MICROPROCESSOR
OVERCURRENT & EARTH FAULT+
BROKEN CONDUCTOR
RELAY

TYPE

# MC30-BC

# OPERATION MANUAL


CE

# 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 - Waste Disposal of Electrical & Electronic Equipment

(Applicable throughout the European Union and other European countries with separate collection program).
This product should not be treated as household waste when you wish dispose of it. Instead, it should be handed over to an applicable collection point for the recycling of electrical and electronic equipment.
By ensuring this product is disposed of correctly, you will help prevent potential negative consequence to the environment and human health, which could otherwise be caused by inappropriate disposal of this product. The recycling of materials will help to conserve natural resource.

## 1.12 - Fault detection and repair

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

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

## 2. General Characteristics

The MC is a very innovative and versatile line of Protective Relays which takes advantage of the long and successful experience coming from the M-Line.

The main features of the MC-Line relays are:

Compact draw-out execution for Flush Mounting or for assembly in 19" 3U chassis for 19" Rack systems.

User friendly front face with 2x8 characters LCD Display, four signal Leds, four keys for complete local management and 9-pin socket for local RS232 serial communication.

Four user programmable Output Relays. On request one of the Output Relays can be replaced by a Can Bus port for control of additional I/O modules.

Three optoisolated self-powered Digital Inputs.

RS485 communication port (independent from the RS232 port on front panel)

Totally draw-out execution with automatic C.T. shorting device.

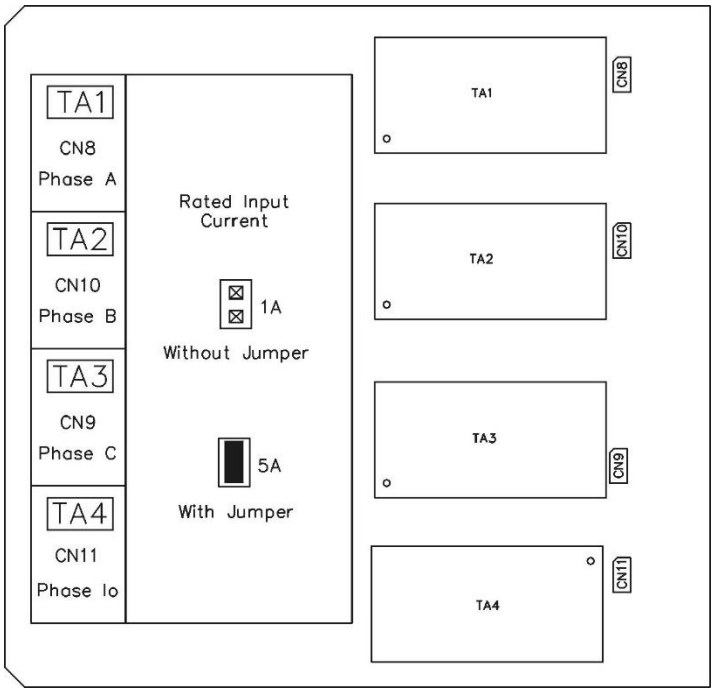
Input currents are supplied to 3 current transformers: measuring phase currents.
An additional internal CT directly measures the residual (Zero Sequence) current of the three inputs.
Current inputs can be 1 or 5A: selection between 1A or 5A is made by movable jumpers provided on the Relay card. (See Fig 1)

***The Measuring Ranges of the different inputs respectively are:***

| | | |
|---|---|---|
| Phase Currents | : | (0.1-40) In |
| Residual Current | : | (0.01-10) In |

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.




## 2.1 - Power Supply

The auxiliary power is supplied by a built-in module fully isolated a self-protected.

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

| | | |
|---|---|---|
| Type 1 | 24V(-20%) / 110V(+15%) a.c. | 24V(-20%) / 125V(+20%) d.c. |
| Type 2 | 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 - Operation and Algorithms

### *2.2.1 - Reference Input Values*

| Display | | | Description | Setting Range | | | Step | Unit |
|---|---|---|---|---|---|---|---|---|
| I1 | 100 | A | Rated Primary current of phase C.T. | 1 | - | 9999 | 1 | A |
| I2 | 5 | A | Rated Secondary current of phase C.T. | 1 | - | 5 | 1/5 | A |
| In | 100 | A | Reference main primary current of the relay | 1 | - | 9999 | 1 | A |
| StIn | 0 | H | Start time "In" for main current | 0 | - | 23 | 1 | H |
| InL | 1 | A | Relay second primary current low | 1 | - | 9999 | 1 | A |
| StInLH | 0 | H | Start time for InL second current | 0 | - | 23 | 1 | H |
| Freq | 50 | Hz | System rated frequency | 50 | - | 60 | 10 | Hz |
| TW | 60 | sec | Warming-up time constant for Thermal Image | 60 | - | 3600 | 1 | sec |
| Ib | 105 | %In | Maximum admissible continuous overload for Thermal Image | 50 | - | 130 | 0.1 | %In |

### *2.2.2 - Input quantities*

#### *2.2.2.1 - Mains Frequency (Freq)*

The relay can operate either in 50Hz or 60Hz systems.
The rated Mains Frequency "Freq" must be set accordingly.

#### *2.2.2.2 - Phase Current inputs (I1)*

The relay directly displays the r.m.s. value of the Phase Currents "**IA**", "**IB**", "**IC**" flowing in the Primary of the input Current Transformers and refers all its measurements to that value.
To make the relay properly working with any C.T., when programming the relay settings, input the value "I1" of the primary current of the phase C.Ts

*The measure is not displayed below* : < 5% In

#### *2.2.2.3 – Reference Primary Current*

To have a better accuracy [In] case of use of CT with bigger ratio, a further setting is foreseen.
This setting better define the rated current of the feeder regardless of the CT ratio.
To get a double setting range, two values of reference primary current are foreseen:

- MAIN
- SECOND

It is possible to switch from main to second setting via digital input or by means of an internal timer ([StIn], [StInLH]).

#### *2.2.2.4 – Start time "In"*

The time is indicated in Hours, every day at this time the relay automatically set the reference primary current to main.

#### *2.2.2.5 – Start time "IL"*

The time is indicated in Hours, every day at this time the relay automatically set the reference primary current to second.

### *2.2.2.4 - Algorithm of the time current curves*

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

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

where:

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

I = Maximum of the three input currents.

Is = Set minimum pick-up level

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

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

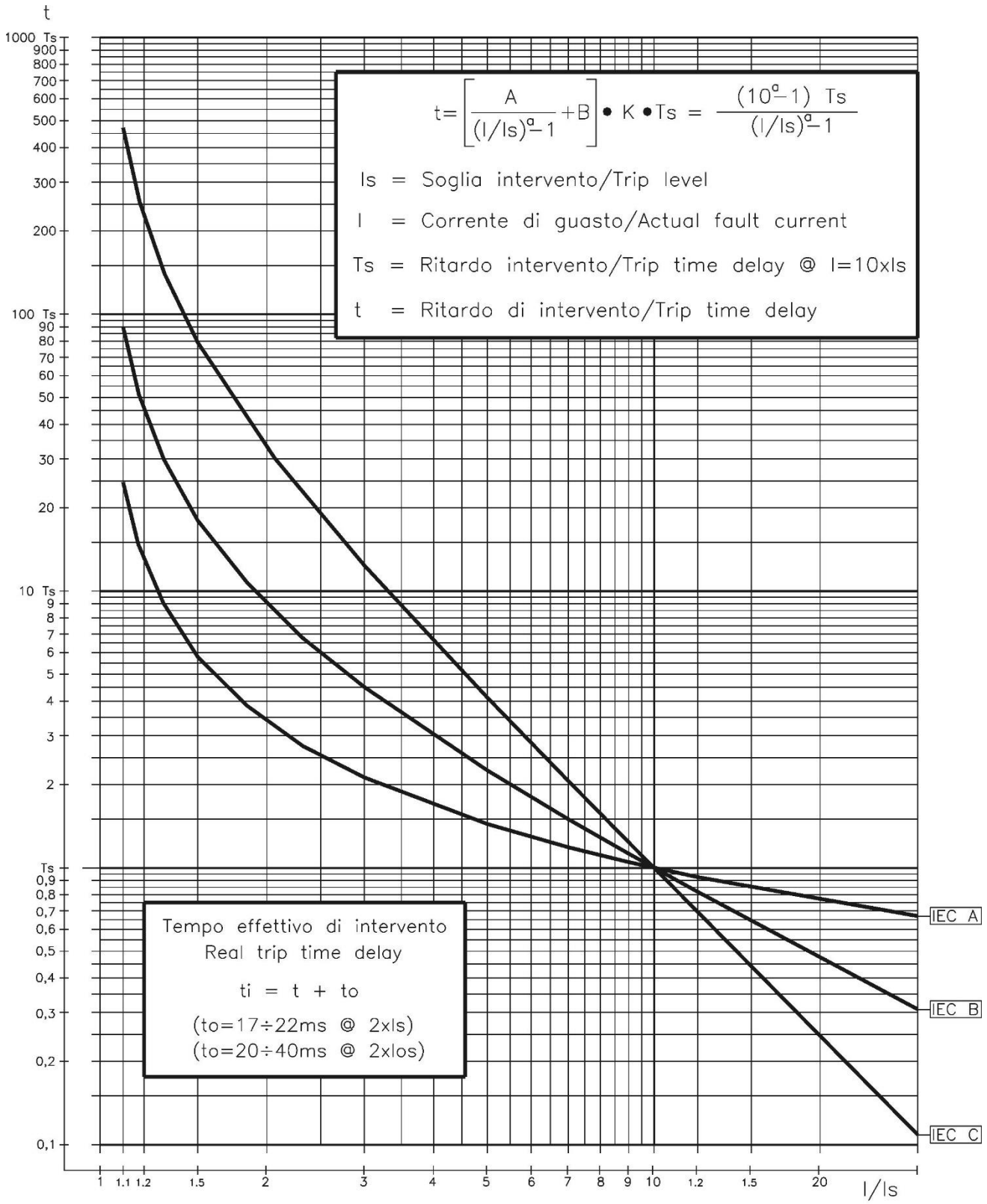
tr = Operation time of the output relay on pick-up (7ms).

