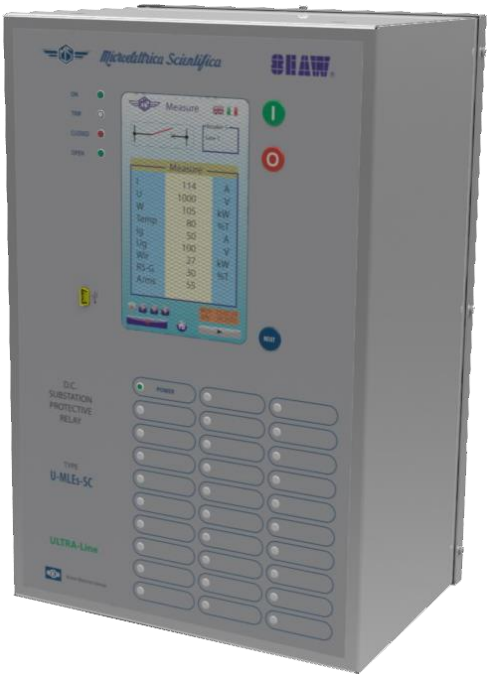
D.C. SUBSTATION PROTECTIVE RELAY

TYPE

U-MLEs-SC

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.

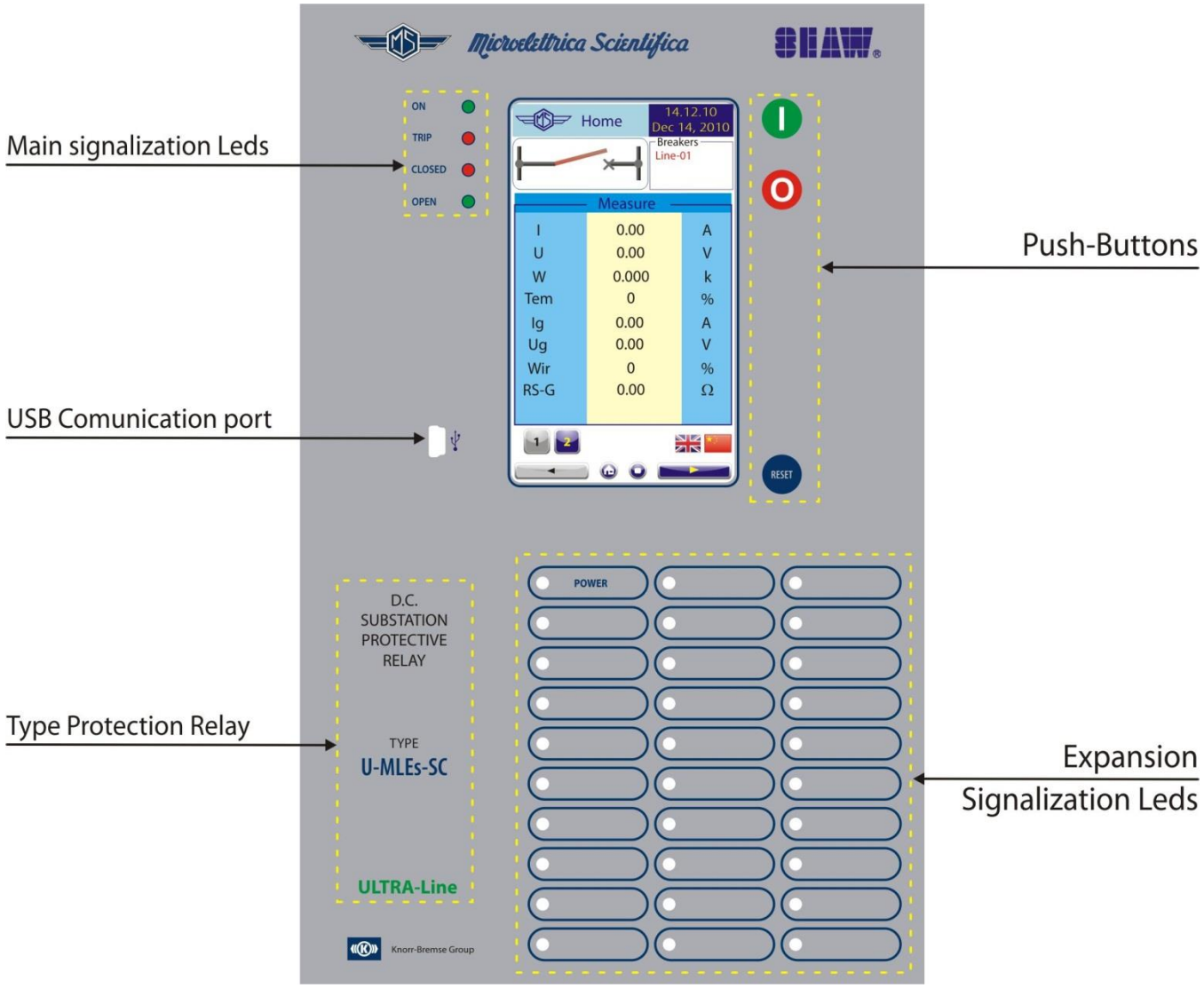
2.1 - Power Supply

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

Type 1) - { 24V(-20%) / 110V(+15%) a.c.
24V(-20%) / 125V(+20%) d.c.

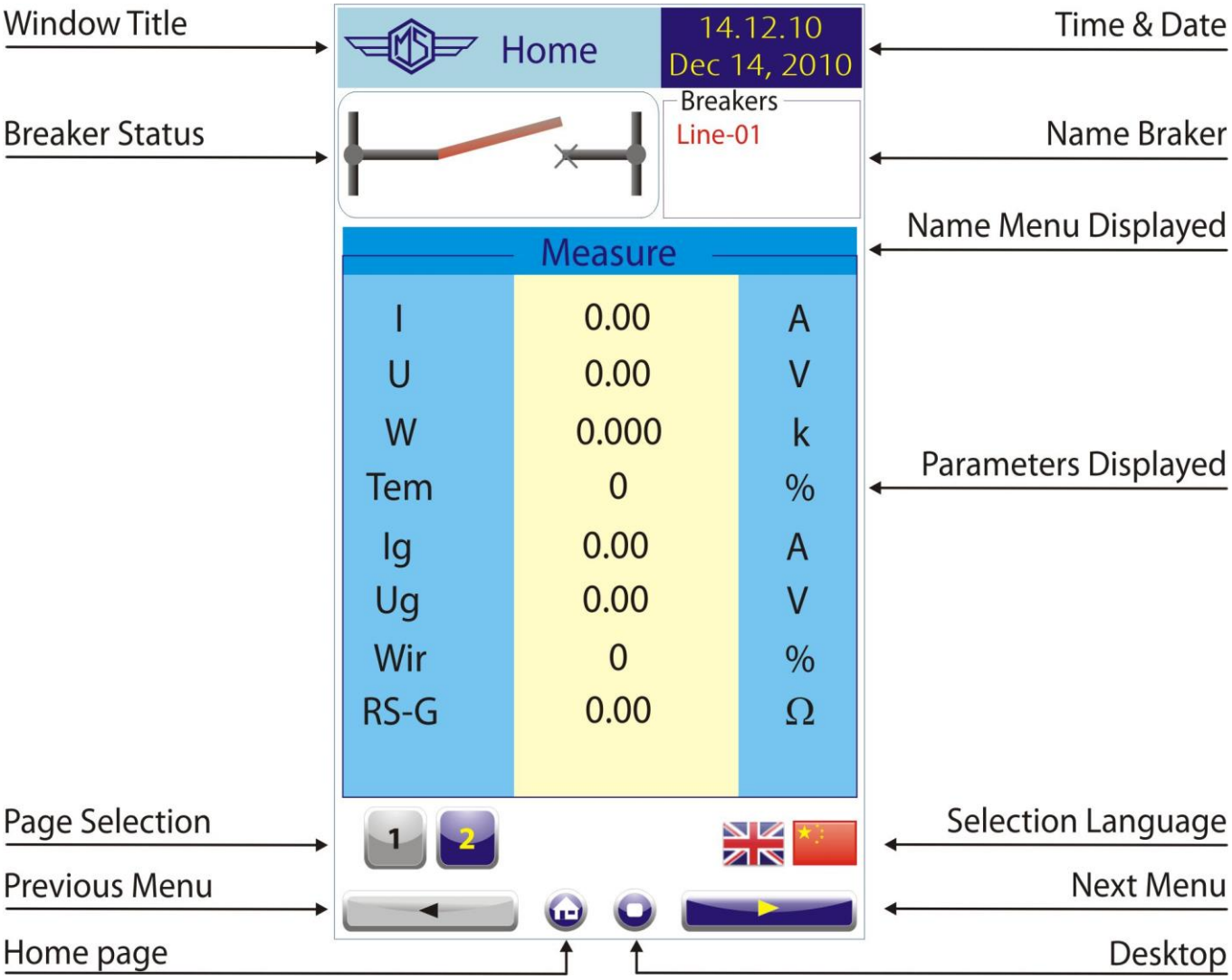
Before energizing the unit check that supply voltage is within the allowed limits.

3. Front Panel



4. Keyboard and Display

The 480x272 pixel LCD Touch display the available information (menu, etc.).



C/B Close control.

C/B Open control.

RESET Reset

5. Icons of Main Menu (Desktop)

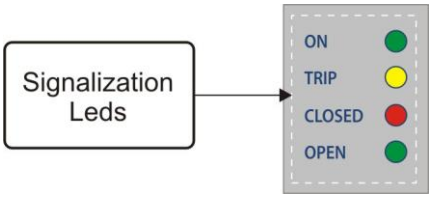
	**Commands**	Local Commands
	**Energy**	Energy Measurements
	**Last Trip**	Last Trip
	**Counter**	Partial Counters (Resettable Counter)
	**Readonly Cnt**	Total Counter (Read Only Counter)
	**Events**	Event Recording
	**Settings**	Function Settings
	**Systems**	System Settings
	**Healthy**	Diagnostic Information
	**Info**	General Info
	**SW Version**	Software version
	**Display Cal**	Display Calibration

Page 1

Page 2

6. Signalization

Four signal leds are provided:



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

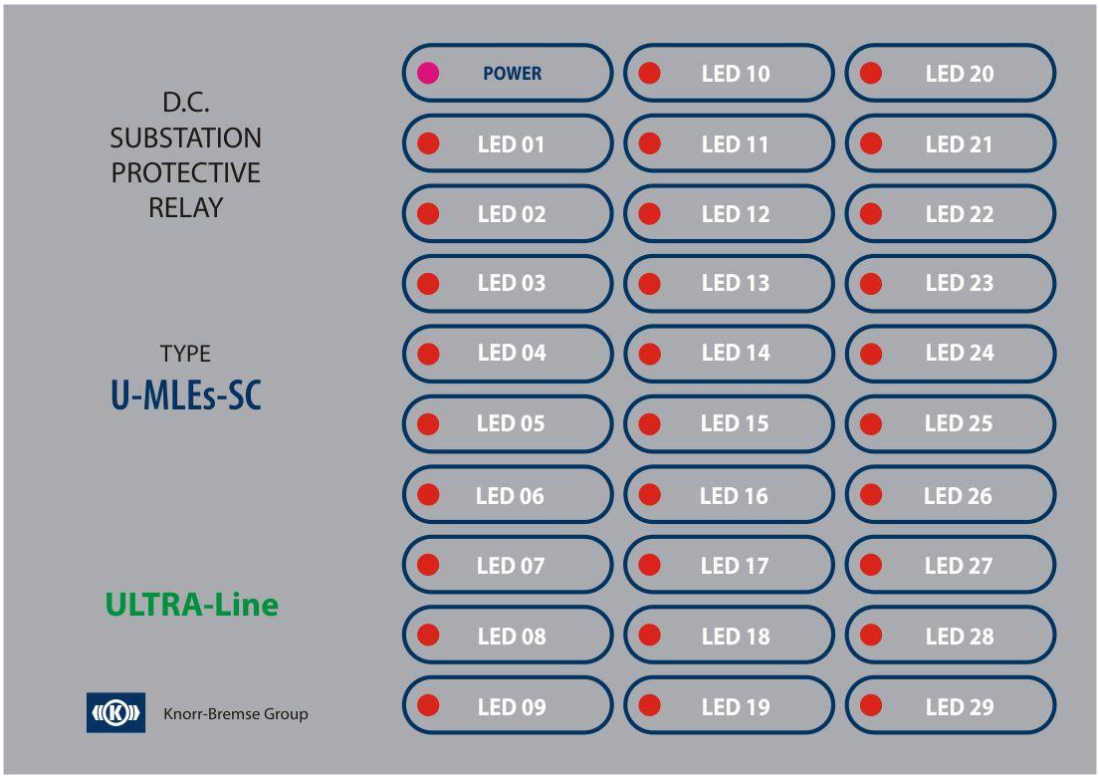
Both Flashing

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.

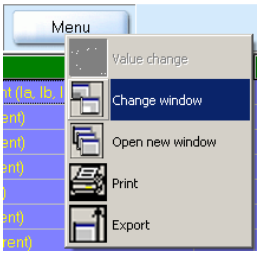
7. Signalization Module

The firmware can manage up to 33 signal leds, 4 led are available on the main relay module, the remaining are available on additional expansion modules (1 “Power” (green), 29 “Programmable” (red)) controlled via the CAN-Bus communication channel.



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 (Read only)	Not linked	Light off	Light on	Volatile	1I>
2	Led 2 (Read only)	Not linked	Light off	Light on	Volatile	1I>

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<39>**	*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.D10	*Digital Input "2.D10"*	*activated*
	2.D10Not	*Digital Input "2.D10"*	*deactivated*
	0.R1 to **0.R6**	*Output relays on Main Relay*	
	1.R1 to **1.R14**	*Output relays on Expansion Board - 14DO*	
	2.R1 to **2.R4**	*Output relays on Expansion Board – UX10-4*	

7.8 - Example: Change settings for "Led5"

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

Led 1 = Read only (see § Signalization on Main Relay)
Led 2 =
Led 3 =
Led 4 =

Led 5 = are provided in signalization module

to

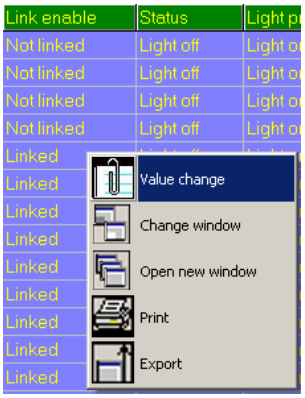
Led 53 =

Main Windows:

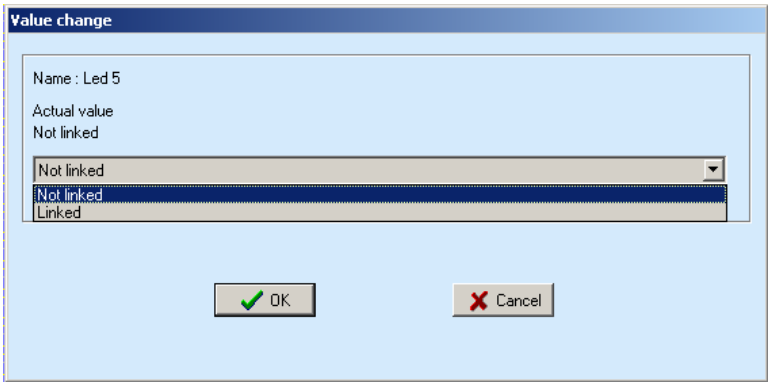
ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1I> (0)
2	Led 2 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1I> (0)
3	Led 3 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1I> (0)
4	Led 4 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1I> (0)
5	Led 5	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1.D1

7.8.1 - "Enable"

