FEEDER MANAGER
RELAY

TYPE

FMR-PL-Ts

(Multiple I/O Boards)

ULTRA Line

OPERATION MANUAL

CE

1. General Utilization and Commissioning Directions

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

1.1 - Storage and Transportation

Must comply with the environmental conditions stated in the product's specification or by the applicable IEC standards.

1.2 - Installation

Must be properly made and in compliance with the operational ambient conditions stated by the Manufacturer.

1.3 - Electrical Connection

Must be made strictly according to the wiring diagram supplied with the Product, to its electrical characteristics and in compliance with the applicable standards particularly with reference to human safety.

1.4 - Measuring Inputs and Power Supply

Carefully check that the value of input quantities and power supply voltage are proper and within the permissible variation limits.

1.5 - Outputs Loading

Must be compatible with their declared performance.

1.6 - Protection Earthing

When earthing is required, carefully check its effectiveness.

1.7 - Setting and Calibration

Carefully check the proper setting of the different functions according to the configuration of the protected system, the safety regulations and the co-ordination with other equipment.

1.8 - Safety Protection

Carefully check that all safety means are correctly mounted, apply proper seals where required and periodically check their integrity.

1.9 - Handling

Notwithstanding the highest practicable protection means used in designing M.S. electronic circuits, the electronic components and semiconductor devices mounted on the modules can be seriously damaged by electrostatic voltage discharge which can be experienced when handling the modules.
The damage caused by electrostatic discharge may not be immediately apparent but the design reliability and the long life of the product will have been reduced. The electronic circuits produced by M.S. are completely safe from electrostatic discharge (8 kV IEC 255.22.2) when housed in their case; withdrawing the modules without proper cautions expose them to the risk of damage.

1.10 - Maintenance

Make reference to the instruction manual of the Manufacturer; maintenance must be carried-out by specially trained people and in strict conformity with the safety regulations.

1.11 - Waste Disposal of Electrical & Electronic Equipment

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

1.12 - Fault Detection and Repair

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

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

2. General

Input currents are supplied to 4 current transformers: - three measuring phase current - one measuring the earth fault zero-sequence current.
Current input can be selected 1A or 5A by movable jumpers available on relay cards.
Input voltage are supplied to 4 Potential Transformers: three measuring phase-to-neutral voltage and one measuring the zero sequence voltage supplied by the secondary of three system P.Ts. Y/Open Delta connected.
The Measuring Ranges of the different inputs respectively are:

Phase Currents	:	(0.1-40)In	Phase Voltage	:	(0.01-2)Un
Neutral Current	:	(0.01-10)On	Neutral Voltage	:	(0.01-2)Un

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 interchangeable module fully isolated an self protected.

2.1 - Power Supply

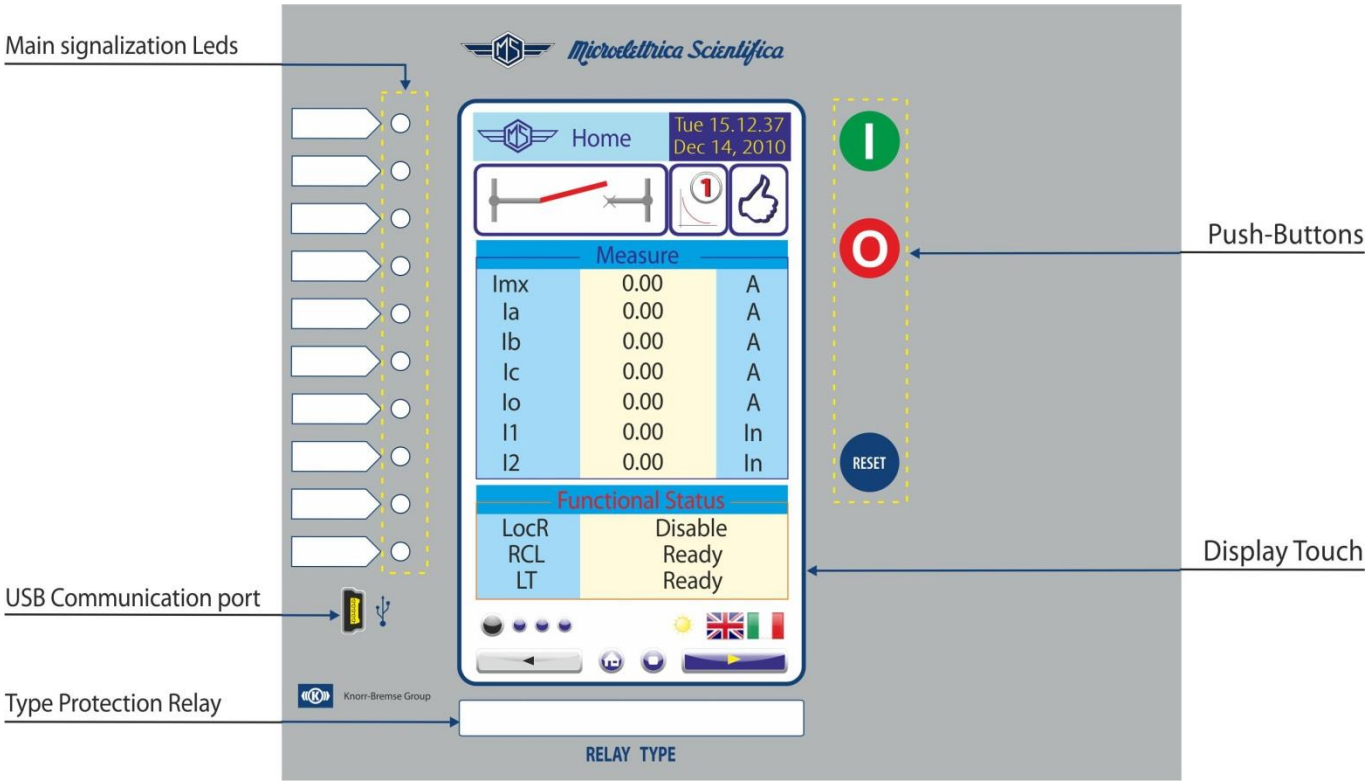
The relay can be fitted with two different types of **power supply**:

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

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

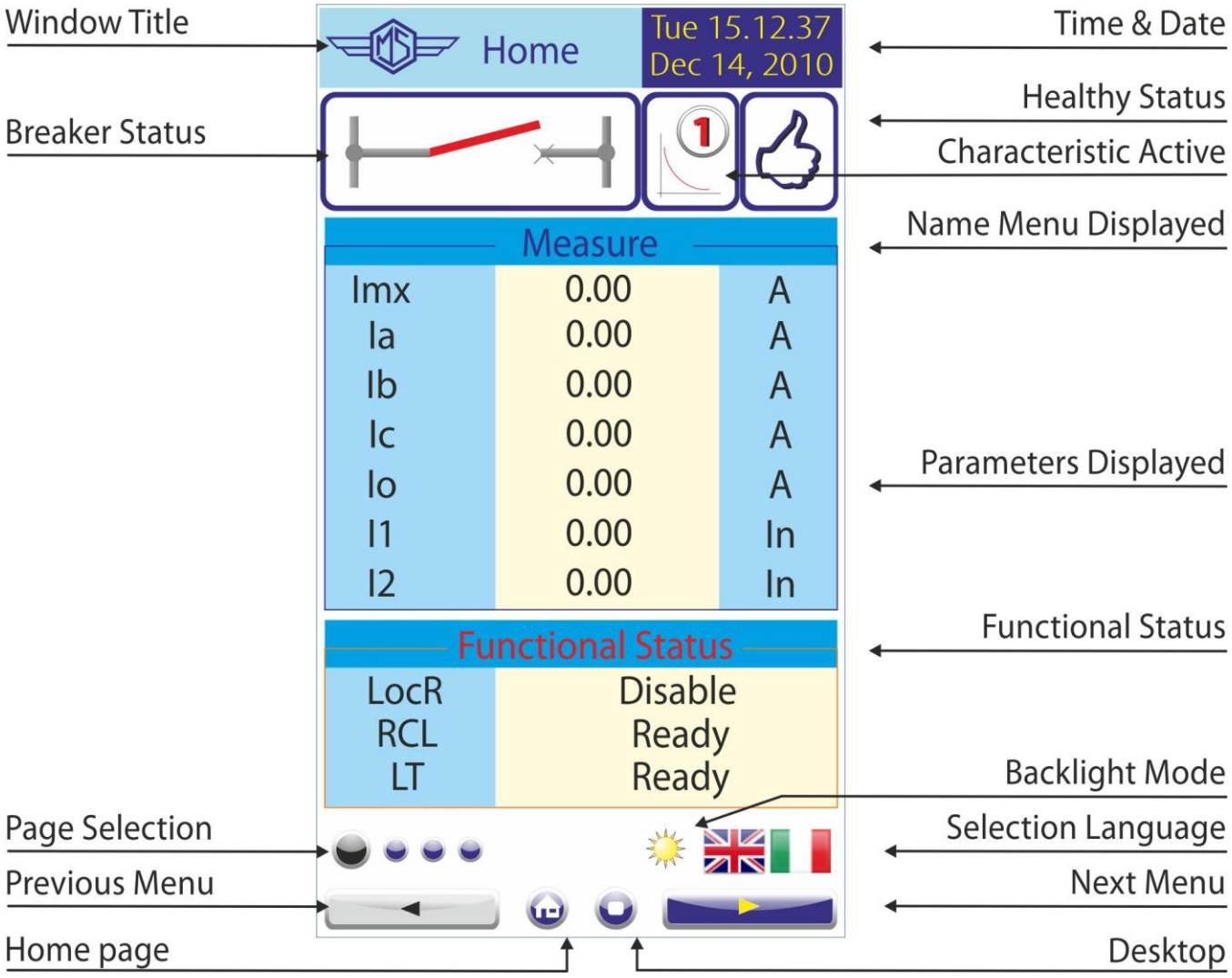
Before energizing the unit check that supply voltage is within the allowed limits.

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

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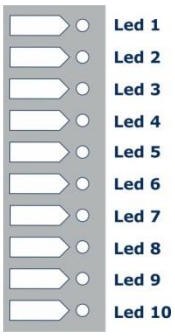
6. Signalization

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.

1

Number of trip before reset.

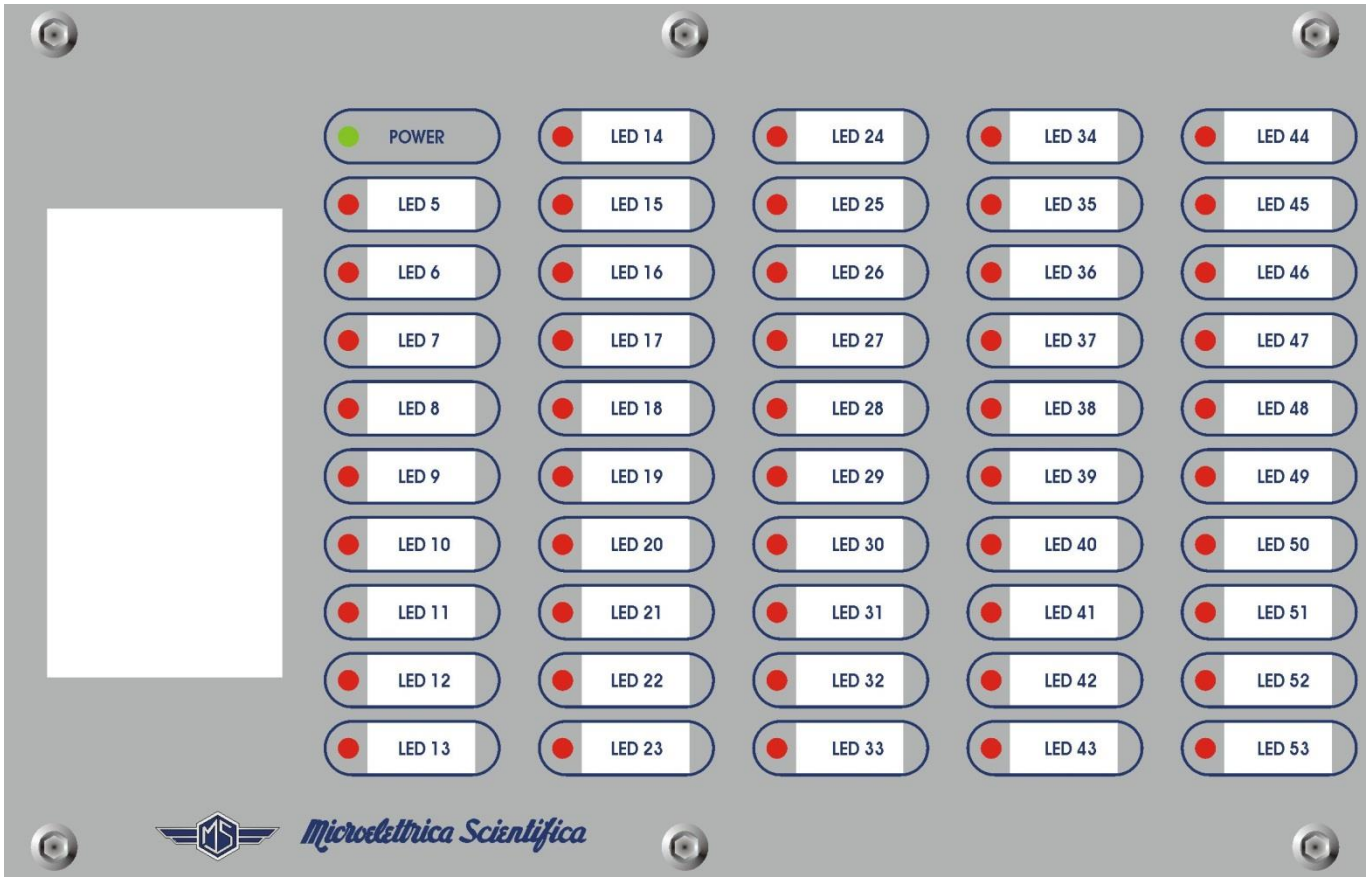
Function tripped

Press to erase visualization

Press to visualization trip parmeter

6.2 Signalization Module (optional)

The firmware can manage up to 53 signal leds, 4 led are available on the main relay module, the remaining are available on additional expansion modules (1 "Power" (green), 49 "Programmable" (red)) controlled via the CAN-Bus communication channel (external wired).

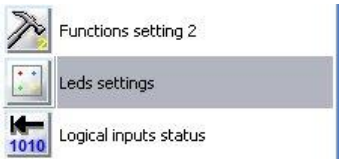


6.3 – Programming Led's

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

Open "MSCom2" program and connect to the relay.
Select "Change Windows" from "Menu" button

Select "Led Setting"



The window for led configuration will show:

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

6.3.1 - Name

Led name – for leds position see picture

6.3.2 - Link enable

Linked	=	Enable to operate
No Linked	=	Disable

6.3.3 - Status

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

6.3.4 - Light Prog.

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

6.3.5 - Funct. Mode

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

6.3.6 - Functions

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

6.3.7 - Table 1

Functions	Element		Description
T>	Tal T>	Alarm Trip	Thermal Image T>
1I>	1I> t1I>	Start Trip	First overcurrent element F50-51
2I>	2I> t2I>	Start Trip	Second overcurrent element F50-51
3I>	3I> t3I>	Start Trip	Third overcurrent element F50-51
1Io>	1Io> t1Io>	Start Trip	First earth fault element F50N-51N
2Io>	2Io> t2Io>	Start Trip	Second earth fault element F50N-51N
3Io>	3Io> t3Io>	Start Trip	Third earth fault element F50N-51N
1Is>	1Is> t1Is>	Start Trip	First negative sequence current element F46
2Is>	2Is> t2Is>	Start Trip	Second negative sequence current element F46
1U>	1U> t1U>	Start Trip	First overvoltage element F59
2U>	2U> t2U>	Start Trip	Second overvoltage element F59
1U<	1U t1U<	Start Trip	First undervoltage element F27
2U<	2U t2U<	Start Trip	Second undervoltage element F27
1f>	1f> t1f>	Start Trip	First overfrequency element F81
2f>	2f> t2f>	Start Trip	Second overfrequency element F81
1f<	1f t1f<	Start Trip	First underfrequency element F81
2f<	2f t2f<	Start Trip	Second underfrequency element F81
1Uo>	1Uo> t1Uo>	Start Trip	First zero sequence voltage element F59Uo
2Uo>	2Uo> t2Uo>	Start Trip	Second zero sequence voltage element F59Uo
U1<	U1 tU1<	Start Trip	Positive sequence undervoltage element F27U1
U2>	U2> tU2>	Start Trip	Negative sequence overvoltage element F59U2
I<	I< tI<	Start Trip	Undercurrent (no-load running) element F37
Wi	tWi>		Circuit breaker maintenance level
TCS	tTCS		Trip coil supervision
IRF	IRF tIRF	Start Trip	Internal Relay Failure
BF	tBF	Trip	Breaker Failure
RT	RT tRT	Start Trip	Remote Trip

Gen.Start	*Start*	*Generic*
Gen.Trip	*Trip*	*Generic*
manOpCmd		*Manual Open Command*
L/Rdisc		*Local/Remote signal Discrepancy*
CL-Cmd		*Close Command*
C/Bfail		*Circuit Breaker failure*
OscilloTrigger Logic		*User Variable for Oscillographic Recording*
Gate1 to Gate25		*User Variable*
Vcc		Reserved
Gnd		Reserved
Reset		Reset signal logic
P1		Push-button Open
P2		Push-button Close
SCDop		*Scada open breaker command*
SCDcl		*Scada close breaker command*
SCDop2		*Scada open breaker 2 command (generic command)*
SCDcl2		*Scada close breaker 2 command (generic command)*
SCDop3		*Scada open breaker 3 command (generic command)*
SCDcl3		*Scada close breaker 3 command (generic command)*
SCDop4		*Scada open breaker 4 command (generic command)*
SCDcl4		*Scada close breaker 5 command (generic command)*
DisRCL		*Scada disable reclose command*
EnRCL		*Scada enable reclose command*
TripTimerR		Trip Time Reduction
0.D1 0.D1Not --- 0.D6 0.D6Not		*Digital Input on Main Relay*
1.D1 1.D1Not --- 1.D15 1.D15Not		*Digital input on Expansion Board 1*
2.D1 2.D1Not --- 2.D15 2.D15Not		*Digital input on Expansion Board 2*
0.R1 0.R2 0.R3 0.R4 0.R5 0.R6		*Output relay on Main Relay*
1.R1 ---- to 1.R14		*Output relay on Expansion Board 3*

6.3.8 - Example: Change settings for "Led5"

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

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

Led 5 = are provided in signalization module

to

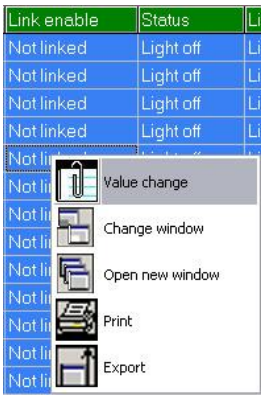
Led 53 =

Main Windows:

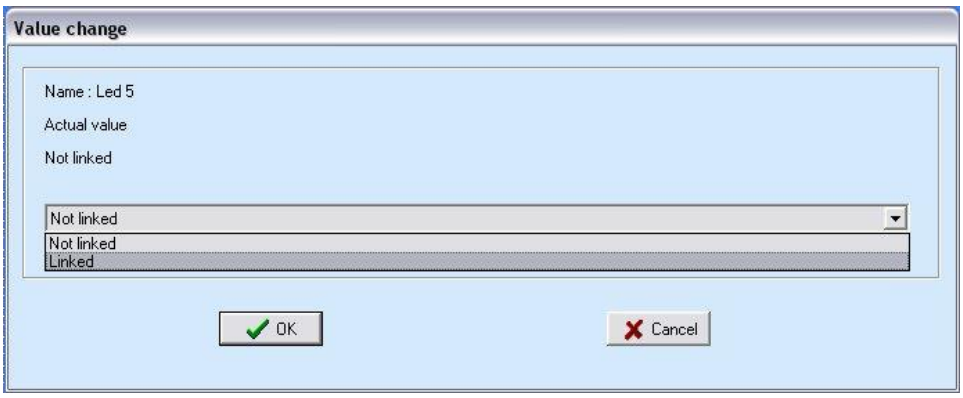
ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1	Not linked	Light off	Light on	Volatile	1I>
2	Led 2	Not linked	Light off	Light on	Volatile	1I>
3	Led 3	Not linked	Light off	Light on	Volatile	1I>
4	Led 4	Not linked	Light off	Light on	Volatile	1I>
5	Led 5	Not linked	Light off	Light on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

