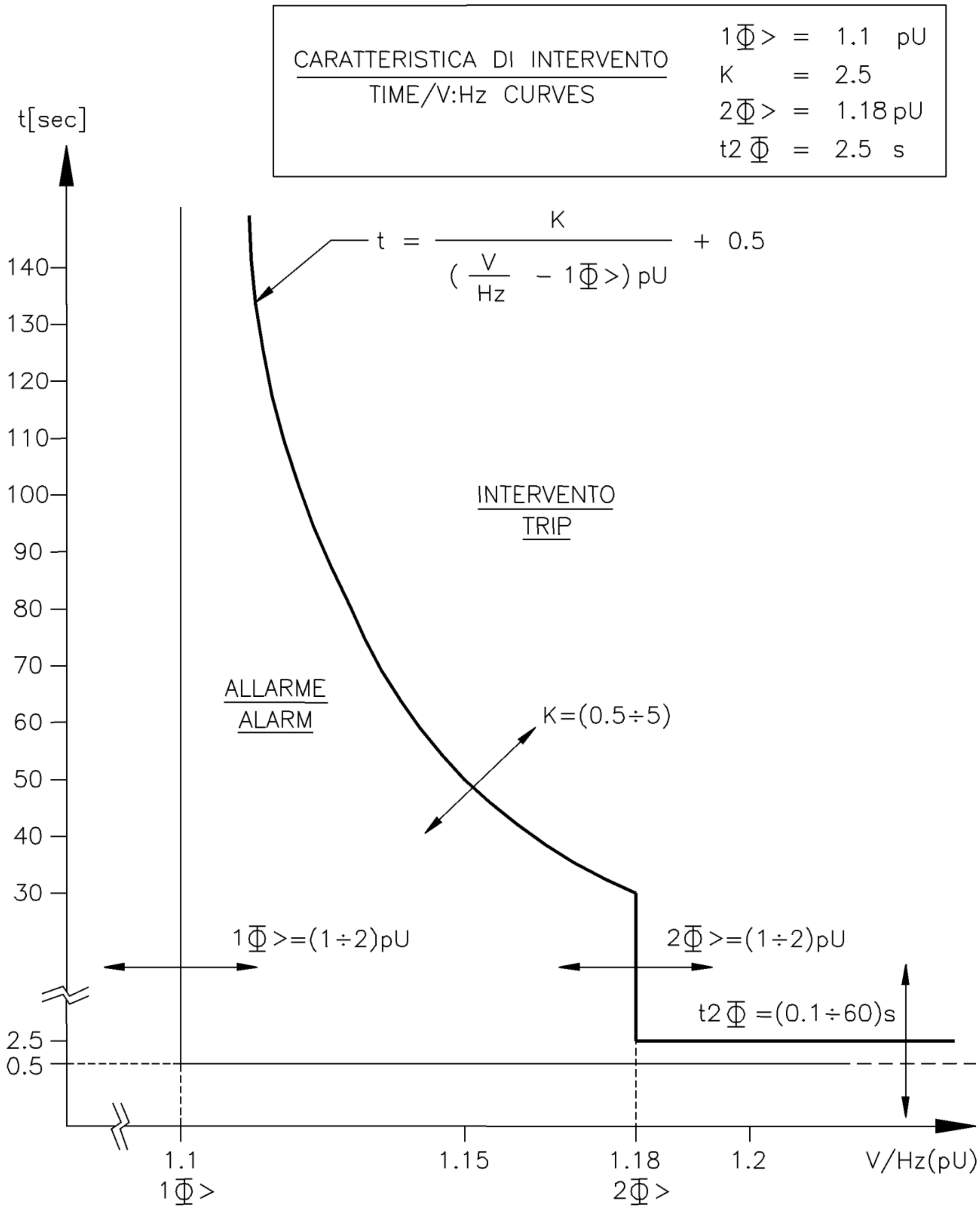
I_2 = (0.05 – 0.5)Ib step 0.01In

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

22. THERMAL IMAGE CURVES (TU0325 Rev.0)



