MICROPROCESSOR
OVERCURRENT and EARTH FAULT RELAY
with AUTORECLOSE

TYPE

# MC30-R2

## 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 in the product's specification 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 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 - 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 authorized Dealers.

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

## 2. General

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, selfpowered Digital Inputs.

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

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

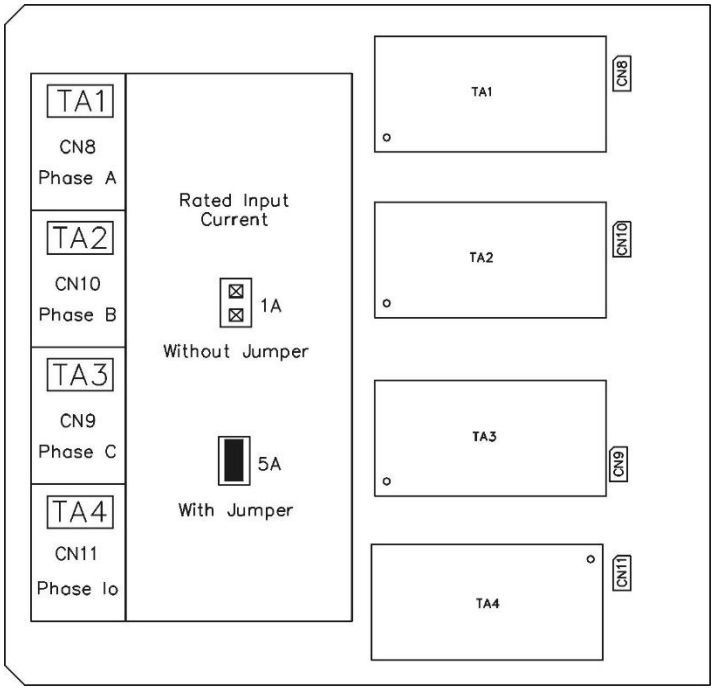
Input currents are supplied to 3 current transformers: measuring phase currents.
An additional internal CT directly measures the residual (Zero Sequence) current of the three inputs.
Current inputs can be 1 or 5A: selection between 1A or 5A is made by movable jumpers provided on the Relay card. (see 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 an 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 primary current of the relay | 1 | - | 9999 | 1 | A |
| Freq | 50 | Hz | System rated frequency | 50 | - | 60 | 10 | Hz |
| TW | 30 | min | Warming-up time constant for Thermal Image | 1 | - | 60 | 1 | min. |
| Ib | 105 | %In | Max. admissible continuous overload for Thermal Image | 50 | - | 130 | 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

#### 2.2.2.3 - Earth Fault Current Input (Ion)

Same as for the Phase Currents, the relay directly displays the r.m.s. value of the Zero Sequence Residual Current flowing at the Primary of the Current Transformers.

### *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) = $T_s$ $\frac{I}{I_s} = 10$ when

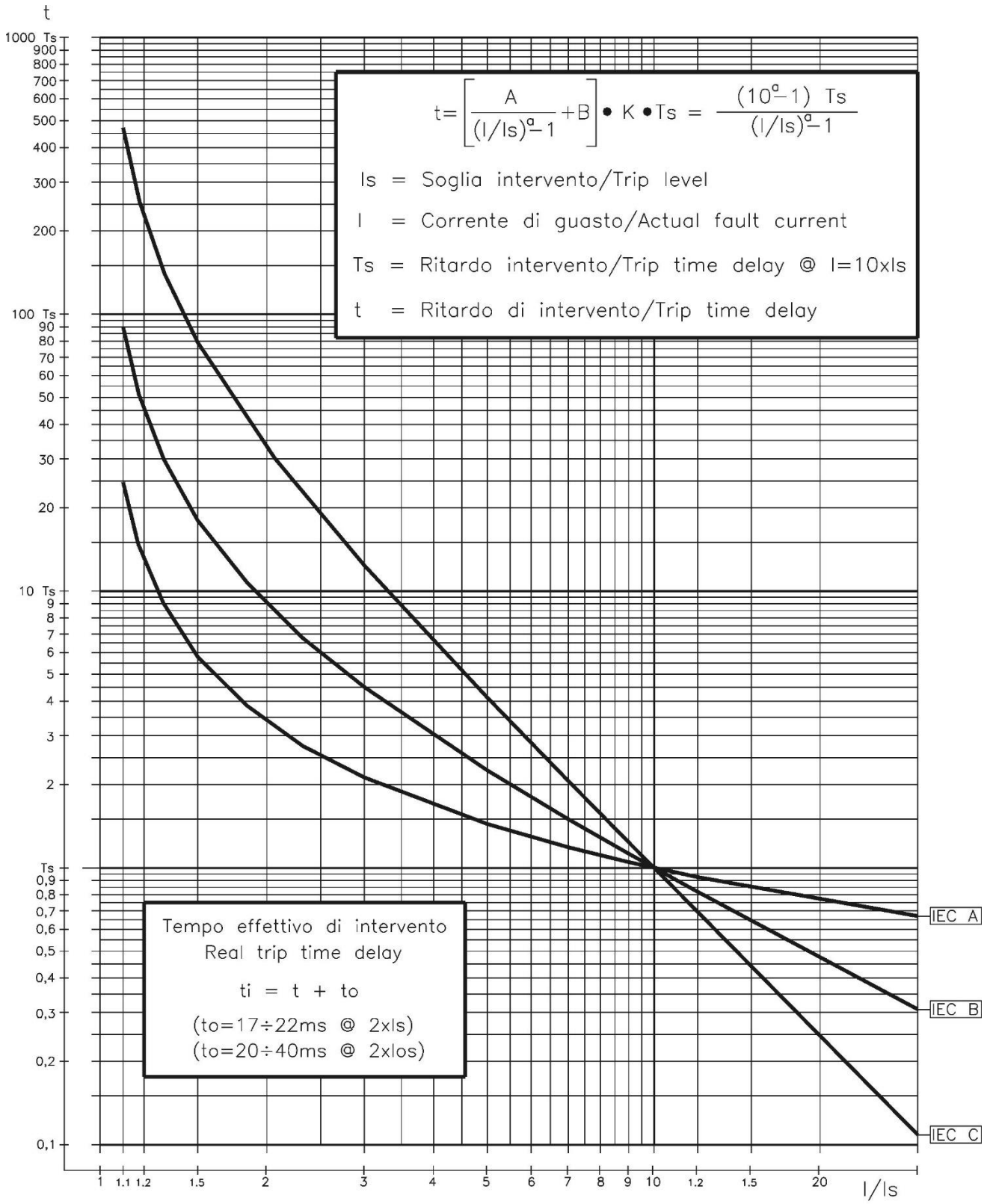
tr = Operation time of the output relay on pick-up (7ms).

