D.C. SUBSTATION PROTECTIVE RELAY

TYPE

U-MLES-PLV-TS

(PLV+)

"ULTRA"

Line

OPERATION MANUAL

CE

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Knorr-Bremse Group

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1. General Utilization and Commissioning Directions

Always make reference to the specific description of the product and to the Manufacturer's instruction.
Carefully observe the following warnings.

1.1 - Storage and Transportation

Must comply with the environmental conditions stated 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.

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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 MHIT 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.

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2.1 - Power Supply

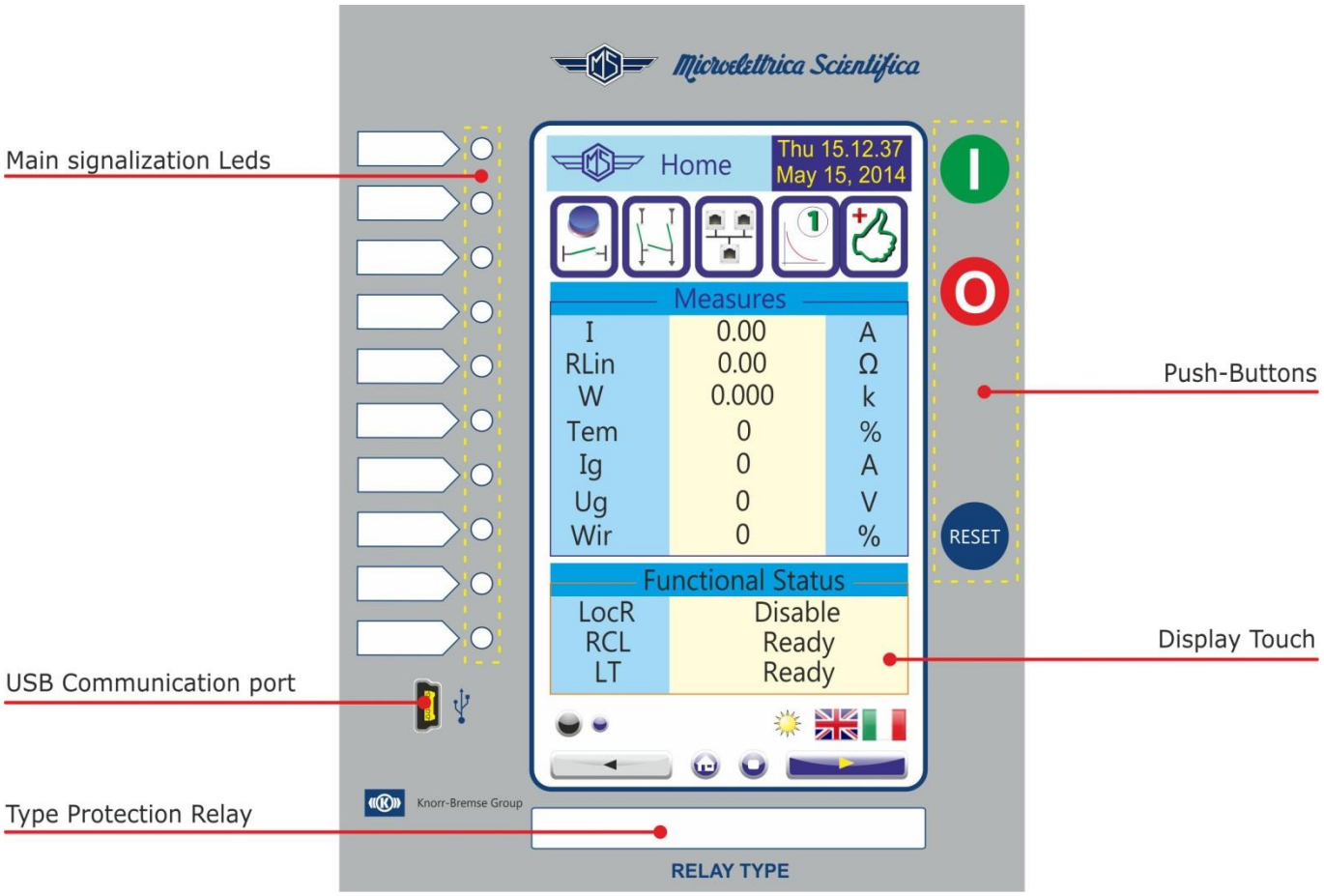
The relay can be fitted with two different types of **power supply**:

Type1 - { 24V(-20%) / 110V(+15%) a.c. ; 24V(-20%) / 125V(+20%) d.c.

Type 2 - { 80V(-20%) / 220V(+15%) a.c. ; 90V(-20%) / 250V(+20%) d.c.

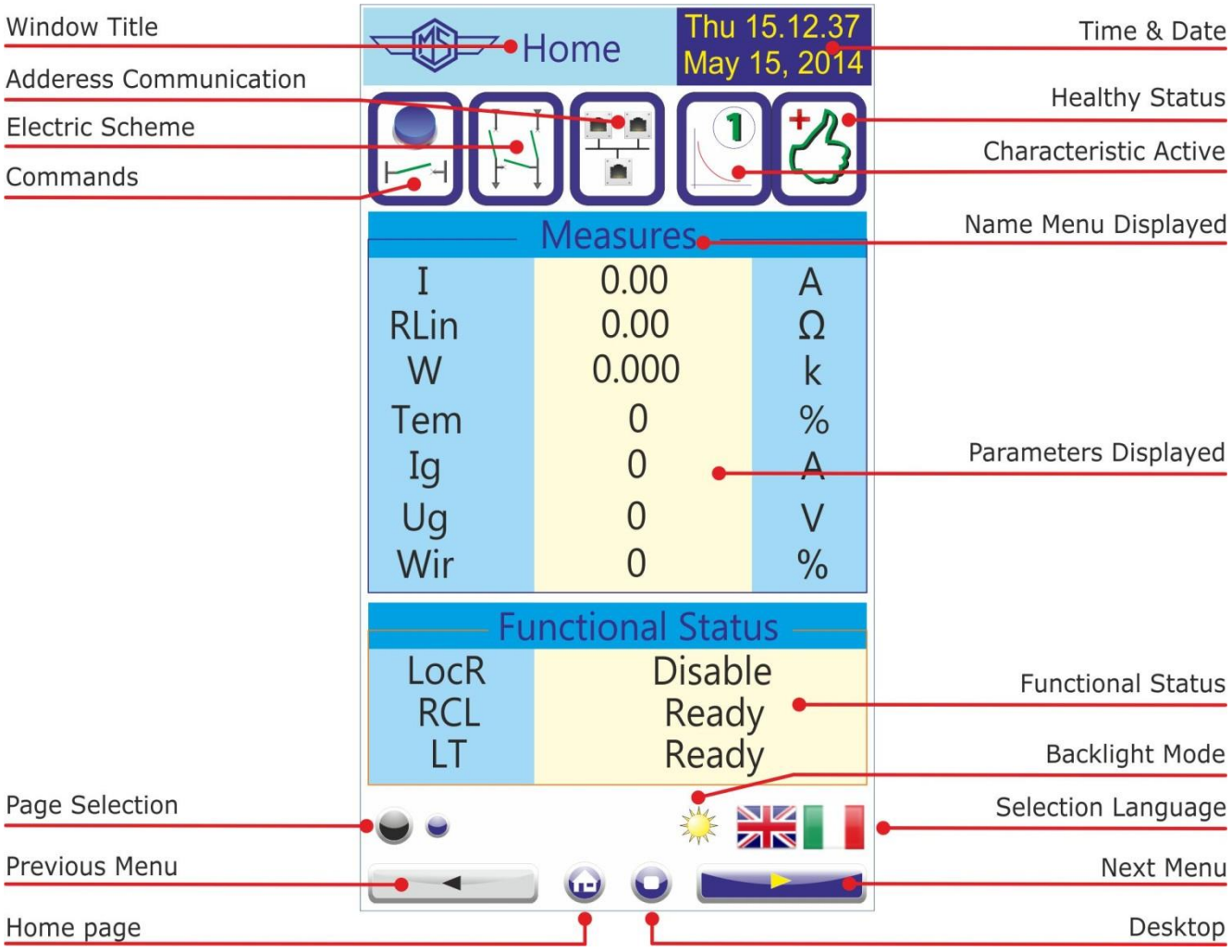
Before energizing the unit check that supply voltage is within the allowed limits.

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

5. Icons of Main Menu (Desktop)

Energy	Energy Measurements
ReadOnlyCnt	Total Counter (Read Only Counter)
Events	Event Recording
Commands	Local Commands
Counters	Partial Counters (Resettable Counter)
Last Trips	Last Trip
Settings	Function Settings
Systems	System Settings
Healthy	Diagnostic Information
InpCfg	*Inputs Configuration*
InpView	*Inputs View*
Info	General Info
OutCfg	*Outputs Configuration*
OutView	Outputs View
User Var	User Variable
Oscillo	Oscillographic recording (Not Available)
FW Version	Firmware version
Display Cal	Display Calibration

Page 1

Page 2

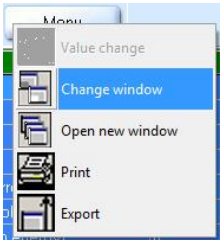
5.1 – Touch home measures settings (available only via MSCom2)

Through this menu is possible to set the order of parameters (maximum 30) shows in the home page

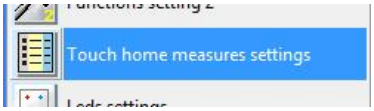
5.1.1 – Example

Open "**MSCOM2**" program and connect to the relay.

Select "Change Windows" from "Menu" button



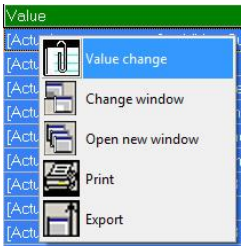
Select "Touch home measures settings".



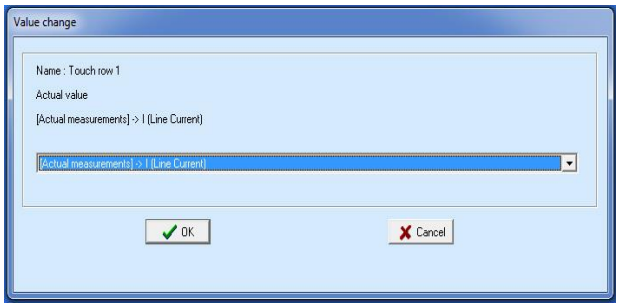
The window configuration will show:

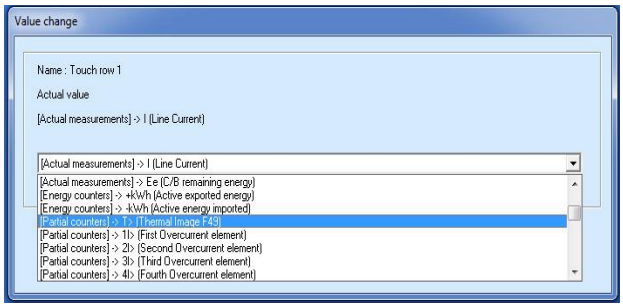
ID	Name	Value
1	Touch row 1	[Actual measurements] -> I (Line Current)
2	Touch row 2	[Actual measurements] -> RLin ()
3	Touch row 3	[Actual measurements] -> W (Power)
4	Touch row 4	[Actual measurements] -> Tem (Thermal Status %Tn)
5	Touch row 5	[Actual measurements] -> Ig (Frame to Ground fault current)
6	Touch row 6	[Actual measurements] -> Ug (Frame to Ground fault voltage)
7	Touch row 7	[Actual measurements] -> Wir (C/B residual interruption energy)
8	Touch row 8	[Actual measurements] -> Vv (C/B downstream voltage)
9	Touch row 9	[Actual measurements] -> Vm (C/B upstream voltage)
10	Touch row 10	[Actual measurements] -> A/ms (Current rate of rise)
11	Touch row 11	[Actual measurements] -> Rapp (Impedance monitoring)
12	Touch row 12	[Actual measurements] -> Ei (C/B remaining energy)
13	Touch row 13	[Actual measurements] -> Ee (C/B remaining energy)

Select "**Value**" related to "Touch row 1" and press right button on mouse, select "Value change":



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





Now on the relay display on line 1 will appear T>.

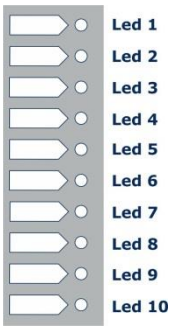
5.1.1.1 - Available parameters

I	*Actual Measurements*	*Line Current*	*default*
RLin	*Actual Measurements*	*Line resistance*	*default*
W	*Actual Measurements*	*Power*	*default*
Tem	*Actual Measurements*	*Thermal status*	*default*
Ig	*Actual Measurements*	*Frame to Ground fault current*	*default*
Ug	*Actual Measurements*	*Frame to Ground fault voltage*	*default*
Wir	*Actual Measurements*	*C/B residual interruption energy*	*default*
Vv	*Actual Measurements*	*C/B downstream voltage*	*default*
Vm	*Actual Measurements*	*C/B upstream voltage*	*default*
A/ms	*Actual Measurements*	*Current rate of rise*	*default*
Rapp	*Actual Measurements*	*Impedance monitoring*	*default*
Ei	*Actual Measurements*	*C/B Remaning energy*	*default*
Ee	*Actual Measurements*	*C/B Remaning energy*	*default*
+kWh	*Energy counters*	*Active Exported energy*	
-kWh	*Energy counters*	*Active Imported energy*	
T>	*Partial Counters*	*Thermal image*	
1I>	*Partial Counters*	*First overcurrent element*	
2I>	*Partial Counters*	*Second overcurrent element*	
3I>	*Partial Counters*	*Third overcurrent element*	
4I>	*Partial Counters*	*First overcurrent element*	
Iis>	*Partial Counters*	*Fourth overcurrent element*	
1dI	*Partial Counters*	*First current step element*	
2dI	*Partial Counters*	*Second current step element*	
1di/dt	*Partial Counters*	*First current rate of rise element*	
1di/dt	*Partial Counters*	*Second current rate of rise element*	
Rapp	*Partial Counters*	*Impedance monitoring di/dt dependence*	
Iapp	*Partial Counters*	*Current monitoring with di/dt dependence*	
1Ig	*Partial Counters*	*First frame fault element*	
2Ig	*Partial Counters*	*Second frame fault element*	
RCL	*Partial Counters*	*Recloser*	
LT	*Partial Counters*	*Line Test*	
1U>	*Partial Counters*	*First Overvoltage element*	
2U<	*Partial Counters*	*Second Overvoltage element*	
1U<	*Partial Counters*	*First Undervoltage element*	
2U<	*Partial Counters*	*Second Undervoltage element*	
RT	*Partial Counters*	*Remote Trip*	
IRF	*Partial Counters*	*Internal Relay Fault*	
TCS	*Partial Counters*	*Trip circuit supervision*	
BrkF	*Partial Counters*	*Breaker Failure*	
Ni	*Partial Counters*	*Trip number arcs interrupts operation*	
Ne	*Partial Counters*	*Trip number electrical contact operation*	
Nm	*Partial Counters*	*Trip number mechanical operation of circuit breaker*	
AutOp	*Partial Counters*	*Automatic C/B open*	
AutCl	*Partial Counters*	*Automatic C/B close*	
ManOp	*Partial Counters*	*Manual / Intentional C/B open*	
ManCl	*Partial Counters*	*Manual / Intentional C/B close*	
OvrOp	*Partial Counters*	*Overall C/B open (automatic + Intentional)*	
OvrCl	*Partial Counters*	*Overall C/B close (automatic + Intentional)*	
RTX	*Partial Counters*	*Remote Trip*	
SelfTrip	*Partial Counters*	*Spontaneous protection trip*	
DiaCB1	*Partial Counters*	*C/B1 Input position discremancy*	
AnCB1	*Partial Counters*	*C/B1 Operation failure*	
OpCB1	*Partial Counters*	*C/B1 Openings operation*	
ClCB1	*Partial Counters*	*C/B1 Closures operation*	
DiaCB2	*Partial Counters*	*C/B1 Input position discremancy*	
AnCB2	*Partial Counters*	*C/B1 Operation failure*	
OpCB2	*Partial Counters*	*C/B1 Openings operation*	
ClCB2	*Partial Counters*	*C/B1 Closures operation*	
DiaCB3	*Partial Counters*	*C/B1 Input position discremancy*	
AnCB3	*Partial Counters*	*C/B1 Operation failure*	
OpCB3	*Partial Counters*	*C/B1 Openings operation*	
ClCB3	*Partial Counters*	*C/B1 Closures operation*	
DiaCB4	*Partial Counters*	*C/B1 Input position discremancy*	
AnCB4	*Partial Counters*	*C/B1 Operation failure*	
OpCB4	*Partial Counters*	*C/B1 Openings operation*	
ClCB4	*Partial Counters*	*C/B1 Closures operation*	
DiaCB5	*Partial Counters*	*C/B1 Input position discremancy*	
AnCB5	*Partial Counters*	*C/B1 Operation failure*	
OpCB5	*Partial Counters*	*C/B1 Openings operation*	
ClCB5	*Partial Counters*	*C/B1 Closures operation*	

6. Signalization

Ten signal leds are provided:

N°	Colour	Default Status
Led 1	Green	Not Assigned
Led 2	Red	Not Assigned
Led 3	Yellow	Not Assigned
Led 4	Yellow	Not Assigned
Led 5	Yellow	Not Assigned
Led 6	Red	Not Assigned
Led 7	Red	Not Assigned
Led 8	Red	Not Assigned
Led 9	Red	Not Assigned
Led 10	Green	Not Assigned



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

Reset from Illuminated status is manual (see § Commands)

6.1 – Display of the last trip

When a generic function trip, the display shows a window indicating the last function that has tripped and the number of events that are stored in the memory. The display will show this window until the reset button or external reset are operated.

Number of trip before reset.

Function tripped

Press to erase visualization

Press to visualization trip parmeter

6.2 - Leds Configuration

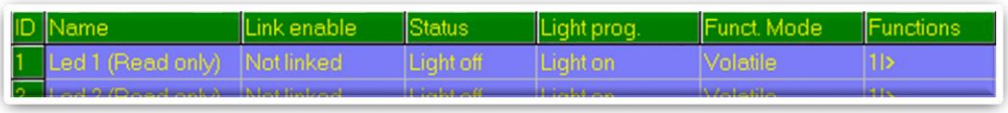
For Leds' programming (only via MSCom2) operate as follows:

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>

6.2.1 - Name

Led name – for leds position see picture

6.2.2 - Link enable

Linked	=	Enable to operate
No Linked	=	Disable

6.2.3 - Status

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

6.2.4 - Light Prog.

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

6.2.5 - Funct. Mode

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

6.2.6 - Functions

Select the function assigned to specific led (see table 1).
It's possible to configure only one function for each led.
For configuration multiple functions use "UserVar" function.

6.2.7 - 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*
3I>	**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 dependance*
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*
RT	**RT** **tRT**	(Trip) (Start)	*First Instantaneous Remote Trip* *First Time delayed Remote Trip*
Wi	**tWi>** **Ni** **aINi** **Ne** **aINe** **Nm** **aINm**		*Circuit breaker maintenance level* *Maximum number of arc chute operation at nominal values* *Alarm maintenance level of arc chute operation* *Maximum number of arc contact operation at nominal values* *Alarm maintenance level of arc contact operation* *Maximum number of mechanical operation* *Alarm maintenance level of mechanical operation*
TCS	**tTCS**	(Trip)	*Time delayed Trip Circuit Supervision*
IRF	**IRF** **tIRF**	(Start) (Trip)	*Time delayed Internal relay Fault* *Instantaneous Internal relay Fault*
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	**cmdOpCB** **cmdClCB** **LocRemInc** **missCBOpe**		*Open C/B command* *Close C/B command* *Local / Remote Inconsistency* *Missed C/B opening (Digital input missing)*
LT	**LTPb** **LTP** **LTF** **LTOK** **LTB** **LT cmd**	(Trip)	*Output to operate an external flashing lamp signalling line test in progress* *Line Test in progress* *Line Test Failed* *Line Test OK* *Line Test Blocked* *Line Test Command*
	Gen.Start **Gen.Trip**		*Start Generic* *Trip Generic*
	UserTriggerOscillo		*User Variable for Oscillographic Recording*
	UserVar<0> **to** **UserVar<48>**		*User Variable*

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MasterOp1	*Modbus Master CB1 Open request*		
MasterCl1	*Modbus Master CB1 Close request*		
MasterOp2	*Modbus Master CB2 Open request*		
MasterCl2	*Modbus Master CB2 Close request*		
MasterOp3	*Modbus Master CB3 Open request*		
MasterCl3	*Modbus Master CB3 Close request*		
MasterOp4	*Modbus Master CB4 Open request*		
MasterCl4	*Modbus Master CB4 Close request*		
MasterOp5	*Modbus Master CB5 Open request*		
MasterCl5	*Modbus Master CB5 Close request*		
CB1Fail	*CB1 Failure*		
CB2Fail	*CB2 Failure*		
CB3Fail	*CB3 Failure*		
CB4Fail	*CB4 Failure*		
CB5Fail	*CB5 Failure*		
CB1MissedOP	*CB1 Missed Operation*		
CB2MissedOP	*CB2 Missed Operation*		
CB3MissedOP	*CB3 Missed Operation*		
CB4MissedOP	*CB4 Missed Operation*		
CB5MissedOP	*CB5 Missed Operation*		
SelfTrip	Spontaneous protection		
t-SelfTrip	Self-Trip time delay		
Vcc	*Reserved*		
Gnd	*Reserved*		
ResLog	*Reset signal logic*		
P1	*Push-button Open*		
P2	*Push-button Close*		
0.D1	*Digital Input "0.D1"*	*activated*	*Digital Input on Main Relay*
0.D1Not	*Digital Input "0.D1"*	*deactivated*	
to			
0.D4	*Digital Input "0.D4"*	*activated*	
0.D4Not	*Digital Input "0.D4"*	*deactivated*	
1.D1	*Digital Input "1.D1"*	*activated*	*Digital input on Expansion Board*
1.D1Not	*Digital Input "1.D1"*	*deactivated*	
to			
1.D15	*Digital Input "1.D15"*	*activated*	
1.D15Not	*Digital Input "1.D15"*	*deactivated*	
2.D1	*Digital Input "2.D1"*	*activated*	*Digital input on Expansion Board*
2.D1Not	*Digital Input "2.D1"*	*deactivated*	
to			
2.D15	*Digital Input "2.D10"*	*activated*	
2.D15Not	*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*		
2.R1 to **2.R14**	*Output relays on Expansion Board*		

6.3 - 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 =

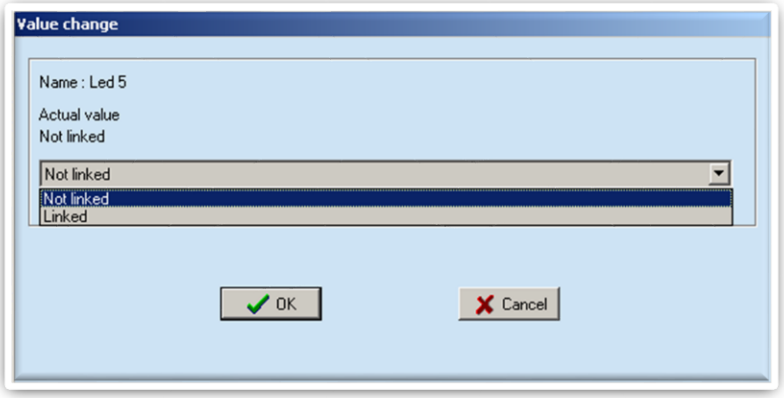
Main Windows:

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

6.3.1 - "Enable"

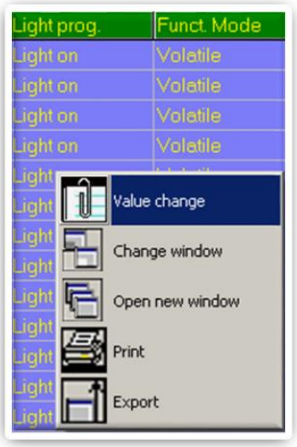
Select "**Link enable**" related to "Led 5" and press right button on mouse, select "Value change":

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

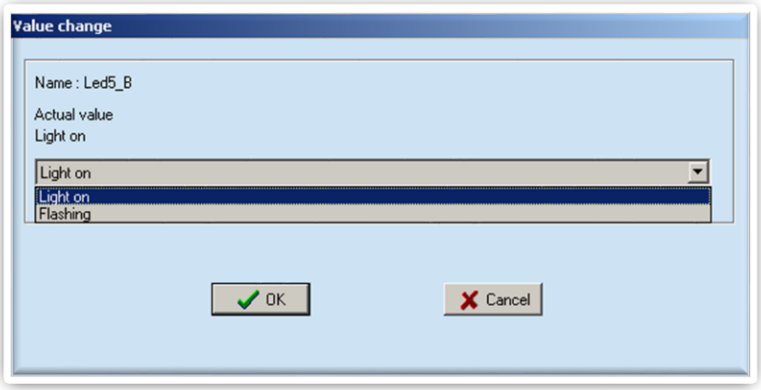


6.3.2 - "Flashing"

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



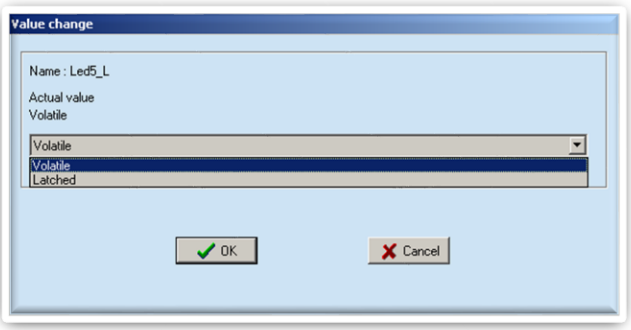
Select "**Flashing**" from combo box and press "OK" (if Password is request, see § Password):



6.3.3 - "Latched"

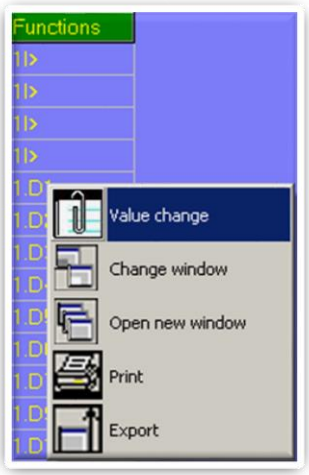
Select "**Latched**" related to Led 5 and press right button on mouse, select "Value change":

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

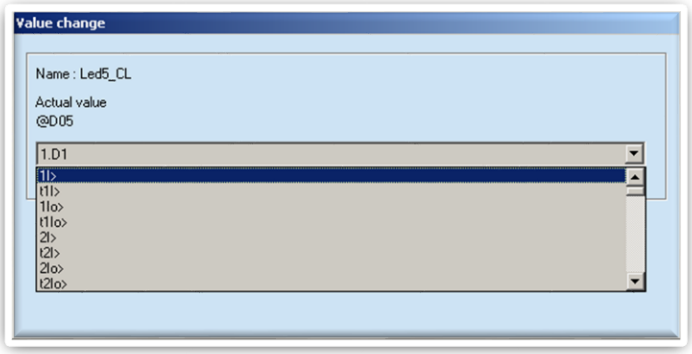


6.3.4 - "Functions"

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):



7. 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.