23. TIME CURRENT CURVES V/Hz (TU0326 Rev.0)



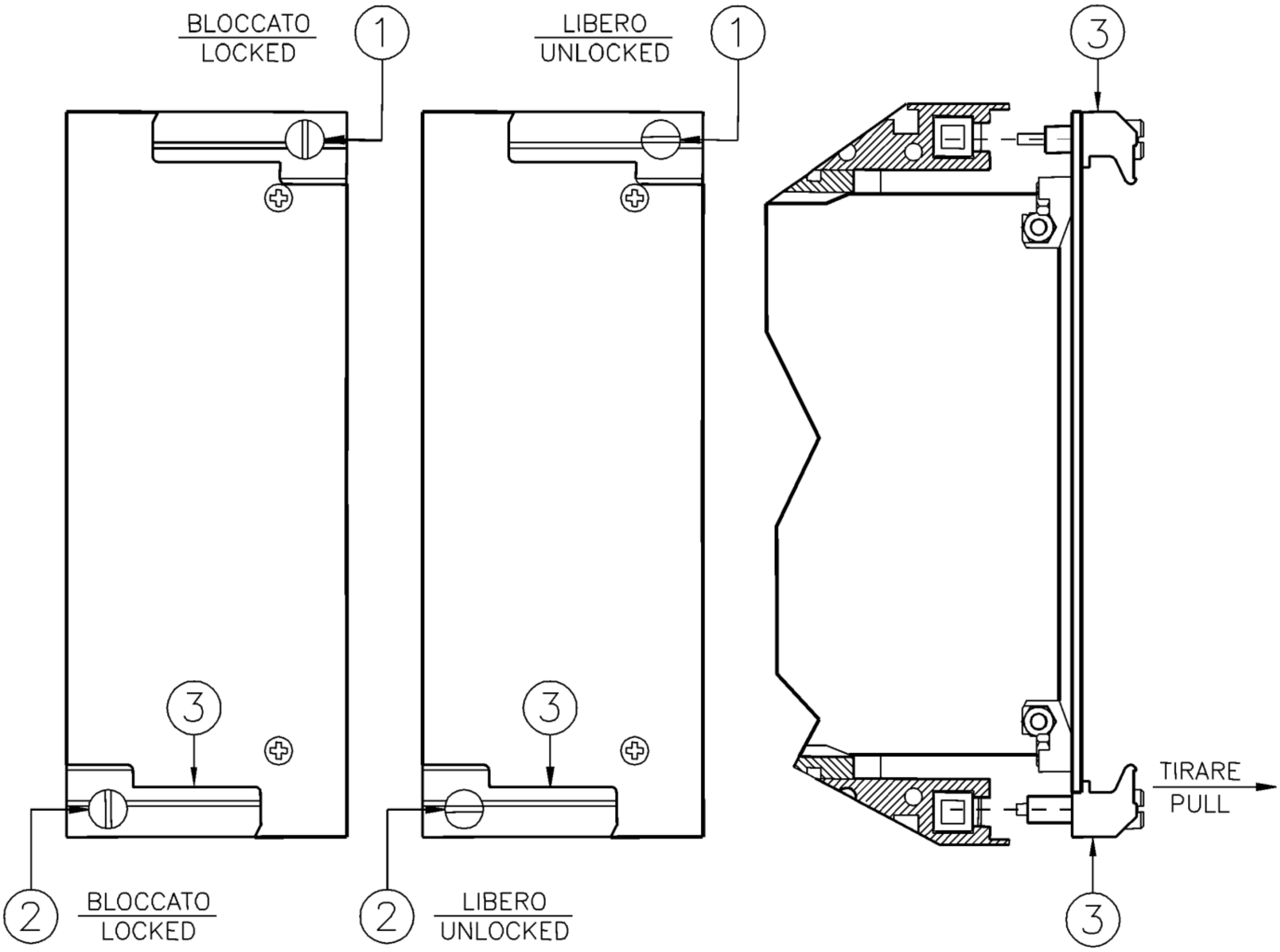
24. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