The parameters "**A**" and "**a**" have different values for the different Time Current Curves.

| *Curve Name* | *Curve Identifier* | *A* | *B* | *a* |
|---|---|---|---|---|
| *IEC A Inverse* | A | 0.14 | 0 | 0.02 |
| *IEC B Very Inverse* | B | 13.5 | 0 | 1 |
| *IEC C Extremely Inverse* | C | 80 | 0 | 2 |
| *IEEE Moderate Inverse* | MI | 0.0104 | 0.0226 | 0.02 |
| *IEEE Short Inverse* | SI | 0.00342 | 0.00262 | 0.02 |
| *IEEE Very Inverse* | VI | 3.88 | 0.0963 | 2 |
| *IEEE Inverse* | I | 5.95 | 0.18 | 2 |
| *IEEE Extremely Inverse* | EI | 5.67 | 0.0352 | 2 |

***The maximum measuring current is "40xIn" for phase elements and "10xOn" for the neutral element.***

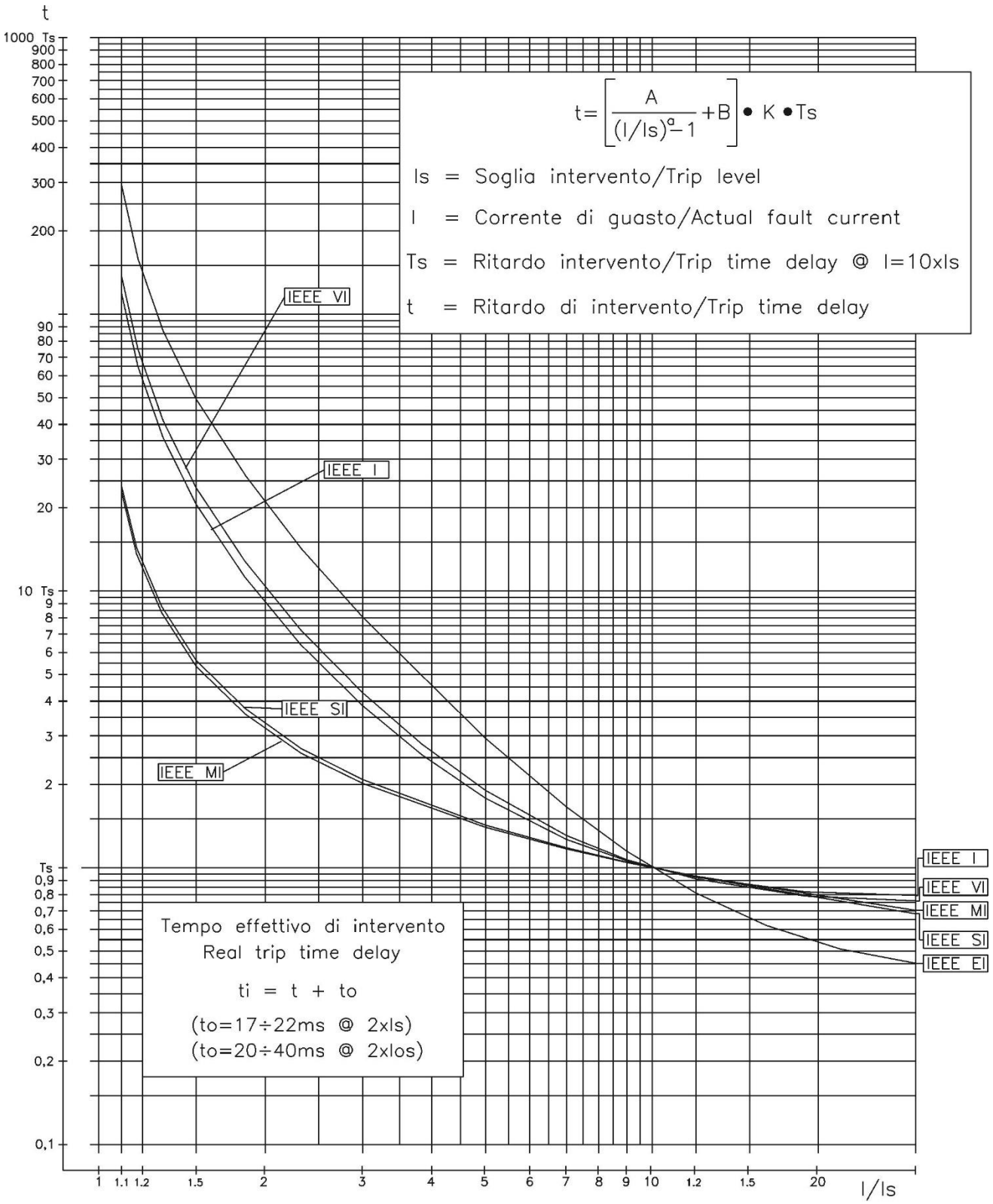
### *2.2.3 - Time Current Curves IEC (TU1029 Rev.0)*




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

Max. "I" Phase = 40xIn
Max. "I" Neutral = 10xOn

## *2.2.4 - Time Current Curves IEEE (TU1028 Rev.0)*




| Curve Type | A | B | K | a |
|---|---|---|---|---|
| MI= IEEE Moderate Inv. | 0.0104 | 0.0226 | 4.110608 | 0.02 |
| SI= IEEE Short Inv. | 0.00342 | 0.00262 | 13.30009 | 0.02 |
| VI= IEEE Very Inv. | 3.88 | 0.0963 | 7.380514 | 2 |
| I= IEEE Inverse | 5.95 | 0.18 | 4.164914 | 2 |
| EI= IEEE Extremely Inv. | 5.67 | 0.0352 | 10.814 | 2 |

Max. "I" Phase = 40xIn
Max. "I" Neutral = 10xOn

## 3. Functions and Settings (Function)

### 3.1 - T> (F49) - Thermal Image protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | | No Param | | No Parameters | | | |
| *TripLev* | → | ***Tal*** | 50 | %Tb | (50 ÷ 110) | step | 1 | %Tb |
| | → | ***Tst*** | 100 | %Tb | (10 ÷ 100) | step | 1 | %Tb |
| *Timers* | → | | No Param | | No Parameters | | | |

#### Description of variables

| | | |
|---|---|---|
| FuncEnab | : | If disable the function is disactivated. |
| Tal | : | Thermal prealarm temperature. |
| Tst | : | Reset level. |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The temperature exceeded for time "tI>". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Led reset when* | : | Return in normal condition | | |

Warming-up is computed proportionally to the square of the largest phase current "I".

- *Allowed overloading time* (See Curve)

The trip time delay "**t**" of the thermal element, depends on the warming-up time constant "**tw**", on the previous thermal status $(Ip/In)^2$, on the admissible continuous overload (Ib) and, of course, on the actual load (I)

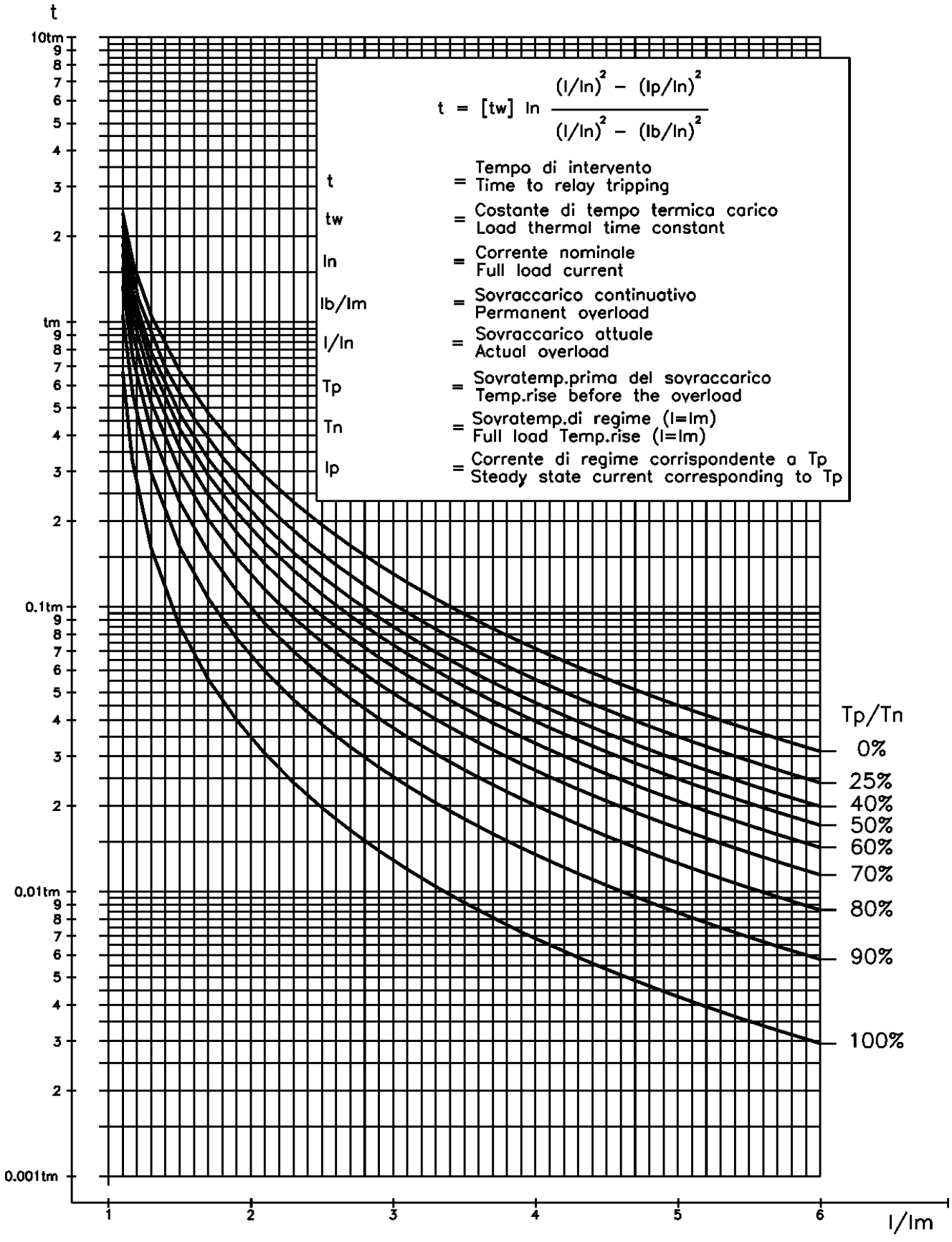
$$t = tw \cdot \ell_n \left[ \frac{(I/In)^2 - (Ip/In)^2}{(I/In)^2 - (Ib/In)^2} \right] \quad \text{where:}$$

| | | | |
|---|---|---|---|
| **tw** | = | Warming-up time constant | (60-3600) s. |
| **I** | = | Largest of the three phase currents | |
| **Ip** | = | Preheating current: Steady-State Current corresponding to the thermal status existing at the moment when the current is increased to the overload value "I" | |
| **Ib** | = | Continuously admissible current | (50-130) %In, step 0.1%In |
| **In** | = | Rated primary current of phase C.Ts | |
| $\ell$ **n** | = | Natural logarithm | |

Reset takes please when the simulated temperature drops below the programming level [Tst].

An alarm signal is issued when the computed warming exceeds the set percentage "Tal" of the Full Load temperature "Tb".

