D.C. FEEDER MANAGER RELAY

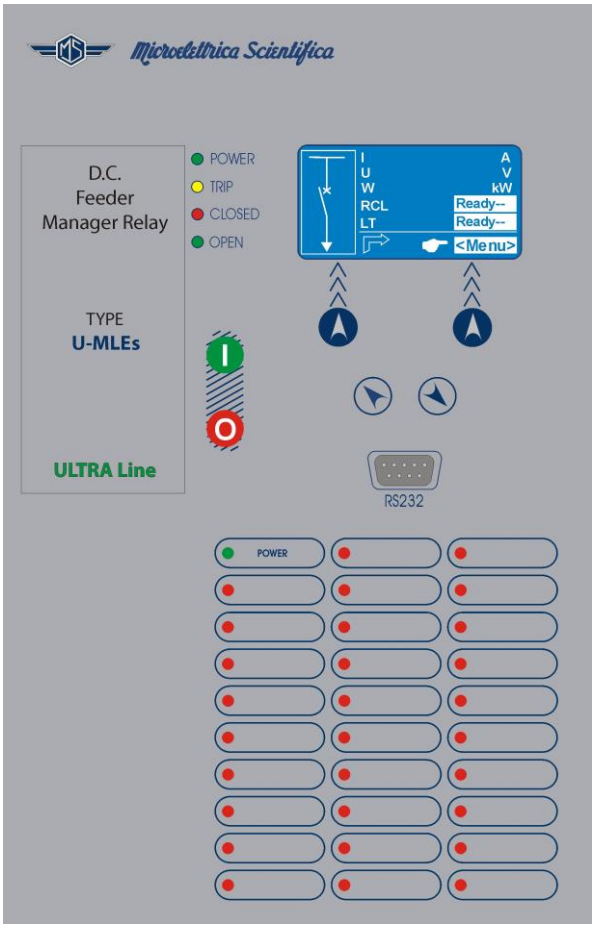
TYPE

U-MLEs-PLv

(Multiple I/O Boards)
(SEAW version)

ULTRA Line

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.

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

Input quantities are supplied via isolated converters with (0 - 20)mA output (overload 25mA).
For best accuracy and reliability we recommend to use MHCO measuring converters for supply of input.

A) Current measurement

- 1 Input 0 - 20mA ≡ 0 - 1In
- 1 Input 0 - 20(25)mA ≡ 0 - 10(12.5)In
- Measuring range 0 - 12,5 times the rated input current (12,5In)
- Resolution 16 bits

B) Line voltage measurement

- 1 Input 0 - 40mA ≡ 0 - 2Un
- Measuring range 0 - 2 times the rated input voltage (2xUn)
- Resolution 12 bits

C) Frame earth fault current measurement

- 1 Input 0 - 20mA (25mA) ≡ 0 - 1In (0 – 1,25In)
- Measuring range 0 - 1 times the rated input current
- Resolution 12 bits

D) Frame voltage measurement

- 1 Input 0 - 40mA ≡ 0 - 2Un
- Measuring range 0 - 2 times the rated input voltage (2xUn)
- Resolution 12 bits

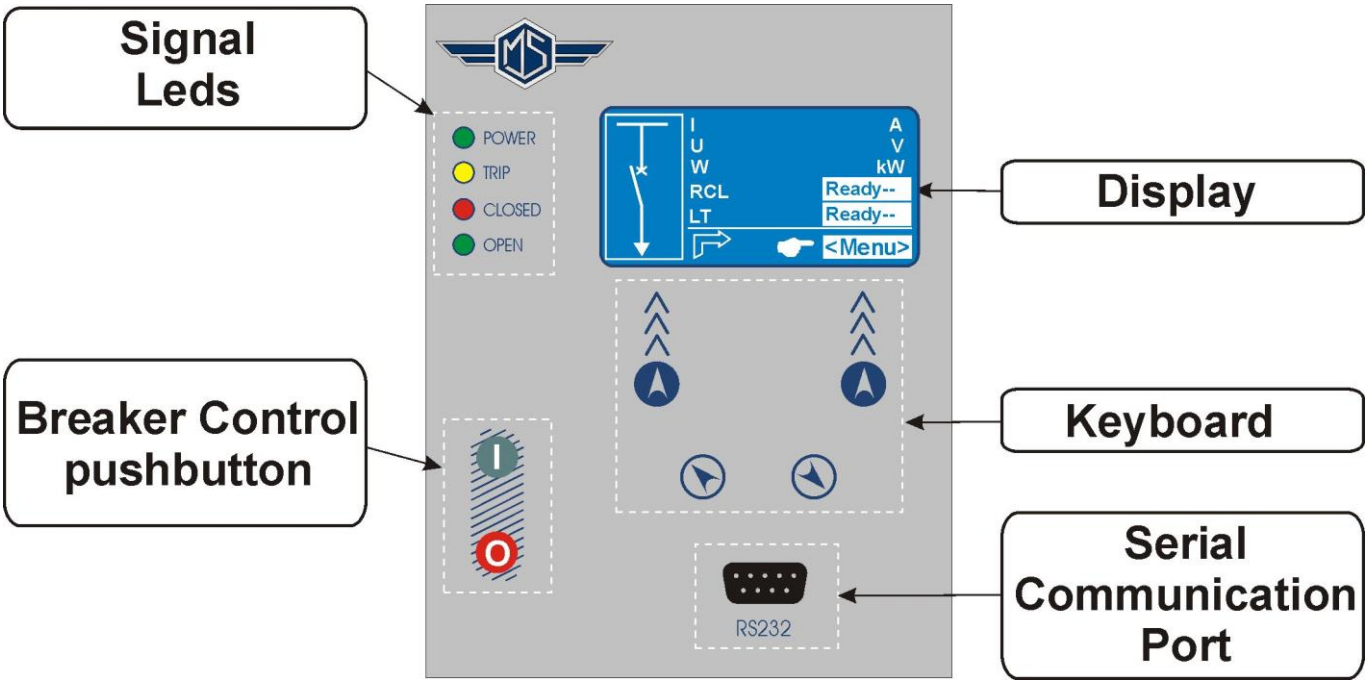
Make electric connection in conformity with the diagram reported on relay's enclosure.
Check that input currents and voltages are same as reported on the diagram and on the test certificate.
The auxiliary power is supplied by a built-in fully isolated an self protected unit.

2.1 - Power Supply

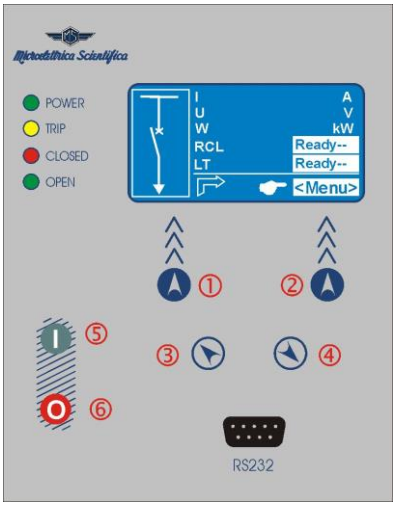
110 (±20%) Vd.c.

Before energizing the unit check that supply voltage is within the allowed limits.

3. Front Panel



4. Keyboard and Display

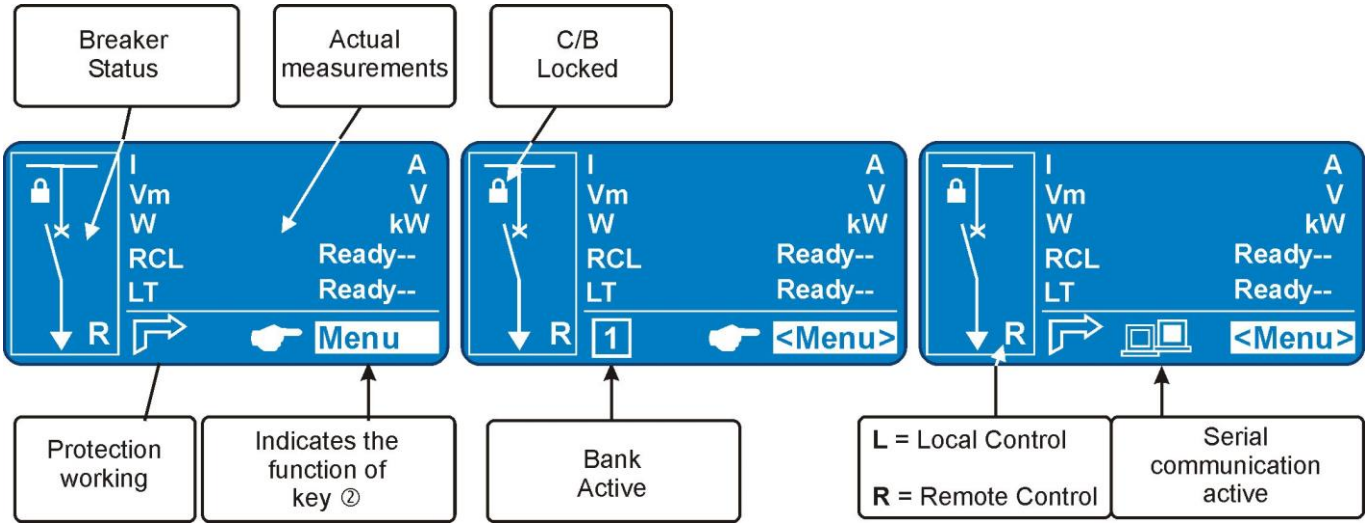


Navigation menu	By these buttons the options showed in correspondence on the display are selected.
Increase	These buttons are used to scroll the items of the different menus (Local Control, Measurements, Energy metering etc).
Decrease	
Open	these buttons (when enabled) operate Circuit Breaker Open/Close control (see § L/R C/B Cmds)
Close	

- By the key ② select the windows showing the ICONS of the available menus.
- By the key ③, ④ select the desired icon and enter by key ①
- The different elements can be selected by the key ③ and ④.
  The details of the individual menus are given in the following paragraphs.

4.1 - Display

The 128x64 pixel LCD display the available information (menu, etc.).

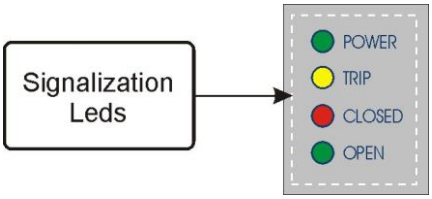


5. Icons of Display

	**Cmd**	Local Commands
	**Measure**	Actual Measurements
	**MaxVal**	Maximum Values (Max Demand Record)
	**Energy**	Energy Measurements
	**LTrip**	Trips Recorded
	**Cnt**	Partial Counters
	**Cnt**	Overall Counters
	**RCE**	Recorder Chronological Event
	**Setting**	Function Settings
	**Sys**	System Parameters
	**InfoSts**	Functional Status
	**Osc**	Oscillographic Recording
	**TimeDate**	Time and Date
	**Healthy**	Diagnostic Information
	**Info**	Info Device

6. Signalization

Four signal leds are provided:



Green Led	POWER	❑ Illuminated ❑ Flashing	- Relay working properly. - Internal Relay Fault
Yellow Led	TRIP	❑ Off ❑ Illuminated ❑ Flashing Reset from Illuminated status is manual	- No Trip - Trip occurred - Function Timing
Red Led	CLOSED	❑ Off ❑ Illuminated	- C/B Open - C/B Close
Green Led	OPEN	❑ Off ❑ Illuminated	- C/B Close - C/B Open

Both Flashing

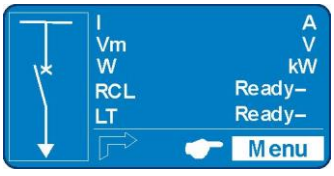
Operation of Trip Circuit Supervision element.

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

6.1 - Leds Manual Reset

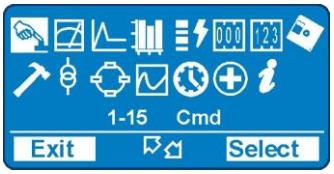
For Leds' manual reset operate as follows:

1



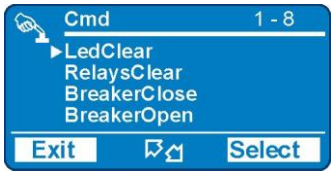
- Press "***Menu***" for access to the main menu with icons.

2



- Select icon "***Cmd***" .
- Press "***Select***",

3



- Select "***LedClear***"
- Press "***Select***" to execute the command. (See § Password).

4

- When command has been executed the display shows "***! Command Done***";

6.2 – Display of the last trip

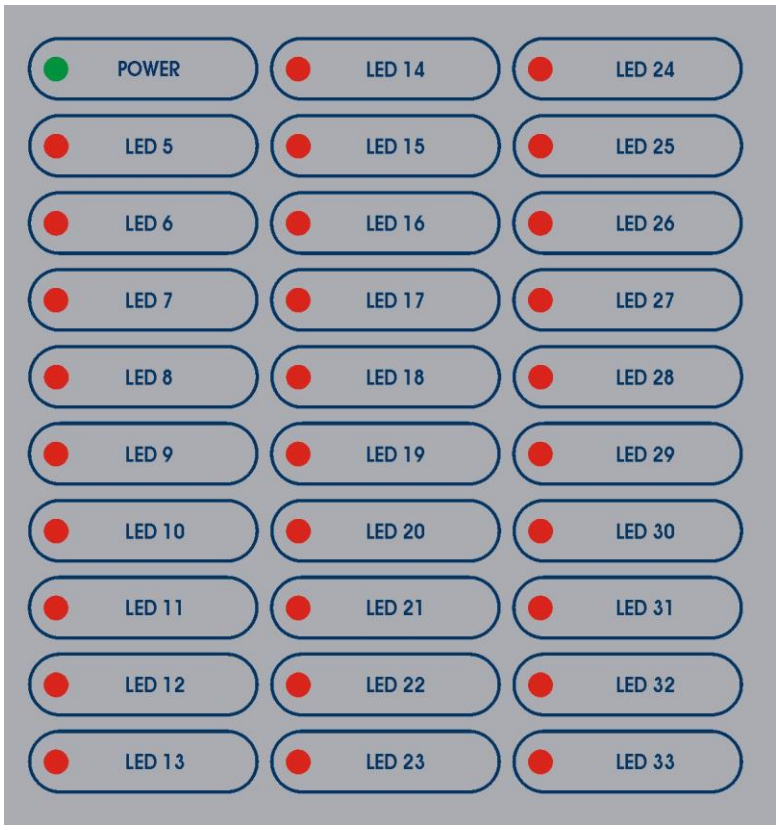
Beside the signalization of the yellow led "Trip", indicating a generic function trip, the display shows a window indicating the last function that was tripped and the number of events that are stored in the memory. The display will show this window until the reset button or external reset are operated.

1

- Press "***Menu***" to access to the main menu with icons.
  Press "***Res.***" to erase visualization.
  Ex. "t1I>" (flashing) is the last trip.

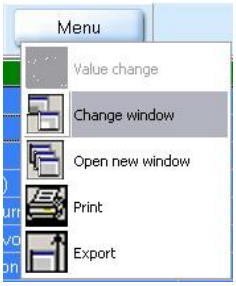
7. Signalization Module

The firmware can manage up to 34 signal leds, 4 led are on the main relay module, the remaining are on additional expansion modules (1 “Power” (green), 29 “Programmable” (red))

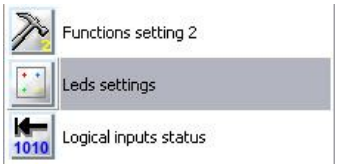


For Leds’ programming (only via MSCom2) operate as follows:

- Open “MSCom2” program and connect to the relay.
- Select “Change Windows” from “Menu” button



- Select “Led Setting”



The window for led configuration will show:

ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1	Not linked	Light off	Light on	Volatile	
2	Led 2	Not linked	Light off	Light on	Volatile	

7.1 - Name

Led name – for leds position see picture

7.2 - Link enable

Linked	=	Enable to operate
No Linked	=	Disable

7.3 - Status

Light-OFF	=	Normal condition	
Light-ON	=	When cause appear led is illuminated	See “Light Prog”
Flashing	=	When cause appear led is flashing	

7.4 - Light Prog.

Light-ON	=	When cause appear led is illuminated
Flashing	=	When cause appear led is flashing

7.5 - Funct. Mode

Volatile	=	When cause disappear led turn-off (Not memorized)
Latched	=	When cause disappear led remain illuminated (memorized)

7.6 - Functions

Select the function assigned to specific led (see table 1).
Its possible to configure only one function for each led.
For configuration multiple functions use “UserVar” function.

7.7 - Table 1

T>	**Tal** **T>**	(alarm) (trip)	*Thermal element*
1I>	**1I>** **t1I>**	(Start) (Trip)	*First overcurrent element*
2I>	**2I>** **t2I>**	(Start) (Trip)	*Second overcurrent element*
3>	**3I>** **t3I>**	(Start) (Trip)	*Third overcurrent element*
4I>	**4I>** **t4I>**	(Start) (Trip)	*Fourth overcurrent element*
1dI	**1dI** **t1dI**	(Start) (Trip)	*First Current step element*
2dI	**2dI** **t2dI**	(Start) (Trip)	*Second Current step element*
1di/dt	**1di/dt** **t1di/dt**	(Start) (Trip)	*First Current rate of rise element*
2di/dt	**2di/dt** **t2di/dt**	(Start) (Trip)	*Second Current rate of rise element*
Rapp	**Rapp**	(Trip)	*Impedance monitoring – di/dt dependence*
Iapp	**Iapp**		*Current monitoring with di/dt dependence*
1Ig	**1Ig** **t1Ig**	(Start) (Trip)	*First instantaneous Frame Fault element* *First time delayed Frame Fault element*
2Ig	**2Ig** **t2Ig**	(Start) (Trip)	*Second Frame Fault element*
RCL	**RCL cmd** **ARP** **ARF** **ARL**	(Trip)	*Reclosure Shot command* *Autoreclosure in progress* *Autoreclosure Failure* *Autoreclosure Lock-out*
1U>	**1U>** **t1U>**	(Start) (Trip)	*First overvoltage element*
2U>	**2U>** **t2U>**	(Start) (Trip)	*Second overvoltage element*
1U<	**1U<** **t1U<**	(Start) (Trip)	*First undervoltage element*
2U<	**2U<** **t2U<**	(Start) (Trip)	*Second undervoltage element*
Wi	**tWi>**		*Circuit breaker maintenance level*
TCS	**tTCS**	(Trip)	*Time delayed Trip Circuit Supervision*
IRF	**IRF** **tIRF**	(Start) (Trip)	*Time delayed Internal relay Fault* *Instantaneous Internal relay Fault*
RT	**RT** **tRT**	(Trip) (Start)	*First Instantaneous Remote Trip* *First Time delayed Remote Trip*
RTX	**RTX** **tRTX**	(Trip) (Start)	*Second Instantaneous Remote Trip* *Second Time delayed Remote Trip*
CB-L	**CB-L**		*C/B reclose Lock-out*
BF	**BF**		*Breaker Failure*
Wh	**+ Wh** **- Wh**		*Imported Energy counter Pulse* *Exported Energy counter Pulse*
L/R CB Cmds	**Open C/B** **Close C/B** **LocRemInc** **missCBOpe**		*Open C/B command* *Close C/B command* *Local / Remote Inconsistency* *Missed C/B opening (Digital input missing)*
LT	**LTPb** **LTP** **LTF** **LT cmd**	 (Trip)	*Output to operate an external flashing lamp signalling line test in progress* *Line Test in progress* *Line Test Failed* *Line Test command*
	Gen.Start **Gen.Trip**		*General start* *General Trip*

	Vcc	*Reserved*		
	Gnd	*Reserved*		
	ResLog	*Reset signal logic*		
	P1	*Push-button Open*		
	P2	*Push-button Close*		
	Gen.Start	*Start Generic*		
	Gen.Trip	*Trip Generic*		
	UserTriggerOscillo	*User Variable for Oscillographic Recording*		
	UserVar<0> **to** **UserVar<24>**	*User Variable*		
	Vcc	*Reserved*		
	Gnd	*Reserved*		
	ResLog	*Reset signal logic*		
	P1	*Push-button Open*		
	P2	*Push-button Close*		
	0.D1	*Digital Input "0.D1"*	*activated*	
	0.D1Not	*Digital Input "0.D1"*	*deactivated*	
	to			*Digital Input on Main Relay*
	0.D4	*Digital Input "0.D4"*	*activated*	
	0.D4Not	*Digital Input "0.D4"*	*deactivated*	
	1.D1	*Digital Input "1.D1"*	*activated*	
	1.D1Not	*Digital Input "1.D1"*	*deactivated*	
	to			*Digital input on Expansion Board*
	1.D15	*Digital Input "1.D15"*	*activated*	
	1.D15Not	*Digital Input "1.D15"*	*deactivated*	
	2.D1	*Digital Input "2.D1"*	*activated*	
	2.D1Not	*Digital Input "2.D1"*	*deactivated*	
	to			*Digital input on Expansion Board*
	2.D15	*Digital Input "2.D15"*	*activated*	
	2.D15Not	*Digital Input "2.D15"*	*deactivated*	
	0.R1 to **0.R6**	*Output relays on Main Relay*		
	1.R1 to **1.R15**	*Output relays on Expansion Board*		
	2.R1 to **2.R15**	*Output relays on Expansion Board*		

7.8 - Example: Change settings for "Led5"

Change settings for "**Led5**" : "Linked", "Flashing", "Latched", "1I>".