24.1 Draw-out

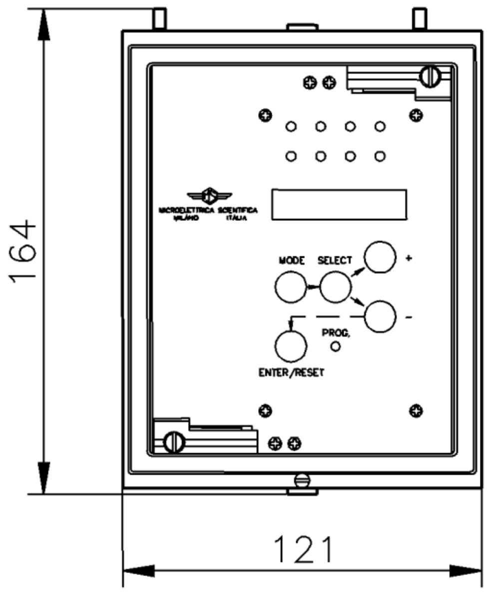
Rotate clockwise the screws ① and ② in the horizontal position of the screws-driver mark.
Draw-out the PCB by pulling on the handle ③

24.2 Plug-in

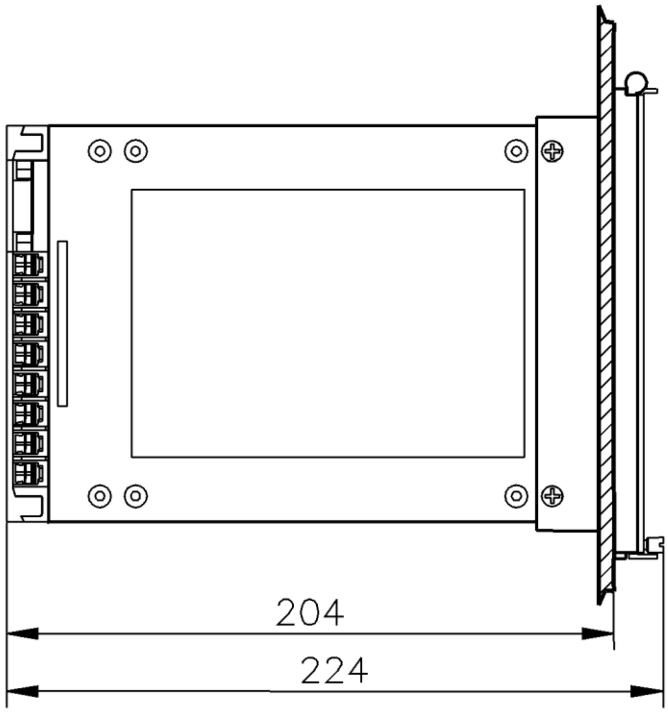
Rotate clockwise the screws ① and ②in the horizontal position of the screws-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and by pressing the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position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