7.1 - Name

Internal progressive name

7.2 - User Descr.

Custom identification label for user variable

7.3 - Linked functions

Selection functions

7.4 - OpLogic

Operation Logic = [None, OR, AND, XOR, NOR, NAND, NOT, Ff-SR, Counter, Rise-Up, Fall-Down]

7.5 - Timer

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

7.6 - Timer type

Delay	=	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
Monostable P	=	Monostable Positive , the positive length of set signal is determinate by the timer
Monostable N	=	Monostable Negative , the negative length of set signal is determinate by the timer
Blinking	=	The output blink at the specify period
Delay-Fall-Down	=	Delay to change edge

7.7 - Logical status

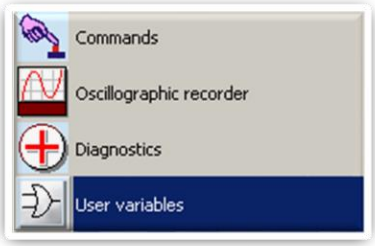
"User Variable" Logical status

7.8 - Example: Setting "User Variable"

Open "**MSCOM2**" program and connect to the relay.

Select "Change Windows" from "Menu" button

Select "**USER VARIABLE**"



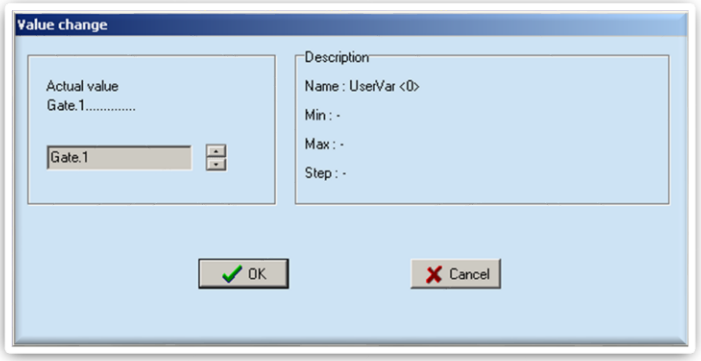
Setting for "**USERVAR<0>**" : "**Current Trip**", "**1I>,2I>,3I>**", "**OR**", "**1**", "**Monostable**".

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

7.8.1 - "User description" (User descr.)

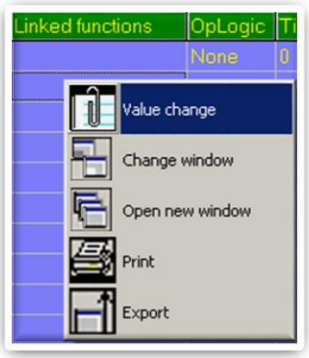
Select "**User descr**" related to "UserVar<0>" and press right button on mouse, select "Value change":

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

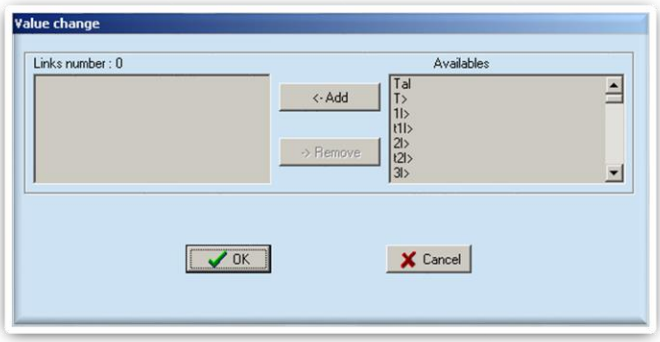


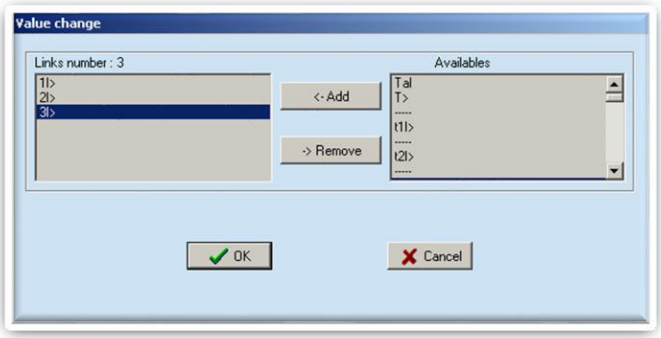
7.8.2 - "Linked Functions"

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



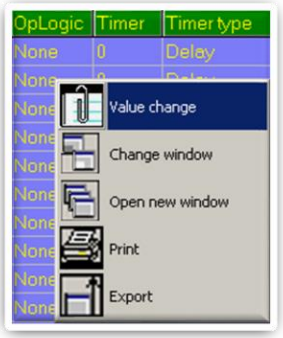
Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".



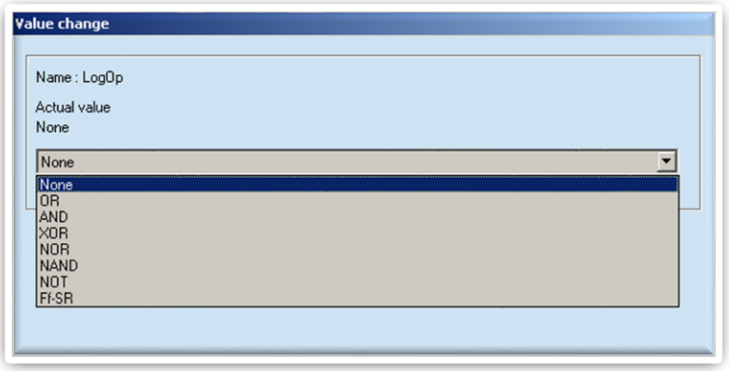


7.8.3 - "Operation Logic" (Oplogic)

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

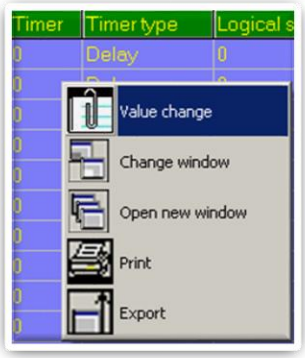


Insert "**OR**" into box and press "OK":

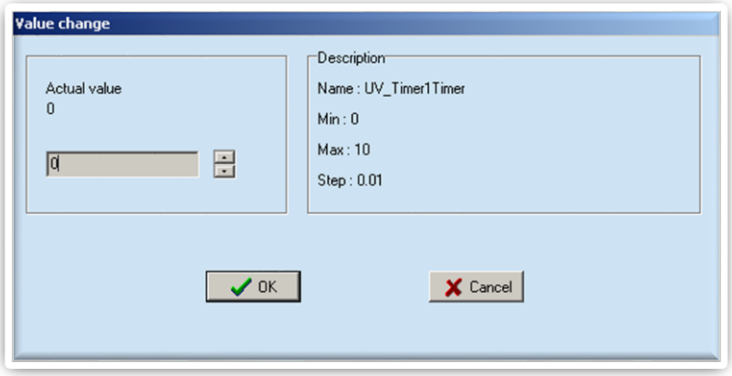


7.8.4 - "Timer"

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

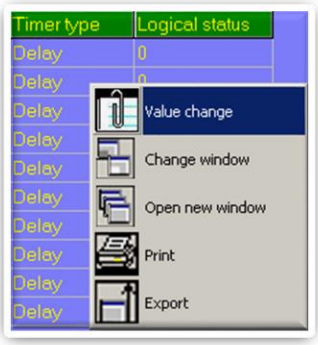


Select "**1**" into box and press "OK":

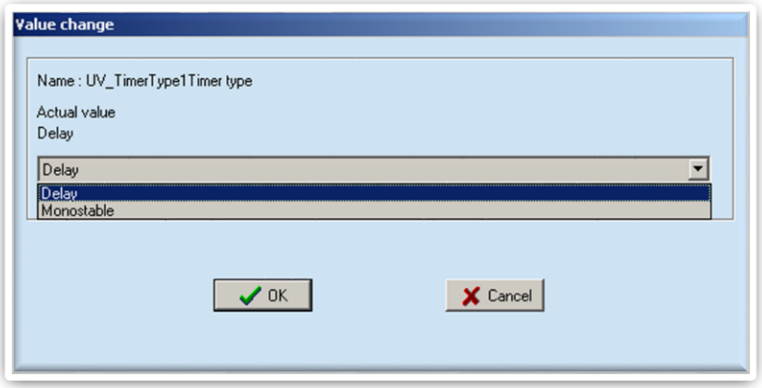


7.8.5 - "Timer type"

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

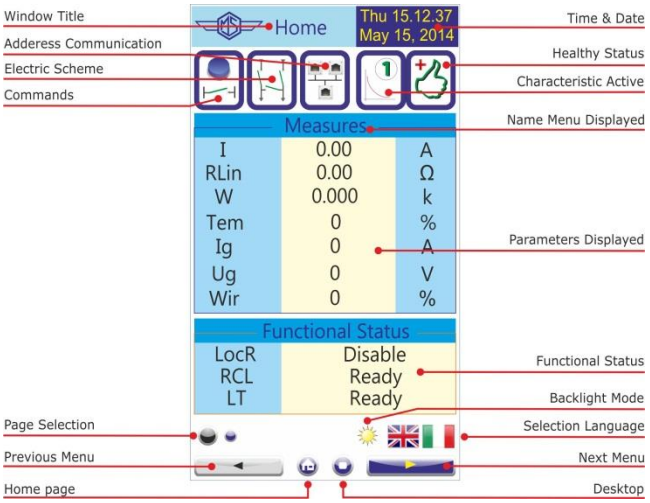


Select "**Monostable**" into box and press "OK":



8. Home

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



Time and Date	Tue 15.12.37 Dec 09, 2012	Displayed Current Date and Time	
Breaker Status (When pressed opens the menu commands)		Breaker Open	Breaker Closed
Electric Scheme		Shows electric scheme	Shows the measure
Communication (When pressed opens the menu commands)		Communication options	Communication option not present
Characteristic Active (When pressed opens the menu characteristics)		Characteristic "1" Active	Characteristic "2" Active
Healthy (When pressed opens the menu Healty)		Normal condition	Faulty (see § Healthy)
Page Selection		Page Active	Next page
Menu Selection		Menu active	Next menu
Backlight Mode		Backlight always active	Backlight Off in 2 minutes

Parameters displayed in the Home page:

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

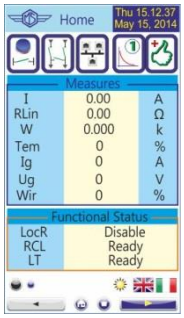
9. Commands

"***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	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
→	**Reset**	**Ei**	Reset of C/B arc chute remaining energy	Yes
→	**Reset**	**Ee**	Reset of C/B arc contact remaining energy	Yes
→	**Leds**	**Test**	Signal Leds test	*No*
→	**OffsetOn**	**Field**	Calculate Offset of current sensor	Yes
→	**Event**	**Clear**	Manual reset of Events	Yes
→	**LTrip**	**Clear**	Manual reset of Last Trips	Yes
→	**Counter**	**Clear**	Manual reset of Counters	Yes
→	**Energy**	**Clear**	Manual reset of Energy	Yes

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

1

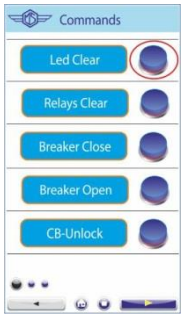


• Press "▬" for access to the "Desktop" menu with icons.

2

• Press " " for access to the menu.

3



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

4

• The blue *pushbutton* " " change into green " " and execute the command.
When command has been executed the display return in the normal position.

10. 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).

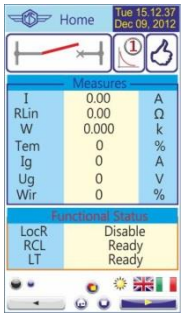
→ **I**	(0 ± 9999)	**A**	Line current
→ **RLin**	(0 ÷ 9999)	**Ω**	Line resistance
→ **W**	(0.00÷99.99÷999.9÷9999999)	**kW**	Power
→ **Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→ **Ig**	(0 ± 9999)	**A**	Frame to ground fault current
→ **Ug**	(0 ±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

11. Energy

Real time energy measurements

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

1

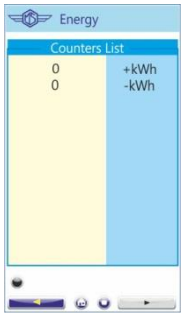


• Press "▬" for access to the "Desktop" icons.

2

• Press " " for access to the Energy parameters.

3



• Display of Real time Energy measurements.

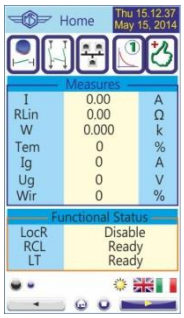
12. Last Trips

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**	(0 ± 9999)	**A**	Line current
→	**RLin**	(0 ÷ 9999)	**Ω**	Line Resistance
→	**W**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**kW**	Power
→	**Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn
→	**Ig**	(0 ± 9999)	**A**	Frame to ground fault current
→	**Ug**	(0 ± 9999)	**V**	Frame to ground fault voltage
→	**Wir**	(100 ÷ 0)	**%W**	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.
→	**Vv**	(0 ± 9999)	**V**	Voltage before C/B
→	**Vm**	(0 ± 9999)	**V**	Voltage after C/B
→	**A/ms**	(0 ÷ 9999)		Current rate of raise
→	**Rapp**	(0 ÷ 1000)	**Ω**	Impedance monitoring
→	**Ei**	(0 ÷ 100)	**%**	C/B arc chute remaining energy
→	**Ee**	(0 ÷ 100)	**%**	C/B arc contact remaining energy
→	**DI-1**	(0 ÷ 9999)	**A**	First current step element
→	**DI-2**	(0 ÷ 9999)	**A**	Second current step element

Erase	→	See § Commands

1



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

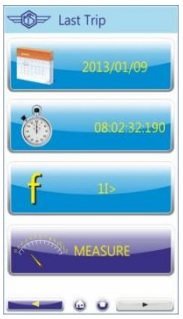
2

• Press "" to access to the Last Trip list.

3

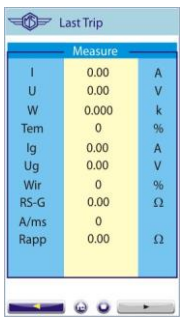
• Display list.
• Press selected Trip recorded.

4



• Select "MEASURE".

5



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

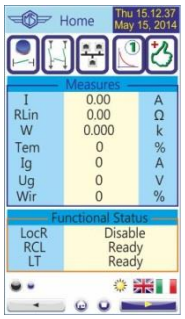
13. Counters

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 Current Element
	→ **1dI**	0	Operations counters	First current step element
	→ **2dI**	0	Operations counters	Second current step element
	→ **1didt**	0	Operations counters	First current rate of rise element
	→ **2didt**	0	Operations counters	Second current rate of rise element
	→ **Rapp**	0	Operations counters	Impedance monitoring (di/dt dependence)
	→ **Iapp**	0	Operations counters	Current monitoring with di/dt dependence
	→ **1Ig**	0	Operations counters	First Frame Fault element
	→ **2Ig**	0	Operations counters	Second Frame Fault element
	→ **RCL**	0	Operations counters	Automatic Reclosure
	→ **LT**	0	Operations counters	Automatic Line Test
	→ **1U>**	0	Operations counters	First Overvoltage element
	→ **2U>**	0	Operations counters	Second Overvoltage element
	→ **1U<**	0	Operations counters	First Undervoltage element
	→ **2U<**	0	Operations counters	Second Undervoltage element
	→ **RT**	0	Operations counters	First Remote Trip
	→ **IRF**	0	Operations counters	Internal Relay Fault
	→ **TCS**	0	Operations counters	Trip Circuit Supervision
	→ **BrkF**	0	Operations counters	Breaker failure to open
	→ **Ni**	0	Operations counters	Arcs interrupts
	→ **Ne**	0	Operations counters	Electrical contact operations
	→ **Nm**	0	Operations counters	Mechanical operations of circuit breaker
	→ **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
	→ **selfT**	0	Operations counters	Spontaneous protection trip
	→ **DiaCB1**	0	Operations counters	C/B1 Input position discrepancy
	→ **AnCB1**	0	Operations counters	C/B1 Operation Failure
	→ **OpCB1**	0	Operations counters	C/B1 Openings operation
	→ **ClCB1**	0	Operations counters	C/B1 Closures operation
	→ **DiaCB2**	0	Operations counters	C/B2 Input position discrepancy
	→ **AnCB2**	0	Operations counters	C/B2 Operation Failure
	→ **OpCB2**	0	Operations counters	C/B2 Openings operation
	→ **ClCB2**	0	Operations counters	C/B2 Closures operation
	→ **DiaCB3**	0	Operations counters	C/B3 Input position discrepancy
	→ **AnCB3**	0	Operations counters	C/B3 Operation Failure
	→ **OpCB3**	0	Operations counters	C/B3 Openings operation
	→ **ClCB3**	0	Operations counters	C/B3 Closures operation
	→ **DiaCB4**	0	Operations counters	C/B4 Input position discrepancy
	→ **AnCB4**	0	Operations counters	C/B4 Operation Failure
	→ **OpCB4**	0	Operations counters	C/B4 Openings operation
	→ **ClCB4**	0	Operations counters	C/B4 Closures operation
	→ **DiaCB5**	0	Operations counters	C/B5 Input position discrepancy
	→ **AnCB5**	0	Operations counters	C/B5 Operation Failure
	→ **OpCB5**	0	Operations counters	C/B5 Openings operation
	→ **ClCB5**	0	Operations counters	C/B5 Closures operation

Erase	→	See § Commands (By the interface program "MSCom2" it is possible to individually reset the counters and set an initial starting number)

1

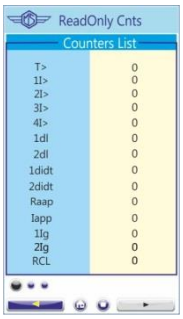


• Press "▬" for access to the "Desktop" menu with icons.

2

• Press "0.0.0" for access to the counters list.

3



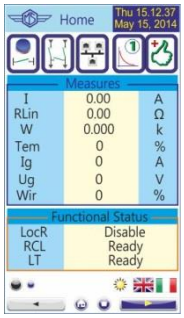
• The display show the list.

14. ReadOnlyCnt

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

Display					
	→	**T>**	0	Operations counters	Thermal Image
	→	**1I>**	0	Operations counters	First overcurrent element
	→	**2I>**	0	Operations counters	Second overcurrent element
	→	**3I>**	0	Operations counters	Third overcurrent element
	→	**4I>**	0	Operations counters	Fourth overcurrent element
	→	**1dI**	0	Operations counters	First current step element
	→	**2dI**	0	Operations counters	Second current step element
	→	**1didt**	0	Operations counters	First current rate of rise element
	→	**2didt**	0	Operations counters	Second current rate of rise element
	→	**Rapp**	0	Operations counters	Impedance monitoring (di/dt dependence)
	→	**Iapp**	0	Operations counters	Current monitoring with di/dt dependence
	→	**1Ig**	0	Operations counters	First Frame Fault element
	→	**2Ig**	0	Operations counters	Second Frame Fault element
	→	**RCL**	0	Operations counters	Automatic Reclosure
	→	**LT**	0	Operations counters	Automatic Line Test
	→	**1U>**	0	Operations counters	First Overvoltage element
	→	**2U>**	0	Operations counters	Second Overvoltage element
	→	**1U<**	0	Operations counters	First Undervoltage element
	→	**2U<**	0	Operations counters	Second Undervoltage element
	→	**RT**	0	Operations counters	First Remote Trip
	→	**IRF**	0	Operations counters	Internal Relay Fault
	→	**TCS**	0	Operations counters	Trip Circuit Supervision
	→	**BrkF**	0	Operations counters	Breaker failure to open
	→	**Wi**	0	Operations counters	Circuit Breaker maintenance alarm
	→	**AutOp**	0	Operations counters	Automatic C/B Open
	→	**AutCL**	0	Operations counters	Automatic C/B Close
	→	**ManOp**	0	Operations counters	Manual C/B Open
	→	**ManCL**	0	Operations counters	Manual C/B Close
	→	**OvrOp**	0	Operations counters	Overall C/B Open (Automatic + Manual)
	→	**OvrCL**	0	Operations counters	Overall C/B Close (Automatic + Manual)
	→	**RTX**	0	Operations counters	Second Remote Trip
	→	**selfT**	0	Operations counters	Spontaneous protection trip
	→	**DiaCB1**	0	Operations counters	C/B1 Input position discrepancy
	→	**AnCB1**	0	Operations counters	C/B1 Operation failure
	→	**OpCB1**	0	Operations counters	C/B1 Openings operation
	→	**ClCB1**	0	Operations counters	C/B1 Closures operation
	→	**DiaCB2**	0	Operations counters	C/B2 Input position discrepancy
	→	**AnCB2**	0	Operations counters	C/B2 Operation failure
	→	**OpCB2**	0	Operations counters	C/B2 Openings operation
	→	**ClCB2**	0	Operations counters	C/B2 Closures operation
	→	**DiaCB3**	0	Operations counters	C/B3 Input position discrepancy
	→	**AnCB3**	0	Operations counters	C/B3 Operation failure
	→	**OpCB3**	0	Operations counters	C/B3 Openings operation
	→	**ClCB3**	0	Operations counters	C/B3 Closures operation
	→	**DiaCB4**	0	Operations counters	C/B4 Input position discrepancy
	→	**AnCB4**	0	Operations counters	C/B4 Operation failure
	→	**OpCB4**	0	Operations counters	C/B4 Openings operation
	→	**ClCB4**	0	Operations counters	C/B4 Closures operation
	→	**DiaCB5**	0	Operations counters	C/B5 Input position discrepancy
	→	**AnCB5**	0	Operations counters	C/B5 Operation failure
	→	**OpCB5**	0	Operations counters	C/B5 Openings operation
	→	**ClCB5**	0	Operations counters	C/B5 Closures operation

1

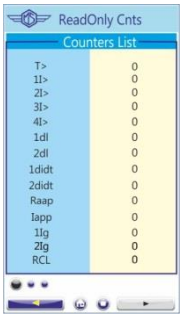


• Press "▬" for access to the "Desktop" menu with icons.