### *3.1.2 - Thermal Image Curves (TU0445 Rev.0)*



## 3.2. - I> (1F51) - First overcurrent protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***TCC*** | D | | [D / A / B / C / MI / VI / I / EI / / SI] | | | |
| | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| *TripLev* | → | ***I>*** | 0.5 | In | (0.10 ÷ 4.00) | step | 0.01 | In |
| *Timers* | → | ***tI>*** | 2.00 | s | (0.05 ÷ 60.00) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *TCC* | : | Time current curves |
| | | *D* = *Independent Definite Time* |
| | | *A* = *IEC A Inverse* |
| | | *B* = *IEC B Very Inverse* |
| | | *C* = *IEC C Extremely Inverse* |
| | | *MI* = *IEEE Moderate Inverse Curve* |
| | | *VI* = *IEEE Very Inverse Curve* |
| | | *I* = *IEEE Inverse Curve* |
| | | *EI* = *IEEE Extremely Inverse Curve* |
| | | *SI* = *IEEE Short Inverse Curve* |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *I>* | : | Minimum phase current pick-up level (limited to 40 times In) |
| *tI>* | : | Trip time delay |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The current trip level is exceeded for time "tI>". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | The current drop below 95% I>. | | |
| *Led reset when* | : | push-button is pressed | | |

## 3.3 - I>> (2F51) - Second overcurrent protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***2xI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| *TripLev* | → | ***I>>*** | 2.00 | In | (0.50 ÷ 40.00) | step | 0.01 | In |
| *Timers* | → | ***tI>>*** | 1.00 | s | (0.05 ÷ 60.00) | step | 0.01 | s |
| | → | ***t2xI*** | 0.10 | s | (0.02 ÷ 9.99) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *2xI* | : | Automatic threshold doubling on inrush |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *I>>* | : | Minimum phase current pick-up level (limited to 40 times In) |
| *tI>>* | : | Trip time delay |
| *t2xI* | : | Trip time delay |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The current trip level is exceeded for time "tI>>". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | The current drop below 95% I>>. | | |
| *Led reset when* | : | push-button is pressed | | |

## 3.4 - IH (3F51) - Third overcurrent protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***2xI*** | Enable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| *TripLev* | → | ***IH*** | 5.00 | In | (0.50 ÷ 40.00) | step | 0.01 | In |
| *Timers* | → | ***tIH*** | 0.05 | s | (0.05 ÷ 60.00) | step | 0.01 | s |
| | → | ***t2xI*** | 0.10 | s | (0.02 ÷ 9.99) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| FuncEnab | : | If disable the function is disactivated |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *2xI* | : | Automatic threshold doubling on inrush |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *IH* | : | Minimum phase current pick-up level (limited to 40 times In) |
| *t2xI* | : | Trip time delay |
| *tIH* | : | Trip time delay |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The current trip level is exceeded for time "tIH". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | The current drop below 95% IH. | | |
| *Led reset when* | : | push-button is pressed | | |

### *3.4.2 – Automatic doubling of Overcurrent thresholds on current inrush*

For some of the phase Overcurrent functions (I>>, IH) it is possible to have the set trip level [Is] automatically doubled when strong inrush current is detected.
If at circuit Breaker closure (i.e. when the input current rises from zero to a minimum measurable value) the current increases from 0 to 1.5 times the rated value [In] in less than 60ms, the set minimum pick-up level [Is] is dynamically doubled ([Is]→[2Is]) and keeps this value until the input current drops below 1.25xIn or the set time [t2xI] has elapsed.
This functionality is very useful to avoid spurious tripping of the instantaneous or short-time delayed Overcurrent elements that could be experienced at switch-on of reactive loads like Transformer or Capacitors.

## 3.5 - Io> (1F51N) - First Earth Fault protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FuncEnab | → | | Enable | | [Disable / Enable] | | | |
| Options | → | ***TCC*** | D | | [D / A / B / C / I / VI / EI / MI / SI] | | | |
| | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| TripLev | → | ***Io>*** | 0.10 | Ion | (0.01 ÷ 4) | step | 0.01 | Ion |
| *Timers* | → | ***tIo>*** | 2.00 | s | (0.05 ÷ 60) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| FuncEnab | : | If disable the function is disactivated |
| *TCC* | : | Time current curves |
| | | *D* = *Independent Definite Time* |
| | | *A* = *IEC A Inverse* |
| | | *B* = *IEC B Very Inverse* |
| | | *C* = *IEC C Extremely Inverse* |
| | | *MI* = *IEEE Moderate Inverse Curve* |
| | | *VI* = *IEEE Very Inverse Curve* |
| | | *I* = *IEEE Inverse Curve* |
| | | *EI* = *IEEE Extremely Inverse Curve* |
| | | *SI* = *IEEE Short Inverse Curve* |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *Io>* | : | Minimum Zero Sequence Residual Current Pick-up level |
| *tIo>* | : | Trip time delay |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The current trip level is exceeded for time "tIo>". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | The current drop below 95% Io>. | | |
| *Led reset when* | : | push-button is pressed | | |

## 3.6 - Io>> (2F51N) - Second Earth Fault protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FuncEnab | → | | Enable | | [Disable / Enable] | | | |
| Options | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| TripLev | → | ***Io>>*** | 0.50 | Ion | (0.01 ÷ 9.99) | step | 0.01 | Ion |
| *Timers* | → | ***tIo>>*** | 1.00 | s | (0.05 ÷ 60) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *Io>>* | : | Minimum Zero Sequence Residual Current Pick-up level |
| *tIo>>* | : | Trip time delay |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The current trip level is exceeded for time "tIo>>". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | The current drop below 95% Io>>. | | |
| *Led reset when* | : | push-button is pressed | | |

## 3.7 - IoH (3F51N) - Third Earth Fault protection level

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FuncEnab | → | | Enable | | [Disable / Enable] | | | |
| Options | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| TripLev | → | ***IoH*** | 2.00 | Ion | (0.01 ÷ 9.99) | step | 0.01 | Ion |
| *Timers* | → | ***tIoH*** | 0.10 | s | (0.05 ÷ 60) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *IoH* | : | Minimum Zero Sequence Residual Current Pick-up level |
| *tIoH* | : | Trip time delay |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | The current trip level is exceeded for time "tIoH". | | |
| *When the function is tripped* | : | *Signalization* | = | Led "Trip" is illuminated |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | The current drop below 95% IoH. | | |
| *Led reset when* | : | Push-button is pressed | | |

## 3.8 - BF (F51BF) - Breaker Failure

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FuncEnab | → | | Enable | | [Disable / Enable] | | | |
| Options | → | ***TrR*** | Relay1 | | Relay1 – Relay2 – Relay3 – Relay4 | | | |
| TripLev | → | | No Param | | No Parameters | | | |
| *Timers* | → | ***tBF*** | 0.2 | s | (0.05 ÷ 0.75) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *TrR* | : | Output relay programmed for trip command to the Circuit Breaker |
| *tBF* | : | Trip time delay |

Operation: If after the time "tBF" from pick-up of the programmed relay "TrR" the current measured still exceeds 5%In, the output relay associated to the "BF" function is operated (relay another than TrR).

## 3.9 - BC (I2/I1) – Broken Conductor

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FuncEnab | → | Enable | | [Disable / Enable] | | | |
| Options | → ***Trg*** | Disable | | [Disable / Enable] | | | |
| TripLev | → ***BC>*** | 10.00 | % | (10 ÷ 100) | step | 1 | % |
| Timers | → ***tBC>*** | 0.20 | s | (0.05 ÷ 60.00) | step | 0.01 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *BC>* | : | Ratio between inverse sequence current and direct sequence current. |
| *tBC>* | : | Trip time delay |

Operation: Minimum operation level >5%In

The function of Broken Conductor is based on the calculation of the ratio of negative and positive sequence current, if this value exceeds the set level [BC>] a relay is energized.
When a broken conductor is big experienced, a negative sequence current appears; measuring not only I2 but computing the ratio I2/I1 gives a much more accuracy at the low values.

## 3.10 – F86 – Lock-out relay

| | | | |
|---|---|---|---|
| *FuncEnab* | → | Enable | [Disable / Enable] |
| *Options* | → ***1I>*** | Enable | [Disable / Enable] |
| | → ***2I>*** | Enable | [Disable / Enable] |
| | → ***IH*** | Enable | [Disable / Enable] |
| | → ***1Io*** | Enable | [Disable / Enable] |
| | → ***2Io*** | Enable | [Disable / Enable] |
| | → ***IoH*** | Enable | [Disable / Enable] |
| | → ***T>*** | Enable | [Disable / Enable] |
| | → ***BC*** | Enable | [Disable / Enable] |
| | → ***IRF*** | Enable | [Disable / Enable] |
| *TripLev* | → | No Param | No Parameters |
| *Timers* | → | No Param | No Parameters |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *1I>* | : | First overcurrent element |
| *2I>* | : | Second overcurrent element |
| *IH* | : | Third overcurrent element |
| *1Io* | : | First earth fault element |
| *2Io* | : | Second earth fault element |
| *IoH* | : | Third earth fault element |
| *T>* | : | Thermal image element |
| *BC* | : | Broken Conductor element |
| *IRF* | : | Internal Relay Fault |

## 3.11 – S Sel – Setting Selection

Selecting the mode of operation of the change value of rated current.

| | | | |
|---|---|---|---|
| *FuncEnab* | → | Disable | [Disable / Enable] |
| *Options* | → ***Md*** | HourSE | [HourSE / InputSE] |
| *TripLev* | → | No Param | No Parameters |
| *Timers* | → | No Param | No Parameters |

### Description of variables

| | | | | |
|---|---|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated | | |
| *Md* | | *HourSE* | = | Change "In" to "InL" setting based on time slot (For settings see § RatedVal. parameters [StIn] and [StInLH]). |
| | | *InputSE* | = | Change "In" to "InL" setting based on Digital input D2 (see § Digital Inputs) |

## 3.12 - I.R.F. - Internal Relay Failure

| | | | |
|---|---|---|---|
| FuncEnab | → | No Param | No Parameters |
| Options | → **Opl** | NoTrip | [NoTrip / Trip] |
| TripLev | → | No Param | No Parameters |
| *Timers* | → | No Param | No Parameters |

### Description of variables

| | | |
|---|---|---|
| *Opl* | : | The variable "Opl" can be programmed to trip the output relays same as the other protection functions (Opl = TRIP), or to only operate the "IRF" signal led without tripping the output relays (Opl = NoTRIP). |

| | | | | |
|---|---|---|---|---|
| *Trip when* | : | an internal fault in the relay is detected (see Diagnostics) | | |
| *When the function is tripped* | : | *Signalization* | = | Led "PWR/I.R.F." blink |
| | | *Last Trip* | = | Is recorded |
| *Function reset when* | : | it returns to normal operation | | |
| *Led reset when* | : | Push-button is pressed | | |

## 3.13 - Osc - Oscillographic Recording

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| Options | → | **Trg** | Trip | | [Disable / Start / Trip / Ext.Inp.] | | | |
| TripLev | → | | No Param | | No Parameters | | | |
| *Timers* | → | **tPre** | 0.3 | s | (0.1 ÷ 0.5) | step | 0.1 | s |
| | → | **tPost** | 0.3 | s | (0.1 ÷ 1.5) | step | 0.1 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *Trg* | : | *Disab* = Function Disable (no recording)<br>*Start.* = Trigger on time start of protection functions<br>*Trip* = Trigger on trip (time delay end) of protection functions<br>*Ext.Inp.* = Trigger from the Digital Input D3 |
| *tPre* | : | Recording time before Trigger |
| *tPost* | : | Recording time after Trigger |

When the option "Start" or "Trip" is selected:

The oscillographic recording is started respectively by the "Time Start" or by the "Time End" of any of the functions that have been programmed to Trigger the Wave Form Capture (I>, I>>, IH, Io>, Io>>, IoH, BC).

The "Osc" Function includes the wave Form Capture of the input quantities (IA, IB, IC, Io) and can totally store a record of 3 seconds.

The number of events recorded depends on the duration of each individual recording (tPre + tPost), up to a maximum of 10 (0.3 sec).
Any new event beyond the 3 sec capacity of the memory, cancel and overwrites the former records (FIFO Memory).