Led 1 = (see § Signalization on Main Relay)
Led 2 = If we change the link of these leds, the label written on the front panel will not
Led 3 = match anymore.
Led 4 =

Led 5 = are provided in signalization module

to

Led 53 =

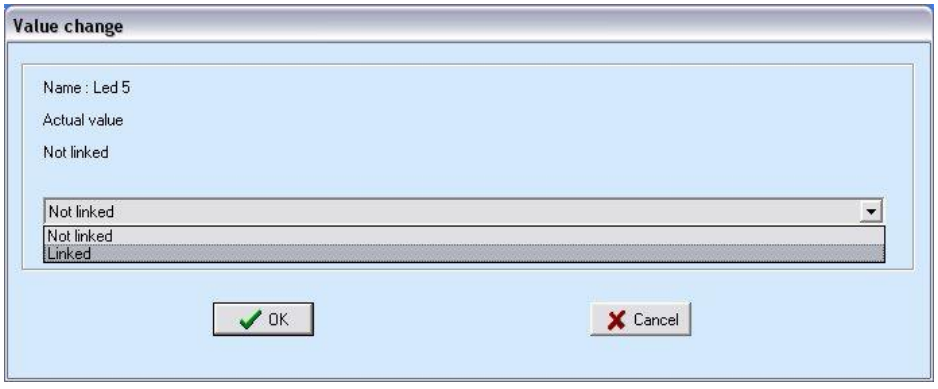
Main Windows:

ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1	Not linked	Light off	Light on	Volatile	BF
2	Led 2	Not linked	Light off	Light on	Volatile	BF
3	Led 3	Not linked	Light off	Light on	Volatile	BF
4	Led 4	Not linked	Light off	Light on	Volatile	BF
5	Led 5	Not linked	Light off	Light on	Volatile	BF

7.8.1 - "Linked"

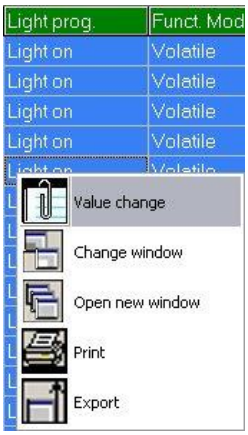
Select "**Link enable**" related to "Led 5" and press right button on mouse, select "Value change":

Select "**Linked**" from combo box and press "OK" (if Password is request, see § Password):

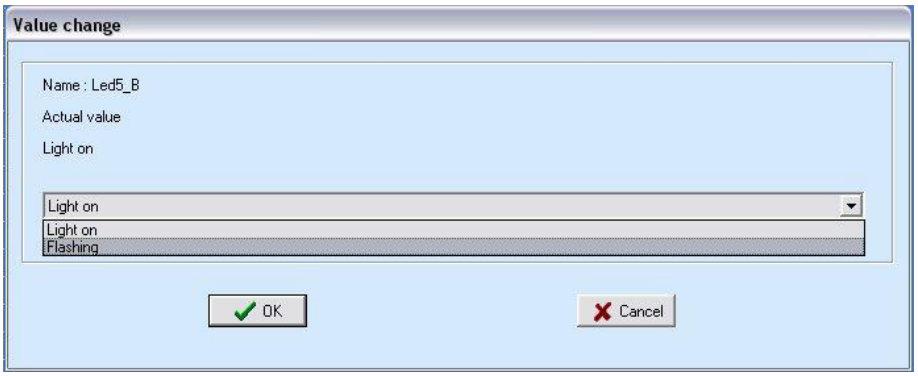


7.8.2 - "Flashing"

Select "**Light prog**" related to "Led 5" and press right button on mouse, select "Value change":



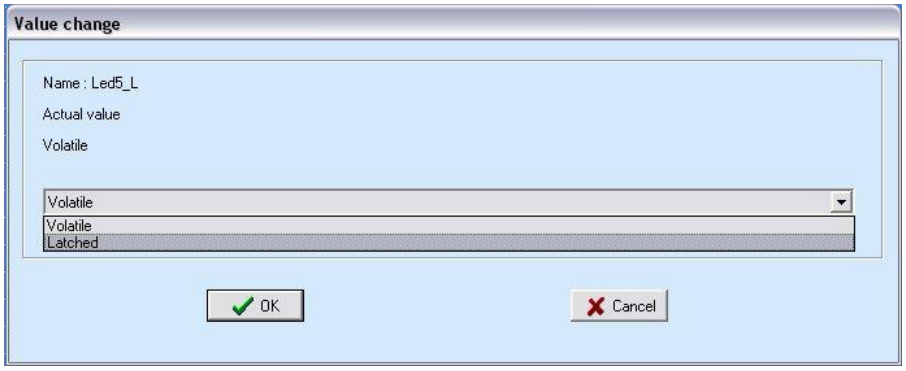
Select "**Flashing**" from combo box and press "OK" (if Password is request, see § Password):



7.8.3 - "Latched"

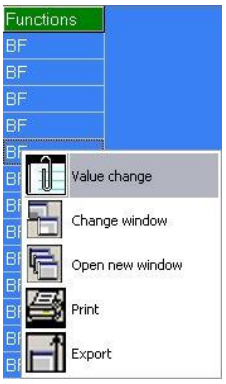
Select "**Latched**" related to "Led 5" and press right button on mouse, select "Value change":

Select "**Latched**" from combo box and press "OK" (if Password is request, see § Password):

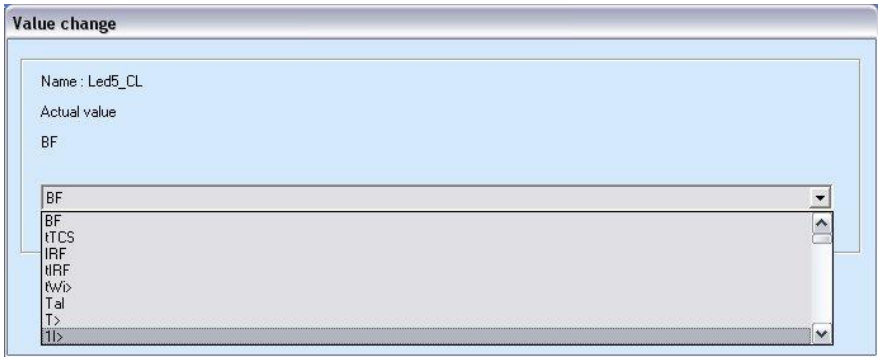


7.8.4 - "Functions"

Select "**Functions**" related to "Led 5" and press right button on mouse, select "Value change":



Select "**1I>**" from combo box and press "OK" (if Password is request, see § Password):



8. User Variables

The “User Variable” is a result of a logical operation (Or, AND, ecc...), it can be used like other logical output. This operation is possible only via “MSCom2” software.

ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status

8.1 - Name

Internal progressive name

8.2 - User Descr.

Custom identification label for user variable

8.3 - Linked functions

Selection functions

8.4 - OpLogic

Operation Logic = [None, OR, AND, XOR, NOR, NAND, NOT, Ff-SR]

8.5 - Timer

Time delay (0-10)s, step 0.01s

8.6 - Timer type

Delay	=	Add a delay on output activation. The “Timer” is edge triggered on rise edge.
Monostable	=	Activated the output for the time “Timer”

8.7 - Logical status

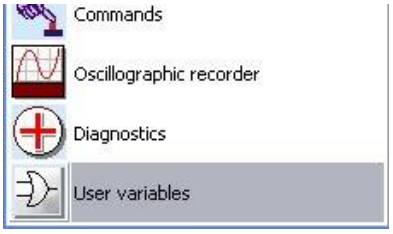
“User Variable” Logical status

8.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button

Select "User Variable"



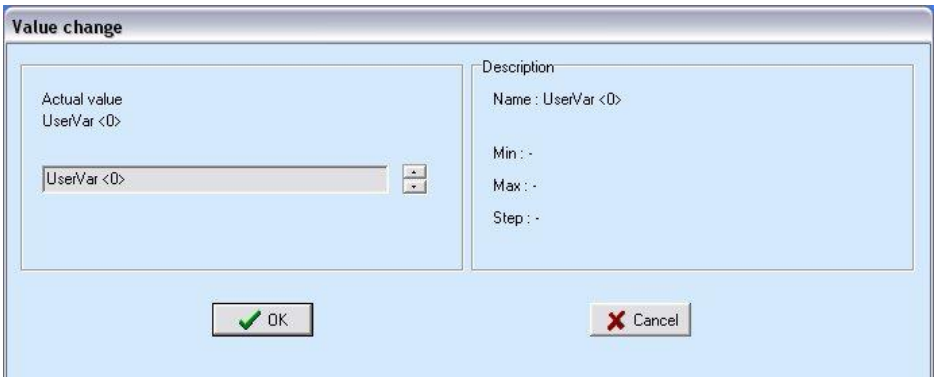
Setting for "**UserVar<0>**" : "Start Overcurrent Element", "1I>,2I>,3I>", "OR", "1", "Monostable".

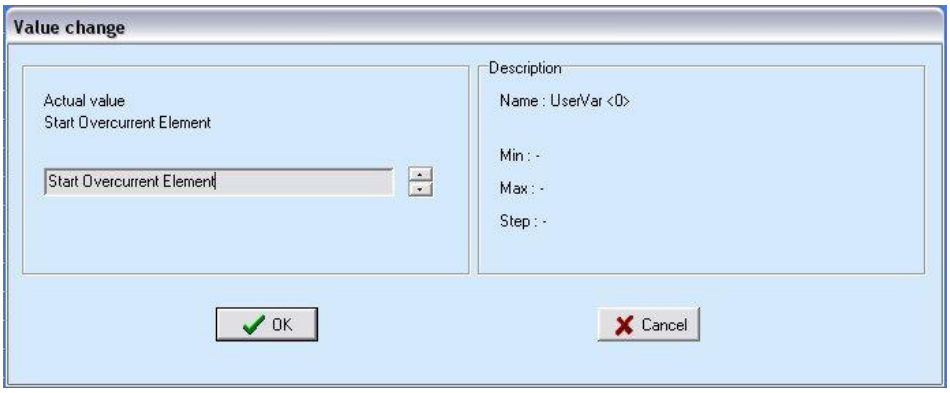
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	UserTrigger Oscillo	UserTrigger Oscillo		None	0	Delay	0
2	UserVar <0>	Start Overcurrent Element	1I>,2I>,3I>,	OR	1	Monostable	0

8.8.1 - "User description" (User descr.)

Select "**User descr**" related to "UserVar<0>" and press right button on mouse, select "Value change":

Insert "Start Overcurrent Element" into box and press "OK":

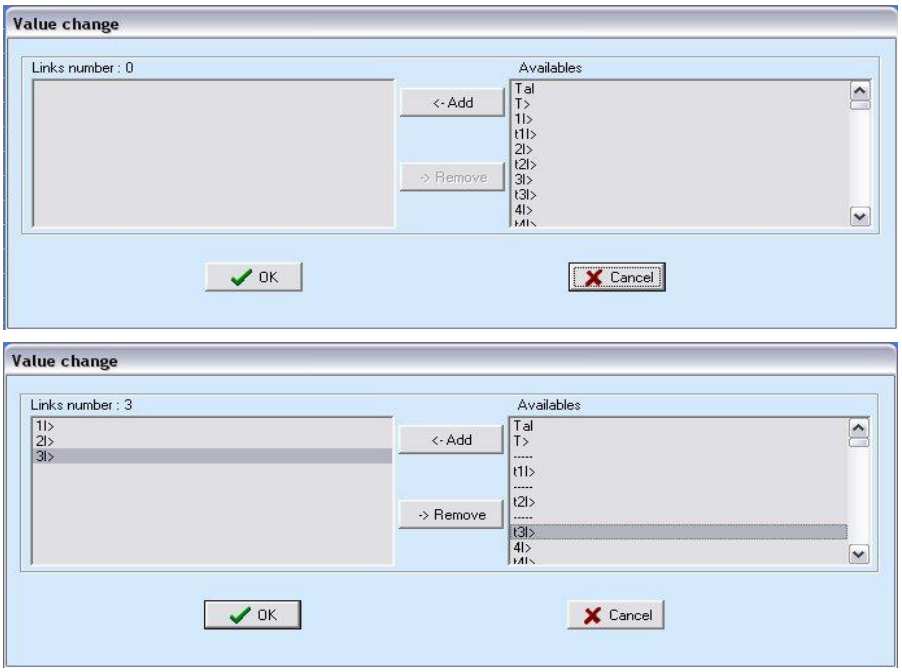




8.8.2 - "Linked Functions"

Select "**Linked Functions**" related to "Start Overcurrent Element" and press right button on mouse, select "Value change":

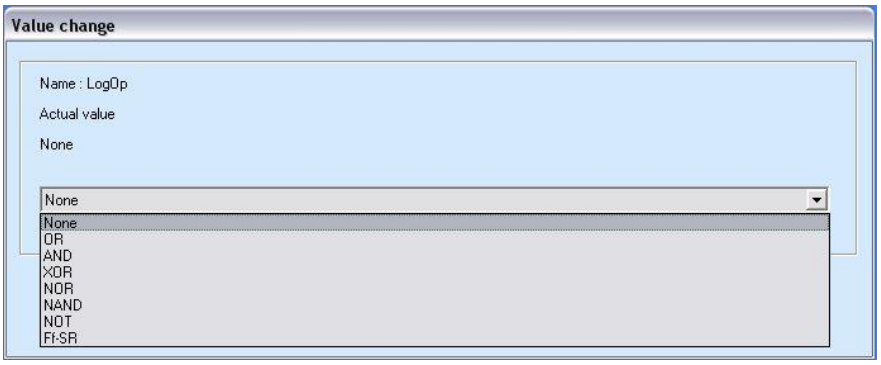
Select "1I>, 2I>, 3I>" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".



8.8.3 - "Operation Logic" (Oplogic)

Select "**Oper Logic**" related to "Start Overcurrent Element" and press right button on mouse, select "Value change":

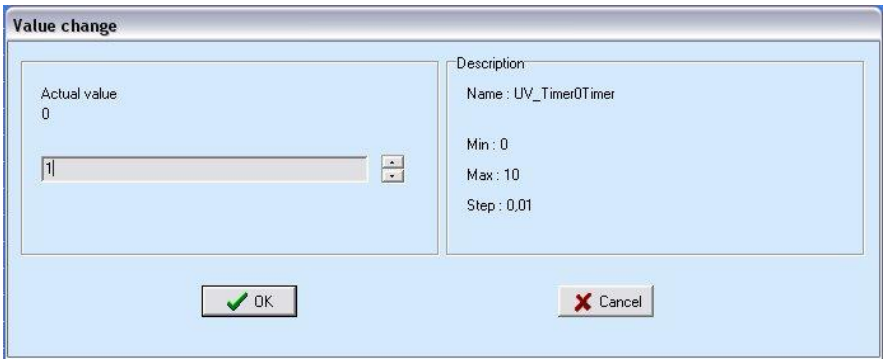
Insert "OR" into box and press "OK":



8.8.4 - "Timer"

Select "**Timer**" related to "Start Overcurrent Element" and press right button on mouse, select "Value change":

Select "1" into box and press "OK":



8.8.5 - "Timer type"

Select "**Timer**" related to "Start Overcurrent Element" and press right button on mouse, select "Value change":

Select "Monostable" into box and press "OK":

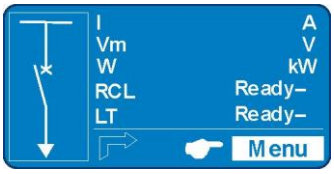
8. Cmd (Local Commands)

"***Cmd***" allow to operate from relay front face controls like Thermal Memory reset, Leds reset, etc.

Menu		Description	Password
→ **Led**	**Clear**	Reset of signal Leds	*No*
→ **Relays**	**Clear**	Manual reset of output relays	*No*
→ **Breaker**	**Close**	Manual C/B closing (conditioned by Password)	Yes
→ **Breaker**	**Open**	Manual C/B opening (conditioned by Password)	Yes
→ **CB**	**Unlock**	Unlock the C/B reclosure (see § CB-L)	Yes
→ **HistFail**	**Clear**	Reset of Internal Failure Historic records	Yes
→ **Reset**	**Term**	Reset to zero of the accumulations relevant to Thermal Image and Interruption Energy.	Yes
→ **Leds**	**Test**	Signal Leds test	*No*

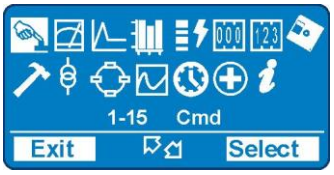
To operate one command by the Front Face Keyboard, proceed as follows (Led Reset in the present example).

1



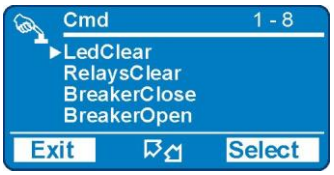
- Press "***Menu***" for access to the main menu with icons.

2



- Select "***Cmd***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



- Select *with pushbutton* "***Increase***" or "***Decrease***" the menu "***LedClear***".
- Press "***Select***" to execute the command.
  (if Password is request, see § Password).

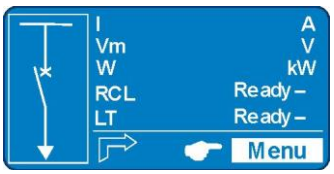
4

- When command has been executed the display shows "***! Command Done***"; go to "*3*".

9. Measure

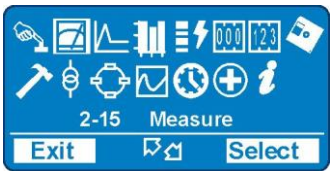
Real time values as measured during the normal operation.

1



- Press "***Menu***" for access to the main menu with icons.

2



- Select "***Measure***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3

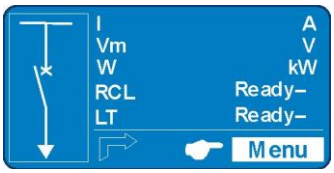
- Scroll the menu "***Measure***" *with pushbutton* "***Increase***" or "***Decrease***" to display the measurement.
- Press "***Exit***" to go to the main menu.

→ **I**	(0 ± 9999)	**A**	Line current
→ **RLin**	(0 ÷ 9999)	**Ω**	Line resistance
→ **W**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**kW**	Power
→ **Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→ **Ig**	(0 ± 9999)	**A**	Frame to ground fault current
→ **Ug**	(0 ± 9999)	**V**	Frame to ground fault voltage
→ **Wir**	(100 ÷ 0)	**%W**	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.
→ **Vv**	(0 ± 9999)	**V**	Voltage before C/B
→ **Vm**	(0 ± 9999)	**V**	Voltage after C/B
→ **A/ms**	(0 ÷ 9999)		Current rate of raise
→ **Rapp**	(0 ÷ 1000)	**Ω**	Impedance monitoring

10. MaxVal (Maximum Values)

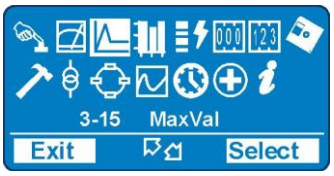
Maximum demand values recorded starting from 100ms after closing of main Circuit Breaker (updated any time the breaker closes).

1



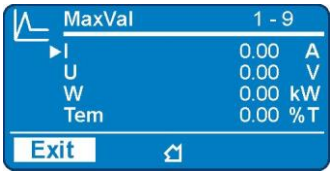
- Press "***Menu***" for access to the main menu with icons.

2



- Select "***MaxVal***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



- Scroll the menu "***MaxVal***" *with pushbutton* "***Increase***" or "***Decrease***" to display the measure
- Press "***Exit***" to go back to the main menu.

→ **I**	(0 ± 9999)	**A**	Line current
→ **RLin**	(0 ÷ 9999)	**Ω**	Line Resistance
→ **W**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**kW**	Power
→ **Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→ **Ig**	(0 ± 9999)	**A**	Frame to ground fault current
→ **Ug**	(0 ± 9999)	**V**	Frame to ground fault voltage
→ **Wir**	(100 ÷ 0)	**%W**	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.
→ **Vm**	(0 ± 9999)	**V**	Voltage after C/B
→ **A/ms**	(0 ÷ 9999)		Current rate of raise
→ **Rapp**	(0 ÷ 1000)	**Ω**	Impedance monitoring

11. Energy

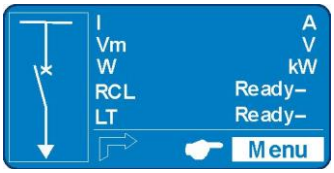
Real time energy measurements

Display	→	**+ kWh**	(0 – 9999999)	Exported Energy
	→	**- kWh**	(0 – 9999999)	Imported Energy

Erase	→	All Energy counters are cleared

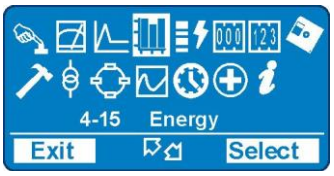
When the measurement exceed “9999999” the counters restart from “0”.

1



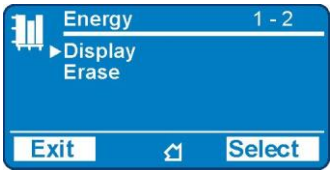
- Press “***Menu***” for access to the main menu with icons.

2



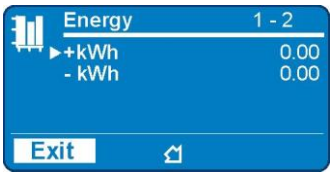
- Select “***Energy****” icon with pushbutton* “***Increase***” or “***Decrease***”.
- Press “***Select***” for access.

3



- Select “***Display****” with pushbutton* “***Increase***” or “***Decrease***”.
- Press “***Select***” for access.

4

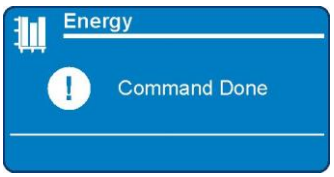


- Display of Real time Energy measurements.
- Press “***Exit***” to go back to the level “*3*”.

5

- Select “***Erase****”* with pushbutton “***Decrease***” to clear all reading.
- Press “***Select***”. (if Password is request, see § Password).

6



- When command has been execute the display shows “***! Command Done***”; to go to the level “*5*”.
- Press “***Exit***” to go back to the main menu.

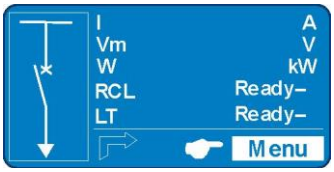
12. LTrip (Trip Recorded)

Display of the function which caused the tripping of the relay plus values of the measurement at the moment of tripping. The last 10 events are recorded.
The memory buffer is refreshed at each new relay tripping (FIFO logic).

Display	→	Reading of recorded Trips.

Erase	→	Clear all Trip recorded.

1

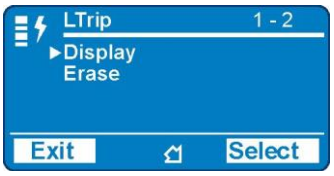


- Press "***Menu***" for access to the main menu with icons.

2

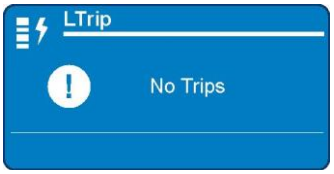
- Select "***LTrip****" icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



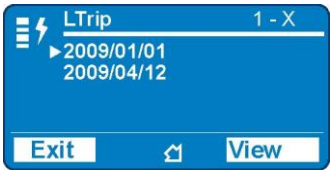
- Select "***Display****" with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" go to "8"

4



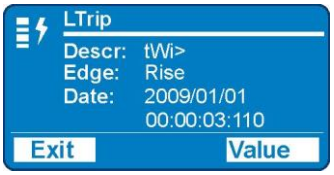
- If no trip is recorded the display shows "***! No Trips***".

5



- If any trip was recorded, select "***View***" to display the chronological list of the records.
- By the keys "***Increase***" or "***Decrease***" select the date of the record to be checked.

6

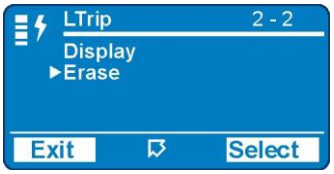


- Will be shown:
  "***Descr***" the function that caused the event (Example: tWi> = Rise)
  "***Edge***" if the function was tripped (Rise) or reset (Fall)
  "***Date***", date of trip, year/month/day, hour:minutes:seconds:milliseconds
- Press "***Value***", for reading the value of input quantities on tripping.

7

- Scroll with pushbuttons "***Increase***" or "***Decrease***" the available measurements.
- Select "***Exit***" to go back to "5" for another selection, or "2" go back to the main menu.

8



- Select "***Erase***" with button "***Decrease***".
- Press "***Select***" to execute the commands; **All** Trips recorded are erased. (if Password is request, see § Password).

9

- When command has been executed the display shows "***! Command Done***";
- Press "***Exit***" to go back to the main menu.

→ **I**	(0 ± 9999)	**A**	Line current
→ **RLin**	(0 ÷ 9999)	**Ω**	Line Resisitance
→ **W**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**kW**	Power
→ **Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→ **Ig**	(0 ± 9999)	**A**	Frame to ground fault current
→ **Ug**	(0 ± 9999)	**V**	Frame to ground fault voltage
→ **Wir**	(100 ÷ 0)	**%W**	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.
→ **Vm**	(0 ± 9999)	**V**	Voltage after C/B
→ **A/ms**	(0 ÷ 9999)		Current rate of raise
→ **Rapp**	(0 ÷ 1000)	**Ω**	Impedance monitoring

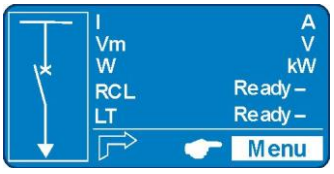
13. Cnt (Partial Counters)

Partial counters of the number of operations for each of the relay functions.

Display				
	→ T>	0	Operations counters	Thermal Image
	→ 1I>	0	Operations counters	First overcurrent element
	→ 2I>	0	Operations counters	Second overcurrent element
	→ 3I>	0	Operations counters	Third overcurrent element
	→ 4I>	0	Operations counters	Fourth overcurrent element
	→ 1dI	0	Operations counters	First current step element
	→ 2dI	0	Operations counters	Second current step element
	→ 1di/dt	0	Operations counters	First current rate of rise element
	→ 2di/dt	0	Operations counters	Second current rate of rise element
	→ Rapp	0	Operations counters	Impedance monitoring (di/dt dependence)
	→ Iapp	0	Operations counters	Current monitoring with di/dt dependence
	→ 1Ig	0	Operations counters	First Frame Fault element
	→ 2Ig	0	Operations counters	Second Frame Fault element
	→ RCL	0	Operations counters	Automatic Reclosure
	→ LT	0	Operations counters	Automatic Line Test
	→ 1U>	0	Operations counters	First Overvoltage element
	→ 2U>	0	Operations counters	Second Overvoltage element
	→ 1U<	0	Operations counters	First Undervoltage element
	→ 2U<	0	Operations counters	Second Undervoltage element
	→ RT	0	Operations counters	First Remote Trip
	→ IRF	0	Operations counters	Internal Relay Fault
	→ TCS	0	Operations counters	Trip Circuit Supervision
	→ BrkF	0	Operations counters	Breaker failure to open
	→ Wi	0	Operations counters	Circuit Breaker maintenance alarm
	→ AutOp	0	Operations counters	Automatic C/B Open
	→ AutCL	0	Operations counters	Automatic C/B Close
	→ ManOp	0	Operations counters	Manual C/B Open
	→ ManCL	0	Operations counters	Manual C/B Close
	→ OvrOp	0	Operations counters	Overall C/B Open (Automatic + Manual)
	→ OvrCL	0	Operations counters	Overall C/B Close (Automatic + Manual)
	→ RTX	0	Operations counters	Second Remote Trip

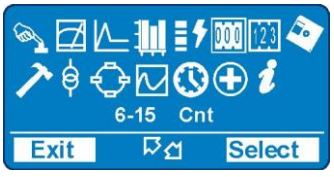
Erase		
	→	Reset all Counters (By the interface program "MSCom 2" it is possible to individually reset the counters and set an initial starting number)

1



- Press "***Menu***" for access to the main menu with icons.