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.***

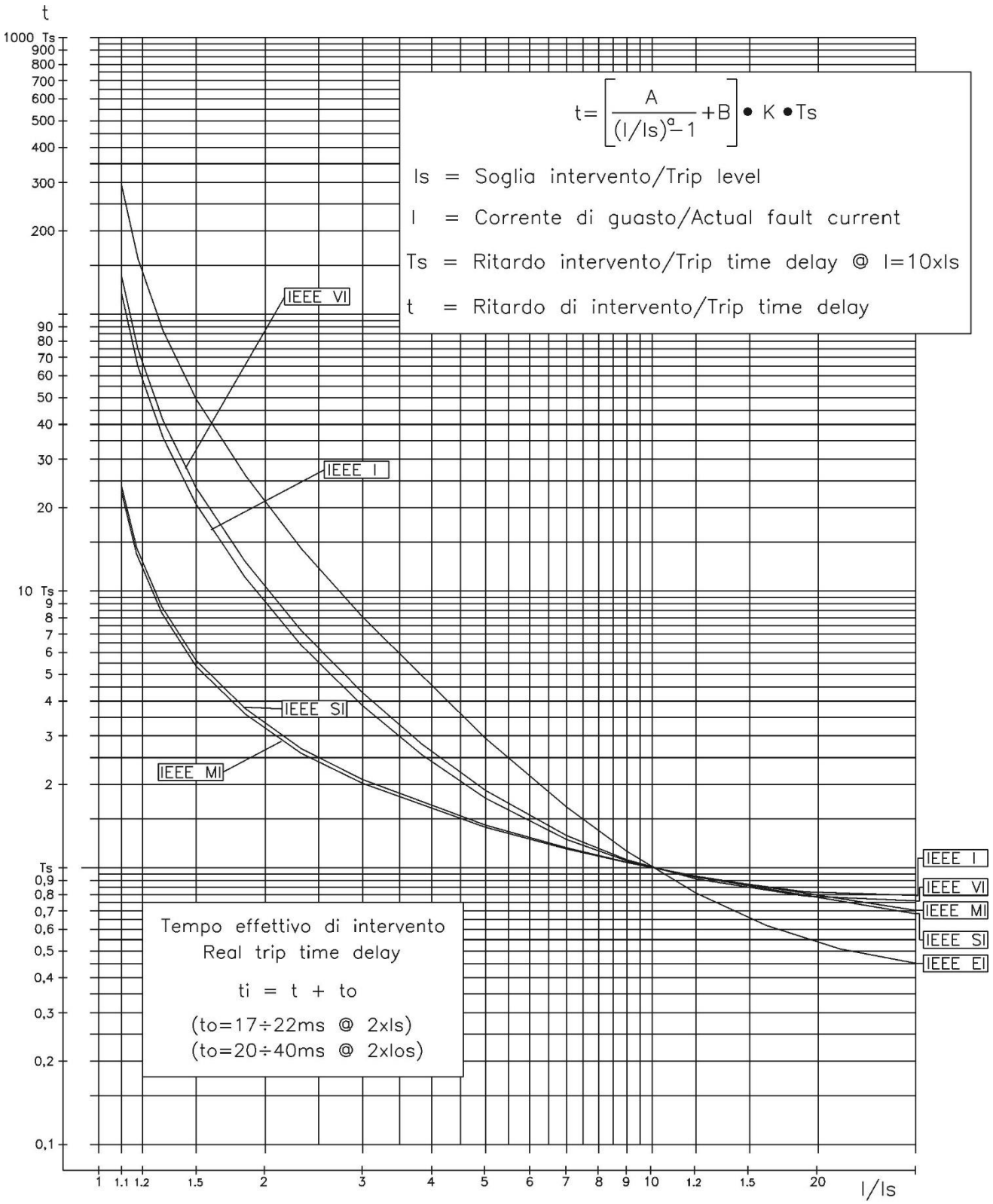
### *2.2.3 - Time Current Curves IEC (TU1029 Rev.0)*




| 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)

The relay is provided with two groups of setting "**GRP1**" and "**GRP2**".

| *Group* | *Functions* |
|---|---|
| GRP1 | T>, I>, I>>, IH, Io>, Io>>, IoH, BF, IRF, RCL, Osc, Comm, LCD. |
| GRP2 | T>, I>, I>>, IH, Io>, Io>>, IoH, RCL. |

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | | No Param | | No Parameters | | | |
| *TripLev* | → | ***Tal*** | 50.00 | %Tb | (50.00 ÷ 110.00) | step | 1 | %Tb |
| | → | ***Tst*** | 100.00 | %Tb | (10.00 ÷ 100.00) | 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. |

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)

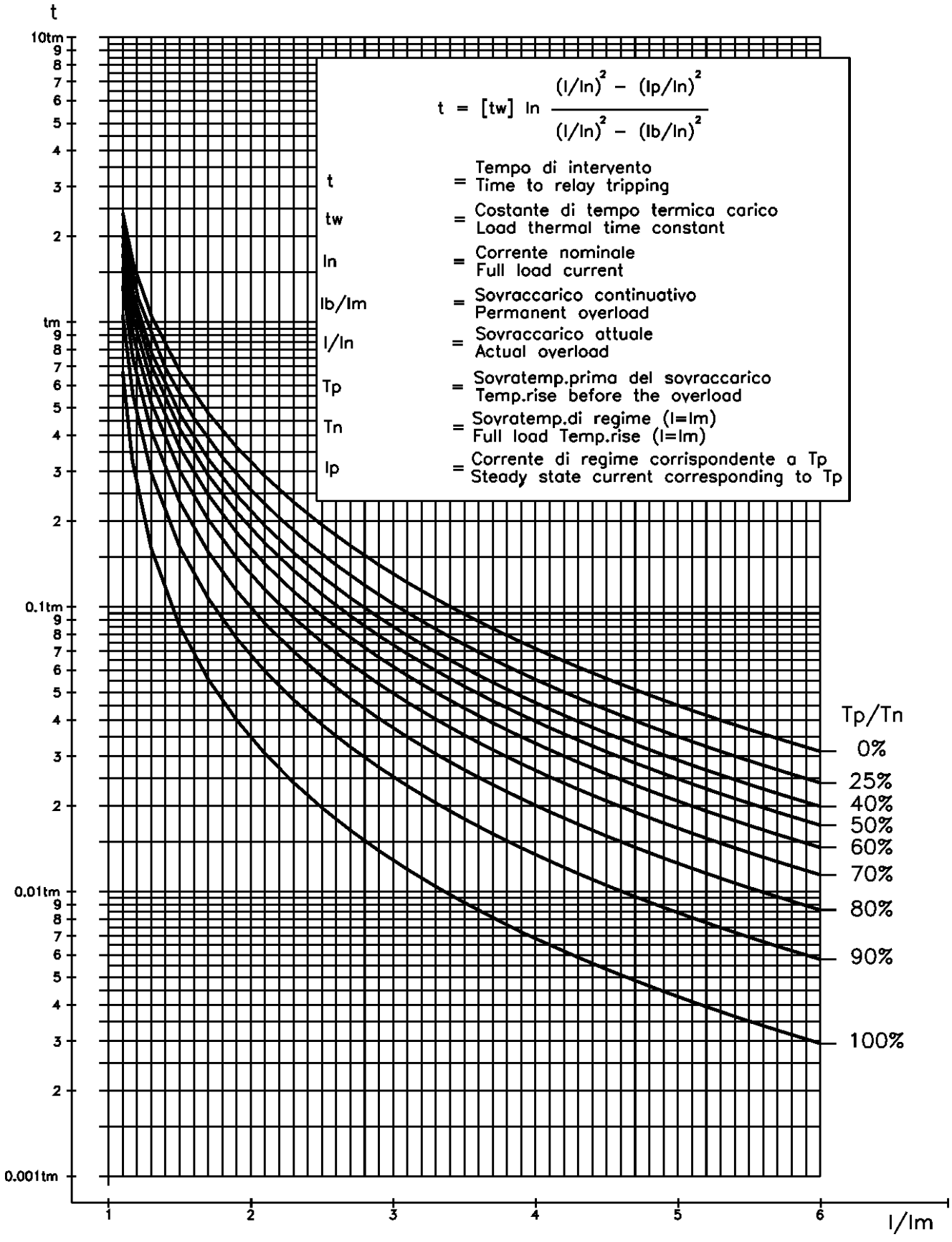
$$t = tw \cdot \ell_n \left[ \frac{(I/In)^2 - (Ip/In)^2}{(I/In)^2 - (Ib/In)^2} \right] \quad \text{where:}$$

| | | | |
|---|---|---|---|
| **tw** | = | Warming-up time constant | (1-60)min. |
| **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 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".