2

• Press "123" for access to the counters list.

3



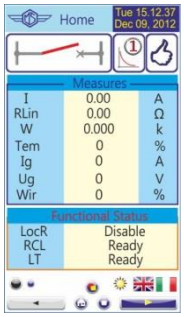
• The display shows the list.

15. 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 at the list.

3

• Select the Events to show.

4

• Display selected Event.

15.1 – Events on display

Functions	Events Displayed	Events Description MScom2		Status	
T>	Tal	*Alarm*	*Thermal Image T>*	Rise	
	T>	*Trip*		Rise	Fall
1I>	1I>	*Start*	*First overcurrent element F50-51*	Rise	Fall
	t1I>	*Trip*		Rise	Fall
2I>	2I>	*Start*	*Second overcurrent element F50-51*	Rise	Fall
	t2I>	*Trip*		Rise	Fall
3I>	3I>	*Start*	*Third overcurrent element F50-51*	Rise	Fall
	t3I>	*Trip*		Rise	Fall
4I>	4I>	*Start*	*Fourth overcurrent element F50-51*	Rise	Fall
	t4I>	*Trip*		Rise	Fall
Iis	Iis>	(Start)	*Instantaneous Current Element*	Rise	Fall
1dI	1dI	*Start*	*First Current Step Element*	Rise	Fall
	t1dI	*Trip*		Rise	Fall
2dI	2dI	*Start*	*Second Current Step Element*	Rise	Fall
	t2dI	*Trip*		Rise	Fall
1di/dt	1di/dt	*Start*	*First Current Rate of Rise Element*	Rise	Fall
	t1di/dt	*Trip*		Rise	Fall
2di/dt	2di/dt	*Start*	*Second Current Rate of Rise Element*	Rise	Fall
	t2di/dt	*Trip*		Rise	Fall
Rapp	Rapp	*Trip*	*Impedance monitoring-di/dt dependence*	Rise	Fall
Iapp	Iapp	*Trip*	*Current monitoring-di/dt dependence*	Rise	Fall
1Ig	1Ig	*Start*	*First Frame Fault Element*	Rise	Fall
	t1Ig	*Trip*		Rise	Fall
2Ig	2Ig	*Start*	*Second Frame Fault Element*	Rise	Fall
	t2Ig	*Trip*		Rise	Fall
RCL	RCLcmd	*Autoreclosure shot*		Rise	
	ARP	*Autoreclosure in Progress*		Rise	
	ARF	*Autoreclosure Failed*		Rise	
	ARL	*Autoreclosure Lockout*		Rise	
LT	LTcmd	*Line Test Command*		Rise	
1U>	1U>	*Start*	*First Overvoltage Element F59*	Rise	
	t1U>	*Trip*		Rise	
2U>	2U>	*Start*	*Second Overvoltage Element F59*	Rise	
	t2U>	*Trip*		Rise	
1U<	1U<	*Start*	*First Undervoltage Element F59*	Rise	Fall
	t1U<	*Trip*		Rise	Fall
2U<	2U<	*Start*	*Second Undervoltage Element F59*	Rise	Fall
	t2U<	*Trip*		Rise	Fall
Wi	tWi>	*Circuit breaker maintenance level*		Rise	
	Ni	*Maximum number of arc chute operation at nominal values*			
	aINi	*Alarm maintenance level of arc chute operation*			
	Ne	*Maximum number of arc contact operation at nominal values*			
	aINe	*Alarm maintenance level of arc contact operation*			
	Nm	*Maximum number of mechanical operation*			
	aINm	*Alarm maintenance level of mechanical operation*			
TCS	TCS	*Start*	*trip coil supervision*	Rise	
	tTCS	*Trip*		Rise	Fall
IRF	IRF	*Start*	*Internal Relay Failure*	Rise	
	tIRF	*Trip*		Rise	
RT	Start RT	*Start*	*First element Remote Trip*	Rise	
	Trip RT	*Trip*		Rise	
RTX	Start RTX	*Start*	*Second element Remote Trip*	Rise	
	Trip RTX	*Trip*		Rise	
BF	BF	*Breaker Failure*		Rise	Fall
SelfTrip	SelfTrip	Spontaneous trip			
	t-SelfTr.	Self-Trip time delay			
L/R CB	cmdOpC/B	*Circuit Breaker (CB) intentional open*		Rise	
Hdl	cmdClC/B	*Circuit Breaker (CB) intentional close*		Rise	
	LocRemInc	*Local Remote inconsistent*		Rise	
LT	LTPb	*Output to operate an external flashing lamp signalling line test in progress*		Rise	
	LTP	*Line Test in progress*		Rise	
	LTF	*Line Test Failed*		Rise	
	LTOK	*Line Test OK*		Rise	
	LTB	*Line Test Blocked*		Rise	
	LT cmd	*Line Test command*		Rise	

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

16. Systems (System Parameters)

Setting of system parameters.

Nominal Values

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

Characteristic

Characteristic-1	Available
Characteristic-2	Available
Characteristic-3	Not Available
Characteristic-4	Not Available

Factors

Not available

System Options

Not available

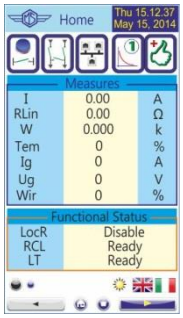
Comm Add Node

Communication Node Address

IO board config

Input/Output Board Configuration

1



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

2

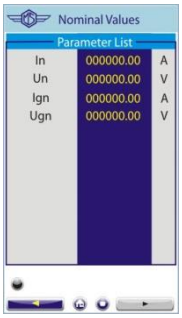
• Press "⚙" to access to the system menu.

16.1 – Nominal Values

3

• Press icons " ".

4



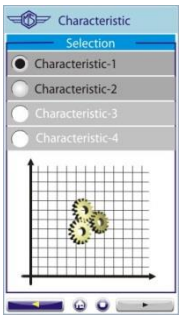
• Press the parameter to modify. (if Password is request, see § Password).

16.2 – Characteristic

3a

• Press icons " ".

4a



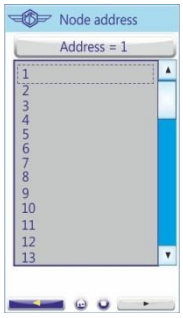
• Press the characteristics that need modify.

16.3 – Comm Add Node

3b

• Press icons " ".

4b



• Select "Address Node"

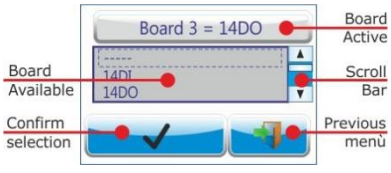
16.4 – IO board configuration

3c

• Press icons " ".

4c

• Select "Board".



17. Settings

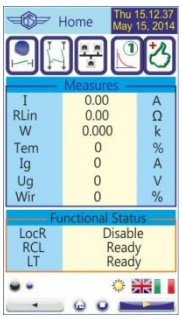
Two complete banks of settings of the programmable variables are available in the "***SETTING***" menu.
Both "**CHARACTERISTIC-1**" and "**CHARACTERISTIC-2**" include the hereunder listed variables.

→ **Communic.**	Serial communication parameters
→ **HMI**	Leds number
→ **T>**	Thermal Image
→ **1I>**	First overcurrent Element
→ **2I>**	Second overcurrent Element
→ **3I>**	Third overcurrent Element
→ **4I>**	Fourth overcurrent Element
→ **Iis**	Instantaneous Current Element
→ **1delta-I**	First current step element
→ **2delta-I**	Second current step element
→ **1di/dt**	First current rate of rise element
→ **2di/dt**	Second current rate of rise element
→ **Rapp**	Impedance monitoring - di/dt dependence
→ **Iapp**	Current monitoring with di/dt dependence
→ **1Ig**	First Frame Fault element
→ **2Ig**	Second Frame Fault element
→ **RCL**	Automatic Reclosure
→ **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
→ **BrkFail**	Setting variables for Breaker Failure detection
→ **Wh**	Energy counter Pulse
→ **selfTrip**	Spontaneous trip
→ **Oscillo**	Setting variables for Oscillographic recording
→ **L/R CB Cmds**	C/B command Local / Remote setting
→ **CB-L**	Locks C/B reclosure
→ **LT**	Line Test
→ **ExtReset**	Configuration for external reset input
→ **Switches**	Diagnostic C/B, switches position and statistic
→ **auxRcmds**	Auxiliary C/B remote command

17.1 - Modifying the setting of variables

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

1



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

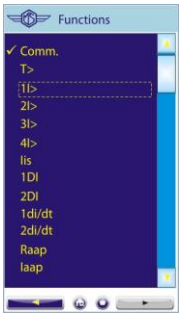
2

• 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

• To enable function, press "I"

• To disable function, press "0"

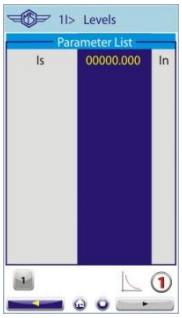
• Function disabled

• Function enabled

6

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

7



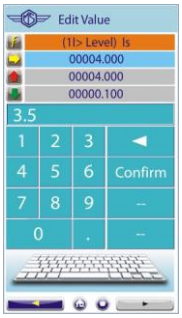
• Press the value (number) to change it.
• Insert the password (if request).

• Press the value (number)

Characteristic 1

Characteristic 2

8



• Insert "3.5"
• Press "Confirm"

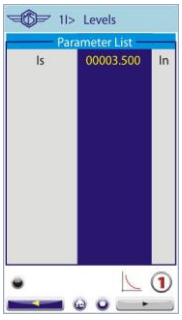
Function

Actual Value

Maximum Value

Minimum Value

9



• Change done.

The icons grey indicate menu not available

17.2 - Password

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

The factory default password is "**1111**".

The password is only modifiable with "MSCom2" software (see Manual "MSCom2").

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

Options	→	**BRRem**	19200	[9600 / 19200 / 38400]
	→	**PRRem**	Modbus	[Modbus / IEC103 / ModBOnTCP]

17.3.1 – Description of variables

BRRem	:	RS485 remote (Rear terminal block) serial communication speed		
PRRem	:	Remote communication protocol:		
		Modbus	= Rear Terminal Block	If present*
		IEC103	= Rear Terminal Block	If present*
		ModBOnTCP	= Rear RJ45 (Ethernet)	If present*
		SerialOnEth	= Rear RJ45 (Ethernet)	If present*

*RS485 and RJ45 are not available at the same time.

17.3.2 – Front Panel USB serial communication port

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. (MSCom2 for Windows XP/Vista/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**".

17.3.3 – Cable for connection from Relay to Personal Computer

The connection cable is a standard
USB-A /mini **USB-B**

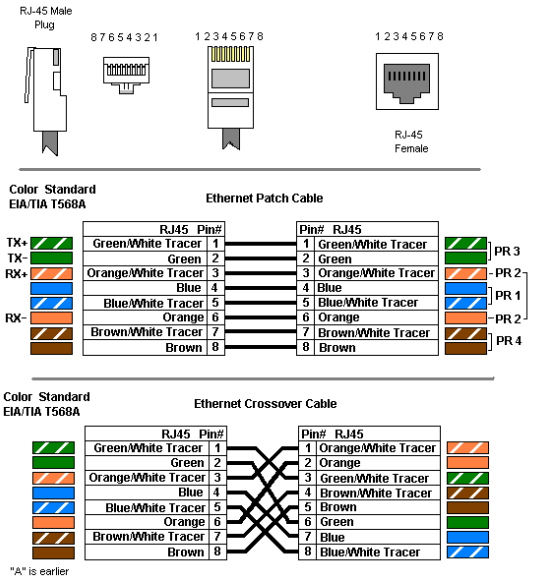
17.3.4 – Rear serial communication port (RS485)

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

17.3.5 – Rear communication port (Ethernet with Modbus protocol)

Relay's back Ethernet connection is available for communication in Modbus protocol, the Ethernet connector is a standard RJ45 and can be connected to a PC with a Ethernet "Cross" cable, or it can be connected to a switch with a Ethernet "Patch" cable.
The default IP address is **192.168.0.100** for Modbus on TCPip (*ModBOnTCP)*

17.3.6 – Wiring the Ethernet Communication



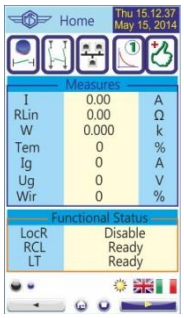
The back Ethernet connector is a standard RJ45 connector and can be wired with a normal Ethernet UTP cable in class 5 minimum.
The relay can be connected directly to a PC with a Ethernet "Cross" cable, or it can be connected to a switch with a Ethernet "Patch" cable.

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

17.4.1 – Led configuration

In this menu allows to customize the number of leds used (Default = 10):

1



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

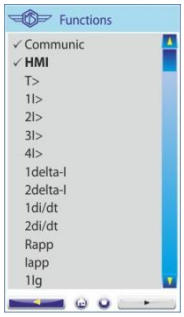
2

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

3

• Select Characteristic "***1***".

4



• Select "***HMI***".

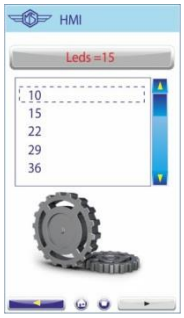
5

• Select "***Options***".

6

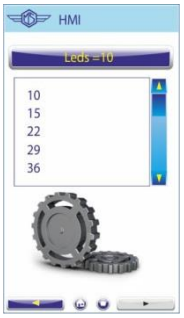
• Select "***Leds***".

7



• Select "***10***".

8



• The label change color and show the select number of leds "***Leds=10***".

9

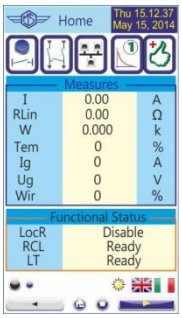
• Complete setting

17.4.2 – WirCB scheme – Scheme configuration

In this configuration, you can select the scheme that appears on the Home page.

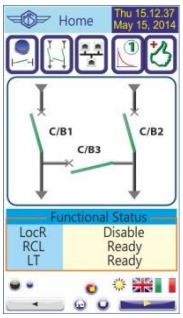
17.4.2.1 – C/B Status (display)

1



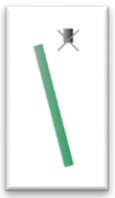
• Press "" to access to the scheme

2

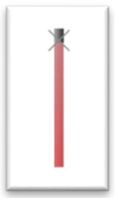


• The display shows the scheme.

17.4.2.2 – C/B Status (Symbol)

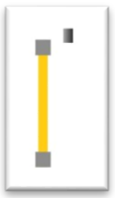


C/B OPEN



C/B CLOSE

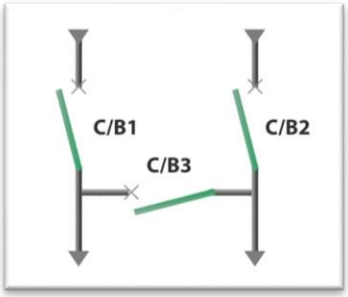
INCONSISTENCY



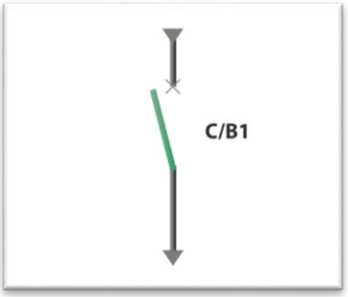
INCONSISTENCY

17.4.2.3 - Scheme types

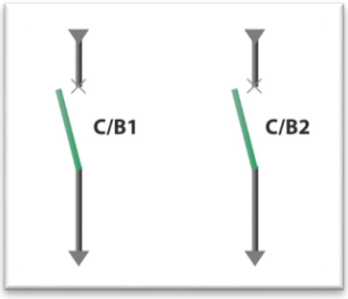
SCHEME 1



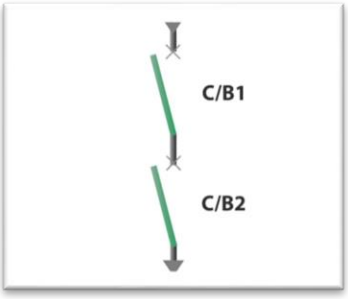
SCHEME 2



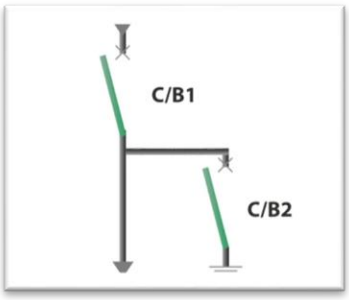
SCHEME 3



SCHEME 4

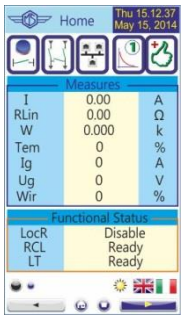


SCHEME 5



17.4.2.4 – Example – Configuration with Touch Screen

1

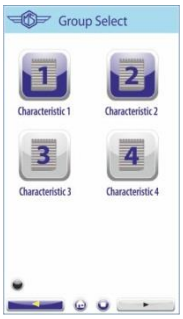


• Press "▬" or "⚙" to access to the "Desktop" menu with icons.

2

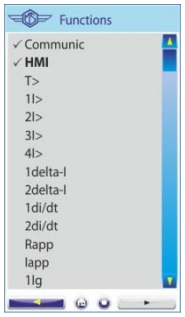
• Press "⚙" to access to the settings menu.

3



• Select Characteristic "***1***".

4



• Select "***HMI***".

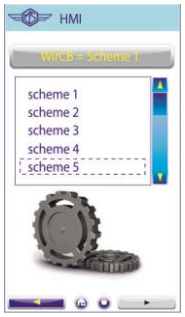
5

• Select "***Options***".

6

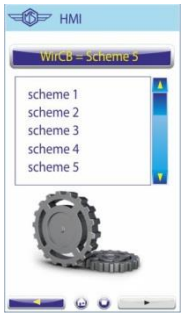
• Select "***WirCB***".

7



• Select "***scheme 5***".

8



• The label change color and show the select number of leds "***WirCB=scheme 5***".

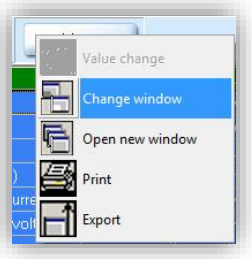
9

• Complete setting

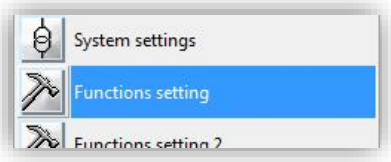
17.4.2.6 – Example – Configuration with MScom2 software

Open "MSCom2" program and connect to the relay.

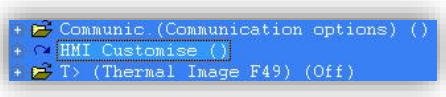
Select "**CHANGE WINDOWS**" from "Menu" button



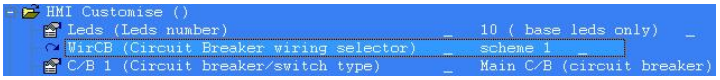
Select "**FUNCTION SETTING**"



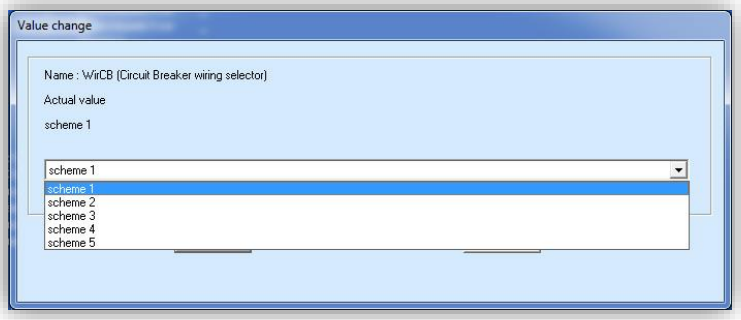
Select "**HMI**" function



Select "**CIRCUIT BREAKER WIRING SELECTOR**"



And select scheme

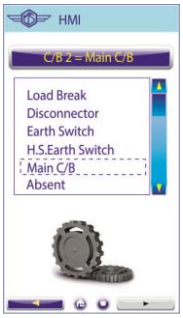


17.4.2.5 – Example – Configuration main C/B

Anyone of the 5 avaiable CB can be set as main CB (according to the selected scheme). If more the one CB is selected as "main", only the higher in the list is considered as main.

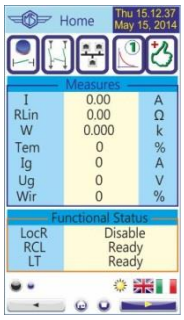
"Main C/B", is identify on the screen in bold (the locker that indicate lockout appear close to main C/B)

"Main C/B" is the CB connected to all logic and protection functions.

1 To 5		• Same procedure	**6**		• Press "C/B 2 = Disconnect" to access to the settings menu.	**7**		• Select main C/B "***Main C/B***".
8		The label change color and the C/B active "***C/B 2 =Main C/B***".	**9**		• Complete setting			

17.4.2.7 – Example – Setting Digital Inputs to C/B status with Touch Screen

1

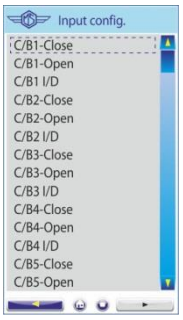


• Press "▬" or "⚙" to access to the "Desktop" menu with icons.

2

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

3

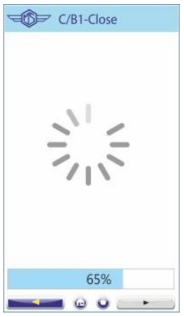


• Select Characteristic "***C/B1***".

4

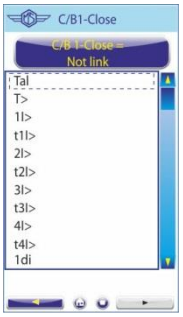
• Select "***Link***".

5



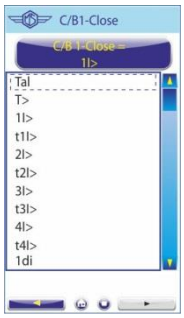
• Load parameters……

6



• Select "***1I>***" from list.