2

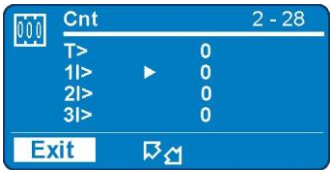


- Select "***Cnt***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3

- Select "***Display****" with pushbutton "****Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" to go to "5"

4



- Display of the number of operations of each individual function.
- With pushbuttons "***Increase***" or "***Decrease***" scroll the parameters
- Press "***Exit***" go back to "*3*".

5

- Select "***Erase****" with pushbutton "****Decrease***".
- Press "***Select***". (if Password is request, see § Password).

6

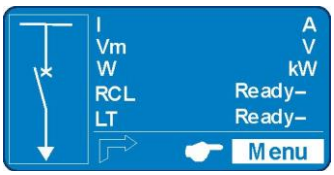
- When command has been executed the display shows "***! Command Done***"; and return to "5".
- With pushbutton "***Exit***" to go back to the main menu.

14. Cnt (Total Counters)

Counters of the total number of operation of each individual function.
These counters cannot be reset.

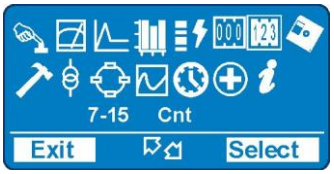
Display				
→	T>	0	Operations counters	Thermal Image
→	1I>	0	Operations counters	First overcurrent element
→	2I>	0	Operations counters	Second overcurrent element
→	3I>	0	Operations counters	Third overcurrent element
→	4I>	0	Operations counters	Fourth overcurrent element
→	1dI	0	Operations counters	First current step element
→	2dI	0	Operations counters	Second current step element
→	1di/dt	0	Operations counters	First current rate of rise element
→	2di/dt	0	Operations counters	Second current rate of rise element
→	Rapp	0	Operations counters	Impedance monitoring (di/dt dependence)
→	Iapp	0	Operations counters	Current monitoring with di/dt dependence
→	1Ig	0	Operations counters	First Frame Fault element
→	2Ig	0	Operations counters	Second Frame Fault element
→	RCL	0	Operations counters	Automatic Reclosure
→	LT	0	Operations counters	Automatic Line Test
→	1U>	0	Operations counters	First Overvoltage element
→	2U>	0	Operations counters	Second Overvoltage element
→	1U<	0	Operations counters	First Undervoltage element
→	2U<	0	Operations counters	Second Undervoltage element
→	RT	0	Operations counters	First Remote Trip
→	IRF	0	Operations counters	Internal Relay Fault
→	TCS	0	Operations counters	Trip Circuit Supervision
→	BrkF	0	Operations counters	Breaker failure to open
→	Wi	0	Operations counters	Circuit Breaker maintenance alarm
→	AutOp	0	Operations counters	Automatic C/B Open
→	AutCL	0	Operations counters	Automatic C/B Close
→	ManOp	0	Operations counters	Manual C/B Open
→	ManCL	0	Operations counters	Manual C/B Close
→	OvrOp	0	Operations counters	Overall C/B Open (Automatic + Manual)
→	OvrCL	0	Operations counters	Overall C/B Close (Automatic + Manual)
→	RTX	0	Operations counters	Second Remote Trip

1



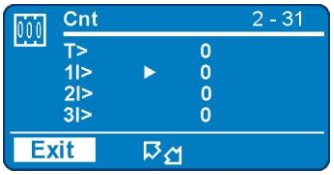
- Press "***Menu***" for access to the main menu with icons.

2



- Select "***Cnt***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



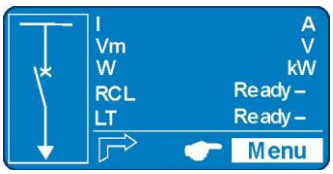
- With pushbuttons "***Increase***" or "***Decrease***" scroll the parameters.
- With pushbutton "***Exit***" to go back to the main menu.

15. RCE (Recorder Chronological Events)

Display of the function which caused any of the following events: - *Status change of digital Inputs/Outputs.* - *Start of protection functions – Trip of protection function – Function reset.*
The last 100 events are recorded at pick-up (rise) or drop-out (fall).
The memory buffer is updated at each new event.

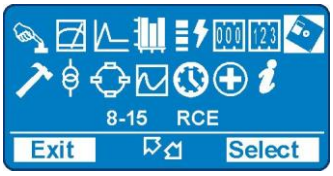
Display	→	Reading events recorded.
Erase	→	Clear all events recorded.

1



- Press "***Menu***" for access to the main menu with icons.

2

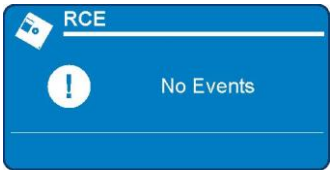


- Select "***RCE****" icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3

- Select "***Display****" with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" go to "7"

4

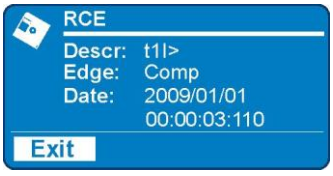


- If no event is recorded the display shows message "***! No Events***".

5

- If any event was recorded, select "***View***" to display the chronological list of the records.
- By the keys "***Increase***" or "***Decrease***" select the date of the record to be checked.

6



- Will be shown:
  "***Descr***" the function that caused the event
  (Example: 1I> = Start, t1I> = Trip)
  "***Edge***" if the function was tripped (Rise) or reset (Fall)
  "***Date***", date of trip, year/month/day, hour:minutes:seconds:milliseconds

7

- Select "***Erase***" with button "***Decrease***".
- Press "***Select***" to execute the commands; **All** Events recorded are erased.
  (if Password is request, see § Password).

8

- When command has been execute the display shows "***! Command Done***";
- Press "***Exit***" to go back to the main menu.

15.1 – Events on display

Functions	Events Displayed	Events Description MScom2		Status	
T>	Tal	*Alarm*	*Thermal Image T>*	Rise	
	T>	*Trip*		Rise	Fall
1I>	1I>	*Start*	*First overcurrent element F50-51*	Rise	Fall
	t1I>	*Trip*		Rise	Fall
2I>	2I>	*Start*	*Second overcurrent element F50-51*	Rise	Fall
	t2I>	*Trip*		Rise	Fall
3I>	3I>	*Start*	*Third overcurrent element F50-51*	Rise	Fall
	t3I>	*Trip*		Rise	Fall
4I>	4I>	*Start*	*Fourth overcurrent element F50-51*	Rise	Fall
	t4I>	*Trip*		Rise	Fall
1dI	1dI	*Start*	*First Current Step Element*	Rise	Fall
	t1dI	*Trip*		Rise	Fall
2dI	2dI	*Start*	*Second Current Step Element*	Rise	Fall
	t2dI	*Trip*		Rise	Fall
1di/dt	1di/dt	*Start*	*First Current Rate of Rise Element*	Rise	Fall
	t1di/dt	*Trip*		Rise	Fall
2di/dt	2di/dt	*Start*	*Second Current Rate of Rise Element*	Rise	Fall
	t2di/dt	*Trip*		Rise	Fall
Rapp	Rapp	*Trip*	*Impedance monitoring-di/dt dependence*	Rise	Fall
Iapp	Iapp	*Trip*	*Current monitoring-di/dt dependence*	Rise	Fall
1Ig	1Ig	*Start*	*First Frame Fault Element*	Rise	Fall
	t1Ig	*Trip*		Rise	Fall
2Ig	2Ig	*Start*	*Second Frame Fault Element*	Rise	Fall
	t2Ig	*Trip*		Rise	Fall
RCL	RCLcmd	*Autoreclosure shot*		Rise	
	ARP	*Autoreclosure in Progress*		Rise	
	ARF	*Autoreclosure Failed*		Rise	
	ARL	*Autoreclosure Lockout*		Rise	
LT	LTcmd	*Line Test Command*		Rise	
1U>	1U>	*Start*	*First Overvoltage Element F59*	Rise	
	t1U>	*Trip*		Rise	
2U>	2U>	*Start*	*Second Overvoltage Element F59*	Rise	
	t2U>	*Trip*		Rise	
1U<	1U<	*Start*	*First Undervoltage Element F59*	Rise	Fall
	t1U<	*Trip*		Rise	Fall
2U<	2U<	*Start*	*Second Undervoltage Element F59*	Rise	Fall
	t2U<	*Trip*		Rise	Fall
Wi	tWi>	*Circuit breaker maintenance level*		Rise	
TCS	TCS	*Start*	*trip coil supervision*	Rise	
	tTCS	*Trip*		Rise	Fall
IRF	IRF	*Start*	*Internal Relay Failure*	Rise	
	tIRF	*Trip*		Rise	
RT	Start RT	*Start*	*First element Remote Trip*	Rise	
	Trip RT	*Trip*		Rise	
RTX	Start RTX	*Start*	*Second element Remote Trip*	Rise	
	Trip RTX	*Trip*		Rise	
BF	BF	*Breaker Failure*		Rise	Fall
L/R C/B Cmds	CB Open	*Circuit Breaker (CB) intentional open*		Rise	
	CB Close	*Circuit Breaker (CB) intentional close*		Rise	
	LocRemInc	*Local Remote inconsistent*		Rise	
CB-L	CB-L	*Breaker close Blocked*		Rise	
	ClCBLTreq	*Required Line Test for Intentional CB Close*		Rise	
	ClCBLTfail	*Line Test for Intentional CB Close Failed*		Rise	
	ClCBLTok	*Line Test for Intentional CB Close Successful*		Rise	

Functions	Events Displayed	Events Description MScom2	Status	
	Vcc	*Reserved*	Rise	Fall
	Gnd	*Reserved*	Rise	Fall
	Gen.Start	*Start Generic*	Rise	Fall
	0.D0 **----** **0.D4**	*Digital Input*	Rise	Fall
	1.D1 **----** **1.D15**	*Digital input*	Rise	Fall
	2.D1 **----** **2.D15**	*Digital input*	Rise	Fall
	0.R1 **----** **0.R6**	*Output relay*	Rise	Fall
	1.R1 **----** **1.R14**	*Output relay*	Rise	Fall
	2.R1 **----** **2.R14**	*Output relay*	Rise	Fall
	UpDateMon	*Update Monitor*	Rise	Fall
	IPU boot	*IPU boot*	Rise	

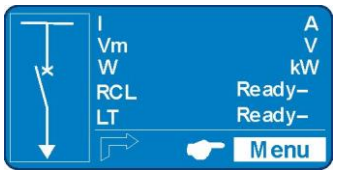
16. Sys (System parameters)

Setting of system parameters.

CTs&PTs	Current Input	**In**	→	4000	A	(1 ÷9999)	step	1	A
		System Rated Current							
	Voltage Input	**Un**	→	1000	V	(100 ÷10000)	step	10	V
		System Rated Voltage							
	Ground Current	**Ign**	→	1000	A	(1÷9999)	step	1	A
		System Rated Ground Current							
	Ground Voltage	**Ugn**	→	1000	V	(100÷10000)	step	10	V
		System Rated Ground Voltage							
		Rtest	→	1	Ω	(1÷500)	step	1	Ω
		Line Test resistance							

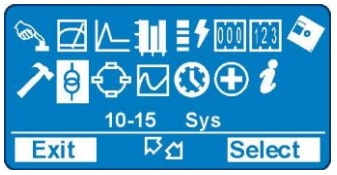
Setting Group	**Group**	→	1	(1 / 2)

1



- Press "***Menu***" for access to the main menu with icons.

2



- Select "***Sys***" *icon with pushbuttons* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3

- Select "***CTs&PTs***".
- Press "***Select***" *for access.*

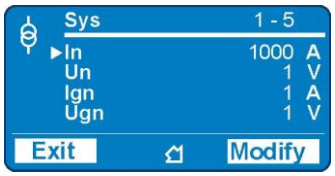
4

- Select "***In***" to modify the value, or press "***Decrease***"
- Press "***Modify***" to modify the parameter. (if Password is request, see § Password).

5

- The value appear as bold figure.
- Use pushbuttons "***Increase***" or "***Decrease***" to set the value.
- Press "***Write***" to confirm the value

6



- The value is now set.
- To set a new value return to the point "4".
- Press "***Exit***".

7

- The display show "***Confirm the change?***".
- Choose "***Yes*** " to convalidate the changes.
- Choose "***No*** " to **not** confirm the changes.
- After set confirmation (or non confirmation) the display goes back to point "3".

8

- Select "***Setting Group***".
- Press "***Select***" *for access.*

9

- Press "***Select***" *for access.*
- Use pushbuttons "***Increase***" or "***Decrease***" to set the Group.

17. Settings

Two complete banks of settings of the programmable variables are available in the "***SETTING***" menu. Both "Group #1" and "Group #2" include the hereunder listed variables.

1

Indicates the Setting Group that is actually being modified.

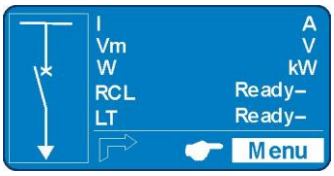
This symbol indicates that the function aside is enabled; symbol missing indicates that the function is disabled.

→ **Comunic.**	Serial communication parameters
→ **HMI**	Visualization parameters
→ **T>**	Thermal Image
→ **1I>**	First overcurrent Element
→ **2I>**	Second overcurrent Element
→ **3I>**	Third overcurrent Element
→ **4I>**	Fourth overcurrent Element
→ **1dI**	First current step element
→ **2dI**	Second current step element
→ **1di/dt**	First current rate of rise element
→ **2di/dt**	Second current rate of rise element
→ **Rapp**	Impedance monitoring - di/dt dependence
→ **Iapp**	Current monitoring with di/dt dependence
→ **1Ig**	First Frame Fault element
→ **2Ig**	Second Frame Fault element
→ **RCL**	Automatic Reclosure
→ **LT**	Automatic Line Test
→ **1U>**	First Overvoltage Element
→ **2U>**	Second Overvoltage Element
→ **1U<**	First Undervoltage Element
→ **2U<**	Second Undervoltage Element
→ **Wi**	Amount of Energy to reach the C/B maintenance level
→ **TCS**	Setting variables for Trip Circuit Supervision
→ **IRF**	Internal Relay Fault
→ **RT**	First Remote Trip
→ **RTX**	Second Remote Trip
→ **BreakerFail**	Setting variables for Breaker Failure detection
→ **Wh**	Energy counter Pulse
→ **Oscillo**	Setting variables for Oscillographic recording
→ **L/R CB Cmds**	C/B command Local / Remote setting
→ **CB-L**	Locks C/B reclosure
→ **LT**	Line Test
→ **ExtResCfg**	Configuration for external reset input

17.1 - Modifying the setting of variables

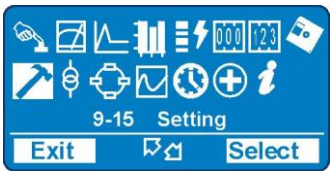
To modify any variable setting by the keyboard proceed as follows:
(example: change setting of element "***1I>***", from "**Is *4.000* In**" to "**Is *3.500* In**")

1



- Press "***Menu***" for access to the main menu with icons.

2



- Select icon "***Setting***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

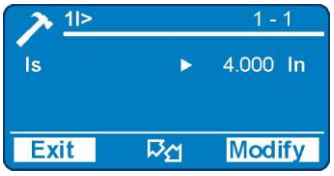
3

- Select by pushbuttons "***Increase***" or "***Decrease***" the parameter "***1I>***".
- Press "***Select***".

4

- Select by buttons "***Increase***" or "***Decrease***" the menu "***Oper.Levels***".
- Press "***Select***".

5



- The arrow aside "***Is***" shows the parameter selected for changing
- Press "***Modify***".
- If Password is request, see § Password

6

- The value appear as bold figure.

7

- Set new values pushbuttons "***Increase***" or "***Decrease***" buttons
- Press "***Write***".

8

- If the change of parameters is completed, press "***Exit***".

9

- "***Yes***" confirm all changes.
- "***No***" voids all the changes.

10

- The relay returns to point "**4**".

17.2 - Password

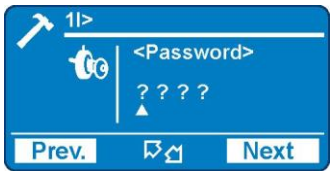
The password is requested any time the user wishes to modify any password protected parameter (example “1I>” menu “Setting”).

The factory default password is “ 1111 “.

The password is only modifiable with “MSCom 2” software (see Manual “MSCom 2”).

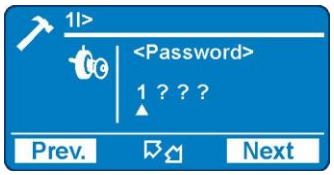
When password is requested, proceed as follows:

1



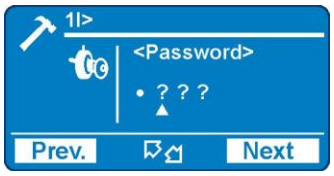
- Use the key “***Increase***” and “***Decrease***” and set the first digit of password.

2



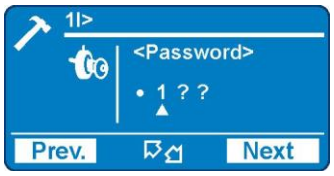
- Press “***Next***” to validate and go to the next digit.

3



- Use the key “***Increase***” or “***Decrease***” to set second digit.

4

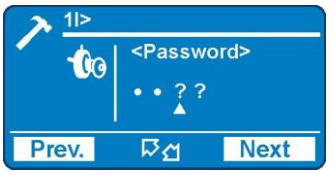


- Press “***Next***” to validate and go to the next digit.

By key “***Prev***” go back to previous digit.

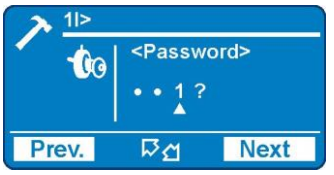
The password validity expires 60 sec after the last setting modification or as soon as you go back to the main menu

5



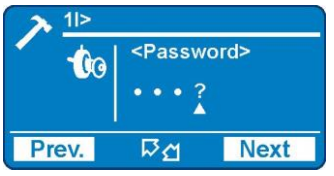
- Use the key “***Increase***” or “***Decrease***” to set the third digit.

6



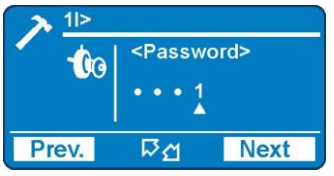
- Press “***Next***” to validate and go to the next digit.

7

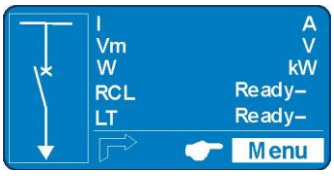


- Use the key “***Increase***” or “***Decrease***” to set the fourth digit.

8



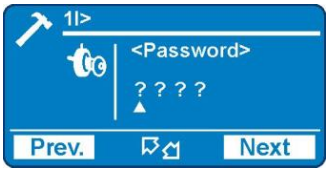
- Press “***Next***” to validate and go to modify the next parameter.



1

- If set the incorrect password the display shows “***! Wrong code***”.

2



- The display will repeat the initial interrogation

17.3 – Menu: **Communic. (Communication)**

Options	→ **BRLoc**	38400	[9600 / 19200 / 38400 / 57600]
	→ **BRRem**	19200	[9600 / 19200 / 38400]
	→ **PRRem**	Modbus	[Modbus / IEC103]
Node Address	→ **Addr.**	1	[1 ÷ 255]

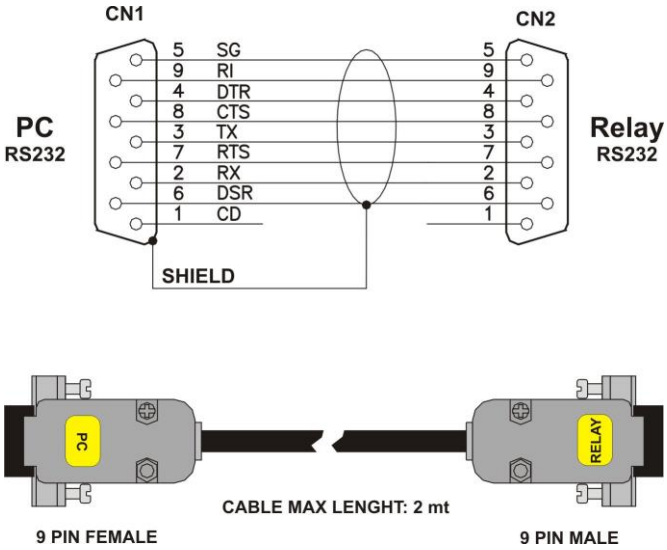
17.3.1 – Description of variables

- **BRLoc** : RS232 local (Front Panel)serial communication speed
- **BRRem** : RS485 remote (Rear terminal block) serial communication speed
- **PRRem** : Protocol for remote (Rear terminal block) serial communication RS485
- **Addr.** : Identification number for the connection on serial communication bus

17.3.2 – Front Panel serial communication port (RS232)

A D-Sub, pin female socket is available on Relay's front face for connection to the local RS232 serial communication line. Through this port - and by the interface program available from Microelettrica Scientifica (MSCom 2 for Windows 98/ME/2000/XP) – it is possible to connect a Personal Computer to download all available information, operate any control and program the relay; the protocol used is " Modbus RTU".

17.3.3 – Cable for direct connection of Relay to Personal Computer



17.3.4 – Main serial communication port (RS485)

From the Relay's back terminal board, a RS485 ports is available for communication with SCADA system with Protocol Modbus RTU or IEC60870-5-103 (selectable).
The communication interface allows to program all settings, operate all commands and download all information and records.
The physical connection can be via a normal pair of wires (RS485) or, on request, via fiber optic.

*17.4 - Menu: **HMI** (Human Machine Interface)*

Options			
	→	**Lang**	English
	→	**Light**	On
	→	**Row1**	Imx
	→	**Row2**	Ia
	→	**Row3**	Ib
	→	**Row4**	Uab
	→	**Row5**	W
	→	**Leds**	4

[English / Loc.Lang]
[Autom. / On]
[Imx / Ia / Ib / Ic / Io / I1 / I2 / Frq / Uan / Ubn / Ucn/ Uab / Ubc / Uca / Uo / V1 / V2 / PhA / PhB / PhC / Ph0 / W / VAr / VA / Cos / Tem / Wir / tst / Ist / LocRm / ModOP / Empty]

[4 / 11 / 18 / 25 / 32 / 39 / 46 / 53]

17.4.1 – Description of variables

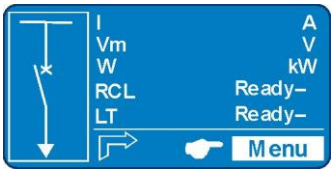
- **Lang** : Set Language
- **Light** : Set Display backlight
- **Row1** : Choosing the variable to be displayed in the rows on main menu
- **Row2** :
- **Row3** :
- **Row4** :
- **Row5** :
- **Leds** : Configuration Leds number

4	:	4	Base leds only			
11	:	4	Base leds only	+	7	configurable leds
18	:	4	Base leds only	+	14	configurable leds
25	:	4	Base leds only	+	21	configurable leds
32	:	4	Base leds only	+	28	configurable leds
39	:	4	Base leds only	+	35	configurable leds
46	:	4	Base leds only	+	42	configurable leds
53	:	4	Base leds only	+	49	configurable leds

This menu allows to customize the Language and the Display's backlight.
The standard languages are English and Italian.
On request, other languages can be loaded (French, German, etc..).
The Display backlight can be programmed always on "ON" or switched-on "Automatically" for a few second at any operation of the keyboard "Auto".

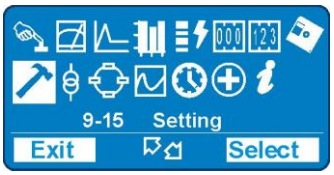
Example: set Local Language.

1



- Press "***Menu***" for access to the main menu with icons.

2



- Select icon "***Setting***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3

- Select "***Group1***" or "***Group2***"
- Select "***HMI***"
- Select "***Options***".
- Press "***Select***".

4

- Select "***Lang***"
- Press "***Modify***".