6.3.8.1 - "Linked"

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



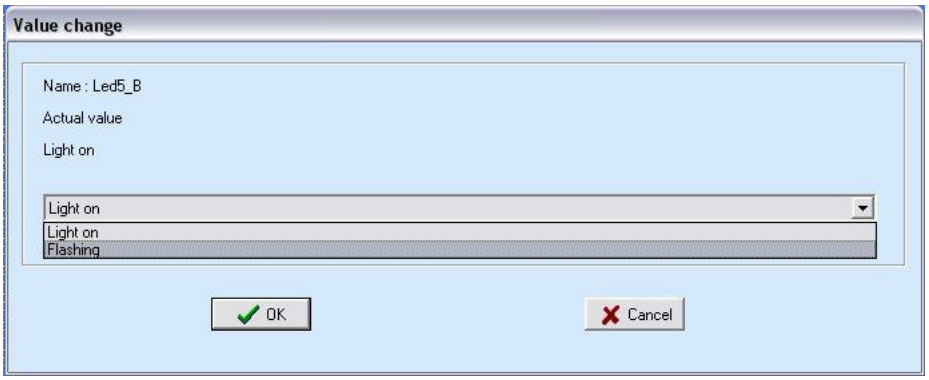
Select "**Linked**" from combo box and press "OK" (if Password is request, see § Password):



6.3.8.2 - "Flashing"

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

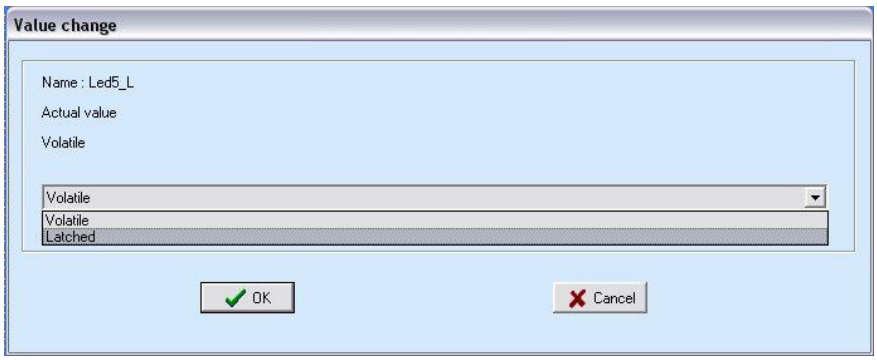
Select "**Flashing**" from combo box and press "OK" (if Password is request, see § Password):



6.3.8.3 - "Latched"

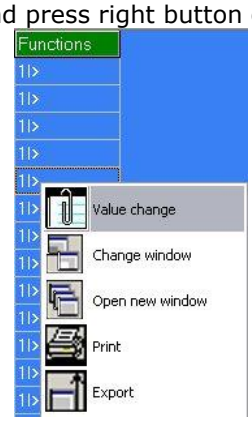
Select "**Latched**" related to "Led 5" and press right button on mouse, select "Value change":

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

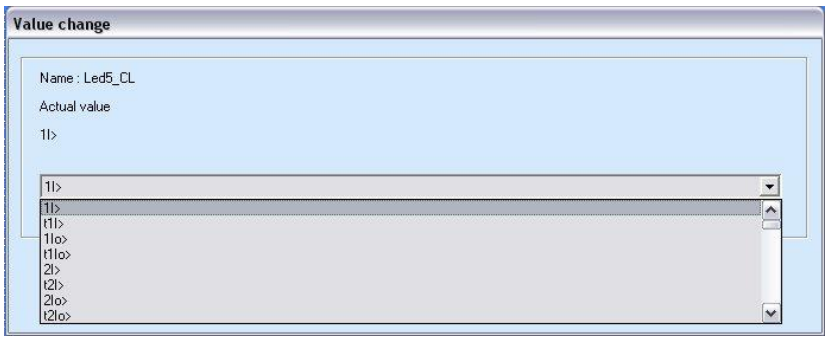


6.3.8.4 - "Functions"

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



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



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.

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

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]

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	=	Activated the output for the time "Timer"

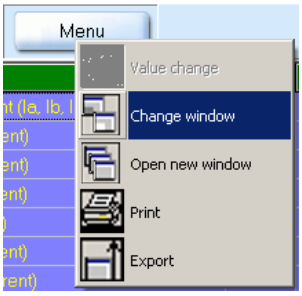
7.7 - Logical status

"User Variable" Logical status

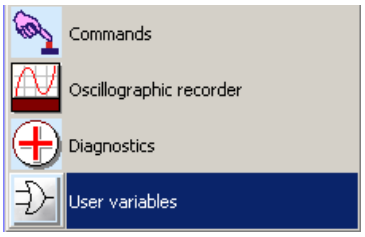
7.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"

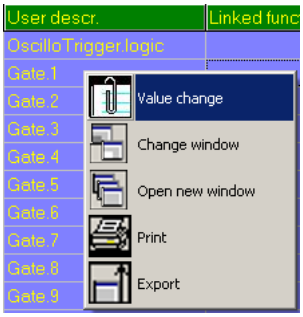


Setting for "**UserVar<0>**" : "Current Trip", "1I>,2I>,3I>", "OR", "1", "Monostable".

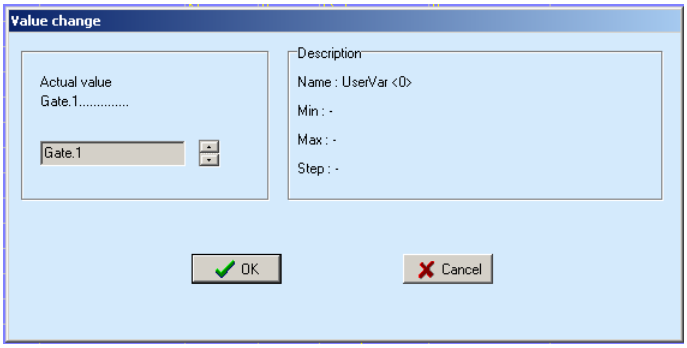
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	User Trigger Oscillo		None	0	Delay	0
2	UserVar <0>	Current trip	1I>,2I>,3I>,	OR	1	Monostable	0

7.8.1 - "User description" (User descr.)

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

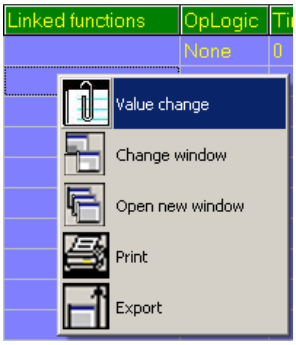


Insert "**Current Trip**" into box and press "OK":

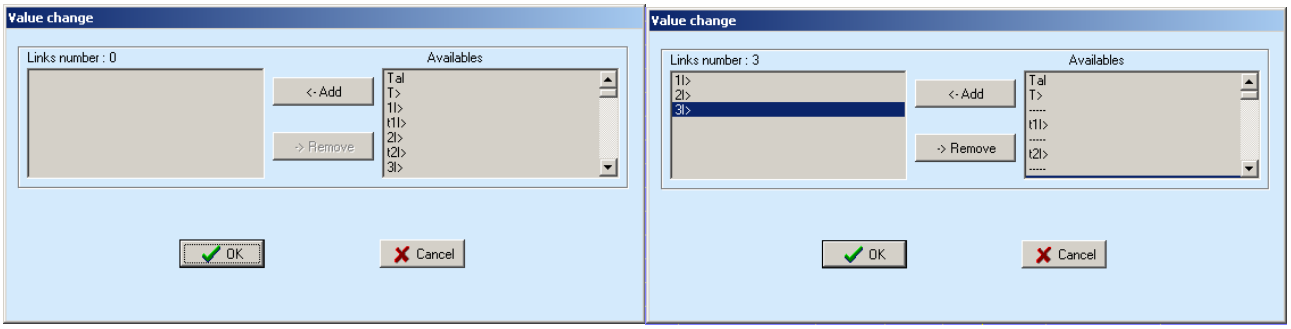


7.8.2 - "Linked Functions"

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

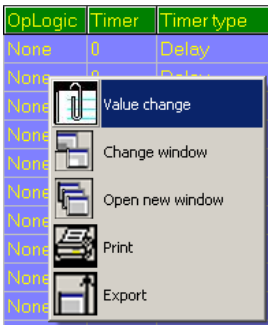


Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".

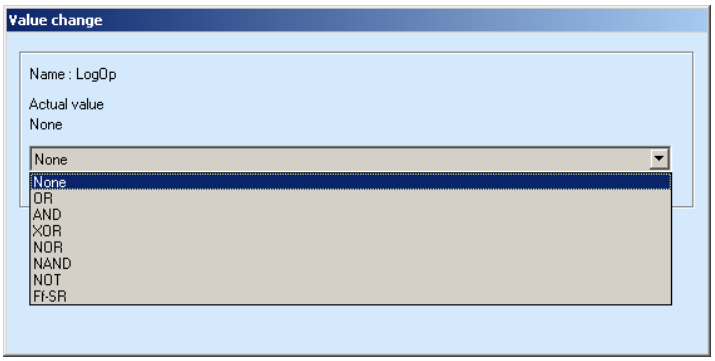


7.8.3 - "Operation Logic" (Oplogic)

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

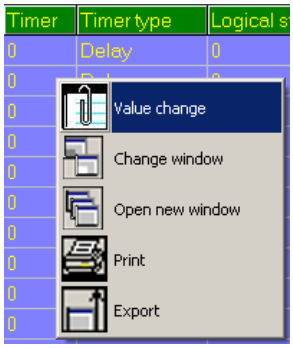


Insert "**OR**" into box and press "OK":

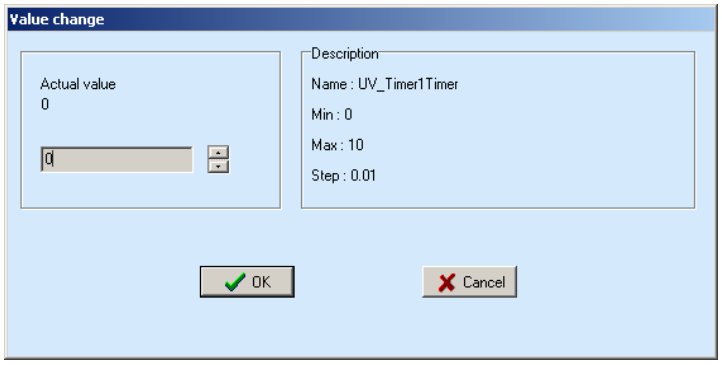


7.8.4 - "Timer"

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

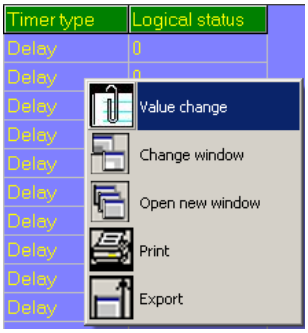


Select "**1**" into box and press "OK":

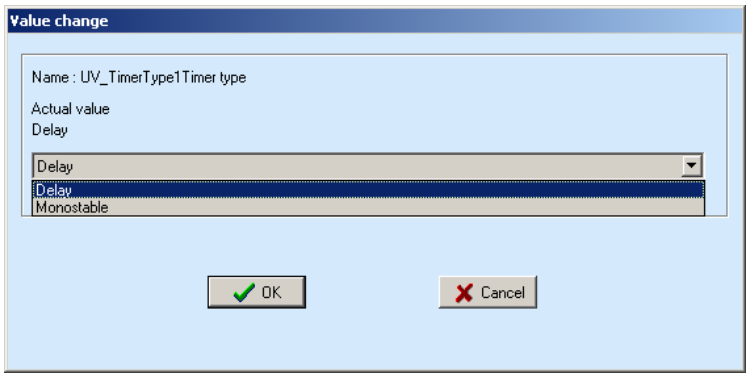


7.8.5 - "Timer type"

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

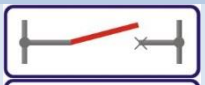
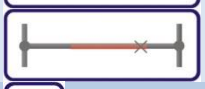


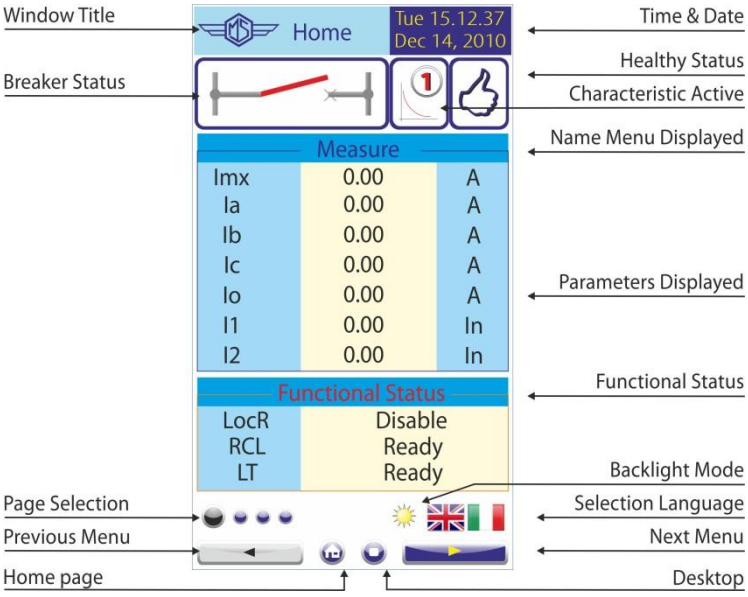
Select "**Monostable**" into box and press "OK":



8. Home (Actual measurements)

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

Time and Date	Tue 15.12.37 Dec 14, 2010	Displayed Current Date and Time
Breaker Status		Breaker Open
		Breaker Closed
Characteristic Active		Characteristic "1" Active
		Characteristic "2" Active
Healthy		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:

→ **Imx**	(0 ÷ 9999)	**A**	Largest phase current (Ia, Ib, Ic).	
→ **Ia**	(0 ÷ 9999)	**A**	Phase A current	(R.M.S. ampere)
→ **Ib**	(0 ÷ 9999)	**A**	Phase B current	(R.M.S. ampere)
→ **Ic**	(0 ÷ 9999)	**A**	Phase C current	(R.M.S. ampere)
→ **Io**	(0 ÷ 9999)	**A**	Zero Sequence Current	(fundamental frequency value 3Io)
→ **I1**	(0.00 ÷ 99.99)	**In**	Positive sequence current	
→ **I2**	(0.00 ÷ 99.99)	**In**	Negative sequence current	
→ **Frq**	(0.00 ÷ 99.99)	**Hz**	Frequency	
→ **Uan**	(0 ÷ 999999)	**V**	Phase Voltage "A-N"	(R.M.S. value)
→ **Ubn**	(0 ÷ 999999)	**V**	Phase Voltage "B-N"	(R.M.S. value)
→ **Ucn**	(0 ÷ 999999)	**V**	Phase Voltage "C-N"	(R.M.S. value)
→ **Uab**	(0 ÷ 999999)	**V**	Phase-to-phase Voltage "A-B"	(R.M.S. value)
→ **Ubc**	(0 ÷ 999999)	**V**	Phase-to-phase Voltage "B-C"	(R.M.S. value)
→ **Uca**	(0 ÷ 999999)	**V**	Phase-to-phase Voltage "C-A"	(R.M.S. value)
→ **Uo**	(0 ÷ 999999)	**V**	Zero Sequence Voltage	(fundamental frequency value 3Vo)
→ **V1**	(0.00 ÷ 99.99)	**Vn**	Positive Sequence Voltage	
→ **V2**	(0.00 ÷ 99.99)	**Vn**	Negative Sequence Voltage	
→ **PhA**	(0 ÷ 359)	**°**	Phase angle "Ia ^ Uan"	
→ **PhB**	(0 ÷ 359)	**°**	Phase angle "Ib ^ Ubn"	
→ **PhC**	(0 ÷ 359)	**°**	Phase angle "Ic ^ Ucn"	
→ **Ph0**	(0 ÷ 359)	**°**	Phase angle "Io ^ Uo"	
→ **W**	(0.00÷9999999)	**k**	Three Phase Active Power	(kW)
→ **VAr**	(0.00÷9999999)	**k**	Three Phase Reactive Power	(kVAr)
→ **VA**	(0.00÷9999999)	**k**	Three Phase Apparent Power	(kVA)
→ **Cos**	(0.000 ÷ 1.000)	**-**	Power Factor	
→ **Tem**	(0 ÷ 9999)	**%T**	Thermal status as % of the full load continuous operation temperature Tn	
→ **Wir**	(100 ÷ 0)	**%W**	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.	

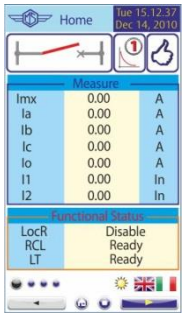
9. Commands

"***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
→ **Breaker2**	**Close**	Manual C/B closing	*(conditioned by Password)*	Yes
→ **Breaker2**	**Open**	Manual C/B opening	*(conditioned by Password)*	Yes
→ **Breaker3**	**Close**	Manual C/B closing	*(conditioned by Password)*	Yes
→ **Breaker3**	**Open**	Manual C/B opening	*(conditioned by Password)*	Yes
→ **Breaker4**	**Close**	Manual C/B closing	*(conditioned by Password)*	Yes
→ **Breaker4**	**Open**	Manual C/B opening	*(conditioned by Password)*	Yes
→ **Event**	**Clear**	Reset of all Events recorded		Yes
→ **HistFail**	**Clear**	Reset of Internal Failure Historic records		Yes
→ **Reset**	**Term**	Reset to zero of the accumulations relevant to Thermal Image and Interruption Energy.		Yes
→ **Leds**	**Test**	Signal Leds test		No
→ **Force**	**Osc**	Issue a trigger on oschillographic recording		Yes
→ **LastTrip**	**Reset**	Reset all Last Trip recorded	*Avalable only in MSCom2*	Yes
→ **Energy Counter**	**Reset**	Reset Energy Counter	*Avalable only in MSCom2*	Yes

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

1

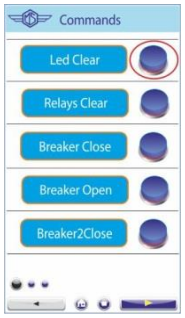


• Press "▬" or "●"to access to the "Desktop" menu with icons.

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. Energy

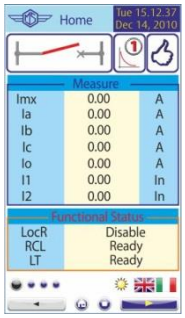
Real time energy measurements

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

Erase	→	All Energy counters are cleared

When the measurement exceed "9999999" the counters restart from "0".

1

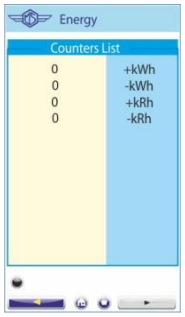


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

• Press "  " for access to the Energy parameters.

3



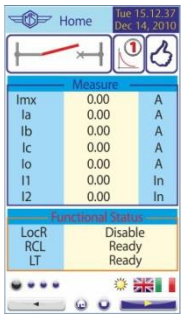
• Display of Real time Energy measurements.

11. Last Trip

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

Display	→	Reading of recorded Trips.
Erase	→	Clear all Trip recorded.