## 3.14 - CBMng – Close Breaker Manage

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FuncEnab | → | | No Param | | No Parameters | | | |
| Options | → | | No Param | | No Parameters | | | |
| TripLev | → | | No Param | | No Parameters | | | |
| Timers | → | ***tcmd*** | 0.10 | s | (0.10 ÷ 5.00) | step | 0.1 | s |
| | → | ***tC*** | 0.10 | s | (0.10 ÷ 5.00) | step | 0.1 | s |

### Description of variables

| | | |
|---|---|---|
| *tcmd* | : | C/B closing output command duration |
| *tC* | : | Maximum admissible delay for detection of status signal after C/B operation. |

## 3.15 - Comm – Communication Parameters

| | | | | |
|---|---|---|---|---|
| *FuncEnab* | → | | No Param | No Parameters |
| *Options* | → | ***LBd*** | 9600 | [9600 / 19200 / 38400 / 57600] |
| | → | ***RBd*** | 9600 | [9600 / 19200] |
| | → | ***Mod*** | 8,n,1 | [8,n,1 / 8,o,1 / 8,e,1] |
| | → | ***RPr*** | Modbus | [Iec103 / Modbus] |
| *TripLev* | → | | No Param | No Parameters |
| *Timers* | → | | No Param | No Parameters |

### Description of variables

| | | |
|---|---|---|
| *LBd* | : | Local Baud Rate (Front panel RS232 communication speed) |
| *RBd* | : | Remote Baud Rate<br>(Rear panel terminal blocks RS485 communication speed) |
| *Mod* | : | Remote mode (communication parameters)<br>**Note**: Any change of this setting becomes valid at the next power on |
| *RPr* | : | Remote Protocol |

## 3.16 - LCD – Display and Buzzer operation

| | | | | |
|---|---|---|---|---|
| FuncEnab | → | | No Param | No Parameters |
| Options | → | ***Key*** | BeepON | [BeepOFF / BeepON] |
| | → | ***BkL*** | Auto | [Auto / On] |
| TripLev | → | | No Param | No Parameters |
| *Timers* | → | | No Param | No Parameters |

### Description of variables

| | | |
|---|---|---|
| *Key* | : | Buzzer "Beep" on operation of Keyboard buttons. |
| *BkL* | : | LCD Backlight continuously "ON" or switched-on Automatically on operation of Keyboard buttons. |

## 4. Logic Blocking of Functions

### 4.1 - Blocking outputs

The instantaneous element of each of the protection functions (1F50, 2F50, 3F50, 1F50N, 2F50N, 3F50N) can be programmed to control one of the Output Relays.
This relay picks-up as soon as the input quantity exceeds the set trip level of the Protection Function associated and it automatically resets when the input quantity drops below the function reset level (≈95% of the trip level) or, in any case as soon as the time delay (tBF) of the Breaker Failure function is expired.
This instantaneous output can be used to activate the Blocking Input of another Protection Relay to implement a logic selectivity system. As above explained, in case of Breaker Failure, the blocking output is released, and the back-up protection enabled.

### 4.2 – Blocking Inputs

The time delayed tripping of any of the Protection functions (1F51, 2F51, 3F51, 1F51N, 2F51N, 3F51N) can be controlled by the activation of the Digital Input D1 (BI=Enable): in this case the set trip time delay of the function is increased by "2xtBF" so that other Protection Relays (set with the same trip time delay) that send the activation signal to the blocking Input D2, can trip before open and the C/B nearest to the Fault.
Also in this case, however, another "2xtBF" seconds from the expiry of the set trip time delay, the blocking input is disregarded so allowing the protection relay to trip in case of Failure to open of the upstream Circuit Breaker.

## 5. Output Relays

Four users programmable Output Relays are normally available R1, R2, R3, R4.
Each of them can be programmed to be controlled by any element (instantaneous or time delayed) of any of the Relay Functions including Breaker Failure and Internal Relay Fault.
Each output relay can also be programmed to control "OPEN" and "CLOSE" the C/B either by the Relay Keyboard or via the serial communication bus
Moreover, the operation of each of the output relays can be programmed to be either Normally Deenergized (energized on tripping of the controlling Functional Element) or Normally Energized (Deenergized on tripping of the controlling Functional Element).
As an option (to be required when ordering the relay), the output relay "R4" can be replaced by a Field Bus output (CANBUS) that controls additional I/O modules for increasing the number of user programmable Output Relays and Digital Inputs controlled from the main relay.

## 6. Digital Inputs

Three optoisolated, self-powered Digital Inputs D1, D2, D3 are provided.

A Digital Input is activated when its terminals are shorted by a cold contact.

| | | | |
|---|---|---|---|
| *D1* | (Terminals 22 - 19) | : | It is usable as Function Blocking Input |
| *D2* | (Terminals 22 - 21) | : | It is used to switch setting from [In] to [InL].<br>*Terminals shorted* = Reference primary current set at [InL] value<br>(If parameter Md is set to "InputSE").<br>*Terminals open* = Reference primary current set at [In]. |
| *D3* | (Terminals 22 - 20) | : | The digital Input is used to get the position of the Circuit Breaker<br>(Input Closed = C/B closed; Input Open = C/B open).<br>If the option External Trigger = Enabled, any time the DI switch from closed to open, the oscillographic recording is started. |

## 7. Self-diagnostic

The relay incorporates a sophisticated self-diagnostic feature that continuously checks the following elements:

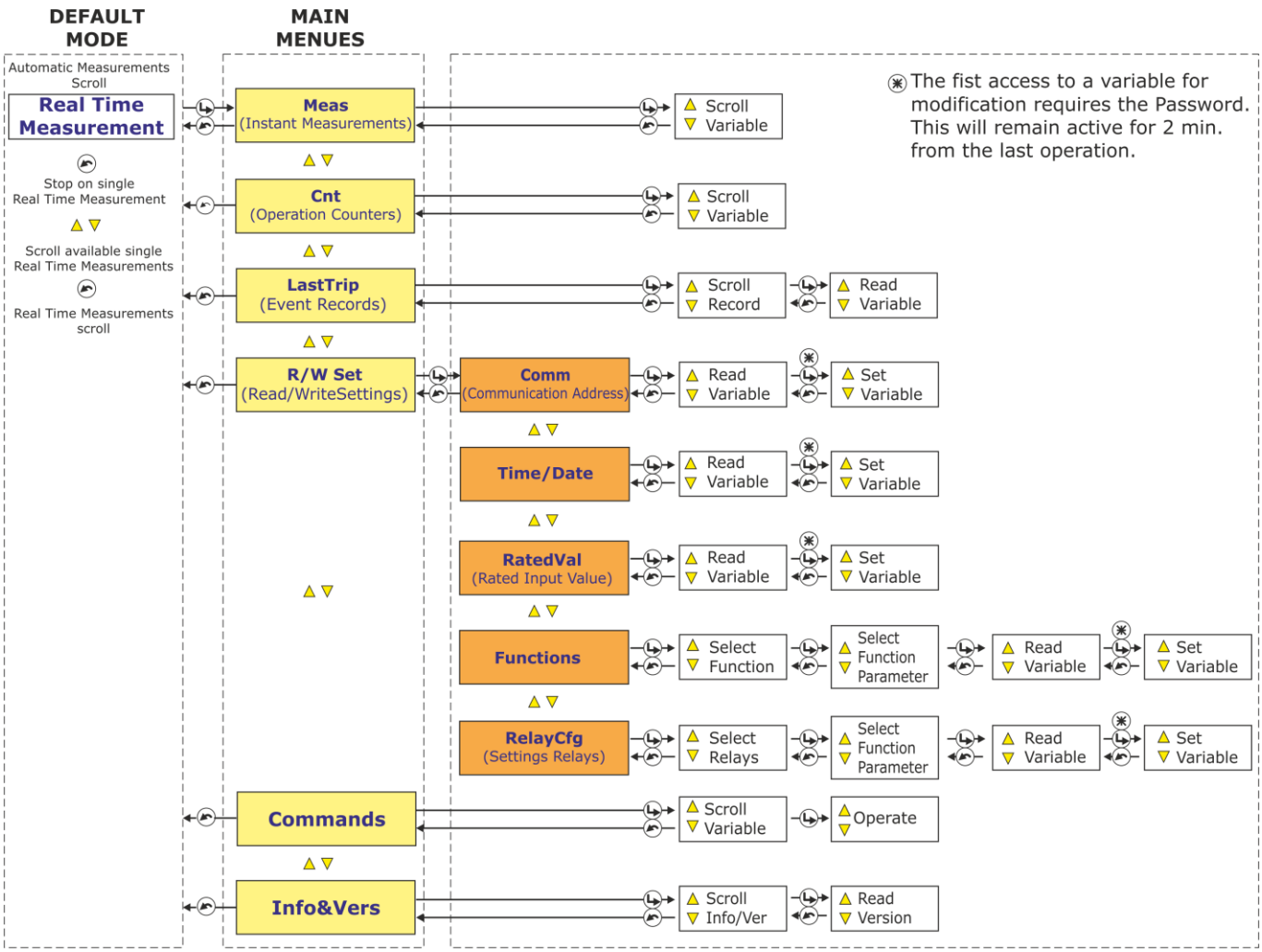
| |
|---|
| A/D conversion |
| Checksum of the settings stored into $E^2$Prom. |
| DSP general operation (Power, Routines, etc.) |
| Lamp test (only on manual test). |

Any time auxiliary power supply is switched on, a complete test run. During normal operation, the test runs continuously, and the checksum is done any time a parameter is stored into $E^2$Prom.
If during the test any Internal Relay Failure (I.R.F) is detected following actions take place:

| |
|---|
| If "I.R.F." is programmed to "Trip", the programmed output relays are operated as on tripping of any protection function. |
| Operation is stored in the "Event Records" and the I.R.F. signal led is flashing. |
| If "I.R.F." is programmed to "NO Trip", only the I.R.F. signal led starts flashing. |

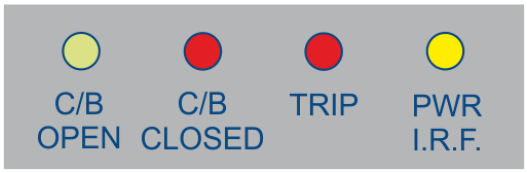
## 8. Relay Management

The relay can be totally managed locally, either by the RS232 communication port or by means the 4 key buttons and the LCD display, or remotely via the rear communication port RS485.
The 2-line x 8 characters LCD display shows the available information.
Key buttons operate according to the flow-chart here below.

## 9. Signalizations

Four signal leds are available on the Front Face Panel:




| | | | |
|---|---|---|---|
| a) | **GREEN LED** | C/B OPEN | Lit-on when C/B open status is detected.<br>(Digital Input D3 Open) |
| b) | **RED LED** | C/B CLOSED | Lit-on when C/B close status is detected.<br>(Digital Input D3 closed)<br>Flashing when Breaker Failure is detected. |
| c) | **RED LED** | TRIP (*) | Flashing when a timed function an instantaneous element at any function is activated.<br>Lit-on when any function time delayed trips; reset takes places by pushing the reset button. |
| d) | YELLOW LED | PWR/ I.R.F. | Illuminated during normal operation when Power Supply is ON.<br>Flashing when a Relay Internal Fault is detected. |

**(*)** When any time delayed protection function trips besides the Led which gives the general trip indication the display shows the function that caused the tripping:

| | |
|---|---|
| LastTrip "Cause" | steady<br>blinking |

## 10. Keyboard Buttons


**Enter** Give access to any menu or confirm any programming change.

This button is also used to control the C/B (Open/Close) (see § Command).