5

- Select "***Loc.Lang***".
- Press "***Write***"
- If Password is requested, see § Password

6

- Press "***Exit***"
- "***Yes***" confirms all changes.
- "***No***" void all changes.

7

- After set confirmation the display shows "***Please Wait***"

8

17.5 - Function: **T>** (Thermal Image F49)

Status	→	**Enab.**	No		[No / Yes]			
Oper.Levels	→	**Tal**	50	**%Tn**	[10 ÷ 100]	step	1	%Tn
	→	**Is**	1	**In**	[0.5 ÷ 1.5]	step	0.010	In
	→	**Kt**	300	**min**	[1 ÷ 600]	step	0.010	min

17.5.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Tal** : Temperature prealarm level
- **Is** : Continuous admissible current
- **Kt** : Warming-up Time Constant of the load

17.5.2 - Trip and Alarm

The algorithm compares the amount of heat accumulated "T" (≡ $i^2 \bullet t$) to the steady state amount of heat "Ts" corresponding to continuous operation at the continuously admissible current "Is".
When the ratio "T/Ts" reaches the level set for Thermal Alarm "Tal" of the max allowed heating, the relay trips accordingly

17.5.2.1 – Trip time of the Thermal Image Element

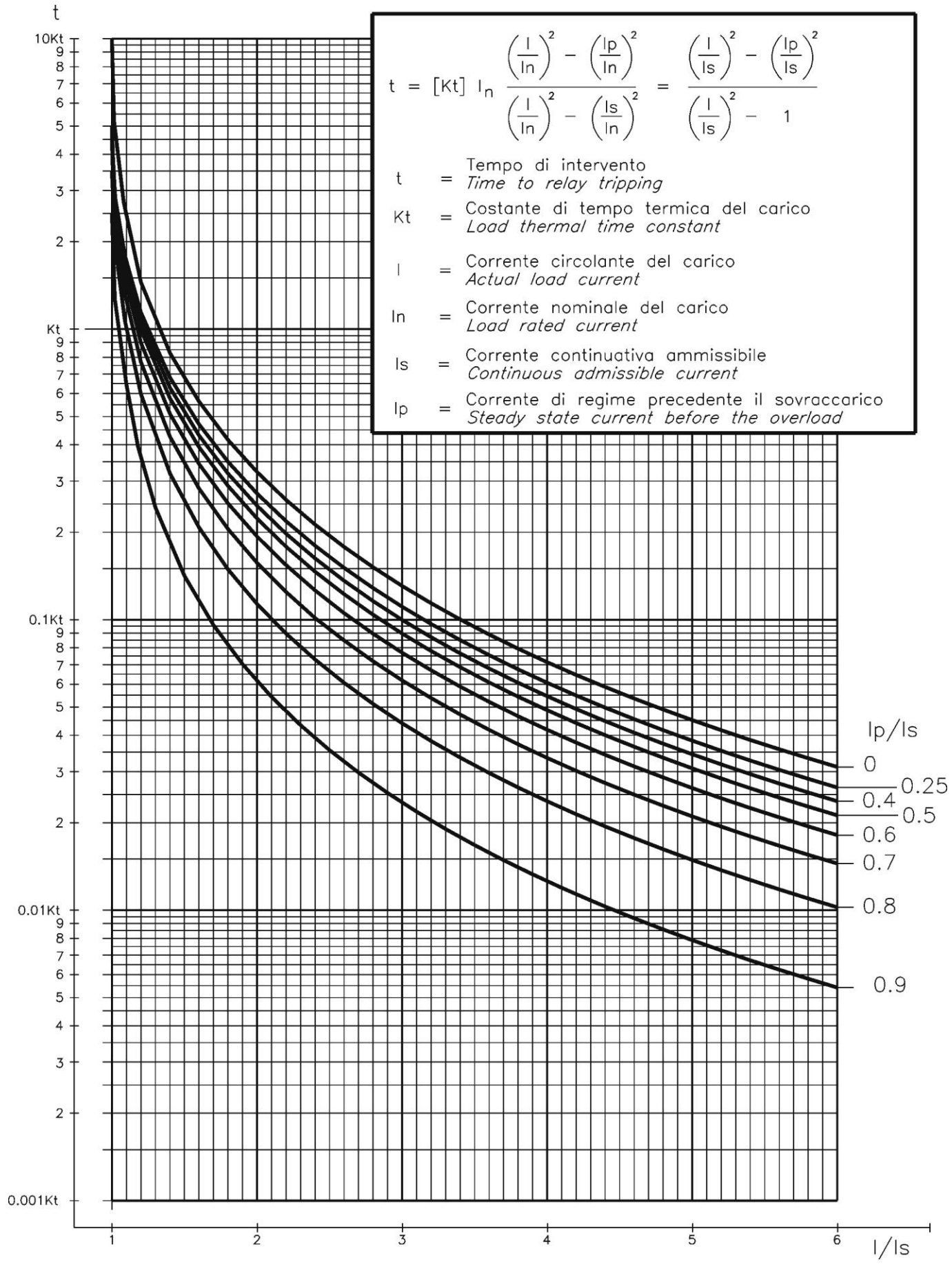
The trip time of the Thermal Image Element is a function of the current "I" flowing into the load and depends on its warming-up Time Constant "Kt", on the previous thermal status "Ip" and on the maximum admissible continuous current "Is" according to the equation:

t = Time to relay tripping
Kt = Load thermal time constant
I = Actual load current
In = Load rated current
Is = Continuous admissible current
Ip = Steady state current before the overload
ℓ_n = Natural Logarithm

$$t = Kt \cdot \ell_n \frac{\left(\frac{I}{In}\right)^2 - \left(\frac{Ip}{In}\right)^2}{\left(\frac{I}{In}\right)^2 - \left(\frac{Is}{In}\right)^2}$$

When the heating exceeds the set alarm level "Tal" or the max. allowed level ("I" > "Is" for the time "t") the output relays programmed for these function will be operated. Reset will take place when the heating will drop below 95% of the trip level.

17.5.2.2 – Thermal Image Curves (TU1024 Rev.1)



17.6 - Function: **1I>** *(First Overcurrent Element F50/51)*

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**RCL**	No		[No / Yes]			
Oper. Levels	→	**Is**	4	**In**	(0.100÷4)	step	0.01	In
Timers	→	**ts**	100	**s**	(0.01÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.6.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **f(t)** : Operation characteristic (Time/Current curve):
  (D) = Independent definite time
  (A) = IEC Inverse Curve type A
  (B) = IEC Very Inverse Curve type B
  (C) = IEC Extremely Inverse Curve type C
- **tBI** : Blocking input reset time
  Disable = Permanent block
  2tBO = Set 2xtBO.
- **f(a)** : Operation mode:
  Disable = Non Directional
  Fw = Directional Forward
  Rev = Directional Reverse
- **RCL** : If “RCL = Yes”, after tripping of the element “1I>” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **Is** : Minimum operation level
- **ts** : Trip time delay
- **tBO** : Time to reset of the Blocking Output after expiring of the Trip time delay. “tBO” is also the trip time delay of the Breaker Failure function.

17.6.2 - Algorithm of the time current curves

The Time Current Curves are generally calculated with the following equation

(1) $t(I)\left[\frac{A}{\left(\frac{I}{Is}\right)^{a}-1}+B\right]\cdot K\cdot T_S\cdot+T_r$ where

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

Is = Set minimum pick-up level

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

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

tr = Operation time of the output relay on pick-up.

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

Curve Name	Curve Identifier	A	B	a
IEC A Inverse	A	0.14	0	0.02
IEC B Very Inverse	B	13.5	0	1
IEC C Extremely Inverse	C	80	0	2

For the IEC curves, being B = 0, the Time/Current equation (1), becomes:

$(1')\quad t(I)=\frac{\left(10^{a}-1\right)Ts}{\left(\frac{I}{Is}\right)^{a}-1}+tr=\frac{Kt}{\left(\frac{I}{Is}\right)^{a}-1}+tr$

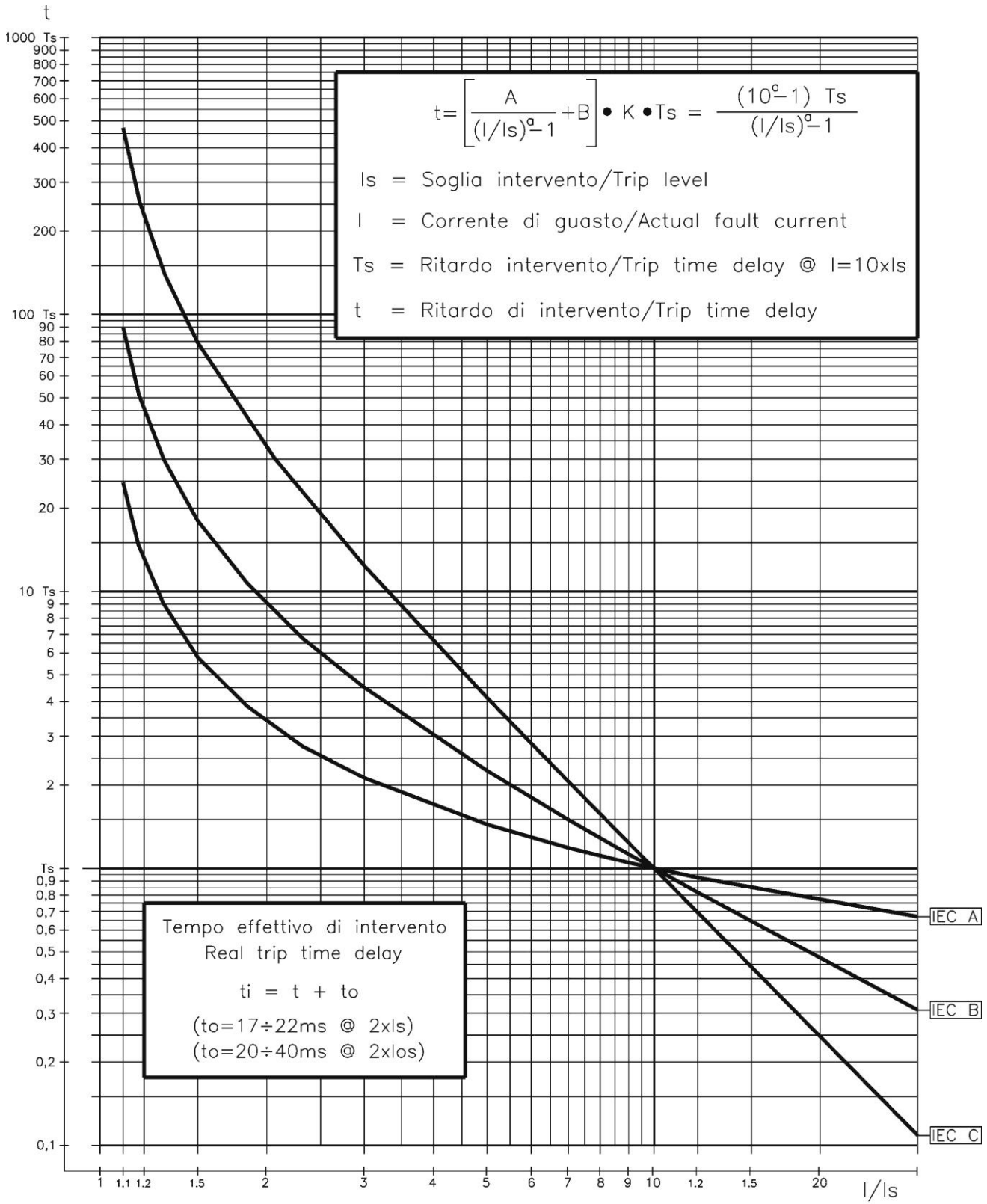
Where $Kt = (10^{a}-1)Ts$ is the time multiplier

When "f(t) = D" is programmed, the trip time delay is Definite and independent from the current: excess "t = ts".

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

Trip takes place when the current measured exceeds (no matter how much) the set level "Is" for the set time "ts".

17.6.3 - IEC Curves



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 = 10x0n

17.6.4 – Blocking Logic (BO-BI)

For each Protection Function it is possible to activate a Blocking Logic allowing for inhibiting their operation by external signals supplied to the Digital Input.

17.6.4.1 – Output Blocking signal "BO"

All the protection functions that can be programmed to operate in the blocking logic mode, element, have an instantaneous element (beside the time delayed) which is operated as soon as the controlled quantity exceeds the set trip level (I > [Is] for current, etc..) and is instantaneously reset when the input quantity drops below the reset level (normally 0.95Is).
The instantaneous element can control one of the user programmable output relays that, by its contacts, makes the signal available for blocking an external element (BO = Blocking Output).
In case, "tBO" sec after the set trip time "ts" has expired, the Protection function is still in operation (current above trip level), the Blocking Output relay (instantaneous element) is anyhow reset to eventually remove the Blocking signal from a back-up protection.

17.6.4.2 – Blocking Input "BI"

For all the functions controllable by the Blocking Logic, it is possible to inhibit the time delayed tripping by an external signal that activates a Digital Input programmed for this functionality.
The programmed Digital Input gets activated by an external cold contact closing across its terminals.
With the variable "tBI" set to "OFF" (tBI=OFF), the tripping of the delayed function is blocked as long as the Blocking Input signal is present at the terminals of the Digital Input.
With the variable "tBI" set to "2xtBI" (tBI=2xtBI), 2xtBI seconds after the set trip time delay of the function has expired the blocking input is anyhow ignored and the function enabled to trip.

17.6.5 - Automatic doubling of 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 when energizing the feeder.

17.7 – Function: **2I>** (Second Overcurrent Element F50/51)

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**RCL**	No		[No / Yes]			
Oper. Levels	→	**Is**	4	**In**	(0.100÷4)	step	0.010	In
Timers	→	**ts**	100	**s**	(0.01÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.7.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **f(t)** : Operation characteristic (Time/Current curve):
  (D) = Independent definite time
  (A) = IEC Inverse Curve type A
  (B) = IEC Very Inverse Curve type B
  (C) = IEC Extremely Inverse Curve type C
- **tBI** : Blocking input reset time
  Disable = Permanent block
  2tBO = Set 2xtBO.
- **f(a)** : Operation mode:
  Disable = Non Directional
  Fw = Directional Forward
  Rev = Directional Reverse
- **RCL** : If “RCL = Yes”, after tripping of the element “2I>” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **Is** : Minimum operation level
- **ts** : Trip time delay
- **tBO** : Time to reset of the Blocking Output after expiring of the Trip time delay. “tBO” is also the trip time delay of the Breaker Failure function.

17.8 - Function: **3I>** (Third Overcurrent Element F50/51)

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**CoF**	Disable		[Disable / Enable]			
	→	**RCL**	No		[No / Yes]			
Oper. Levels	→	**Is**	10	**In**	(0.100÷10)	step	0.010	In
Timers	→	**ts**	100	**s**	(0.01÷100)	step	0.01	s
	→	**tCoF**	0.05	**s**	(0.02÷0.20)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.8.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **tBI** : Blocking input reset time
  Disable = Permanent block
  2tBO = Set 2xtBO.
- **f(a)** : Operation mode:
  Disable = Non Directional
  Fw = Directional Forward
  Rev = Directional Reverse
- **CoF** : If “CoF = Enable”, any time the circuit breakers status changes from open to close the “3I>” element is enabled to trip instantaneously if the current exceeds the set value “Is” within the time “tCoF”. (Close On Fault Function)
- **RCL** : If “RCL = Yes”, after tripping of the element “3I>” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **Is** : Minimum operation level.
- **ts** : Trip time delay
- **tCoF** : Maximum duration of the Close on Fault function.
- **tBO** : Time to reset of the Blocking Output after expiring of the Trip time delay. “tBO” is also the trip time delay of the Breaker Failure function.

17.9 - Function: **4I>** (Fourth Overcurrent Element F50/51)

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**CoF**	Disable		[Disable / Enable]			
	→	**RCL**	No		[No / Yes]			
Oper. Levels	→	**Is**	10	**In**	(0.100÷10)	step	0.010	In
Timers	→	**ts**	100	**s**	(0.01÷100)	step	0.01	s
	→	**tCoF**	0.05	**s**	(0.02÷0.20)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.9.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **tBI** : Blocking input reset time
  Disable = Permanent block
  2tBO = Set 2xtBO.
- **f(a)** : Operation mode:
  Disable = Non Directional
  Fw = Directional Forward
  Rev = Directional Reverse
- **CoF** : If “CoF = Enable”, any time the circuit breakers status changes from open to close the “3I>” element is enabled to trip instantaneously if the current exceeds the set value “Is” within the time “tCoF”. (Close On Fault Function)
- **RCL** : If “RCL = Yes”, after tripping of the element “4I>” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **Is** : Minimum operation level.
- **ts** : Trip time delay
- **tCoF** : Maximum duration of the Close on Fault function.
- **tBO** : Time to reset of the Blocking Output after expiring of the Trip time delay. “tBO” is also the trip time delay of the Breaker Failure function.

17.10 - Function: **1dI** *(First Current Step Element)*

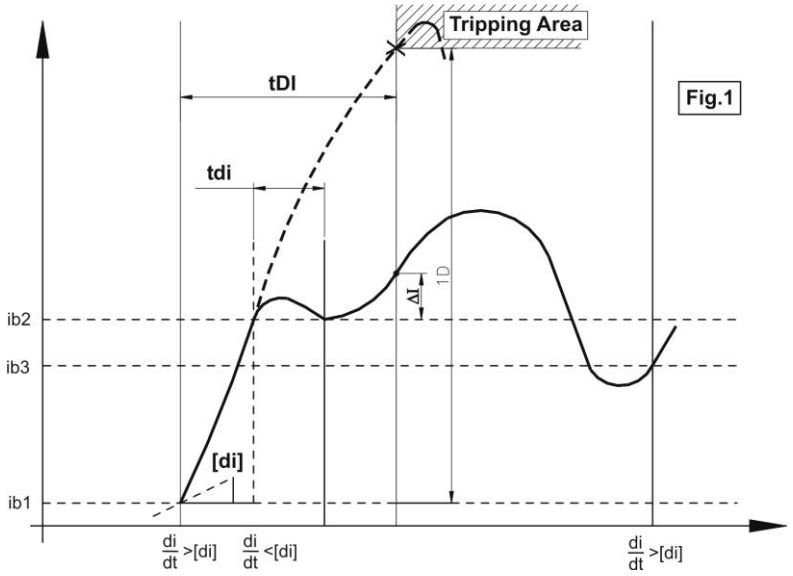
Status	→ **Enab.**	No		[No / Yes]			
Options	→ **RCL**	No		[No / Yes]			
Oper. Levels	→ **DI**	1000	**A**	(100÷9990)	step	10	A
	→ **di**	200	**A/ms**	(4÷400)	step	1	A/ms
Timers	→ **tDI**	100	**ms**	(0÷500)	step	1	ms
	→ **tdi**	20	**ms**	(0÷100)	step	1	ms

17.10.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **RCL** : If “RCL = Yes”, after tripping of the element “1dI” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **DI** : Current step trip level
- **di** : Minimum di/dt level to start “ΔI” evaluation and detection reset level
- **tDI** : Trip time delay
- **tdi** : Detection reset time delay

17.10.2 - Operation of the Current step monitoring element

The timely detection of a current step allow to clear a near short circuit long before the current can reach the prospective peak value.



Protection Function Operation (see Fig. 1):

- Any time a current rate of rise exceeding the set value [di] is detected the value of the current "i_{1b}" is recorded as reference basic value to evaluate the current step "$\Delta I = i - i_{1b}$" and the timer "tDI" is started.
  "ΔI" is evaluated every 1ms.
- If during [tDI] the rate of rise "di/dt" never goes below the set level [di] for a time longer than [tdi], when [tDI] expires, the difference $\Delta I = i - i_{1b}$ is measured and if "$\Delta I \geq$[DI]" the protection function trips.
- If during [tDI] the rate of rise "di/dt" goes below the set level [di] for a time longer than [tdi], a new value of the current i_{2b} is recorded and, when [tDI] expires. If the difference $\Delta I = i - i_{2b}$ measured is greater than [DI], the protection function trips.

In terms of equation the protection function operation is as follow:

$$\text{If } \frac{di}{dt} \geq [di] \Rightarrow \left\{ \begin{array}{l} \text{Value of Current } i_{1b} \text{ is recorded} \\ \text{Timer tDI is Started} \end{array} \right\} \Rightarrow \text{If During tDI} \Rightarrow$$

$$\Rightarrow \begin{cases} \dfrac{di}{dt} \geq [di] \text{ during tdi} \Rightarrow \text{Trip if } \Delta = i - i_{1b} \geq [DI] \text{ after tDI} \\ \dfrac{di}{dt} < [di] \text{ during tdi} \Rightarrow \text{New Value of Current } i_{2b} \text{ is recorded} \Rightarrow \text{Trip if } \Delta = i - i_{2b} \geq [DI] \text{ after tDI} \end{cases}$$

If, at the end of [tDI] no trip occurs "ΔI " evaluation is stopped and will restart when the set "di/dt" level is exceeded.

17.11 - Function: **2dI** *(Second Current Step Element)*

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**RCL**	No		[No / Yes]			
Oper. Levels	→	**DI**	1000	**A**	(100÷9990)	step	10	A
	→	**di**	200	**A/ms**	(4÷400)	step	1	A/ms
Timers	→	**tDI**	100	**ms**	(0÷500)	step	1	ms
	→	**tdi**	20	**ms**	(0÷100)	step	1	ms

17.11.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **RCL** : If “RCL = Yes”, after tripping of the element “2dI” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **DI** : Current step trip level
- **di** : Minimum di/dt level to start “ΔI” evaluation and detection reset level
- **tDI** : Trip time delay
- **tdi** : Detection reset time delay

17.12 - Function: **1di/dt** (First Current Rate of Rise Element)

Status	→ **Enab.**	No		[No / Yes]			
Options	→ **RCL**	No		[No / Yes]			
Oper. Levels	→ **G**	20	**A/ms**	(4÷400)	step	1	A/ms
Timers	→ **tG**	20	**ms**	(2÷500)	step	1	ms

17.12.1 - Description parameters

❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**RCL**	:	If “RCL = Yes”, after tripping of the element “1di/dt” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If “RCL = No” no test and no reclosure is started.
❑	**G**	:	di/dt trip level
❑	**tG**	:	Trip time delay

17.12.2 - Operation of the current rate of rise monitoring element

This function is used to detect remote faults
Current is sampled at 1kHz, is measured as the average of 3 samples and stored in a buffer from which every 1ms the relay computes the average rate of rise in the set time delay:

$$\frac{di}{dt} = \frac{I_{(t+[tG])} - I_{(t)}}{tG}$$

if $\frac{di}{dt} \geq [G]$ the relay trip

17.13 - Function: **2di/dt** (Second Current Rate of Rise Element)

Status	→ **Enab.**	No		[No / Yes]			
Options	→ **RCL**	No		[No / Yes]			
Oper. Levels	→ **G**	20	**A/ms**	(4÷400)	step	1	A/ms
Timers	→ **tG**	20	**ms**	(2÷500)	step	1	ms

17.13.1 - Description parameters

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **RCL** : If “RCL = Yes”, after tripping of the element “1di/dt” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **G** : di/dt trip level
- **tG** : Trip time delay

17.13.2 - Operation of the current rate of rise monitoring element

This function is used to detect remote faults
Current is sampled at 1kHz, is measured as the average of 3 samples and stored in a buffer from which every 1ms the relay computes the average rate of rise in the set time delay:

$$\frac{di}{dt} = \frac{I_{(t+[tG])} - I_{(t)}}{tG}$$

if $\frac{di}{dt} \geq [G]$ the relay trip

17.14 - Function: **Rapp** (Impedance monitoring - di/dt dependence)

Status	→ **Enab.**	No		[No / Yes]			
Options	→ **RCL**	No		[No / Yes]			
Oper. Levels	→ **Va**	400	**V**	(0÷800)	step	1	V
	→ **Ri**	0.100	**Ω**	(0÷0.250)	step	0.001	Ω
	→ **Rt**	1	**Ω**	(0.001÷2.500)	step	0.001	Ω
	→ **Li**	0.005	**H**	(0.001÷0.010)	step	0.001	H
	→ **Lt**	0.010	**H**	(0.002÷0.050)	step	0.001	H
	→ **R***	50	**Ω**	(0÷100)	step	0.01	Ω
	→ **g**	50	**A/ms**	(10÷500)	step	1	A/ms
Timers	→ **tr**	50	**ms**	(0÷100)	step	1	ms

17.14.1 - Description of variables

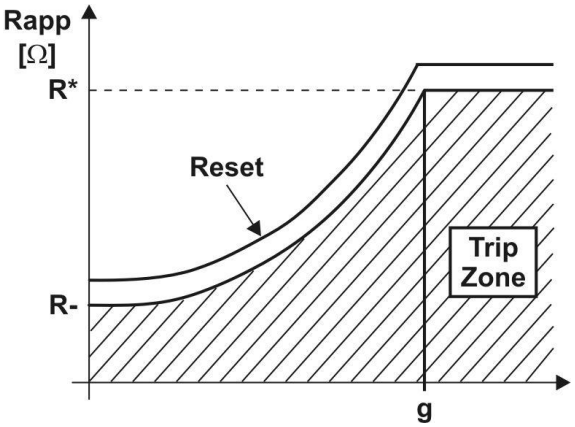
- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **RCL** : I If “RCL = Yes”, after tripping of the element “Rapp” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **Va** : Arc voltage.
- **Ri** : Internal Resistance = Resistance of the circuit upstream the Circuit Breaker.
- **Rt** : Total resistance of the circuit including the Contact Line.
- **Li** : Internal Inductance = Inductance of the circuit upstream the Circuit Breaker.
- **Lt** : Total Inductance of the circuit including the Contact Line.
- **R*** : Resistance trip level if di/dt ≥ g.
- **g** : Limit value of di/dt.
- **tr** : Trip time delay.