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

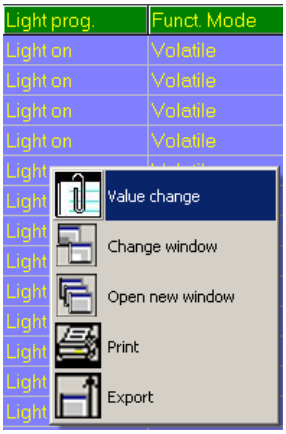


Select "**Linked**" from combo box and press "OK" (if Password is request, see § Password):

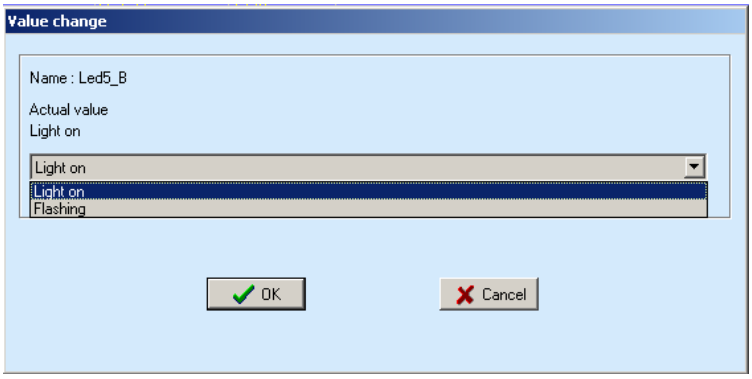


7.8.2 - "Flashing"

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

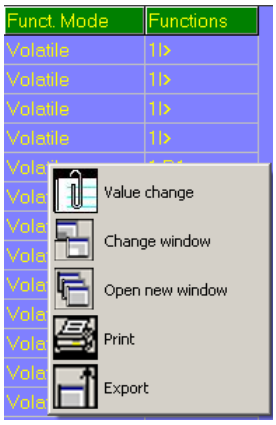


Select "**Flashing**" from combo box and press "OK" (if Password is request, see § Password):

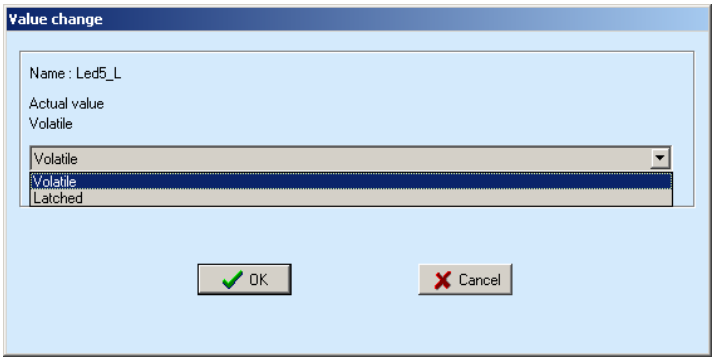


7.8.3 - "Latched"

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

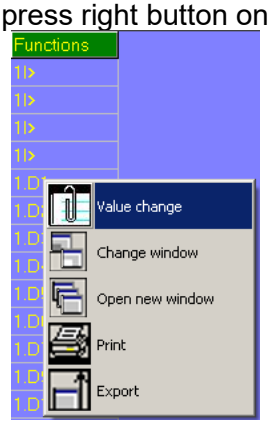


Select "**Latched**" from combo box and press "OK" (if Password is request, see § Password):

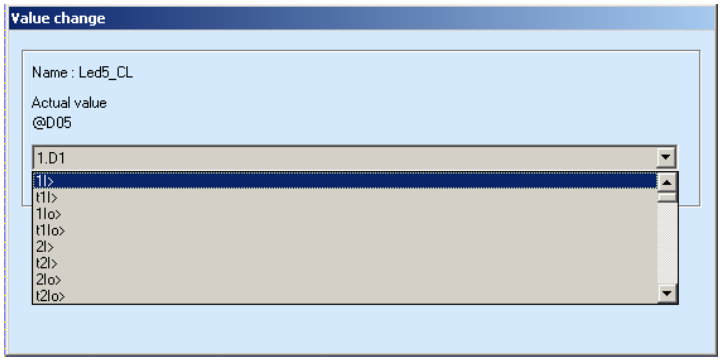


7.8.4 - "Functions"

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.

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”

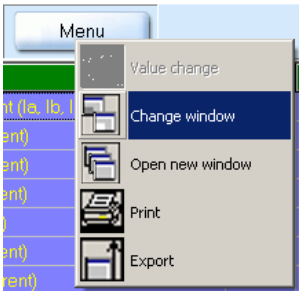
8.7 - Logical status

“User Variable” Logical status

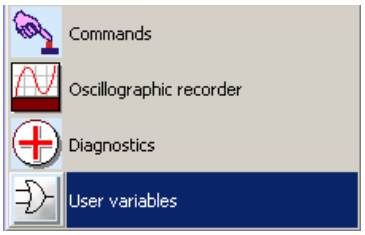
8.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"

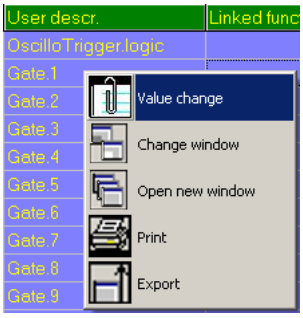


Setting for "**UserVar<0>**" : "**Current Trip**", "**1I>,2I>,3I>**", "**OR**", "**1**", "**Monostable**".

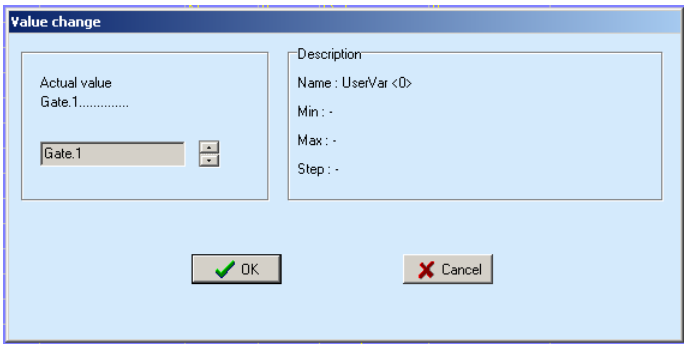
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	User Trigger Oscillo		None	0	Delay	0
2	UserVar <0>	Current trip	1I>,2I>,3I>,	OR	1	Monostable	0

8.8.1 - "User description" (User descr.)

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

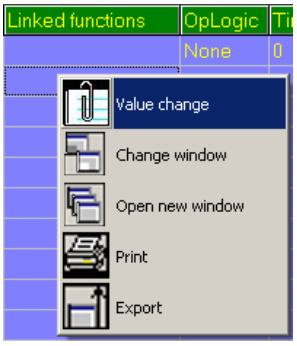


Insert "**Current Trip**" into box and press "OK":

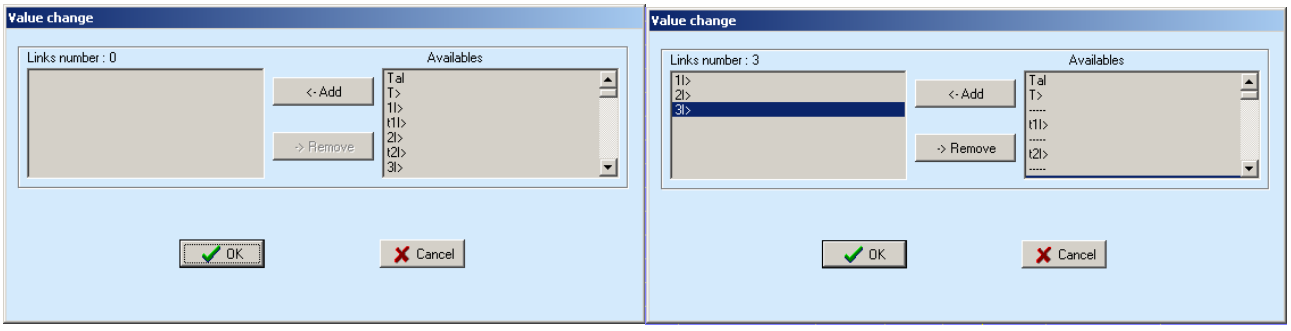


8.8.2 - "Linked Functions"

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

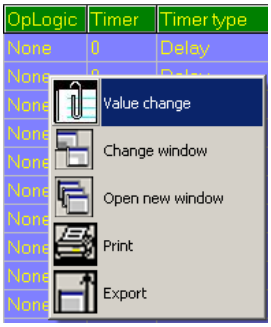


Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".

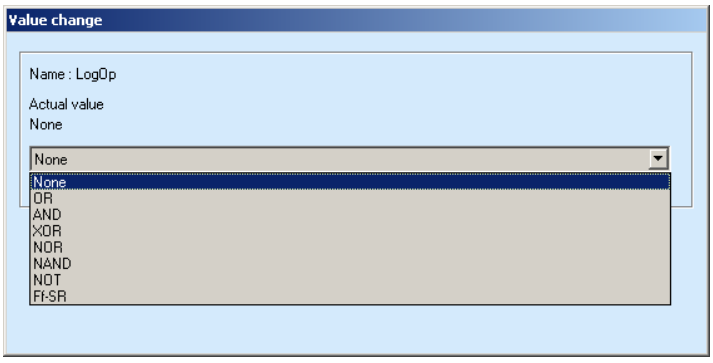


8.8.3 - "Operation Logic" (Oplogic)

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

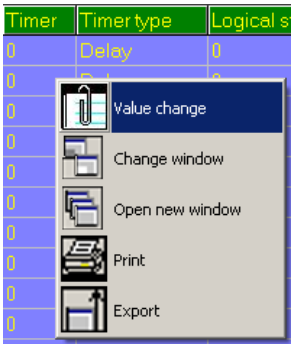


Insert "**OR**" into box and press "OK":

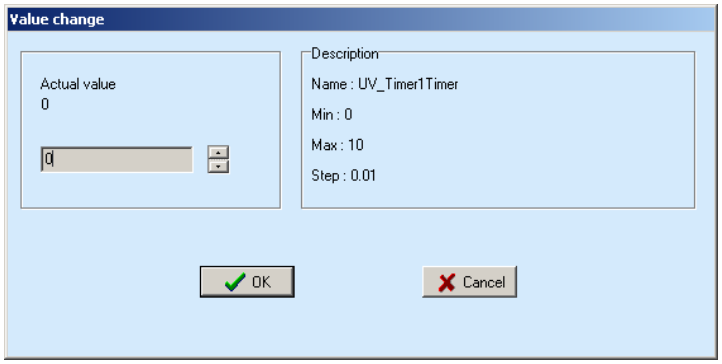


8.8.4 - "Timer"

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

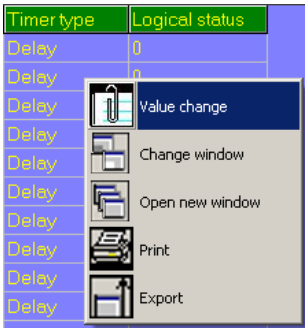


Select "**1**" into box and press "OK":

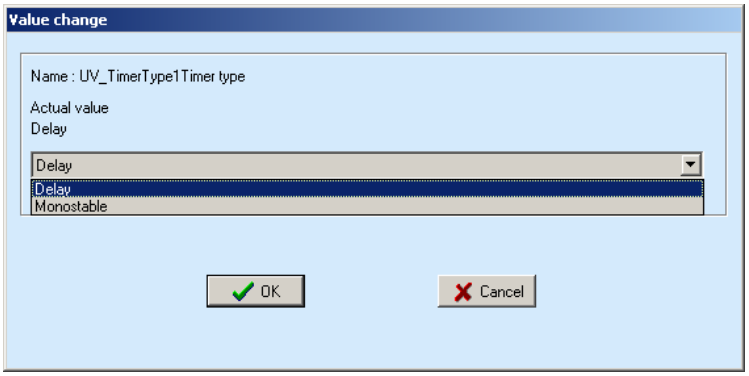


8.8.5 - "Timer type"

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

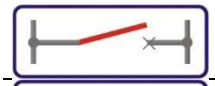
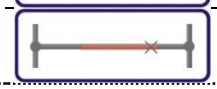


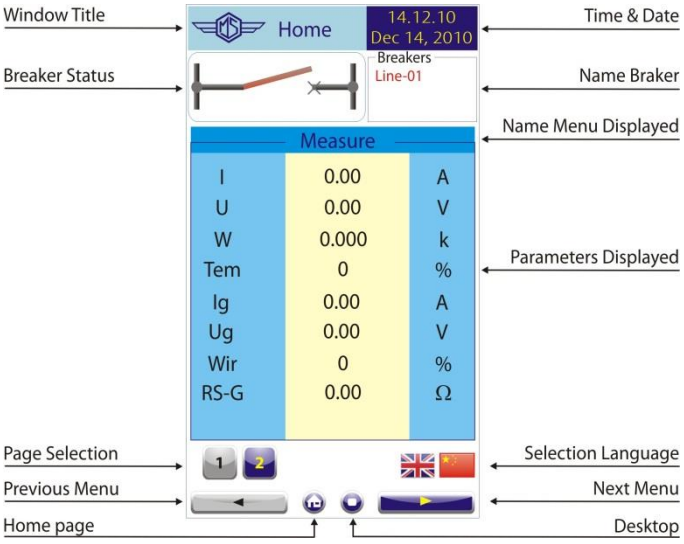
Select "**Monostable**" into box and press "OK":



9. Home

In the “Home” page, is displayed the real time values measured during the normal operation.

Time and Date	Tue 15.12.37 Dec 14, 2010	Displayed Current Date and Time
Breaker Status		Breaker Open
		Breaker Closed
Name Breaker	Breakers Line-01	
Page Selection		Page Active
		Next page
Menu Selection		Menu Active
		Next menu



→	**I**	(0 ± 9999)	**A** Line current
→	**U**	(0 ± 9999)	**V** Line voltage
→	**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.
→	**RS-G**	(0 ÷ 20000)	**Ω** Cable Insulation resistance Screen/Ground
→	**A/ms**	(0 ÷ 9999)	Current rate of raise
→	**Rapp**	(0 ÷ 1000)	**Ω** Impedance monitoring

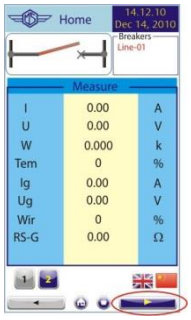
10. Commands

"***COMMANDS***" 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
→ **Event**	**Clear**	Manual reset of Events	Yes
→ **LastTrip**	**Clear**	Manual reset of Last Trips	Yes
→ **Counter**	**Clear**	Manual reset of Counters	Yes
→ **Energy**	**Clear**	Manual reset of Energy	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, proceed as follows (Led Reset in the present example):

1

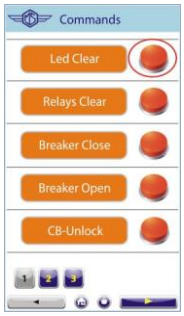


• Press "▬" to access to the "Desktop" menu with icons.

2

• Press "  " to access to the menu.

3



• Press the Red *pushbutton* "●" to execute the command.
(if Password is request, see § Password).

4

• The red *pushbutton* "●" change in green "●" and execute the command.
When command has been executed the display return in the starting position.

11. Maximum Values (available only via MSCom2)

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

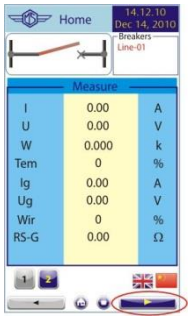
→ **I**	(0 ± 9999)	**A**	Line current
→ **U**	(0 ± 9999)	**V**	Line voltage
→ **W**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**kW**	Power
→ **Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→ **Ig**	(0 ± 9999)	**A**	Frame to ground fault current
→ **Ug**	(0 ±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

12. Energy

Real time energy measurements

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

1

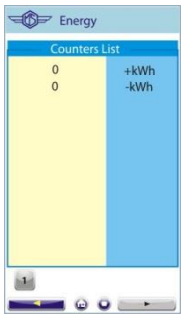


• Press "▬" to access to the "Desktop" menu with icons.