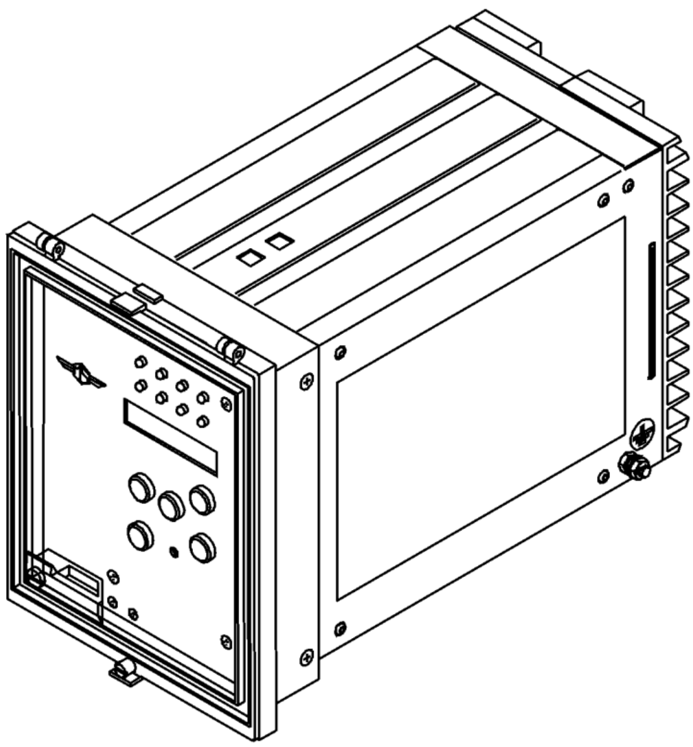


25. OVERALL DIMENSIONS

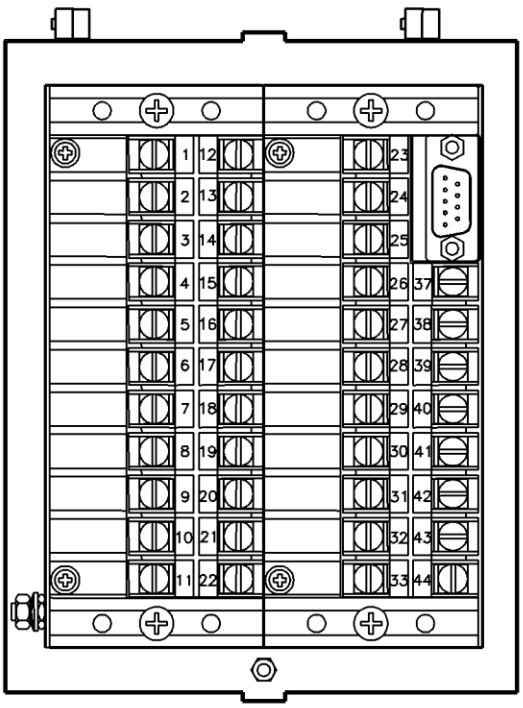


PANEL CŪT OUT 113x142 (LxH)