17.14.2 - Operation the Impedance monitoring element

The protection element shall trip if the impedance “Rapp” calculated as the ratio of the line voltage to the line current drops below the calculated value with the current rate of rise exceeding the level as reported on the trip characteristics. Trip takes place if the situation lasts longer than the set time delay “tr”.

$$Rapp = \left[V - \frac{Ri(V - Va)}{Rt} + \left(\frac{Lt}{Rt} \cdot Ri - Li \right) g \right] : \left(\frac{V - Va}{Rt} - \frac{Lt}{Rt} \cdot g \right)$$

Reset takes place when “Rapp” is 10% higher than the trip value.



17.15 - Function: **Iapp** (Current monitoring with di/dt dependence)

Status	→ **Enab.**	No		[No / Yes]			
Options	→ **RCL**	No		[No / Yes]			
Oper. Levels	→ **IA**	1500	**A**	(500÷5000)	step	10	A
	→ **I***	500	**A**	(400÷1500)	step	10	A
	→ **g**	50	**A/ms**	(30÷500)	step	1	A/ms
	→ **Res**	90	**%**	(80÷100)	step	1	%Iapp
Timers	→ **tr**	0.1	**s**	(0÷5.00)	step	0.01	s

17.15.1 - Description of variables

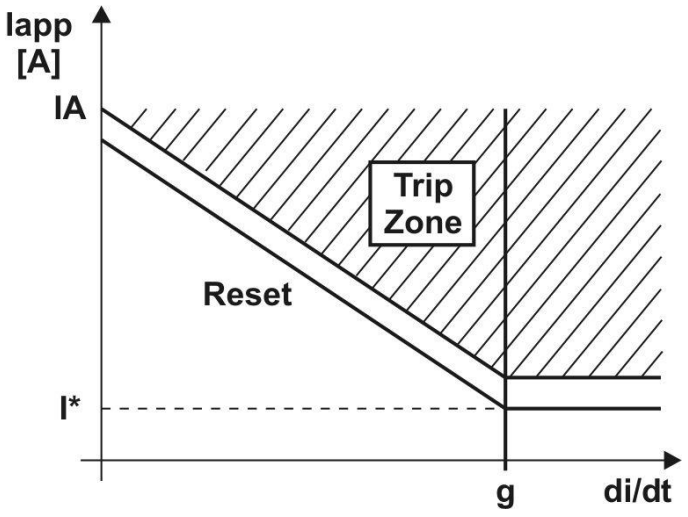
❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**RCL**	:	If “RCL = Yes”, after tripping of the element “Iapp” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If “RCL = No” no test and no reclosure is started.
❑	**IA**	:	Current trip level when di/dt = 0
❑	**I***	:	Current trip level when di/dt ≥ [g]
❑	**g**	:	Limit value of di/dt
❑	**Res**	:	Drop-out percentage (operation reset)
❑	**tr**	:	Trip time delay.

17.15.2 - Operation of the “Iapp” element

The protection shall trip if current measured exceeds the value [Iapp] calculated as hereunder showed for longher than the set time “tr” reset takes place as soon as the current drops below $[Iapp]\cdot\frac{Res}{100}$

$$Iapp = -\left[\frac{IA - I^*}{g}\right]\cdot\frac{di}{dt} - [IA] \quad \text{if} \quad 0 \le \frac{di}{dt} \le g$$

$$Iapp = I^* \quad \text{if} \quad \frac{di}{dt} > g$$



17.16 - Function: **1Ig** (First Frame Fault Element)

Status	→ **Enab.**	No		[No / Yes]				
Options	→ **f(t)**	Type - D		[D / A / B / C]				
	→ **RCL**	No		[No / Yes]				
Oper. Levels	→ **Is**	1.00	**Ign**	(0.10÷4.00)	step	0.01	Ign	
	→ **Us**	0.20	**Ugn**	(0.01÷1.00)	step	0.01	Ugn	
Timers	→ **ts**	20	**s**	(0.02÷100.00)	step	0.01	s	

17.16.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **f(t)** : Operation characteristic (Time/Current curve):
  (D) = Independent definite time
  (A) = IEC Inverse Curve type A
  (B) = IEC Very Inverse Curve type B
  (C) = IEC Extremely Inverse Curve type C
- **RCL** : If “RCL = Yes”, after tripping of the element “1Ig” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **Is** : Minimum operation level of frame to earth current.
- **Us** : Minimum operation level of frame to earth voltage.
- **ts** : Trip time delay

17.16.2 - Operation

Trip takes places if, for larger than the set time delay [ts], both the ground fault current “Ig” and the Voltage to ground “Ug” exceed the set values [Is] and [Us].
If “Is = 0” the relay shall consider “Ug” only, viceversa if “Ug = 0” the relay shall consider “Ig” only.

Setting		Tripping condition
Is	**Us**	
≠0	≠0	Ig>[Is] & Ug>[Us]
≠0	=0	Ig>[Is]
=0	≠0	Ug>[Us]

17.17 - Function: **2Ig** (Second Frame Fault Element)

Status	→ **Enab.**	No		[No / Yes]				
Options	→ **f(t)**	Type - D		[D / A / B / C]				
	→ **RCL**	No		[No / Yes]				
Oper. Levels	→ **Is**	1.00	**Ign**	(0.10÷4.00)	step	0.01	Ign	
	→ **Us**	0.20	**Ugn**	(0.01÷1.00)	step	0.01	Ugn	
Timers	→ **ts**	20	**s**	(0.02÷100.00)	step	0.01	s	

17.17.1 - Description of variables

❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**f(t)**	:	Operation characteristic (Time/Current curve): (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C
❑	**RCL**	:	If “RCL = Yes”, after tripping of the element “2Ig” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If “RCL = No” no test and no reclosure is started.
❑	**Is**	:	Minimum operation level
❑	**Us**	:	Minimum operation level
❑	**ts**	:	Trip time delay

17.17.2 - Operation

Trip take place if, for larger than the set time delay [ts], both the ground fault current “Ig” and the Voltage to ground “Ug” exceed the set values [Is] and [Us].
If “Is = 0” the relay shall consider “Ug” only viceversa if “Ug = 0” the relay shall consider “Ig” only.

Setting		Tripping condition
Is	**Us**	
≠0	≠0	Ig>[Is] & Ug>[Us]
≠0	=0	Ig>[Is]
=0	≠0	Ug>[Us]

*17.18 - Function: **RCL** (Automatic Reclosure)*

Status	→ **Enab.**	No		[No / Yes]				
Options	→ **ShNum**	2		[1 / 2 / 3 / 4]				
	→ **Test**	Yes		[No / Yes]				
Timers	→ **tr**	10	**s**	(1÷200)	step	1	s	
	→ **t1**	0.3	**s**	(0.1÷1000)	step	0.1	s	
	→ **t2**	1	**s**	(0.1÷1000)	step	0.1	s	
	→ **t3**	3	**s**	(0.1÷1000)	step	0.1	s	
	→ **t4**	10	**s**	(0.1÷1000)	step	0.1	s	

17.18.1 - Description of variables

❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**ShNum**	:	Number of reclosure shots to Lock-out
❑	**Test**	:	"Yes" - Before any reclosure the Line Test is started and the reclosure is operated only after a successful Line Test is carried-out. "No" - Reclosure is operated without Line-Test.
❑	**tr**	:	Reclaim time. Any new trip during "tr" after a successful reclosure shot starts the next shot of the cycle. Any new trip after "tr" restarts a complete cycle.

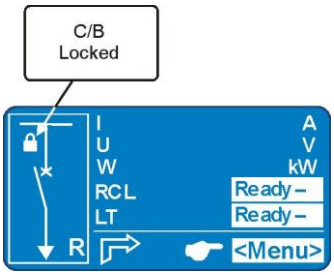
17.18.2 - Operation

- ❑ 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.
- ❑ A reclose shot is started after a C/B's opening operated by one of the relay's protection functions programmed to control this reclose shot; C/B's opening operated by one element not programmed to control the reclosure shot activates the Lock-out status of the Reclosure function.
- ❑ Any time the Circuit Breaker (C/B) is closed either manually or automatically the Reclaim time "tr" is started.
- ❑ After a manual closure of the C/B, operation time start or tripping of any of the relay protection elements during "tr", makes the relay enter into the Lock-Out status (L.O.). In the L.O. status the relay, after breaker opening, does not produce any command for automatic reclose ; the lock-out status is shows on the display.
  Reset from the L.O. status takes place when the C/B is opened and then manually reclosed or by operating the external reset command.
- ❑ If none of the relay protection elements is started during "tr" after a manual closure of the C/B, the relay is ready to start the Automatic Reclose Sequence.
- ❑ If "tr" is started by an automatic reclosure, the operation time start during "tr" and the tripping of any element programmed for the operation of the next reclosure makes the relay proceed with the reclosing cycle.

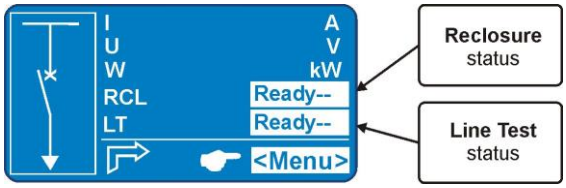
- After “tr” is expired the reclosing cycle restarts from the first reclosure (1C).
- Pick-up of the time start of any protection element, stops the counting down of “tr”; counting is restarted as soon as the element resets.
- As soon as the C/B is opened due to tripping of one of the relay’s elements programmed to initiate the next automatic reclose shot, the relevant reclose time delay (t1, t2, t3, t4) is started and at the end of this tx time the reclose command is issued by the relay. The C/B is then automatically reclosed and the reclaim time “tr” is started again. If during “tr” the C/B is again opened by a relay’s element programmed to initiate the next automatic reclose, the next reclose takes place after the relevant time tx; the C/B is reclosed and “tr” restarted. When the last Automatic Reclose shot of the sequence has been done, any further tripping during “tr” produces a relay’s lock-out status. If after any reclose shot no tripping takes peace during “tr”, the Reclose Sequence is restarted from the beginning (starting from the first reclose shot 1C)

17.18.3 – Display Lock-out indication

If the variable "Lock" (§ CB-L) is set to "Enable", reclosing of the C/B is inhibited after a "Failed reclosure" or after a "Failed Line Test" (the symbol of a Locker appears on the display).
The reset from the Lock-out status can be operated either b the keyboard via the "CB Unlock" command available in the menu "Local Commands" (§ Local Commands) or by an external command via the Digital Input programmed for "Ext.Reset".



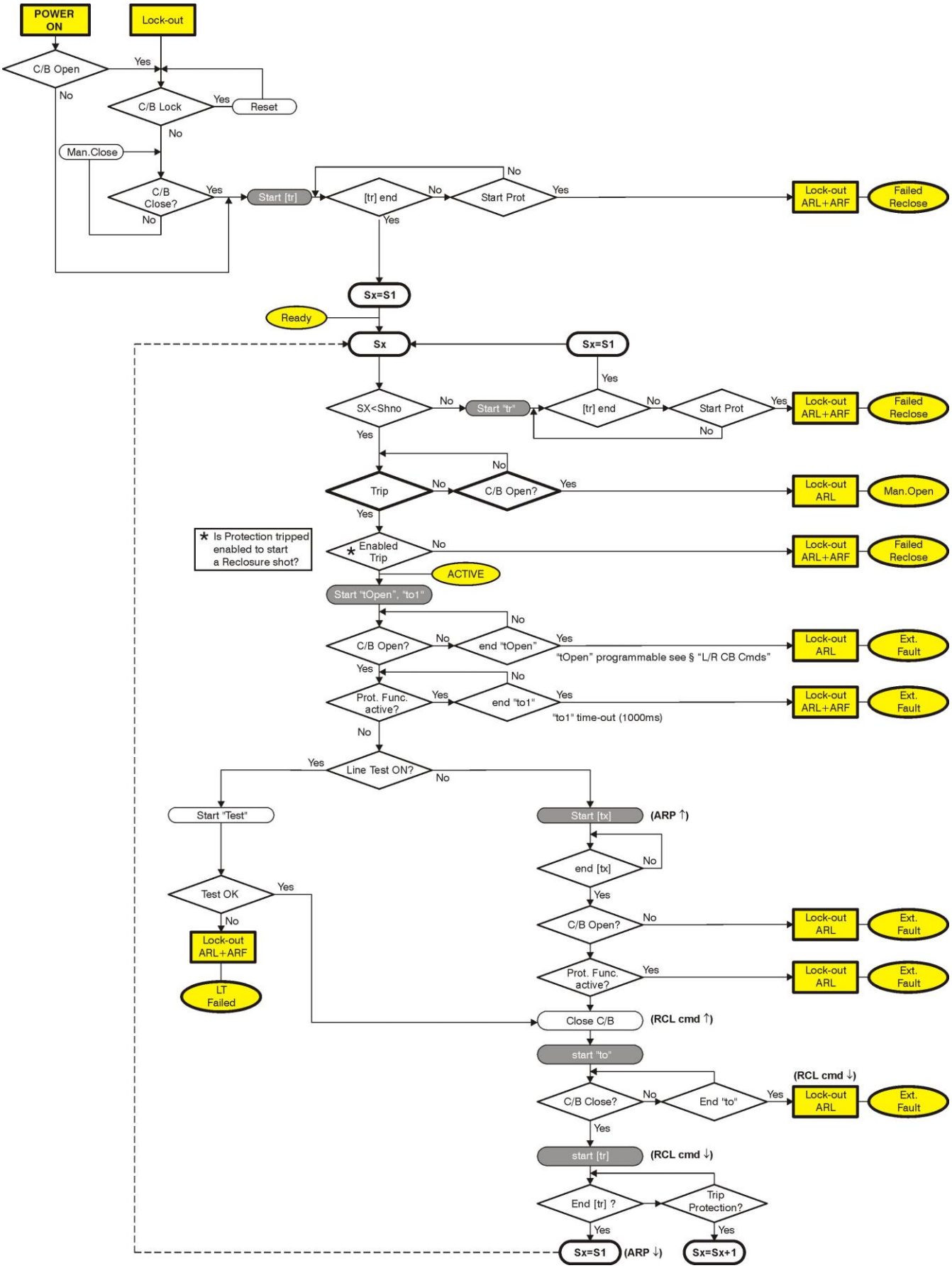
17.18.4 – Display status indication



Display of Reclosure status

- **Ready** Ready to operate
- **Active** Reclosure in progress
- **Fail** Failed Reclosure
- **Wait** Standby
- **ExtFail** Reclosure lock-out due to an External Failure (see flow chart RCL)
- **ManOpen** Manual Opening
- **ExtLock** External reclosure lock-out by digital input

17.18.5 - Flow chart RCL



*17.19 - Function: **1U>** (First OverVoltage Element F59)*

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	1.10	**Un**	(0.5÷1.50)	step	0.01	Un
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s

17.19.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Us** : Minimum operation level
- **ts** : Trip time delay

*17.20 - Function: **2U>** (Second OverVoltage Element F59)*

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	1.10	**Un**	(0.5÷1.50)	step	0.01	Un
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s

17.20.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Us** : Minimum operation level
- **ts** : Trip time delay

*17.21 - Function: **1U<** (First UnderVoltage Element F27)*

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	0.70	**Un**	(0.2÷1.00)	step	0.01	Un
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s

17.21.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Us** : Minimum operation level
- **ts** : Trip time delay

*17.22 - Function: **2U<** (Second UnderVoltage Element F27)*

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	0.70	**Un**	(0.2÷1.00)	step	0.01	Un
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s

17.22.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Us** : Minimum operation level
- **ts** : Trip time delay

17.23 - Function: **Wi** (Circuit Breaker maintenance level)

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Ii**	1.000	**In**	(0.1÷99)	step	0.1	In
	→ **Wi**	1.000		(1÷9999)	step	1	

17.23.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Ii** : Circuit Breaker Rated Current in multiples of the Relay rated input current In
- **Wi** : Maximum allowed amount of accumulated interruption energy before maintenance as stated by the C/B Manufactured.

17.23.2 - Operation (Accumulation of the interruption Energy)

The relay computes the Arc Energy developed during each interruption of the Circuit Breaker and accumulates these values.
When the amount of the accumulated energy exceeds a settable level the relay gives out an alarm to signalize that maintenance inspection of the Circuit Breaker is needed.
The operation of this function is based on the following parameters:

Ii = Ii = (0.1-99)In

Wi = Wi =(1 - 9999)

“Wi is set as a multiple of the conventional interruption energy unit.
Any time the Circuit Breaker opens (change of status from closed to open of the digital input connected to the normally open contact 52a of the C/B) the relay decreases the amount of energy corresponding to a number of conventional units:

$$nW_C = \frac{W}{Wc} = \frac{I^2 \cdot t_X}{Ii^2 \cdot t_i}$$

where:

W = $I^2 \bullet t_X$ Interruption Energy during the interruption time “tx” with interruption current “I”.

Wc = $Ii^2 \bullet t_i$ Conventional unit of interruption energy corresponding to C/B rated current and rated interruption time “t_i”.

When the set Energy level before maintenance is decreased to zero a user programmable output relay is operated.

Reset to Zero of the Energy accumulation is available in the menu “***Cmd***” (Reset Term).

17.24 - Function: **TCS** (Trip Circuit Supervision)

Status	→ **Enab.**	No		[No / Yes]			
Timers	→ **ts**	0.10	**s**	(0.1÷100)	step	0.01	s

17.24.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **ts** : Trip time delay

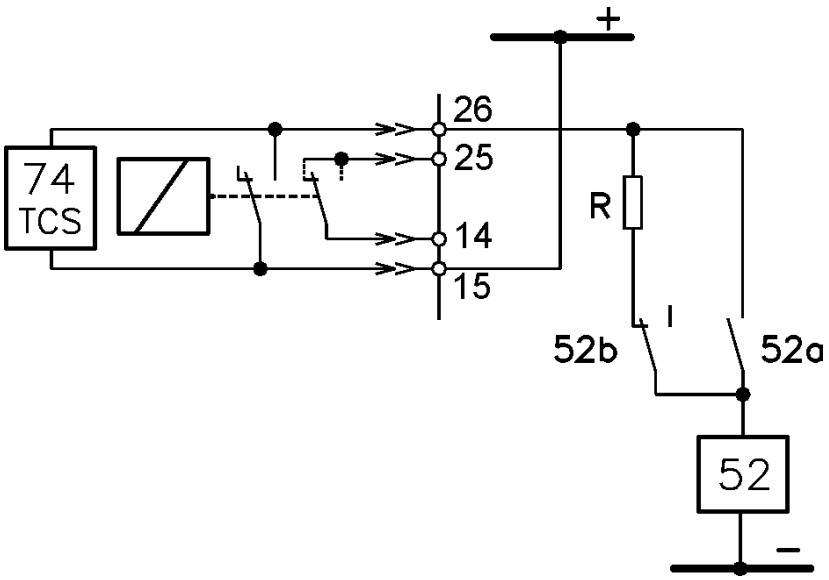
17.24.2 - Operation

The relay includes a complete Circuit Breaker Trip Circuit Supervision unit that is associated to the Contact "15-26" of the "R1" Output Relay.
The contact of "R1" is used to trip the C/B as reported in the drawing here below.
The supervision works when the C/B is closed and recognizes the Trip Circuit as sound as far as the current flowing exceeds "1mA".
In case of Trip Circuit Fault detection, the diagnostic relay is operated and the Led starts flashing (see § Signalization).
To have Supervision also with the C/B open one N/C contact (52b) from the C/B and an external resistor "R" are needed.

$$R[k\Omega] \le \frac{V}{1mA} - R_{52}$$ where **R_{52}**= Trip Coil internal resistance [kΩ]

V = Trip Circuit Voltage

$$P_R \ge 2 \cdot \frac{V^2}{R}[W]$$ Designed power of external resistance "R"



Tripping of the function operates a user programmable output relay.

*17.25 - Function: **IRF** (Internal Relay Fault)*

In this menu it is possible to configurate the operation of the Relay Internal Fault detection element

Status	→ **Enab.**	No		[No / Yes]			
Timers	→ **tIRF**	5.00	**s**	(5÷200)	step	0.01	s

17.25.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **tIRF** : Trip time delay

17.25.2 - Operation

Tripping of the function operates a user programmable output relay.

*17.26 - Function: **RT** (First Element Remote Trip)*

In this menu it is possible to configurate the Remote Trip Element.

Status	→ **Enab.**	No		[No / Yes]		
Options	→ **RCL**	No		[No / Yes]		
	→ **RTon**	FallEdge		[RiseEdge – FallEdge]		
Timers	→ **ts**	5.00	**s**	(0 ÷ 10.00)	step	0.01 s

17.26.1 - Description of variables

❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**RCL**	:	If “RCL = Yes”, after tripping of the element “RT” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If “RCL = No” no test and no reclosure is started.
❑	**RTon**	:	Remote trip Edge selector
❑	**ts**	:	Trip time delay

17.26.2 - Operation

Tripping of the function operates a user programmable output relay.
When Remote Trip is enabled to initiate a reclosure shot, the relevant input signal must be cleared within the time-out “to1” (1000ms); if the signal stays for longer than “to1” the reclosure function goes into the lock-out status giving an External Fail signal.

*17.27 - Function: **RTX** (Second Element Remote Trip)*

In this menu it is possible to configurate the Remote Trip Element.

Status	→ **Enab.**	No		[No / Yes]		
Options	→ **RCL**	No		[No / Yes]		
	→ **RTon**	FallEdge		[RiseEdge – FallEdge]		
Timers	→ **ts**	5.00	**s**	(0 ÷ 10.00)	step	0.01 s

17.27.1 - Description of variables

❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**RCL**	:	If “RCL = Yes”, after tripping of the element “RTX” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If “RCL = No” no test and no reclosure is started.
❑	**RTon**	:	Remote trip Edge selector
❑	**ts**	:	Trip time delay

17.27.2 - Operation

Tripping of the function operates a user programmable output relay.
When Remote Trip is enabled to initiate a reclosure shot, the relevant input signal must be cleared within the time-out “to1” (1000ms); if the signal stays for longer than “to1” the reclosure function goes into the lock-out status giving an External Fail signal.

*17.28 - Function: **BreakerFail** (Breaker Failure)*

Status	→ **Enab.**	No		[No / Yes]			
Timers	→ **tBF**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.28.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **tBF** : Trip time delay

17.28.2 - Operation

The Breaker Failure detection is started by the operation of the output relay “R1” (programmed to be controlled by the Protection Functions that trip the C/B).
If after [tBF] seconds from operation of the relay “R1”, any input current flow is still detected (>10% In), the function “BF” trips and operate one user programmable output relay,

*17.29 - Function: **Wh** (Energy counter Pulse)*

In this menu it is possible to configurate the Energy counter Pulse.

Status	→ **Enab.**	No		[No / Yes]				
Oper. Levels	→ **WpP**	100	**kW**	(10 ÷ 1000)		step	10	kWh
Timers	→ **Pulse**	1.00	**s**	(0.10 ÷ 2.00)		step	0.01	s

17.29.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **WpP** : Energy counter Pulse Level
- **Pulse** : Pulse duration

17.29.2 - Operation

One selected output relay issued a pulse from an external energy counter, each pulse corresponds to the programmed Energy unit "WpP" and its duration is the set time "Pulse".