2

• Press "  " to access to the menu.

3



• Display of Real time Energy measurements.

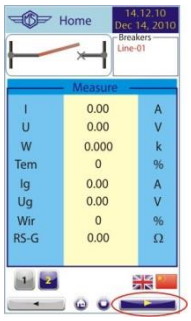
13. Last Trip

Display of the function which caused the tripping of the relay plus values of the measurement at the moment of tripping. The last 20 events are recorded.
The memory buffer is refreshed at each new relay tripping (FIFO logic).

→ **I**	**A**	Line current
→ **U**	**V**	Line voltage
→ **W**	**kW**	Power
→ **Tem**	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→ **Ig**	**A**	Frame to ground fault current
→ **Ug**	**V**	Frame to ground fault voltage
→ **Wir**	**%W**	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.
→ **RS-G**	**Ω**	Cable Insulation resistance Screen/Ground
→ **A/ms**		Current rate of raise
→ **Rapp**	**Ω**	Impedance monitoring

Erase	→ See § Commands

1



• Press "▬" for access to the "Desktop" menu with icons.

2

• Press "  " for access to the menu.

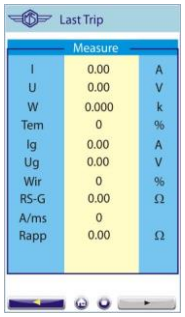
3

• Display list.
• Press selected Trip recorded.

4

• Display selected trip.
• Press "Measure" to show the recorded value at the moment of trip.

5



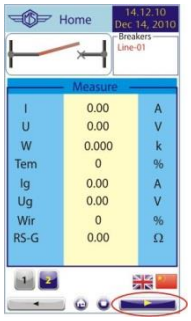
• The display shows the recorded value at the moment of trip.

14. 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
	→ Iis	0	Operations counters	Instantaneous overcurrent
	→ 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
	→ RS-G	0	Operations counters	Cable insulation (Screen-Ground)
	→ 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

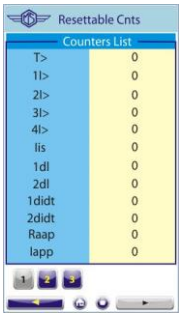
Erase		
	→	See § Commands (By the interface program “MSCom 2” it is possible to individually reset the counters and set an initial starting number)

1 

• Press “ ” to access to the “Desktop” menu with icons.

2 

• Press “ ” to access to the menu.

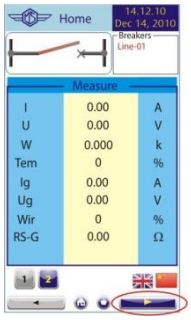
3 

• The display show the list.

15. Total Counters

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

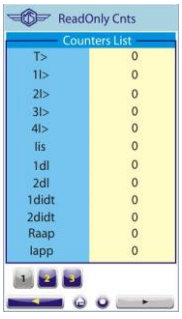
Display				
	→ T>	0	Operations counters	Thermal Image
	→ 1I>	0	Operations counters	First overcurrent element
	→ 2I>	0	Operations counters	Second overcurrent element
	→ 3I>	0	Operations counters	Third overcurrent element
	→ 4I>	0	Operations counters	Fourth overcurrent element
	→ Iis	0	Operations counters	Instantaneous overcurrent
	→ 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
	→ RS-G	0	Operations counters	Cable insulation (Screen-Ground)
	→ 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 "▬" to access to the "Desktop" menu with icons.

2 

• Press "123" to access to the menu.

3 

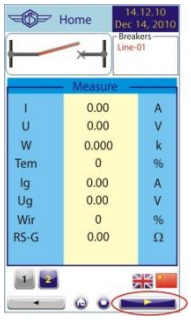
• The display show the list.

16. 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 50 events are recorded at pick-up (rise) or drop-out (fall).
The memory buffer is updated at each new event.

Erase	→	See § Commands

1



• Press “ ” to access to the “Desktop” menu with icons.

2

• Press “ ” to access to the menu.

3

• Select the Events to show.

4

• Display selected Event.

16.1 – Events on display

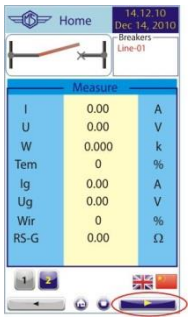
Functions	Events Displayed	Events Description MScom2	Status	
T>	Tal	Tal (Alarm – Thermal Image T>)	Rise	
	T>	T> (Trip – Thermal Image T>)	Rise	Fall
1I>	1I>	1I> (Start - Fist overcurrent element F50-51)	Rise	
	t1I>	1I> (Trip - Fist overcurrent element F50-51)	Rise	Fall
2I>	2I>	2I> (Start – Second overcurrent element F50-51)	Rise	
	t2I>	2I> (Trip – Second overcurrent element F50-51)	Rise	Fall
3I>	3I>	3I> (Start – Third overcurrent element F50-51)	Rise	
	t3I>	3I> (Trip - Third overcurrent element F50-51)	Rise	Fall
4I>	4I>	4I> (Start - Fourth overcurrent element F50-51)	Rise	
	t4I>	4I> (Trip - Fourth overcurrent element F50-51)	Rise	Fall
Iis	Iis	Iis (Trip – Instantaneous overcurrent)		
1dI	1dI	1dI (Start - First Current Step Element)	Rise	Fall
	t1dI	1dI (Trip - First Current Step Element)	Rise	Fall
2dI	2dI	2dI (Start - Second Current Step Element)	Rise	Fall
	t2dI	2dI (Trip - Second Current. Step Element)	Rise	Fall
1di/dt	1di/dt	1di/dt (Start - First Current Rate of Rise Element)	Rise	Fall
	t1di/dt	1di/dt Trip - (First Current Rate of Rise Element)	Rise	Fall
2di/dt	2di/dt	2di/dt (Start - Second Current Rate of Rise Element)	Rise	Fall
	t2di/dt	2di/dt (Trip - Second Current Rate of Rise Element)	Rise	Fall
Rapp	Rapp	Rapp (Trip - Impedance monitoring-di/dt dependence)	Rise	Fall
Iapp	Iapp	Iapp (Trip - Current monitoring-di/dt dependence)	Rise	Fall
1Ig	1Ig	1Ig (Start - First Frame Fault Element)	Rise	Fall
	t1Ig	t1Ig (Trip - First Frame Fault Element)	Rise	Fall
2Ig	2Ig	2Ig (Start - Second Frame Fault Element)	Rise	Fall
	t2Ig	t2Ig (Trip - Second Frame Fault Element)	Rise	Fall
RS-G	RS-G	RS-G (Start - Cable insulation (Screen-Ground))	Rise	Fall
	tRS-G	RS-G (Trip - Cable insulation (Screen-Ground))	Rise	Fall
RCL	RCL	RCL (Autoreclosure shot)	Rise	
	ARP	ARP (Autoreclosure in Progress)	Rise	
	ARF	ARF (Autoreclosure Failed)	Rise	
	ARL	ARL (Autoreclosure Lockout)	Rise	
LT	LT	LT (Line Test Command)	Rise	
1U>	1U>	1U> (Start - First Overvoltage Element F59)	Rise	
	t1U>	1U> (Trip - First Overvoltage Element F59)	Rise	
2U>	2U>	2U> (Start - Second Overvoltage Element F59)	Rise	
	t2U>	2U> (Trip - Second Overvoltage Element F59)	Rise	
1U<	1U<	1U< (Start - First Undervoltage Element F59)	Rise	
	t1U<	t1U< (Trip - First Undervoltage Element F59)	Rise	
2U<	2U<	2U< (Start - Second Undervoltage Element F59)	Rise	
	t2U<	t2U< (Trip - Second Undervoltage Element F59)	Rise	
Wi	tWi>	tWi> (Circuit breaker maintenance level)	Rise	
TCS	TCS	TCS (Start - trip coil supervision)	Rise	
	tTCS	tTCS (trip coil supervision)	Rise	Fall
IRF	IRF	IRF (Start - Internal Relay Failure)	Rise	
	tIRF	tIRF (Trip - Internal Relay Failure)	Rise	
RT	Start RT	RT (Start - First element Remote Trip)	Rise	
	Trip RT	tRT (Trip - First element Remote Trip)	Rise	
RTX	Start RTX	RTX (Second element Remote Trip)	Rise	
	Trip RTX	tRTX (Trip - Second element Remote Trip)	Rise	
BF	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	
	UpDateMon	Update Monitor	Rise	Fall
	IPU boot	IPU boot	Rise	

17. Systems (System Parameters)

Setting of system parameters.

Nominal Value	*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							

Characteristic	*Characteristic-1* Available *Characteristic-2* Available *Characteristic-3* Not available *Characteristic-4* Not available
Factors	Not available
System Options	Not available

1 

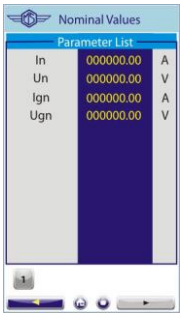
• Press "▬" to access to the "Desktop" menu with icons.

2 

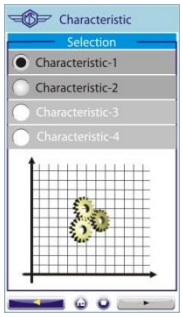
• Press "  " to access to the menu.

3 

• Press icons wished.

4 

• Press the parameter to modify.
(if Password is request, see § Password).

5 

• Press the characteristics that need modify.

18. Settings

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

→ **Comm.**	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
→ **Iis**	Instantaneous overcurrent
→ **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
→ **RS-G**	Cable insulation (Screen-Ground)
→ **RCL**	Automatic Reclosure
→ **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
→ **BrkFailure**	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
→ **LineTest**	Line Test
→ **ExtReset**	Configuration for external reset input

18.1 - 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 "▬" to access to the "Desktop" menu with icons.

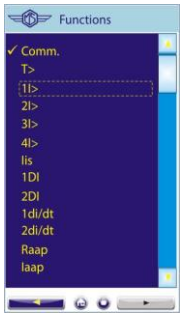
2

• Press "⚙" to access to the settings menu.

3

• Select Characteristic "***1***".

4



• Select function "***1I>***".

✓ This symbol in the list of the setting indicates that the function is enable

5

✗ 0 I

• To enable function, press "I"

✓ 0 I

• To disable function, press "0"

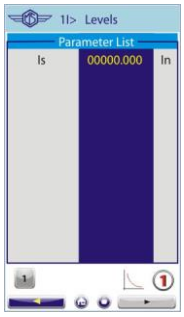
✗ • Function disabled

✓ • Function enabled

6

• Press "▬" to access to the level setting.

7

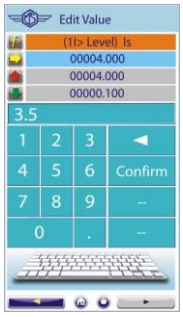


• Press the value (number) to change it.
• Insert the password (if request).
• Press the value (number)

① Characteristic 1

② Characteristic 2

8



• Insert "3.5"
• Press "Confirm"

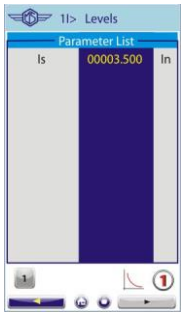
f Function

Actual Value

Maximum Value

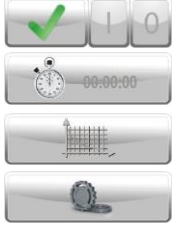
Minimum Value

9



• Change done.

The icons grey indicate menu not available



18.2 - 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 II” software (see Manual “MSCom II”).

18.3 – Menu: ***Comm. (Communication)***

Options	→	**BRLoc**	38400	[9600 / 19200 / 38400 / 57600]
	→	**BRRem**	19200	[9600 / 19200 / 38400]

18.3.1 – Description of variables

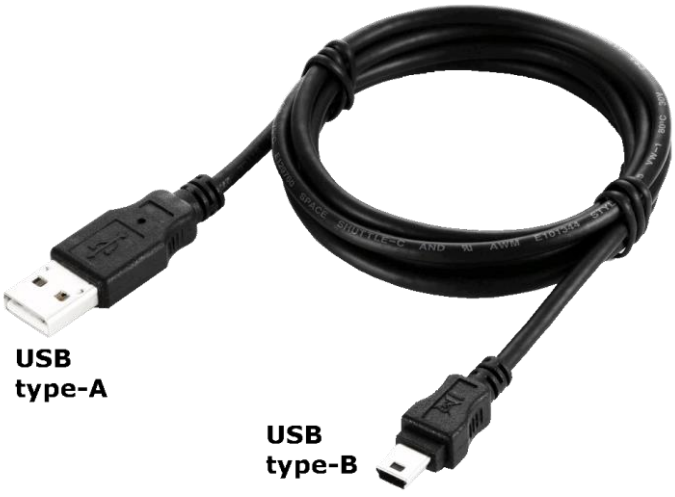
- **BRLoc** : USB local (Front Panel)serial communication speed
- **BRRem** : Ethernet communication speed

18.3.2 – Front Panel serial communication port (RS232)

A Mini-USB socket is available on Relay's front face for connection.
Through this port - and by the interface program available from Microelettrica Scientifica S.p.A. (MSCom II for Windows XP/7) – it is possible connect a Personal Computer to download all available information's, operate any control and program the relay; the protocol used is " Modbus RTU".

18.3.3 – Cable for connection from Relay to Personal Computer

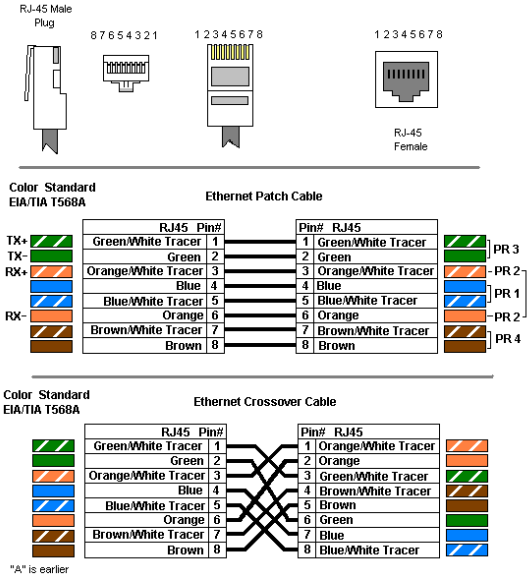
The connection cable is a standard
USB-A → mini USB-B



18.3.4 – Main serial communication port (Ethernet)

Ethernet ports is available for communication with SCADA system with Protocol Modbus RTU.
The communication interface allows programming all settings, operating all commands and downloading all information and records.

18.3.5 – Wiring the Ethernet Communication



The back Ethernet connector is a standard RJ45 connector and can be wired with a normal Ethernet UTP cable in class 5 minimum.
The relay can be connected directly to a PC with a Ethernet “Crossover” cable, or it can be connected to a switch with a Ethernet “Patch” cable.

*18.4 - Menu: **HMI** (Human Machine Interface - customize)*

This option is not used in this relay version.