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



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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***TCC*** | A | | [D / A / B / C / MI / VI / I / EI / / SI ] | | | |
| | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| | → | ***Sh1*** | No | | [No / Yes] | | | |
| | → | ***Sh2*** | No | | [No / Yes] | | | |
| | → | ***Sh3*** | No | | [No / Yes] | | | |
| | → | ***Sh4*** | No | | [No / Yes] | | | |
| *TripLev* | → | ***I>*** | 0.1 | In | (0.10 ÷ 4.00) | step | 0.01 | In |
| *Timers* | → | ***tI>*** | 0.05 | s | (0.05 ÷ 60.00) | step | 0.01 | s |

Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *TCC* | : | Time current curves<br>*D* = Independent Definite Time<br>*A* = IEC A Inverse<br>*B* = IEC B Very Inverse<br>*C* = IEC C Extremely Inverse<br>*MI* = IEEE Moderate Inverse Curve<br>*VI* = IEEE Very Inverse Curve<br>*I* = IEEE Inverse Curve<br>*EI* = IEEE Extremely Inverse Curve<br>*SI* = IEEE Short Inverse Curve |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *Sh1* | : | Tripping of this function (1F51) starts (Yes) or not (No) the first reclosure shot. |
| *Sh2* | : | Tripping of this function (1F51) starts (Yes) or not (No) the 2nd reclosure shot. |
| *Sh3* | : | Tripping of this function (1F51) starts (Yes) or not (No) the 3rd reclosure shot. |
| *Sh4* | : | Tripping of this function (1F51) starts (Yes) or not (No) the 4th reclosure shot. |
| *I>* | : | Minimum phase current pick-up level (limited to 40 times In) |
| *tI>* | : | Trip time delay |

### *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] | | | |
| | → | ***Sh1*** | No | | [No / Yes] | | | |
| | → | ***Sh2*** | No | | [No / Yes] | | | |
| | → | ***Sh3*** | No | | [No / Yes] | | | |
| | → | ***Sh4*** | No | | [No / Yes] | | | |
| *TripLev* | → | ***I>>*** | 0.05 | In | (0.50 ÷ 40.00) | step | 0.01 | In |
| *Timers* | → | ***tI>>*** | 0.05 | s | (0.05 ÷ 60.00) | step | 0.01 | s |
| | → | ***t2xI*** | 0.02 | 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) |
| *Sh1* | : | Tripping of this function (2F51) starts (Yes) or not (No) the first reclosure shot. |
| *Sh2* | : | Tripping of this function (2F51) starts (Yes) or not (No) the 2nd reclosure shot. |
| *Sh3* | : | Tripping of this function (2F51) starts (Yes) or not (No) the 3rd reclosure shot. |
| *Sh4* | : | Tripping of this function (2F51) starts (Yes) or not (No) the 4th reclosure shot. |
| *I>>* | : | Minimum phase current pick-up level (limited to 40 times In) |
| *tI>>* | : | Trip time delay |
| *t2xI* | : | Trip time delay |

### *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] | | | |
| | → | ***Sh1*** | No | | [No / Yes] | | | |
| | → | ***Sh2*** | No | | [No / Yes] | | | |
| | → | ***Sh3*** | No | | [No / Yes] | | | |
| | → | ***Sh4*** | No | | [No / Yes] | | | |
| *TripLev* | → | ***IH*** | 0.5 | In | (0.50 ÷ 40.00) | step | 0.01 | In |
| *Timers* | → | ***tIH*** | 0.05 | s | (0.05 ÷ 60.00) | step | 0.01 | s |
| | → | ***t2xI*** | 0.02 | 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) |
| *Sh1* | : | Tripping of this function (3F51) starts (Yes) or not (No) the first reclosure shot. |
| *Sh2* | : | Tripping of this function (3F51) starts (Yes) or not (No) the 2nd reclosure shot. |
| *Sh3* | : | Tripping of this function (3F51) starts (Yes) or not (No) the 3rd reclosure shot. |
| *Sh4* | : | Tripping of this function (3F51) starts (Yes) or not (No) the 4th reclosure shot. |
| *IH* | : | Minimum phase current pick-up level (limited to 40 times In) |
| *t2xI* | : | Trip time delay |
| *tIH* | : | Trip time delay |

### *3.4.1 – Automatic doubling or Overcurrent thresholds on current inrush*

For some of the phase Overcurrent functions it is possible to have the set trip level [Is] automatically doubled when strong inrush current is detected.
If at circuit Breaker switch-on (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] | | | |
| | → | ***Sh1*** | No | | [No / Yes] | | | |
| | → | ***Sh2*** | No | | [No / Yes] | | | |
| | → | ***Sh3*** | No | | [No / Yes] | | | |
| | → | ***Sh4*** | No | | [No / Yes] | | | |
| *TripLev* | → | ***Io>*** | 0.01 | Ion | (0.01 ÷ 4.00) | step | 0.01 | Ion |
| *Timers* | → | ***tIo>*** | 0.05 | s | (0.05 ÷ 60.00) | step | 0.01 | s |

#### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *TCC* | : | Time current curves<br>*D* = Independent Definite Time<br>*A* = IEC A Inverse<br>*B* = IEC B Very Inverse<br>*C* = IEC C Extremely Inverse<br>*MI* = IEEE Moderate Inverse Curve<br>*VI* = IEEE Very Inverse Curve<br>*I* = IEEE Inverse Curve<br>*EI* = IEEE Extremely Inverse Curve<br>*SI* = IEEE Short Inverse Curve |
| *BI* | : | Operation controlled by Blocking Digital Input |
| *Trg* | : | Function operation triggers the oscillographic wave form capture (see § Oscillographic Recording) |
| *Sh1* | : | Tripping of this function (1F51N) starts (Yes) or not (No) the first reclosure shot. |
| *Sh2* | : | Tripping of this function (1F51N) starts (Yes) or not (No) the 2nd reclosure shot. |
| *Sh3* | : | Tripping of this function (1F51N) starts (Yes) or not (No) the 3rd reclosure shot. |
| *Sh4* | : | Tripping of this function (1F51N) starts (Yes) or not (No) the 4th reclosure shot. |
| *Io>* | : | Minimum Zero Sequence Residual Current Pick-up level |
| *tIo>* | : | Trip time delay |

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| | → | ***Sh1*** | No | | [No / Yes] | | | |
| | → | ***Sh2*** | No | | [No / Yes] | | | |
| | → | ***Sh3*** | No | | [No / Yes] | | | |
| | → | ***Sh4*** | No | | [No / Yes] | | | |
| *TripLev* | → | ***Io>>*** | 0.01 | Ion | (0.01 ÷ 9.99) | step | 0.01 | Ion |
| *Timers* | → | ***tIo>>*** | 0.05 | s | (0.05 ÷ 60.00) | 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) |
| *Sh1* | : | Tripping of this function (2F51N) starts (Yes) or not (No) the first reclosure shot. |
| *Sh2* | : | Tripping of this function (2F51N) starts (Yes) or not (No) the 2nd reclosure shot. |
| *Sh3* | : | Tripping of this function (2F51N) starts (Yes) or not (No) the 3rd reclosure shot. |
| *Sh4* | : | Tripping of this function (2F51N) starts (Yes) or not (No) the 4th reclosure shot. |
| *Io>>* | : | Minimum Zero Sequence Residual Current Pick-up level |
| *tIo>>* | : | Trip time delay |

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***BI*** | Disable | | [Disable / Enable] | | | |
| | → | ***Trg*** | Enable | | [Disable / Enable] | | | |
| | → | ***Sh1*** | No | | [No / Yes] | | | |
| | → | ***Sh2*** | No | | [No / Yes] | | | |
| | → | ***Sh3*** | No | | [No / Yes] | | | |
| | → | ***Sh4*** | No | | [No / Yes] | | | |
| *TripLev* | → | ***IoH*** | 0.01 | Ion | (0.01 ÷ 9.99) | step | 0.01 | Ion |
| *Timers* | → | ***tIoH*** | 0.05 | s | (0.05 ÷ 60.00) | 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) |
| *Sh1* | : | Tripping of this function (3F51N) starts (Yes) or not (No) the first reclosure shot. |
| *Sh2* | : | Tripping of this function (3F51N) starts (Yes) or not (No) the 2nd reclosure shot. |
| *Sh3* | : | Tripping of this function (3F51N) starts (Yes) or not (No) the 3rd reclosure shot. |
| *Sh4* | : | Tripping of this function (3F51N) starts (Yes) or not (No) the 4th reclosure shot. |
| *IoH* | : | Minimum Zero Sequence Residual Current Pick-up level |
| *tIoH* | : | Trip time delay |

## *3.8 - BF (F51BF) - Breaker Failure*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | ***TrR*** | Relay1 | | Relay1 – Relay2 – Relay3 – Relay4 | | | |
| *TripLev* | → | | No Param | | No Parameters | | | |
| *Timers* | → | ***tBF*** | 0.20 | 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 - I.R.F. - Internal Relay Failure*

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

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

## *3.10 - RCL - Reclosing function*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | **Rsh** | 1 | | [1 / 2 / 3 / 4] | | | |
| *TripLev* | → | | No Param | | No Parameters | | | |
| *Timers* | → | **RCLtr** | 5 | s | (0.10 ÷ 300) | step | 0.1 | s |
| | → | **RCLt1** | 2 | s | (0.10 ÷ 300) | step | 0.1 | s |
| | → | **RCLt2** | 4 | s | (0.10 ÷ 300) | step | 0.1 | s |
| | → | **RCLt3** | 6 | s | (0.10 ÷ 300) | step | 0.1 | s |
| | → | **RCLt4** | 8 | s | (0.10 ÷ 300) | step | 0.1 | s |

### Description of variables

| | | |
|---|---|---|
| *FuncEnab* | : | If disable the function is disactivated |
| *Rsh* | : | Number of reclosure shots to Lock-out. |
| *RCLtr* | : | Reset interval (reclaim time)after any successful reclosure |
| *RCLt1* | : | Reclosing time interval of first reclosing shot |
| *RCLt2* | : | Reclosing time interval of 2nd reclosing shot |
| *RCLt3* | : | Reclosing time interval of 3rd reclosing shot |
| *RCLt4* | : | Reclosing time interval of 4th reclosing shot |

The status of the Circuit Breaker (C/B) is indicated by one normally open contact of the C/B itself and is detected by a digital input of the relay.