1



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

2

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

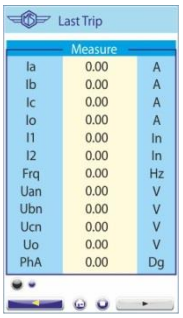
3

• Display list.
• Press selected Trip recorded.

4

• Press Measure to show the recorded values

5



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

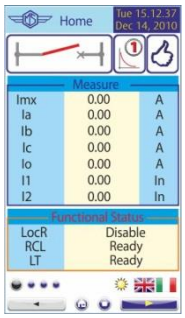
Date	*Date* : Year/Month/Day *Time* : hours/minutes/second/hundredths of seconds	
Cause	Indication of the protection function which caused the relay tripping.	
Ia	Phase A current	**A**
Ib	Phase B current	**A**
Ic	Phase C current	**A**
Io	Zero Sequence Current	**A**
I1	Positive sequence current	**In**
I2	Negative sequence current	**In**
Frq	Frequency	**Hz**
Uan	Phase Voltage "A-N"	**V**
Ubn	Phase Voltage "B-N"	**V**
Ucn	Phase Voltage "C-N"	**V**
Uo	Zero Sequence Voltage	**V**
PhA	Phase angle "Ia ^ Uan"	**°**
PhB	Phase angle "Ib ^ Ubn"	**°**
PhC	Phase angle "Ic ^ Ucn"	**°**
Ph0	Phase angle "Io ^ Uo"	**°**
Tem	Thermal status as % of the full load continuous operation temperature Tn	**%T**
Wir	Amount still remaining of permissible interruption energy before Circuit Breaker maintenance is requested.	**%W**

12. Partial Counters

Partial counters of the number of operations for each of the relay functions
This counter is resettable only via MSCom2 Software.

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
	→ **1Io>**	0	Operations counters	First Earth Fault element
	→ **2Io>**	0	Operations counters	Second Earth Fault element
	→ **3Io>**	0	Operations counters	Third Earth Fault element
	→ **1Is>**	0	Operations counters	First Negative Sequence element
	→ **2Is>**	0	Operations counters	Second Negative Sequence element
	→ **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
	→ **1f>**	0	Operations counters	First Overfrequency element
	→ **2f>**	0	Operations counters	Second Overfrequency element
	→ **1f<**	0	Operations counters	First Underfrequency element
	→ **2f<**	0	Operations counters	Second Underfrequency element
	→ **1Uo>**	0	Operations counters	First Zero Sequence overvoltage element
	→ **2Uo>**	0	Operations counters	Second Zero Sequence overvoltage element
	→ **U1<**	0	Operations counters	Positive Sequence undervoltage element
	→ **U2>**	0	Operations counters	Negative Sequence overvoltage element
	→ **Wi**	0	Operations counters	Circuit Breaker maintenance alarm
	→ **TCS**	0	Operations counters	Trip Circuit Supervision
	→ **IRF**	0	Operations counters	Internal Relay Fault
	→ **RT**	0	Operations counters	Remote Trip
	→ **RCLf**	0	Operations counters	Autoreclosure Failed
	→ **TwRCL**	0	Operations counters	Trip not enabled for initiating Automatic Reclosure
	→ **RCLok**	0	Operations counters	Autoreclosure successful
	→ **MCLok**	0	Operations counters	Manual Reclosure successful
	→ **RCLBL**	0	Operations counters	Autoreclosure blocked (Lock-Out)
	→ **BrkF**	0	Operations counters	Breaker failure to open
	→ **Aut Op**	0	Operations counters	Automatic C/B Openings
	→ **Aut CL**	0	Operations counters	Automatic C/B Closings
	→ **Man Op**	0	Operations counters	Manual C/B Openings
	→ **Man CL**	0	Operations counters	Manual C/B Closings
	→ **OvrOp**	0	Operations counters	Overall C/B Openings total (Man+Aut)
	→ **OvrCL**	0	Operations counters	Overall C/B Closings total (Man+Aut)

1

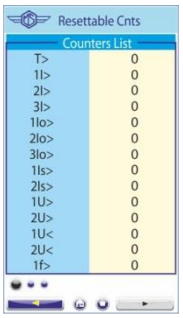


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

• Press "000" for access to the counters list.

3



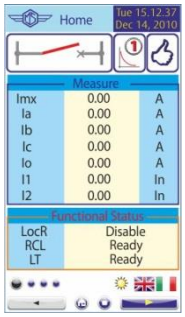
• The display show the list.

13. Total Counters

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

Display	→ **T>**	0	Operations counters	Thermal Image
	→ **1I>**	0	Operations counters	First overcurrent element
	→ **2I>**	0	Operations counters	Second overcurrent element
	→ **3I>**	0	Operations counters	Third overcurrent element
	→ **1Io>**	0	Operations counters	First Earth Fault element
	→ **2Io>**	0	Operations counters	Second Earth Fault element
	→ **3Io>**	0	Operations counters	Third Earth Fault element
	→ **1Is>**	0	Operations counters	First Negative Sequence element
	→ **2Is>**	0	Operations counters	Second Negative Sequence element
	→ **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
	→ **1f>**	0	Operations counters	First Overfrequency element
	→ **2f>**	0	Operations counters	Second Overfrequency element
	→ **1f<**	0	Operations counters	First Underfrequency element
	→ **2f<**	0	Operations counters	Second Underfrequency element
	→ **1Uo>**	0	Operations counters	First Zero Sequence overvoltage element
	→ **2Uo>**	0	Operations counters	Second Zero Sequence overvoltage element
	→ **U1<**	0	Operations counters	Positive Sequence undervoltage element
	→ **U2>**	0	Operations counters	Negative Sequence overvoltage element
	→ **Wi**	0	Operations counters	Circuit Breaker maintenance alarm
	→ **TCS**	0	Operations counters	Trip Circuit Supervision
	→ **IRF**	0	Operations counters	Internal Relay Fault
	→ **RT**	0	Operations counters	Remote Trip
	→ **RCLf**	0	Operations counters	Autoreclosure Failed
	→ **TwRCL**	0	Operations counters	Trip not enabled for initiating Automatic Reclosure
	→ **RCLok**	0	Operations counters	Autoreclosure successful
	→ **MCLok**	0	Operations counters	Manual Reclosure successful
	→ **RCLBL**	0	Operations counters	Autoreclosure blocked (Lock-Out)
	→ **BrkF**	0	Operations counters	Breaker failure to open
	→ **Aut Op**	0	Operations counters	Automatic C/B Openings
	→ **Aut CL**	0	Operations counters	Automatic C/B Closings
	→ **Man Op**	0	Operations counters	Manual C/B Openings
	→ **Man CL**	0	Operations counters	Manual C/B Closings
	→ **OvrOp**	0	Operations counters	Overall C/B Openings total (Man+Aut)
	→ **OvrCL**	0	Operations counters	Overall C/B Closings total (Man+Aut)

1

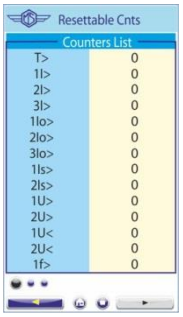


• Press "▬" or "●"to access to the "Desktop" menu with icons.

2

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

3



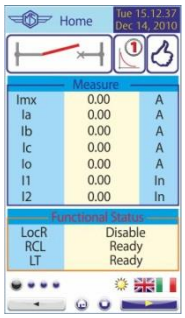
• The display shows the list.

14. Events

Display of the function which caused any of the following events: - *Status change of digital Inputs/Outputs.* - *Start of protection functions – Trip of protection function – Function reset.*
The last 100 events are recorded at pick-up (rise) or drop-out (fall).
The memory buffer is updated at each new event.
Only the latest 72 events are showed in the display, the remainders are available via MSCom2 software.

Erase	→	See § Commands

1



• Press "▬" or "○"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.

14.1 – Events on display

Functions	Events Displayed		Status		Description
T>	Tal	Alarm	Rise		Thermal Image T>
	T>	Trip	Rise	Fall	
1I>	1I>	Start	Rise		First overcurrent element F50-51
	t1I>	Trip	Rise	Fall	
2I>	2I>	Start	Rise		Second overcurrent element F50-51
	t2I>	Trip	Rise	Fall	
3I>	3I>	Start	Rise		Third overcurrent element F50-51
	t3I>	Trip	Rise	Fall	
1Io>	1Io>	Start	Rise		First earth fault element F50N-51N
	t1Io>	Trip	Rise	Fall	
2Io>	2Io>	Start	Rise		Second earth fault element F50N-51N
	t2Io>	Trip	Rise	Fall	
3Io>	3Io>	Start	Rise		Third earth fault element F50N-51N
	t3Io>	Trip	Rise	Fall	
1Is>	1Is>	Start	Rise		First negative sequence current element F46
	t1Is>	Trip	Rise	Fall	
2Is>	2Is>	Start	Rise		Second negative sequence current element F46
	t2Is>	Trip	Rise	Fall	
1U>	1U>	Start	Rise		First overvoltage element F59
	t1U>	Trip	Rise	Fall	
2U>	2U>	Start	Rise		Second overvoltage element F59
	t2U>	Trip	Rise	Fall	
1U<	1U<	Start	Rise		First undervoltage element F27
	t1U<	Trip	Rise	Fall	
2U<	2U<	Start	Rise		Second undervoltage element F27
	t2U<	Trip	Rise	Fall	
1f>	1f>	Start	Rise		First overfrequency element F81
	t1f>	Trip	Rise	Fall	
2f>	2f>	Start	Rise		Second overfrequency element F81
	t2f>	Trip	Rise	Fall	
3f>	3f>	Start	Rise		Third overfrequency element F81
	t3f>	Trip	Rise	Fall	
1f<	1f<	Start	Rise		First underfrequency element F81
	t1f<	Trip	Rise	Fall	
2f<	2f<	Start	Rise		Second underfrequency element F81
	t2f<	Trip	Rise	Fall	
3f<	3f<	Start	Rise		Third underfrequency element F81
	t3f<	Trip	Rise	Fall	
1Uo>	1Uo>	Start	Rise		First zero sequence voltage element F59Uo
	t1Uo>	Trip	Rise	Fall	
2Uo>	2Uo>	Start	Rise		Second zero sequence voltage element F59Uo
	t2Uo>	Trip	Rise	Fall	
U1<	U1<	Start	Rise		Positive sequence undervoltage element F27U1
	tU1<	Trip	Rise	Fall	
U2>	U2>	Start	Rise		Negative sequence overvoltage element F59U2
	tU2>	Trip	Rise	Fall	
Wi	tWi>		Rise		Circuit breaker maintenance level
TCS	TCS	Start	Rise		Trip coil supervision
	tTCS	Trip	Rise	Fall	
IRF	IRF	Start	Rise		Internal Relay Failure
	tIRF	Trip	Rise		
RT	RT	Trip	Rise	Fall	Remote Trip
	tRT	Trip	Rise		
BF	BF	Trip	Rise	Fall	Breaker Failure
ILR	ILR	Start	Rise	Fall	Locked Rotor
	tLR	Trip	Rise	Fall	
I<	I<	Start	Rise	Fall	No load running
	tI<	Trip	Rise	Fall	

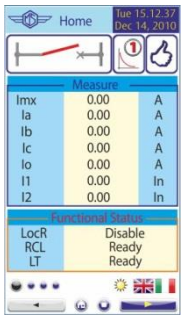
Functions	Events Displayed	Status		Description
	L/Rdisc.	Rise		*Local/Remote signal Discrepancy*
	manOpKey	Rise		*Circuit Breaker intentional open by Key*
	manOpLocC	Rise		*Circuit Breaker intentional open by local command*
	manOpRemC	Rise		*Circuit Breaker intentional open by remote command*
	manOpExtIn	Rise		*Circuit Breaker intentional open by external input*
	ExterManOp	Rise		*Circuit Breaker intentional external open*
	manClKey	Rise		*Circuit Breaker intentional close by Key*
	manClLocC	Rise		*Circuit Breaker intentional close by local command*
	manClRemC	Rise		*Circuit Breaker intentional close by remote command*
	manClExtIn	Rise		*Circuit Breaker intentional close by external input*
	ExterManCh	Rise		*Circuit Breaker intentional external close*
	CB-Fail	Rise	Fall	*Circuit Breaker failure*
	Vcc			Reserved
	GND			Reserved
	Mot On	Rise	Fall	*Motor staus – ON*
	Time Sincro	Rise		*Time Synchronization*
	0.D0 **----** **0.D4**	Rise	Fall	*Digital Input*
	1.D1 **----** **1.D15**	Rise	Fall	*Digital input*
	2.D1 **----** **2.D15**	Rise	Fall	*Digital input*
	0.R1 **----** **0.R6**	Rise	Fall	*Output relay*
	1.R1 **----** **1.R14**	Rise	Fall	*Output relay*
	2.R1 **----** **2.R14**	Rise	Fall	*Output relay*
	UpDateMon	Rise	Fall	*Update Monitor*
	IPU boot	Rise		*IPU boot*

15. Systems (System Parameters)

Setting of system parameters.

Nominal Value		**Fn** → System Nominal Frequency	50	Hz	(50 / 60)			
		In → System Nominal Current	500	A	(1÷9999)	step	1	A
		Un → System Nominal Voltage	10	kV	(0.10 ÷500.00)	step	0.01	kV
Characteristic		*Characteristic-1*	Available					
		Characteristic-2	Available					
		Characteristic-3	Not Available					
		Characteristic-4	Not Available					
Factors	Phase CT	**Prim.** →	1000	A	(1 ÷9999)	step	1	A
		Sec. →	1	A	(1 / 5)			
	PT (Ph-Ph)	**Prim.** →	10.00	kV	(0.10 ÷500.00)	step	0.01	kV
		Sec. →	100	V	(50 ÷150)	step	1	V
	Neut. CT	**Prim.** →	1000	A	(1÷9999)		1	A
		Sec. →	1	A	(1 / 5)			
System Options		Not available						

1



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

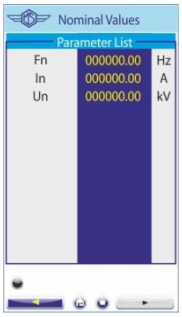
2

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

3

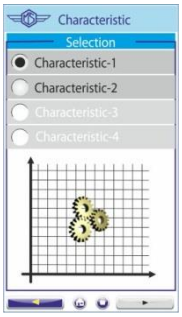
• Press icons wished.

4



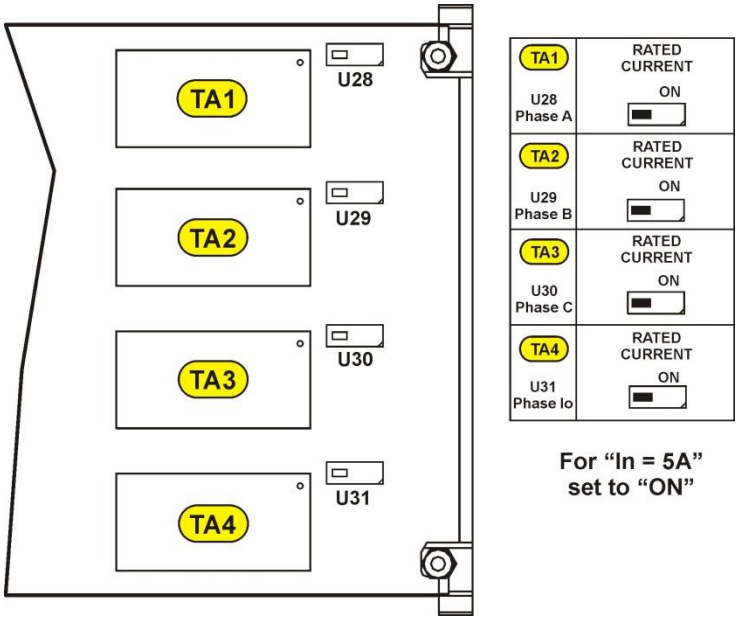
• Press the parameter to modify.
(if Password is request, see § Password).

5



• Press the characteristics that need modify.

(1) Move the switch in the corresponding founding to the required input current as herebelow shorted.



(2) Set the value of the phase-to-phase PT voltage.

$$\text{Example: TV}\quad \frac{10000:\sqrt{3}}{100:\sqrt{3}} \rightarrow \text{set} \quad \frac{\text{Prim.} = 10000}{\text{Sec.} = 100}$$

(3) Zero sequence voltage input is to be supplied by three system P.Ts. Y/Open Delta connected; the open delta connected secondary are rated 1/3 of the phase-to-phase secondary voltage (Example: 10000 / 100:√3 / 100:3).

16. Settings

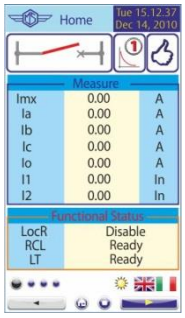
Two complete banks of settings of the programmable variables are available in the "***SETTING***" menu.
Both "Characteristic-1" and "Characteristic-2" include the hereunder listed variables.

→ **LCD**	Human Machine Interface	
→ **Comunic.**	Serial communication parameters	
→ **T>**	Thermal Image	
→ **1I>**	First	Overcurrent Element
→ **2I>**	Second	Overcurrent Element
→ **3I>**	Third	Overcurrent Element
→ **1Io>**	First	Earth Fault Element
→ **2Io>**	Second	Earth Fault Element
→ **3Io>**	Third	Earth Fault Element
→ **1Is>**	First	Negative Sequence Current Element
→ **2Is>**	Second	Negative Sequence Current Element
→ **1U>**	First	Overvoltage Element
→ **2U>**	Second	Overvoltage Element
→ **1U<**	First	Undervoltage Element
→ **2U<**	Second	Undervoltage Element
→ **1f>**	First	Overfrequency Element
→ **2f>**	Second	Overfrequency Element
→ **1f<**	First	Underfrequency Element
→ **2f<**	Second	Underfrequency Element
→ **1Uo>**	First	Zero Sequence Voltage Element
→ **2Uo>**	Second	Zero Sequence Voltage Element
→ **U1<**	Positive Sequence Undervoltage Element F27U1	
→ **U2>**	Negative sequence Overvoltage Element F59U2 or F47	
→ **Wi**	Amount of Energy to reach the C/B maintenance level	
→ **IRF**	Internal Relay Fault	
→ **RT**	Remote Trip	
→ **tTripRd**	Trip time reduction	
→ **Reclos**	Automatic Reclose	
→ **BrkFail**	Setting variables for Breaker Failure detection	
→ **ExtReset**	Configuration for external reset input	
→ **CB-Mngn**	C/B command Local / Remote setting	
→ **Oscillo**	Setting variables for Oscillographic recording	

16.1 - 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

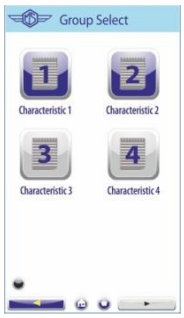


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

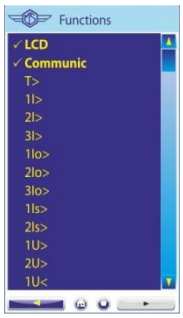
• Press "⚙" to access to the settings menu.

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"

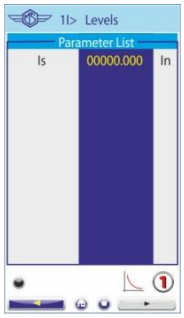
• Function disabled

• 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"

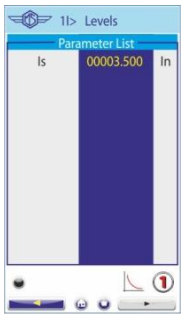
Function

Actual Value

Maximum Value

Minimum Value

9



• Change done.

The icons grey indicate menu not available

16.2 - Password

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

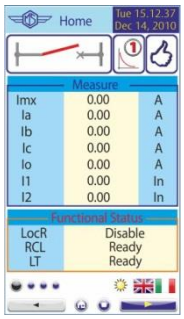
The factory default password is " 1111 ".