17.30 - Function: **Oscillo** (Oscillographic Recording)

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**Trig**	Disable		[Disable / Start / Trip / ExtInp]			
Timers	→	**tPre**	0.50	**s**	(0.01÷0.50)	step	0.01	s
	→	**tPost**	0.50	**s**	(0.01÷1.50)	step	0.01	s

17.30.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Trig** : Selection of the Trigger command source (start recording):
  - *Disable* = Function Disable (no recording)
  - *Start* = Trigger on time start of protection functions
  - *Trip* = Trigger on trip (time delay end) of protection functions
  - *ExtInp* = External Trigger from Digital Input
- **tPre** : Recording time before Trigger
- **tPost** : Recording time after Trigger

17.30.2 - Operation

In the options: “Trig = Start” and “Trig = Trip”, the oscillographic recording starts respectively when any protection function starts operating or trip (provided the function was programmed “TrigEnab”).

In the option “ExtInp”, the oscillographic record starts when the Digital Input is activated (terminals shorted)

The “Osc” Function includes the wave Form Capture of the input quantities (I, U, Ig, Ug) and can totally store a record of 6 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 0.6 sec).
Any new event beyond the 6 sec capacity of the memory, cancels and overwrites the former records (FIFO Memory).
Example: “10x0.6s” or “9x0.66” or “8x0.75” .... etc.

15.30.3 – Available on MSCom2

T>	**Tal** **T>**	(alarm) (trip)	*Thermal element*
1I>	**1I>** **t1I>**	(Start) (Trip)	*First overcurrent element*
2I>	**2I>** **t2I>**	(Start) (Trip)	*Second overcurrent element*
3>	**3I>** **t3I>**	(Start) (Trip)	*Third overcurrent element*
4I>	**4I>** **t4I>**	(Start) (Trip)	*Fourth overcurrent element*
1dI	**1dI** **t1dI**	(Start) (Trip)	*First Current step element*
2dI	**2dI** **t2dI**	(Start) (Trip)	*Second Current step element*
1di/dt	**1di/dt** **t1di/dt**	(Start) (Trip)	*First Current rate of rise element*
2di/dt	**2di/dt** **t2di/dt**	(Start) (Trip)	*Second Current rate of rise element*
Rapp	**Rapp**	(Trip)	*Impedance monitoring – di/dt dependence*
Iapp	**Iapp**		*Current monitoring with di/dt dependence*
1Ig	**1Ig** **t1Ig**	(Start) (Trip)	*First instantaneous Frame Fault element* *First time delayed Frame Fault element*
2Ig	**2Ig** **t2Ig**	(Start) (Trip)	*Second Frame Fault element*
RCL	**RCL cmd** **ARP** **ARF** **ARL**	(Trip)	*Reclosure Shot command* *Autoreclosure in progress* *Autoreclosure Failure* *Autoreclosure Lock-out*
1U>	**1U>** **t1U>**	(Start) (Trip)	*First overvoltage element*
2U>	**2U>** **t2U>**	(Start) (Trip)	*Second overvoltage element*
1U<	**1U<** **t1U<**	(Start) (Trip)	*First undervoltage element*
2U<	**2U<** **t2U<**	(Start) (Trip)	*Second undervoltage element*
Wi	**tWi>**		*Circuit breaker maintenance level*
TCS	**tTCS**	(Trip)	*Time delayed Trip Circuit Supervision*
IRF	**IRF** **tIRF**	(Start) (Trip)	*Time delayed Internal relay Fault* *Instantaneous Internal relay Fault*
RT	**RT** **tRT**	(Trip) (Start)	*First Instantaneous Remote Trip* *First Time delayed Remote Trip*
RTX	**RTX** **tRTX**	(Trip) (Start)	*Second Instantaneous Remote Trip* *Second Time delayed Remote Trip*
CB-L	**CB-L**		*C/B reclose Lock-out*
BF	**BF**		*Breaker Failure*
Wh	**+ Wh** **- Wh**		*Imported Energy counter Pulse* *Exported Energy counter Pulse*
L/R CB Cmds	**Open C/B** **Close C/B** **LocRemInc** **missCBOpe**		*Open C/B command* *Close C/B command* *Local / Remote Inconsistency* *Missed C/B opening (Digital input missing)*
LT	**LTPb** **LTP** **LTF** **LT cmd**	 (Trip)	*Output to operate an external flashing lamp signalling line test in progress* *Line Test in progress* *Line Test Failed* *Line Test command*
	Gen.Start **Gen.Trip**		*General start* *General Trip*

	Vcc	*Reserved*		
	Gnd	*Reserved*		
	ResLog	*Reset signal logic*		
	P1	*Push-button Open*		
	P2	*Push-button Close*		
	Gen.Start	*Start Generic*		
	Gen.Trip	*Trip Generic*		
	UserTriggerOscillo	*User Variable for Oscillographic Recording*		
	UserVar<0> **to** **UserVar<24>**	*User Variable*		
	Vcc	*Reserved*		
	Gnd	*Reserved*		
	ResLog	*Reset signal logic*		
	P1	*Push-button Open*		
	P2	*Push-button Close*		
	0.D1	*Digital Input "0.D1"*	*activated*	
	0.D1Not	*Digital Input "0.D1"*	*deactivated*	
	to			*Digital Input on Main Relay*
	0.D4	*Digital Input "0.D4"*	*activated*	
	0.D4Not	*Digital Input "0.D4"*	*deactivated*	
	1.D1	*Digital Input "1.D1"*	*activated*	
	1.D1Not	*Digital Input "1.D1"*	*deactivated*	
	to			*Digital input on Expansion Board*
	1.D15	*Digital Input "1.D15"*	*activated*	
	1.D15Not	*Digital Input "1.D15"*	*deactivated*	
	2.D1	*Digital Input "2.D1"*	*activated*	
	2.D1Not	*Digital Input "2.D1"*	*deactivated*	
	to			*Digital input on Expansion Board*
	2.D15	*Digital Input "2.D15"*	*activated*	
	2.D15Not	*Digital Input "2.D15"*	*deactivated*	

17.30.4 – Setting "User Trigger Oscillo"

The "User trigger Oscillo" is a result of a logical operation (Or, AND, ecc...), it can be used like other logical output. This operation is possible only via "MSCom2" software.

Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status

17.30.4.1 – Name

Internal name

17.30.4.2 – User descr.

Fixed

17.30.4.3 – Linked functions

Selection functions

17.30.4.4 – OpLogic

Operation Logic = [None, OR, AND, XOR, NOR, NAND, NOT, Ff-SR]

17.30.4.5 – Timer

Time delay (0-10)s, step 0.01s

17.30.4.6 – Timer type

Delay	=	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
Monostable	=	Activated the output for the time "Timer"

17.30.4.7 – Logical status

"User Trigger Oscillo" Logical status

17.30.5 – Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button

Select "User Variable"

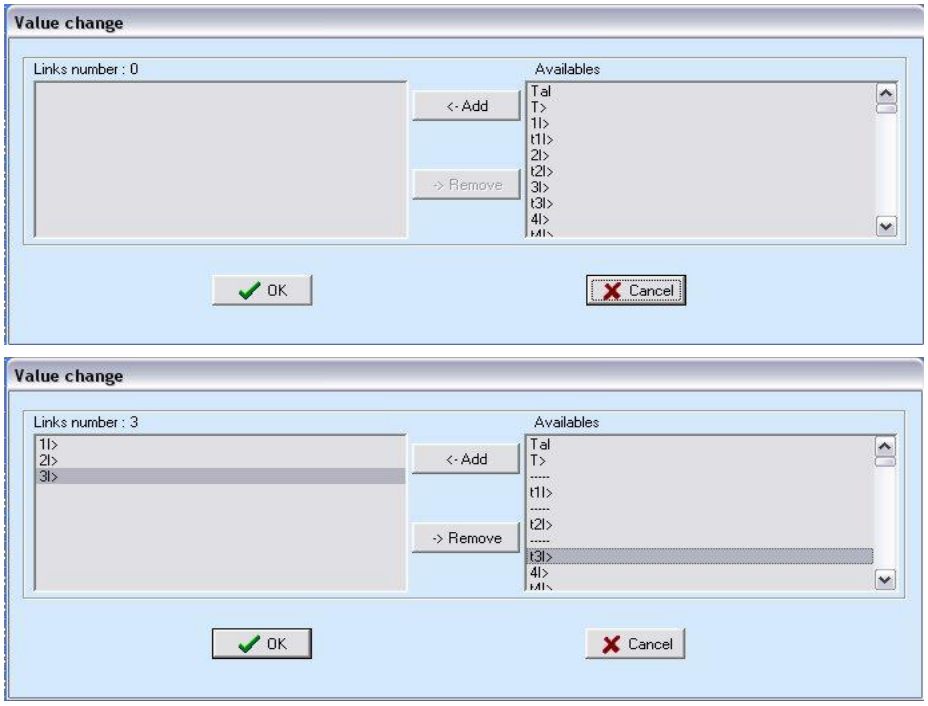
Setting for "User Trigger Oscillo" : "**1I>/2I>/3I>**", "**OR**", "**1**", "**Monostable**".

ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	UserTrigger Oscillo	UserTrigger Oscillo	1I>,2I>,3I>,	OR	1	Monostable	0
2	UserVar <0>	UserVar <0>		None	0	Delay	0

17.30.5.1 – "Linked Functions"

Select "**Linked Functions**" related to "User Trigger Oscillo" and press right button on mouse, select "Value change":

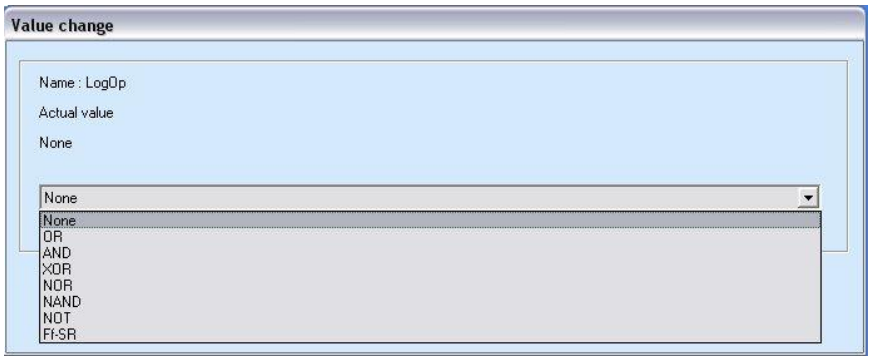
Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".



17.30.5.2 – "Operation Logic" (Oplogic)

Select "**Oper Logic**" related to "User Trigger Oscillo" and press right button on mouse, select "Value change":

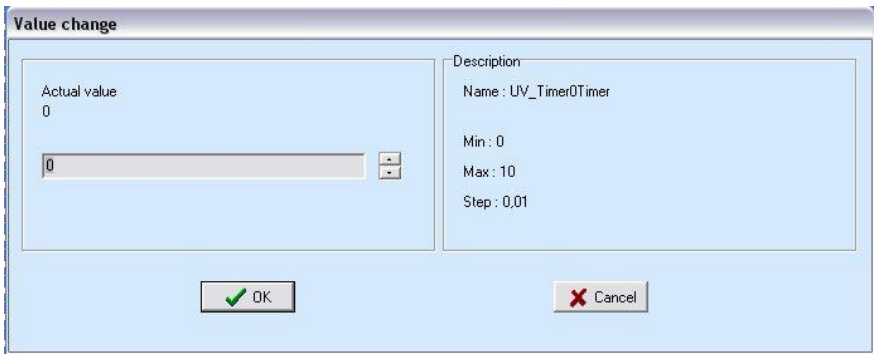
Insert "**OR**" into box and press "OK":



17.30.5.3 – "Timer"

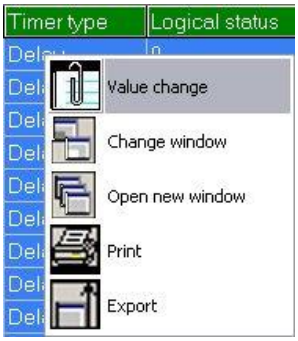
Select "**Timer**" related to "User Trigger Oscillo" and press right button on mouse, select "Value change":

Select "**1**" into box and press "OK":



17.30.5.4 – "Timer type"

Select "**Timer**" related to "User Trigger Oscillo" and press right button on mouse, select "Value change":



Select "**Monostable**" into box and press "OK":

*17.31 - Function: **L/R C/B Cmds** (Local Remote Close Breaker Command)*

This menu allows to configurate the command for C/B operation.

C/B Local command in Front Face panel

C/B Open control

C/B Close control

Options	→	**LocRm**	Disable		[Enable / Disable]			
	→	**LineT**	Disable		[Enable / Disable]			
	→	**Key**	Enable		[Enable / Disable]			
Timers	→	**tLRIn**	0.05	s	(0.05 ÷ 1.00)	step	0.05	s
	→	**tOpen**	1.00	s	(0.05 ÷ 2.00)	step	0.01	s

17.31.1 - Description of variables

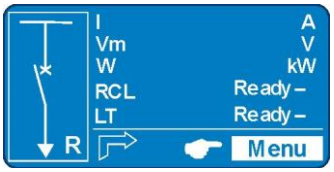
- **LocRm** : Enable/Disable [Local/Remote] Digital input.
- **LineT** : Line Test Enable/Disable
  If Enabled = Line Test will by started any time C/B Close control is activated.
- **Key** : Enable = The C/B can be controlled by the pushbuttons available on Relay's Front Face as well as by commands sent via the serial communication bus.
  Disable = The pushbuttons on Front Panel are disabled; the operation of the C/B can be controlled either by the serial bus commands or by (password protected) commands available in the menu "***Cmd***".

	C/B Open control.
	C/B Close control.

- **tLRIn** : Local/Remote inconsistent time.
- **tOpen** : C/B operation time-out.

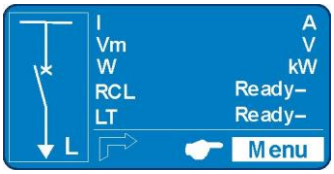
17.31.2 - Display

1



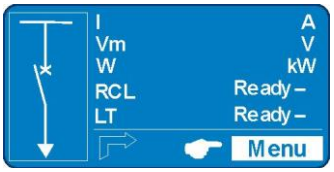
- "***R***" the control of C/B is in "Remote" mode

2



- "***L***" the control of C/B is in "Local" mode

3



- If the symbol "***R***" or "***L***" don't show up the relay is in discrepancy Local/Remote

*17.32 - Function: **CB-L** (CB Lock)*

This menu allows to configurate the command lock for C/B.

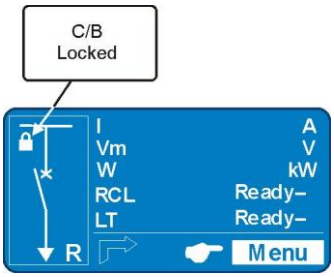
Options	→ **Lock**	Enable	[Enable / Disable]

17.32.1 - Description of variables

❑	**Lock**	:	Enable = Enabling of the close command lock-out. Disable = Disabling of the close command lock-out.

17.32.2 - Operation

If the variable "Lock" is set to "Enable", reclosing of the C/B is inhibited after a "Failed reclosure" or after a "Failed Line Test" (the symbol of a Locker appears an the display).
The reset from the Lock-out status can be operated either b the keyboard via the "CB Unlock" command available in the menu "Local Commands" (§ Local Commands) or by an external command via the Digital Input programmed for "Ext.Reset".



*17.33 - Function: **LT** (Automatic Line Test)*

Options	→ **TNum**	1		[0 / 1 / 2 / 3]			
	→ **Fast**	No		[No / Yes]			
	→ **Rem**	No		[No / Yes]			
Oper. Levels	→ **Vv<**	0.5	**Vn**	(0÷1.00)	step	0.1	Vn
	→ **Vm<**	0.5	**Vn**	(0÷1.00)	step	0.1	Vn
	→ **Rr<**	100	**Ω**	(0÷500)	step	1	Ω
	→ **VFast**	0.5	**Vn**	(0.5÷1.00)	step	0.1	Vn
Timers	→ **tp**	3	**s**	(0÷30)	step	1	s
	→ **tt**	3	**s**	(1÷10)	step	1	s
	→ **tcy**	10	**s**	(1÷60)	step	1	s
	→ **tw**	3	**s**	(0÷10)	step	1	s

17.33.1 - Description of variables

- **TNum** : Number of tests after an unsuccessful test.
- **Fast** : When set to “Yes” if the voltage measured during the set pre-closing time [tp] exceeds the set level [VFast], the C/B is closed immediately without the Line Test.
  If set “No” test is normally carried out.
- **Rem** : Remote line test; if “Yes” Line Test can be started by the logical output RCL

- **Vv<** : Voltage (after C/B) level to allow C/B closing.
- **Vm<** : Voltage (before C/B) level to allow C/B closing.
- **Rr<** : Minimum Residual Resistance level to allow C/B closing.
- **VFast** : Minimum Line Voltage level to allow C/B closing without Line Test.

- **tp** : Waiting time after C/B closing command request to start the line test cycle.
- **tt** : Duration of the Line Test.
- **tcy** : Wait time between two consecutive tests.
- **tw** : Wait time to start reclosing after success fine test.

17.33.2 - Operation

The Line Test is started by a request of Automatic Reclosure or Manual Closure of the C/B (see § "RCL" and § "L/R C/B Cmds").
It is also possible to start the Line Test by activating a Digital Input programmed for this purpose (see § Remote Line Test control).

Test is considered successful depending on “Vv<”, “Vm<”and “Rr<” measurement according to programming.

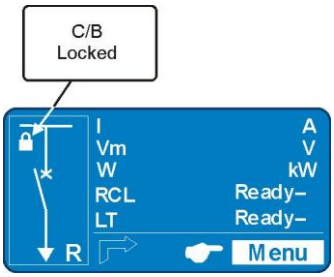
Setting			Test condition
Vm<	**Vv<**	**Rr<**	
>Vmin	> Vmin	≠0	Vv ≥ [Vv<] & Vm ≥ [Vm<] & Rr≥ [Rr<]
>Vmin	> Vmin	=0	Vv ≥ [Vv<] & Vm ≥ [Vm<]
<Vmin	< Vmin	NC	1 contactor shot

If the test was unsuccessful:

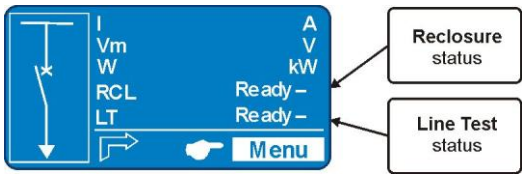
- If “Test N°=0” C/B reclosing blocked
- If “Test N°=1,2,3” The timer “tcy” is started and, at the end of “tcy” the test is repeated only 1 or 2 or three times before the C/B reclosing is blocked (if one of the tests is successful, “tw” is started and then the C/B closed).

17.33.3 - Visualization on main Display

If the variable "Lock" (§ CB-L) is set to "Enable", reclosing of the C/B is inhibited after a "Failed reclosure" or after a "Failed Line Test" (the symbol of a Locker appears an the display).
The reset from the Lock-out status can be operated either b the keyboard via the "CB Unlock" command available in the menu "Local Commands" (§ Local Commands) or by an external command via the Digital Input programmed for "Ext.Reset".



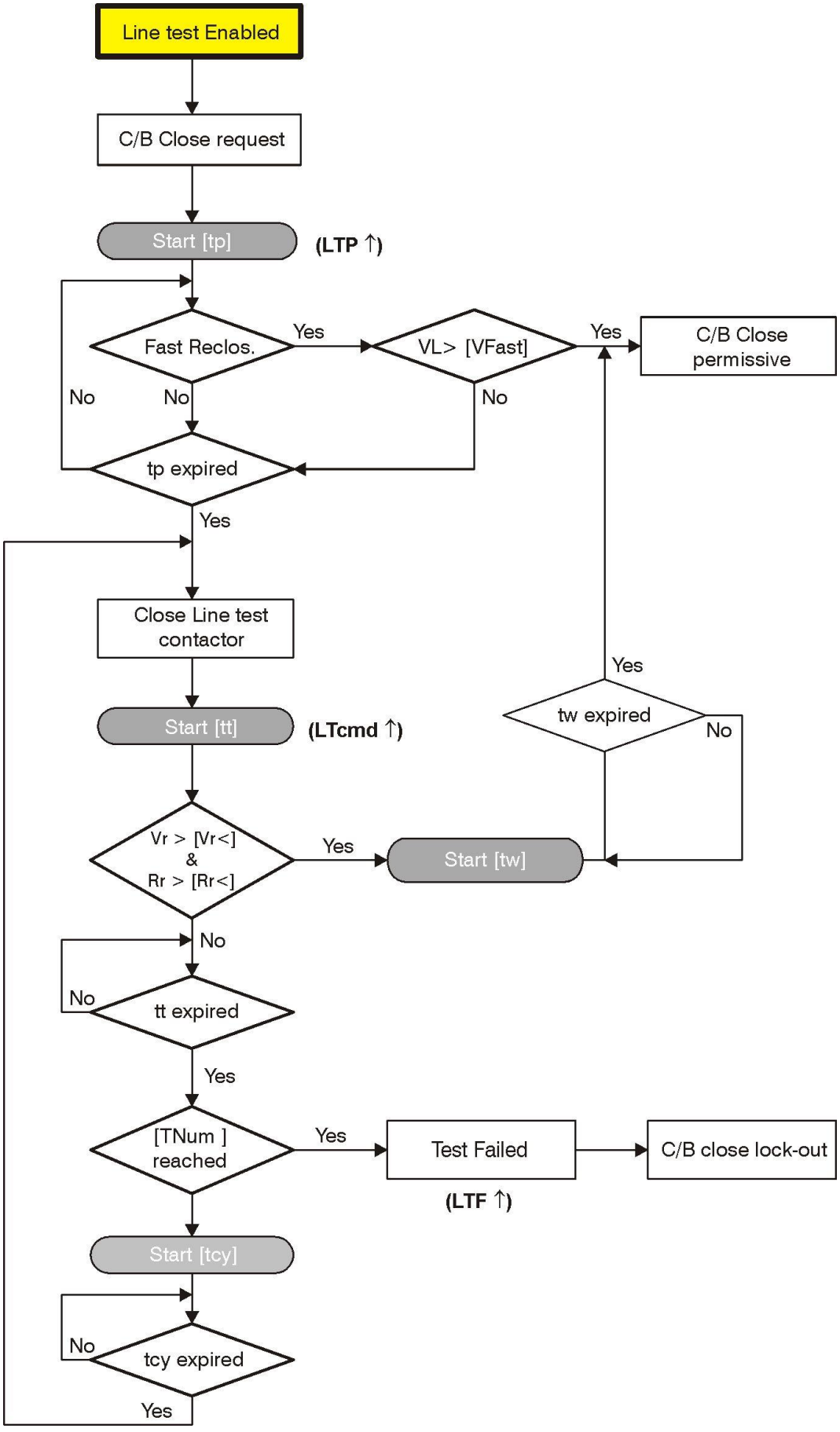
17.33.4 - Display status indication



Display of Line Test status

- **Standby** Line Test in standby
- **Ready** Line Test Ready
- **Fail** Line test failure

17.33.5 - Flow chart



*17.34 - Function: **ExtResCfg** (External Reset Configuration)*

This menu allows to select the edge polarity of the signal on the digital input configured to reset the relay after a trip (see input ExtReset).
The reset input will reset all the output relays configured as manual reset (latched), the signalisation of the trip on the display and the indication of the LED are cleared also.

Options	→ **ActOn**	RiseEdge	[RiseEdge / FallEdge]

17.34.1 - Description of variables

- **ActOn** : RiseEdge Active on Rise Edge (Digital Input close).
  FallEdge Active on Fall Edge (Digital Input open).

18. Input – Output (via software MSCom2)

The firmware can manage up to 32 digital inputs and 20 output relays; among these, 4 digital inputs and 6 output relays are available on the relay module, the remaining are available on additional expansion modules controlled via the CAN-Bus communication channel:

14DI	Module		=	14 Digital Inputs
14DO	Module		=	14 Outputs Relay
UX10-4	Module		=	10 Digital Inputs and 4 Outputs Relay

The interfacing software “MSCom 2” also allows to program the operation of the output relays (Physical Output), and Digital Inputs (see MSCom2 Manual).

18.1 – Digital Input

→ **0.D1**	Programmable (D1)	When the relevant terminals are open and get activated when the relevant terminals are shorted by an external cold contact.	*Available in the relay*
→ **0.D2**	Programmable (D2)		
→ **0.D3**	Programmable (D3)		
→ **0.D4**	Programmable (D4)	Reserved - dont use	
→ **1.D1** → **1.D--** → **1.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board*	Any digital input of the expansion modules is active when the relevant terminals (see wiring diagram) are shorted.
→ **2.D1** → **2.D--** → **2.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board*	

18.2 – “DI” Configuration (via MSCom2 software)

Any of the Digital Inputs can be programmed to control one or more of the following functions.