Any time the Circuit Breaker (C/B) is closed either manually or automatically the Reclaim time "RCLtr" is started.

During "RCLtr" after manual closure of the C/B operation starting of any of the protection function stops the "RCLtr" time counting:

- if the protection element is reset before tripping, the timer "RCLtr" is restarted.
- it the protection function trips (end of its trip time delay) the autoreclosure is blocked.

**FIRST** Autoreclose shot is started on C/B opening **after "RCLtr"** operated by tripping of one of the protection functions programmed to control the first reclose shot;
C/B opening operated manually or by one function not programmed to control the next reclosure shot, activates the Lock-out status of the Automatic Reclosure.

Reset from the Lock-out status takes place by manual closure of the C/B.

**NEXT** Autoreclose shots (after the first) are started on C/B opening **during "RCLtr"** operated by tripping of one of the protection functions programmed to control this reclose shot;

During "RCLtr" operation starting (during the trip time delay) of any of the protection functions programmed to initiate the next Reclosure Shot, stops the "RCLtr" time counting:

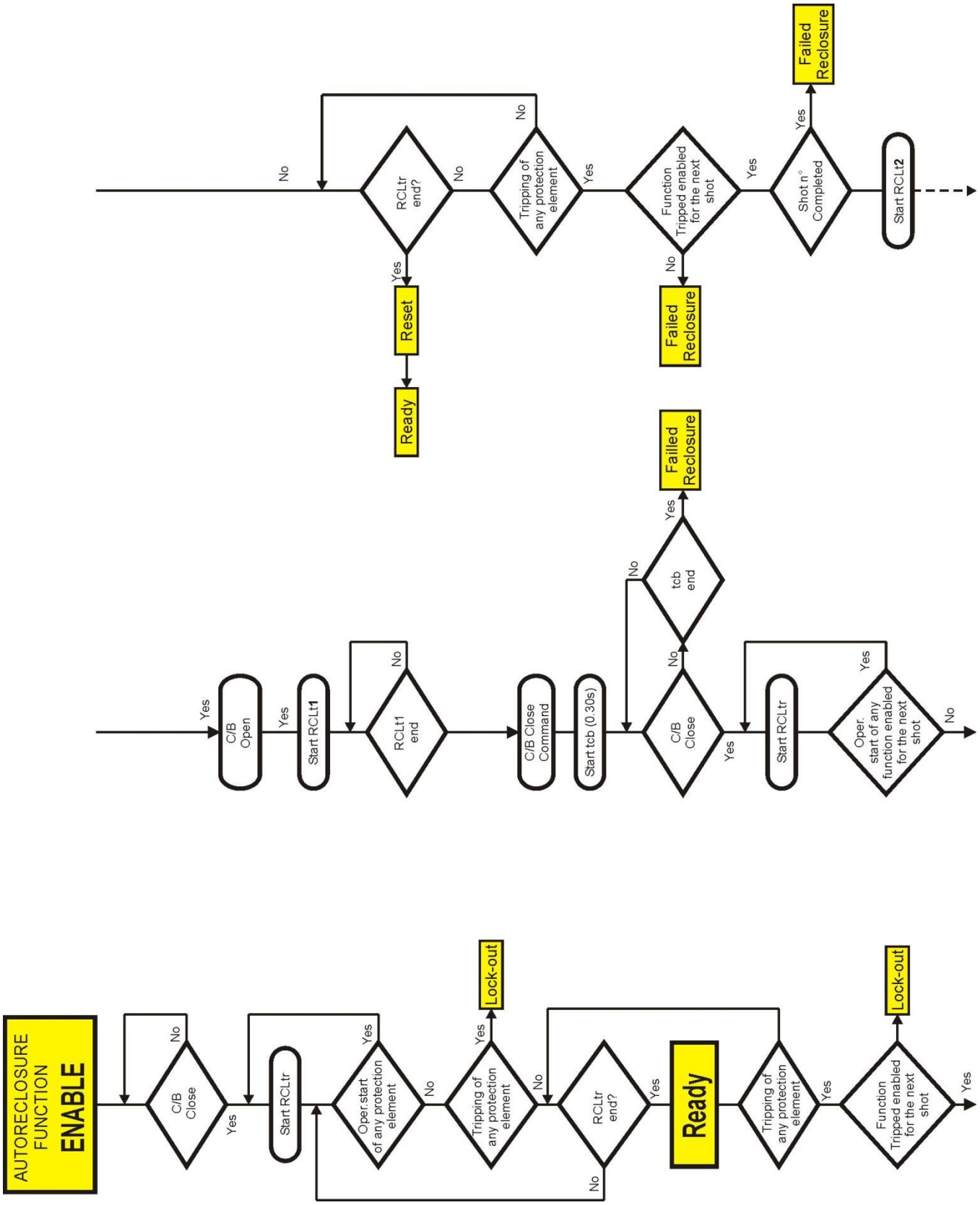
- if the protection element is reset before tripping, the timer "RCLtr" is restarted.
- if the protection element trips (end of its trip time delay) the Automatic Reclosure sequence proceeds initiating the next reclosure shot.

C/B opening operated manually or by one function not programmed to control the next reclosure shot, activates the Lock-out status of the Automatic Reclosure and the indication of "**FAILED RECLOSURE**".

Reset from the Lock-out status takes place by manual closure of the C/B.

After "RCLtr" is expired the relay is ready for a new reclosure sequence.

As soon as the C/B is opened due to tripping of one of the protection functions programmed to initiate an automatic reclosure shot, the relevant reclose time delay (RCLt1, RCLt2, RCLt3, RCLt4) is started and, at the end of this time delay, the reclose command is issued. The C/B is then automatically reclosed and the reclaim time "RCLtr" is started again.
If the closed status of the C/B is not detected within 0.3s from expiry of the reclose time delay, the relay indicates "**RECLOSURE FAILED**".


AUTORECLOSURE FUNCTION ENABLE
C/B Close
Start RCLtr
Oper.start of any protection element
Tripping of any protection element
Lock-out
RCLtr end?
Ready
Tripping of any protection element
Function Tripped enabled for the next shot
Lock-out
C/B Open
Start RCLt1
RCLt1 end
C/B Close Command
Start tcb (0.30s)
C/B Close
tcb end
Failled Reclosure
Start RCLtr
Oper. start of any function enabled for the next shot
RCLtr end?
Reset
Ready
Tripping of any protection element
Function Tripped enabled for the next shot
Failed Reclosure
Shot n° Completed
Start RCLt2
Failed Reclosure

## 3.11 - Osc - Oscillographic Recording

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *FuncEnab* | → | | Enable | | [Disable / Enable] | | | |
| *Options* | → | **Trg** | Trip | | [Disable / Start / Trip / Ext.Inp.] | | | |
| *TripLev* | → | | No Param | | No Parameters | | | |
| *Timers* | → | **tPre** | 0.30 | s | (0.10 ÷ 0.50) | step | 0.1 | s |
| | → | **tPost** | 0.30 | s | (0.10 ÷ 1.50) | 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).
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).
In any case the number of event stored can not exceed ten (10 x 0.3 sec).
Any new event beyond the 3 sec capacity of the memory, cancel and overwrites the former records (FIFO Memory).