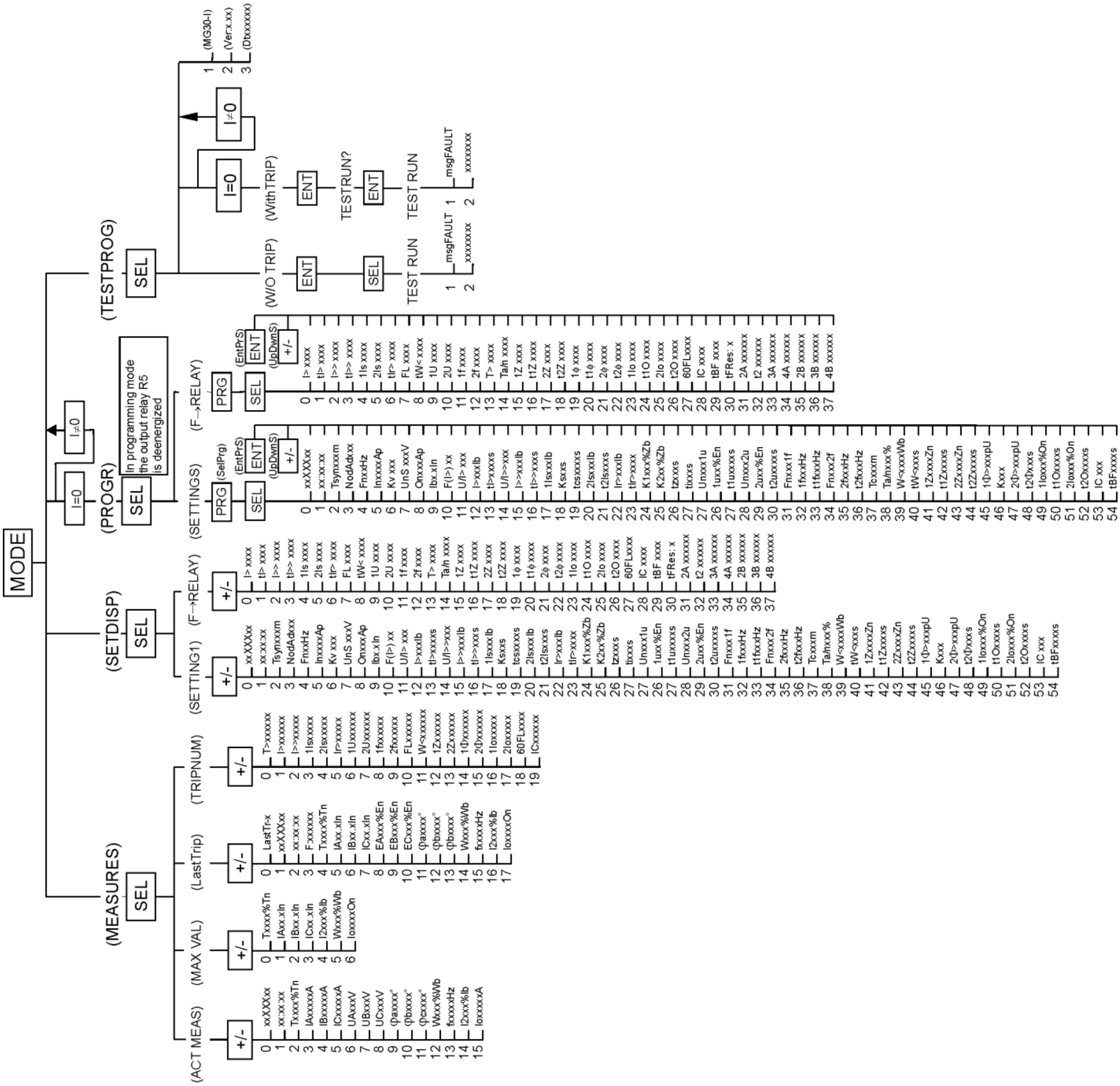




View of Rear Terminal Connection



26. KEYBOARD OPERATIONAL DIAGRAM



27. PROGRAMMING'S FORM

Relay Type	**MG30-I**	**Station :**	**Circuit :**
Date :	/ /		**Relay Serial Number :**
Power Supply	☐ 24V(-20%) / 110V(+15%) a.c. 24V(-20%) / 125V(+20%) d.c.	**Rated Current :**	☐ **1A** ☐ **5A**
	☐ 80V(-20%) / 220V(+15%) a.c. 90V(-20%) / 250V(+20%) d.c.	**Rated Voltage :**	