**Reset** Return from the actual selected menu to the former one.


**Select +** Scrolls variables of the different menus or increases/decreases setting values.


**Select -**

## 11. Serial Communication Port

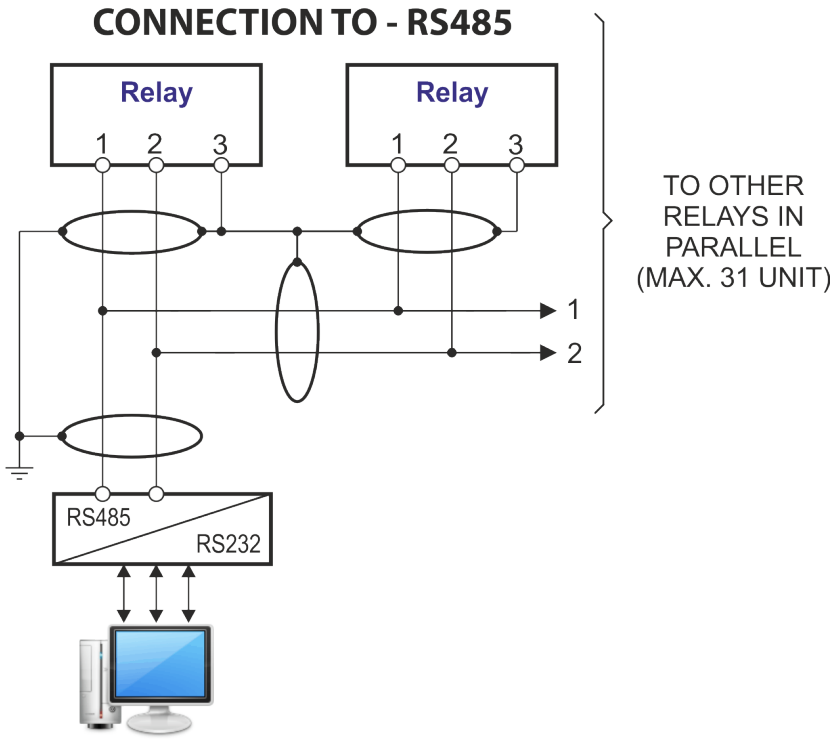
### 11.1 - Main RS485 Serial Communication Port

This port is accessible via the terminals 1-2-3 provided on the relay terminal board.
It is used for connection to a serial bus interfacing up to 31 units with the Central Supervision System (SCADA, DCS, ecc).
The serial bus is a shielded pair of twisted cables connecting in parallel (Multi Drop) the different units (slaves) by the relevant terminals.
The physical link is RS485, and the Communication Protocol is MODBUS/RTU / IEC60870-5-103.
The configuration of transmission parameters is selectable.

| | | | | |
|---|---|---|---|---|
| *Baud Rate* | : | 9600/19200 bps | 9600/19200 bps | 9600/19200 bps |
| *Start bit* | : | 1 | 1 | 1 |
| *Data bit* | : | 8 | 8 | 8 |
| *Parity* | : | None | Odd | Even |
| *Stop bit* | . | 1 | 1 | 1 |

**Note**: any change of this setting becomes valid at the next power on.

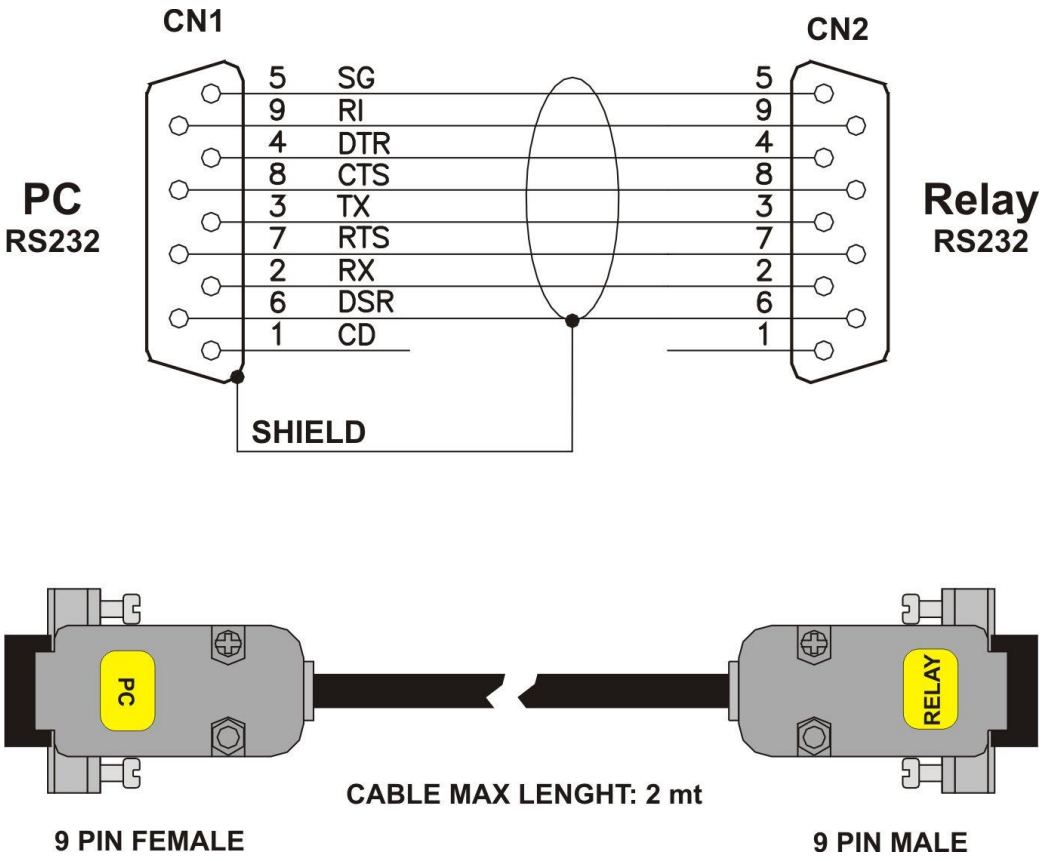
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCom) for windows is available on www.microelettrica.com.
Maximum length of the serial bus can be up to 200m.
For longer distance and for connection more than 31 units (up to 250), fibre optic link is recommended.
(Please ask Microelettrica for accessories)



## 11.2 - Communication Port on Front Face Panel

This port is used for communication through the Front Face Panel between a local Lap-top PC.

The physical link is RS232 by the standard female 9-pin D-sub connector available on the Front Face Panel. Via this Port complete Relay management and data acquisition is possible.



# 12. Menu and Variables

## 12.1 - Real Time Measurements

Automatic scrolling display of the Real Time Measurements is the Default operation.
Scrolling can be stopped at any of the measurements and restarted by pressing the Reset button.
When stopped on one variable, a mark appears aside the measurement.
The different measurements can be manually scrolled by the buttons.

| Display | | | | Description |
|---|---|---|---|---|
| *I* | = | 0 – 65535 | %In | Largest of the 3 phase-currents (% of rated current) |
| *IA* | = | 0 – 65535 | A | RMS value of Phase A current |
| *IB* | = | 0 – 65535 | A | RMS value of Phase B current |
| *IC* | = | 0 – 65535 | A | RMS value of Phase C current |
| *Io* | = | 0.0 – 6553.5 | A | RMS value of Zero Sequence Current (RMS Primary Amps) |
| *I1* | = | 0 – 65535 | % | Direct sequence |
| *I2* | = | 0 – 65535 | % | Inverse sequence |
| *Tem* | = | 0 - 65535 | %T | Actual temperature rise |
| *SR* | = | 0 – 65535 | % | Inverse sequence / Direct sequence |

## 12.2 - Meas (Instantaneous Measurements)

Real time measurements can be frozen at any moment selecting the menu "Instant Measure":

"**R**eal **T**ime **M**eas"
"Measure"
"1st Measurement
to go back to "Measure"

other measurements

| Display | | | | Description |
|---|---|---|---|---|
| I | = | 0 – 65535 | %In | Largest of the 3 phase-currents (% of rated current) |
| IA | = | 0 – 65535 | A | RMS value of Phase A current |
| IB | = | 0 – 65535 | A | RMS value of Phase B current |
| IC | = | 0 – 65535 | A | RMS value of Phase C current |
| Io | = | 0.0 – 6553.5 | A | RMS value of Zero Sequence Current (RMS Primary Amps) |
| I1 | = | 0 – 65535 | % | Direct sequence |
| I2 | = | 0 – 65535 | % | Inverse sequence |
| Tem | = | 0 - 65535 | %T | Actual temperature rise |
| SR | = | 0 – 65535 | % | Inverse sequence / Direct sequence |

## 12.3 - Counter (Operation Counters)

The operation of any of the function here below reported, is counted, and recorded in the menu "Counters".

"**R**eal **T**ime **M**eas"
"Counter"
"1st counters
to go back to "Counter"

other counters

| Display | | | Description |
|---|---|---|---|
| T> | = | 0 – 65535 | Number of Thermal Image |
| I> | = | 0 – 65535 | Number of 1st Overcurrent (time delayed) trip |
| I>> | = | 0 – 65535 | Number of 2nd Overcurrent (time delayed) trip |
| IH | = | 0 – 65535 | Number of 3rd Overcurrent (time delayed) trip |
| Io> | = | 0 – 65535 | Number of 1st time delayed Earth Fault trip |
| Io>> | = | 0 – 65535 | Number of 2nd time delayed Earth Fault trip |
| IoH | = | 0 – 65535 | Number of 3rd time delayed Earth Fault trip |
| BF | = | 0 – 65535 | Number of operations of Breaker Failure |
| BC | = | 0 – 65535 | Number of Broken Conductor |
| I.R.F. | = | 0 – 65535 | Number of Internal Relay Faults |
| HR | = | 0 – 65535 | Number of HW recovery operations |

## 12.4 - LastTrip (Event Recording)

The MC records any tripping and stores the information relevant to the last 20 tripping of protection functions (FIFO).
Each event recording includes the following information.

"Real Time Meas"
"LastTrip"
1st event,
to scroll available events,
to "Rec #" selected,
to select the different fields;

| Display | | | | Description |
|---|---|---|---|---|
| **Func** | | | xxxxx | Indication of the protection function which caused the relay tripping.<br>For indication of the TRIP Cause the following acronyms are used:<br>*T>* = Thermal Image<br>*I>* = 1st Overcurrent (Short Circuit)<br>*I>>* = 2nd Overcurrent (Short Circuit)<br>*IH* = 3rd Overcurrent (Short Circuit)<br>*Io>* = 1st Earth Fault<br>*Io>>* = 2nd Earth Fault<br>*IoH* = 3rd Earth Fault<br>*RTD* = External Trip commands<br>*IRF* = Internal Relay Fault |
| Date | : | YYYY/MM/GG | | Date: Year/Month/Day |
| Time | : | hh:mm:ss:cc | | Time: hours/minutes/second/hundredths of seconds |
| IA | = | 0 – 65535 | A | RMS value of phase A current (Primary Amps) |
| IB | = | 0 – 65535 | A | RMS value of phase B current (Primary Amps) |
| IC | = | 0 – 65535 | A | RMS value of phase C current (Primary Amps) |
| Io | = | 0.0 – 6553.5 | A | RMS value of residual Current (Primary Amps) |
| I1 | = | 0 – 65535 | % | Direct sequence |
| I2 | = | 0 – 65535 | % | Inverse sequence |
| Tem | = | 0 – 65535 | %T | Actual temperature rise |
| SR | = | 0 – 65535 | % | Inverse sequence / Direct sequence |

to go back to "Rec #",
to go back to "Real Time Meas".