## 3.12 - Comm – Communication Parameters

| | | | | |
|---|---|---|---|---|
| *FuncEnab* | → | | No Param | No Parameters |
| *Options* | → | **LBd** | 9600 | [9600 / 19200 / 38400] |
| | → | **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 |

## 3.13 - 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 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 systems. 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 user 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 operate "**OPEN**" and "**CLOSE**" control of 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 as needed the number of user programmable Output Relays and Digital Inputs controlled from the relay.

## 6. Digital Inputs

Three optoisolated, selfpowered 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 for Remote Trip |
| *D3* | (terminals 22 - 20) | : | The digital Input indicates the position of the Circuit Breaker (Input Closed = C/B closed; Input Open = C/B open). If the option External Trigger = Enabled any time the DI passed from closed to open the oscillographic recording is started. |

## 7. Selfdiagnostic

The relay incorporates a sophisticated selfdiagnostic feature that continuously checks the following elements:

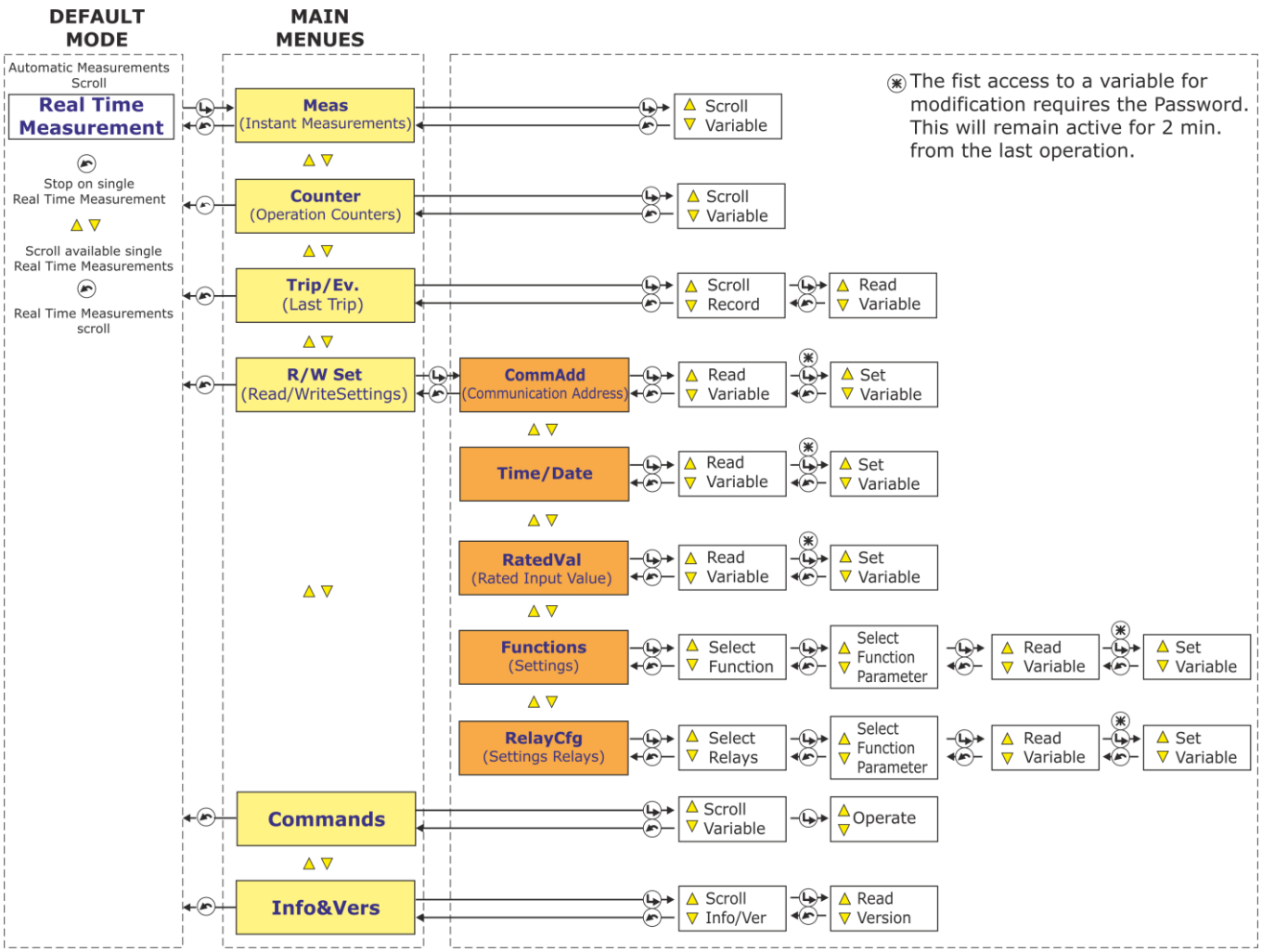
| |
|---|
| A/D conversion |
| Checksum of the settings stored into $E^2$Prom. |
| DSP general operation (Power, Routines, etc.) |
| Lamp test (only on manual test). |

Any time Power is switched on, a complete test is run; then, 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 Relay Internal Failure (I.R.F) is detected:

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

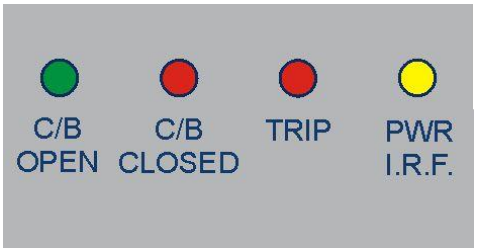
## 8. Relay Management

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

## 9. Signalizations

Four signal leds are available on the Front Face Panel:




| | | | |
|---|---|---|---|
| a) | **GREEN LED** | C/B OPEN | ❑ Illuminated when C/B open status is detected. (Digital Input D3 Open) |
| b) | **RED LED** | C/B CLOSED | ❑ Illuminated when C/B close status is detected. (Digital Input D3 closed)<br>❑ Flashing when Breaker Failure is detected. |
| c) | **RED LED** | TRIP (*) | ❑ Flashing when a timed function starts to operate.<br>❑ Illuminated when any function is tripped; reset takes places by pressing 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 protection function is tripped 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 convalidate any programming changement.


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


**B-RCL** Lockout


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


**Select -**

## 11. Serial Communication Port

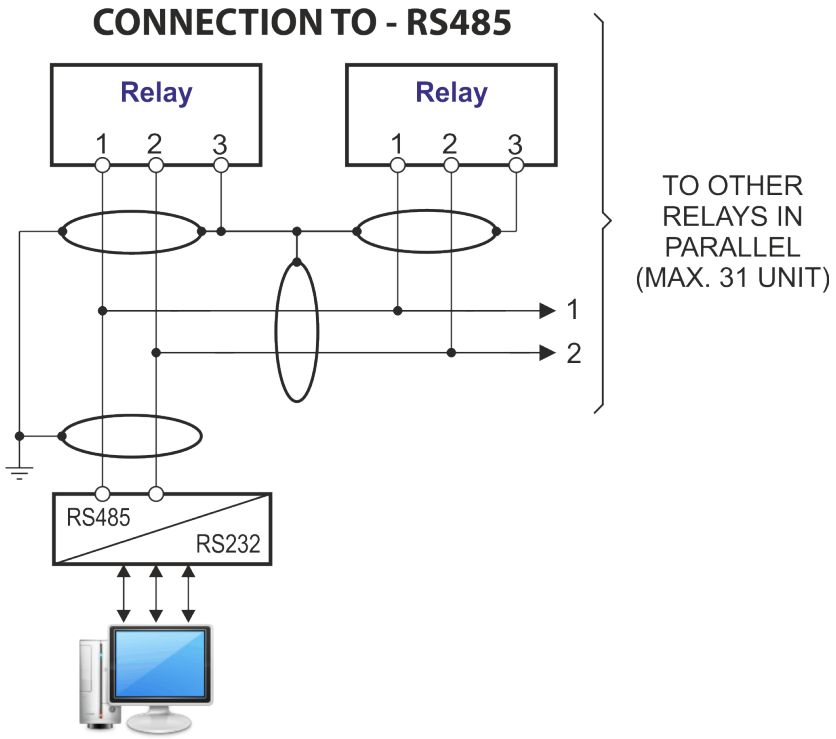
### *11.1 . Main RS485 Serial Communication Port*

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.