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

*16.3 - Menu: **LCD** (Human Machine Interface - customize)*

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

1

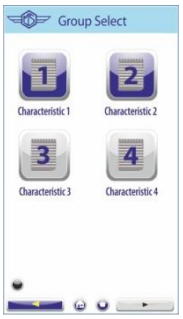


• Press "▬" or "⚙"to access to the "Desktop" menu with icons.

2

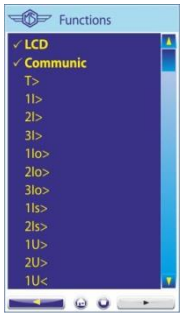
• Press "⚙" to access to the settings menu.

3



• Select Characteristic "***1***".

4



• Select "***LCD***".

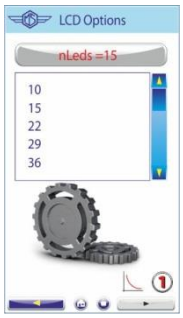
5

• Select "***Options***".

6

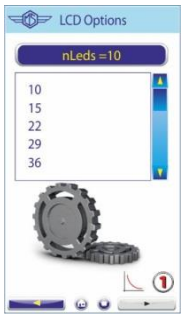
• Select "***nLeds***".

7



• Select "***10***".

8



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

9

• Complete setting

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

Status	→	**Enab.**	[Enable]
Options	→	**BRRem**	19200 [9600 / 19200 / 38400]
	→	**PRRem**	ModBus [ModBus / Iec103]

16.4.1 – Description of variables

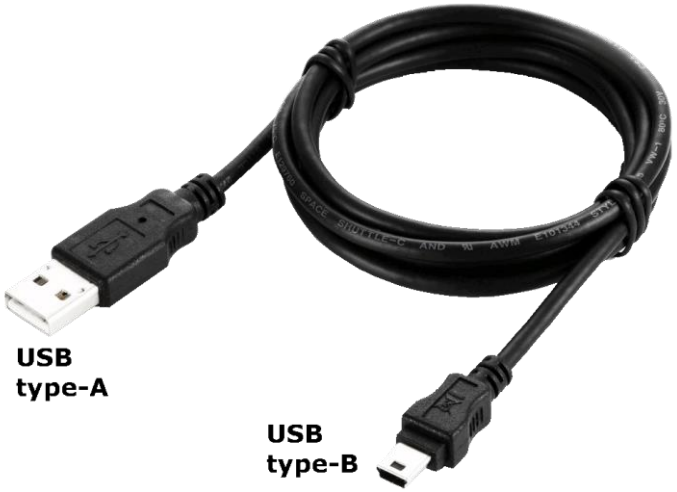
BRRem	:	RS485 remote (Rear terminal block) serial communication speed
PRRem	:	RS485 remote (Rear terminal block) serial communication protocol

16.4.2 – Front Panel USB serial communication port (RS232)

A Mini-USB socket is available on Relay's front face for connection.
Through this port - and by the interface program available from Microelettrica Scientifica S.p.A. (MSCom 2 for Windows XP/7) – it is possible connect a Personal Computer to download all available informations, operate any control and program the relay; the protocol used is " Modbus RTU".

16.4.3 – Cable for connection from Relay to Personal Computer

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



16.4.4 – Main serial communication port (RS485)

From the Relay's back terminal board, a RS485 ports is available for communication with SCADA system with Protocol Modbus RTU or IEC60870-5-103 (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.

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

Status	→	**Enab.**			[Disable / Enable]			
Oper.Levels	→	**Tal**	10.000	**%Tn**	[10 ÷ 100]	step	1.000	%Tn
	→	**Is**	0.500		[0.5 ÷ 1.5]	step	0.010	
	→	**Kt**	1.000	**min**	[1 ÷ 600]	step	0.010	min
Options	→	**OPMOD**	I1 I2		[I1 I2 – Imax]			

16.5.1 - Description of variables

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

16.5.2 - Trip and Alarm

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

16.5.2.1 – Operation mode "Imax"

With this option, the largest of the three phase currents measured is used to compute the Thermal Image:

$$I = MAX(Ia, Ib, Ic)$$

16.5.2.2 – Operation mode "I1-I2"

With this option, a composition of Positive and Negative Sequence components of the current measured is used to compute the Thermal Image:

$$I = \sqrt{(I_1)^2 + 3(I_2)^2}$$

16.5.2.3 – Trip time of the Thermal Image Element

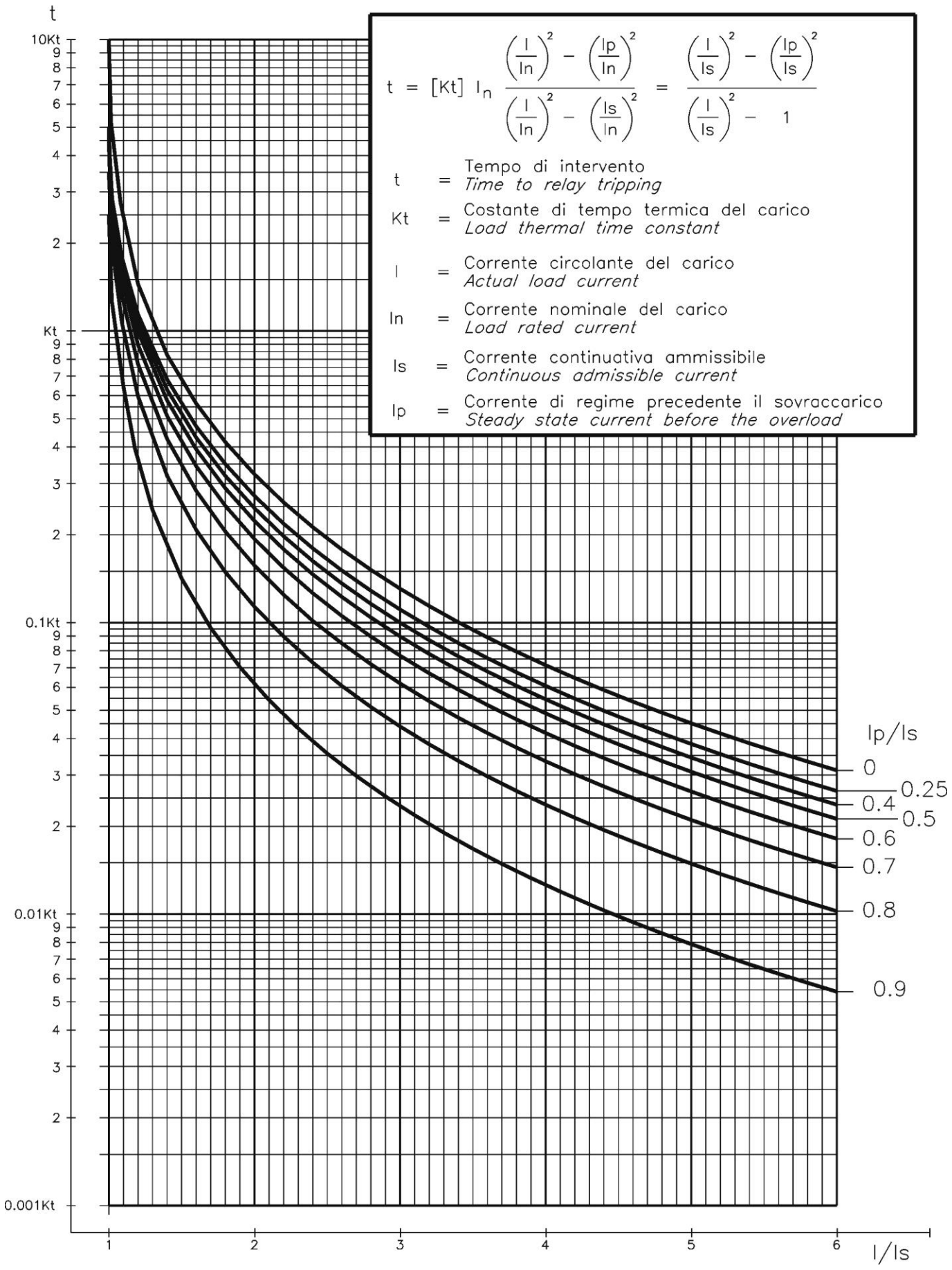
The trip time of the Thermal Image Element is a function of the current "I" flowing into the load and depends on its warming-up Time Constant "Kt", on the previous thermal status "Ip" and on the maximum admissible continuous current "Is" according to the equation:

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

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

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 99% of the trip level.

16.5.2.4 – Thermal Image Curves (TU1024 Rev.1)



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

Status	→	**Enab.**			[ Disable /  Enable]			
Levels	→	**Is**	4.000	**In**	(0.100÷4)	step	0.010	In
	→	**a**	359.000	**°**	(0.000÷359)	step	1.000	°
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
Options	→	**f(t)**	Type - D		[D / A / B / C / I / VI / EI / MI / SI]			
	→	**tBI**	Off		[Off / 2tBO]			
	→	**f(a)**	Disable		[Disable / Sup / Dir]			
	→	**f(U)**	Disable		[Disable / Enable]			

16.6.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
Is	:	Minimum operation level
a	:	Reference phase current displacement angle for Directional operation
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.
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 *(I)* = IEEE Inverse Curve *(VI)* = IEEE Very Inverse Curve *(EI)* = IEEE Extremely Inverse Curve *(MI)* = IEEE Moderate Inverse Curve *(SI)* = IEEE Short Inverse Curve
tBI	:	Blocking input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
f(a)	:	Operation mode: *Disable* = Non Directional *Sup.* = Directional Supervision *Dir.* = Total Directional
f(U)	:	Voltage restraint

16.6.2 - 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
IEEE Moderate Inverse	MI	0.0104	0.0226	0.02
IEEE Short Inverse	SI	0.00342	0.00262	0.02
IEEE Very Inverse	VI	3.88	0.0963	2
IEEE Inverse	I	5.95	0.18	2
IEEE Extremely Inverse	EI	5.67	0.0352	2

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

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

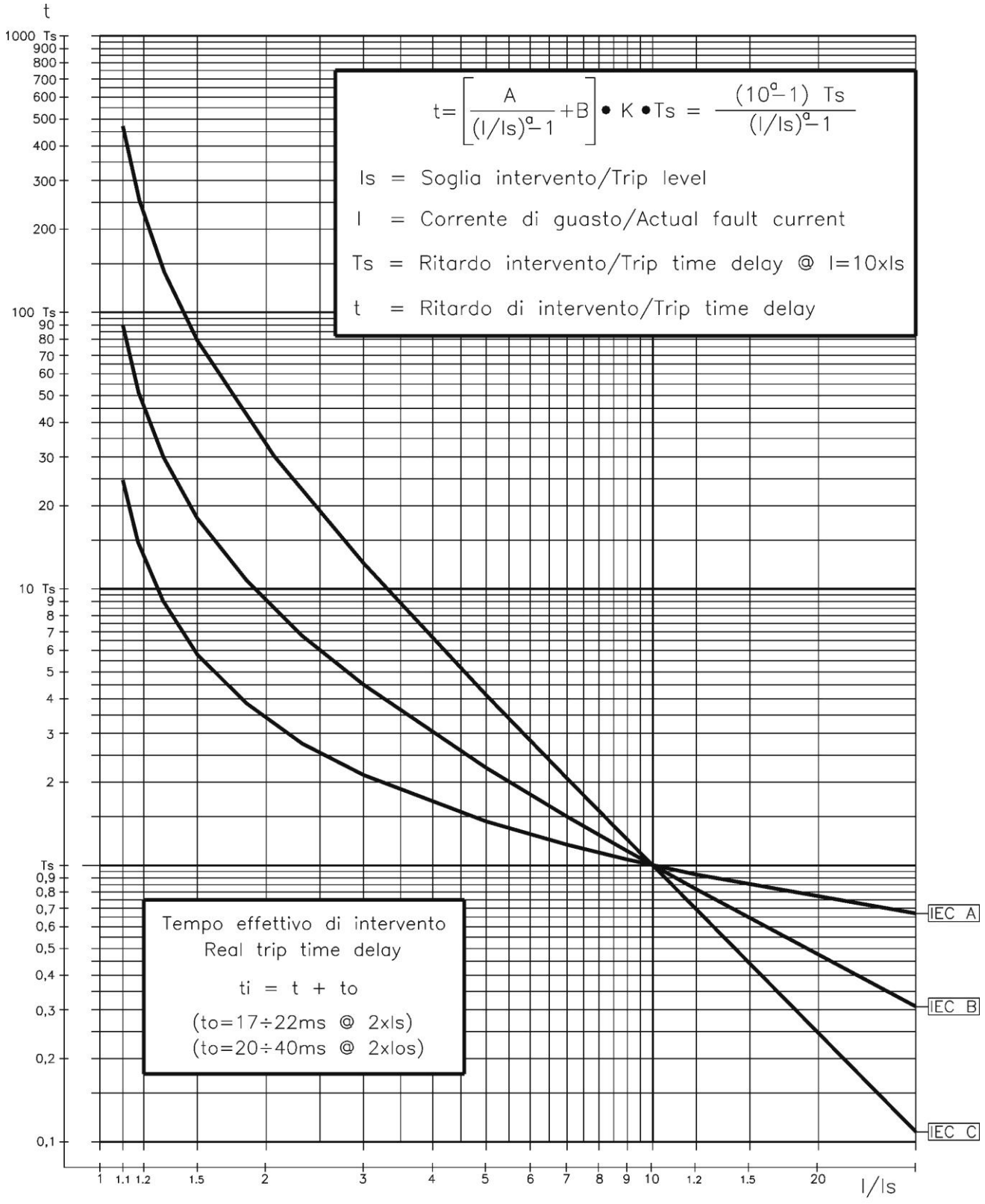
Where $Kt = (10^{a}-1)Ts$ is the time multiplier

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".

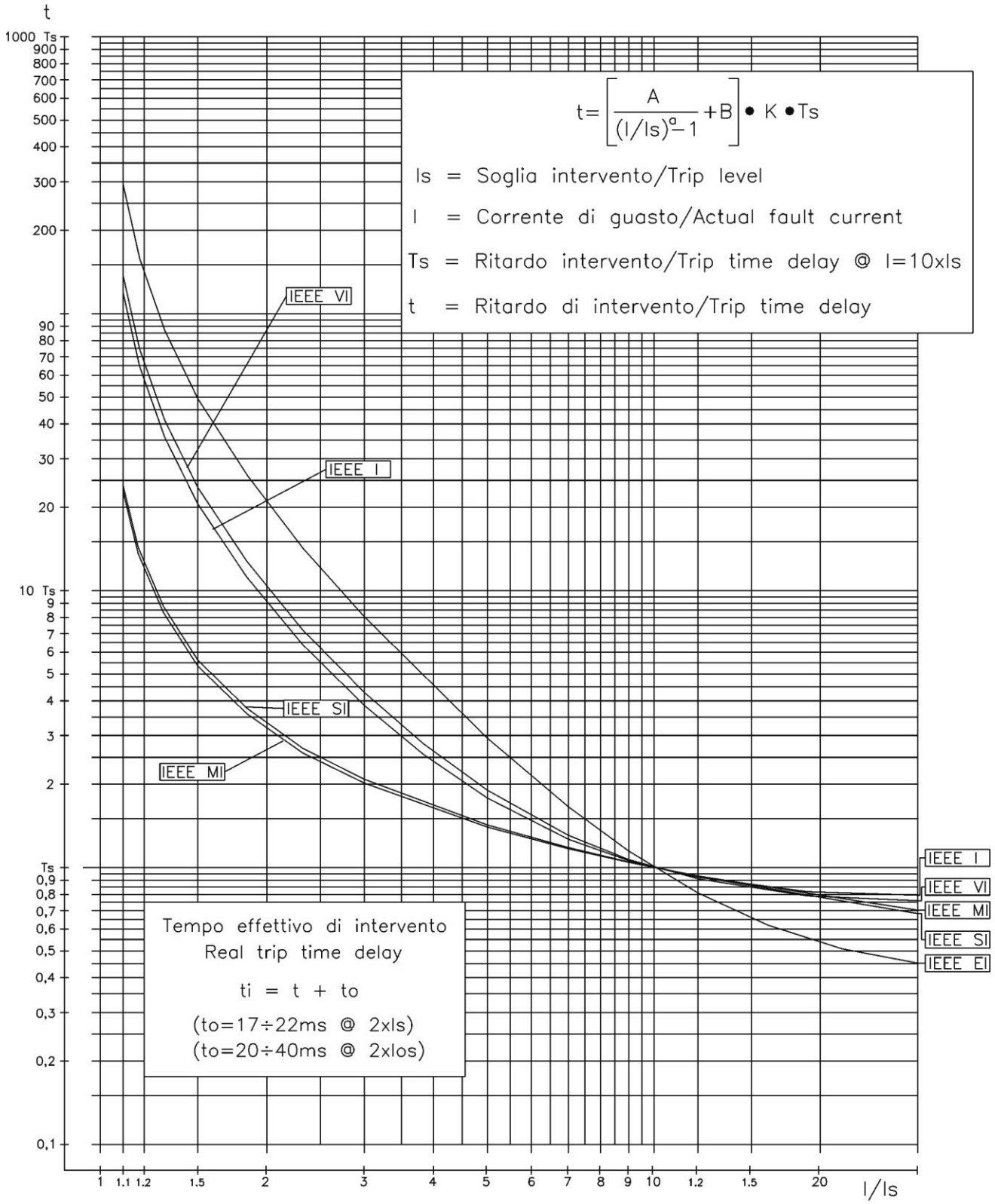
16.6.3 - IEC Curves



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

16.6.4 – IEEE Curves



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

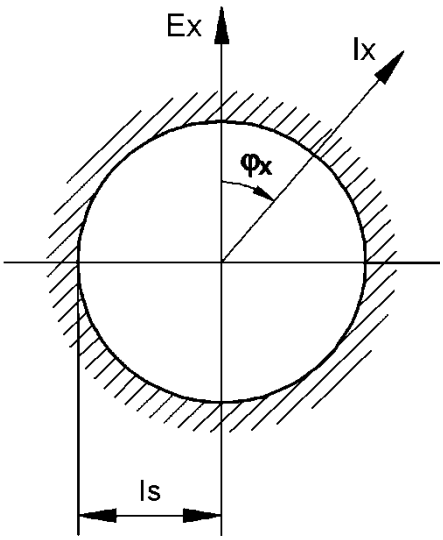
Max. "I" Phase = 40xIn
Max. "I" Neutral = 10xOn

16.6.5 – Operation of the phase Overcurrent Elements in function of variable "f(a)"

On each phase the relay measures the current "Ix" and its displacement "φ_x" from the relevant phase-to-neutral voltage "Ex".
Different operation modes are possible according to the programming of the variable "f(a)".

Is	=	Minimum operation current level.
a	=	Operation reference angle (phase x; x = A, B, C).
Ix	=	Measured input current (largest among the three phase currents IA, IB, IC).
φ_x	=	Phase displacement of current "Ix" from phase-to-neutral "Ex" (X = A, B, C).
Idx	=	Component of "Ix" on the direction "a".

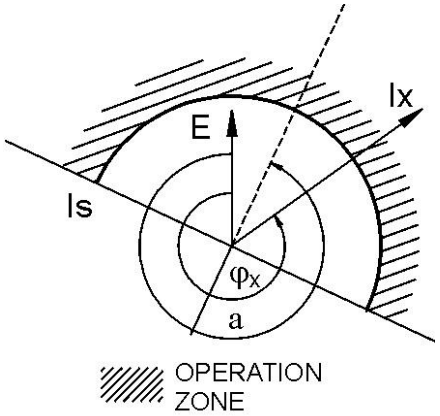
A) Set f(a) = Disab.



Ix>[Is]

The overcurrent element operates independently from the current direction.

B) Set f(a) = Sup.