7



• The box show "**C/B1-Close= 1I>**".
• The function is Linked

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

Status	→	**Disable**			[Disable / Enable]			
Oper.Levels	→	**Tal**	50	**%Tn**	[10 ÷ 100]	step	1	%Tn
	→	**Is**	1	**In**	[0.5 ÷ 1.5]	step	0.010	In
	→	**Kt**	300	**min**	[1 ÷ 600]	step	0.010	min

17.5.1 - Description of variables

Enab.	:	Function enabling (Disable / Enable)
Tal	:	Temperature prealarm level
Is	:	Continuous admissible current
Kt	:	Warming-up Time Constant of the load

17.5.2 - Trip and Alarm

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

17.5.2.1 – Trip time of the Thermal Image Element

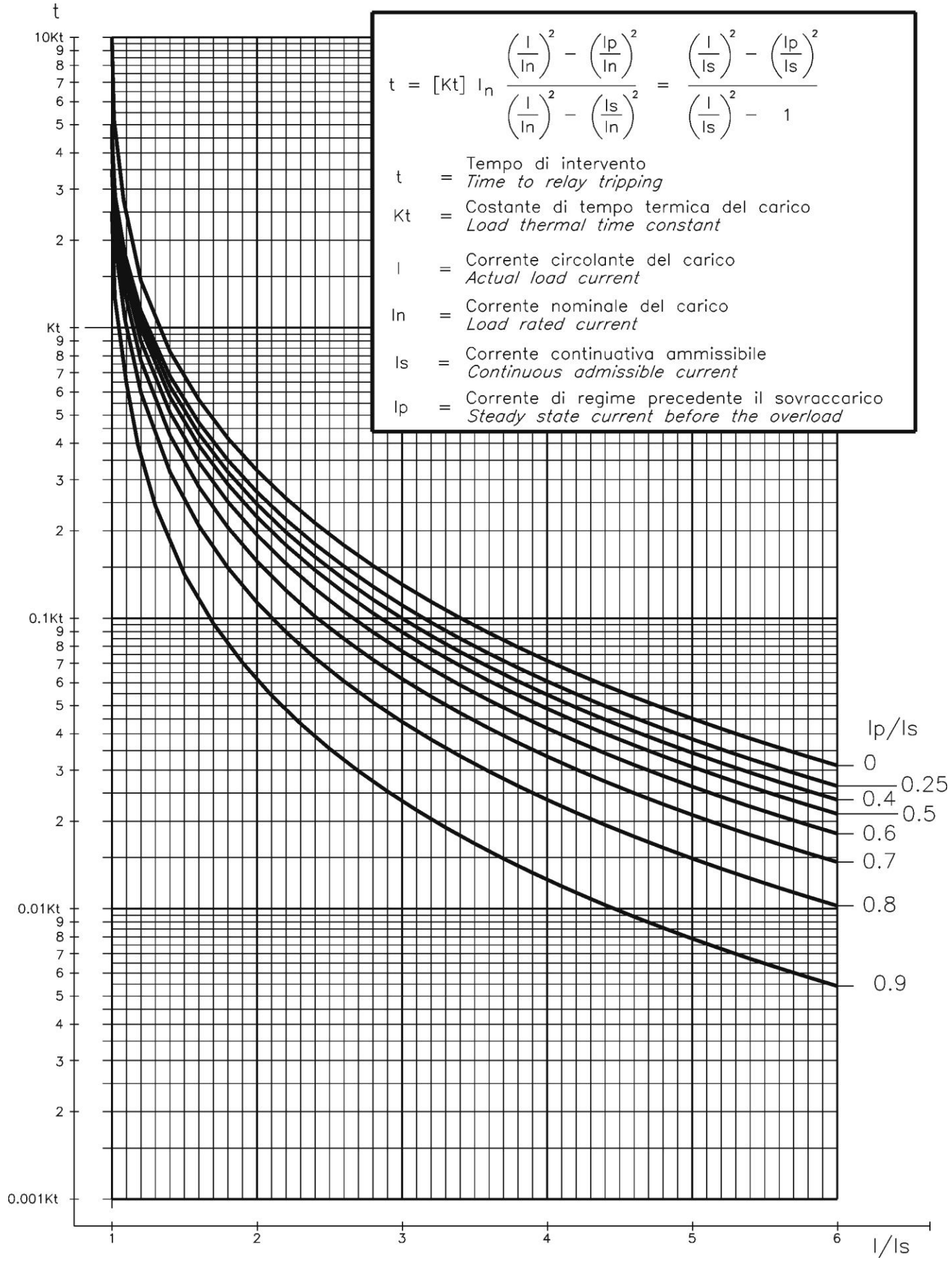
The trip time of the Thermal Image Element is a function of the current "I" flowing into the load and depends on its warming-up Time Constant "Kt", on the previous thermal status "Ip" and on the maximum admissible continuous current "Is" according to the equation:

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

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

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

17.5.2.2 – Thermal Image Curves (TU1024 Rev.1)



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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Fw		[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

17.6.1 - 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 "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.

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17.6.2 - Algorithm of the time current curves

The Time Current Curves are generally calculated with the following equation

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

t(I) = Actual trip time delay when the input current equals "I"
Is = Set minimum pick-up level

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

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

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

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

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

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

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

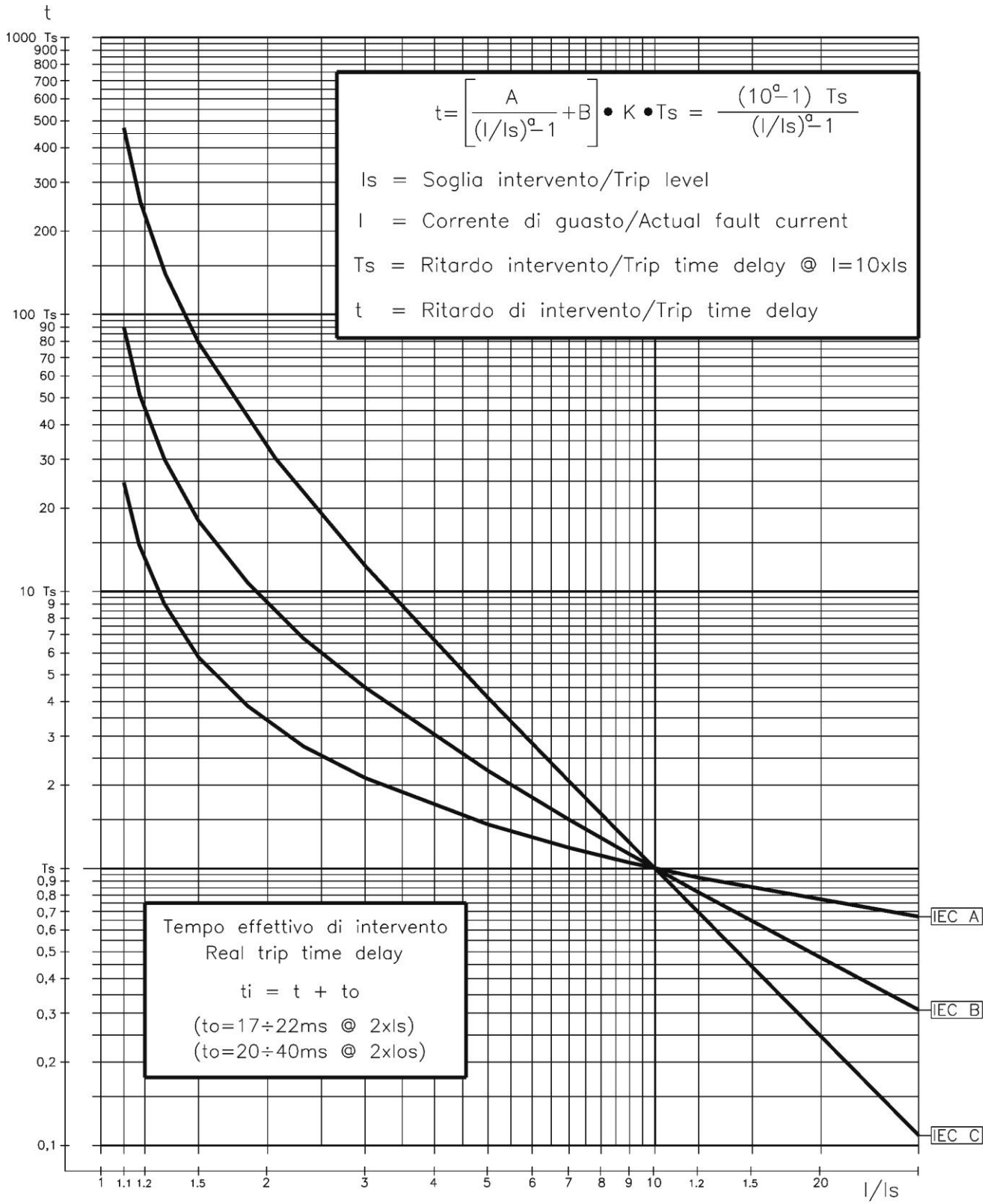
Where $Kt = (10^{a}-1)Ts$ is the time multiplier

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

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

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

17.6.3 - IEC Curves



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

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

17.6.4 – Blocking Logic (BO-BI)

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

17.6.4.1 – Output Blocking signal "BO"

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

17.6.4.2 – Blocking Input "BI"

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

17.6.5 - Automatic doubling of Overcurrent thresholds on current inrush

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

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

Status	→	**Disable**			[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**	1	**In**	(0.100÷4)	step	0.01	In
Timers	→	**ts**	100	**s**	(0.01÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.7.1 - Description of variables

Disable	:	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.

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

Status	→	**Disable**			[Disable / Enable]			
Options	→	**tBI**	Disable		[Disable / 2tBO]			
	→	**f(a)**	Disable		[Disable / Fw / Rev]			
	→	**CoF**	Disable		[Disable / Enable]			
	→	**RCL**	No		[No / Yes]			
Levels	→	**Is**	1	**In**	(0.100÷10)	step	0.01	In
Timers	→	**ts**	100	**s**	(0.01÷100)	step	0.01	s
	→	**tCoF**	0.05	**s**	(0.02÷0.20)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.8.1 - Description of variables

Disable	:	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.

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

Status	→	**Disable**			[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	0.01	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**	(0.02÷0.20)	step	0.01	s

17.9.1 - Description of variables

Disable	:	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.

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

Status	→	**Enab.**			[Disable / Enable]			
Options	→	**RCL**	No		[No / Yes]			
Levels	→	**Is**	1	**In**	(1÷10)	step	0.1	In

17.10.1 - Description of variables

Disable	:	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.

17.11 - Function: **1delta-I** *(First Current Step Element)*

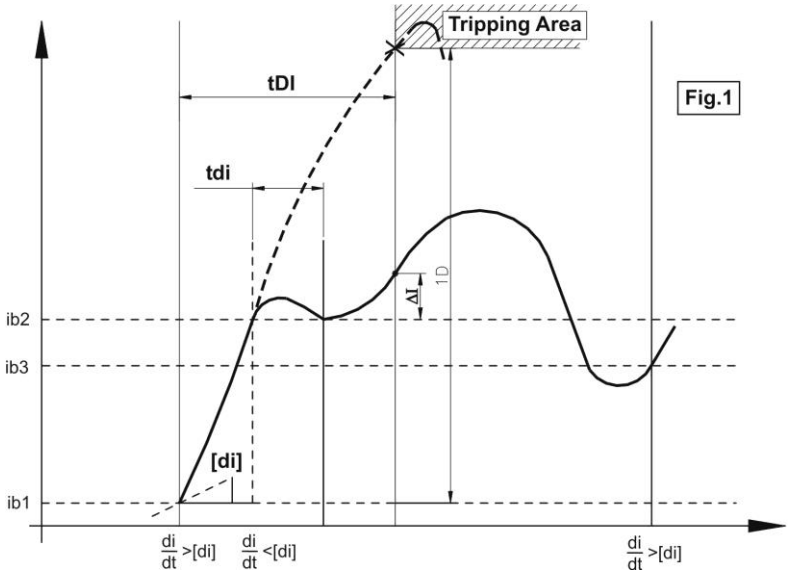
Status	→	**Disable**			[Disable / Enable]			
Options	→	**RCL**	No		[No / Yes]			
Levels	→	**DI**	1000	**A**	(100÷9990)	step	10	A
	→	**di**	200	**A/ms**	(4÷400)	step	1	A/ms
Timers	→	**tDI**	100	**ms**	(0÷500)	step	1	ms
	→	**tdi**	20	**ms**	(0÷100)	step	1	ms

17.11.1 - Description of variables

Disable	:	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.
DI	:	Current step trip level
di	:	Minimum di/dt level to start "ΔI" evaluation and detection reset level
tDI	:	Trip time delay
tdi	:	Detection reset time delay

17.11.2 - 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:

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

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

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

17.12 - Function: **2delta-I** *(Second Current Step Element)*

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

17.12.1 - Description of variables

Disable	:	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.
DI	:	Current step trip level
di	:	Minimum di/dt level to start "ΔI" evaluation and detection reset level
tDI	:	Trip time delay
tdi	:	Detection reset time delay

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

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

17.13.1 - Description parameters

Disable	:	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.
G	:	di/dt trip level
tG	:	Trip time delay

17.13.2 - Operation of the current rate of rise monitoring element

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

$$\frac{di}{dt} = \frac{I_{(t+[tG])} - I_{(t)}}{tG} \qquad \text{if } \frac{di}{dt} \geq [G] \text{ the relay trip}$$

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

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

17.14.1 - Description parameters

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

17.14.2 - 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:

$$\frac{di}{dt} = \frac{I_{(t+[tG])} - I_{(t)}}{tG} \qquad \text{if } \frac{di}{dt} \geq [G] \text{ the relay trip}$$

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

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

17.15.1 - Description of variables

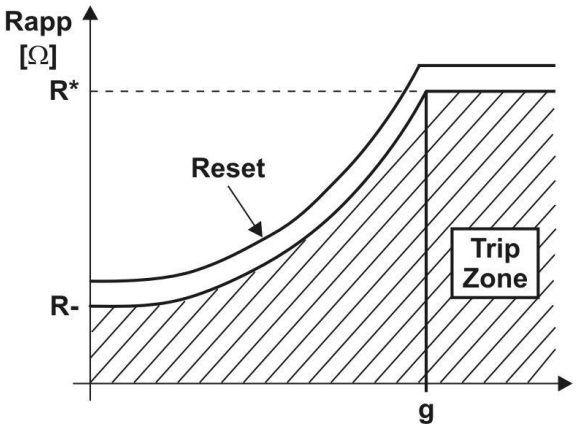
Disable	:	Function enabling (Disable / Enable)
RCL	:	I If "RCL = Yes", after tripping of the element "Rapp" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Va	:	Arc voltage.
Ri	:	Internal Resistance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

17.15.2 - 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.



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

Status	→	**Disable**			[Disable / Enable]			
Options	→	**RCL**	No		[No / Yes]			
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**	0.10	**s**	(0÷5.00)	step	0.01	s

17.16.1 - Description of variables

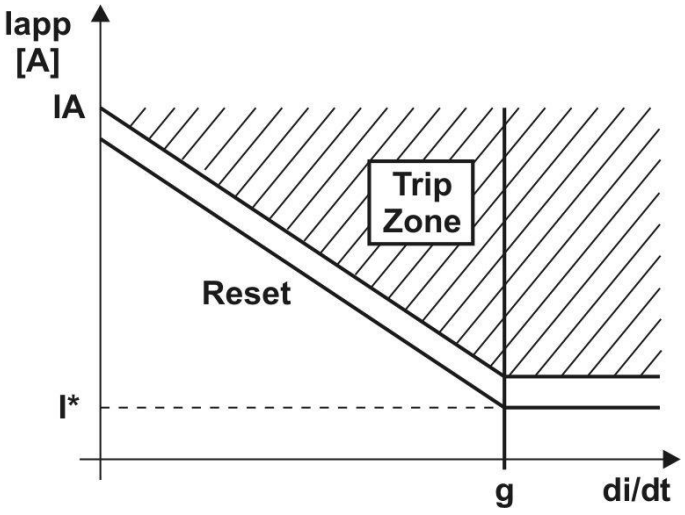
Disable	:	Function enabling (Disable / Enable)
RCL	:	If "RCL = Yes", after tripping of the element "Iapp" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
IA	:	Current trip level when di/dt = 0
I*	:	Current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

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

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

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



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

Status	→	**Disable**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**RCL**	No		[No / Yes]			
Levels	→	**Is**	1.00	**Ign**	(0.00÷2.00)	step	0.01	Ign
	→	**Us**	0.20	**Ugn**	(0.00÷1.00)	step	0.01	Ugn
Timers	→	**ts**	20	**s**	(0.02÷100.00)	step	0.01	s

17.17.1 - Description of variables

Disable	:	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
RCL	:	If "RCL = Yes", after tripping of the element "1Ig" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Is	:	Minimum operation level of frame to earth current.
Us	:	Minimum operation level of frame to earth voltage.
ts	:	Trip time delay

17.17.2 - 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]

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

Status	→	**Disable**			[Disable / Enable]			
Options	→	**f(t)**	Type - D		[D / A / B / C]			
	→	**RCL**	No		[No / Yes]			
Levels	→	**Is**	1.00	**Ign**	(0.00÷2.00)	step	0.01	Ign
	→	**Us**	0.20	**Ugn**	(0.00÷1.00)	step	0.01	Ugn
Timers	→	**ts**	20	**s**	(0.02÷100.00)	step	0.01	s

17.18.1 - Description of variables

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

17.18.2 - 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]

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

Status	→	**Disable**			[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

17.19.1 - Description of variables

Disable	:	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.

17.19.2 - Operation

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

A reclose shot is started after a C/B's opening operated by one of the relay's protection functions programmed to control this reclose shot; C/B's opening operated by one element not programmed to control the reclosure shot activates the Lock-out status of the Reclosure function.

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

After a manual closure of the C/B, operation time start or tripping of any of the relay protection elements during "tr", makes the relay enter into the Lock-Out status (L.O.). In the L.O. status the relay, after breaker opening, does not produce any command for automatic reclose ; the lock-out status is shows on the display.
Reset from the L.O. status takes place when the C/B is opened and then manually reclosed or by operating the external reset command.

If none of the relay protection elements is started during "tr" after a manual closure of the C/B, the relay is ready to start the Automatic Reclose Sequence.

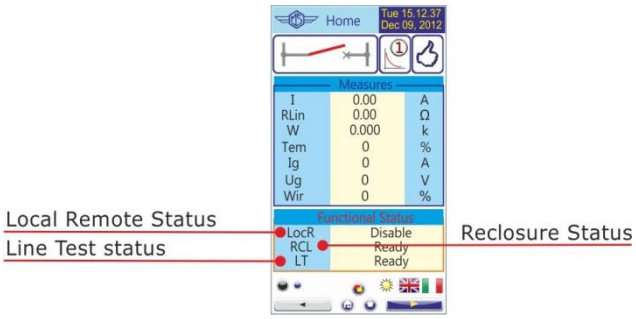
If "tr" is started by an automatic reclosure, the operation time start during "tr" and the tripping of any element programmed for the operation of the next reclosure makes the relay proceed with the reclosing cycle.

After "tr" is expired the reclosing cycle restarts from the first reclosure (1C).

Pick-up of the time start of any protection element, stops the counting down of "tr"; counting is restarted as soon as the element resets.

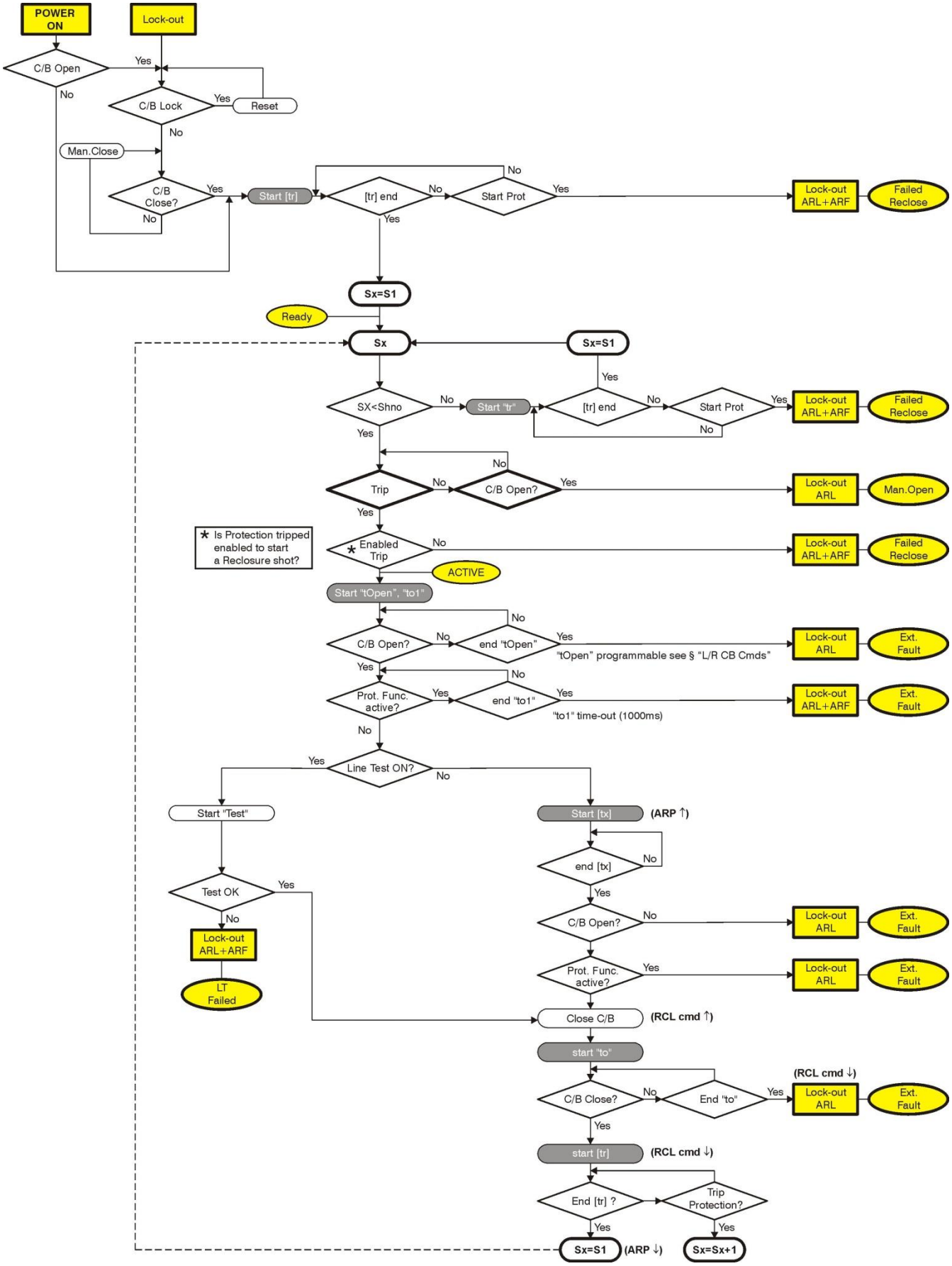
As soon as the C/B is opened due to tripping of one of the relay's elements programmed to initiate the next automatic reclose shot, the relevant reclose time delay (t1, t2, t3, t4) is started and at the end of this tx time the reclose command is issued by the relay. The C/B is then automatically reclosed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

17.19.3 – Status indication



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

17.19.4 - Flow chart RCL



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

Status	→	**Disable**			[Disable / Enable]			
Levels	→	**Us**	1.10	**Un**	(0.5÷1.50)	step	0.01	Un
Timers	→	**ts**	10	**s**	(0÷650)	step	1	s

17.20.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
Us	:	Minimum operation level
ts	:	Trip time delay

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

Status	→	**Disable**			[Disable / Enable]			
Levels	→	**Us**	1.10	**Un**	(0.5÷1.50)	step	0.01	Un
Timers	→	**ts**	10	**s**	(0÷650)	step	1	s

17.21.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
Us	:	Minimum operation level
ts	:	Trip time delay

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

Status	→	**Disable**			[Disable / Enable]			
Levels	→	**Us**	0.70	**Un**	(0.2÷1.00)	step	0.01	Un
Timers	→	**ts**	10	**s**	(0÷650)	step	1	s

17.22.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
Us	:	Minimum operation level
ts	:	Trip time delay

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

Status	→	**Disable**			[Disable / Enable]			
Levels	→	**Us**	0.70	**Un**	(0.2÷1.00)	step	0.01	Un
Timers	→	**ts**	10	**s**	(0÷650)	step	1	s

17.23.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
Us	:	Minimum operation level
ts	:	Trip time delay

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

Status	→	**Disable**			[Disable / Enable]			
Options	→	**TrOsc**	TrigDisab		[TrigDisab / Yes]			
Levels	→	**Ni**	1.000		(10÷1000)	step	1	
	→	**alNi**	80	**%**	(5÷95)	step	1	
		Ne	1.000		(10÷100000)	step	1	
		alNe	80	**%**	(5÷95)	step	1	
		Nm	1.000		(10÷100000)	step	1	
		alNm	900		(10÷100000)	step	1	
	→	**Ii**	3.000	**A**	(100÷9999)	step	1	A
Timers	→	**ti**	20	**ms**	(10÷40)	step	1	**ms**
	→	**tr**	8	**ms**	(0÷50)	step	1	**ms**

17.24.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
TrOsc	:	Trigger
Ni	:	Maximum number of arc chute operation at nominal values
alNi	:	Alarm maintenance level of arc chute operation
Ne	:	Maximum number of arc contact operation at nominal values
alNe	:	Alarm maintenance level of arc contact operation
Nm	:	Maximum number of mechanical operation
alNm	:	Alarm maintenance level of mechanical operation
Ii	:	Circuit Breaker Rated Current primary amps.
ti	:	HSCB open time
tr	:	HSCB auxiliary contact delay

17.24.2 - Operation (Accumulation of the interruption Energy)

The relay computes the Circuit Breaker interruption Energy.
On the relay is possible to set the total level of energy that the breaker is able to interrupt.
During each C/B operation the remain energy is calculated.
The operation of this function is based on the following principle:

Arc chute:

Any time the Circuit Breaker opens, the relay accumulate the square value of the current measured from the instance of the circuit breaker opening to the instant when the current expire.
The opening instant is detected by the change of status from closed to open of digital input connected to normally open contact of the C/B; it is compensated by the parameter "tr":

$$Ei = \sum_{0}^{n} [i^2]$$

The value calculated is subtracted from the amount total energy available calculated with the following formula:

$$Ei_{(total)} = Ii^2 * ti * Ni$$

"Ni" is the number of operation that the arc chute can done at the nominal values of C/B (current, and interrupting time).