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**TrOsc**	TrigDisab		[TrigDisab – TrigEnab]			
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

18.5.1 - Description of variables

- **Enab.** : Function enabling Disable / Enable)
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the "T>" function.
- **Tal** : Temperature prealarm level
- **Is** : Continuous admissible current
- **Kt** : Warming-up Time Constant of the load

18.5.2 - 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

18.5.2.1 – Trip time of the Thermal Image Element

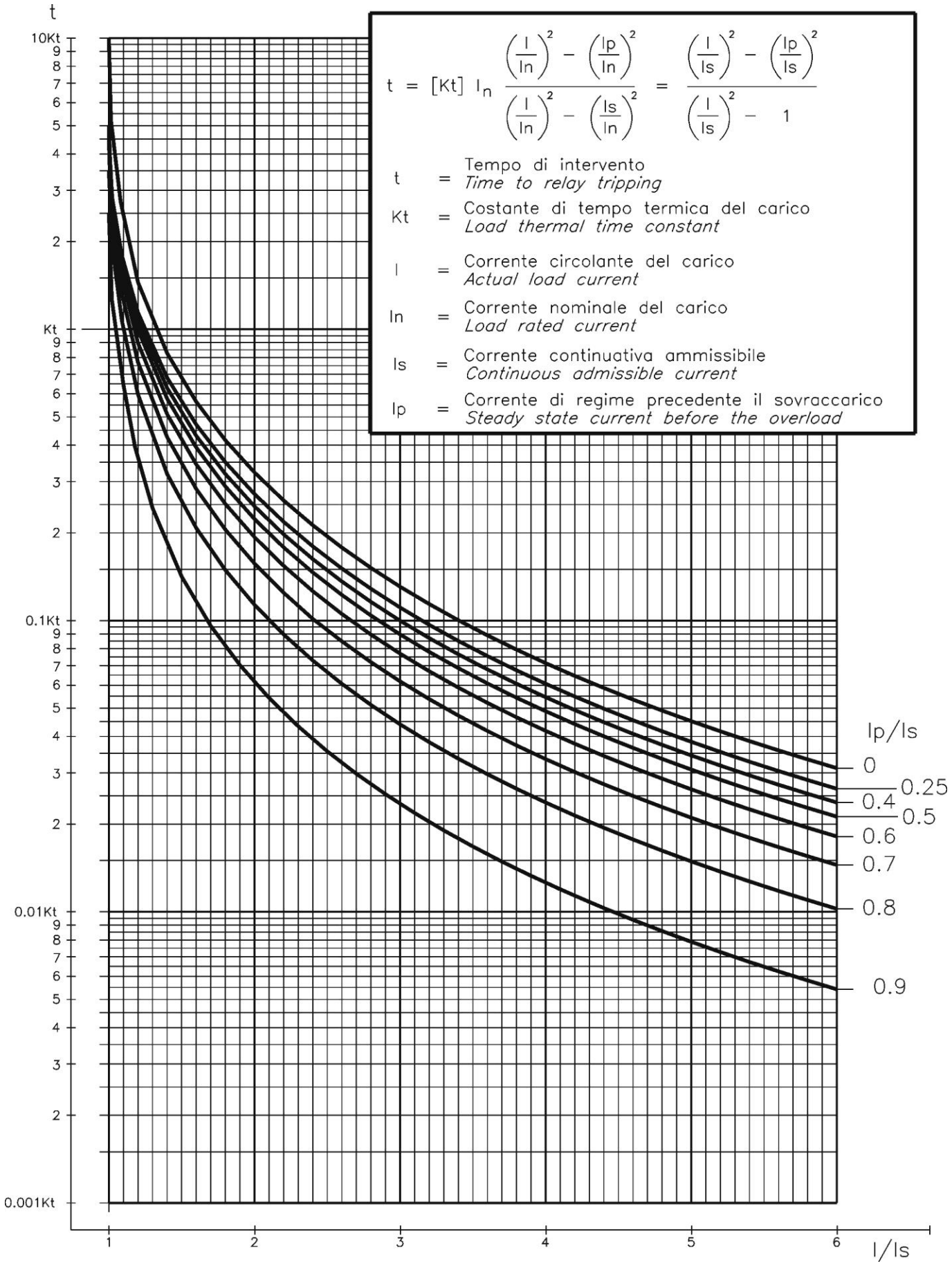
The trip time of the Thermal Image Element is a function of the current "I" flowing into the load and depends on its warming-up Time Constant "Kt", on the previous thermal status "Ip" and on the maximum admissible continuous current "Is" according to the equation:

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.

18.5.2.2 – Thermal Image Curves (TU1024 Rev.1)



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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**RCL**	No		[No / Yes]			
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

18.6.1 - 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.

18.6.2 - 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:

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

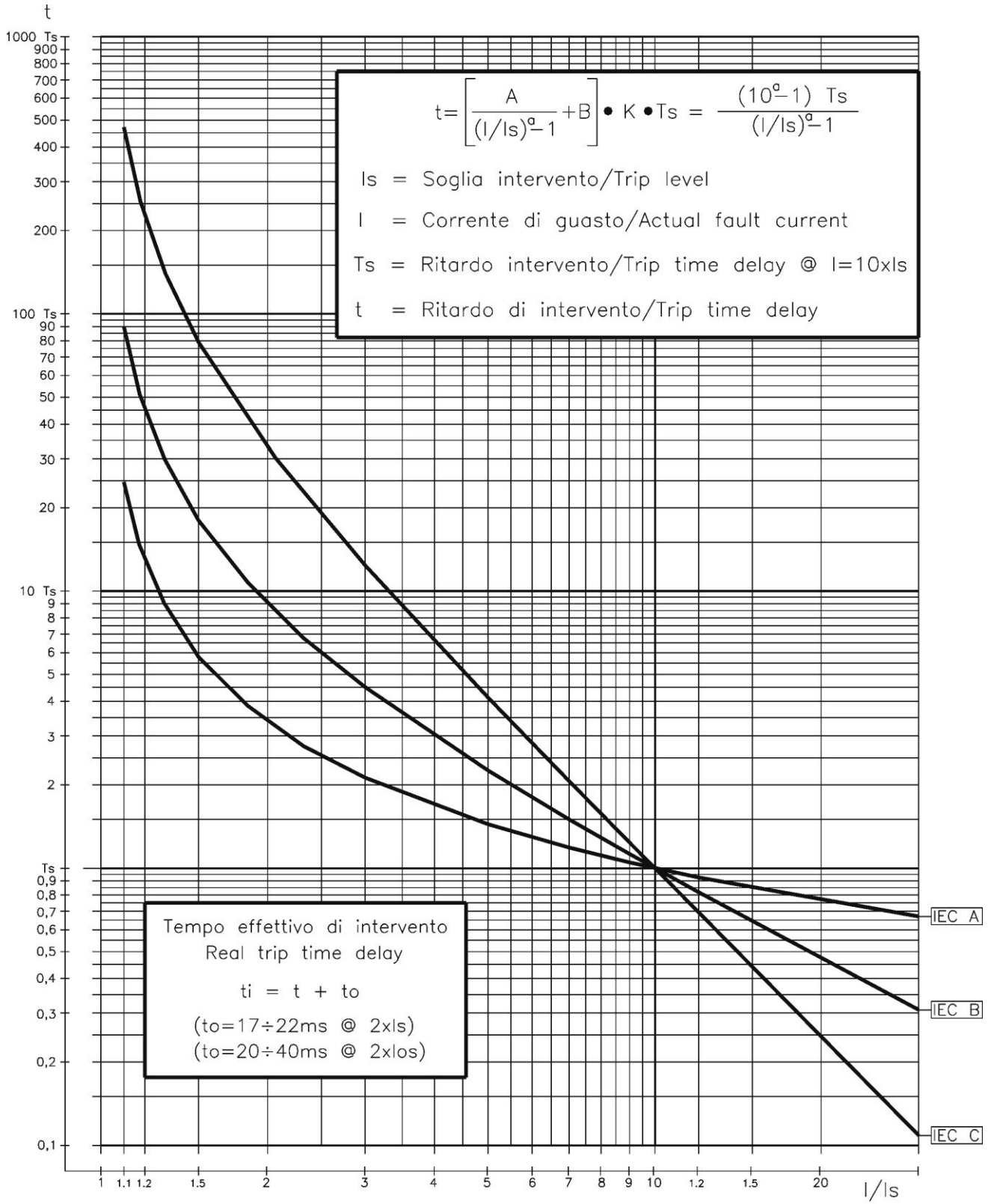
Where $Kt = (10^{a}-1)Ts$ is the time multiplier

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".

18.6.3 - 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 = 10xOn

18.6.4 – 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.

18.6.4.1 – 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.

18.6.4.2 – 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.

18.6.5 - 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.

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**RCL**	No		[No / Yes]			
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

18.7.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**CoF**	Disable		[Disable / Enable]			
	→	**RCL**	No		[No / Yes]			
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

18.8.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**CoF**	Disable		[Disable / Enable]			
	→	**RCL**	No		[No / Yes]			
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

18.9.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.

18.10 - Function: **Iis** (*Instantaneous Current Element*)

Status	→	**Enab.**			[Disable / Enable]
Options	→	**RCL**	No		[No / Yes]
Levels	→	**Is**	1	**In**	(1÷10) step 0.010 In

18.10.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **RCL** : If “RCL = Yes”, after tripping of the element “Iis” 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.

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

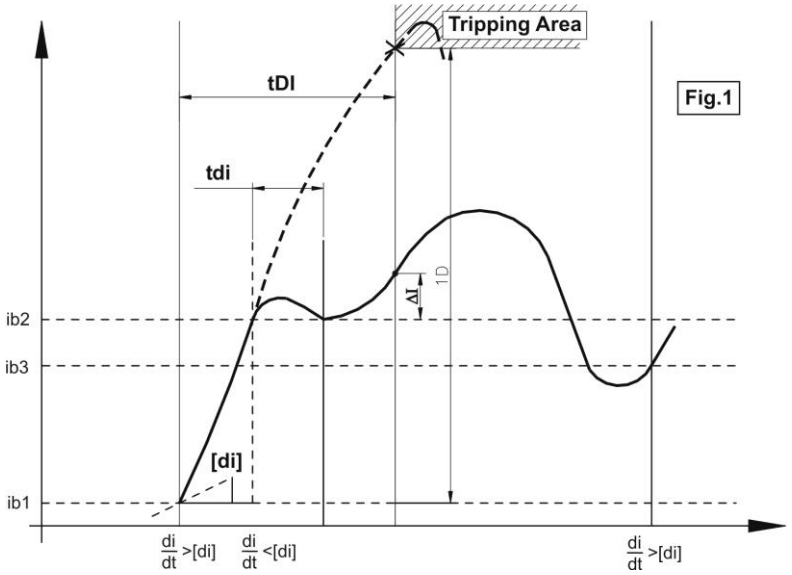
Status	→ **Enab.**			[Disable / Enable]				
Options	→ **RCL**	No		[No / Yes]				
	→ **TrOsc**	TrigDisab		[TrigDisab – TrigEnab]				
Levels	→ **DI**	1000	**A**	(100÷9990)	step	10	A	
	→ **di**	200	**A/ms**	(4÷400)	step	1	A/ms	
Timers	→ **tDI**	100	**ms**	(0÷500)	step	1	ms	
	→ **tdi**	20	**ms**	(0÷100)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

18.11.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **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

18.11.2 - 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.

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**RCL**	No		[No / Yes]			
	→	**TrOsc**	TrigDisab		[TrigDisab – TrigEnab]			
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

18.12.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **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

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

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

18.13.1 - Description parameters

❑	**Enab.**	:	Function enabling (Disable / 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.
❑	**TrOsc**	:	Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
❑	**G**	:	di/dt trip level
❑	**tG**	:	Trip time delay

16.13.2 - 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

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

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

18.14.1 - 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.
❑	**TrOsc**	:	Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
❑	**G**	:	di/dt trip level
❑	**tG**	:	Trip time delay

18.14.2 - 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

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**RCL**	No		[No / Yes]			
	→	**TrOsc**	TrigDisab		[TrigDisab – TrigEnab]			
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

18.15.1 - Description of variables

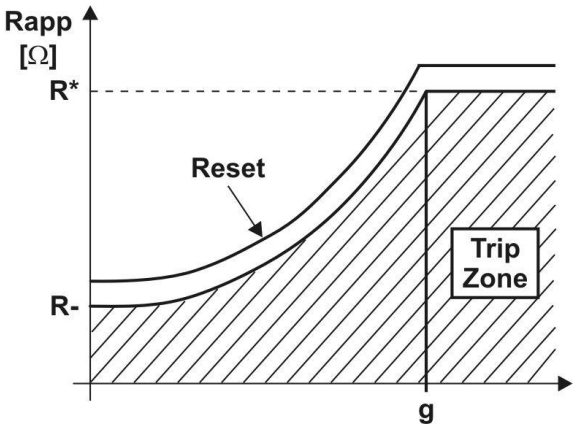
- **Enab.** : Function enabling (Disable / Enable)
- **RCL** : I If “RCL = Yes”, after tripping of the element “Rapp” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle.
  If “RCL = No” no test and no reclosure is started.
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **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.

18.15.2 - 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.



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

Status	→ Enab.			[Disable / Enable]				
Options	→ RCL	No		[No / Yes]				
	→ TrOsc	TrigDisab		[TrigDisab – TrigEnab]				
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

18.16.1 - Description of variables

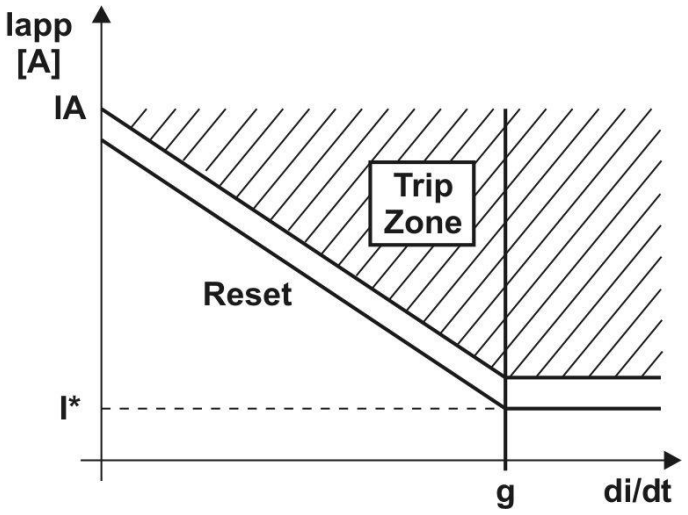
❑	**Enab.**	:	Function enabling (Disable / Enable)
❑	**RCL**	:	If “RCL = Yes”, after tripping of the element “Iapp” and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If “RCL = No” no test and no reclosure is started.
❑	**TrOsc**	:	Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
❑	**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.

18.16.2 - 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 $[\text{Iapp}]\cdot\frac{\text{Res}}{100}$

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

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



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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**A/T**	Trip		[Trip / Alarm]			
	→	**Vt**	D		[D / EN50122-1]			
	→	**RCL**	No		[No / Yes]			
	→	**TrOsc**	TrigDisab		[TrigDisab – TrigEnab]			
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

18.17.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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
- **A/T** : If “A/T = Trip” tripping of the function operates the signal led that needs manual reset.
  If “A/T = Alarm” the signal led flashes as long as the function is in operation and extinguishes after tripping.
- **V(t)** : Operation characteristic (Time/Current curve):
  (D) = Independent definite time
  (EN50122-1) = Inverse Curve
- **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.
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **Is** : Minimum operation level of frame to earth current.
- **Us** : Minimum operation level of frame to earth voltage.
- **ts** : Trip time delay

18.17.2 - 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]

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**A/T**	Trip		[Trip / Alarm]			
	→	**Vt**	D		[D / EN50122-1]			
	→	**RCL**	No		[No / Yes]			
	→	**TrOsc**	TrigDisab		[TrigDisab – TrigEnab]			
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

18.18.1 - 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
- **A/T** : If “A/T = Trip” tripping of the function operates the signal led that needs manual reset.
  If “A/T = Alarm” the signal led flashes as long as the function is in operation and extinguishes after tripping.
- **V(t)** : Operation characteristic (Time/Current curve):
  (D) = Independent definite time
  (EN50122-1) = Inverse Curve
- **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.
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **Is** : Minimum operation level
- **Us** : Minimum operation level
- **ts** : Trip time delay

18.18.2 - 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]

*18.19 - Function: **RS-G** (Cable insulation (Screen-Ground))*

Status	→ **Enab.**			[ Disable /  Enable]				
Options	→ **RCL**	No		[No – Yes]				
Levels	→ **RS-G**	500	**Ω**	(100÷5000)	step	100	**Ω**	
Timers	→ **tRS-G**	0.1	**s**	(0.05÷100)	step	0.01	s	

18.19.1 - Description of variables

❑	**Enab.**	:	Function enabling (Disable / Enable)
❑	**A/T**	:	If “A/T = Trip” tripping of the function operates the signal led that needs manual reset. If “A/T = Alarm” the signal led flashes as long as the function is in operation and extinguishes after tripping.
❑	**RS-G**	:	Trip level for Insulation Resistance between Conductor and screen.
❑	**tRS-G**	:	Trip time delay

18.19.2 - Operation

The relay receives from the (optional) external unit “A-MSG-1” the measurement of the leakage current and computes the resultant isolation resistance to ground “RS-G” of the Cable’s Screen.
If the value of “RS-G” drops below the set level the relay trips after the set time delay “tRS-G”.