RELAY PROGRAMMING

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result	
						Pick-up	Reset
xxxxxxx	Current date	DDMMMYY	**-**	random			
xx:xx:xx	Current time	HH:MM:SS	**-**	random			
Tsyn	Synchronisation Time	5 - 60 - Dis	**m**	Dis			
NodAd	Identification number for serial communication bus	1 - 250	-	1			
Fn	System frequency	50 - 60	**Hz**	50			
In	Rated primary current of the phase C.Ts.	1 - 9999	**Ap**	500			
Kv	Ratio of system PTs	2.0 - 655	**-**	3.8			
UnS	P.Ts. rated secondary phase-to-phase voltage	50 – 125	**V**	100			
On	Rated secondary voltage of neutral-to-ground PT	1 - 9999	**Ap**	100			
Ib	Generator's rated current as p.u. of C.Ts rated current	0.5 - 1.1	**In**	0.5			
F(I>)	Operation characteristic of the low-set overcurrent element	D - SI	-	D			
U/I>	Voltage control on level I>	ON - OFF	**-**	ON			
I>	Trip level of low-set overcurrent element (p.u. of Ib)	1 - 2.5 - Dis	**Ib**	1.0			
tI>	Trip time delay of the low-set overcurrent element	0.05 - 30	**s**	0.05			
U/I>>	Voltage control on level I>>	ON - OFF	-	ON			
I>>	Trip level of high-set overcurrent element (p.u. of Ib)	1 - 9.9 - Dis	**Ib**	3			
tI>>	Trip time delay of the high-set overcurrent element	0.05 - 3	**s**	0.05			
1Is	Generator's max. continuos negative sequence current	0.05-0.5-Dis	**Ib**	0.05			
Ks	Time multiplier of the I_2^2t time-current curve	5 – 80	**s**	5			
tcs	Cooling time from trip level to the state corresp. to I2=1Is	10 - 1800	**s**	10			
2Is	Negative sequence current alarm level	0.03-0.5-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>	Independent trip time delay of reverse power element	0.1 - 60	**s**	0.1			
K1	Diameter of the circle including the underimpedance tripping zone	50-300-Dis	**%Zb**	300			
K2	Offset of the circle	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			
Un	Operation mode of first voltage element	-,+,+/-,Dis	**1u**	+/-			
1u	Pick-up level of the first voltage element	1 - 50	**%Un**	15			
t1u	Trip time delay of the first voltage element	0.10 - 60	**s**	1.00			
Un	Operation mode of second voltage element	-,+,+/-,Dis	**2u**	+			
2u	Pick-up level of the second voltage element	1 - 50	**%Un**	10			
t2u	Trip time delay of the second voltage element	0.10 - 60	**s**	3			
Fn	Operation mode of first frequency element	-,+,+/-,Dis	**1f**	+/-			
1f	Pick-up level of the first frequency element	0.05 – 9.99	**Hz**	0,5			
t1f	Trip time delay of the first frequency element	0.1 - 60	**s**	3			
Fn	Operation mode of second frequency element	-,+,+/-,Dis	**2f**	+			
2f	Pick-up level of the second frequency element	0.05 – 9.99	**Hz**	1			
t2f	Trip time delay of the second frequency element	0.1 - 60	**s**	0,5			
Tc	Thermal time constant of the alternator	1 - 400	**m**	60			
Ta/n	Prealarm level of the thermal image	50 - 110	**%**	100			
W<	Pick-up level of the active underpower element	0.05-1.0–Dis	**Wb**	0.05			
tW<	Trip time delay	0.1 - 60	**s**	0.1			
1Z	Pick-up level of the 1st underimpedance element	0.1 – 1 - Dis	**Zn**	0.5			
t1Z	Trip time delay of 1Z element	ist-0.05–9.99	**s**	1			
2Z	Pick-up level of the 2nd underimpedance element	0.1 – 1 - Dis	**Zn**	1			
t2Z	Trip time delay of 2Z element	ist-0.05–9.99	**s**	2			