Bi1I>	Blocking input to the	1I>
Bi2I>	Blocking input to the	2I>
Bi3I>	Blocking input to the	3I>
Bi4I>	Blocking input to the	4I>
BiRCL	Reclosure lock-out	RCL
Bi1U<	Blocking input to the	1U<
Bi2U<	Blocking input to the	2U<
LT-Disable	Line test disable	
C/B	Indication of the Open/Close status of the C/B	
RT	First element Remote Trip	
RTX	Second element Remote Trip	
ExtTrgOsc	External Trigger of the Oscillo. Recording.	
Local	Local C/B Command	
Remote	Remote C/B Command	
OpenCB	Open C/B Command	
CloseCB	Close C/B Command	
Rem LT	Remote line test request	
ExtReset	External Reset	
Group 1-2	Selection of the setting Group 1 or 2.	

18.3 – Example

ID	Name	Status	OpLogic	Functions
1	Bi1I>	Not active	None	

18.3.1 – Name

Logical Input name

18.3.2 – Status

Logical Input status

18.3.3 – OpLogic

Not Used

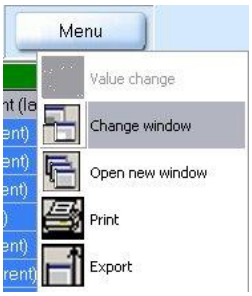
18.3.4 – Functions

Selection function

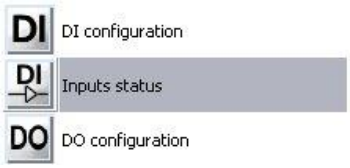
18.4 - Example: Setting "Digital Input"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "DI configuration"



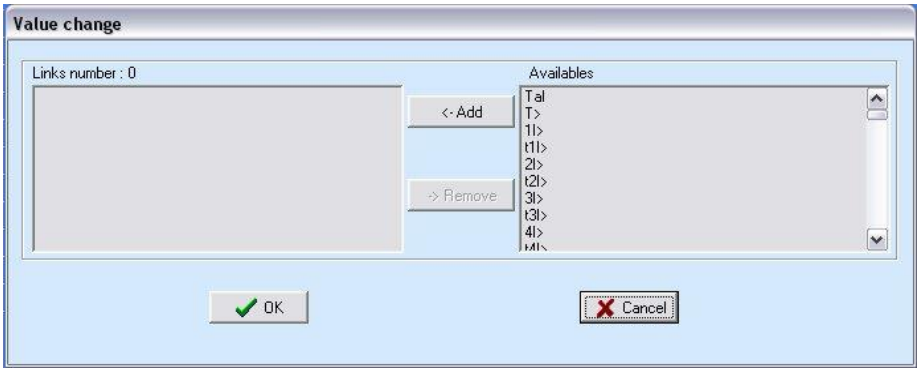
Setting for "**Bi1I>**" : "**1I>**".

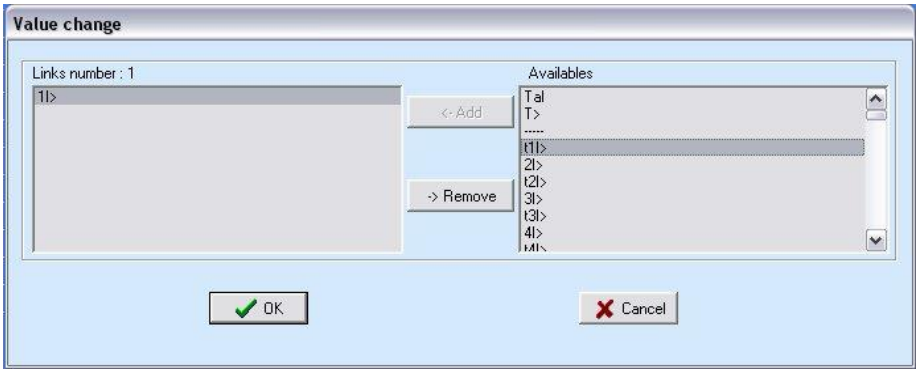
ID	Name	Status	OpLogic	Functions
1	Bi1I>	Not active	None	1I>

18.4.1 - "Functions"

Select "**Functions**" related to "Bi1I>" and press right button on mouse, select "Value change":

From box "Available", select "1I>" and press "Add".
Press "OK" for confirmation. (if Password is request, see § Password)





18.5 – Outputs Relay

The output relay are fully user programmable and controlled by any protection functions and by any digital inputs.

→	**0.R1**	Programmable (R1)	*Available in the relay*
→	**0.R2**	Programmable (R2)	
→	**0.R3**	Programmable (R3)	
→	**0.R4**	Programmable (R4)	
→	**0.R5**	Programmable (R5)	
→	**0.R6**	Programmable (R6)	
→	**1.R1**	Programmable	*Output Relays on Expansion Board*
→	**1.R--**		
→	**1.R14**		

18.6 - "DO" Configuration

Any Output Relay can be programmed to be controlled (energized) by one or more of the following functions or Digital Inputs:

T>	**Tal** **T>**	Alarm Trip	Thermal
1I>	**1I>** **t1I>**	Start Trip	First overcurrent element
2I>	**2I>** **t2I>**	Start Trip	Second overcurrent element
3>	**3I>** **t3I>**	Start Trip	Third overcurrent element
4I>	**4I>** **t4I>**	Start Trip	Fourth overcurrent element
1dI	**1dI** **t1dI**	Start Trip	First Current step element
2dI	**2dI** **t2dI**	Start Trip	Second Current step element
1di/dt	**1di/dt** **t1di/dt**	Start Trip	First Current rate of rise element
2di/dt	**2di/dt** **t2di/dt**	Start Trip	Second Current rate of rise element
Rapp	**Rapp**	Trip	Impedance monitoring – di/dt dependence
Iapp	**Iapp**		Current monitoring with di/dt dependence
1Ig	**1Ig** **t1Ig**	Start Trip	First Frame Fault element

2Ig	**2Ig** **t2Ig**	Start Trip	Second Frame Fault element	
RCL	**RCL cmd** **ARP** **ARF** **ARL**	Trip	Reclosure Shot command Autoreclosure in progress Autoreclosure Failure Autoreclosure Lock-out	
1U>	**1U>** **t1U>**	Start Trip	First overvoltage element	
2U>	**2U>** **t2U>**	Start Trip	Second overvoltage element	
1U<	**1U<** **t1U<**	Start Trip	First undervoltage element	
2U<	**2U<** **t2U<**	Start Trip	Second undervoltage element	
Wi	**tWi>**		Circuit breaker maintenance level	
TCS	**tTCS**	Trip	Time delayed Trip Circuit Supervision	
IRF	**IRF** **tIRF**	Start Trip	Internal relay Fault	
RT	**RT** **tRT**	Start Trip	First Remote Trip	
RTX	**RTX** **tRTX**	Start Trip	Second Remote Trip	
CB-L	**CB-L**		C/B reclose Lock-out	
BF	**BF**		Breaker Failure	
Wh	**+ Wh** **- Wh**		Imported Energy counter Pulse Exported Energy counter Pulse	
L/R CB Cmds	**Open C/B** **Close C/B** **LocRem Inc** **missCBOpe**		Open C/B command Close C/B command Local / Remote Inconsistency Missed C/B opening (Digital input missing)	
LT	**LTPb** **LTP** **LTF** **LT cmd**	 Trip	Output to operate an external flashing lamp signalling line test in progress Line Test in progress Line Test Failed Line Test command	
	Gen.Start **Gen.Trip**		General start General Trip	
	0.D1 **0.D1Not** to **0.D4** **0.D4Not**	*Digital Input "0.D1"* *Digital Input "0.D1"* *Digital Input "0.D4"* *Digital Input "0.D4"*	*activated* *deactivated* *activated* *deactivated*	*Digital Input on Main Relay*
	1.D1 **1.D1Not** to **1.D15** **1.D15Not**	*Digital Input "1.D1"* *Digital Input "1.D1"* *Digital Input "1.D15"* *Digital Input "1.D15"*	*activated* *deactivated* *activated* *deactivated*	*Digital input on Expansion Board*
	2.D1 **2.D1Not** to **2.D15** **2.D15Not**	*Digital Input "2.D1"* *Digital Input "2.D1"* *Digital Input "2.D15"* *Digital Input "2.D15"*	*activated* *deactivated* *activated* *deactivated*	*Digital input on Expansion Board*

18.7 - Example

ID	Relay	Linked functions	OpLogic	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]		None	Off	Normally open	Pulse	0,01	Off
2	0.R2 [Master board, R:2]		None	Off	Normally open	Pulse	0,01	Off

18.7.1 - Relay

Relay internal name

18.7.2 - Linked function

Select the function for tripping the output relay (for multiple association use “User Variable”)

18.7.3 - Operation Logic

Not Used

18.7.4 - Logical Status

Relay Logical status

18.7.5 - Output Configuration

Normally Deenergized	The output relay is deenergized in normal conditions and gets energized on activation of the controlling Functional Output; reset means deenergizing.
Normally Energized	The output relay is energized in normal conditions and gets deenergized on activation of the controlling Functional Output; reset means energizing.

18.7.6 - tON - Operation Time

This timer controls the duration of the activation of the output relay.

tON : 0 (0.01-10)s, step 0.01s

18.7.7 - Relay Status

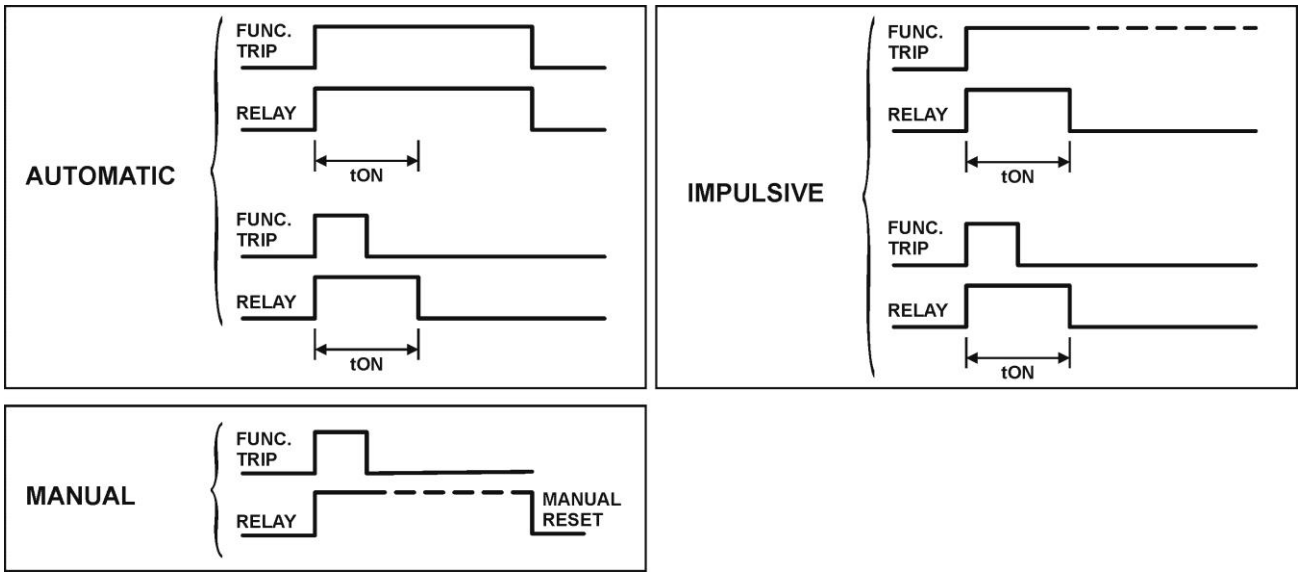
Relay – Physical status

18.8 - Functions - Operation Mode

Automatic : In this mode the output relay is “operated” (energized if “N.D.”, deenergized if “N.E.”) when the controlling Functional Output is activated and it is reset to the “non operated” condition when the Functional Output gets disactivated but, anyhow, not before the time “tON” has elapsed (minimum duration of the operation time)

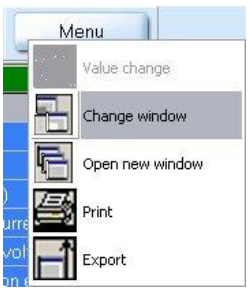
Manual : In this mode the output relay is “operated” when the controlling Functional Output is activated and remains in the operated condition until a manual reset command is issued by the relay keyboard (local commands menu) or via the serial communication. In this mode the timer “tON” has no effect.

Impulsive : In this mode the output relay is “operated” when the controlling Functional Output is activated and it remains in the “operated” condition (energized if “N.D.”, deenergized if “N.E.”) for the set time “tON” independently from the status of the controlling Functional Output.

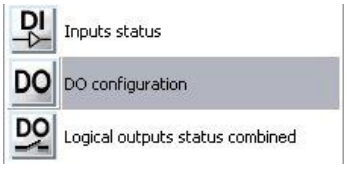


Open “MSCom2” program and connect to the relay.

Select “Change Windows” from “Menu” button



Select “DO Configuration”



18.9 - Example: Change settings for "0.R1"

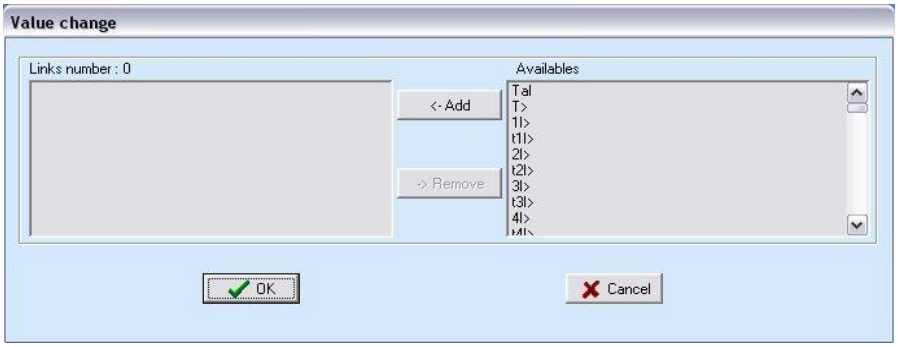
Change settings for "**0.R1**" : "1I>", "Normally Close", "Pulse", "0.5".

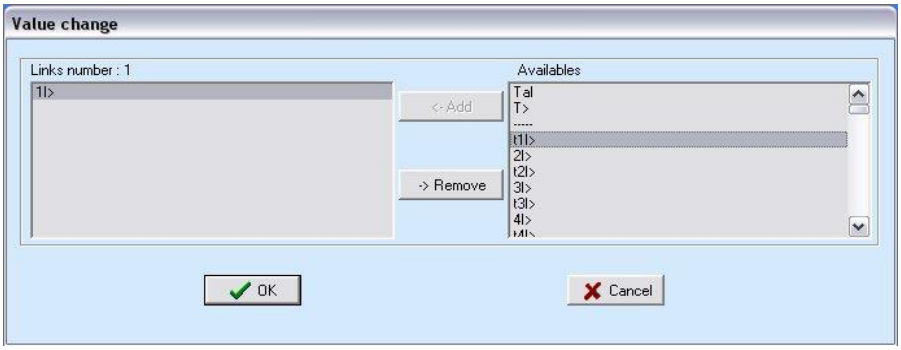
ID	Relay	Linked functions	OpLogic	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]	1I>,	None	Off	Normally close	Pulse	0,5	Off
2	0.R2 [Master board, R:2]		None	Off	Normally open	Pulse	0,01	Off

18.9.1 - "Linked Functions"

Select "**Linked Functions**" related to "0.R1" and press right button on mouse, select "Value change":

From box "Available", select "1I>" and press "Add".
Press "OK" for confirmation. (if Password is request, see § Password)

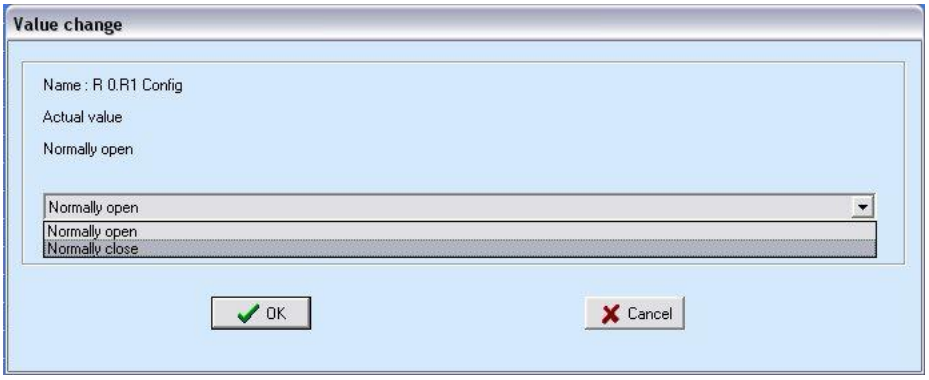




18.9.2 - "Output Config"

Select "**Output Config**" related to "0.R1" and press right button on mouse, select "Value change":

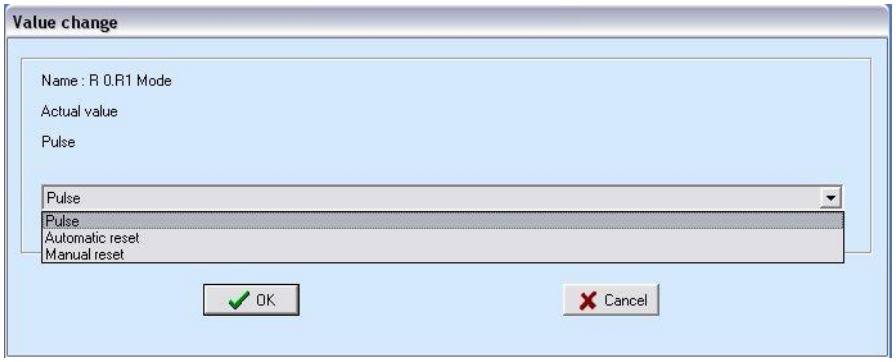
Select "**Normally Close**" from combo box and press "OK" (if Password is request, see § Password)



18.9.3 - "Function"

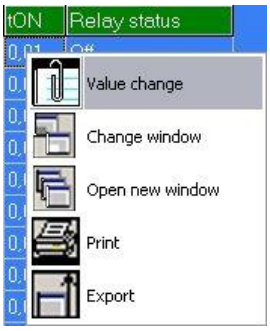
Select "**Function**" related to "0.R1" and press right button on mouse, select "Value change":

Select "**Pulse**" from combo box and press "OK" (if Password is request, see § Password):

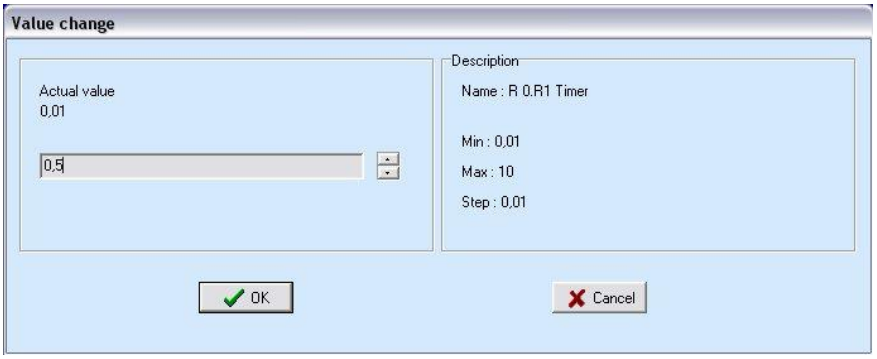


18.9.4 - "tON"

Select "**tON**" related to "0.R1" and press right button on mouse, select "Value change":



Select "**0.5**" from combo box and press "OK" (if Password is request, see § Password):



19. InfoSts (Info Status)

In this menu is showed the status of relay

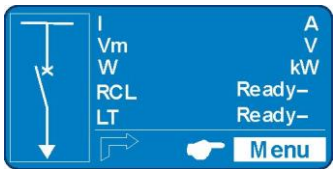
Options			
	→	LocRm	Disable
	→	RCL	Ready
	→	LT	Ready

- **LocRm** : Local / Remote / Discrepancy Status
- **RCL** : Reclosure Status
- **LT** : Automatic Line Test Status

20. Osc. (Oscillographic Recording)

This menu contains the status of the oscillographic recording.

1



- Press "***Menu***" for access to the main menu with icons.

2

- Select icon "***Record***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3

- "*Available*" – Indicates the available number of oscillographic records.
- "*Stored*" – Indicates number of records already stored.
- "*RecTotalTime*" – Indicates the total available recording time.

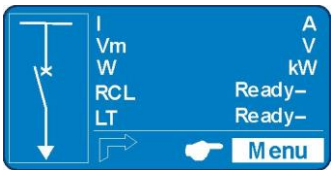
The oscillographic recording can be downloaded from the RS232 port on Relay's front face or from the main RS485 serial port using the communication protocol Modbus RTU and the application software "MSCom 2".
Using the protocol "IEC870-5-103" the recording can be downloaded from the RS485 serial port with the relevant procedure of the IEC protocol itself.

21. Date and Time

In this menu it is possible to configurate the Date and Time

Date:	20YY	/	MM	/	DD	(2000/01/01 ÷ 2099/12/31) YY = Year / MM = Month / DD = Day
Time:	HH	:	MM	:	00	HH = hour / MM = Minutes / 00
DofW:	Day					Es: Wednesday

1



- Press "***Menu***" for access to the main menu with icons.

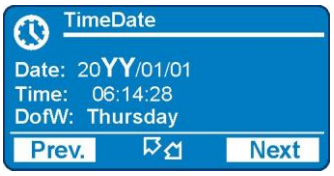
2

- Select icon "***TimeDate***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3

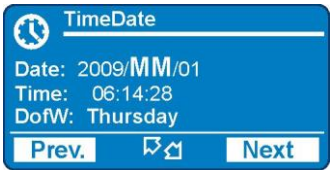
- Press "***Modify***".

4



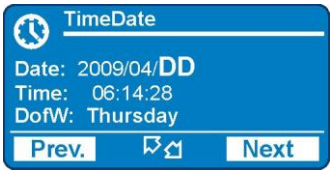
- The last two figures of the Year will appear in bold character; by pushbuttons "***Increase***" or "***Decrease***" set the new figures.
- Press "***Next***" to go to the next setting.

5



- As above for changing the "Month"
- Press "***Next***" to go to the next setting.

6

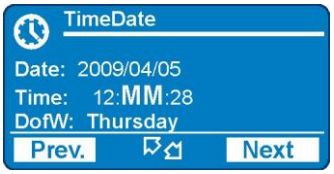


- As above for changing the "Day"
- Press "***Next***" to go to the next setting.

7

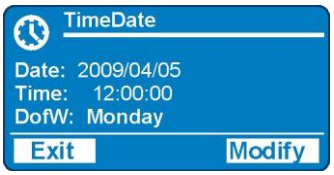
- As above for changing the “Hours”
- Press “***Next***” to go to the next setting.

8



- As above for changing the “Minutes”
- Press “***Next***” to go to the next setting.

9



- The **D**ay **of** the **W**eek is calculated and displayed automatically.
- Press “***Exit***” to go back to the main menu.
- Press “***Modify***” to go back to the step “3”

Press the button “***Next***” to go back to the previous display.

21.1- Clock synchronization

The internal clock has 1ms resolution and a stability of ±35ppm in the operational temperature range.

It can be synchronized with an external time reference in the following ways:

- Using the standard “Time Synchronization” procedure of the “IEC870-5-103” protocol.
- Using the “MSCom II” software or from the DCS with the Modbus RTU protocol.

Note: On power supply failure an internal battery supports the internal clock for over two years.

22. Healthy (Diagnostic Information)

The relay operates a continuous checking of the vital functionalities and in case an internal failure is detected, the I.R.F. function (see § I.R.F.) is activated and the Power/IRF led is set to flashing.

Device	→	**No Fail**	→	No Fail
		Fail	→	Fail present
		MinorFail	→	Minor Fail
		HisoricalFail	→	Cleared Fail
		FW not comp.	→	Firmware not compatible

If an internal self-clearing (transient) fault is detected, it is recorded into an historical file without any other action.

23. Info (Info Device)

In this menu it is possible to read the information relevant to relay unit.