18.19.3 - Compensation of the inherent leakage current

Due to the natural capacitance between the cable's screen and ground, a small leakage current always flows in the monitoring circuit supplied by the A-MSG-1 unit.
To properly monitor the real deterioration of the screen-to-ground insulation and the value of the insulation resistance, the contribution of that inherent leakage current must be compensated when first installing the monitoring apparatus in the field.
The following procedure allows to do the initial compensation:

- The compensation can only be operated via the application software MSCom2 loaded on a P.C. to be connected either via the RS232 port one relays front face or to the RS485 port available on the back side.

1

- Open application software MSCom2 and connect the relay.
- The measure window appear,

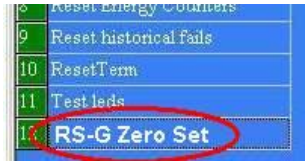
2

- Press "***Change***".

3

- Press "***Commands***"

4



- Double click on "***RS-G Zero Set***".

5

- Press "***Yes***"

6

- Insert the relay password when request.

7

- The inherent leakage current is set to zero.

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

Status	→ **Enab.**		[Disable / Enable]
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
	→ **tCHK**	0.4	**s**	(0.2÷3)	step	0.1	s

18.20.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.
- **tCHK** : Time check C/B operation

18.20.2 - 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)

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

Status	→ **Enab.**			[Disable / Enable]				
Options	→ **TrOsc**	TrigDisab		[TrigDisab – TrigEnab]				
Levels	→ **Us**	1.10	**Un**	(0.5÷1.50)	step	0.01	Un	
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s	

18.21.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **Us** : Minimum operation level
- **ts** : Trip time delay

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

Status	→ **Enab.**			[Disable / Enable]				
Options	→ **TrOsc**	TrigDisab		[TrigDisab – TrigEnab]				
Levels	→ **Us**	1.10	**Un**	(0.5÷1.50)	step	0.01	Un	
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s	

18.22.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **Us** : Minimum operation level
- **ts** : Trip time delay

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

Status	→ **Enab.**			[Disable / Enable]				
Options	→ **TrOsc**	TrigDisab		[TrigDisab – TrigEnab]				
Levels	→ **Us**	0.70	**Un**	(0.2÷1.00)	step	0.01	Un	
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s	

18.23.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **Us** : Minimum operation level
- **ts** : Trip time delay

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

Status	→ **Enab.**			[Disable / Enable]				
Options	→ **TrOsc**	TrigDisab		[TrigDisab – TrigEnab]				
Levels	→ **Us**	0.70	**Un**	(0.2÷1.00)	step	0.01	Un	
Timers	→ **ts**	10	**s**	(0÷650)	step	1	s	

18.24.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **TrOsc** : Oscillographic Recording triggered (TrigEnab) or not triggered (TrigDisab) on tripping of the function.
- **Us** : Minimum operation level
- **ts** : Trip time delay

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

Status	→ **Enab.**			[Disable / Enable]			
Levels	→ **Ii**	1.000	**In**	(0.1÷99)	step	0.1	In
	→ **Wi**	1.000		(1÷9999)	step	1	

18.25.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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.

18.25.2 - 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 “***Command***” (Reset Term).

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

Status	→ **Enab.**			[Disable / Enable]
Timers	→ **ts**	0.10	**s**	(0.1÷100) step 0.01 s

18.26.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **ts** : Trip time delay

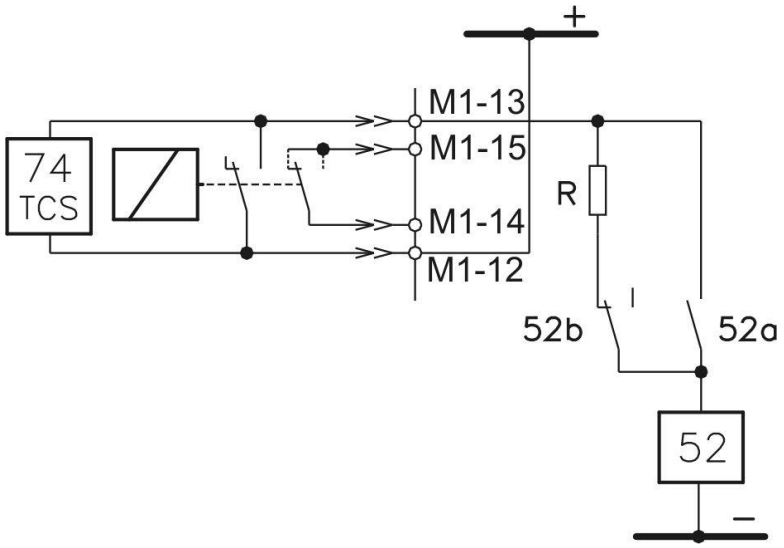
18.26.2 - Operation

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.

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

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

Status	→ **Enab.**		[Disable / Enable]	
Timers	→ **tIRF**	5.00	**s**	(5÷200) step 0.01 s

18.27.1 - Description of variables

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

18.27.2 - Operation

Tripping of the function operates a user programmable output relay.

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

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

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

18.28.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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

18.28.2 - 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.

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

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

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

18.29.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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

18.29.2 - 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.

*18.30 - Function: **BrKFailure** (Breaker Failure)*

Status	→ **Enab.**			[Disable / Enable]			
Timers	→ **tBF**	0.75	**s**	(0.05÷0.75)	step	0.01	s

18.30.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **tBF** : Trip time delay

18.30.2 - 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,

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

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

Status	→ **Enab.**			[ Disable /  Enable]			
Levels	→ **WpP**	100	**kW**	(10 ÷ 1000)	step	10	kWh
Timers	→ **Pulse**	1.00	**s**	(0.10 ÷ 2.00)	step	0.01	s

18.31.1 - Description of variables

- **Enab.** : Function enabling (Disable / Enable)
- **WpP** : Energy counter Pulse Level
- **Pulse** : Pulse duration

18.31.2 - 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".

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

Status	→	**Enab.**			[Disable / Enable]			
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

18.32.1 - Description of variables

- **Enab.** : Function enabling (Disable / 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

18.32.2 - 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”).

T>	**1I>**	**1dI**	**Rapp**	**Wi**	**1U>**
	2I>	**2dI**	**Iapp**	**RT**	**2U>**
	3I>	**1di/dt**	**1Ig**	**RTX**	**1U<**
	4I>	**2di/dt**	**2Ig**		**2U<**

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.

18.32.3 – 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

18.32.3.1 – "Name"

Internal name

18.32.3.2 – "User descr."

Fixed

18.32.3.3 – "Linked functions"

Selection functions

18.32.3.4 – "OpLogic"

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

18.32.3.5 – "Timer"

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

18.32.3.6 – "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"

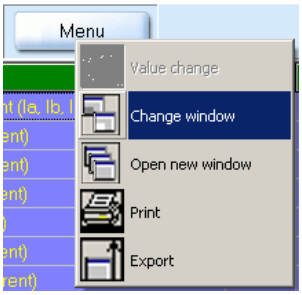
18.32.3.7 – "Logical status"

"User Trigger Oscillo" Logical status

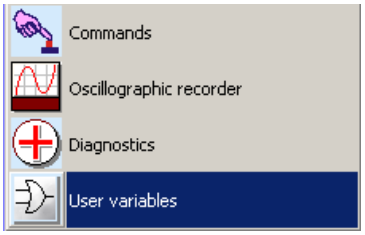
18.32.3.8 – Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"

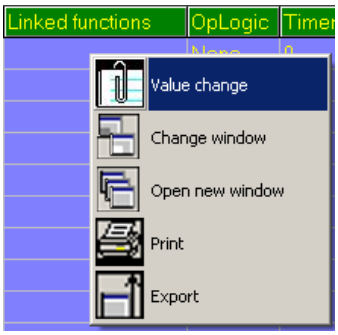


Setting for "User Trigger Oscillo" : "**1I>/2I>/3I>**", "**AND**", "**1**", "**Monostable**".

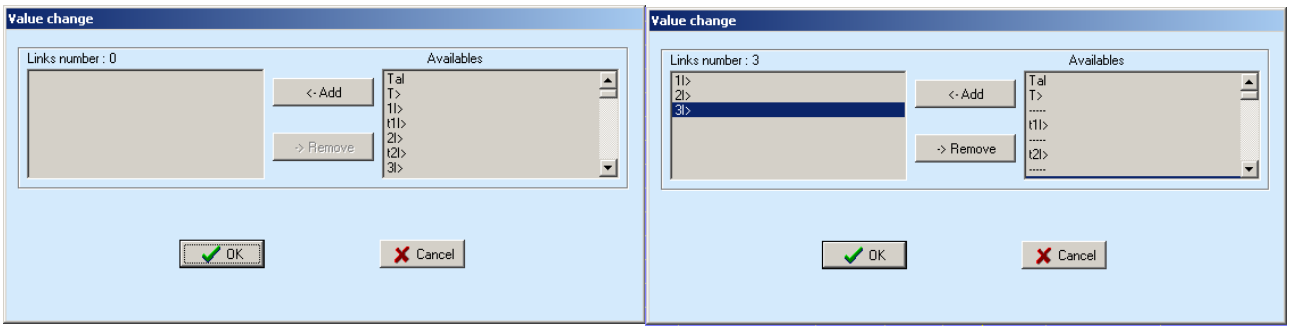
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	OscilloTrigger.logic		None	0	Delay	0
2	UserVar <0>	Gate.1		None	0	Delay	0

18.32.3.9 – "Linked Functions"

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

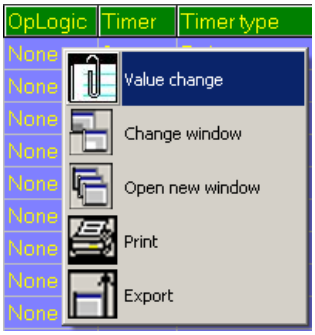


Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".

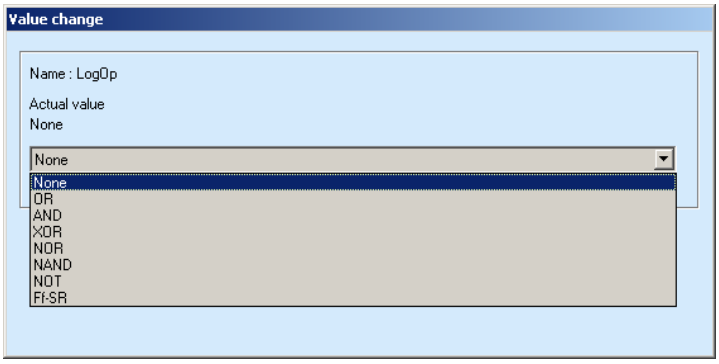


18.32.3.10 – "Operation Logic" (Oplogic)

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

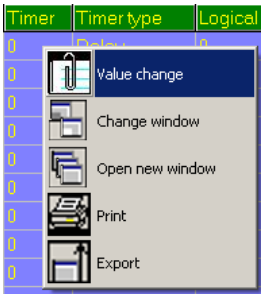


Insert "**AND**" into box and press "OK":

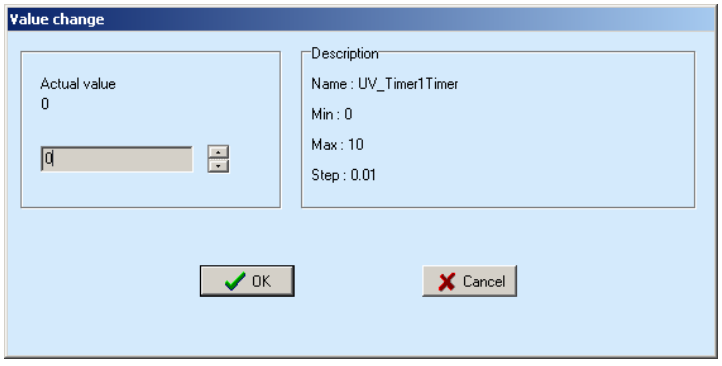


18.32.3.11 – "Timer"

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

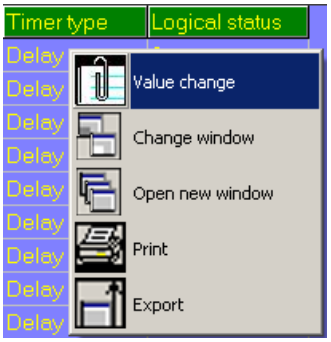


Select "**1**" into box and press "OK":

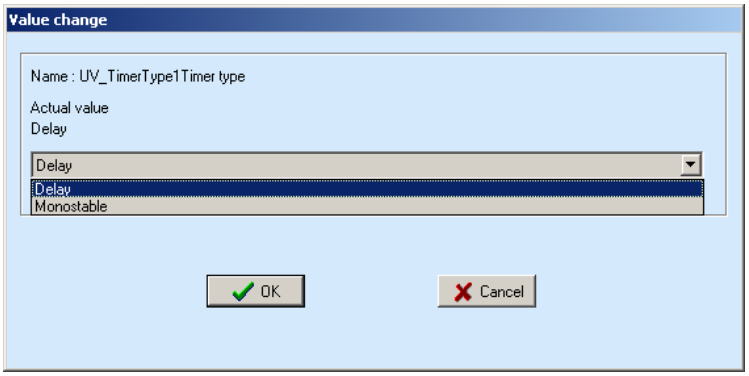


18.32.3.12 – "Timer type"

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



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



*18.34 - 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

18.34.1 - 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.
- **DI_M** : Local/Remote digital input management
- **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 "***Command***".

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

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

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

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

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

18.35.1 - Description of variables

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

18.35.2 - 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 reset from the Lock-out status can be operated either b the keyboard via the "CB Unlock" command available in the menu "Commands" (§ Commands) or by an external command via the Digital Input programmed for "Ext.Reset".

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

Options	→ TNum	1		[0 / 1 / 2 / 3]			
	→ Fast	No		[No / Yes]			
	→ Rem	No		[No / Yes]			
Levels	→ Vr<	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
	→ Vlock	0.5	**Vn**	(0.5÷0.2)	step	0.01	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

18.36.1 - 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
- **Vr<** : Minimum Residual Voltage 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.
- **Vlock** : Minimum Line Voltage level to allow 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.

18.36.2 - Operation

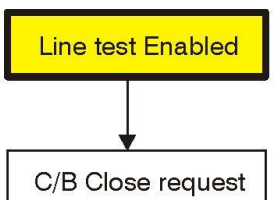
The Line Test is started by a request of Automatic Reclosure or Manual Closure of the C/B (see § "RCL" and § "L/R C/B Cmds").
It is also possible to start the Line Test by activating a Digital Input programmed for this purpose (see Remote Line Test control § "17.2.2").
Test is considered successful depending on “Vr<” and “Rr<” measurement according to programming.

Setting		Test condition
Vr<	**Rr<**	
≠0	≠0	Vr ≥ [Vr<] & Rr≥ [Rr<]
≠0	=0	Vr ≥ [Vr<]
=0	≠0	Rr≥ [Rr<]

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).