Variable	Description	Setting Range		Default Setting	Actual Setting	Test Result	
						Pick-up	Reset
1Φ>	Pick-up level of the V/Hz inverse time element	1 – 2 - Dis	**pU**	1.2			
K	Time multiplier of the V/Hz T.C.C.	0.5 – 5	**-**	0.5			
2Φ>	Pick-up level of the V/Hz definite time element	1 – 2 - Dis	**pU**	1.2			
t2Φ	Trip time delay of the 2Φ element	0.1 – 60	**s**	5.0			
1Io	Pick-up level of the 1st 64S element	2 – 80 – Dis	**%On**	10			
t1O	Trip time delay of the element 1Uo	ist-0.05–9.99	**s**	2			
2Io	Pick-up level of the 2nd 64S element	2 – 80 – Dis	**%On**	20			
t2O	Trip time delay of the element 2Uo	ist-0.05–9.99	**s**	3			
60FL	PTs' Fuse Failure element	ON – OFF	-	ON			
IC	Inadvertent generator energization element	ON – OFF	-	ON			
tBF	Max. reset time delay of the instantaneous elements	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>	-	-	-	-	Instantaneous element of low-set overcurrent operates relays	**I>**				
tI>	1	-	-	-	As above, time delayed element	**tI>**				
I>>	-	-	-	-	Instantaneous element of high-set overcurrent operates relay	**I>>**				
tI>>	1	-	-	-	As above, time delayed element	**tI>>**				
1Is	-	2	-	-	First unbalance element (time delayed) operates relay	**1Is**				
2Is	-	-	-	4	As above, second unbalance element	**2Is**				
tIr>	-	2	3	-	Reverse power time delayed element operates relay	**tIr>**				
FL	-	2	-	-	Underimpedance time delayed element operates relay	**FL**				
tW<	-	-	-	4	Underpower time delayed element operates relay	**tW<**				
1U	-	-	-	4	Time delayed element 1U operates relay	**1U**				
2U	-	2	3	-	Time delayed element 2U operates relay	**2U**				
1f	-	-	-	4	Time delayed element 1f operates relay	**1f**				
2f	-	-	-	4	Time delayed element 1f operates relay	**2f**				
T>	-	2	-	-	Overtemperature element operates relay	**T>**				
Ta/n	-	-	-	4	Thermal prealarm operates relay	**Ta/n**				
1Z	-	-	-	-	Instantaneous element 1Z operates relay	**1Z**				
t1Z	1	-	-	-	Delayed element t1Z operates relay	**t1Z**				
2Z	-	-	-	-	Instantaneous element 2Z operates relay	**2Z**				
t2Z	1	-	-	-	Delayed element t2Z operates relay	**t2Z**				
1ϕ	-	-	-	-	Instantaneous element 1ϕ operates relay	**1ϕ**				
t1ϕ	1	-	-	-	Delayed element t1ϕ operates relay	**t1ϕ**				
2ϕ	-	-	-	-	Instantaneous element 2ϕ operates relay	**2ϕ**				
t2ϕ	1	-	-	-	Delayed element t2ϕ operates relay	**t2ϕ**				
1Io	-	-	-	-	Instantaneous element 1Io operates relay	**1Io**				
t1Io	1	-	-	-	Delayed element t1O operates relay	**t1IO**				
2Io	-	-	-	-	Instantaneous element 2Io operates relay	**2Io**				
t2Io	1	-	-	-	Delayed element t2O operates relay	**t2IO**				
IC	1	-	-	-	Function IC operates relay	**IC**				
60FL	-	-	-	4	Function 60FL operates relay	**60FL**				
tBF	-	-	-	-	Breaker Failure function operates relay	**tBF**				
tFRes:	A				Relay reset mode A= Automatic , M = Manual	**tFRes:**				
2A=	I>>				The input (2) for blocking the time delayed elements relevant to phase and ground faults operate on (I>) or (I>>) or (I>+I>>)	**2A=**				
t2=	OFF				The operation of the blocking input (2)	**t2=**				
3A=	Ir				The blocking input (3) operate on function (FL) or (Ir>) or (FL+Ir>)	**3A=**				
4A=	-				The blocking input (4) blocks the operation of the delayed elements of functions (1f) or (2f) or (1f+2f).	**4A=**				
2B=	-				The blocking input (2) blocks the operation of the delayed elements of functions (1Z) or (2Z) or (1Z+2Z)	**2B=**				
3B=	-				The blocking input (3) blocks the operation of the delayed elements of functions (1Io) or (2Io) in any possible combination	**3B=**				
4B=	-				The blocking input (2) blocks the operation of the delayed elements of functions (1u) or (2u) or (1u+2u)	**4B=**				

Commissioning Engineer : ______________________________ **Date :** ______________

Customer Witness : ______________________________ **Date :** ______________