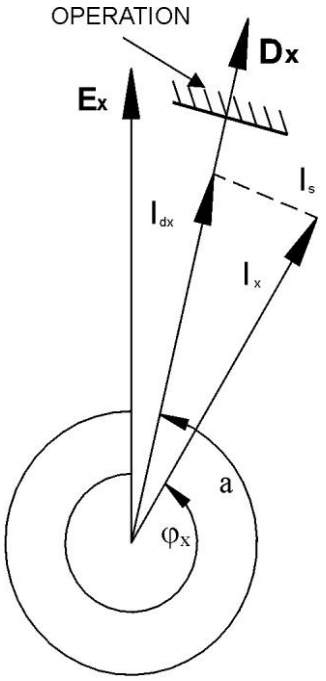
The Overcurrent element only supervises the direction of the current:

the operation conditions are:

- Input voltage above 1-2% of the rated input value.
- Input current above the set level: Ix > [Is]
- Phase displacement "φ_x" within ±90° from the reference direction "a".

$$(a - 90°) < \varphi_x < (a + 90°)$$

C) Set f(a) = Dir.



The overcurrent element operates in a real directional mode measuring the component "Idx" of the input current in the reference direction "a" (x = A, B, C).

$I_{dA}=I_A \cos(\varphi_A-a)$ $I_{dB}=I_B \cos(\varphi_B-a)$ $I_{dC}=I_C \cos(\varphi_C-a)$

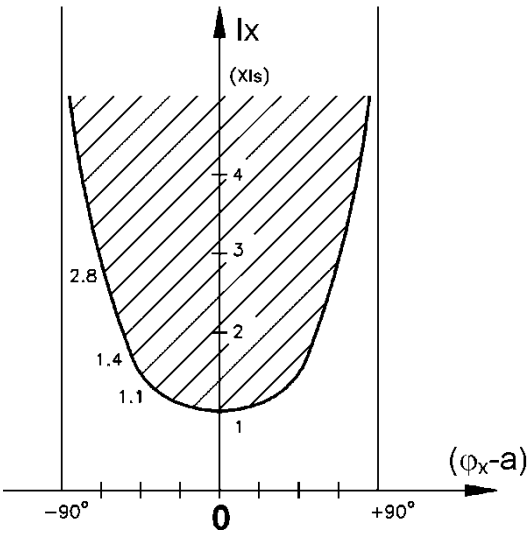
The overcurrent starts to operate when the component "Idx" of the input current in the direction "Dx" (versor displaced of "a°" from the phase-to-neutral voltage "Ex") exceeds the set level "Is".

$I_{dx} = Ix \cos(\varphi_x-a) \geq Is$

In details:

- When $\varphi_x = a$: $I_{dx}= I_x \rightarrow$ operation if $I_x>Is$
- When $(\varphi_x-a) = 90°$: $I_{dx}= 0 \rightarrow$ no operation
- When $(\varphi_x-a) > 90°$: I_{dx} opposite to Dx $\rightarrow$ no operation

The operation is practically independent from the voltage as low as 1-2% of rated value.

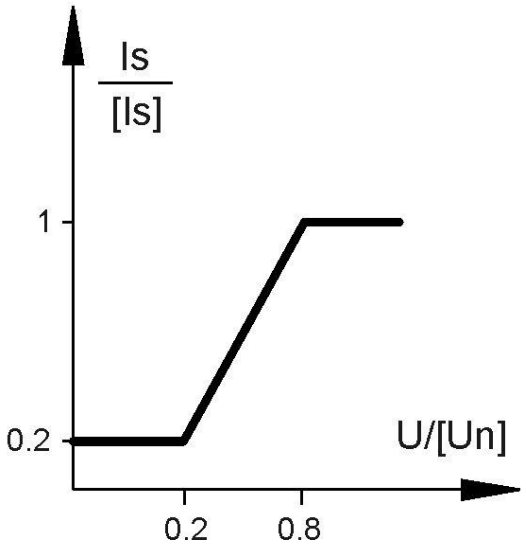


Recommended Reference angles for different applications:

- Measurement of resistive component of current (active power) :
  Direct : a = 0° - Reverse : a = 180°
- Directional phase fault detection:
  Direct : a = 300°(60° lag) – Reverse : a = 120°
- Measurement of inductive reactive component:
  Direct : a = 270°(90° lag) - Reverse : a = 90°
- Measurement of capacitive reactive component:
  Direct : a = 90°(90° lead) - Reverse: a = 270°

16.6.6 – Operation of the Overcurrent Element with Voltage Control f(U)

When the "Voltage Restraint" function is enabled (F(U)=Enable), the set minimum pick-up level "Is" of the overcurrent elements, changes proportionally to the smallest of the input phase-to-phase voltages:
Is = F(U).



$$\frac{Is}{[Is]} = \frac{\text{Actual pick - up level}}{[\text{Set pick - up level}]}$$

$$\frac{U}{[Uns]} = \frac{\text{Actual input voltage}}{[\text{Set rated input voltage}]}$$

the algorithm uses the smallest among the ratios $\frac{Ex \cdot \sqrt{3}}{[Uns]} (x = A, B, C)$

Practically, between 0.2 Uns and 0.8 Uns, the trip level of the Overcurrent element variates according to the equation:

$$\frac{Is}{[Is]} = \frac{0.8}{0.6} \cdot \left(\frac{U}{[Uns]} - 0.8 \right) + 1$$

Below 0.2 [Un] $\frac{Is}{[Is]} = 0.2$

Above 0.8 [Un] $\frac{Is}{[Is]} = 1$

16.6.7 – 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.

16.6.7.1 – 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.

16.6.7.2 – 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.

16.6.8 - 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 of reactive loads like Transformer or Capacitors.

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

Status	→	**Enab.**			[ Disable /  Enable]			
Levels	→	**Is**	40.000	**In**	(0.100÷40)	step	0.010	In
	→	**a**	359.000	**°**	(0.000÷359)	step	1.000	°
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
	→	**t2xI**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**td2xI**	0.06	**s**	fixed			
Options	→	**tBI**	Off		[Off / 2tBO]			
	→	**f(a)**	Disable		[Disable / Sup / Dir]			
	→	**2xI**	Disable		[Disable / Enable]			
	→	**f(U)**	Disable		[Disable / Enable]			

16.7.1 – Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
Is	:	Minimum operation level
a	:	Reference phase current displacement angle for Directional operation
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.
t2xI	:	Maximum time of automatic threshold doubling on inrush
td2xI	:	Time for calculation of current rate of rise.
tBI	:	Blocking input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
f(a)	:	Operation mode: *Disable* = Non Directional *Sup.* = Directional Supervision *Dir.* = Total Directional
2xI	:	Automatic doubling of trip level on inrush
f(U)	:	Voltage restraint

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

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Is**	40.000	**In**	(0.100÷40)	step	0.010	In
	→	**a**	359.000	**°**	(0.000÷359)	step	1.000	°
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
	→	**t2xI**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**td2xI**	0.06	**s**	fixed			
Options	→	**tBI**	Off		[Off / 2tBO]			
	→	**f(a)**	Disable		[Disable / Sup / Dir]			
	→	**2xI**	Disable		[Disable / Enable]			

16.8.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
tBI	:	Blocking input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
f(a)	:	Operation mode: *Disable* = Non Directional *Sup.* = Directional Supervision *Dir.* = Total Directional
2xI	:	Automatic doubling of trip level on inrush
Is	:	Minimum operation level.
a	:	Reference phase current displacement angle for Directional operation
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.
t2xI	:	Maximum time of automatic threshold doubling on inrush
td2xI	:	Time for calculation of current rate of rise

16.9 - Function: **1Io>** (First Earth Fault Element 50N/51N)

Status	→	**Enab.**		[ Disable /  Enable]				
Levels	→	**Is**	0.010	**On**	(0.01÷4)	step	0.01	On
	→	**Vo**	0.000	**%Un**	(0.000÷20)	step	0.100	%Un
	→	**a_o**	0.000	**°**	(0.000÷359)	step	1.000	°
	→	**a_z**	0.000	**°**	(0.000÷359)	step	1.000	°
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
Options	→	**f(t)**	Type - D		[D / A / B / C / I / VI / EI / MI / SI]			
	→	**tBI**	Off		[Off / 2tBO]			
	→	**f(a_o)**	Disable		[Disable / Dir]			

On = Rated primary current of CTs or of the current Tore CT.

16.9.1 - Description of variables

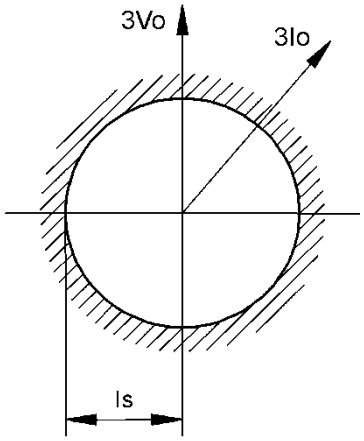
Enab.	:	Function enabling (No = Disable / Yes = Enable)
Is	:	Minimum operation level
Vo	:	Minimum residual voltage level for enabling the directional operation
a_o	:	Reference Zero Sequence current displacement angle for Directional operation
a_z	:	Trip sector amplitude
ts	:	Trip time delay
tBO	:	Time 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.
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 *(I)* = IEEE Inverse Curve *(VI)* = IEEE Very Inverse Curve *(EI)* = IEEE Extremely Inverse Curve *(MI)* = IEEE Moderate Inverse Curve *(SI)* = IEEE Short Inverse Curve
tBI	:	Blocking Input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
f(a_o)	:	Operation mode: *Disable* = Non Directional *Dir.* = Total Directional

16.9.2 – Operation mode of the Earth Fault elements programming the variable "f(a_o)"

The relay measures the current "3Io" and the input voltage "3Vo" of the Earth Fault input and the displacement "φ_o" of the current from the voltage. Different operation modes are programmable by the variable "f(a_o)".

Is	=	Set minimum pick-up residual current "3Io".
Vo	=	Set minimum residual voltage (3Vo) to enable operation.
a_o	=	Set displacement of the reference current direction.
3Io	=	Earth Fault current.
3Vo	=	Earth Fault voltage.
φ_o	=	Io/Vo phase displacement.
a_z	=	Angle defining the directional operation area around the reference direction.

The Directional Earth Fault element can operate in two different modes:



f(a_o) = Dis (Disable)

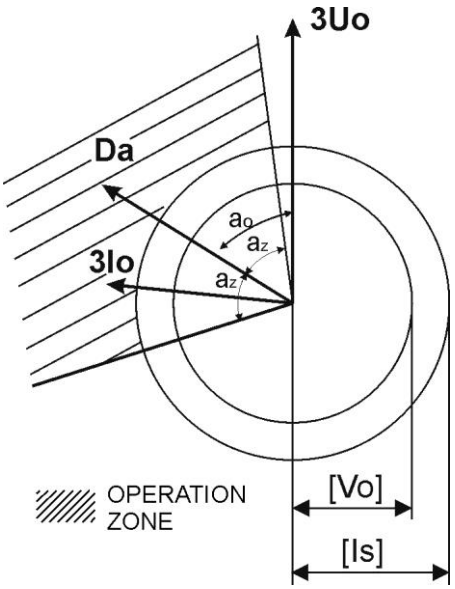
Operation is Non Directional without any influence by the Zero Sequence Voltage "Vo" and the displacement "φ_o".

- ❑ Operation starts when : 3Io ≥ [Is]

f(a_o) = Dir (Directional).

Operation starts when the following 3 conditions are present:

- ❑ The Residual Voltage "3Vo" exceeds the set level "Vo" : 3Vo ≥ [Vo]
- ❑ The Residual Current "3Io" exceeds the set level "Is" : 3Io ≥ [Is]
- ❑ The angle "φ_o" is within "± a_z" from "a"
  $(a_o - a_Z) \leq \varphi_o \leq (a_o + a_Z)$



- ❑ 3Uo > [Vo]
- ❑ 3Io > [Is]
- ❑ $(a_o - a_Z) \leq \varphi_o \leq (a_o + a_Z)$

16.10 - Function: **2Io>** (Second Earth Fault Element 50N/51N)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Is**	0.010	**On**	(0.01÷9.99)	step	0.01	On
	→	**Vo**	0.000	**%Un**	(0.000÷20)	step	0.100	%Un
	→	**a_o**	0.000	**°**	(0.000÷359)	step	1.000	°
	→	**a_z**	0.000	**°**	(0.000÷359)	step	1.000	°
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
Options	→	**tBI**	Off		[Off / 2tBO]			
	→	**f(a_o)**	Disable		[Disable / Dir]			

On = Rated primary current of CTs or of the current Tore CT.

16.10.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
Is	:	Minimum operation level
Vo	:	Minimum residual voltage level for enabling the directional operation
a_o	:	Reference Zero Sequence current displacement angle for Directional operation
a_z	:	Trip sector amplitude
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.
tBI	:	Blocking Input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
f(a_o)	:	Operation mode: *Disable* = Non Directional *Dir.* = Total Directional

16.11 - Function: **3Io>** (Second Earth Fault Element 50N/51N)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Is**	0.010	**On**	(0.01÷9.99)	step	0.001	On
	→	**Vo**	0.000	**%Un**	(0.000÷20)	step	0.100	%Un
	→	**a_o**	0.000	**°**	(0.000÷359)	step	1.000	°
	→	**a_z**	0.000	**°**	(0.000÷359)	step	1.000	°
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
Options	→	**tBI**	Off		[Off / 2tBO]			
	→	**f(a_o)**	Disable		[Disable / Dir]			

On = Rated primary current of CTs or of the current Tore CT.

16.11.1 - Description parameters

Enab.	:	Function enabling (No = Disable / Yes = Enable)
Is	:	Minimum operation level
Vo	:	Minimum residual voltage level for enabling the directional operation
a_o	:	Reference Zero Sequence current displacement angle for Directional operation
a_z	:	Trip sector amplitude
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.
tBI	:	Blocking Input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
f(a_o)	:	Operation mode: *Disable* = Non Directional *Dir.* = Total Directional

16.12 - Function: **1Is>** (First Negative Sequence Element F46)

Status	→	**Enab.**			[ Disable /  Enable]			
Levels	→	**Is**	4.000	**In**	(0.1÷4)	step	0.01	In
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
Options	→	**t(t)**	Type-D		[D / A / B / C / I / VI / EI / MI / SI /]			
	→	**tBI**	Off		[Off / 2tBO]			

16.12.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
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.
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 *(I)* = IEEE Inverse Curve *(VI)* = IEEE Very Inverse Curve *(EI)* = IEEE Extremely Inverse Curve *(MI)* = IEEE Moderate Inverse Curve *(SI)* = IEEE Short Inverse Curve
tBI	:	Blocking Input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.

16.12.2 – Time/Current operation of the first Current Unbalance element "f(t)"

The relay measures the Negative Sequence component "I2" of the input current.
The Time/Current curves can be selected by programming the variable "f(t)":

f(t) = D	Independent definite time operation.
f(t) = I, VI, EI, MI, SI, A, B, C	Dependent Inverse time operation

16.13 - Function: **2Is>** (Second Negative Sequence Element F46)

Status	→	**Enab.**			[ Disable /  Enable]			
Levels	→	**Is**	4.000	**In**	(0.1÷4)	step	0.01	In
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
Options	→	**tBI**	Off		[Off / 2tBO]			

16.13.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
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.
tBI	:	Blocking Input reset time *Off* = Permanent block *2tBO* = Set 2tBO.

16.14 - Function: **1U>** (First Overvoltage Element F59)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Us**	90.000	**%Un**	(10÷190)	step	1	%Un
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.14.1 - Description of variables

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

16.15 - Function: **2U>** (Second Overvoltage Element F59)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Us**	90.000	**%Un**	(10÷190)	step	1	%Un
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.15.1 - Description of variables

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

16.16 - Function: **1U<** (First Undervoltage Element F27)

Status	→	**Enab.**			[ Disable /  Enable]			
Levels	→	**Us**	90.000	**%Un**	(10÷190)	step	1	%
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.16.1 - Description of variables

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

16.17 - Function: **2U<** (Second Undervoltage Element F27)

Status	→	**Enab.**			[ Disable /  Enable]			
Levels	→	**Us**	90.000	**%Un**	(10÷190)	step	1	%
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.17.1 - Description of variables

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

16.18 - Function: **1f>** (First Overfrequency Element F81>)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→	**ts**	10.00	**s**	(0.02÷100)	step	0.01	s

16.18.1 - Description of variables

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

16.19 - Function: **2f>** (Second Overfrequency Element F81>)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→	**ts**	10.00	**s**	(0.02÷100)	step	0.01	s

16.19.1 - Description of variables

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

16.20 – Function: **1f<** (First Underfrequency Element F81<)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→	**ts**	10.00	**s**	(0.02÷100)	step	0.01	s

16.20.1 - Description of variables

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

16.21 - Function: **2f<** (Second Underfrequency Element F81<)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→	**ts**	10.00	**s**	(0.02÷100)	step	0.01	s

16.21.1 - Description of variables

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

16.22 - Function: **1Uo>** (First Zero Sequence Overvoltage Element F59Uo)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Us**	1.000	**%Un**	(1÷100)	step	1	%Un
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.22.1 - Description of variables

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

16.23 - Function: **2Uo>** (Second Zero Sequence Overvoltage Element F59Uo)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Us**	1.000	**%Un**	(1÷100)	step	1	%Un
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.23.1 - Description of variables

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

16.24 - Function: **U1<** (Positive Sequence Undervoltage Element F27U1)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Us**	90.000	**%Un**	(10÷190)	step	1	%Un
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.24.1 - Description of variables

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

16.25 - Function: **U2>** (Negative sequence Overvoltage Element F59U2 or F47)

Status	→	**Enab.**			[Disable / Enable]			
Levels	→	**Us**	90.000	**%Un**	(10÷190)	step	1	%Un
Timers	→	**ts**	100.00	**s**	(0.02÷100)	step	0.01	s

16.25.1 - Description of variables

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

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

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

16.26.1 - Description of variables

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

16.26.2 - Operation (Accumulation of the interruption Energy)

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

Ii = Ii = (0.1-99)In

Wi = Wi =(1 - 9999)

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

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

where:

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

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

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

Reset to Zero of the Energy accumulation is available in the menu "***Commands***" (Reset Term).

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

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

16.27.1 - Description of variables

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

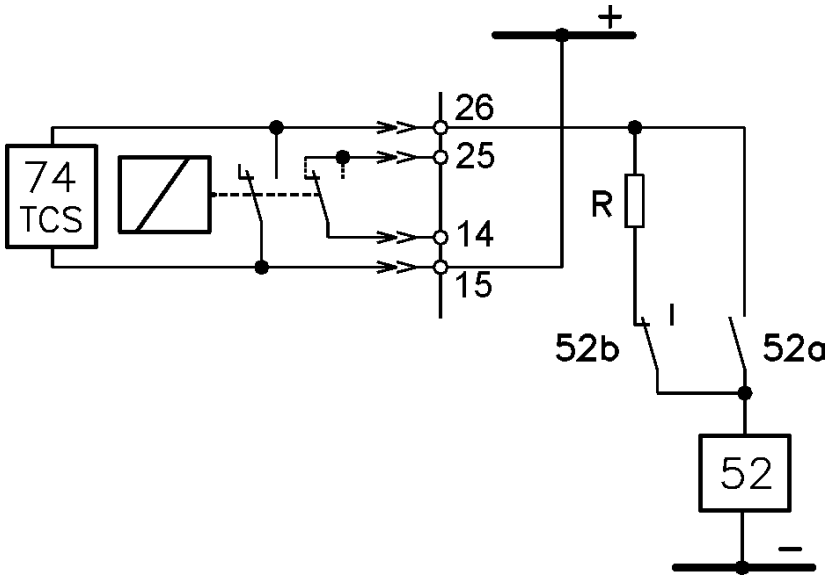
16.27.2 - Operation

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

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



Tripping of the function operates a user programmable output relay.

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

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

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

16.28.1 - Description of variables

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

16.28.2 - Operation

Tripping of the function operates a user programmable output relay.

16.29 - Function: **RT** (Remote Trip)

In this menu it is possible to configurate the operation of Remote Trip via the relevant Digital Input.