18.36.4 - Flow chart



*18.37 - Function: **ExtReset** (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 17.2 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]

18.37.1 - Description of variables

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

19. 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 (Board 1) = 14 Digital Inputs
14DI Module (Board 2) = 14 Digital Inputs
14DO-F Module (Board 3) = 14 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).

19.1 – 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 1 - 14DI*	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 2 - 14DI*	

19.2 – “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	
R LT	Remote line test request	
ExtReset	External Reset	
Group 1-2	Selection of the setting Group 1 or 2.	

17.2.1 - Example

ID	Name	Status	OpLogic	Functions

19.2.2 – "Name"

Logical Input name

19.2.3 – "Status"

Logical Input status

19.2.4 – "OpLogic"

Not Used

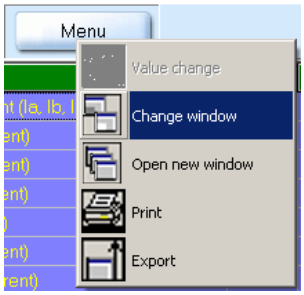
19.2.5 – "Functions"

Selection function

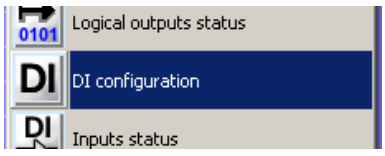
19.2.6 - Example: Setting "Digital Input"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "DI configuration"

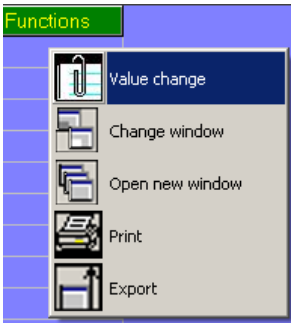


Setting for "**Bi1I>**" : "**1I>**".

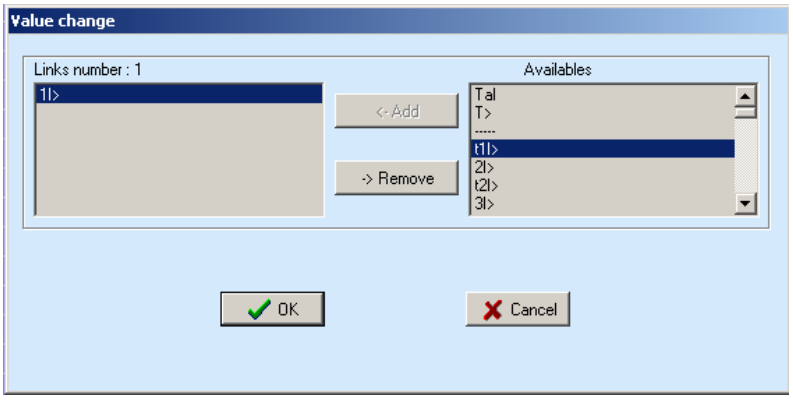
ID	Name	Status	OpLogic	Functions
1	Bi1I>	Not active	None	1I>,
2	Bi1Ie>	Not active	None	

19.2.7 - "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)



19.3 – 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 3 - 14DO-F*
→	**1.R--**		
→	**1.R14**		

19.4 - "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**	Thermal alarm	
	T>	Thermal trip	
1I>	**1I>**	First instantaneous overcurrent element	(Start)
	t1I>	First time delayed overcurrent element	(Trip)
2I>	**2I>**	Second instantaneous overcurrent element	(Start)
	t2I>	Second time delayed overcurrent element	(Trip)
3>	**3I>**	Third instantaneous overcurrent element	(Start)
	t3I>	Third time delayed overcurrent element	(Trip)
4I>	**4I>**	Fourth instantaneous overcurrent element	(Start)
	t4I>	Fourth time delayed overcurrent element	(Trip)
Iis	**Iis**	Instantaneous overcurrent	
1dI	**1dI**	First instantaneous Current step element	(Start)
	t1dI	First time Current step element	(Trip)
2dI	**2dI**	Second instantaneous Current step element	(Start)
	t2dI	Second time Current step element	(Trip)
1di/dt	**1di/dt**	First instantaneous Current rate of rise element	(Start)
	t1di/dt	First time Current rate of rise element	(Trip)
2di/dt	**2di/dt**	Second instantaneous Current rate of rise element	(Start)
	t2di/dt	Second time Current rate of rise element	(Trip)
Rapp	**Rapp**	Impedance monitoring – di/dt dependence	(Trip)
Iapp	**Iapp**	Current monitoring with di/dt dependence	
1Ig	**1Ig**	First instantaneous Frame Fault element	(Start)
	t1Ig	First time delayed Frame Fault element	(Trip)

2Ig	2Ig	Second instantaneous Frame Fault element	(Start)
	t2Ig	Second time delayed Frame Fault element	(Trip)
RS-G	RS-G	Cable insulation (Screen-Ground)	(Start)
	tRS-G	Cable insulation (Screen-Ground)	(Trip)
RCL	RCL cmd	Reclosure Shot command	(Trip)
	ARP	Autoreclosure in progress	
	ARF	Autoreclosure Failure	
	ARL	Autoreclosure Lock-out	
1U>	1U>	First instantaneous overvoltage element	(Start)
	t1U>	First time delayed overvoltage element	(Trip)
2U>	2U>	Second instantaneous overvoltage element	(Start)
	t2U>	Second time delayed overvoltage element	(Trip)
1U<	1U<	First instantaneous undervoltage element	(Start)
	t1U<	First time delayed undervoltage element	(Trip)
2U<	2U<	Second instantaneous undervoltage element	(Start)
	t2U<	Second time delayed undervoltage element	(Trip)
Wi	tWi>	Circuit breaker maintenance level	
TCS	tTCS	Time delayed Trip Circuit Supervision	(Trip)
IRF	IRF	Time delayed Internal relay Fault	(Start)
	tIRF	Instantaneous Internal relay Fault	(Trip)
RT	RT	First Instantaneous Remote Trip	(Trip)
	tRT	First Time delayed Remote Trip	(Start)
RTX	RTX	Second Instantaneous Remote Trip	(Trip)
	tRTX	Second Time delayed Remote Trip	(Start)
CB-L	CB-L	C/B reclose Lock-out	
BF	BF	Breaker Failure	
Wh	+ Wh	Imported Energy counter Pulse	
	- Wh	Exported Energy counter Pulse	
L/R CB Cmds	Open C/B	Open C/B command	
	Close C/B	Close C/B command	
	LocRem Inc	Local / Remote Inconsistency	
	missCBOpe	Missed C/B opening (Digital input missing)	
LT	LTPb	Output to operate an external flashing lamp signalling line test in progress	
	LTP	Line Test in progress	
	LTF	Line Test Failed	
	LT cmd	Line Test command	(Trip)
	Gen.Start	General start	
	Gen.Trip	General Trip	

0.D1	Digital Input “0.D1”	activated
0.D1 (not)	Digital Input “0.D1”	deactivated
0.D2	Digital Input “0.D2”	activated
0.D2 (not)	Digital Input “0.D2”	deactivated
0.D3	Digital Input “0.D3”	activated
0.D3 (not)	Digital Input “0.D3”	deactivated
0.D4	Digital Input “0.D4”	activated
0.D4 (not)	Digital Input “0.D4”	deactivated
1.D1	Digital Input “1.D1”	activated
1.D1 (not)	Digital Input “1.D1”	deactivated
1.D --	Digital Input “1.D--”	activated
1.D -- (not)	Digital Input “1.D--”	deactivated
1.D15	Digital Input “1.D15”	activated
1.D15 (not)	Digital Input “1.D15”	deactivated
2.D1	Digital Input “2.D1”	activated
2.D1 (not)	Digital Input “2.D1”	deactivated
2.D --	Digital Input “2.D--”	activated
2.D -- (not)	Digital Input “2.D--”	deactivated
2.D15	Digital Input “2.D15”	activated
2.D15 (not)	Digital Input “2.D15”	deactivated

19.4.1 – 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	Automatic reset	0.1	Off
2	0.R2 [Master board, R:2]		None	Off	Normally open	Automatic reset	0.1	Off

19.4.2 – "Relay"

Relay internal name

19.4.3 – "Linked function"

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

19.4.4 – "Operation Logic"

Not Used

19.4.5 – "Logical Status"

Relay Logical status

19.4.6 – "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.

19.4.7 – "tON - Operation Time"

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

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

19.4.8 – "Relay Status"

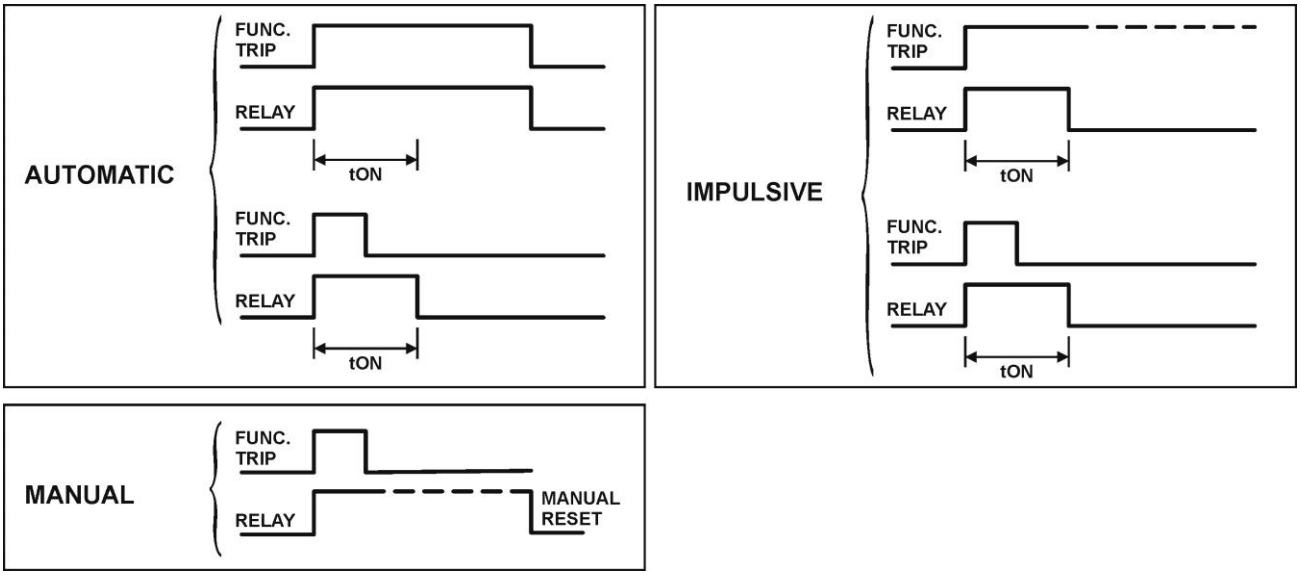
Relay – Physical status

19.4.9 – "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)

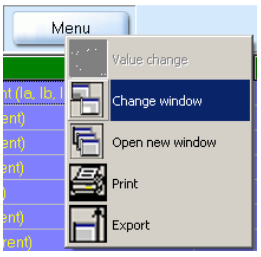
Manual : In this mode the output relay is "operated" when the controlling Functional Output is activated and remains in the operated condition until a manual reset command is issued by the relay keyboard (local commands menu) or via the serial communication. In this mode the timer "tON" has no effect.

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.

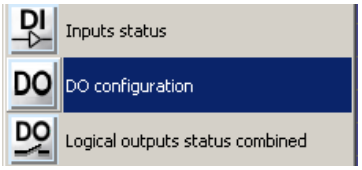


Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "DO Configuration"



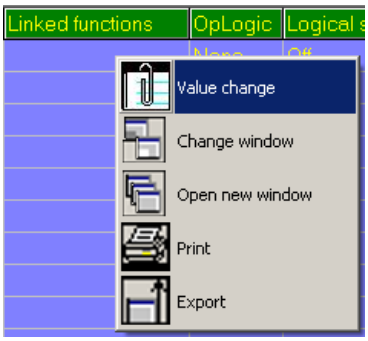
19.4.10 – Example: Change settings for "0.R1"

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

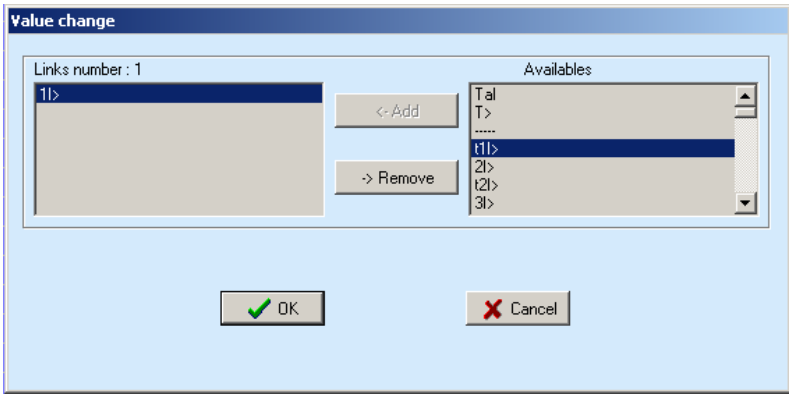
ID	Relay	Linked functions	OpLogic	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]		None	Off	Normally open	Automatic reset	0.1	Off
2	0.R2 [Master board, R:2]		None	Off	Normally open	Automatic reset	0.1	Off

19.4.11 – "Linked Functions"

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

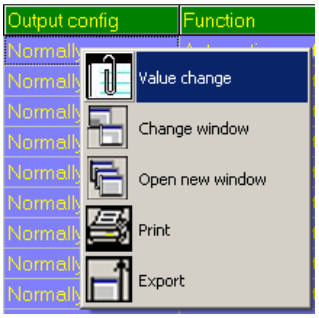


From box "Available", select "1I>" and press "Add".
Press "OK" for confirmation. (if Password is request, see § Password)

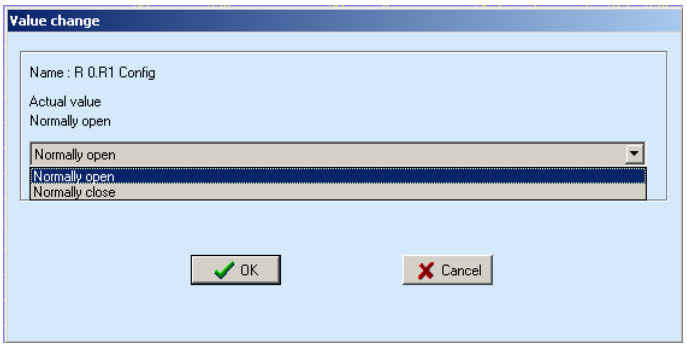


19.4.12 – "Output Config"

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

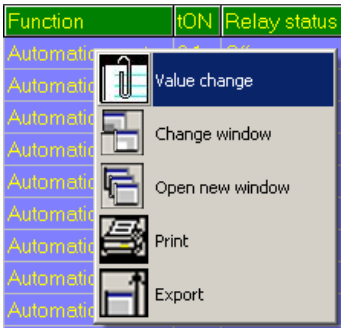


Select "**Normally Close**" from combo box and press "OK" (if Password is request, see § Password)

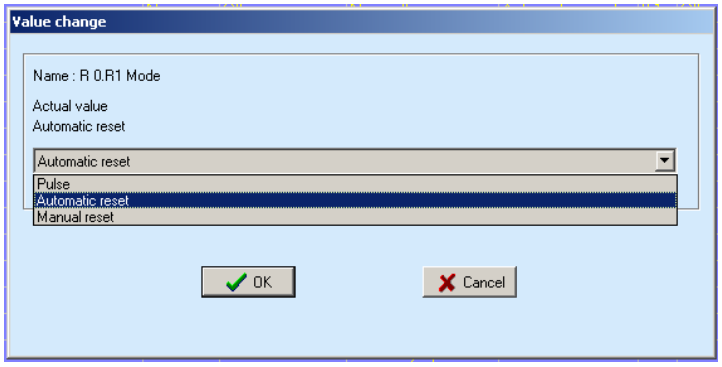


19.4.13 – "Function"

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

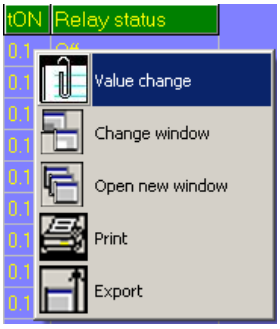


Select "**Pulse**" from combo box and press "OK" (if Password is request, see § Password):



19.4.14 – "tON"

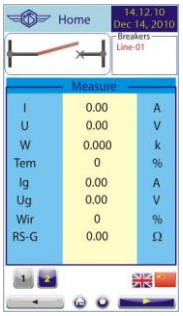
Select "**tON**" related to "0.R1" and press right button on mouse, select "Value change":



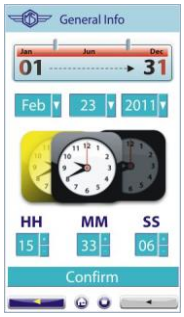
Select "**0.5**" from combo box and press "OK" (if Password is request, see § Password):

20. Tue 15.12.37 Dec 14, 2010 Date and Time

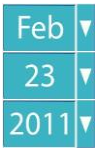
In this menu it is possible to configurate the Date and Time

1 

• Press "Tue 15.12.37 Dec 14, 2010" to access to the "Date and Time" menu.