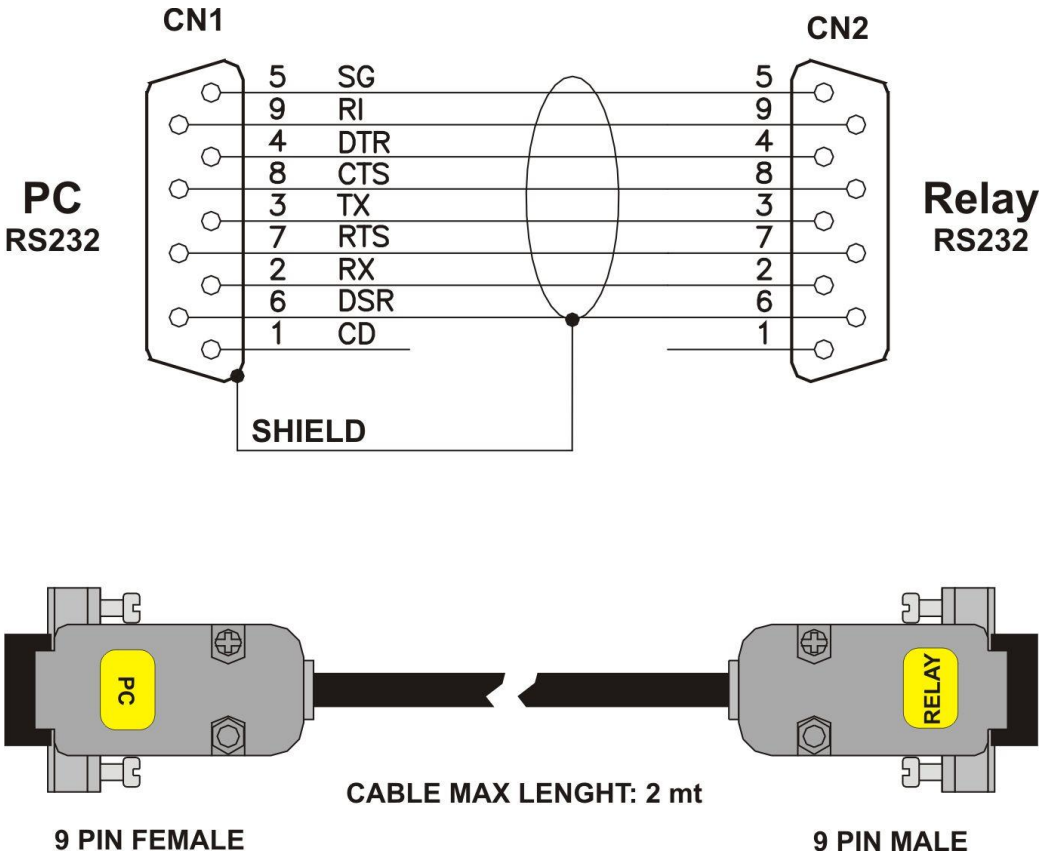



For longer distance and for connection of up to 250 Relays, optical interconnection is recommend.
(please ask Microelettrica for accessories)

### *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*

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, ✱ appears aside the measurement and the different available measurements can be selected 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) |
| Tem | = | 0 - 65535 | %T | Actual temperature rise |

## *12.2 - Measure (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) |
| Tem | = | 0 - 65535 | %T | Actual temperature rise |

## *12.3 - Counter (Operation Counters)*

The operation of any of the function herebelow 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 operation of Breaker Failure |
| I.R.F. | = | 0 – 65535 | Number of Internal Relay Faults |
| RCL1 | = | 0 – 65535 | Number of first Reclosure |
| RCL2 | = | 0 – 65535 | Number of 2nd Reclosure |
| RCL3 | = | 0 – 65535 | Number of 3rd Reclosure |
| RCL4 | = | 0 – 65535 | Number of 4th Reclosure |
| RCLF | = | 0 – 65535 | Number of failed Reclosure |
| HR | = | 0 – 65535 | Number of HW recovery operations |

## *12.4 – Trip/Ev. (Event Recording)*

The MC records any tripping and stores the information relevant to the last five 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:ms | | Time: hours/minutes/second/milliseconds |
| *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 Zero Sequence Current (Primary Amps) |
| *Tem* | = | 0 - 65535 | %T | Actual temperature rise |

← 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" Date: Current Date, Time: Current time
"YY/……" to set year,
"XX/MM" to set month,
"XX/XX/DD" to set day,
"XX/XX/XX"
"hh/mm" to set hour,
"XX/mm" to set minutes,
To validate Set Done!
Exit

### 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 primary current of the relay | 1 | - | 9999 | 1 | A |
| Freq | 50 | Hz | System rated frequency | 50 | - | 60 | 10 | Hz |
| TW | 30 | min | Warming-up time constant for Thermal Image | 1 | - | 60 | 1 | min. |
| Ib | 105 | %In | Max. admissible continuous overload for Thermal Image | 50 | - | 130 | 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 - TripLev - Options - 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** | | = 0000-0999 | 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> | 0.2 | In | Trip level of overcurrent protection | 0.20 – 4.00 | 0.01 |
| | *Timers* → | tI> | 0.05 | 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>> | 0.5 | In | Trip level of overcurrent protection | 0.50 – 40.00 | 0.01 |
| | *Timers* → | tI>> | 0.05 | s | Trip time delay | 0.05 – 60.00 | 0.01 |
| | | t2x I | 0.02 | 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 | 0.5 | 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 | 0.02 | 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> | 0.01 | Ion | Trip level of Earth Fault protection | 0.01 – 4.00 | 0.01 |
| | *Timers* → | tIo> | 0.05 | 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>> | 0.01 | Ion | Trip level of Earth Fault protection | 0.01 – 9.99 | 0.01 |
| | *Timers* → | tIo>> | 0.05 | 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 | 0.01 | Ion | Trip level of Earth Fault protection | 0.01 – 9.99 | 0.01 |
| | *Timers* | → | tIoH | 0.05 | 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<br>Relay3- Relay4 | - |
| | *TripLev* | → | No Parameters | | | | | |
| | *Timers* | → | tBF | 0.20 | s | Time delay for Breaker Failure alarm | 0.05 – 0.75 | 0.01 |
| **IRF** | *FuncEnab* | → | No Parameters | | | | | |
| | *Options* | → | Opz | NoTrip | | Operation of output Relays on detection of Internal Relay Fault | NoTrip – Trip | - |
| | | | No Parameters | | | | | |
| | *TripLev* | → | No Parameters | | | | | |
| | *Timers* | → | No Parameters | | | | | |
| **RCL** | *FuncEnab* | → | | Enable | | Enable of the protection function | Enable/Disable | - |
| | *Options* | → | Rsh | 1 | | Number of reclosure shots to Lock-out. | 1-2-3-4 | - |
| | *TripLev* | → | No Parameters | | | | | |
| | *Timers* | → | RCLtr | 5 | | Reset interval (reclaim time)after any successful reclosure | (0.10 ÷ 300) | 0.1 |
| | | | RCL1 | 2 | | Reclosing time interval of first reclosing shot | (0.10 ÷ 300) | 0.1 |
| | | | RCL2 | 4 | | Reclosing time interval of 2nd reclosing shot | (0.10 ÷ 300) | 0.1 |
| | | | RCL3 | 6 | | Reclosing time interval of 3rd reclosing shot | (0.10 ÷ 300) | 0.1 |
| | | | RCL4 | 8 | | Reclosing time interval of 4th reclosing shot | (0.10 ÷ 300) | 0.1 |
| **Osc** | *FuncEnab* | → | | Enable | | Enable of the protection function | Enable/Disable | - |
| | *Options* | → | Trg | Trip | | Trigger operation mode | Disable<br>Start<br>Trip<br>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 |
| **Comm** | *FuncEnab* | → | No Parameters | | | | | |
| | *Options* | → | Com LBd | 9600 | | Local Baud Rate (Front panel RS232 communication speed) | 9600 - 19200<br>38400 | - |
| | | | Com RBd | 9600 | | Remote Baud Rate (Rear panel terminal blocks RS485 communication speed) | 9600 - 19200 | - |
| | | | Com Mod | 8,N,1 | | Remote mode (communication parameters)<br>***Note**: any change of this setting became valid at the next power on* | 8,N,1<br>8,O,1<br>8,E,1 | - |
| | | | Com 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-<br>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 than 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* | *Display Type* | | *Default Value* | *Description* | *Setting Range* |
|---|---|---|---|---|---|
| **Relay1** (R1) | *Link* | → | T>, tI>, tI>>,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 – IRF - LOCKOUT - RCL - CRC – FR – CBopen - CBclose – HwRecov – 0.D1 – 0.D1not - 0.D2 – 0.D2not -0.D3 – 0.D3not - Chs |
| | *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– IRF - LOCKOUT - RCL - CRC – FR – CBopen - CBclose – HwRecov – 0.D1 – 0.D1not - 0.D2 – 0.D2not -0.D3 – 0.D3not - Chs |
| | *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– IRF - LOCKOUT - RCL - CRC – FR – CBopen - CBclose – HwRecov – 0.D1 – 0.D1not - 0.D2 – 0.D2not -0.D3 – 0.D3not - Chs |
| | *OpMode* | → | N.D. | N.D. (Normally Deenergized) N.E. (Normally Energized) | N.D./N.E. |
| **Relay4** (R4) | *Link* | → | IRF | Association of functions to output relay R4 | T> - Ta -I> - tI> - I>> - tI>> - IH – tIH - Io> - tIo> - Io>> - tIo>> - tIoH -BF – IRF - LOCKOUT - RCL - CRC – FR – CBopen - CBclose – HwRecov – 0.D1 – 0.D1not - 0.D2 – 0.D2not -0.D3 – 0.D3not - Chs |
| | *OpMode* | → | N.E. | N.D. (Normally Deenergized) N.E. (Normally Energized) | N.D./N.E. |