Status	→	**Enab.**			[Disable / Enable]		
Timers	→	**ts**	5.00	**s**	(0.00÷10.00)	step	0.01 s
Options	→	**RTon**	Low		[Low – High]		

16.29.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
RTon	:	Status Selector selector
ts	:	Remote Trip time delay

16.29.2 - Operation

This function operate when the Digital Input "RT" is activated.
It can also be used to receive an external command from another protection.
(Temperature sensor, RTD, etc.)

16.30 - Function: **tTripRd** (Trip Time Reduction)

Status	→	**Enab.**			[Disable / Enable]			
Timers	→	**tHold**	0.00	**s**	(0.00÷180)	step	1	s
	→	**tC1 I**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC2 I**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC3 I**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC1 Io**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC2 Io**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC3 Io**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC1 Uo**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC2 Uo**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tCRT**	0.00	**s**	(0.00÷10)	step	0.1	s

16.30.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
tHold	:	Duration of the trip time reduction; is set to 0,00 the reduction function does not operate.
tC1 I	:	Reduced trip time for 1I>
tC2 I	:	Reduced trip time for 2I>
tC3 I	:	Reduced trip time for 3I>
tC1 Io	:	Reduced trip time for 1Io>
tC2 Io	:	Reduced trip time for 2Io>
tC3 Io	:	Reduced trip time for 3Io>
tC1 Uo	:	Reduced trip time for 1Uo>
tC2 Uo	:	Reduced trip time for 2Uo>
tCRT	:	Reduced trip time for RT

16.30.2 - Operation

When this function is enabled, after a manual or automatic reclosure, the trip time delay of the protection functions is reduced from the original set value to the new time delay "tc" until "tHold" is expired.
Anyhow when the ongoing reclose cycle is over and the relay is ready for new reclose cycle, the original trip time delay is restored.
Functions originally programmed for a inverse time operation, during "tHold" operate as independent time function with definite time delay "tc".

16.31 - Function: ***Reclos*** *(Automatic Reclosure RCL)*

Status	→	**Enab.**			[Disable / Enable]			
Timers	→	**tSeqC**	0.00	**s**	(0.00 ÷ 5.00)	step	0.01	s
	→	**t1**	0.30	**s**	(0.10 ÷ 200)	step	0.1	s
	→	**Tr1**	5.00	**s**	(5.00 ÷ 200)	step	1	s
	→	**Td1**	0.00	**s**	(0.00 - 5.00)	step	0 / 5	s
	→	**t2**	1.00	**s**	(0.10 ÷ 1000)	step	0.1	s
	→	**Tr2**	5.00	**s**	(5.00 ÷ 200)	step	1	s
	→	**Td2**	0.00	**s**	(0.00 - 5.00)	step	0 / 5	s
	→	**t3**	3.00	**s**	(0.10 ÷ 1000)	step	0.1	s
	→	**Tr3**	5.00	**s**	(5.00 ÷ 200)	step	1	s
	→	**Td3**	0.00	**s**	(0.00 - 5.00)	step	0 / 5	s
	→	**t4**	10.00	**s**	(0.10 ÷ 1000)	step	0.1	s
	→	**Tr4**	5.00	**s**	(5.00 ÷ 200)	step	1	s
	→	**TrCL**	5.00	**s**	(5.00 ÷ 200)	step	1	s
	→	**ThExt**	5.00	**s**	(5.00 ÷ 200)	step	1	s

Options	→	**ShNum**	1		[0 - 1 - 2 - 3 - 4]
	→	**R 1I>**	Recl. Dis.	→	Recl. Dis = Automatic Reclosure (AR) disable 1 = AR Enable on shot 1 2 = AR Enable on shot 2 1+2 = AR Enable on shot 1+2 3 = AR Enable on shot 3 1+3 = AR Enable on shot 1+3 2+3 = AR Enable on shot 2+3 1+2+3 = AR Enable on shot 1+2+3 4 = AR Enable on shot 4 1+4 = AR Enable on shot 1+4 2+4 = AR Enable on shot 2+4 1+2+4 = AR Enable on shot 1+2+4 3+4 = AR Enable on shot 3+4 1+3+4 = AR Enable on shot 1+3+4 2+3+4 = AR Enable on shot 2+3+4 1+2+3+4 = AR Enable on shot 1+2+3+4 (*) see example
	→	**R 2I>**	Recl. Dis.		Same as above
	→	**R 3I>**	Recl. Dis.		Same as above
	→	**R 1Io>**	Recl. Dis.		Same as above
	→	**R 2Io>**	Recl. Dis.		Same as above
	→	**R 3Io>**	Recl. Dis.		Same as above
	→	**R 1Uo>**	Recl. Dis.		Same as above
	→	**R 2Uo>**	Recl. Dis.		Same as above
	→	**RRT**	Recl. Dis.		Same as above
	→	**GR1-2**	Disable		[Disable / Shot1 / Shot2 / Shot3 / Shot4]
	→	**SeqC**	Disable		[Disable / Enable]

16.31.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)	
ShNum	:	Number of Shots available in one Autoreclosure Cycle	
R1I>	:	Allows to select one or more of the Shots of a Cycle to be initiated by tripping of the function.....:	1I>
R2I>	:	Same as above.....:	2I>
R3I>	:	Same as above.....:	3I>
R1Io>	:	Same as above.....:	1Io>
R2Io>	:	Same as above.....:	2Io>
R3Io>	:	Same as above.....:	3Io>
R1Uo>	:	Same as above.....:	1Uo>
R2Uo>	:	Same as above.....:	2Uo>
RRT	:	Same as above.....:	RT
GR1-2	:	Change-over SetGroup 1 to SetGroup 2	
SeqC	:	Sequence coordination	
tSeqC	:	Sequence coordination time	
t1	:	Reclosure time of 1st AR shot	
Tr1	:	Reclaim time of 1st AR shot	
Td1	:	Discrimination of 1st AR shot	
t2	:	Reclosure time of 2nd AR shot	
Tr2	:	Reclaim time of 2nd AR shot	
Td2	:	Discrimination of 2nd AR shot	
t3	:	Reclosure time of 3rd AR shot	
Tr3	:	Reclaim time of 3rd AR shot	
Td3	:	Discrimination of 3rd AR shot	
t4	:	Reclosure time of 4th AR shot	
Tr4	:	Reclaim time of 4th AR shot	
TrCL	:	Reclaim time on manual closure	
ThExt	:	Hold of lock-out signal after removal of external lock-out	

16.31.2 – Definitions

Shot Number (ShNum = 0, 1, 2, 3, 4):
Number of autoreclosure commands that can be issued in a Reclosure cycle before lock-out.
Selection of the reclose shot of a cycle (R1, R2, ...) that can be initiated by the tripping of selectable protection elements (1I<, 2I>, ...).

Set Group Change-over (GR1-2):
Determines the reclosure shot in a cycle after switch the relay automatically switches from setting group 1 to setting group 2.
At the end of the reclaim time "Tr" the setting group 1 is automatically restored.

Sequence Coordination (SeqC), (tSeqC):
When "SeqC" is set to "enable", it allows the reclose element to count any downstream recloser operation, taking place within the sequence coordination time "tSeqC", as its own, thereby preventing unnecessary operations of the back-up device for a fault beyond the downstream device. This is particularly useful when the back-up breaker feeds several branch reclosers, only one of which is experiencing a fault.

Reclosure time (t1, t2, t3, t4):
It is the reclose dead time before a reclosure command (R1, R2, R3, R4) is issued after C/B opening.

Reclaim time (Tr1, Tr2, Tr3, Tr4):
It is the reclaim time started after any automatic reclosure command.
Any initiation signal (trip of enabled protection or seqC function) detected during "Trx" starts the next autoreclosure shot of the cycle.
Any initiation signal detected during "Trx" after the last shot of the reclose cycle, produces the lock-out status.

Discrimination time (Td1, Td2, Td3):
Any new trip detected after a automatic reclosure shot, during the time "Tdx" (Td<Tr) produces the "lock-out" status with display information "Failed Reclosure".

Reclaim time after manual closure (TrCL):
It is the reclaim time started after a manual closure of the C/B.
Tripping of any protection element detected during "TrCL", produces the lock-out status.
Tripping of an "enabled" protection, shows the display "Failed" Reclosure.

Holding time of the external lock-out signal (ThExt):
The digital input programmed to detected an external reclosure lock-out signal, remains activated for the time the signal is present plus the holding time "ThExt" from the external signals removal.

16.31.2.1 - Example

Example: programming of the Reclose Shots initiated by tripping of the protection function 1I>.

R 1I>	=	Recl.Dis.	:	no shot is initiated on tripping of the function 1I>.
R 1I>	=	1	:	only the shot n°1 of the AR cycle is initiated on tripping of the function 1I>.
R 1I>	=	1+2	:	only the shots n°1 and 2 of the AR cycle are initiated on tripping of the function 1I>.
R 1I>	=	1+2+3	:	only the shots n°1 and 2 and 3 of the AR cycle are initiated on tripping of the function 1I>.
R 1I>	=	1+2+3+4	:	all the shots n°1 and 2 and 3 and 4 of the AR cycle are initiated on tripping of the function 1I>.

R RT	=	Recl.Dis.	:	no shot is initiated on Remote Trip signal (RT).
R RT	=	1	:	only the shot n°1 of the AR cycle is initiated on Remote Trip signal (RT).
R RT	=	1+2	:	only the shots n°1 and 2 of the AR cycle are initiated on Remote Trip signal (RT).
R RT	=	1+2+3	:	only the shots n°1 and 2 and 3 of the AR cycle are initiated on Remote Trip signal (RT).
R RT	=	1+2+3+4	:	all the shots n°1 and 2 and 3 and 4 of the AR cycle are initiated on Remote Trip signal (RT).

Similarly for the other variables (R 2I>, R 3I>, R 1Io>, R 2Io>, R 3Io>, R 1Uo>, R 2Uo>).

16.31.3 - Operation

The Autoreclose function is based on the setting of the variables described in the § Setting and involves the following operational status (§ Definition and Description variable).

E/D	Enable/Disable	Autoreclosing function Enabled/Disabled.
S0	"Wait C/B cl"	Waiting for C/B's manual closure
Sx=S1	"Ready"	Ready to start a AR Cycle after manual C/B closure
Sx=Sh	"Progress"	Ready to operate the next AR shot of the Cycle.
L.O.	"Lock-out"	Function blocked due to external blocking signal present at the relevant Digital Input, or due to the detection of a failure of the Circuit Breaker operation.

The status of the Circuit Breaker (C/B) is indicated by one normally open contact of the C/B itself and it is detected by the digital input "C/B" of the relay that has been programmed for monitoring C/B status (see § Pysical Input).

A reclose shot is started after a C/B's opening operated by one of the relay's protection elements programmed to initiate this reclose shot; C/B's opening operated by one element not programmed to initiate the next reclosure shot, interrupts the Reclose cycle and activates the status "TwRCL" (Trip without Reclosure) of the relay. C/B's opening operated manually interrupts the Reclose cycle: the display of the relay shows "WaitC/Bcl" (Wait for C/B manual closure).

- Any time the Circuit Breaker (C/B) is manually closed the Reclaim time "TrCL" is started.
- Any time the C/B is reclosed by one AR shot (Sh1, 2, 3, 4) the relevant reclaim time (Tr1, Tr2, Tr3, Tr4) and the discrimination time (Td1, Td2, Td3) are started.
- After a manual closure of the C/B, tripping of any of the relay protection elements during "TrCL" 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 ; in this situation the "RCL" display indicates "Failed" Reclosure; if programmed the output relay (RCLf) is operated.
- Reset from the L.O. status take place when C/B manually closed or when the digital input "ExtReset" (if programmed) is activated.
- If none of the relay protection elements trips during "TrCL" after a manual closure of the C/B, the relay is ready to start the Automatic Reclose Sequence;
  the display indications are : RCL = Ready, LRC = Manual Close.
- The tripping of any element programmed for the operation of the next reclosure during the reclaim time "Trx" makes the relay proceed with the reclosing cycle.
- After "Trx" is expired the relay is ready for a new AR Cycle.

N.B.
For operation of the Autoreclose Function C/B trip must be controlled by output relay "R1", and C/B close must be controlled by relay "R2".

16.31.4 - Reclose Command

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 the relevant reclose, the relevant time delay (t1, t2, t3, t4) is started and at the end of this time the reclose command is issued by the relay.

The C/B is then automatically reclosed, the reclaim time "Trx" and the discrimination time "TDx" are started.

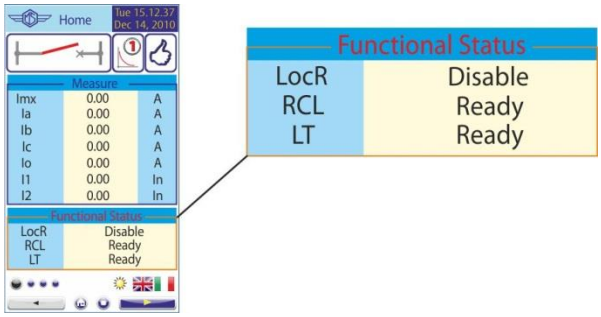
If during Tdx the C/B is again opened by any relay's protection element the relay goes in to L.O. status.

If during Trx the C/B is again opened by tripping of a protection element programmed to initiate the next AR shot, the C/B is reclosed after the relevant delay time "tx".

When the last shot of the AR Cycle sequence has been done, any further tripping during tr produces the relay's lock-out status.

If after any reclose shot no tripping takes peace during "Tr", the relay gets ready for a new AR Cycle.

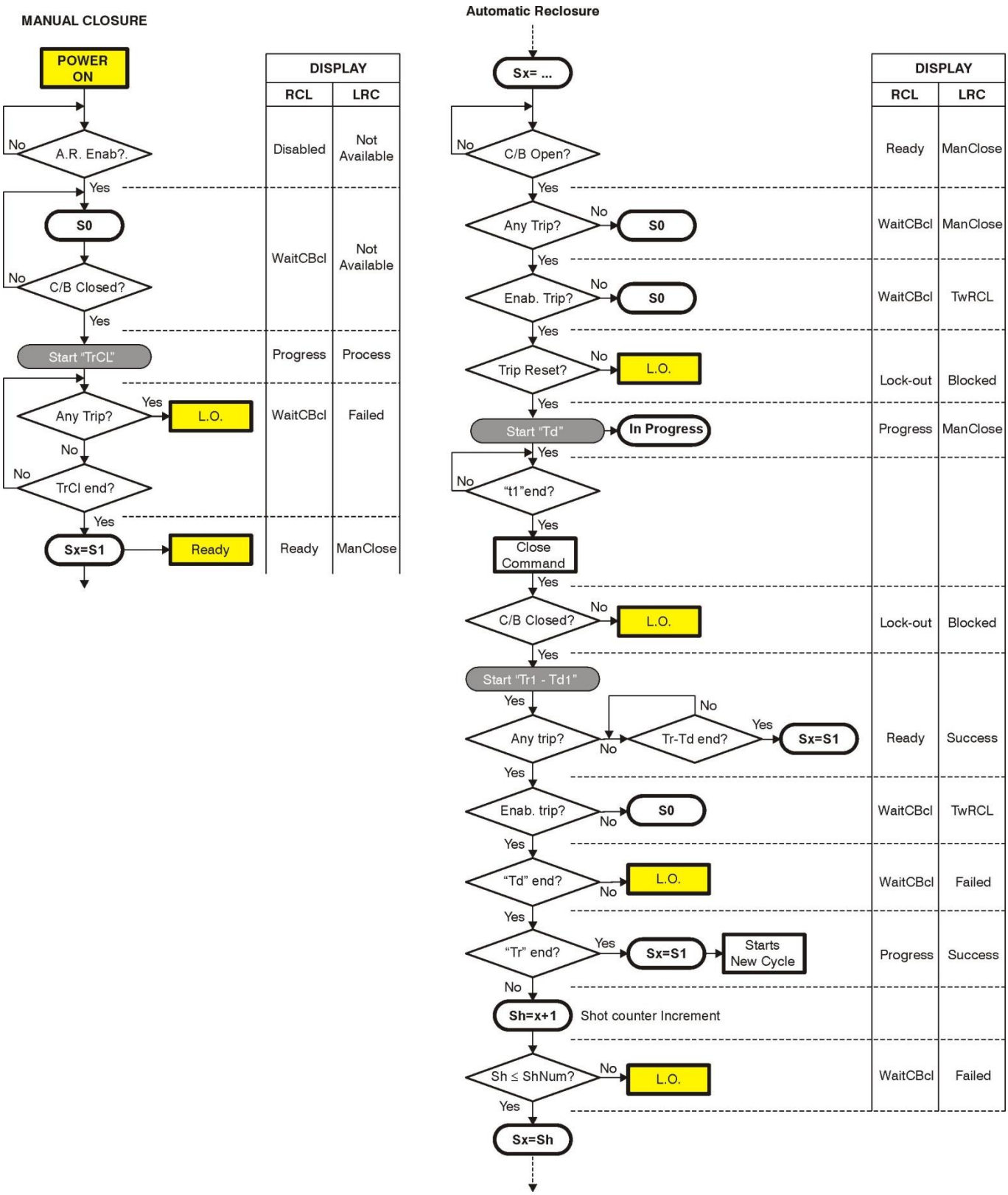
16.31.5 - Display Message



RCL	Status of the current Autoreclosure.		
	Disable	:	Disabled
	WaitC/Bcl	:	Wait for C/B manual closure
	Ready	:	Ready
	Progress	:	In Progress
	LockOut	:	LockOut

LRC	Last Autoreclosure		
	ManClose	:	Manual Closure
	Success	:	Successful Automatic Reclosure
	Failed	:	Reclosure Failed
	TwRCL	:	Trip without Automatic Reclosure
	Blocked	:	Blocked by external cause
	NotAvail	:	Information not Available
	Process	:	Automatic Reclosure in Process

16.31.6 - Flow chart - Automatic Reclosure RCL



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

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

16.32.1 - Description of variables

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

16.32.2 - 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,

16.33 - Function: **ExtReset** (External Reset Configuration)

This menu allows to configurate the edge polarity of the digital input associated to the trip reset function.

Status	→ **Enab.**		[Enable]
Options	→ **ActOn**	RiseEdge	[RiseEdge / FallEdge]

16.33.1 - Description of variables

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

16.34 - Function: **CB Mngn** (Control C/B)

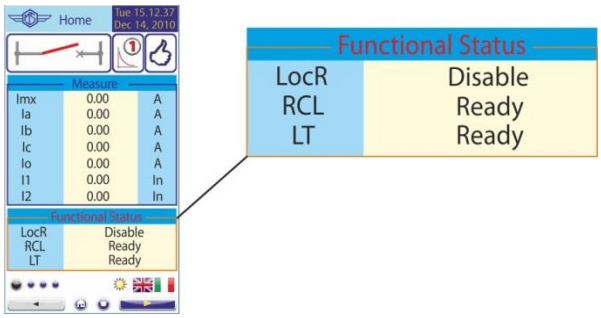
This menu allows to configurate the command for C/B operation.

Status	→	**Enab.**			[Enable]			
Timers	→	**tL/R**	0.05	**s**	(0.05 ÷ 1.00)	step	0.05	s
	→	**tC/Bs**	0.50	**s**	(0.05 ÷ 1.00)	step	0.05	s
Options	→	**L/R**	Ignored		[Ignored – Active]			
	→	**Key**	Enable		[Disable – Enable]			

16.34.1 - Description of variables

tL/R	:	Admissible time before detection of the Local/Remote discrepancy alarm.
tC/Bs	:	Maximum admissible delay for detection of status signal after C/B operation.
L/R	:	Selection of Local/Remote C/B operation mode Ignored or Active
Key	:	*Disable* = The pushbuttons on Front Panel are disabled; the operation of the C/B can be controlled by; 1 - serial bus commands 2 - commands available in the menu "***Command***" (Password protected). 3 - Digital Inputs.
		Enable = The C/B can be controlled also by the pushbuttons available on Relay's Front Face.