On the measures menu is available the remaining energy value calculated as follow:

$$Ei\% = \frac{Ei(total) - Ei}{Ei\ (total)} * 100$$

When the remaining energy value goes below the **AlNi** threshold an alarm is generated .

When the remaining energy value decreased to **zero** another alarm is generated.

The generated alarm can be "linked" to digital outputs (relays) or used in programmable logic functions.

Reset to **100%** of the Energy accumulation is available in the menu "***Command***" (Reset Ei).

Arc contact:

Any time the Circuit Breaker opens, the relay record the value of the current measured at the instance of the circuit breaker opening.
The opening instant is detected by the change of status from closed to open of digital input connected to normally open contact of the C/B; it is compensated by the parameter "tr":

$$Ee = [i^2]$$

The value calculated is subtracted from the amount total energy available calculated with the following formula:

$$Ee(total) = Ii^2 * Ne$$

"Ne" is the number of operation that the arc contact can done at the nominal values of C/B (current).

On the measures menu is available the remaining energy value calculated as follow:

$$Ee\% = \frac{Ee(total) - Ee}{Ee\ (total)} * 100$$

When the remaining energy value goes below the **AlNe** threshold an alarm is generated .

When the remaining energy value decreased to **zero** another alarm is generated.

The generated alarm can be "linked" to digital outputs (relays) or used in programmable logic functions.

Reset to **100%** of the Energy accumulation is available in the menu "***Command***" (Reset Ee).

Mechanical operations:

Any time the Circuit Breaker opens, the relay compute the mechanical operation (opening and closing).

When the mechanical operations counter [**OVrOP**] value exceed the **AlNm** threshold an alarm is generated .

When the mechanical operations counter [**OVrOP**] value exceed the **Nm** threshold another alarm is generated .

The generated alarm can be "linked" to digital outputs (relays) or used in programmable logic functions.

Reset of the mechanical operation is available in the menu "***Command***" (Reset Counters).

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

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

17.25.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
ts	:	Trip time delay

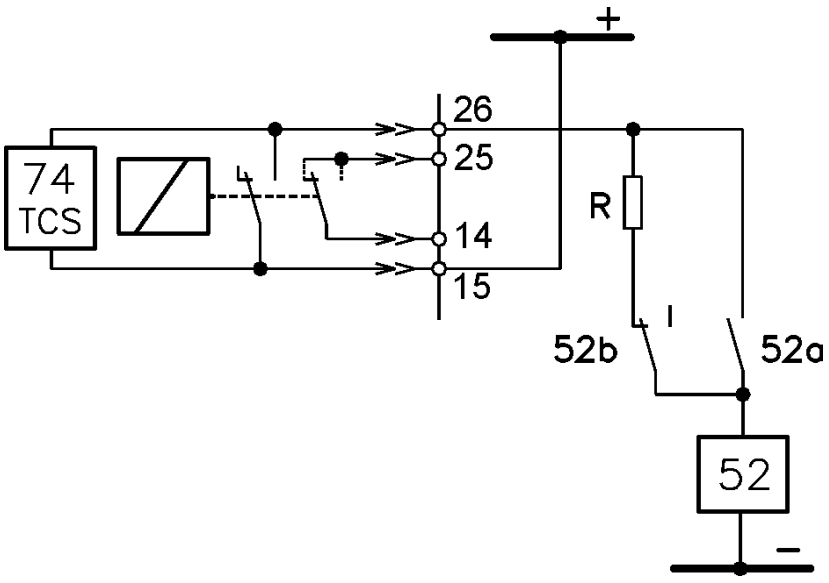
17.25.2 - Operation

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

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

V = Trip Circuit Voltage

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



Tripping of the function operates a user programmable output relay.

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

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

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

17.26.1 - Description of variables

Disable	:	Function enabling (No = Disable / Yes = Enable)
tIRF	:	Trip time delay

17.26.2 - Operation

Tripping of the function operates a user programmable output relay.

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

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

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

17.27.1 - Description of variables

Disable	:	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

17.27.2 - Operation

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

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

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

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

17.28.1 - Description of variables

Disable	:	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

17.28.2 - 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

*17.29 - Function: **BrkFail** (Breaker Failure)*

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

17.29.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
tBF	:	Trip time delay

17.29.2 - Operation

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

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

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

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

17.30.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
WpP	:	Energy counter Pulse Level
Pulse	:	Pulse duration

17.30.2 - Operation

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

*17.31 - Function: **Self Trip** (Spontaneous trip)*

In this menu it is possible to configure the Self Trip function.

Status	→	**Disable**			[Disable / Enable]			
Options	→	**RCL**	No		[No / Yes]			
Timers	→	**ts**	1.00	**s**	(0.10 ÷ 2.00)	step	0.01	s

17.31.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
RCL	:	Reclosure
ts	:	Self-Trip time delay

17.31.2 - Operation

This function is use to individuate the "CB self-trip" without make any complex logic with "user variables". The function check only the "Main HSCB", and if it pass from close status to open, without a command issued by the relay, the "self-trip" variable is set.

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

Status	→	**Disable**			[Disable / Enable]			
Options	→	**Trig**	Start		[Start / Trip / OnCmd / REUserLg / FEUserLG]			
Timers	→	**tPre**	0.50	**s**	(0.01÷0.50)	step	0.01	s
	→	**tPost**	0.50	**s**	(0.01÷1.50)	step	0.01	s

17.32.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
Trig	:	Selection of the Trigger command source (start recording): *Start* = Trigger on time start of protection functions *Trip* = Trigger on trip (time delay end) of protection functions *OnCmd* = On Asynchronous Force trigger command *REUserLg* = On rising edge of "User Logic" *FEUserLg* = On falling edge of "User Logic" (see § "OscilloTriggerLogic")
tPre	:	Recording time before Trigger
tPost	:	Recording time after Trigger

17.32.2 - 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.

17.32.3 – Available on MSCom2

T>	**Tal** **T>**	(alarm) (trip)	*Thermal element*
1I>	**1I>** **t1I>**	(Start) (Trip)	*First overcurrent element*
2I>	**2I>** **t2I>**	(Start) (Trip)	*Second overcurrent element*
3>	**3I>** **t3I>**	(Start) (Trip)	*Third overcurrent element*
4I>	**4I>** **t4I>**	(Start) (Trip)	*Fourth overcurrent element*
Iis	**Iis>**	(Start)	Instantaneous Current 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>** **Ni** **aINi** **Ne** **aINe** **Nm** **aINm**		*Circuit breaker maintenance level* *Maximum number of arc chute operation at nominal values* *Alarm maintenance level of arc chute operation* *Maximum number of arc contact operation at nominal values* *Alarm maintenance level of arc contact operation* *Maximum number of mechanical operation* *Alarm maintenance level of mechanical operation*
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**		*Exported Energy counter Pulse* *Imported Energy counter Pulse*
SelfTrip	**SelfTrip** **t-SelfTr.**		Spontaneous trip Self-Trip time delay
L/R CB Hdl	**cmdOpC/B** **cmdClC/B** **LocRemInc** **missCBOpe**		*Open C/B command* *Close C/B command* *Local / Remote Inconsistency* *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*
	LTOK		*Line Test OK*
	LTB		*Line Test Blocked*
	LT cmd	(Trip)	*Line Test command*
	CB1Fail		*CB1 Failure*
	CB2Fail		*CB2 Failure*
	CB3Fail		*CB3 Failure*
	CB4Fail		*CB4 Failure*
	CB5Fail		*CB5 Failure*
	CB1missedOp		*CB1 Missed Operation*
	CB2missedOp		*CB2 Missed Operation*
	CB3missedOp		*CB3 Missed Operation*
	CB4missedOp		*CB4 Missed Operation*
	CB5missedOp		*CB5 Missed Operation*
	MasterOp1		*Modbus Master CB1 Open request*
	MasterCL1		*Modbus Master CB1 Close request*
	MasterOp2		*Modbus Master CB2 Open request*
	MasterCL2		*Modbus Master CB2 Close request*
	MasterOp3		*Modbus Master CB3 Open request*
	MasterCL3		*Modbus Master CB3 Close request*
	MasterOp4		*Modbus Master CB4 Open request*
	MasterCL4		*Modbus Master CB4 Close request*
	MasterOp5		*Modbus Master CB5 Open request*
	MasterCL5		*Modbus Master CB5 Close request*
	Gen.Start		*General start*
	Gen.Trip		*General Trip*
	Vcc		*Reserved*
	Gnd		*Reserved*
	ResLog		*Reset signal logic*
	P1		*Push-button Open*
	P2		*Push-button Close*
	OscilloTriggerLogic		*User Variable for Oscillographic Recording*
	UserVar<0> to **UserVar<49>**		*User Variable*

Only for "**DIGITAL INPUT**"

	0.D1	*Digital Input "0.D1"*	*activated*	*Digital Input on Main Relay*
	0.D1Not	*Digital Input "0.D1"*	*deactivated*	
	to			
	0.D4	*Digital Input "0.D4"*	*activated*	
	0.D4Not	*Digital Input "0.D4"*	*deactivated*	
	1.D1	*Digital Input "1.D1"*	*activated*	*Digital input on Expansion Board*
	1.D1Not	*Digital Input "1.D1"*	*deactivated*	
	to			
	1.D15	*Digital Input "1.D15"*	*activated*	
	1.D15Not	*Digital Input "1.D15"*	*deactivated*	
	2.D1	*Digital Input "2.D1"*	*activated*	*Digital input on Expansion Board*
	2.D1Not	*Digital Input "2.D1"*	*deactivated*	
	to			
	2.D15	*Digital Input "2.D15"*	*activated*	
	2.D15Not	*Digital Input "2.D15"*	*deactivated*	

Only for "**OUTPUT RELAY**"

	0.R1 to **0.R6**	*Output relays on Main Relay*
	1.R1 to **1.R14**	*Output relays on Expansion Board*
	2.R1 to **2.R14**	*Output relays on Expansion Board*

17.32.4 – Setting "Oscillo Trigger Logic"

The "**OSCILLO TRIGGER LOGIC**" 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.

17.32.4.1 - Name

Internal name

17.32.4.2 - User descr.

Fixed

17.32.4.3 - Linked functions

Selection functions

17.32.4.4 - OpLogic

Operation Logic = [None, OR, AND, XOR, NOR, NAND, NOT, Ff-SR, Counter, Rise-UP, Fall-Down]

16.32.4.5 - Timer

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

17.32.4.6 - Timer type

Timer =			
	Delay	:	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
	Monostable P	:	Monostable Positive pulse time
	Monostable N	:	Monostable Negative pulse time
	Blink	:	When selected output is a 50% duty cycle square wave
	Drop Off	:	Time added on falling output edge

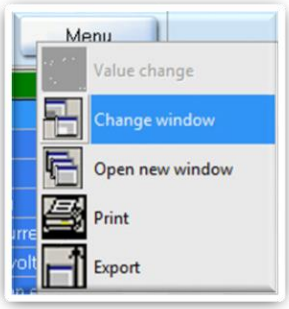
17.32.4.7 - Logical status

"OscilloTriggerLogic" Logical status

17.32.4.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



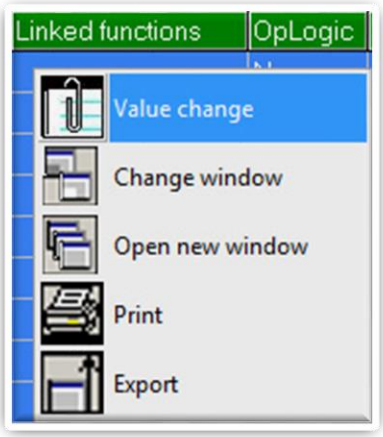
Select "User Variable"

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

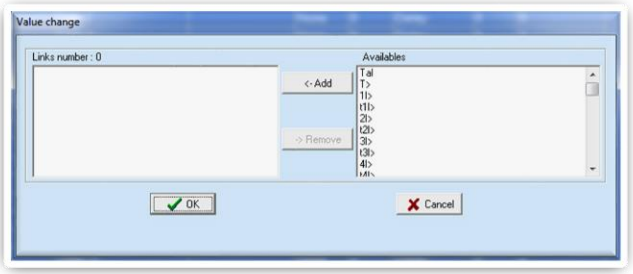
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	UserTrigger Oscillo	OscilloTrigger.logic		None	0	Delay	0
2	UserVar <0>	Gate.1.....		None	0	Delay	0

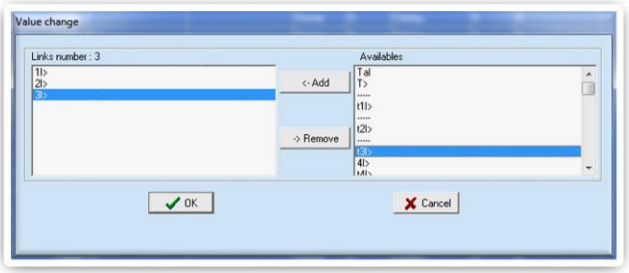
17.32.4.9 - "Linked Functions"

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



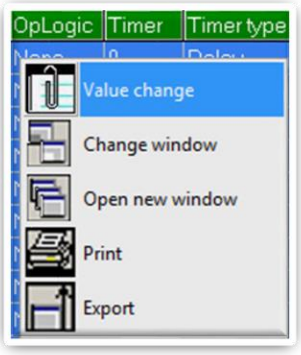
Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".



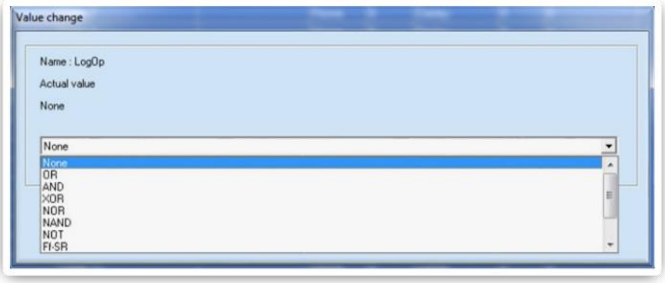


17.32.4.10 - "Operation Logic" (Oplogic)

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

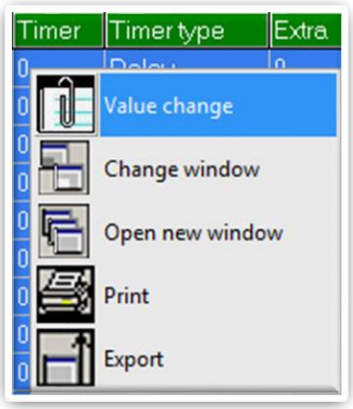


Insert "**AND**" into box and press "OK":

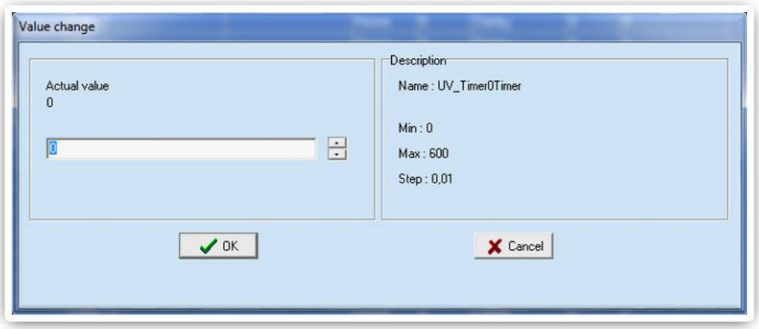


17.32.4.11 - "Timer"

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

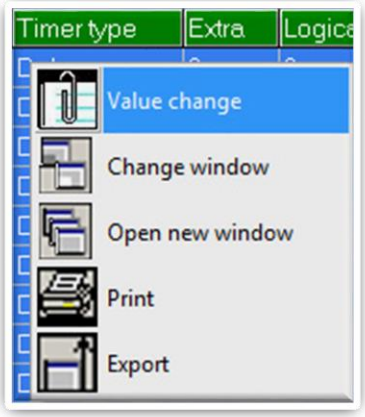


Select "**1**" into box and press "OK":

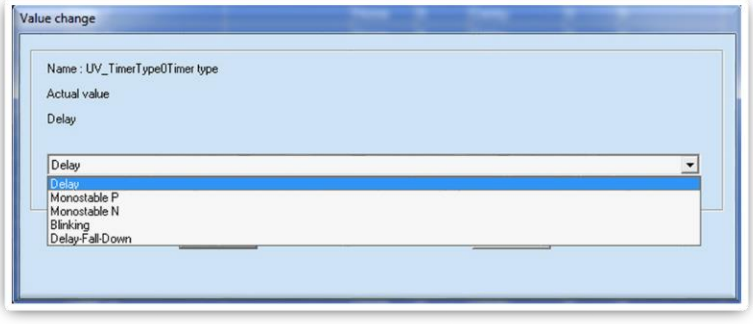


17.32.4.12 - "Timer type"

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



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



*17.33 - Function: **L/R CB Hdl** (Local / Remote and Main C/B Handler)*

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

17.33.1 - 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 "***Commands***". C/B Open control. C/B Close control.
tLRIn	:	Local/Remote inconsistent time.
tOpen	:	C/B operation time-out.

*17.34 - Function: **CB-L** (Lock C/B reclosure)*

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

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

17.34.1 - Description of variables

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

17.34.2 - 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 by 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".

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

Options	→ **TNum**	1		[0 / 1 / 2 / 3]			
	→ **Fast**	No		[No / Yes]			
	→ **Rem**	No		[No / Yes]			
Levels	→ **Vv<**	0.5	**Vn**	(0÷1.00)	step	0.001	Vn
	→ **Vm<**	0.5	**Vn**	(0÷1.00)	step	0.001	Vn
	→ **Rr<**	100	**Ω**	(0÷500)	step	0.1	Ω
	→ **VFast**	0.5	**Vn**	(0.5÷1.00)	step	0.1	Vn
Timers	→ **tp**	3	**s**	(0÷30)	step	1	s
	→ **tt**	3	**s**	(1÷10)	step	1	s
	→ **tcy**	10	**s**	(1÷60)	step	1	s
	→ **tw**	3	**s**	(0÷10)	step	1	s

17.35.1 - Description of variables

TNum	:	Number of tests after an unsuccessful test.
Fast	:	When set to "Yes" if the voltage measured during the set pre-closing time [tp] exceeds the set level [VFast], the C/B is closed immediately without the Line Test. If set "No" test is normally carried out.
Rem	:	Remote line test; if "Yes" Line Test can be started by the logical output RCL
Vv<	:	Voltage (after C/B) level to allow C/B closing.
Vm<	:	Voltage (before C/B) level to allow C/B closing.
Rr<	:	Minimum Residual Resistance level to allow C/B closing.
VFast	:	Minimum Line Voltage level to allow C/B closing without Line Test.
tp	:	Waiting time after C/B closing command request to start the line test cycle.
tt	:	Duration of the Line Test.
tcy	:	Wait time between two consecutive tests.
tw	:	Wait time to start reclosing after success fine test.

17.35.2 - Operation

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

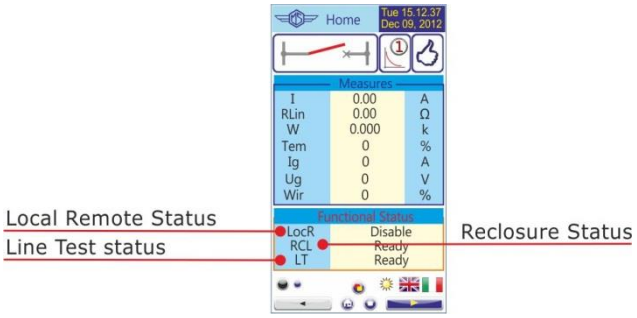
Setting			Test condition
Vm<	**Vv<**	**Rr<**	
≠0	≠0	≠0	Vv ≥ [Vv<] & Vm ≥ [Vm<] & Rr≥ [Rr<]
≠0	≠0	=0	Vv ≥ [Vv<] & Vm ≥ [Vm<]
=0	=0	≠0	Rr≥ [Rr<]

If the test was unsuccessful:

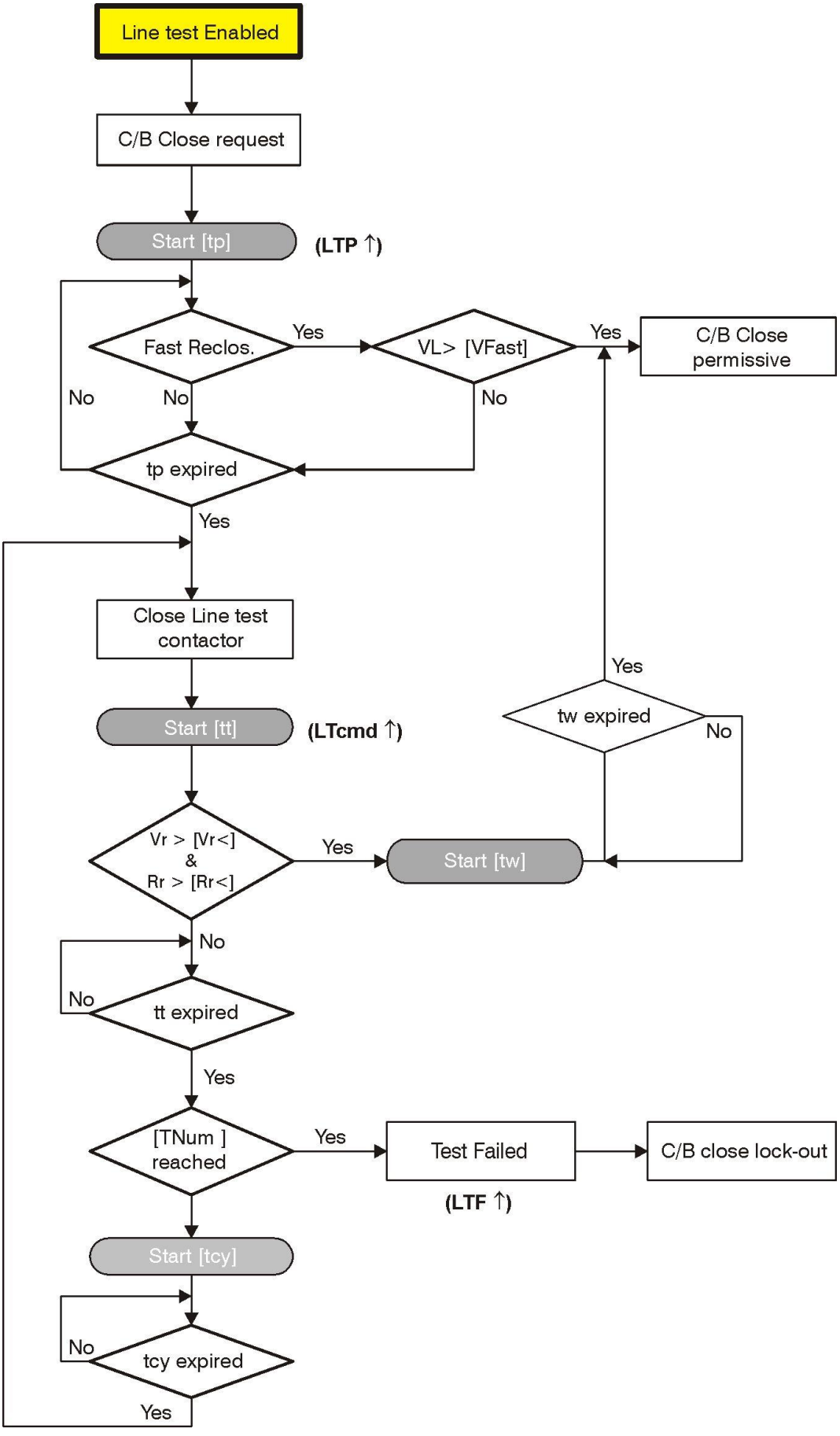
- If "Test N°=0" C/B reclosing blocked
- If "Test N°=1,2,3" The timer "tcy" is started and, at the end of "tcy" the test is repeated only 1 or 2 or three times before the C/B reclosing is blocked (if one of the tests is successful, "tw" is started and then the C/B closed).