2 

Through this control is possible change the system "Date"



To change month

To change day

To change year

Through this control is possible change the system "Time"

To change hours

To change minutes

To change seconds

Press Confirm to apply change

20.1- 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:

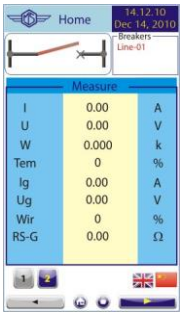
- Using the "MSCom II" software or from the DCS with the Modbus RTU protocol.

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

21. 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.

1

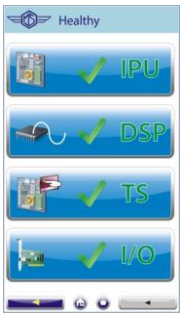


• Press "▬" to access to the "Desktop" menu with icons.

2

• Press "  " to access.

3



• In this menu is showed the status of device.

IPU Board		No IPU error		IPU faulty
DSP Board		No DSP error		DSP faulty
Touch Screen		No Touch Screen error		Touch Screen faulty
I/O Board		No I/O error		I/O faulty

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

For any repair please ask the Manufacturer or its authorized Dealers.

22. **Info** (Device Information)

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

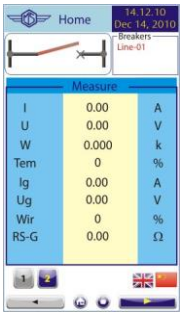
Line Name	Line identification label.	(1)
Station Name	Build identification label.	(1)
Serial Number	Relay Serial Number	Not modifiable
U-MLE-PLS	Protection Type	Not modifiable

(1) This information can only be modified by the interface program “MSCom II”

23. SW Version (Software Version)

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

1



• Press "▬" to access to the "Desktop" menu with icons.

2

• Press "2" to next page.

3

• Press "SW Version" to access.

4

• In this menu is showed the informations of device.

Type Relay		Type Relay	**U-MLEs-SC**
IPU		Firmware number	**0561.29.1.A**
DSP		Firmware number	**023.02.A**
Touch Screen		Firmware number	**0561.01.0.A**

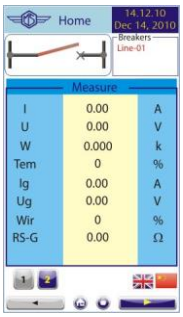
❑ **Application Software**

MSCom 2 1.03.38 or later

24. Display Cal. (Display Calibration)

In this menu it is possible to recalibrate the Display Touch.

1



- Press "▬" to access to the "Desktop" menu with icons.

2

- Press "2" to next page.

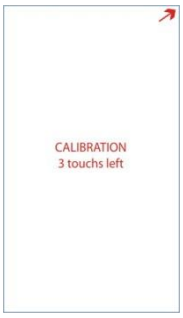
3

- Press "▬" to calibration.

4

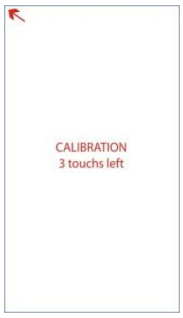
- Touch to continue.

5



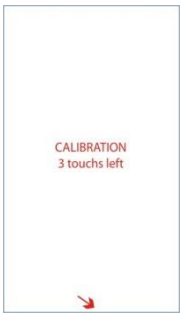
- 3 Touches Right-up.

6



- 3 Touches Left-up.

7



- 3 Touches Middle point down.

8

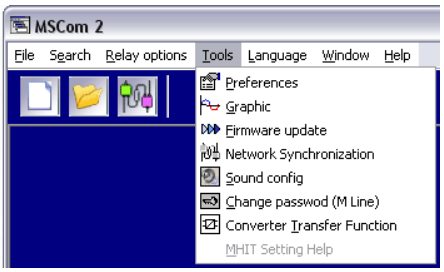
- Calibration Done.

24.1 – Set Default Calibration Touch Panel (via software MSCom2)

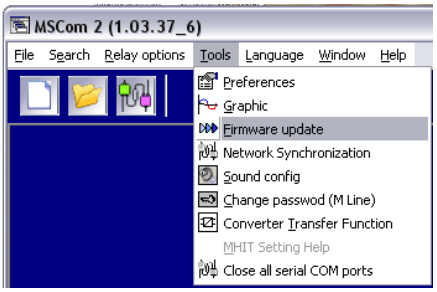
Insert USB cable in the front face connector.

Open MSCom2 software:

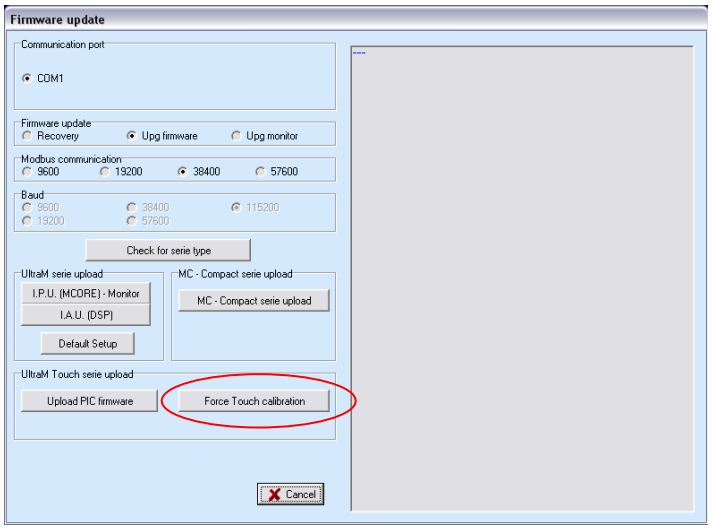
Select "**Tools**" on main menu:



Select "**Firmware update**" on main menu:



Press "**Force Touch calibration**":

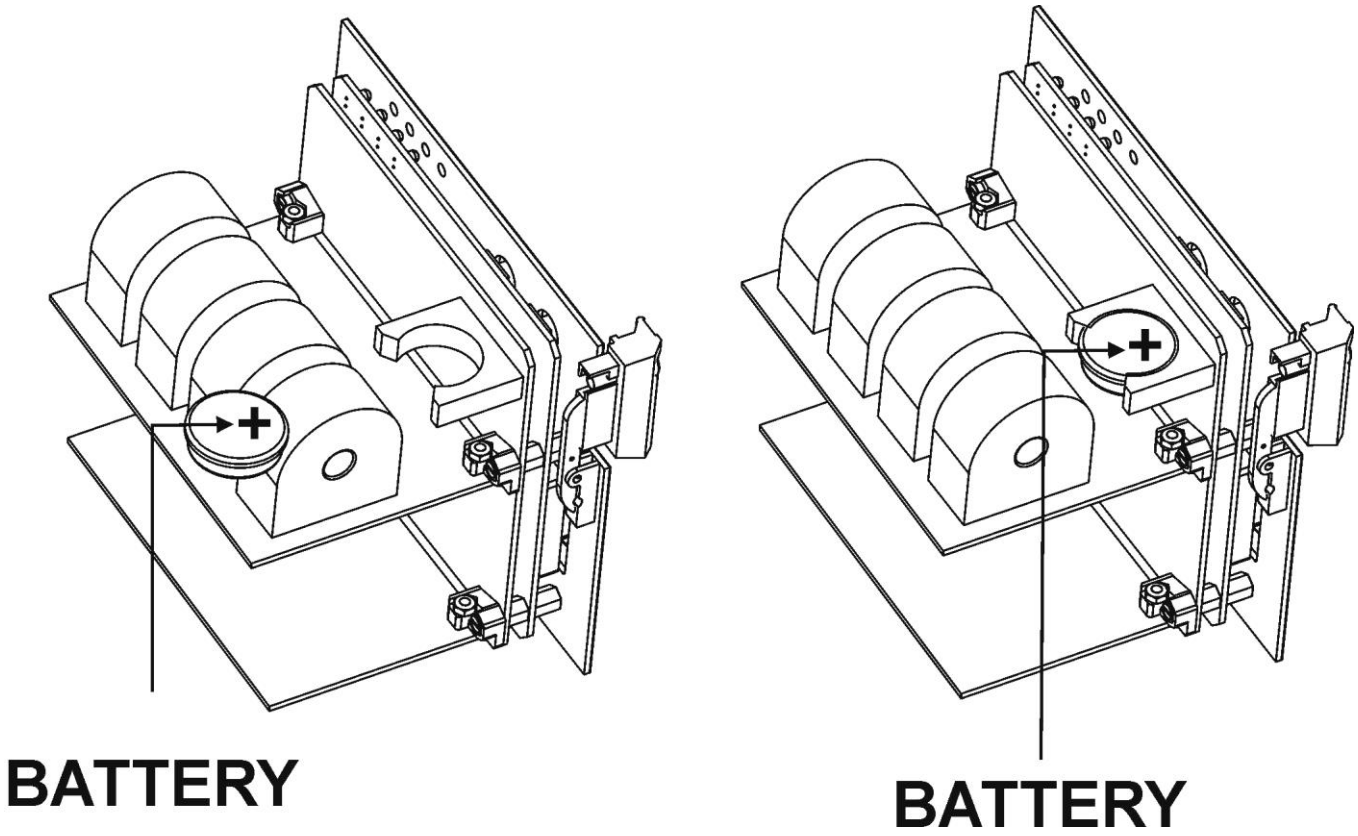


25. Battery

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:



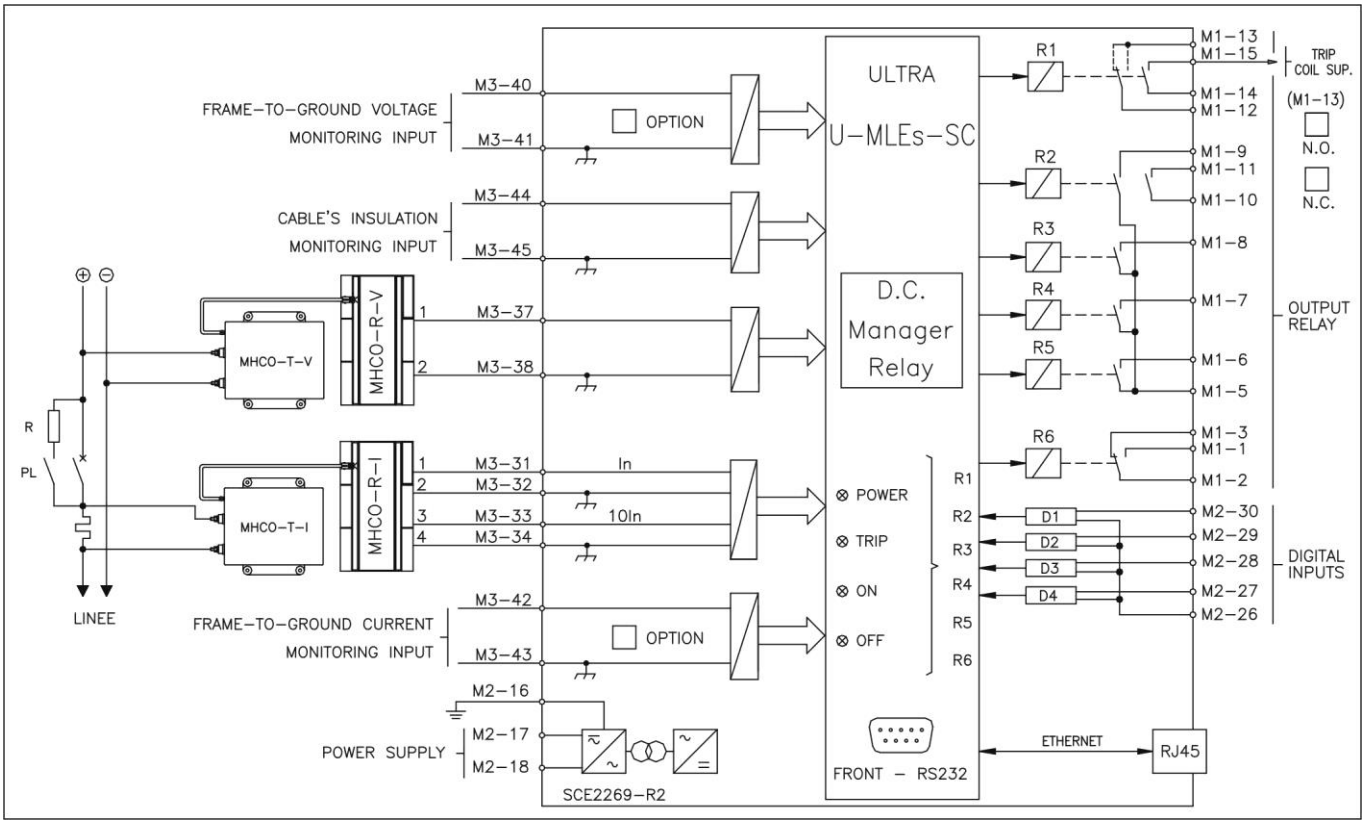
26. Maintenance

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.

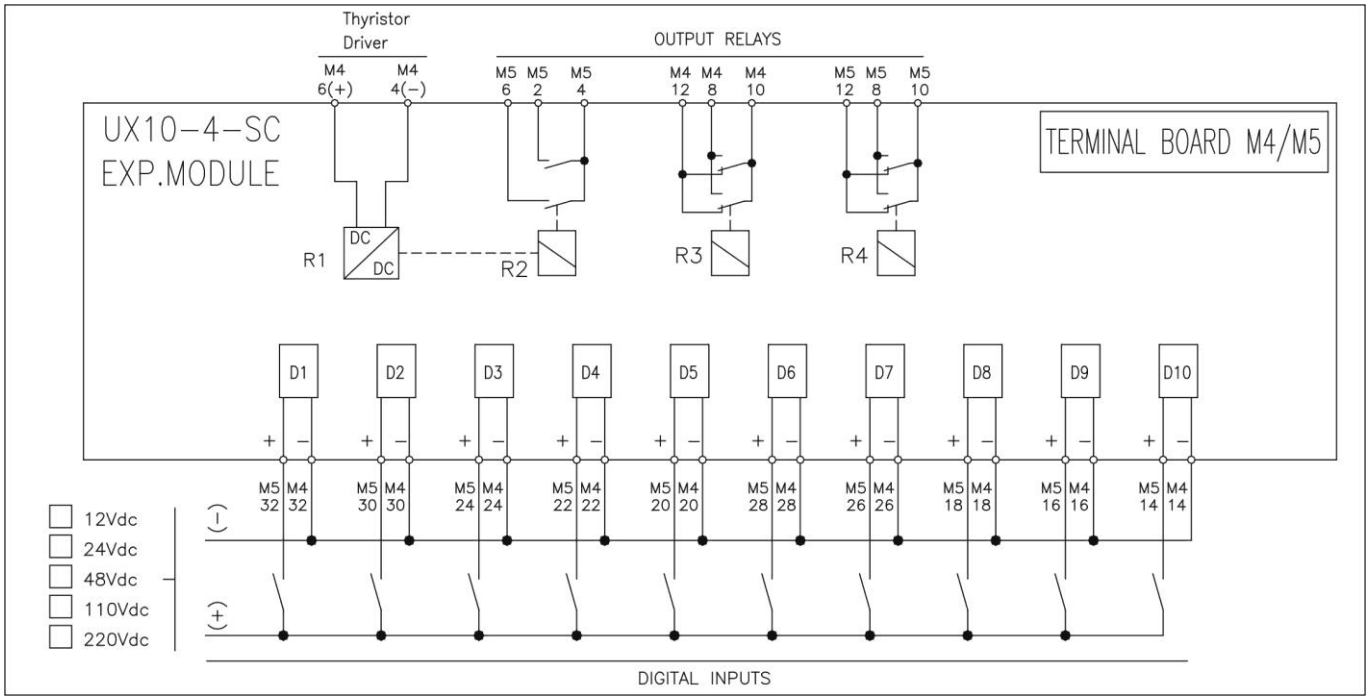
27. Power Frequency Insulation Test

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.