16.34.2 - Display Message



LocR	Local/Remote Status	
Disable	:	Disabled
Local	:	Local Status
Remote	:	Remote Status
LockOut	:	LockOut

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

Status	→	**Enab.**			[Disable / Enable]			
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
Options	→	**Trig**	Start		[Start / Trip / OnCmd / REUserLg / REUserLg]			

16.35.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
tPre	:	Recording time before Trigger
tPost	:	Recording time after Trigger
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" (see § "User Trigger Oscillo")
		FEUserLg = On falling edge of "User Logic"

16.35.2 - Operation

In the options: "Trig = Start" and "Trig = Trip", the oscillographic recording starts respectively when any protection function starts operating or trip.

The "Oscillo" Function includes the wave Form Capture of the input quantities and can totally store a record of 3 seconds.
The number of events recorded depends on the duration of each individual recording (tPre + tPost).
In any case the number of event stored can not exceed ten (10 x 0.3 sec).
Any new event beyond the 3 sec capacity of the memory, cancels and overwrites the former records (FIFO Memory).

16.35.3 – Available on MSCom2

	SCDop	*Scada open breaker command*	
	SCDcl	*Scada close breaker command*	
	SCDop2	*Scada open breaker 2 command (generic command)*	
	SCDcl2	*Scada close breaker 2 command (generic command)*	
	SCDop3	*Scada open breaker 3 command (generic command)*	
	SCDcl3	*Scada close breaker 3 command (generic command)*	
	SCDop4	*Scada open breaker 4 command (generic command)*	
	SCDcl4	*Scada close breaker 5 command (generic command)*	
	DisRCL	*Scada disable reclose command*	
	EnRCL	*Scada enable reclose command*	
T>	**Tal** **T>**	*Alarm* *Trip*	*Thermal Image T>*
1I>	**1I>** **t1I>**	*Start* *Trip*	*First overcurrent element F50-51*
2I>	**2I>** **t2I>**	*Start* *Trip*	*Second overcurrent element F50-51*
3I>	**3I>** **t3I>**	*Start* *Trip*	*Third overcurrent element F50-51*
1Io>	**1Io>** **t1Io>**	*Start* *Trip*	*First earth fault element F50N-51N*
2Io>	**2Io>** **t2Io>**	*Start* *Trip*	*Second earth fault element F50N-51N*
3Io>	**3Io>** **t3Io>**	*Start* *Trip*	*Third earth fault element F50N-51N*
1Is>	**1Is>** **t1Is>**	*Start* *Trip*	*First negative sequence current element F46*
2Is>	**2Is>** **t2Is>**	*Start* *Trip*	*Second negative sequence current element F46*
1U>	**1U>** **t1U>**	*Start* *Trip*	*First overvoltage element F59*
2U>	**2U>** **t2U>**	*Star* *Trip*	*Second overvoltage element F59*
1U<	**1U<** **t1U<**	*Start* *Trip*	*First undervoltage element F27*
2U<	**2U<** **t2U<**	*Start* *Trip*	*Second undervoltage element F27*
1f>	**1f>** **t1f>**	*Start* *Trip*	*First overfrequency element F81*
2f>	**2f>** **t2f>**	*Start* *Trip*	*Second overfrequency element F81*
1f<	**1f<** **t1f<**	*Start* *Trip*	*First underfrequency element F81*
2f<	**2f<** **t2f<**	*Start* *Trip*	*Second underfrequency element F81*
1Uo>	**1Uo>** **t1Uo>**	*Start* *Trip*	*First zero sequence voltage element F59Uo*
2Uo>	**2Uo>** **t2Uo>**	*Start* *Trip*	*Second zero sequence voltage element F59Uo*
U1<	**U1<** **tU1<**	*Start* *Trip*	*Positive sequence undervoltage element F27U1*
U2>	**U2>** **tU2>**	*Start* *Trip*	*Negative sequence overvoltage element F59U2*
Wi	**tWi>**	*Circuit breaker maintenance level*	
TCS	**TCS** **tTCS**	*Start* *Trip*	*trip coil supervision*
IRF	**IRF** **tIRF**	*Start* *Trip*	*Internal Relay Failure*
RT	**RT** **tRT**	*Start* *Trip*	*Element Remote Trip*

	TripTimeR	*Trip time reduction active*		
	RCLf	*Autoreclosure failed*		
	RCLrun	*Autoreclosure in progress*		
	TwRCL	*Trip not enabled for Automatic Reclosure*		
	RCL-OK	*Successful Automatic Reclosure*		
	ManCL-OK	*Manual Closure*		
	BiRCL	*Presence Reclosure external lockout cause (input/CB Failure)*		
	Gr1to2	*Switch to SetUp Group2*		
	manOpCmd	*Manual Open Command*		
	CL-Cmd	*Close Command*		
	C/Bfail	*Circuit Breaker failure*		
	L/Rdisc	*Local/Remote signal Discrepancy*		
	BF	*Breaker Failure*		
	Gen.Start	*Start Generic*		
	Gen.Trip	*Trip Generic*		
	UserTriggerOscillo	*User Variable for Oscillographic Recording*		
	UserVar<0> **to** **UserVar<24>**	*User Variable*		
	Vcc	*Reserved*		
	Gnd	*Reserved*		
	ResLog	*Reset signal logic*		
	P1	*Push-button Open*		
	P2	*Push-button Close*		
	0.D1 **0.D1Not** to **0.D4** **0.D4Not**	*Digital Input "0.D1"* *Digital Input "0.D1"* *Digital Input "0.D4"* *Digital Input "0.D4"*	*activated* *deactivated* *activated* *deactivated*	*Digital Input on Main Relay*
	1.D1 **1.D1Not** to **1.D15** **1.D15Not**	*Digital Input "1.D1"* *Digital Input "1.D1"* *Digital Input "1.D15"* *Digital Input "1.D15"*	*activated* *deactivated* *activated* *deactivated*	*Digital input on Expansion Board*
	2.D1 **2.D1Not** to **2.D15** **2.D15Not**	*Digital Input "2.D1"* *Digital Input "2.D1"* *Digital Input "2.D15"* *Digital Input "2.D15"*	*activated* *deactivated* *activated* *deactivated*	*Digital input on Expansion Board*

16.35.4 – Setting "User Trigger Oscillo"

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

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

16.36.4.1 - Name

Internal name

16.36.4.2 - User descr.

Fixed

16.36.4.3 - Linked functions

Selection functions

16.36.4.4 - OpLogic

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

16.36.4.5 - Timer

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

16.36.4.6 - Timer type

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

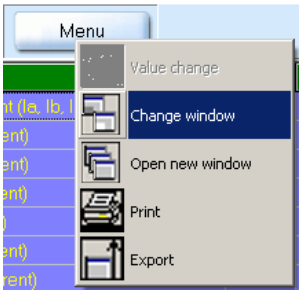
16.36.4.7 - Logical status

"User Trigger Oscillo" Logical status

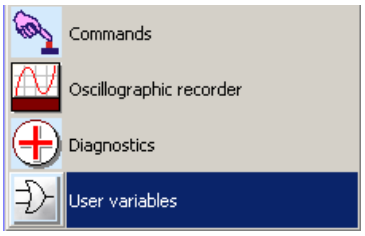
16.36.4.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu"



Select "User Variable"

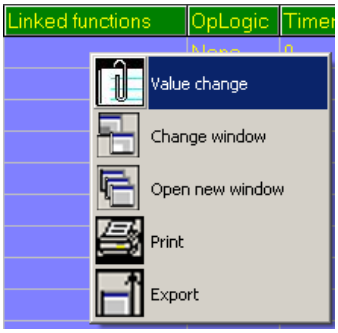


Setting for "User Trigger Oscillo" : "**1I>/2I>/3I>**", "**AND**", "**1**", "**Monostable**".

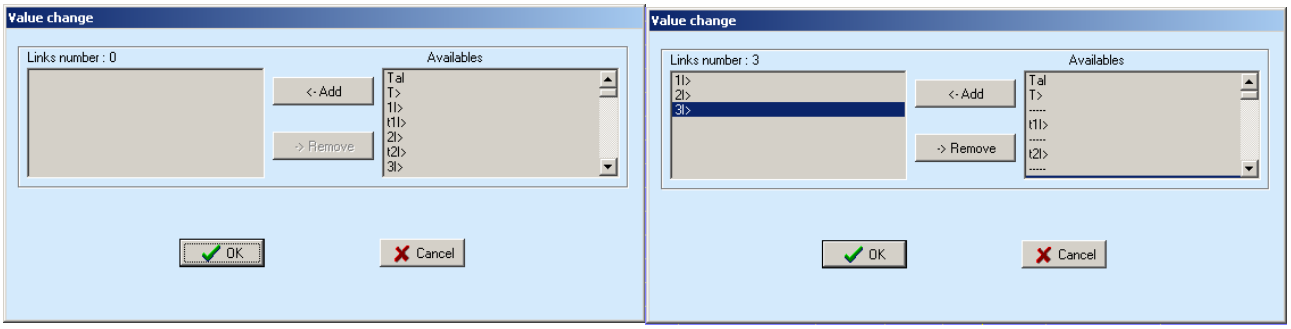
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	OscilloTrigger.logic		None	0	Delay	0
2	UserVar <0>	Gate.1		None	0	Delay	0

16.36.4.9 - "Linked Functions"

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

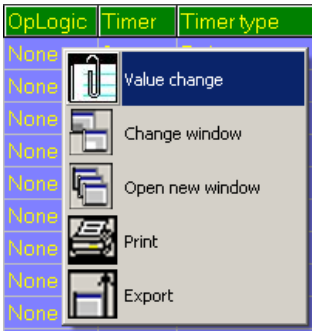


Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".

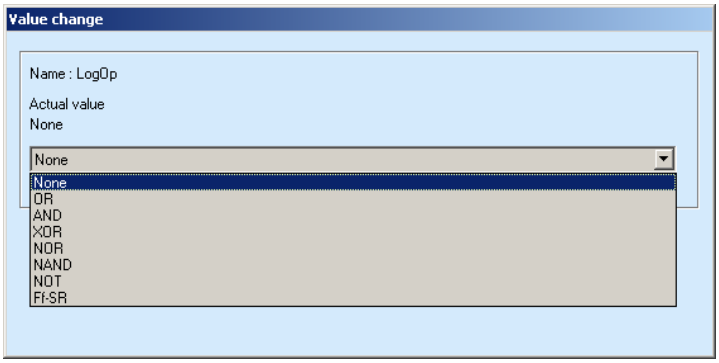


16.36.4.10 - "Operation Logic" (Oplogic)

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

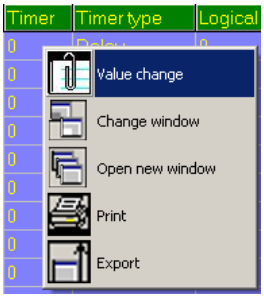


Insert "**AND**" into box and press "OK":

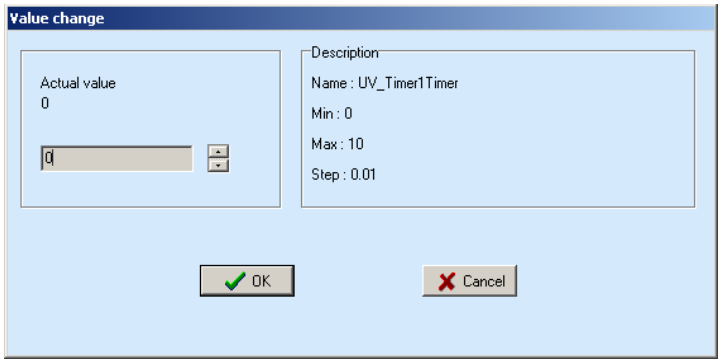


16.36.4.11 - "Timer"

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

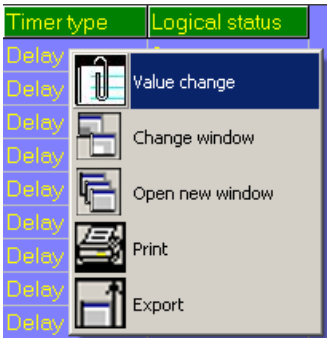


Select "**1**" into box and press "OK":

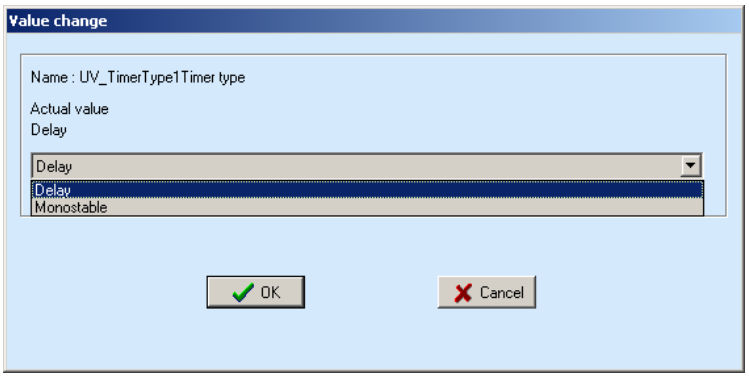


16.36.4.12 - "Timer type"

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



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



17. User Variables

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

ID	Nome	Descr. utente	Funz. associate	OpLogic	Timer	Tipo timer	Stato logico

17.1 - Name

Internal progressive name

17.2 - User Descr.

Custom identification label for user variable

17.3 - Linked functions

Selection functions

17.4 - OpLogic

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

17.5 - Timer

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

17.6 - Timer type

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

17.7 - Logical status

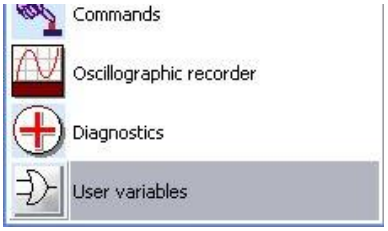
"User Variable" Logical status

17.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button

Select "User Variable"



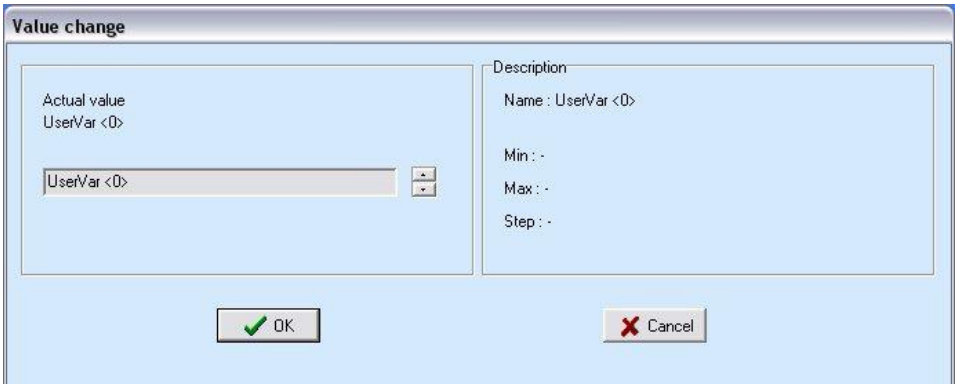
Setting for "**UserVar<0>**" :
"**Start Overcurrent Element**", "**1I>, 2I>, 3I>**", "**OR**", "**1**", "**Monostable**".

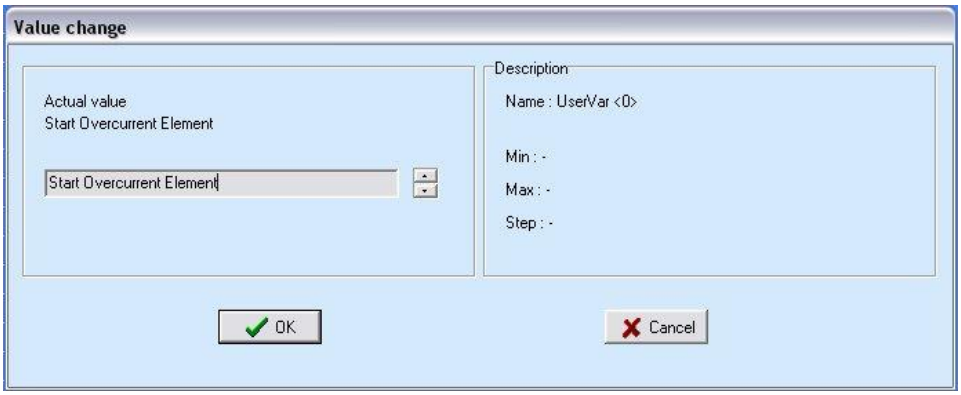
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	UserTrigger Oscillo	UserTrigger Oscillo		None	0	Delay	0
2	UserVar <0>	Start Overcurrent Element	1I>,2I>,3I>,	OR	1	Monostable	0

17.8.1 - "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":

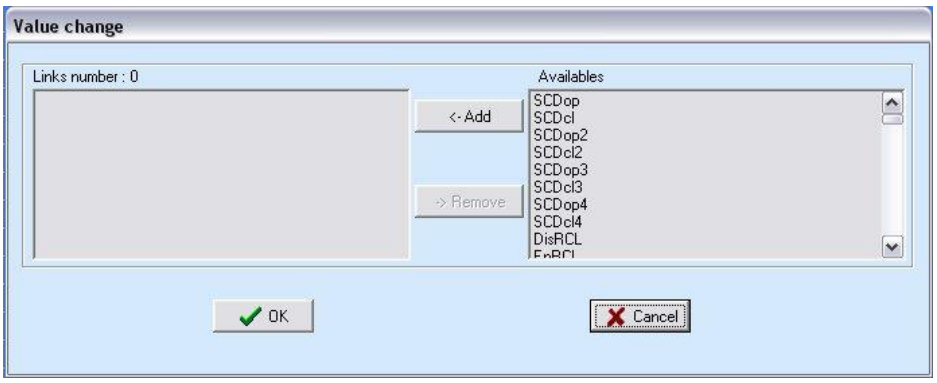


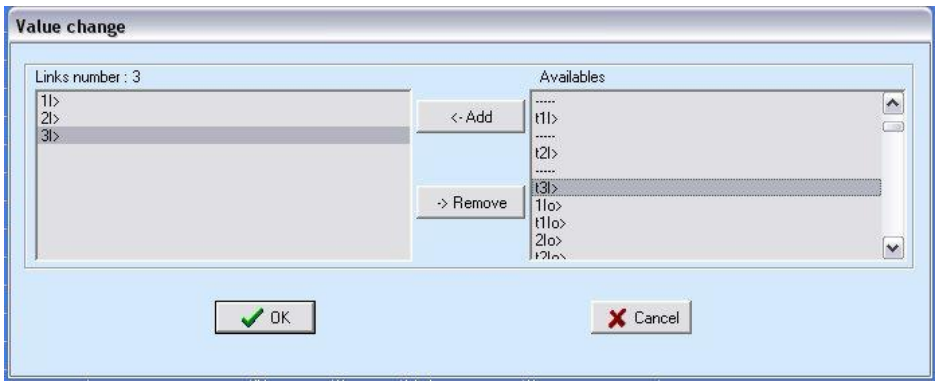


17.8.2 - "Linked Functions"

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".