| *Function* | *Description* | *Function* | *Description* |
|---|---|---|---|
| *T>* | Thermal Image protection level | *IRF* | Internal Realy Fault |
| *Ta* | Thermal prealarm | *LockOut* | LockOut |
| *I>* | First overcurrent protection level | *RCL* | Reclosing function |
| *tI>* | Trip time delay | *CRC* | Reclosing cycle in progress |
| *I>>* | Second overcurrent protection level | *FR* | Reclosing failed |
| *tI>>* | Trip time delay | *CBopen* | Open C/B |
| *IH* | Third overcurrent protection level | *CBclose* | Close C/B |
| *tIH* | Trip time delay | *HwRecov* | HW recovery operations |
| *Io>* | First Earth Fault protectione level | *0.D1* | Digital Input activated |
| *tIo>* | Trip time delay | *0.D1not* | Digital Input deactivated |
| *Io>>* | Second Earth Fault protectione level | *0.D2* | Digital Input activated |
| *tIo>>* | Trip time delay | *0.D2not* | Digital Input deactivated |
| *IoH* | Third Earth Fault protectione level | *0.D3* | Digital Input activated |
| *tIoH* | Trip time delay | *0.D4not* | Digital Input deactivated |
| *BF* | Breaker Failure | *Chs* | Change Setting |

## *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 |

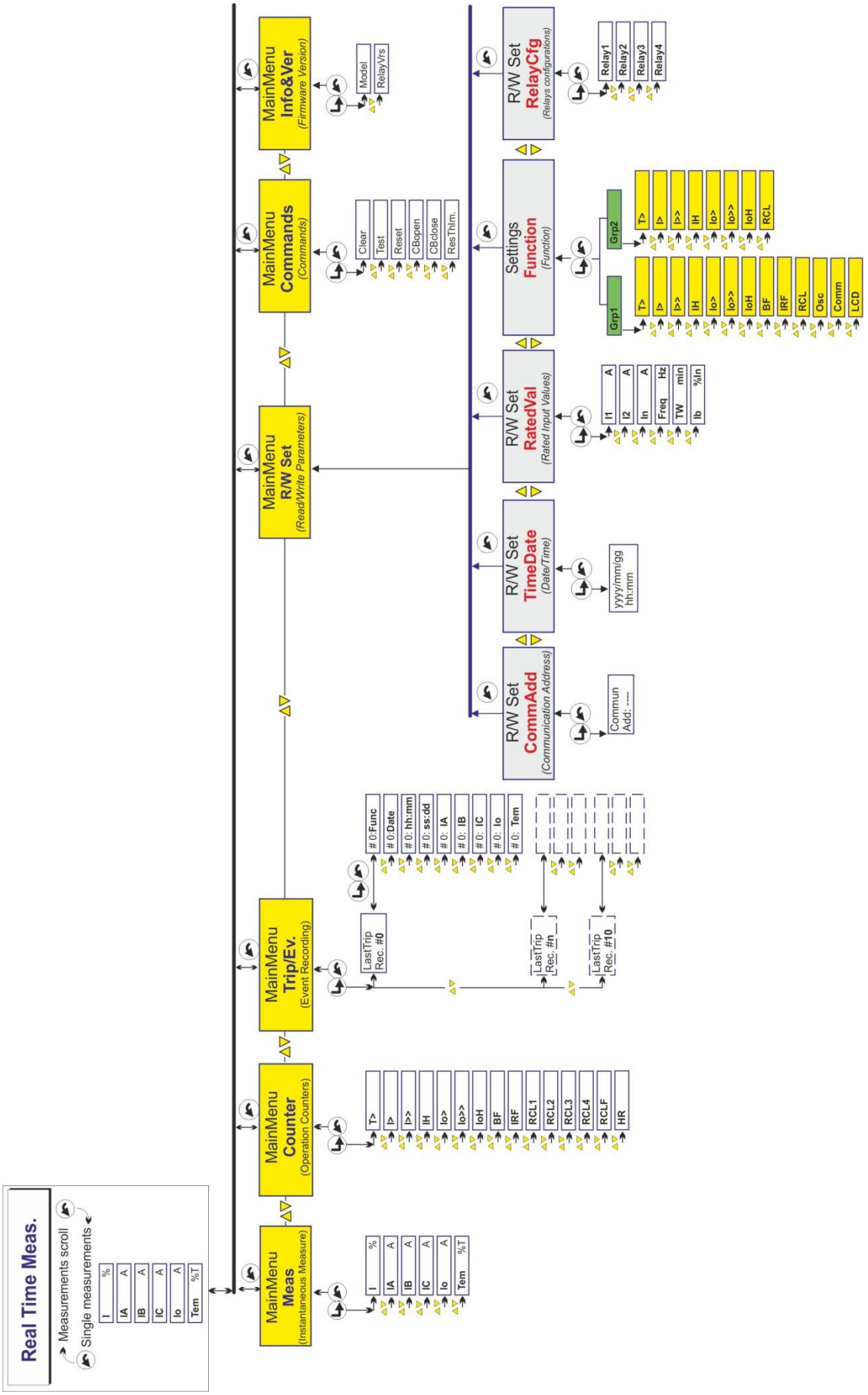
## *12.8 - Info&Ver (Firmware - Info&Version)*

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.