## 12.5 - R/W Set (Programming / Reading the Relay Settings)

"Main Menu"
select "Function"
select among following sub menus:

### *12.5.1 - CommAdd (Communication Address)*

"CommAdd"
"Add: #"
"Password ????" (If not yet entered; see § Password)
to select the Address (1-250)
to validate. Set Done!

The default address is 1.

| Display | | Description | Setting Range | | | Step | Unit |
|---|---|---|---|---|---|---|---|
| Add: | 1 | Identification number for connection on serial communication bus | 1 | - | 250 | 1 | - |

### *12.5.2 - Time/Date (Time/Date)*

"Time/Date"
"YY/……"
"XX/MM"
"XX/XX/DD"
"XX/XX/XX"
"hh/mm"
"XX/mm"
To validate
Exit

Date: Current Date, Time: Current time
to set year,
to set month,
to set day,
to set hour,
to set minutes,
Set Done!

### *12.5.3 - RatedVal (Rated Input Values)*

"RatedVal"
1st Variable
to scroll variables
to modify selected variable
"Password ????" (If not yet entered) or #???
(If not yet entered; see § Password)
to set variable value,
to validate. Set Done!

| Display | | | Description | Setting Range | | | Step | Unit |
|---|---|---|---|---|---|---|---|---|
| I1 | 100 | A | Rated Primary current of phase C.T. | 1 | - | 9999 | 1 | A |
| I2 | 5 | A | Rated Secondary current of phase C.T. | 1 | - | 5 | 1/5 | A |
| In | 100 | A | Reference main primary current of the relay | 1 | - | 9999 | 1 | A |
| StIn | 0 | H | Start time "In" for main current | 0 | - | 23 | 1 | H |
| InL | 1 | A | Relay second primary current low | 1 | - | 9999 | 1 | A |
| StInLH | 0 | H | Start time for InL second current | 0 | - | 23 | 1 | H |
| Freq | 50 | Hz | System rated frequency | 50 | - | 60 | 10 | Hz |
| TW | 60 | sec | Warming-up time constant for Thermal Image | 60 | - | 3600 | 1 | sec |
| Ib | 105 | %In | Maximum admissible continuous overload for Thermal Image | 50 | - | 130 | 0.1 | %In |

### *12.5.4 - Function (Functions)*

"Function",
1st function,
to scroll available Functions,
to Read/Write setting of the selected function,
to select the different definable fields
- FuncEnab
- Options
- TripLev
- Timers

to access the selected field and read the actual setting of the relevant variable
to modify the actual setting;
to set the new value.
to validate. Set Done!

| Function | Type | Display Variable | Default Setting | Unit | Description | Setting Range | Step |
|---|---|---|---|---|---|---|---|
| **Password** | | = 0000-9999 | 1111 | - | Password for programming enable (see § Password) | | |
| **T>** | *FuncEnab* | → | Disable | | Enable of the protection function | Enable/Disable | - |
| (F49) | *Options* | → | NoParam | | No Parameters | - | - |
| | *TripLev* | → Tal | 50 | %Tb | Thermal prealarm | 50 - 110 | 1 |
| | | Tst | 100 | %Tb | Reset level. | 10 - 100 | 1 |
| | *Timers* | → | NoParam | | No Parameters | - | - |
| **I>** | *FuncEnab* | → | Enable | | Enable of the protection function | Enable/Disable | - |
| (1F51) | *Options* | → TCC | D | | Time Current Curves | D,A,B,C, I, VI, EI, MI, SI | - |
| | | BI | Disable | | Operation controlled by Blocking Digital Input | Enable/Disable | - |
| | | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → I> | 0.5 | In | Trip level of overcurrent protection | 0.20 – 4.00 | 0.01 |
| | *Timers* | → tI> | 2.00 | s | Trip time delay | 0.05 – 60.00 | 0.01 |
| **I>>** | *FuncEnab* | → | Enable | | Enable of the protection function | Enable/Disable | - |
| (2F51) | *Options* | → BI | Disable | | Operation controlled by Blocking Digital Input | Enable/Disable | - |
| | | 2xI | Disable | | Automatic threshold doubling on inrush | Enable/Disable | - |
| | | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → I>> | 2.00 | In | Trip level of overcurrent protection | 0.50 – 40.00 | 0.01 |
| | *Timers* | → tI>> | 1.00 | s | Trip time delay | 0.05 – 60.00 | 0.01 |
| | | t2x I | 0.01 | s | Trip time delay Automatic threshold doubling | 0.02 – 9.99 | 0.01 |
| **IH** | *FuncEnab* | → | Enable | | Enable of the protection function | Enable/Disable | - |
| (3F51) | *Options* | → BI | Disable | | Operation controlled by Blocking Digital Input | Enable/Disable | - |
| | | 2xI | Enable | | Automatic threshold doubling on inrush | Enable/Disable | - |
| | | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → IH | 5.00 | In | Trip level of overcurrent protection | 0.50 – 40.00 | 0.01 |
| | *Timers* | → tIH | 0.05 | s | Trip time delay | 0.05 – 60.00 | 0.01 |
| | | t2xI | 0.10 | s | Trip time delay Automatic threshold doubling | 0.02 – 9.99 | 0.01 |
| **Io>** | *FuncEnab* | → | Enable | | Enable of the protection function | Enable/Disable | - |
| (1F51N) | *Options* | → TCC | D | | Time Current Curves | D,A,B,C, I, VI, EI, MI, SI | - |
| | | BI | Disable | | Operation controlled by Blocking Digital Input | Enable/Disable | - |
| | | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → Io> | 0.10 | Ion | Trip level of Earth Fault protection | 0.01 – 4.00 | 0.01 |
| | *Timers* | → tIo> | 2.00 | s | Trip time delay | 0.05 – 60.00 | 0.01 |
| **Io>>** | *FuncEnab* | → | Enable | | Enable of the protection function | Enable/Disable | - |
| (2F51N) | *Options* | → BI | Disable | | Operation controlled by Blocking Digital Input | Enable/Disable | - |
| | | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → Io>> | 0.50 | Ion | Trip level of Earth Fault protection | 0.01 – 9.99 | 0.01 |
| | *Timers* | → tIo>> | 1.00 | s | Trip time delay | 0.05 – 60.00 | 0.01 |

| Function | Type | Display | Variable | Default Value | Unit | Description | Setting Range | Step |
|---|---|---|---|---|---|---|---|---|
| **IoH** | *FuncEnab* | → | | Enable | | Enable of the protection function | Enable/Disable | - |
| (3F51N) | *Options* | → | BI | Disable | | Operation controlled by Blocking Digital Input | Enable/Disable | - |
| | | | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → | IoH | 2.00 | Ion | Trip level of Earth Fault protection | 0.01 – 9.99 | 0.01 |
| | *Timers* | → | tIoH | 0.10 | s | Trip time delay | 0.05 – 60.00 | 0.01 |
| **BF** | *FuncEnab* | → | | Enable | | Enable of the protection function | Enable/Disable | - |
| (F51BF) | *Options* | → | TrR | Relay1 | | Output relay operated on BF tripping | Relay1- Relay2 Relay3- Relay4 | - |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | tBF | 0.20 | s | Time delay for Breaker Failure alarm | 0.05 – 0.75 | 0.01 |
| **BC** | *FuncEnab* | → | | Disable | | Enable of the protection function | Enable/Disable | - |
| | *Options* | → | Trg | Enable | | Function operation triggers the oscillographic wave form capture | Enable/Disable | - |
| | *TripLev* | → | BC> | 10.00 | % | Ratio between inverse sequence current and direct sequence current. | 10 – 100 | % |
| | *Timers* | → | tBC> | 0.20 | s | Trip time delay | 0.05 - 60 | s |
| **F86** | *FuncEnab* | → | | Enable | | Enable of the protection function | Enable/Disable | - |
| | *Options* | → | 1I> | Enable | | Block first overcurrent element | Enable/Disable | - |
| | | | 2I> | Enable | | Block second overcurrent element | Enable/Disable | - |
| | | | IH | Enable | | Block third overcurrent element | Enable/Disable | - |
| | | | 1Io | Enable | | Block first earth fault element | Enable/Disable | - |
| | | | 2Io | Enable | | Block second earth fault element | Enable/Disable | - |
| | | | IoH | Enable | | Block third earth fault element | Enable/Disable | - |
| | | | T> | Enable | | Block Thermal Image element | Enable/Disable | - |
| | | | BC | Enable | | Block Broken Conductor element | Enable/Disable | - |
| | | | IRF | Enable | | Block Internal Relay Fault | Enable/Disable | - |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | | No Parameters | | | | |
| **S Sel** | *FuncEnab* | → | | Disable | | Enable of the protection function | Enable/Disable | - |
| | *Options* | → | Md | HourSE | | Ratio between inverse sequence current and direct sequence current. | HourSE– InputSE | - |
| | | | | No Parameters | | | | |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | | No Parameters | | | | |
| **IRF** | *FuncEnab* | → | | No Parameters | | | | |
| | *Options* | → | Opl | NoTrip | | Operation of output Relays on detection of Internal Relay Fault | NoTrip – Trip | - |
| | | | | No Parameters | | | | |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | | No Parameters | | | | |
| **Osc** | *FuncEnab* | → | | Enable | | Enable of the protection function | Enable/Disable | - |
| | *Options* | → | Trg | Trip | | Trigger operation mode | Disable Start Trip Ext.Inp | - |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | tPre | 0.30 | | Recording time before Trigger | 0.10 – 0.50 | 0.1 |
| | | → | tPost | 0.30 | | Recording time after Trigger | 0.10 – 1.50 | 0.1 |
| **CBMng** | *FuncEnab* | → | | | | | | |
| | *Options* | → | | | | | | |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | tcmd | 0.10 | | C/B closing output command duration | 0.10 – 5.00 | 0.1 |
| | | → | tC | 0.10 | | Maximum admissible delay for detection of status signal after C/B operation. | 0.10 – 5.00 | 0.1 |
| **Comm** | *FuncEnab* | → | | No Parameters | | | | |
| | *Options* | → | LBd | 9600 | | Local Baud Rate (Front panel RS232 communication speed) | 9600 - 19200 38400 - 57600 | - |
| | | | RBd | 9600 | | Remote Baud Rate (Rear panel terminal blocks RS485 communication speed) | 9600 - 19200 | - |
| | | | Mod | 8,n,1 | | Remote mode (communication parameters) ***Note**: any change of this setting became valid at the next power on* | 8,n,1 8,o,1 8,e,1 | - |
| | | | RPr | Modbus | | Remote Protocol | Iec103-Modbus | - |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | | No Parameters | | | | |
| **LCD** | *FuncEnab* | → | | No Parameters | | | | |
| | *Options* | → | Key | BeepON | | Buzzer "Beep" on operation of Keyboard buttons. | BeepON- BeepOFF | - |
| | | | BkL | Auto | | LCD Backlight continuously "ON" or switched-on Automatically on operation of Keyboard buttons. | Auto - ON | - |
| | *TripLev* | → | | No Parameters | | | | |
| | *Timers* | → | | No Parameters | | | | |

Settings can also be programmed via the serial communication ports.