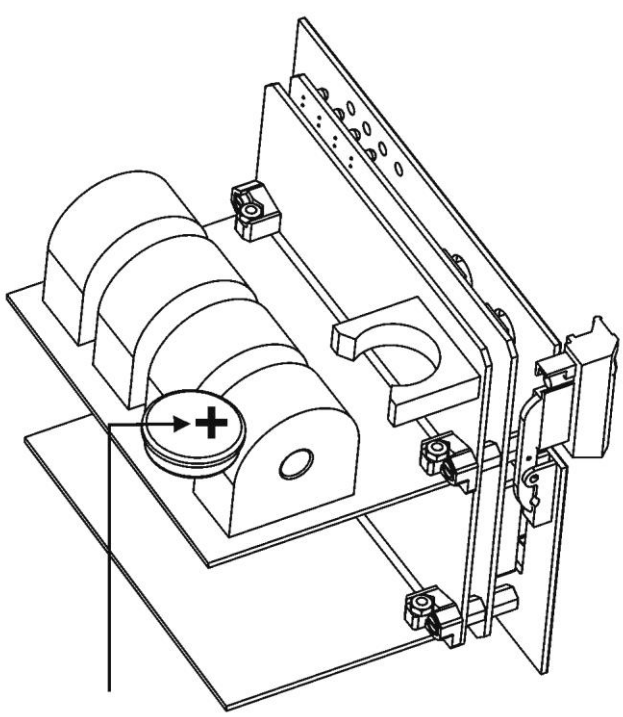
SW Version	**AcqUnit-I/O**	→	####.##.##.#	Firmware version of acquisition unit
	ProtectUnit	→	####.##.##.#	Firmware version of CPU unit
Protect.Model		→	##############	Protection Type
Serial Number		→	###/##/##/####	Relay Serial Number
User Tag		→	U-MLEs-PLv	Relay identification label. This information can only be modified by the interface program “MSCom 2” and allows the user to give to the relay any suitable denomination.
Build		→	##############	Build identification label.
Line		→	##############	Line identification label.

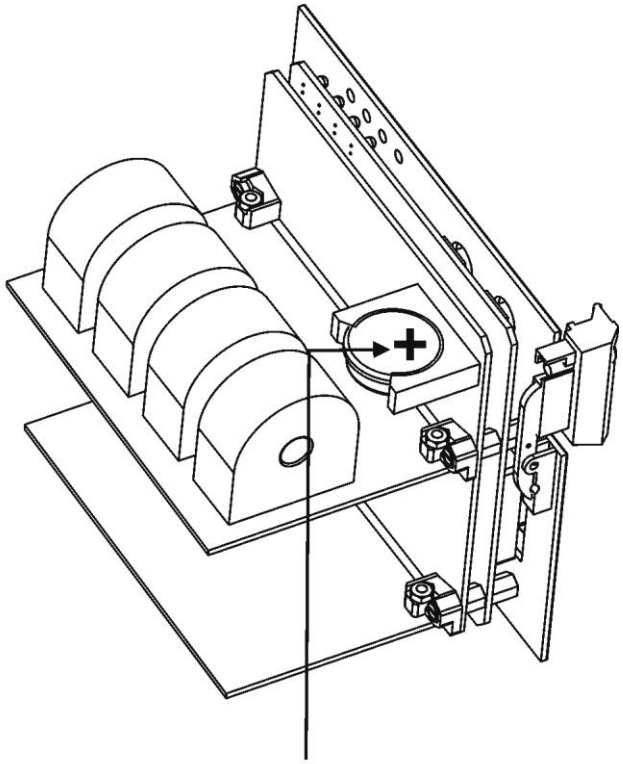
24. Battery

The relay is equipped with a lithium battery type “CR2477N 3V”, to support the internal clock and the oscillographic recording memory in case of programmed lack of power.
The expected minimum duration without power exceed 2 years.

Attention!! Use only battery specified.

Instruction for replacement the battery:





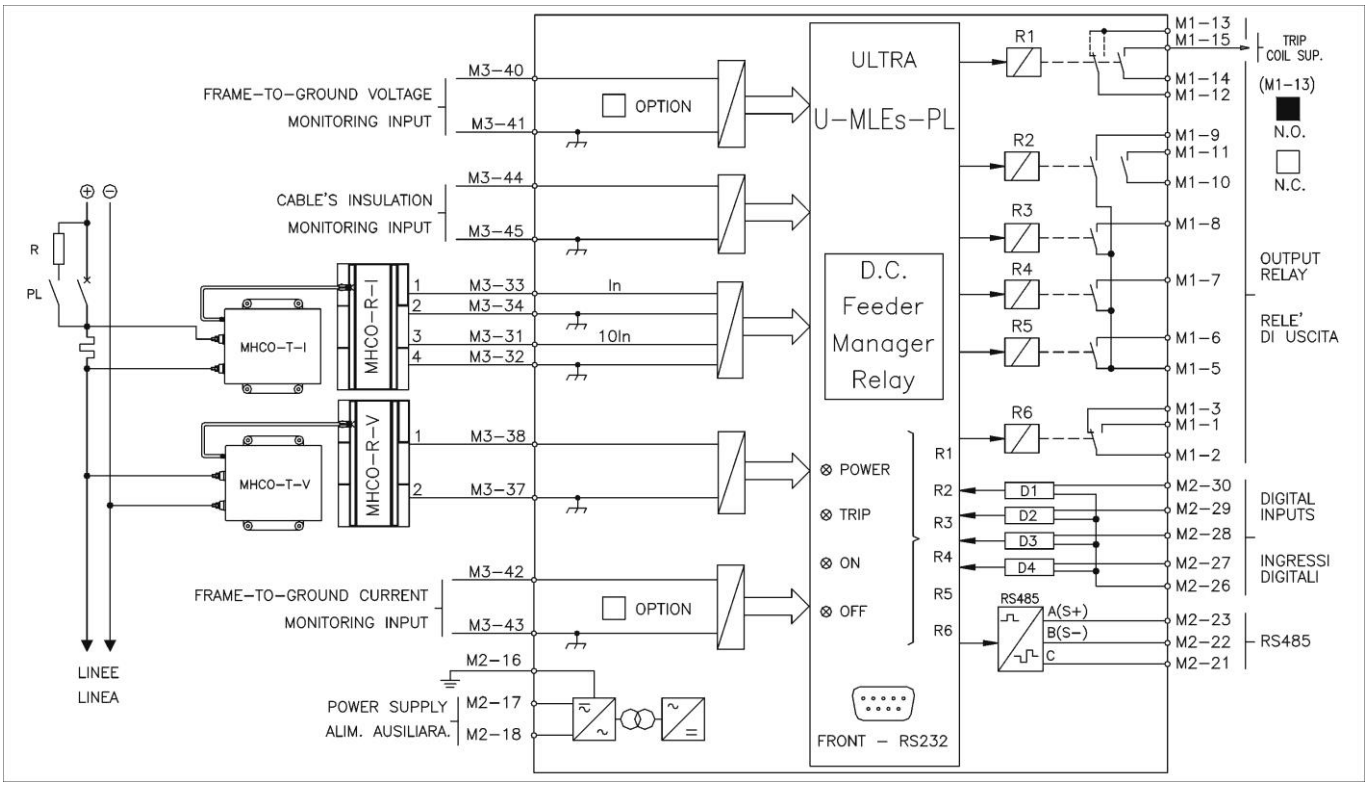
25. Maintenance

No maintenance is required. In case of malfunctioning please contact Microelettrica Scientifica Service or the local Authorized Dealer mentioning the relay's Serial No reported in the label on relays enclosure.

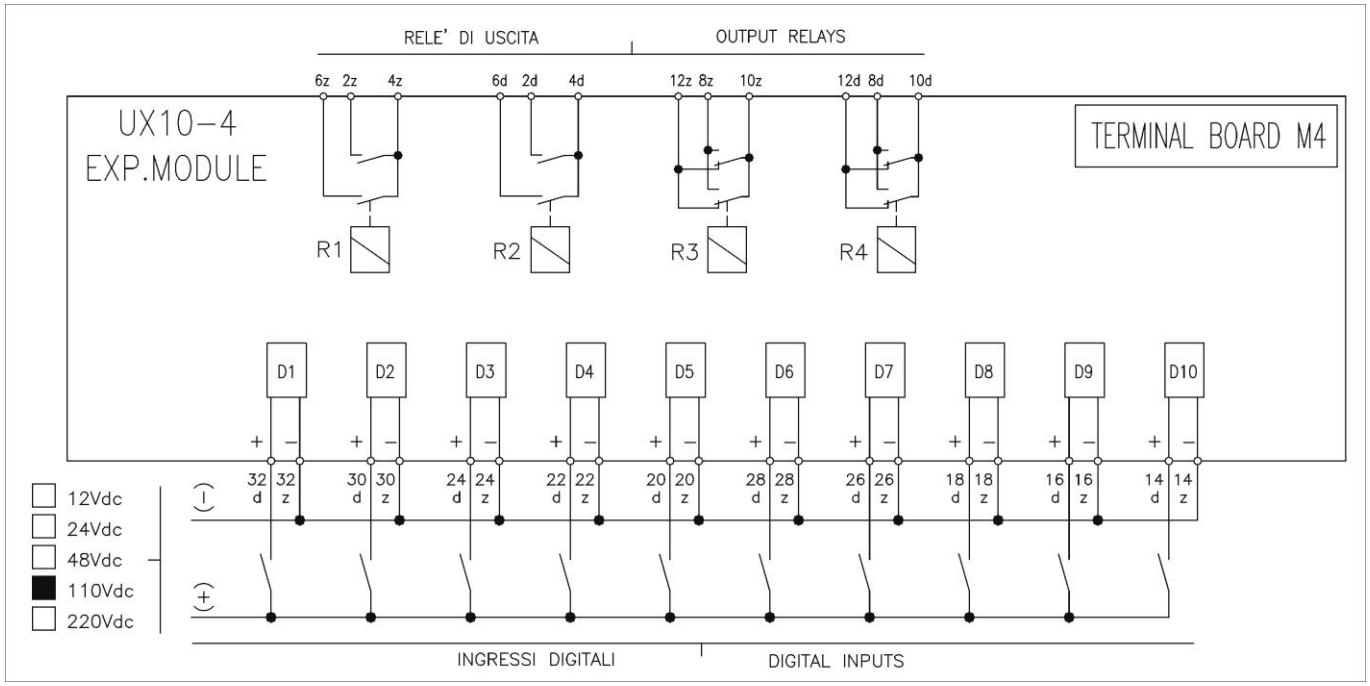
26. Power Frequency Insulation Test

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.

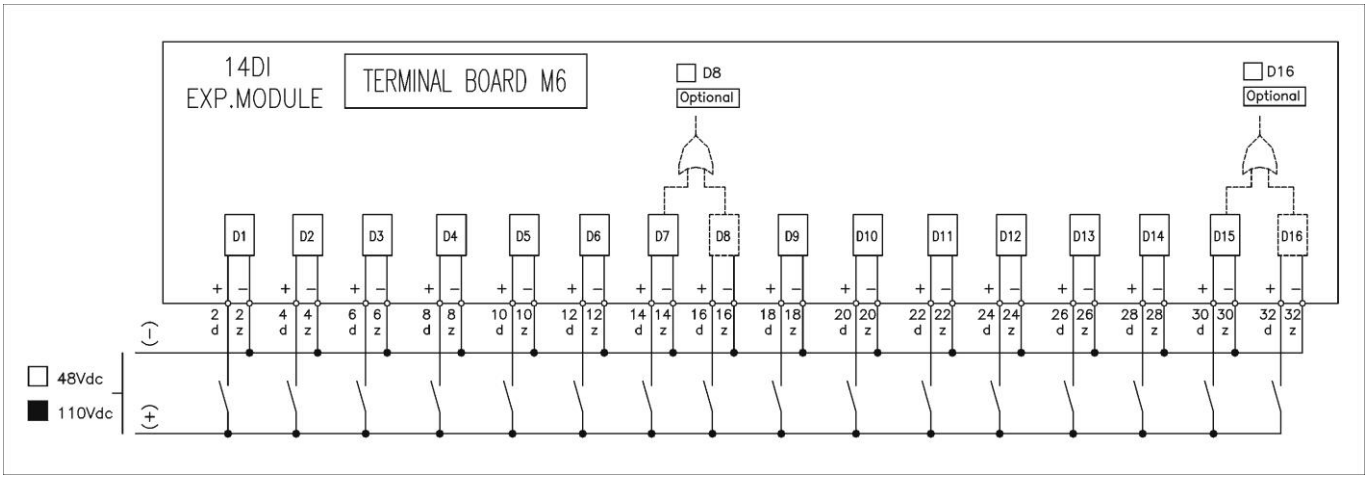
27. Wiring Diagram



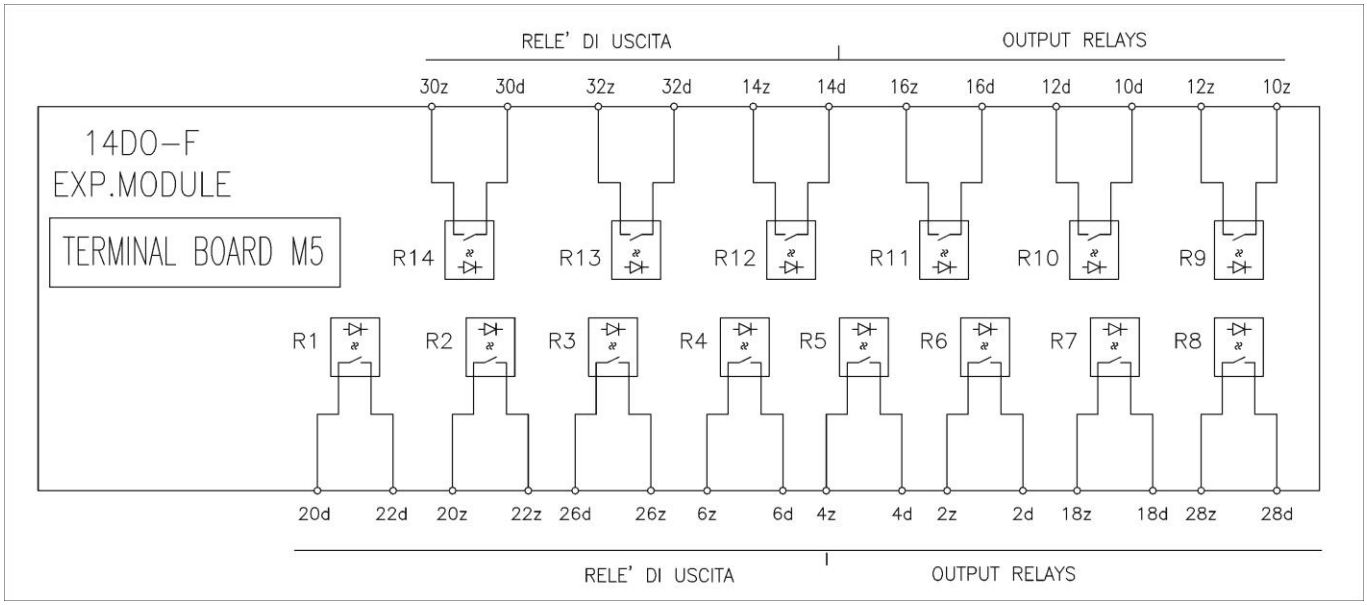
*27.2 - **UX10-4** - Wiring Diagram (10 Digital Inputs + 4 Output Relays)*



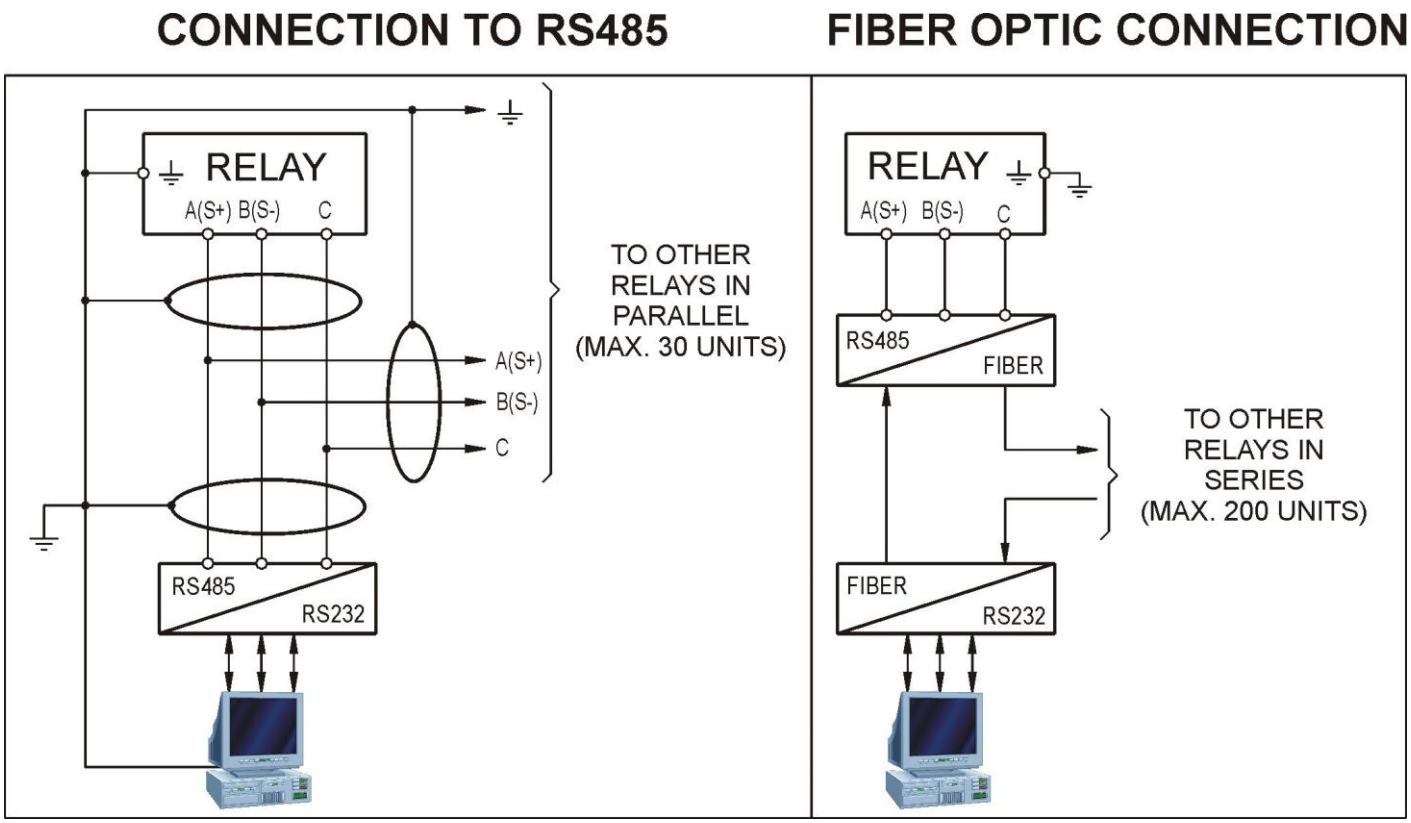
*27.3 – **UX14-DI** - Wiring Diagram (14 Digital Inputs)*



*27.4 –**14DO** - Wiring Diagram (14 Output Relays)*

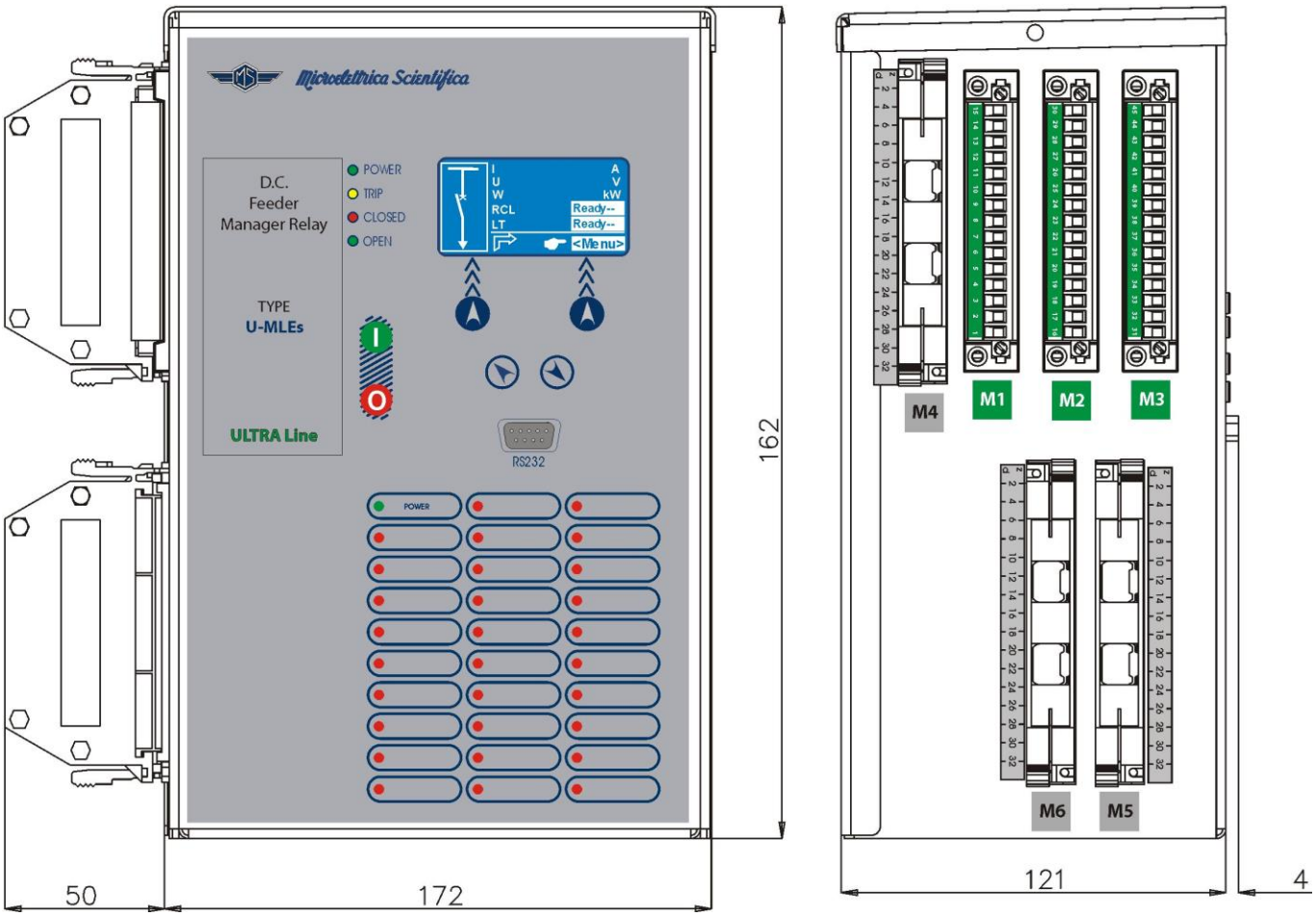


28. Wiring the Serial Communication Bus



Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCom2) for Windows 9x/2000/XP (or later) is available.
Please refer to the MSCom2 instruction manual for more information.
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).

29. Overall Dimensions



30. 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) (Dry heat) (Change of temperature) (Damp heat, steady state)	IEC60068-2-1 IEC60068-2-2 IEC60068-2-14 IEC60068-2-78	RH 93% Without Condensing AT 40°C	
CE EMC Compatibility (EN61000-6-2 - EN61000-6-4 - EN50263)					
❑	Electromagnetic emission		EN55011	industrial environment	
❑	Radiated electromagnetic field immunity test		IEC61000-4-3 ENV50204	level 3	80-2000MHz 10V/m 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		
CARACTERISTICS					
❑	Accuracy at reference value of influencing factors		1% In 2% + to (to=20÷30ms @ 2xIs)		for measure for times
❑	Rated Current Rated Voltage		0 - ±20mA (±40) ≡ 0 – In (2In) 0 - 20mA (40) ≡ 0 – Vn (2Vn)		
❑	Average power supply consumption		< 10 VA		
❑	Output relays		rating 5 A; Vn = 380 V A.C. resistive switching = 1100W (380V max) make = 30 A (peak) 0,5 sec. break = 0.3 A, 110 Vcc, L/R = 40 ms (100.000 op.)		

COMMUNICATION PARAMETER

❑	Rear serial port	RS485 – 9600 to 38400 bps – 8,n,1 – Modbus RTU – IEC60870-5-103
❑	Front serial port	RS232 – 9600 to 57600 bps – 8,n,1 – Modbus RTU

31. Software & Firmware Version

Firmware for version

IAU (Intelligent Acquisition Unit)	023.01.X
IPU (Processor Unit)	0380.23.01.X

Application Software

MSCom 2	1.03.28 or later

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