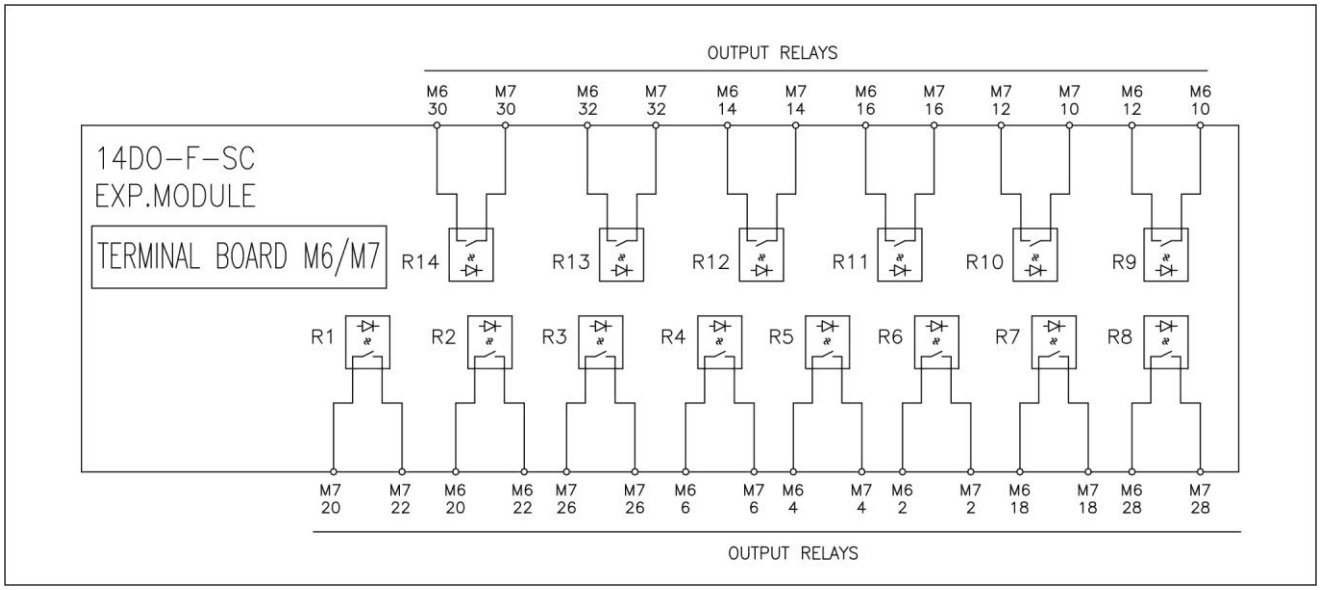
28. Wiring Diagram



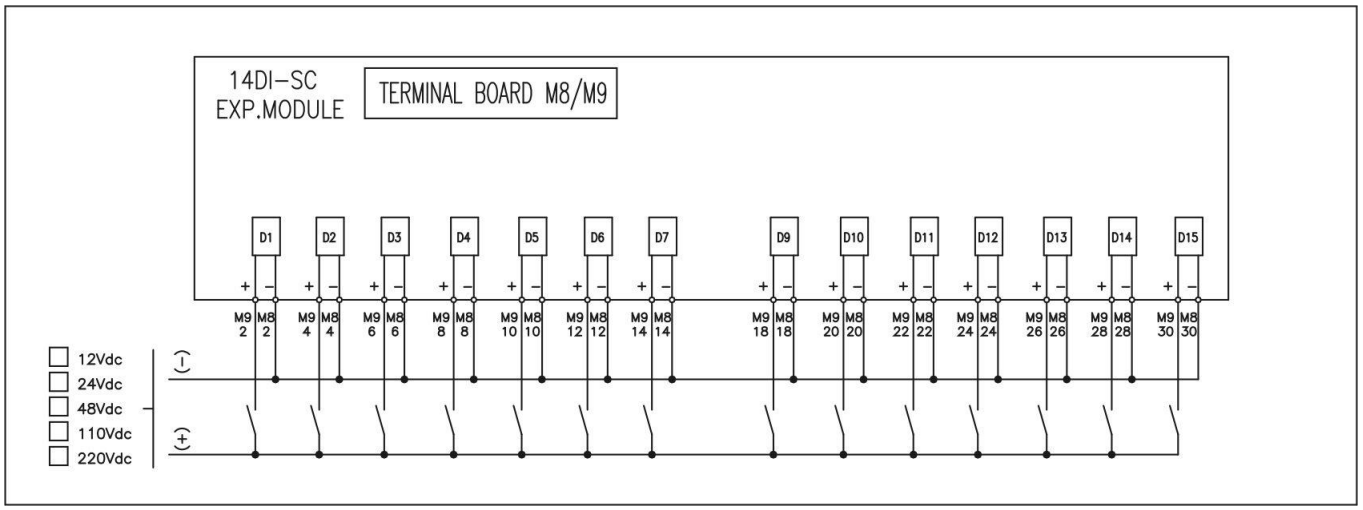
*28.1 – **UX10-4** - Expansion Module - Wiring Diagram (10 Digital Inputs + 4 Output Relays)*



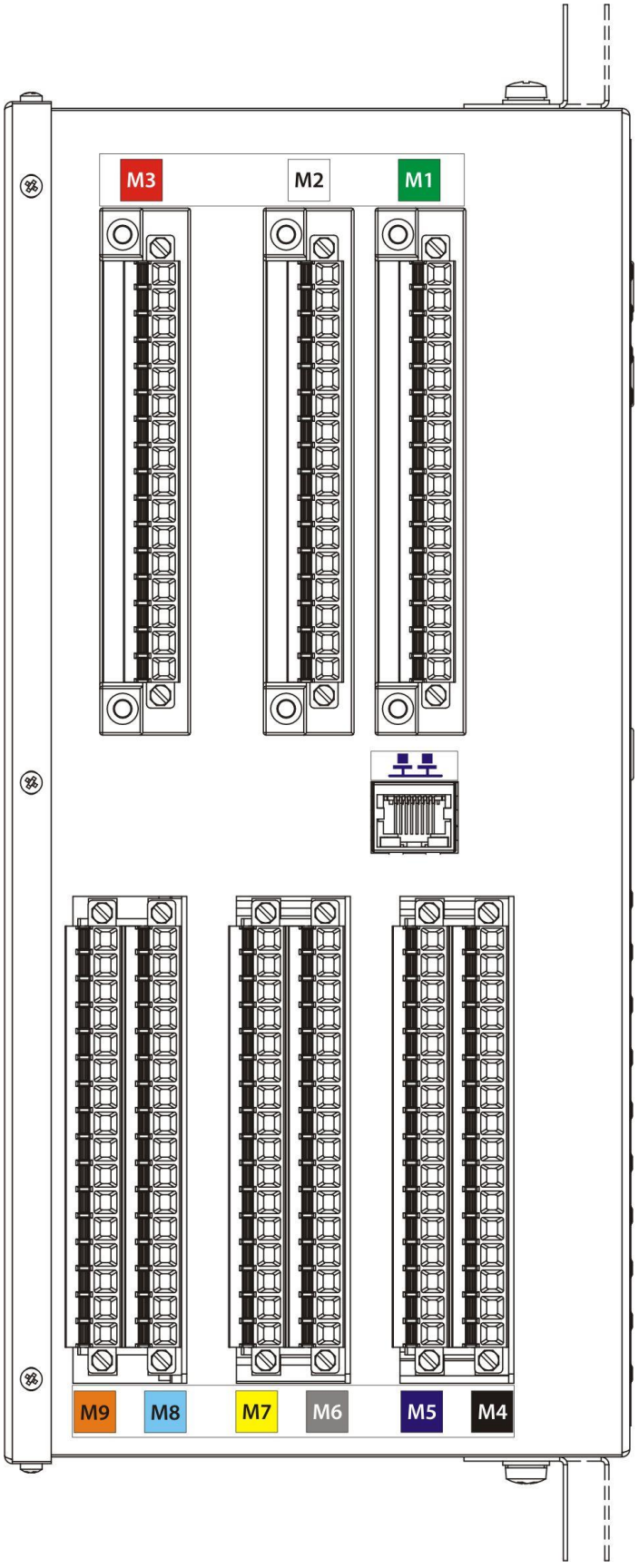
*28.2 – **14DO** - Expansion Module - Wiring Diagram (14 Output Relays)*



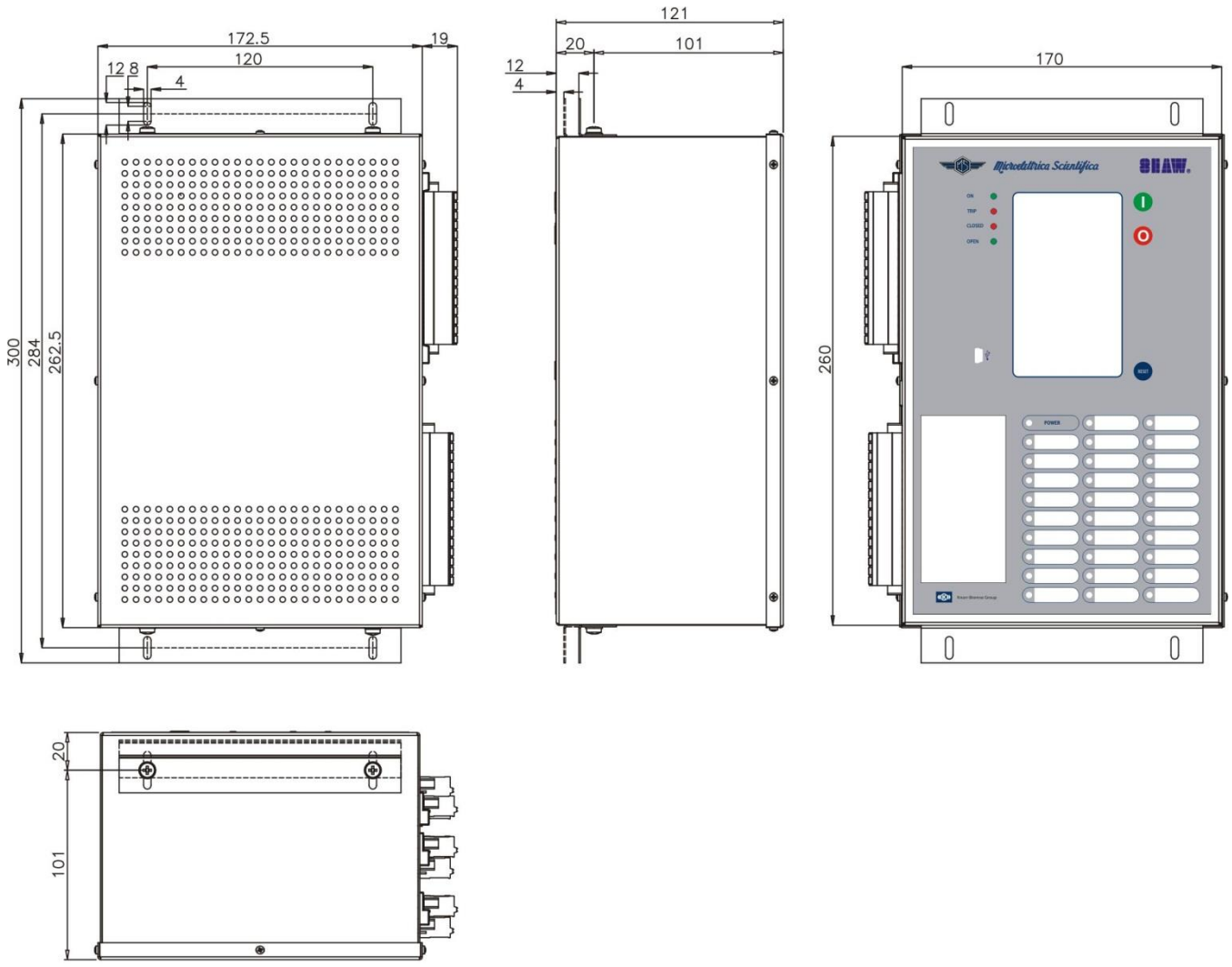
*28.3 – **14DI** - Expansion Module - Wiring Diagram (14 Digital Inputs)*



29. Terminals Block



30. Overall Dimensions



31. Electrical Characteristics

APPROVAL: CE

REFERENCE STANDARDS	**IEC 60255 - CE Directive - EN/IEC61000 - IEEE C37**			
❑ Dielectric test voltage	IEC 60255-5	2kV, 50/60Hz, 1 min.		
❑ Impulse test voltage	IEC 60255-5	5kV (c.m.), 2kV (d.m.) – 1,2/50μs		
❑ Insulation resistance	> 100MΩ			
Environmental Std. Ref. (IEC 60068)				
❑ Operation ambient temperature	-10°C / +55°C			
❑ Storage temperature	-25°C / +70°C			
❑ Environmental testing (Cold)	IEC60068-2-1			
(Dry heat)	IEC60068-2-2			
(Change of temperature)	IEC60068-2-14			
(Damp heat, steady state)	IEC60068-2-78	RH 93% Without Condensing AT 40°C		
CE EMC Compatibility (EN61000-6-2 - EN61000-6-4 - EN50263)				
❑ Electromagnetic emission	EN55011	industrial environment		
❑ Radiated electromagnetic field immunity test	IEC61000-4-3	level 3	80-2000MHz	10V/m
	ENV50204		900MHz/200Hz	10V/m
❑ Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
❑ Electrostatic discharge test	IEC61000-4-2	level 3	6kV contact / 8kV air	
❑ Power frequency magnetic test	IEC61000-4-8		1000A/m	50/60Hz
❑ Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs	
❑ Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz	
❑ Immunity to conducted common mode disturbance 0Hz-150KHz	IEC61000-4-16	level 4		
❑ Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz	
❑ HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)	
❑ Oscillatory waves (Ring waves)	IEC61000-4-12	level 4	4kV(c.m.), 2kV(d.m.)	
❑ Surge immunity test	IEC61000-4-5	level 4	2kV(c.m.), 1kV(d.m.)	
❑ Voltage interruptions	IEC60255-4-11			
❑ Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 10-500Hz 1g			
CARACTERISTICS				
❑ Accuracy at reference value of influencing factors	1% In	for measure		
	2% + to (to=20÷30ms @ 2xIs)	for times		
❑ Rated Current	0 - ±20mA (±40) ≡ 0 – In (2In)			
Rated Voltage	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			

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