17.35.4 - Display status indication

Display of Line Test status	
Standby	Line Test in standby
Ready	Line Test Ready
Fail	Line test failure



17.35.3 - Flow chart



*17.36 - 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.
The reset input will reset all the output relays configured as manual reset (latched), the signalisation of the trip on the display and the indication of the LED are cleared also.

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

17.36.1 - Description of variables

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

*17.37 - Function: **Switches** (Diagnostic C/B position)*

In this menu it is possible to configure the CB incongruence function.

Status	→	**Disable**			[Disable / Enable]			
Timers	→	**tCB1f**	3	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB1A**	2	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB2f**	3	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB2A**	2	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB3f**	3	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB3A**	2	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB4f**	3	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB4A**	2	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB5f**	3	**s**	(0 ÷ 10)	step	0.1	s
	→	**tCB5A**	2	**s**	(0 ÷ 10)	step	0.1	s

17.37.1 - Description of variables

Disable	:	Function enabling (Disable / Enable)
tCB1f	:	C/B1 Diagnostic position discrepancy filter time
tCB1A		C/B1 Operation control time
tCB2f	:	C/B2 Diagnostic position discrepancy filter time
tCB2A		C/B2 Operation control time
tCB3f	:	C/B3 Diagnostic position discrepancy filter time
tCB3A		C/B3 Operation control time
tCB4f	:	C/B4 Diagnostic position discrepancy filter time
tCB4A		C/B4 Operation control time
tCB5f	:	C/B5 Diagnostic position discrepancy filter time
tCB5A		C/B5 Operation control time

17.37.2 - Operation

For each auxiliary CB is possible set the incongruence status of its auxiliary contact (1NO e 1 NC). In case the two contacts are in the same status (open are close) for a time longer then tCBxf, a variable (linkable) is set.

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*17.38 - Function: **auxRCmds** (Auxiliary Remote Commands)*

In this menu it is possible to configurate timer for duration of command.

Timers	→	**tCl1**	1	**s**	(0÷10)	step	0.1	s
	→	**tOp1**	1	**s**	(0÷10)	step	0.1	s
	→	**tCl2**	1	**s**	(0÷10)	step	0.1	s
	→	**tOp2**	1	**s**	(0÷10)	step	0.1	s
	→	**tCl3**	1	**s**	(0÷10)	step	0.1	s
	→	**tOp3**	1	**s**	(0÷10)	step	0.1	s
	→	**tCl4**	1	**s**	(0÷10)	step	0.1	s
	→	**tOp4**	1	**s**	(0÷10)	step	0.1	s
	→	**tCl5**	1	**s**	(0÷10)	step	0.1	s
	→	**tOp5**	1	**s**	(0÷10)	step	0.1	s

17.38.1 - Description of variables

tCl1	:	Master close breaker 1 command duration
tOp1	:	Master open breaker 1 command duration
tCl2	:	Master close breaker 2 command duration
tOp2	:	Master open breaker 2 command duration
tCl3	:	Master close breaker 3 command duration
tOp3	:	Master open breaker 3 command duration
tCl4	:	Master close breaker 4 command duration
tOp4	:	Master open breaker 4 command duration
tCl5	:	Master close breaker 5 command duration
tOp5	:	Master open breaker 5 command duration

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18. Input – Output (Via Keyboard or MSCom2 software)

The firmware can manage up to 28 digital inputs and 24 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
14DO	Module	(Board 2)	=	14 Outputs Relay
UX10-4	Module	(Board 3)	=	10 Digital Inputs - 4 Outputs Relay

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

18.1 – Digital Input

→ **0.D1** → **0.D2** → **0.D3** → **0.D4**	Programmable (D1) Programmable (D2) Programmable (D3) Programmable (D4)	When the relevant terminals are open and get activated when the relevant terminals are shorted by an external cold contact.	*Available in the relay*
→ **1.D1** → **1.D--** → **1.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board 1*	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*	

Three of them (0.D1, 0.D2, 0.D3) are deactivated, when the relevant terminals are open and get activated when the relevant terminals are shorted by an external cold contact.

The operation of the Input "0.D4" is dependent on the value "R" of resistance of the external circuit connected to its terminals (38-19):

- Activated if "R < 50Ω" or "R > 3000Ω". - Deactivated if "50Ω ≤ R ≤ 3000Ω".

Therefore, if the terminals "38-19" are open-circuited, the input "0.D4" is activated; for using "0.D4" as A normal Digital Input simply controlled by an external cold contact, it is necessary to permanently connect across the terminal's "38-19" (in parallel to the external contact) a load resistor of value between 50 and 3000Ω (example 1000Ω - 0.5W).

18.2 – "DI" Configuration paremeter availabe (via keyboard or MSCom2 software)

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

C/B1-Close	Close position status	**Bi2didt**	Blocking input to the 2didt
C/B1-Open	Open position status	**BiRCL**	Reclosure lock-out RCL
C/B1-I/D	Insertion status	**Bypass-LT**	Line test bypass
C/B2-Close	Close position status	**Bi1U<**	Blocking input to the 1U<
C/B2-Open	Open position status	**Bi2U<**	Blocking input to the 2U<
C/B2-I/D	Insertion status	**Main C/B CL.Status**	Circuit breaker status
C/B3-Close	Close position status	**RT**	Remote Trip input
C/B3-Open	Open position status	**RTX**	Second Remote Trip input
C/B3-I/D	Insertion status	**BiSelfT**	Blocking input self Trip
C/B4-Close	Close position status	**Local**	Local mode operation
C/B4-Open	Open position status	**Remote**	Remote mode operation
C/B4-I/D	Insertion status	**Open CB**	Open C/B Command
C/B5-Close	Close position status	**Close CB**	Close C/B Command
C/B5-Open	Open position status	**BiOpenCB**	Blocking input open CB
C/B5-I/D	Insertion status	**BiCloseCB**	Blocking input close CB
Bi1I>	Blocking input to the 1I>	**RemLT**	Remote line test input
Bi2I>	Blocking input to the 2I>	**BiLT**	Blocking input LT
Bi3I>	Blocking input to the 3I>	**Ext Reset**	External Reset input
Bi4I>	Blocking input to the 4I>	**SetupGroup 1-2**	Selection of the setting
Bi1didt	Blocking input to the 1didt		

18.3 – Function available

In this list are show the functions that can be associated with digital inputs or output relay.

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*
Iis	**Iis>**	(Start)	Instantaneous Current 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>** **Ni** **aINi** **Ne** **aINe** **Nm** **aINm**		*Circuit breaker maintenance level* *Maximum number of arc chute operation at nominal values* *Alarm maintenance level of arc chute operation* *Maximum number of arc contact operation at nominal values* *Alarm maintenance level of arc contact operation* *Maximum number of mechanical operation* *Alarm maintenance level of mechanical operation*
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**		*Exported Energy counter Pulse* *Imported Energy counter Pulse*
SelfTrip	**SelfTrip** **t-SelfTr.**		Spontaneous trip Self-Trip time delay
L/R CB Hdl	**cmdOpC/B** **cmdClC/B** **LocRemInc** **missCBOpe**		*Open C/B command* *Close C/B command* *Local / Remote Inconsistency* *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*
	LTOK		*Line Test OK*
	LTB		*Line Test Blocked*
	LT cmd	(Trip)	*Line Test command*
	CB1Fail		*CB1 Failure*
	CB2Fail		*CB2 Failure*
	CB3Fail		*CB3 Failure*
	CB4Fail		*CB4 Failure*
	CB5Fail		*CB5 Failure*
	CB1missedOp		*CB1 Missed Operation*
	CB2missedOp		*CB2 Missed Operation*
	CB3missedOp		*CB3 Missed Operation*
	CB4missedOp		*CB4 Missed Operation*
	CB5missedOp		*CB5 Missed Operation*
	MasterOp1		*Modbus Master CB1 Open request*
	MasterCL1		*Modbus Master CB1 Close request*
	MasterOp2		*Modbus Master CB2 Open request*
	MasterCL2		*Modbus Master CB2 Close request*
	MasterOp3		*Modbus Master CB3 Open request*
	MasterCL3		*Modbus Master CB3 Close request*
	MasterOp4		*Modbus Master CB4 Open request*
	MasterCL4		*Modbus Master CB4 Close request*
	MasterOp5		*Modbus Master CB5 Open request*
	MasterCL5		*Modbus Master CB5 Close request*
	Gen.Start		*General start*
	Gen.Trip		*General Trip*
	Vcc		*Reserved*
	Gnd		*Reserved*
	ResLog		*Reset signal logic*
	P1		*Push-button Open*
	P2		*Push-button Close*
	OscilloTriggerLogic		*User Variable for Oscillographic Recording*
	UserVar<0> to **UserVar<49>**		*User Variable*

Only for "**DIGITAL INPUT**"

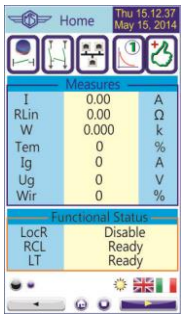
	0.D1	*Digital Input "0.D1"*	*activated*	*Digital Input on Main Relay*
	0.D1Not	*Digital Input "0.D1"*	*deactivated*	
	to			
	0.D4	*Digital Input "0.D4"*	*activated*	
	0.D4Not	*Digital Input "0.D4"*	*deactivated*	
	1.D1	*Digital Input "1.D1"*	*activated*	*Digital input on Expansion Board*
	1.D1Not	*Digital Input "1.D1"*	*deactivated*	
	to			
	1.D15	*Digital Input "1.D15"*	*activated*	
	1.D15Not	*Digital Input "1.D15"*	*deactivated*	
	2.D1	*Digital Input "2.D1"*	*activated*	*Digital input on Expansion Board*
	2.D1Not	*Digital Input "2.D1"*	*deactivated*	
	to			
	2.D15	*Digital Input "2.D15"*	*activated*	
	2.D15Not	*Digital Input "2.D15"*	*deactivated*	

Only for "**OUTPUT RELAY**"

	0.R1 to **0.R6**	*Output relays on Main Relay*
	1.R1 to **1.R14**	*Output relays on Expansion Board*
	2.R1 to **2.R14**	*Output relays on Expansion Board*

18.4 – "InpCfg" Inputs Configuration - via Touch Screen

1

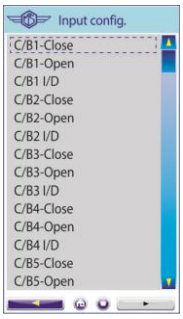


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

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

3

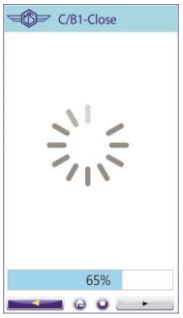


• Select Input "***Bi1I>***" from list.

4

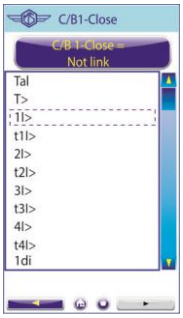
• Press "***Link***".

5



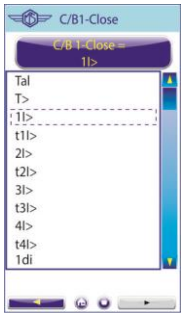
• Load parameters……

6



• Select "***T>***" from list.

7



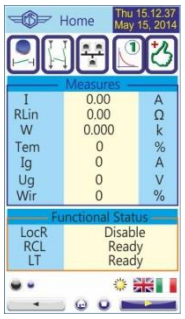
• The box show "**C/B1=1I>**".
• The function is Linked

8

To link multiple functions to digital input, use "**USER VARIABLES**".

18.5 – "InpView" Inputs Status View - via Touch Screen

1

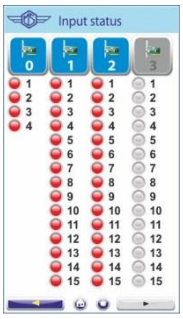


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

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

3

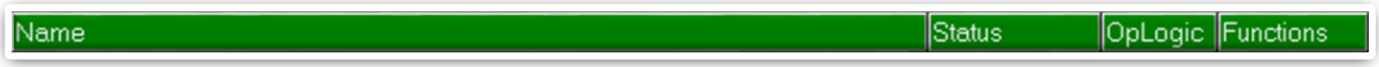


• This list shows actual status of digital inputs.

Expansion Board	Expansion Board	Signalization Leds
Assigned	Not Assigned/Present	Inputs active
Assigned	Not Assigned/Present	Inputs not active
Assigned	Not Assigned/Present	Inputs not present
Assigned	Not Assigned/Present	

18.6 – "DI" Configuration - via MSCom2 software

18.6.1 – Example



18.6.2 - Name

Logical Input name

18.6.3 - Status

Logical Input status

18.6.4 - OpLogic

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

18.6.5 - Functions

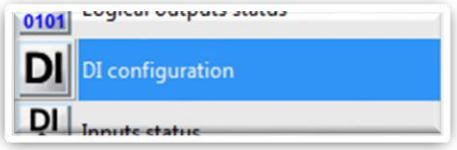
Function available.

18.6.6 - Example: Setting "Digital Input"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button

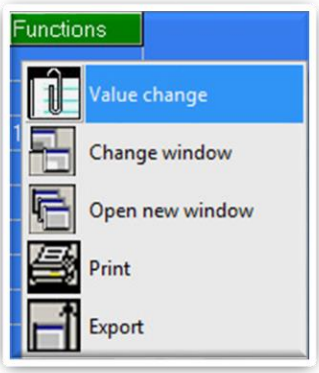
Select "**DI CONFIGURATION**"



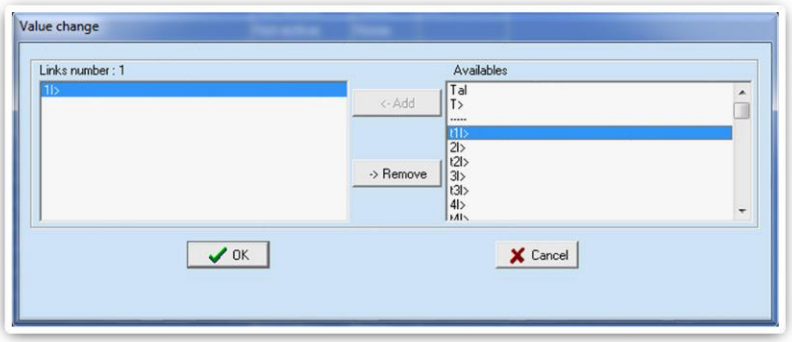
Setting for "**BI1I>**" : "**1I>**".

18.6.7 - "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)



18.7 – Outputs Relay

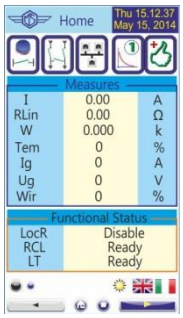
The output relay are fully user programmable and controlled by any protection functions and by any digital inputs.

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

Any Output Relay can be programmed to be controlled (energized) by one or more of the following functions or Digital Inputs, see § Function available

18.8 – "OutCfg" Outputs Configuration - via Touch Screen

1

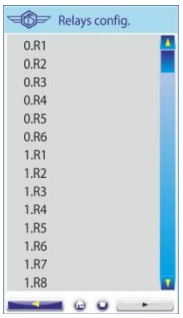


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

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

3

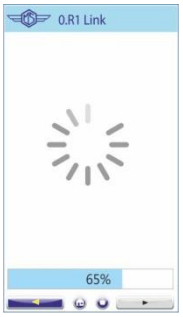


• Select Input "***0.R1***" from list.

4

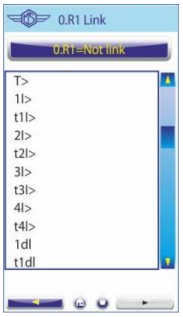
• Press "***Link***".

5



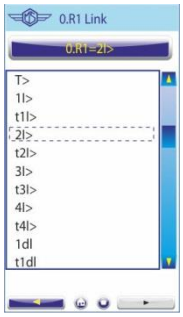
• Load parameters……

6



• Select "***2I>***" from list.

7



• The box show "**0.R1=2I>**".
• The function is linked.

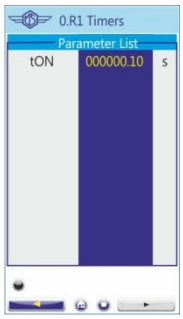
8

To link multiple functions to Outputs Relay, use "**USER VARIABLES**".

9

• Press "**Timers**".

10



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

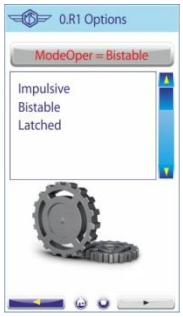
11

• Press "***Options***".

12

• Press "***ModeOper***", to select the Operative Mode.

13

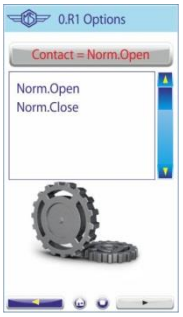


• Select the "Operative Mode" needed.

14

• Press "***Contact***", to select the contact status.

15



• Select the "contact" needed.

18.9 – "OutCfg" Outputs Configuration - via MSCom2 software

18.9.1 – "Example"

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

18.9.2 – "Relay"

Relay internal name

18.9.3 – "Linked function"

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

18.9.4 – "Operation Logic"

Operation Logic = Not used

18.9.5 – "Logical Status"

Relay Logical status

18.9.6 – "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.

18.9.7 – "tON - Operation Time"

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

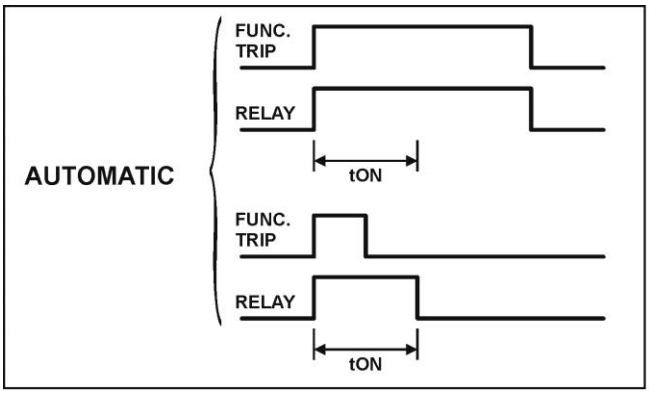
tON : 0 (0.01-10)s, step 0.01s

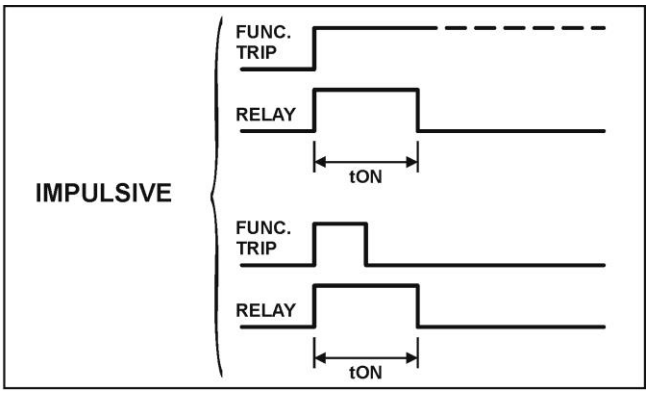
18.9.8 – "Relay Status"

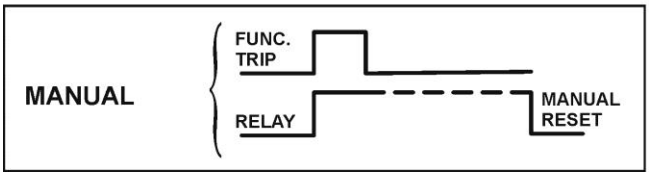
Relay – Physical status

18.9.9 - 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.