## 12.6 - RelayCfg (Relay Configuration)

To associate one of the Output Relays to one or more functions: enter the menu "R/W Set", select "Relay Cfg", select the "Relay #" to be programmed, select "Link"; at this stage the list of the available functions is displayed. Scrolling the list by the "+" and "-" keys the function is selected and then assigned by the key "Enter".
The assignation is confirmed by the function indication that switches from blinking to steady.
Any of the Output Relays can be programmed to work in two different modes:

| | | |
|---|---|---|
| *N.D.* | Normally Deenergized | (Relay is energized on trip of the associated functions) |
| *N.E.* | Normally Energized | (Relay is deenergized on trip of the associated functions) |

Programming of working mode is made as above selecting "OpMode" instead of "Link".

| *Relay* | *Type* | *Display Default Value* | *Description* | *Setting Options* | *Step* |
|---|---|---|---|---|---|
| **Relay1** (R1) | *Link* | → T>, tI>, I>>, tIH, tIo>, tIo>>, tIoH | Association of functions to output relay R1 | T> - Ta -I> - tI> - I>> - tI>> - IH – tIH - Io> - tIo> - Io>> - tIo>> - tIoH -BF – BC – tBC – F86 SetStd – SetLow - IRF – CBopen – Cbclose – CBFail – HwRec. | - |
| | *OpMode* | → N.D. | N.D. (Normally Deenergized) N.E. (Normally Energized) | N.D./N.E. | - |
| **Relay2** (R2) | *Link* | → BF | Association of functions to output relay R2 | T> - Ta -I> - tI> - I>> - tI>> - IH – tIH - Io> - tIo> - Io>> - tIo>> - tIoH -BF – BC – tBC – F86 SetStd – SetLow - IRF – CBopen – Cbclose – CBFail – HwRec. | - |
| | *OpMode* | → N.D. | N.D. (Normally Deenergized) N.E. (Normally Energized) | N.D./N.E. | - |
| **Relay3** (R3) | *Link* | → Ta, I>, I>>, IH, Io>, Io>>, IoH | Association of functions to output relay R3 | T> - Ta -I> - tI> - I>> - tI>> - IH – tIH - Io> - tIo> - Io>> - tIo>> - tIoH -BF – BC – tBC – F86 SetStd – SetLow - IRF – CBopen – Cbclose – CBFail – HwRec. | - |
| | *OpMode* | → N.D. | N.D. (Normally Deenergized) N.E. (Normally Energized) | N.D./N.E. | - |
| **Relay4** (R4) | *Link* | → F86 | Association of functions to output relay R4 | T> - Ta -I> - tI> - I>> - tI>> - IH – tIH - Io> - tIo> - Io>> - tIo>> - tIoH -BF – BC – tBC – F86 SetStd – SetLow - IRF – CBopen – Cbclose – CBFail – HwRec. | - |
| | *OpMode* | → N.E. | N.D. (Normally Deenergized) N.E. (Normally Energized) | N.D./N.E. | - |

## 12.7 - Commands

"Commands"
1st Control,
to select other available control,
to operate selected control.

| Display | | Description |
|---|---|---|
| *Clear* | : | Erase memory of Trip Counters, Event Records. |
| *Test* | : | Starts a relay diagnostic test |
| *Reset* | : | Reset after trip |
| *CBopen* | : | Manual Open - Close Breaker |
| *CBclose* | : | Manual Close - Close Breaker |
| *ResThIm* | : | Reset Thermal Image |

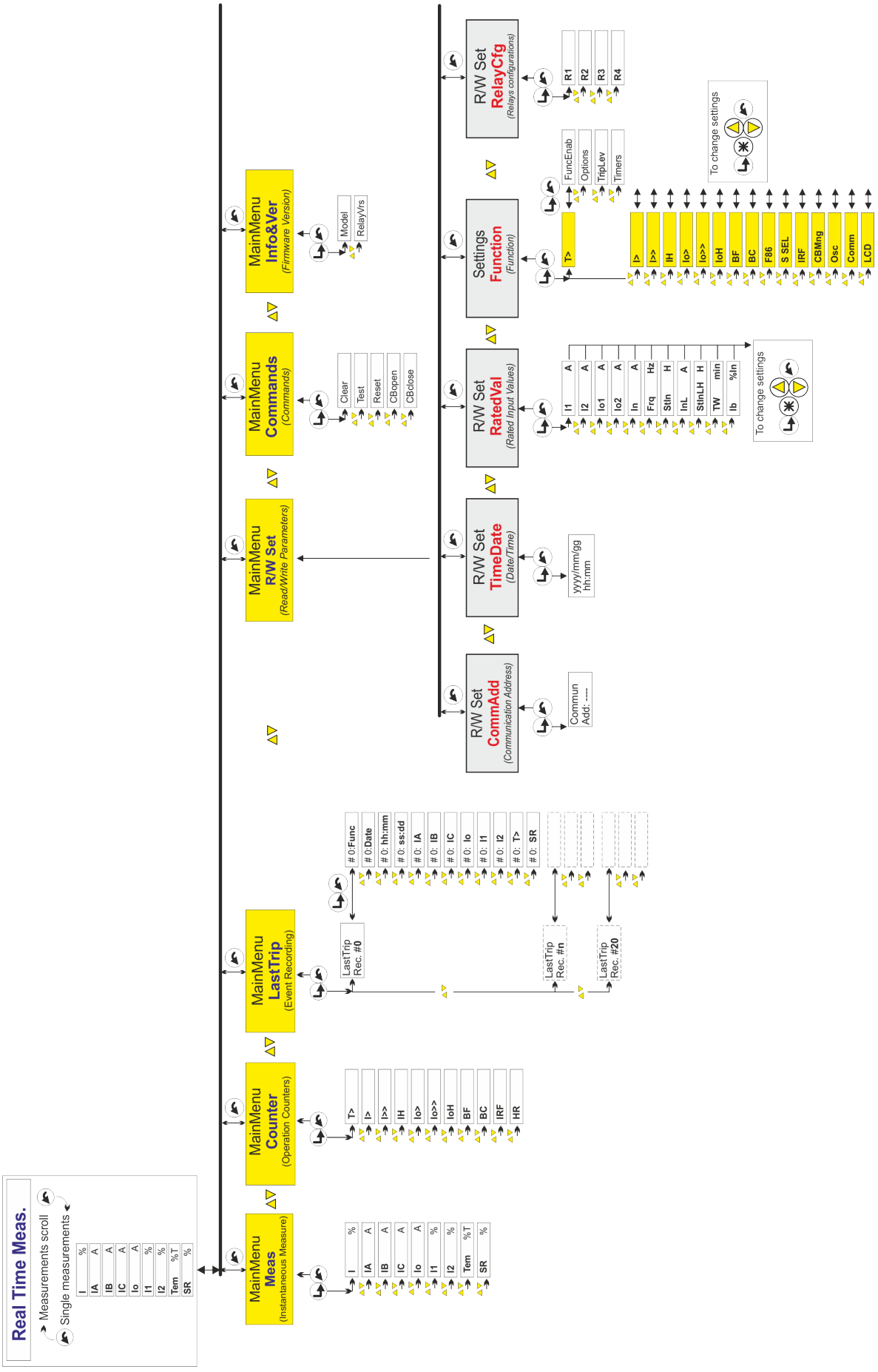
## 12.8 - Info&Ver (Firmware - Info&Version)

The menu displays the Relay Model and the Firmware Version

"**R**eal **T**ime **M**eas"
"Info/Ver",
"Model XXXXXX",
"RelayVrs ###.#.#*X*",
to go back to "Info&Ver".
to go back to "**R**eal **T**ime **M**eas"

Model Relay
Firmware Version

## 13. Keyboard Operational Diagram



## 14. Password

This password is requested anytime the user wants to write in the "Settings" menu a command of the "Commands" menu.

The default password is "1111"

When password is required, proceed as follows

The Display shows the message "Password ????"

| | |
|---|---|
| to select 1st digit (1-9) | to validate |
| to select 2nd digit (1-9) | to validate |
| to select 3rd digit (1-9) | to validate |
| to select 4th digit (1-9) | to complete procedure. |

The "password" is required any time you attempt to modify one of the programmable variables at the first entrance in the "Settings" and/or "Commands" menus.

The "password "remains valid for 2 minutes from the last operation of the programming buttons or until the button is pressed to return to the default display (RT Meas).
Once the Password has been entered, a "#" appears before the variable that can be modified.

### 14.1 - MS-Com Password

This password is requested anytime the user wants to send to the relay a setting parameters modification or to issue a command through the relay itself using the managing software MSCom.
The user can decide whether inserting his own password (see MS-Com Operational Manual) or keeping the password disabled just clicking on the OK button when the password is requested.

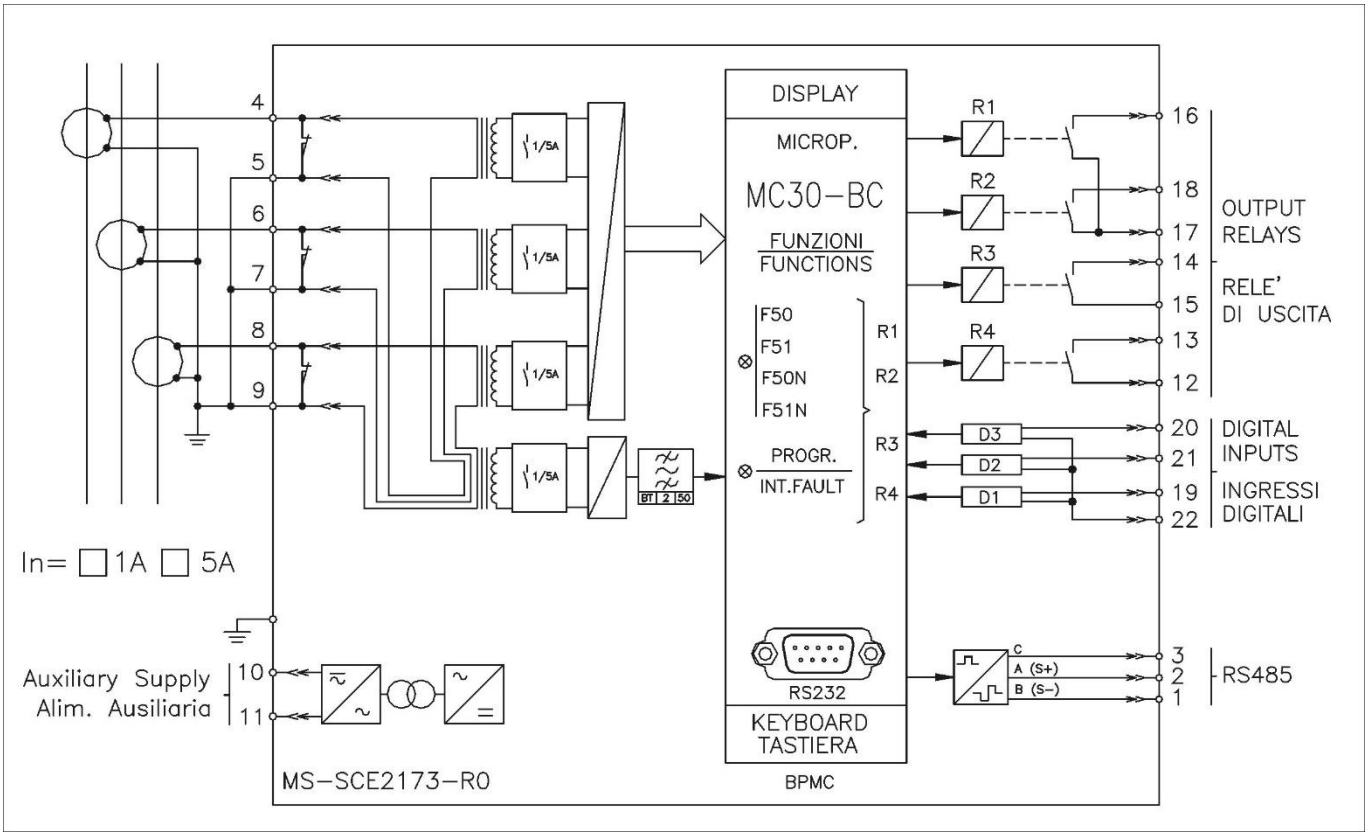
## 15. Maintenance

No maintenance is required. 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.