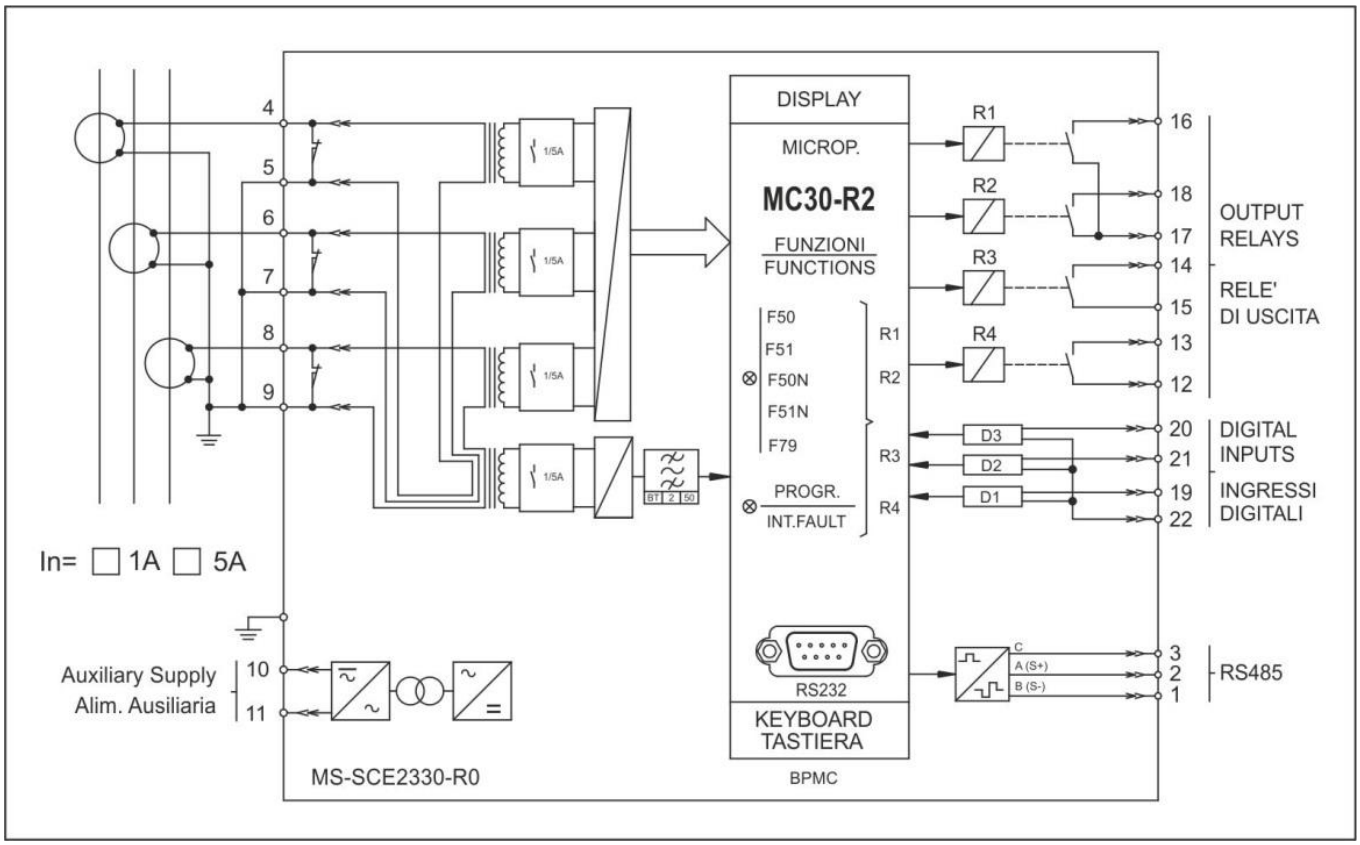
## 15. Maintenance

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.

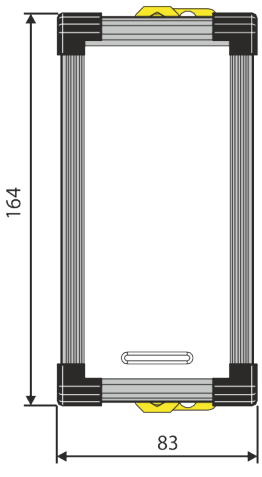
## 16. Power Frequency Insulation Test

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.

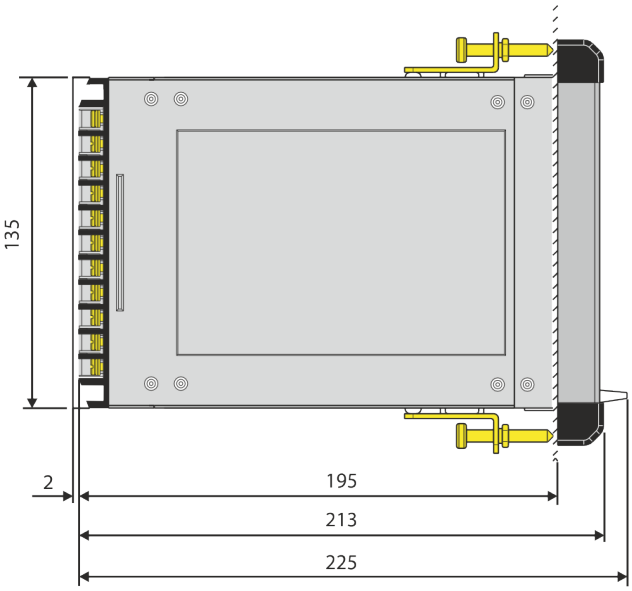
## 17. Connection Diagram




## 18. Overall Dimensions




PANEL CUT OUT
64X137 (LXH)



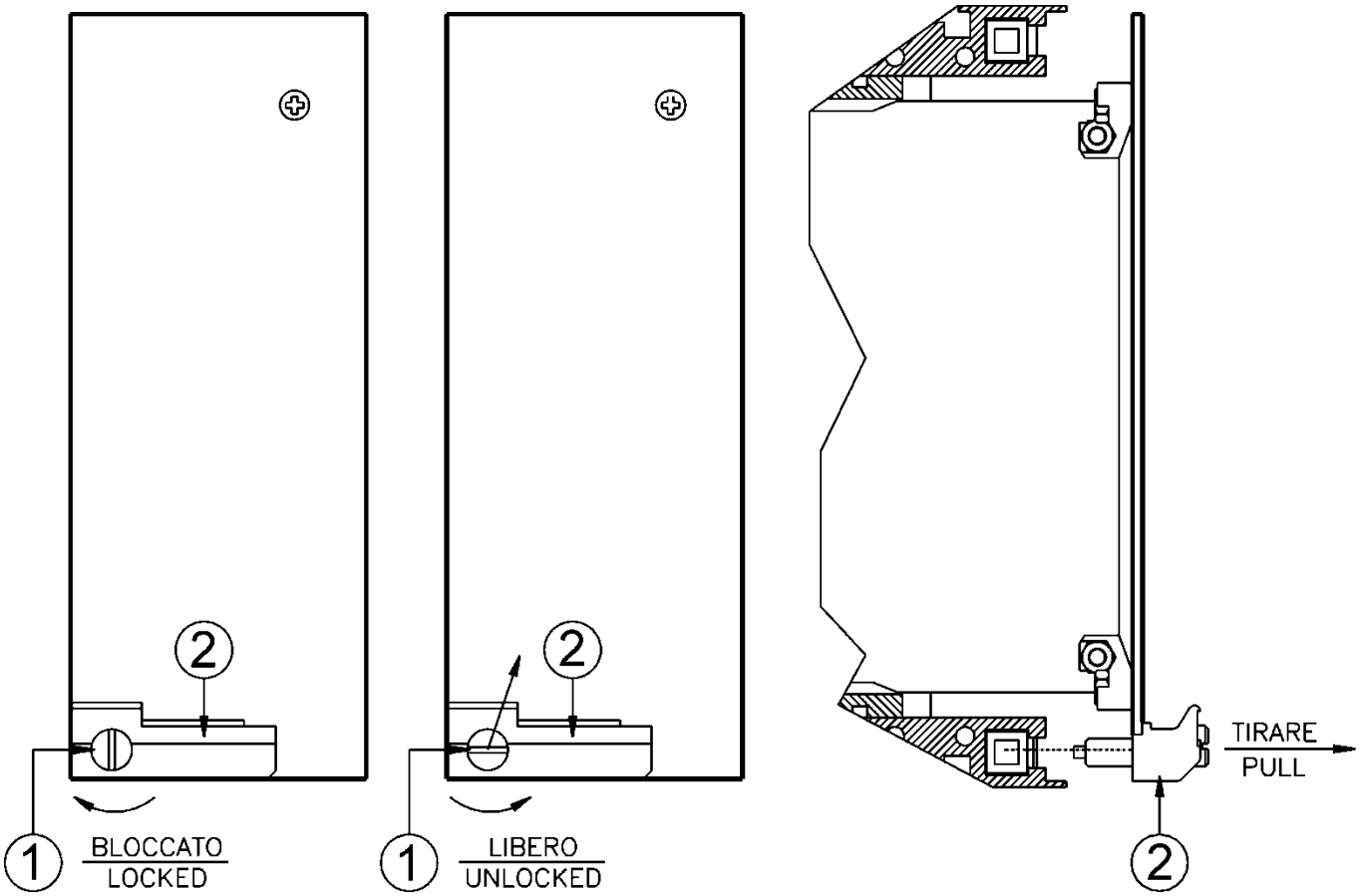
## 19. Direction for Pcb's Draw-Out and Plug-In

### *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*<br>*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 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 (EN50081-2 - EN50082-2 - 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 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 | |
| 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<br>(*) In, On = Nominal Current of the System's Current Transformer | 2% In<br>0,2% On (*)<br>2% + to (to=20÷30ms @ 2xIs) | for measure<br><br>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 Parameter* | |
|---|---|
| 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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