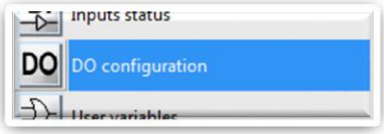




Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button

Select "**DO CONFIGURATION**"



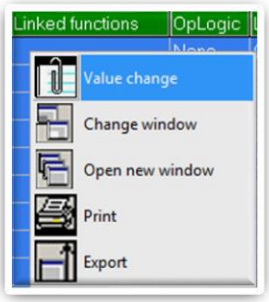
18.9.10 - Example: Change settings for "0.R1"

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

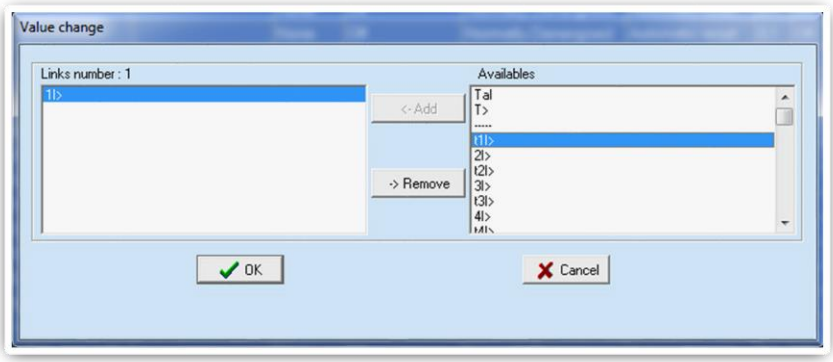
ID	Relay	Linked functions	OpLogic	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]		None	Off	Normally Denergized	Automatic reset	0,1	Off

18.9.10.1 - "Linked Functions"

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

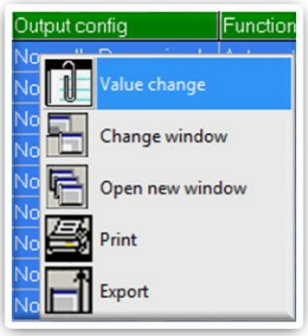


From box "Available", select "1I>" and press "Add".
Press "OK" for confirmation. (if Password is request, see § Password)

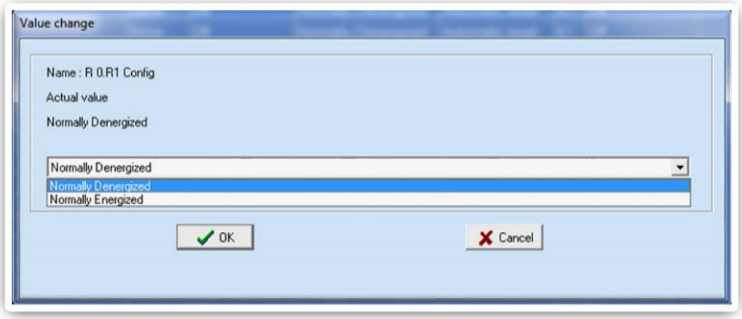


18.9.10.2 - "Output Config"

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

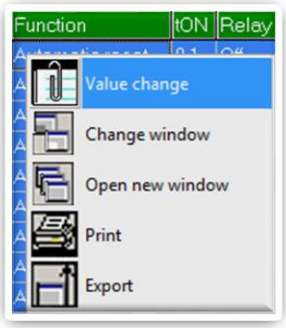


Select "**Normally Energized**" from combo box and press "OK" (if Password is request, see § Password)

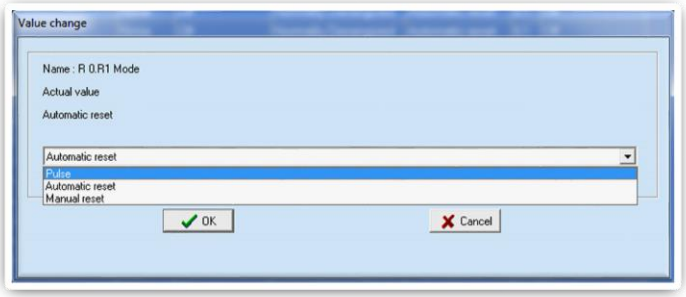


18.9.10.3 - "Function"

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

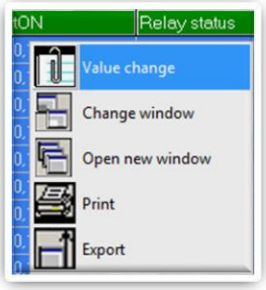


Select "**Pulse**" from combo box and press "OK" (if Password is request, see § Password):

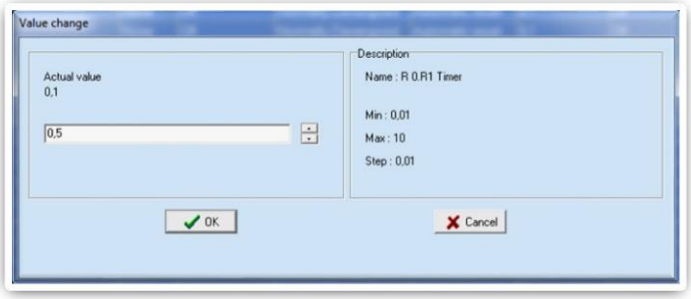


18.9.10.4 - "tON"

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



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



19. UserVar

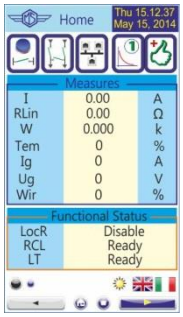
The "User Variable" is a result of a logical operation (OR, AND, ecc...), it can be used like other logical output.

19.1 – Configuration – via Touch Screen

	Logic gate / components ("Up Counter")		Button not active
	Functions assigned		Button not active
	Timer		Button not active
	Preset (is available only with "Up Counter"enable)		Button not active

19.1.1 – Selection Gate

1

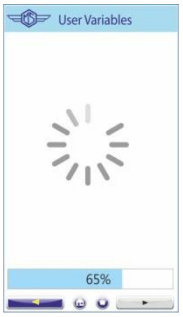


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

• Press " " to access to the settings menu.

3



• Load parameters……

4

• Select "**Gate.1**" from list.

19.1.2 – "Logic"

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

19.1.2.1 – "Logic"

1

• Press " " to access to the Logic menu.

2

• Select "***Logic***" to assign the logic gate.

3

• Select "***Logic***" needed.
• When the parameter is select, the display return at point 2

4

• The icon "***Logic***" shows "***AND***"

19.1.2.2 – "Timer"

Delay	:	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
Impulse P	:	Monostable Positive pulse time
Impulse N	:	Monostable Negative pulse time
Blink	:	When selected output is a 50% duty cycle square wave
Drop Off	:	Time added on falling output edge

1

• Press " " to access to the Logic menu.

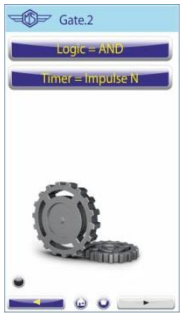
2

• Select "***Timer***" to assign the type of time.

3

• Select "***Timer***" needed.
• When the parameter is select, the display return at point 2

4



• The icon "***Timer***" shows "***Impulse N***"

19.1.3 – "Link" (example without "Logic" assigned)

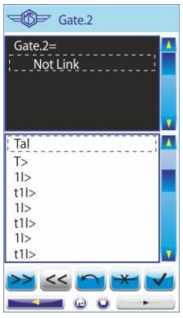
>>	Button to add the selected parameter	>>	Button not active
<<	Button to remove the selected parameter	<<	Button not active
↶	Button to return to pre-existent parameters	↶	Button not active
✕	Button to remove all parameter	✕	Button not active
✓	Button to confirm parameter selected	✓	Button not active

In this mode (no logic), you can only assign one item to the gate

1

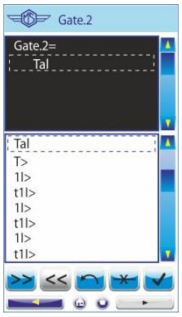
• Press " " to access to the Link page.

2



• Select element (ex. Tal)
• Press >> to assign.

3



• The "**Tal**" parameter is showed in the box.
• Press ✓ to confirm.

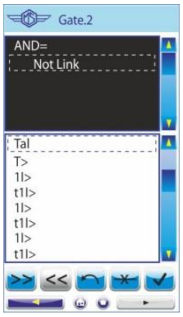
19.1.4 – "Link" (example with "Logic = AND" assigned)

In this mode (logic), you can assign various items (max. 8 items) to the gate

1

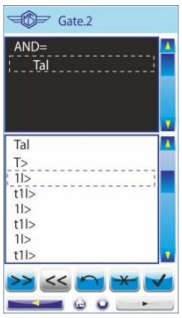
• Press " " to access to the Link page.

2



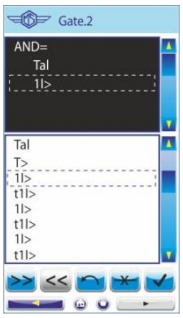
• Select element "**Tal**"
• Press >> to assign.

3



• The "**Tal**" parameter is showed in the box.
• Press ✓ to confirm.

4



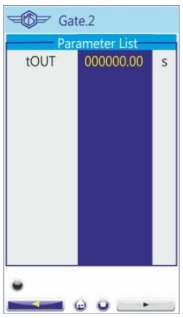
• Select element "**1I>**"
• Press >> to assign.
• Press ✓ to confirm.

19.1.5 – "Timer"

1

• Press " " to access.

2



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

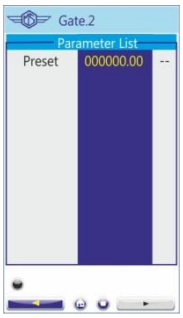
19.1.6 – "Preset"

This menu is available only with "Up Counter" enable

1

• Press " " to access.

2



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

19.2 – Configuration – via MSCom2 software

19.2.1 - Name

Internal progressive name

19.2.2 - User Descr.

Custom identification label for user variable

19.2.3 - Linked functions

Selection functions

19.2.4 - OpLogic

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

19.2.5 - Timer

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

19.2.6 - Timer type

Delay	:	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
Impulse P	:	Monostable Positive pulse time
Impulse N	:	Monostable Negative pulse time
Blink	:	When selected output is a 50% duty cycle square wave
Drop Off	:	Time added on falling output edge

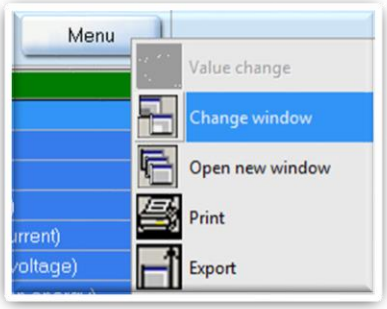
19.2.7 - Logical status

"User Variable" Logical status

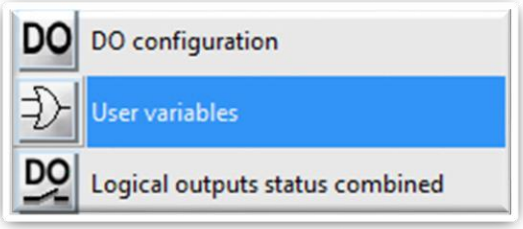
19.2.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "**USER VARIABLE**"

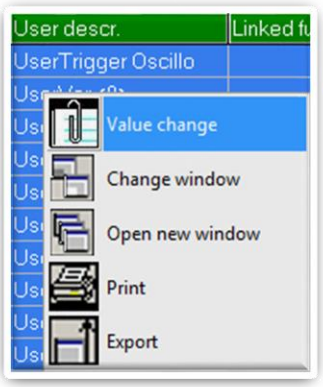


Setting for "**UserVar<0>**" :
"**Start Overcurrent Element**", "**1I>, 2I>, 3I>**", "**OR**", "**1**", "**Monostable P**".

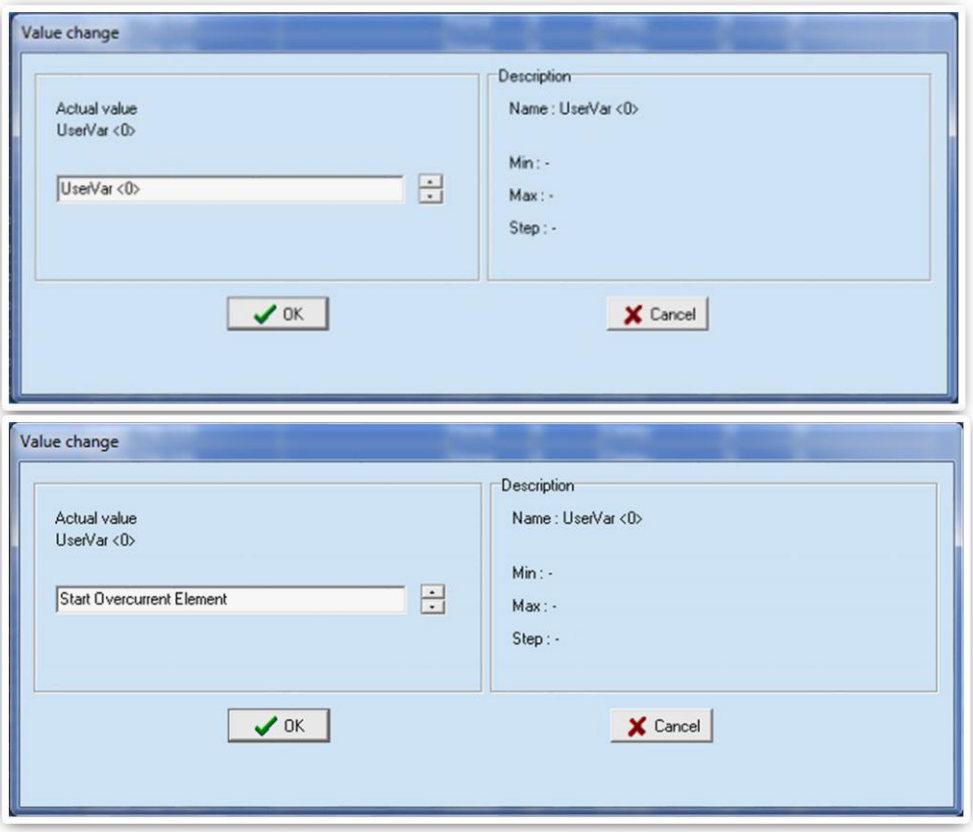
Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Extra	Logical status
UserTrigger Oscillo	UserTrigger Oscillo		None	0	Delay	0	0
UserVar <0>	UserVar <0>		None	0	Delay	0	0

19.2.8.1 - "User description" (User descr.)

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

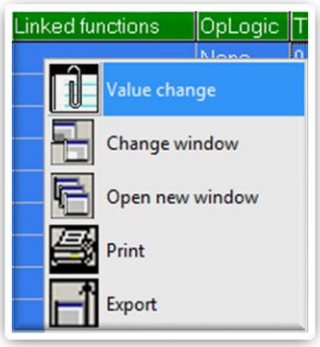


Insert "**Start Overcurrent Element**" into box and press "OK":

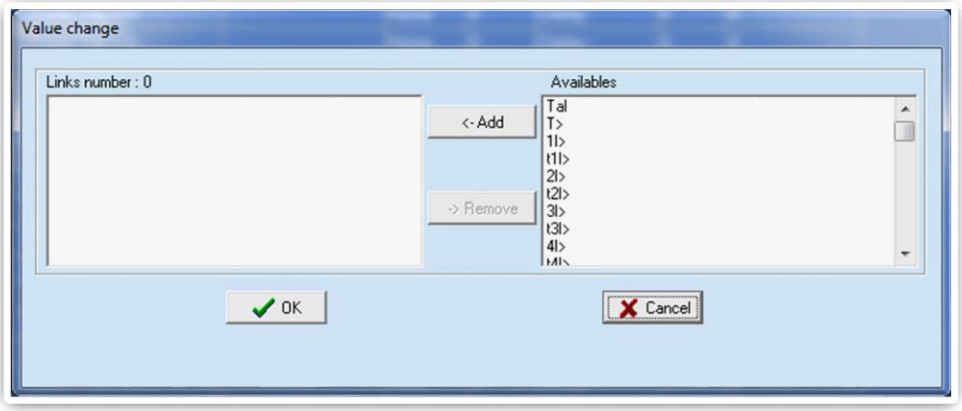


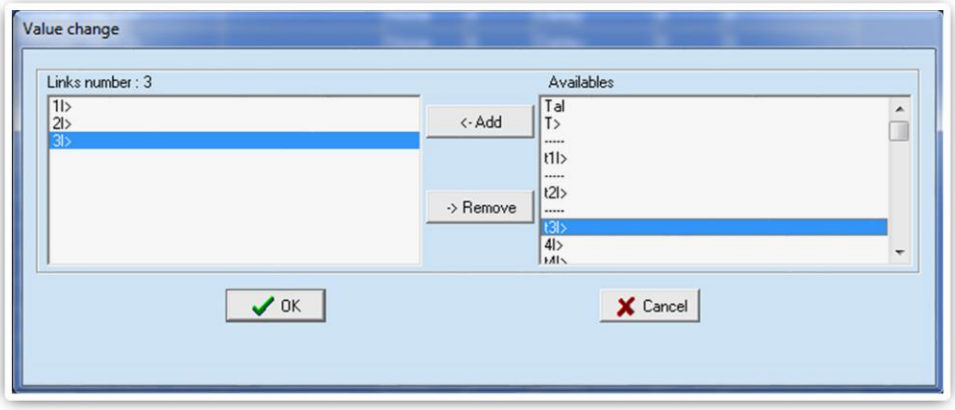
19.2.8.2 - "Linked Functions"

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



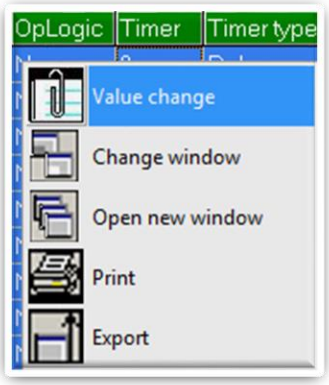
Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".

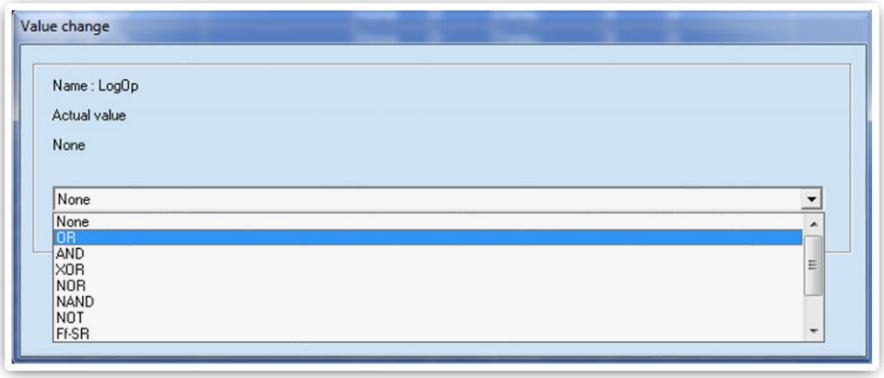




19.2.8.3 - "Operation Logic" (Oplogic)

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

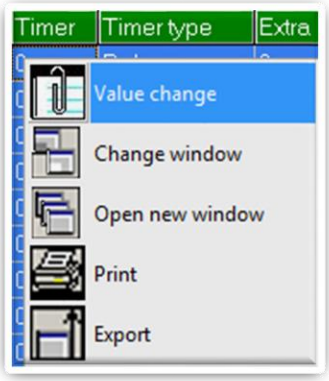




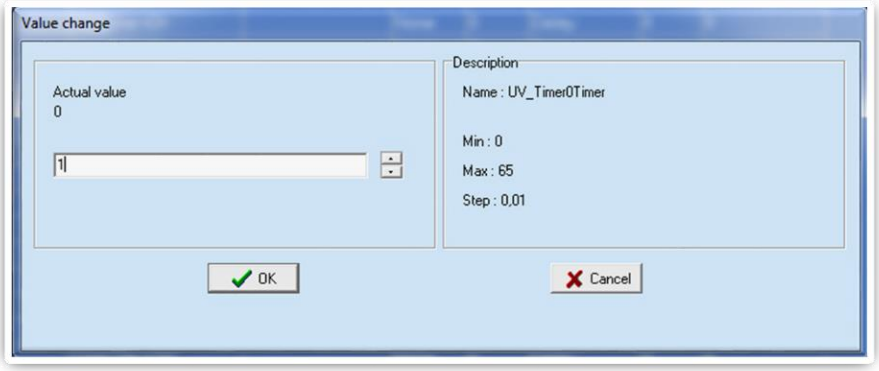
Insert "**OR**" into box and press "OK":

19.2.8.4 - "Timer"

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

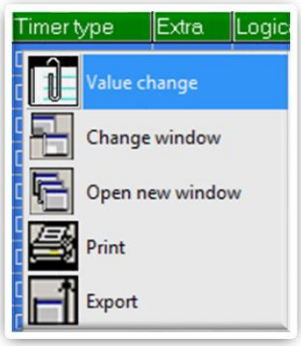


Select "**1**" into box and press "OK":

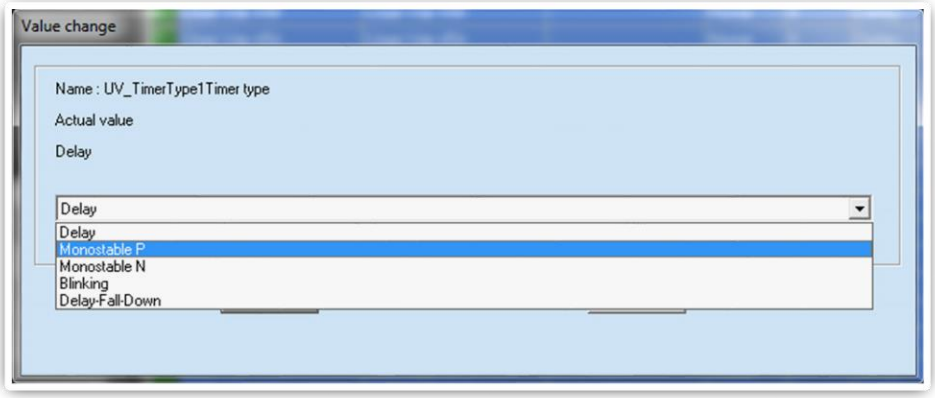


19.2.8.5 - "Timer type"

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



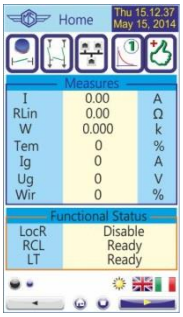
Select "**Monostable**" into box and press "OK":



20. Date and Time

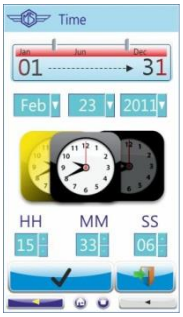
In this menu it is possible to configurate the Date and Time

1



• Press "Tue 15.12.37 Dec 09, 2012" for access to the "Date and Time" menu.

2



Feb 23 2011 — Through this control is possible change the system "Date"

Feb — To change month

23 — To change day

2011 — To change year

HH 15 MM 33 SS 06 — Through this control is possible change the system "Time"

HH 15 — To change hours

MM 33 — To change minutes

SS 06 — To change seconds

Confirm

Exit

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:

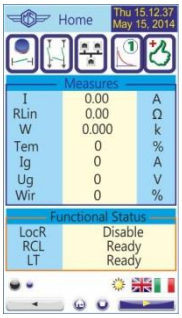
- Using the "MSCom2" software or from the DCS with the Modbus RTU protocol.

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

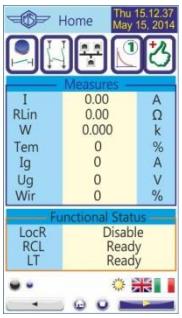
• Press "✚" to access.

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
Firmware		Firmware Ok		Firmware compatibility fault

1



In Home page, is present an Icon Healthy.
This icon shows the status of the device.

No device error.

Faulty.
Press to go the Healthy page.

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.

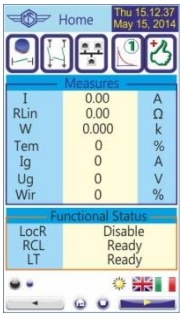
Line Name	Line identification label.	(1)
Station Name	Build identification label.	(1)
Serial Number	Relay Serial Number	Not modifiable
U-MLE-PLS	Protection Type	Not modifiable

(1) This information can only be modified by the interface program "MSCom2"

23. FW Version (Firmware 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 "●" to next page.

3

• Press "▬" to access.

4

• In this menu is showed the information of device.

Type Relay		Type Relay	**U-MLE-PLV-TS**
IPU		Firmware number	**0861.35.01.x**
DSP		Firmware number	**024.01.A**
Touch Screen		Firmware number	**861.08.01**

24. Software Application

Application Software	
MSCom 2	Last version

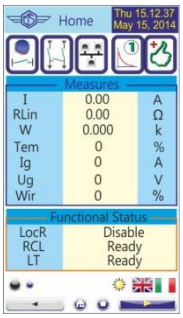
25. Display Cal. (Display Calibration)

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

In case the Display is out of calibration, press the pushbuttons

at the same time for 2" to access the calibration procedure (start at point 4).

1



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

2

• Press "●" for next page.

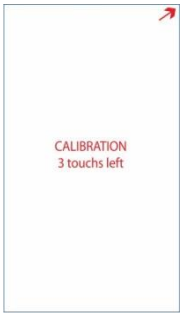
3

• Press "▬" to calibration.

4

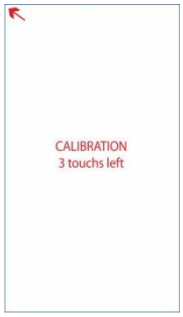
• Touch to continue.

5



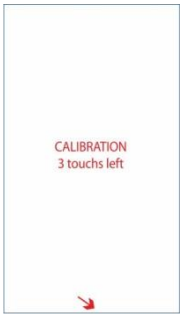
• 3 Touches Right-up.

6



• 3 Touches Left-up.

7



• 3 Touches Middle point down.

8

• Calibration Done.