## 16. Power Frequency Insulation Test

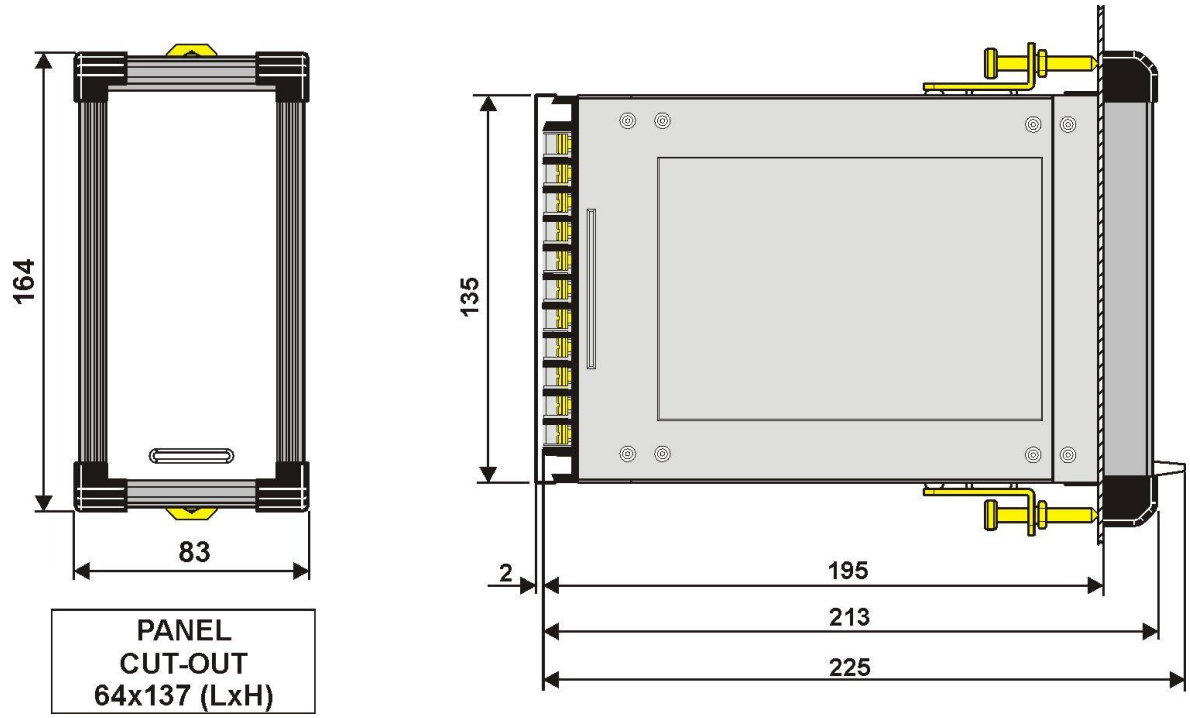
Every relay individually undergoes a factory insulation test according to IEC255-5 standard at
2 kV, 50 Hz 1min. Insulation test should not be repeated as it unusefully stresses the dielectrics.
When doing the insulation test, the terminals relevant to serial output, digital inputs and RTD input must always be short circuited to ground. When relays are mounted in switchboards or relay boards that have to undergo the insulation tests, the relay should be isolated. 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.

## 17. Connection Diagram




## 18. Overall Dimensions

PROTECTION DEGREE IP44 (IP54 on request)



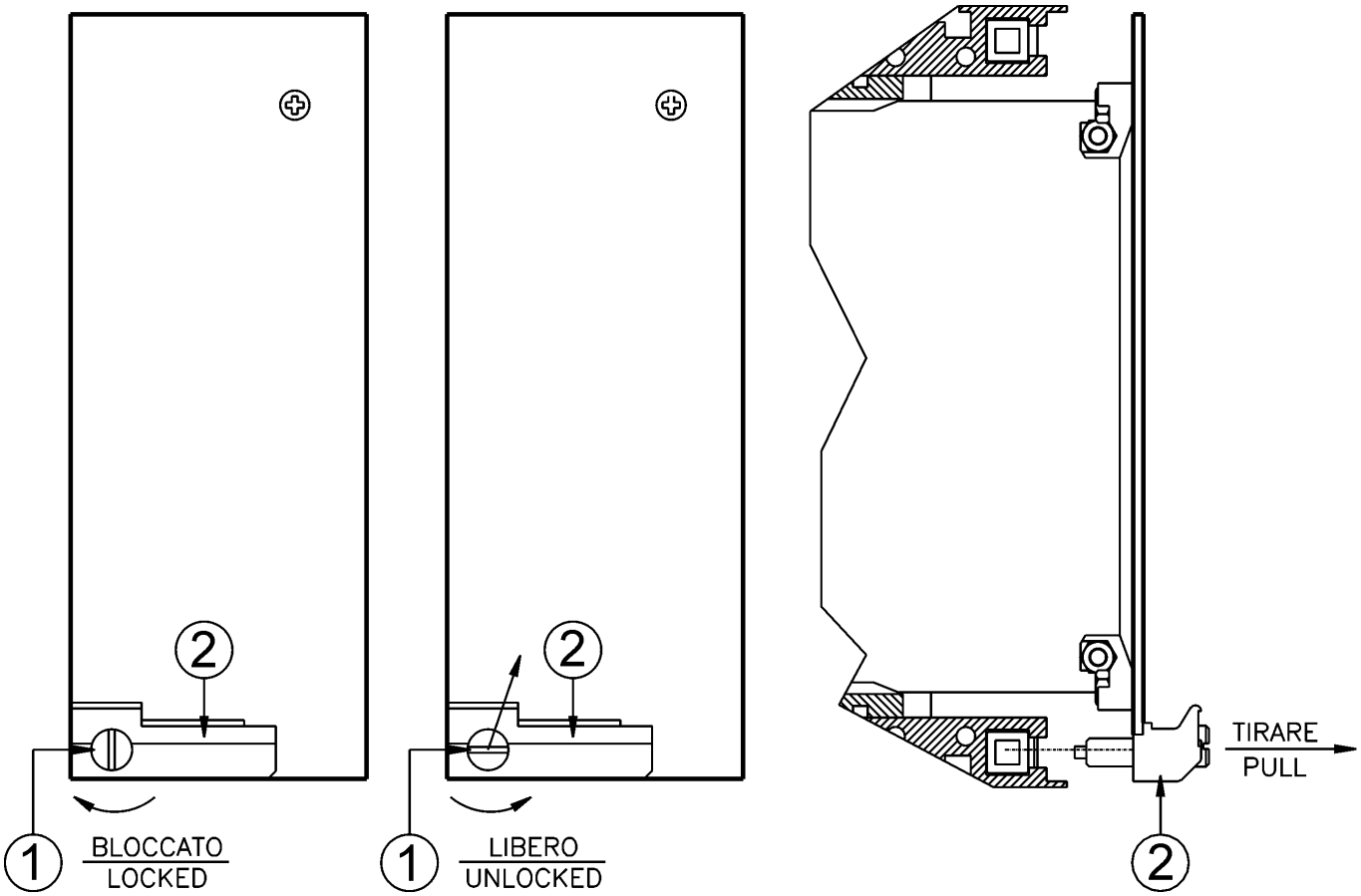
## 19. Direction For Pcb's Draw-Out And Plug-In

### 19.1 - Draw-Out

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

### 19.2 - Plug-In

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



## 20. Electrical Characteristics

| *APPROVAL : CE* | | | |
|---|---|---|---|
| *REFERENCE STANDARDS* | *IEC 60255 - 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 60068)* | | | |
|---|---|---|---|
| *Operation ambient temperature* | | -10°C / +55°C | |
| *Storage temperature* | | -25°C / +70°C | |
| *Environmental testing* | (Cold) | IEC60068-2-1 | |
| | (Dry heat) | IEC60068-2-2 | |
| | (Change of temperature) | IEC60068-2-14 | |
| | (Damp heat, steady state) | IEC60068-2-78 | RH 93% Without Condensing AT 40°C |

| *CE EMC Compatibility (EN61000-6-2 - EN61000-6-4 - EN50263)* | | | | |
|---|---|---|---|---|
| *Electromagnetic emission* | EN55011/22 | industrial environment | | |
| *Radiated electromagnetic field immunity test* | IEC61000-4-3 | level 3 | 80-2000MHz | 10V/m |
| | ENV50204 | | 900MHz/200Hz | 10V/m |
| *Conducted disturbances immunity test* | IEC61000-4-6 | level 3 | 0.15-80MHz | 10V |
| *Electrostatic discharge test* | IEC61000-4-2 | level 3 | 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 | |
| *Immunity to conducted common mode disturbance 0Hz-150KHz* | IEC61000-4-16 | level 4 | | |
| *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 | | | |

| *Electric Rated Value* | | |
|---|---|---|
| Accuracy at reference value of influencing factors | 2% In | for measure |
| (*) In, On = Nominal Current of the System's Current Transformer | 0,2% On (*) | |
| | 2% + to (to=20÷30ms @ 2xIs) | for times |
| Rated Current | In = 1A/5A - On = 1A/5A | |
| Current overload | 400 A for 1 sec; 20A continuous | |
| Burden on current inputs | Fase : 0.1VA a In = 1A ; 0.3VA a In = 5A | |
| Average power supply consumption | ≤ 7 VA | |
| Output relays | rating 6 A; Vn = 250 V<br>A.C. resistive switching = 1500VA (400V max)<br>make = 30 A (peak) 0,5 sec.<br>break = 0.3 A, 110 Vcc,<br>L/R = 40 ms (100.000 op.) | |

| *Communication Parameters* | |
|---|---|
| *RS485 (Back)* | 9600/19200 bps – 8,n,1 - 8,e,1 - 8,o,1 – Modbus RTU or IEC60870-5-103 |
| *RS232 (Front)* | 9600/19200/38400/57600 – 8,n,1 – Modbus RTU |



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