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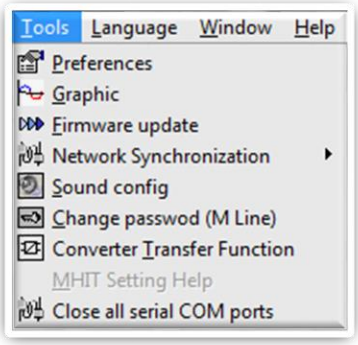
Knorr-Bremse Group

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

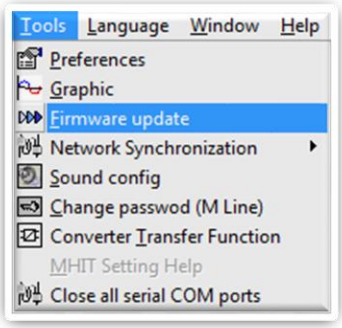
Insert USB cable in the front face connector.

Open "MSCom2" software:

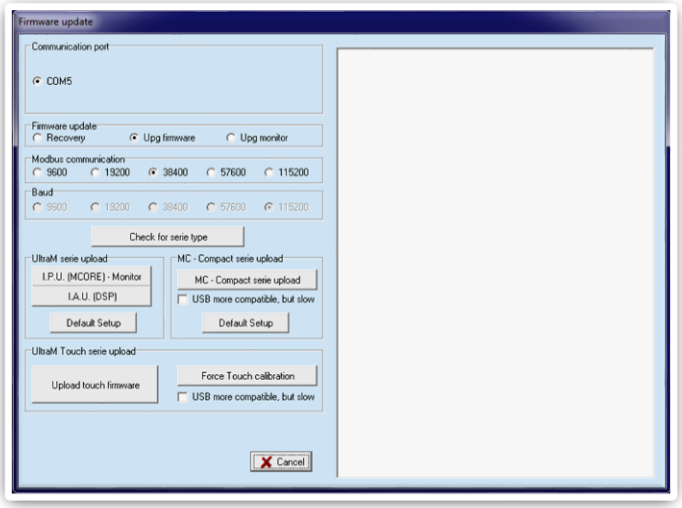
Select "**Tools**" on main menu:



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



Press "**Force Touch calibration**":

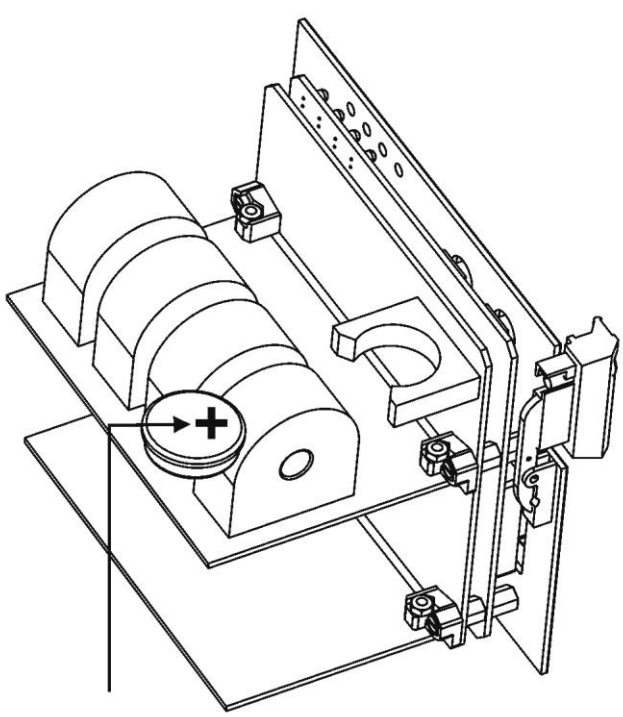


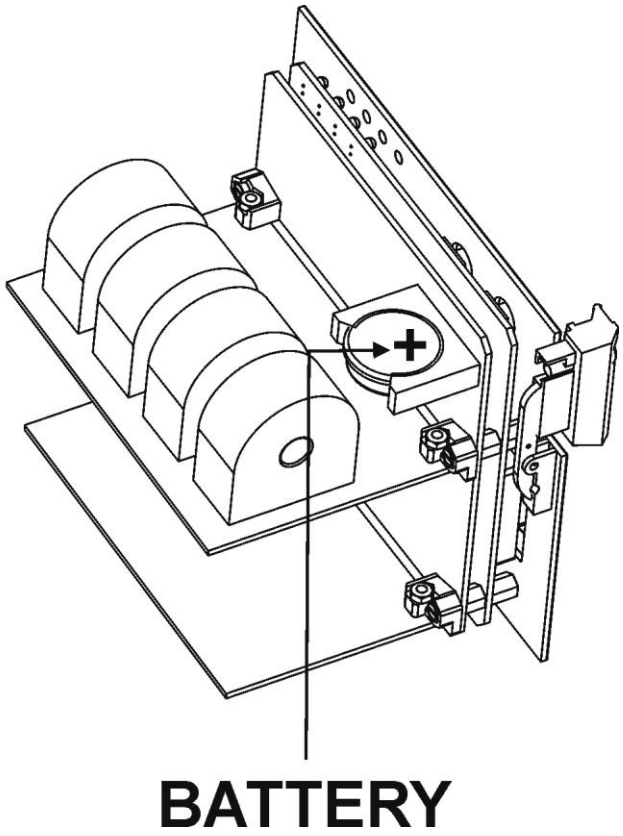
26. Battery

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:





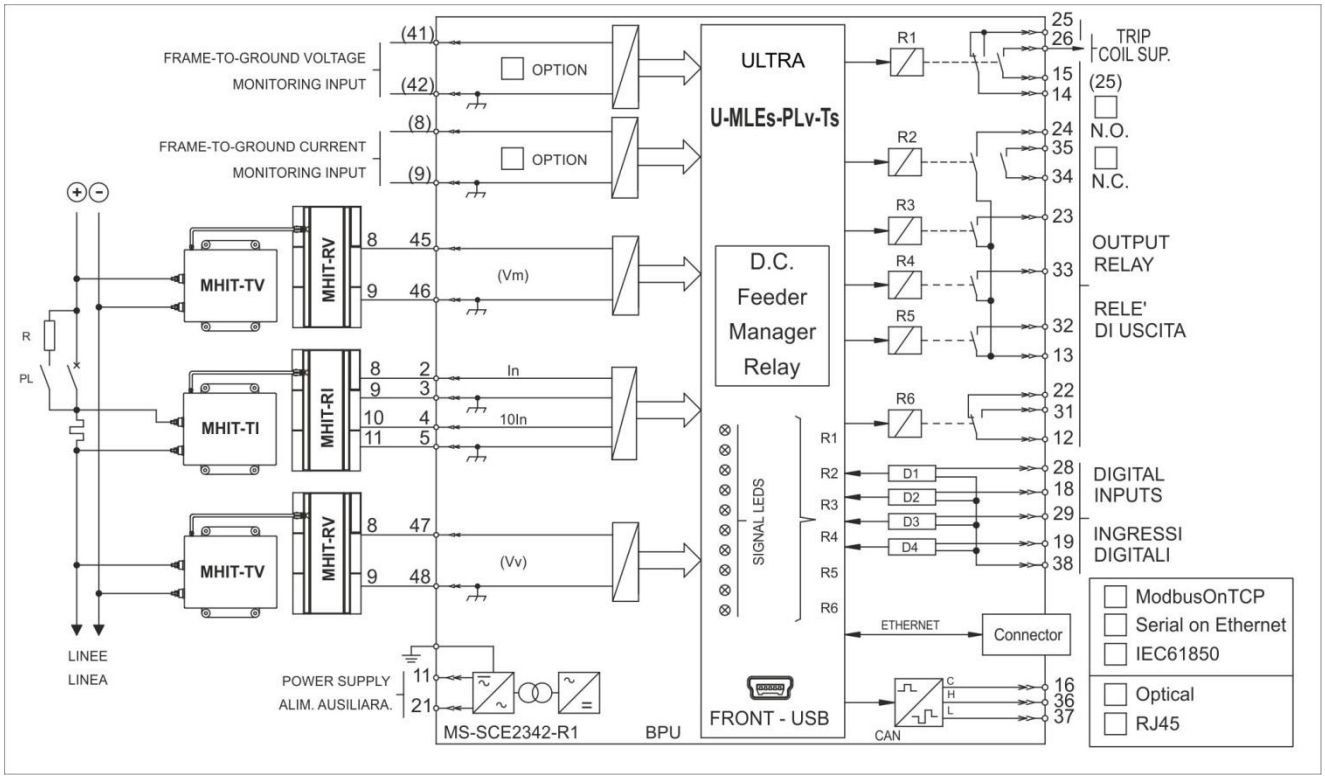
27. Maintenance

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.

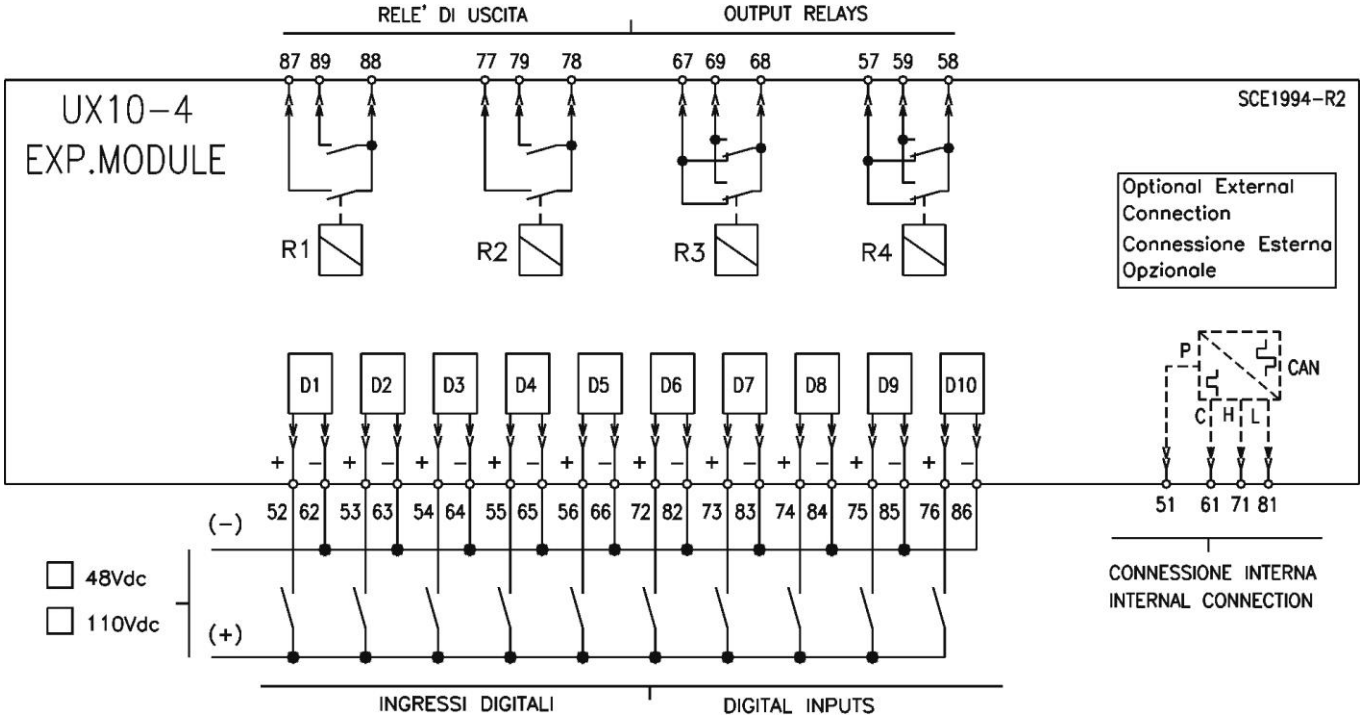
28. Power Frequency Insulation Test

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.

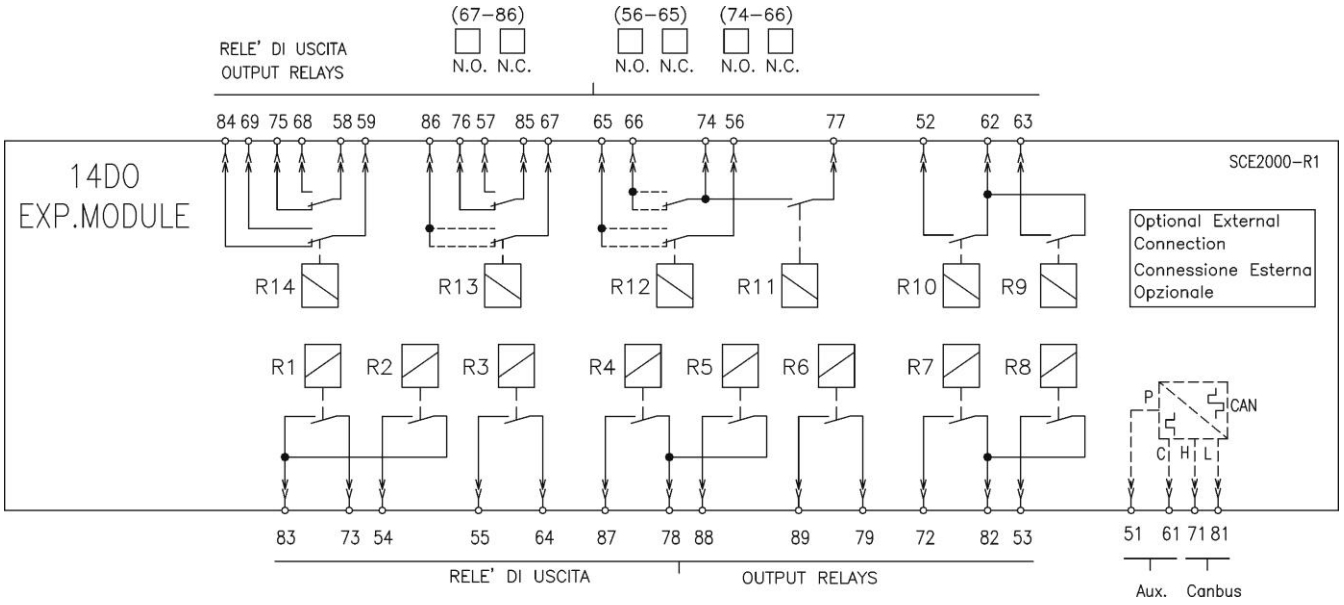
29. Wiring Diagram



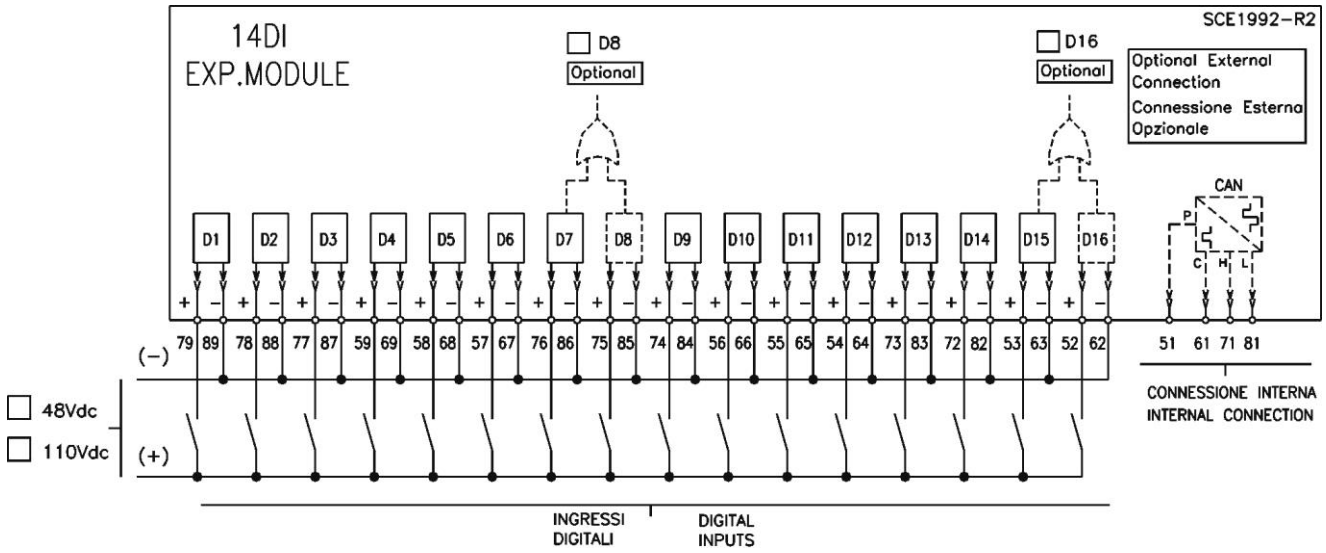
*29.1 – **UX10-4** - Expansion Module - Wiring Diagram (10 Digital Inputs + 4 Output Relays)*



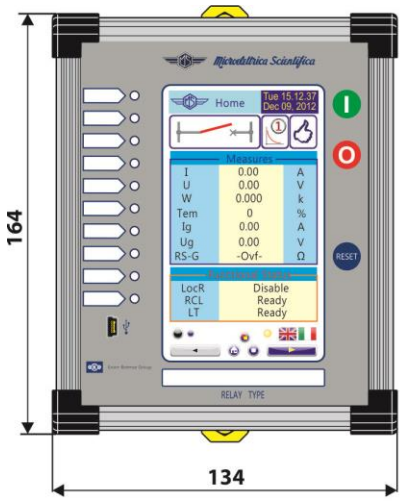
*29.2 – **14DO** - Expansion Module - Wiring Diagram (14 Output Relays)*



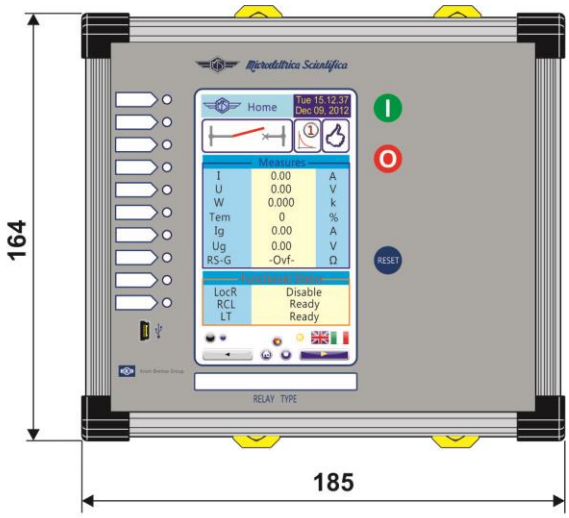
*29.3 – **14DI** - Expansion Module - Wiring Diagram (14 Digital Inputs)*



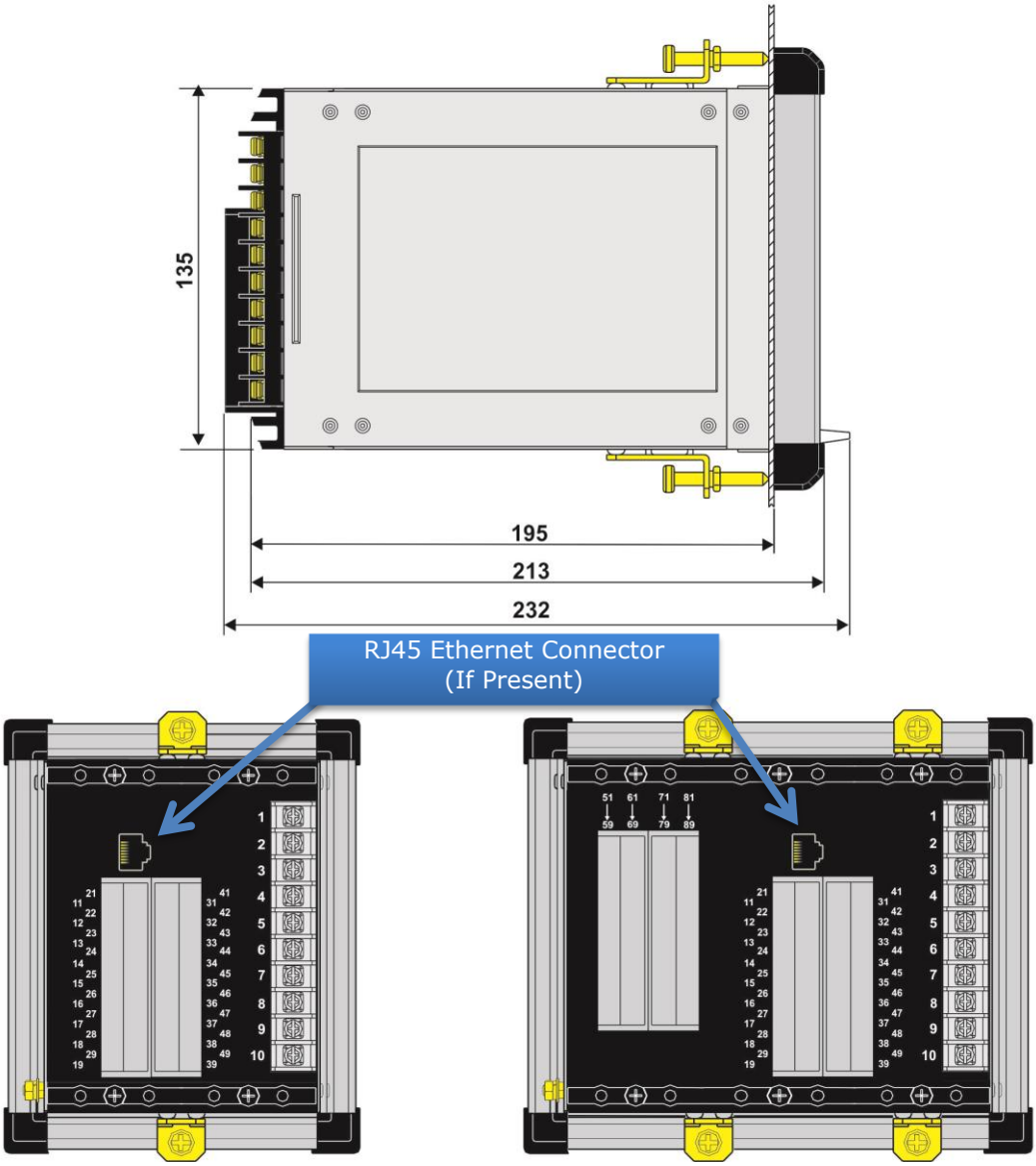
30. Overall Dimensions



PANEL CUT-OUT
115x137 (LxH)



PANEL CUT-OUT
165x137 (LxH)



31. Electrical Characteristics

APPROVAL: CE
REFERENCE STANDARDS IEC 60255 - EN50263 - CE Directive - EN/IEC61000 - IEEE C37

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

Environmental Std. Ref. (IEC 60068)

Operation ambient temperature		-10°C / +55°C	
Storage temperature		-25°C / +70°C	
Environmental testing	(Cold)	IEC60068-2-1	
	(Dry heat)	IEC60068-2-2	
	(Change of temperature)	IEC60068-2-14	
	(Damp heat, steady state)	IEC60068-2-78	RH 93% Without Condensing AT 40°C

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

Electromagnetic emission	EN55022	industrial environment		
Radiated electromagnetic field immunity test	IEC61000-4-3	level 3	80-2000MHz	10V/m
	ENV50204		900MHz/200Hz	10V/m
Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
Electrostatic discharge test	IEC61000-4-2	level 4	6kV contact / 8kV air	
Power frequency magnetic test	IEC61000-4-8		1000A/m	50/60Hz
Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs	
Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz	
Immunity to conducted common mode disturbance 0Hz-150KHz	IEC61000-4-16	level 4		
Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz	
HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)	
Oscillatory waves (Ring waves)	IEC61000-4-12	level 4	4kV(c.m.), 2kV(d.m.)	
Surge immunity test	IEC61000-4-5	level 4	2kV(c.m.), 1kV(d.m.)	
Voltage interruptions	IEC60255-4-11			
Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 10-500Hz 1g			

ELECTRIC RATED VALUE

Accuracy at reference value of influencing factors	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

Front port	USB (Modbus RTU)
Rear port (Terminal Block)	RS485 – 9600 to 38400 bps – 8,n,1 (Modbus RTU or IEC103)
Rear port (Ethernet)	RJ45 (ModOnTCP or SerialOnEth) *IP Address : 192.168.0.100 default, modifiable by MSCom2 program*

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The performances and the characteristics reported in this manual are not binding and can modified at any moment without notice