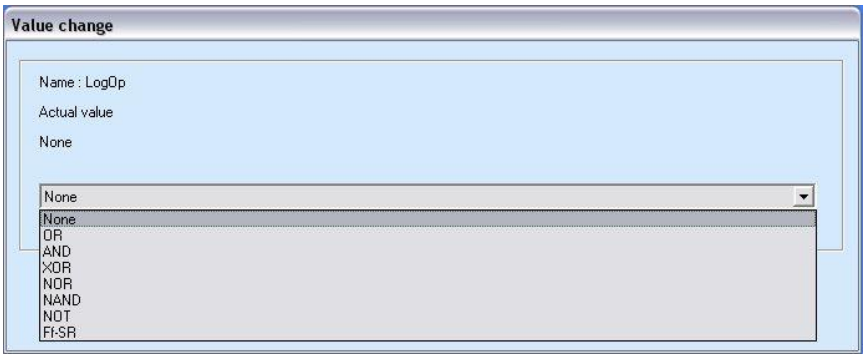




17.8.3 - "Operation Logic" (Oplogic)

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

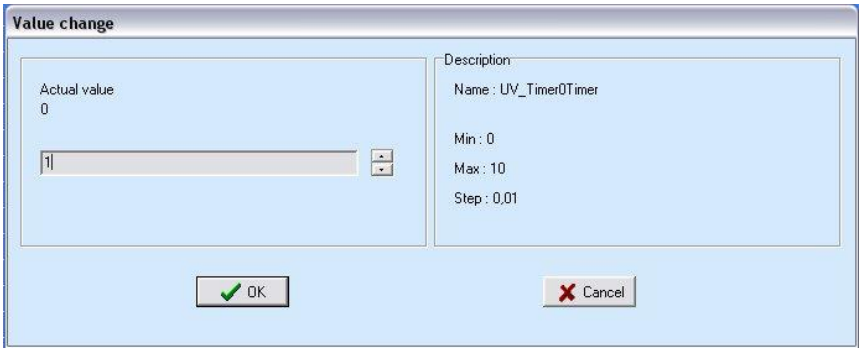
Insert "**OR**" into box and press "OK":



17.8.4 - "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":



17.8.5 - "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":

18. Input – Output (via software MSCom2)

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 "MSCom 2" also allows to program the operation of the output relays (Physical Output), and Digital Inputs (see MSCom2 Manual).

18.1 – Digital Input

→ **0.D1** → **0.D2** → **0.D3** → **0.D4**	Programmable (D1) Programmable (D2) Programmable (D3) Programmable (D4) (PTC)	*Available in the Main Relay*	Any digital input of the expansion modules is active when the relevant terminals (see wiring diagram) are shorted.
→ **1.D1** → **1.D--** → **1.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board*	
→ **2.D1** → **2.D--** → **2.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board*	

Three of them (0.D1, 0.D2, 0.D3) are disactivated, 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". - Disactivated 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).

The additional inputs "1.D1....1.D15" are available when the first expansion module is present.

The additional inputs "2.D1....2.D15" are available when the second expansion module is present.

Any digital input of the expansion modules is active when the relevant terminals (see wiring diagram) are shorted.

18.2 – "DI" Configuration (via MSCom2 software)

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

Bi1I>	Blocking input	First overcurrent element
Bi2I>	Blocking input	Second overcurrent element
Bi3I>	Blocking input	Third overcurrent element
Bi1Io>	Blocking input	First earth fault element
Bi2Io>	Blocking input	Second earth fault element
Bi3Io>	Blocking input	Third earth fault element
Bi1Is>	Blocking input	First negative sequence current element
Bi2Is>	Blocking input	Second negative sequence current element
Bi1U>	Blocking input	First overvoltage element
Bi2U>	Blocking input	Second overvoltage element
Bi1U<	Blocking input	First undervoltage element
Bi2U<	Blocking input	Second undervoltage element
Bi1Uo>	Blocking input	First zero sequence voltage element
Bi2Uo>	Blocking input	Second zero sequence voltage element
BiU1<	Blocking input	Positive sequence undervoltage element
BiU2>	Blocking input	Negative sequence overvoltage element
Group 1-2	Selection of the setting Group 1 or 2.	
Circuit Breaker	Status Circuit Breaker	
ExtR	External Reset input	
Blocking of reclosing functions	Blocking of reclosing functions	
Dig.Input for reduction of trip time	Digital Input for reduction of trip time	
Local state	Locate state	
Remote state	Remote state	
C/B open command	Open C/B Command	
C/B close command	Close C/B Command	
Remote (external) trip	Remote Trip	

18.2.1 – Example:

ID	Name	Status	OpLogic	Functions

18.2.2 – Name

Logical Input name

18.2.3 – Status

Logical Input status

18.2.4 – OpLogic

Not Used

18.2.5 – Functions

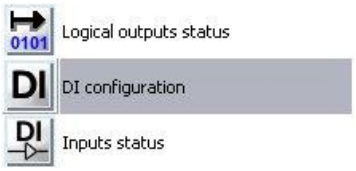
Selection function

18.2.6 – Example: Setting "Digital Input"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu"

Select "DI configuration"



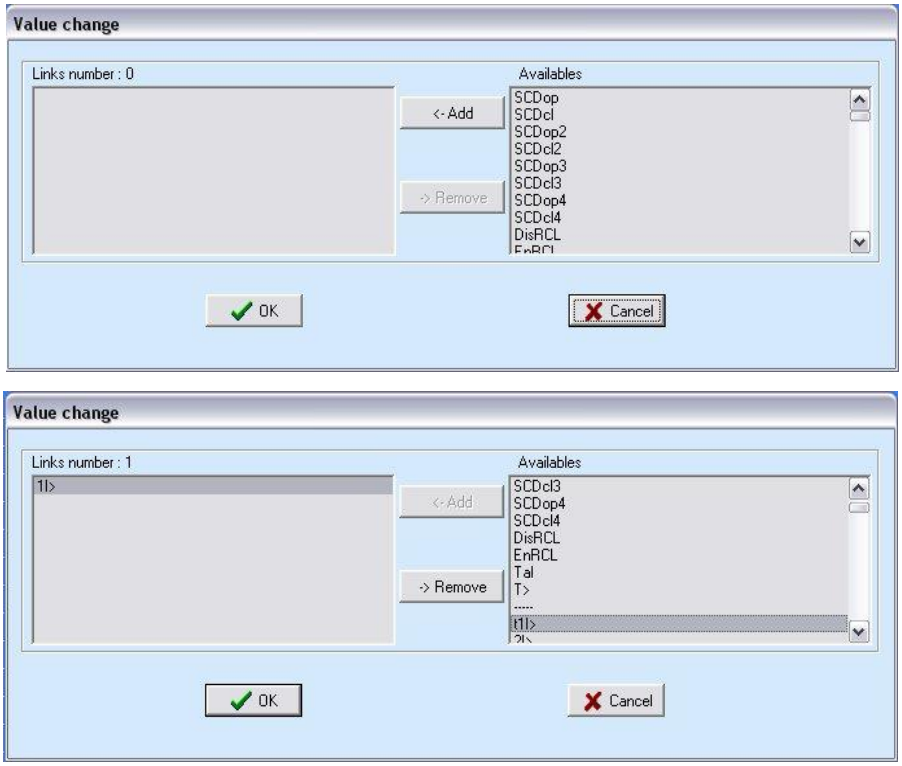
Setting for "**Bi1I>**" : "**1I>**".

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

18.2.6.1 – "Functions"

Select "**Functions**" related to "**BiR1I>**" 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)



18.3 – Physical Outputs

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

→ **0.R1** → **0.R2** → **0.R3** → **0.R4** → **0.R5** → **0.R6**	Programmable (R1) Programmable (R2) Programmable (R3) Programmable (R4) Programmable (R5) Programmable (R6)	*Available in the main relay*
→ **1.R1** → **1.R--** → **1.R14**	Programmable	*Output Relays on Expansion Board*
→ **2.R1** → **2.R--** → **2.R14**	Programmable	*Output Relays on Expansion Board*

18.4 - "DO" Configuration

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

	SCDop	*Scada open breaker command*	
	SCDcl	*Scada close breaker command*	
	SCDop2	*Scada open breaker 2 command (generic command)*	
	SCDcl2	*Scada close breaker 2 command (generic command)*	
	SCDop3	*Scada open breaker 3 command (generic command)*	
	SCDcl3	*Scada close breaker 3 command (generic command)*	
	SCDop4	*Scada open breaker 4 command (generic command)*	
	SCDcl4	*Scada close breaker 5 command (generic command)*	
	DisRCL	*Scada disable reclose command*	
	EnRCL	*Scada enable reclose command*	
T>	**Tal** **T>**	*Alarm* *Trip*	*Thermal Image T>*
1I>	**1I>** **t1I>**	*Start* *Trip*	*First overcurrent element F50-51*
2I>	**2I>** **t2I>**	*Start* *Trip*	*Second overcurrent element F50-51*
3I>	**3I>** **t3I>**	*Start* *Trip*	*Third overcurrent element F50-51*
1Io>	**1Io>** **t1Io>**	*Start* *Trip*	*First earth fault element F50N-51N*
2Io>	**2Io>** **t2Io>**	*Start* *Trip*	*Second earth fault element F50N-51N*
3Io>	**3Io>** **t3Io>**	*Start* *Trip*	*Third earth fault element F50N-51N*
1Is>	**1Is>** **t1Is>**	*Start* *Trip*	*First negative sequence current element F46*
2Is>	**2Is>** **t2Is>**	*Start* *Trip*	*Second negative sequence current element F46*
1U>	**1U>** **t1U>**	*Start* *Trip*	*First overvoltage element F59*
2U>	**2U>** **t2U>**	*Star* *Trip*	*Second overvoltage element F59*
1U<	**1U<** **t1U<**	*Start* *Trip*	*First undervoltage element F27*
2U<	**2U<** **t2U<**	*Start* *Trip*	*Second undervoltage element F27*
1f>	**1f>** **t1f>**	*Start* *Trip*	*First overfrequency element F81*
2f>	**2f>** **t2f>**	*Start* *Trip*	*Second overfrequency element F81*
1f<	**1f<** **t1f<**	*Start* *Trip*	*First underfrequency element F81*
2f<	**2f<** **t2f<**	*Start* *Trip*	*Second underfrequency element F81*

1Uo>	1Uo> t1Uo>	Start Trip	First zero sequence voltage element F59Uo	
2Uo>	2Uo> t2Uo>	Start Trip	Second zero sequence voltage element F59Uo	
U1<	U1< tU1<	Start Trip	Positive sequence undervoltage element F27U1	
U2>	U2> tU2>	Start Trip	Negative sequence overvoltage element F59U2	
Wi	tWi>	Circuit breaker maintenance level		
TCS	TCS tTCS	Start Trip	trip coil supervision	
IRF	IRF tIRF	Start Trip	Internal Relay Failure	
RT	RT tRT	Start Trip	Element Remote Trip	
	TripTimeR	Trip time reduction active		
	RCLf	Autoreclosure failed		
	RCLrun	Autoreclosure in progress		
	TwRCL	Trip not enabled for Automatic Reclosure		
	RCL-OK	Successful Automatic Reclosure		
	ManCL-OK	Manual Closure		
	BiRCL	Presence Reclosure external lockout cause (input/CB Failure)		
	Gr1to2	Switch to SetUp Group2		
	manOpCmd	Manual Open Command		
	CL-Cmd	Close Command		
	C/Bfail	Circuit Breaker failure		
	L/Rdisc	Local/Remote signal Discrepancy		
	BF	Breaker Failure		
	Gen.Start	Start Generic		
	Gen.Trip	Trip Generic		
	UserTriggerOscillo	User Variable for Oscillographic Recording		
	UserVar<0> to UserVar<24>	User Variable		
	Vcc	Reserved		
	Gnd	Reserved		
	ResLog	Reset signal logic		
	P1	Push-button Open		
	P2	Push-button Close		
	0.D1 0.D1Not to 0.D4 0.D4Not	Digital Input "0.D1" Digital Input "0.D1" Digital Input "0.D4" Digital Input "0.D4"	activated deactivated activated deactivated	Digital Input on Main Relay
	1.D1 1.D1Not to 1.D15 1.D15Not	Digital Input "1.D1" Digital Input "1.D1" Digital Input "1.D15" Digital Input "1.D15"	activated deactivated activated deactivated	Digital input on Expansion Board
	2.D1 2.D1Not to 2.D15 2.D15Not	Digital Input "2.D1" Digital Input "2.D1" Digital Input "2.D15" Digital Input "2.D15"	activated deactivated activated deactivated	Digital input on Expansion Board

18.4.1 - Example configuration

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

18.4.1.1 - Relay

Relay internal name

18.4.1.2 - Linked function

It's available only 1 link, select the function for tripping the output relay (for multiple association use "User Variable")

18.4.1.3 - Operation Logic

Not Used

18.4.1.4 - Logical Status

Relay Logical status

18.4.1.5 - Output Configuration

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

18.4.1.6 - tON (Operation Time)

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

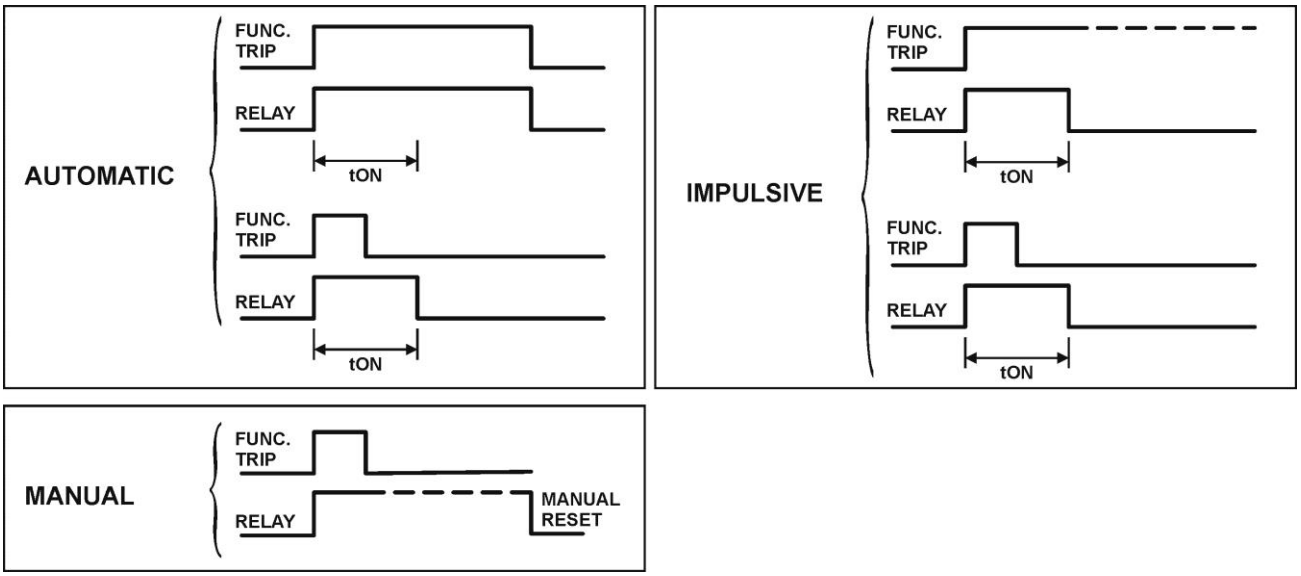
tON : 0 (0.01-10)s, step 0.01s

18.4.1.7 - Relay Status

Relay – Physical status

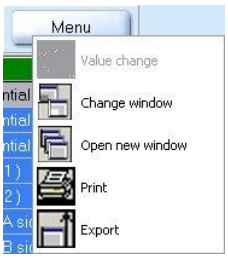
18.4.2 - Functions - Operation Mode

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.

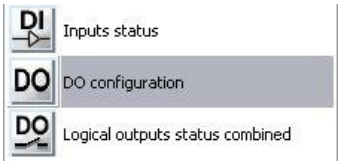


Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu"



Select "DO Configuration"



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

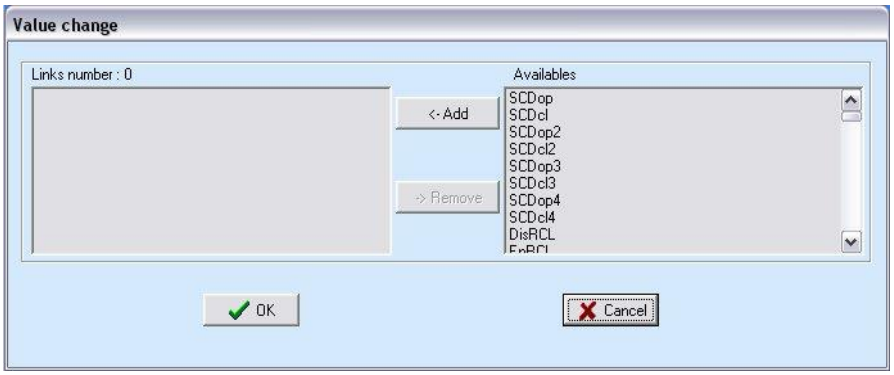
Change settings for "0.R1" : "1I>", "Normally Close", "Automatic reset", "0.5".

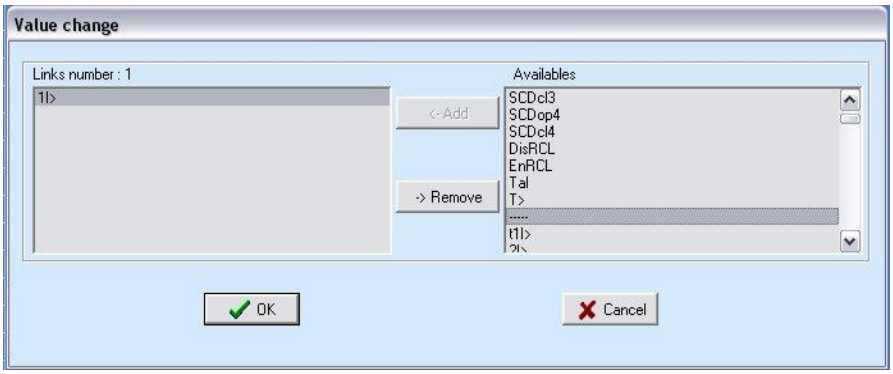
ID	Relay	Linked functions	OpLogic	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]	1I>,	None	Off	Normally close	Automatic reset	0,5	Off
2	0.R2 [Master board, R:2]		None	Off	Normally open	Pulse	0,01	Off

18.4.2.2 - "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)

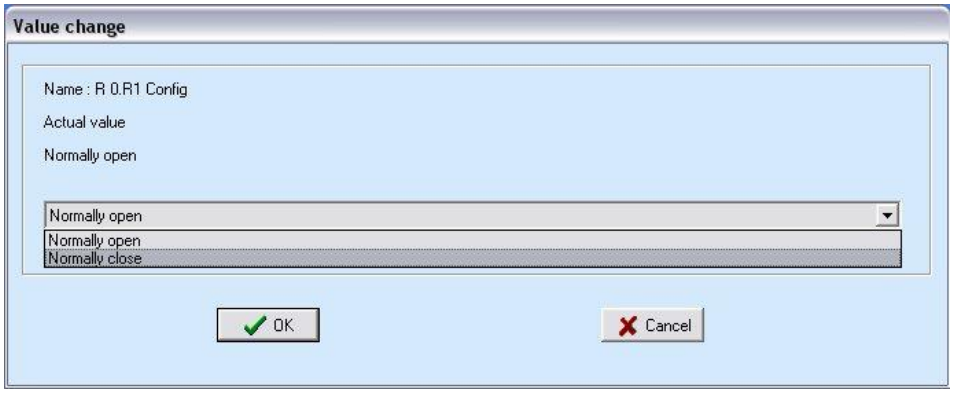




18.4.2.3 - "Output Config"

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

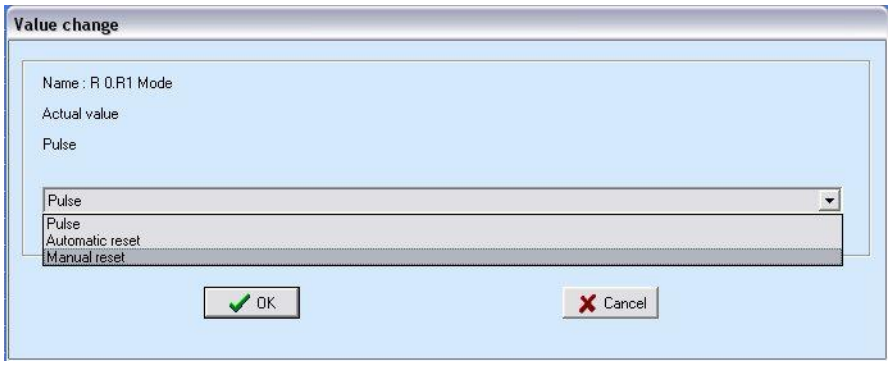
Select "**Normally Close**" from combo box and press "OK"
(if Password is request, see § Password)



18.4.2.4 - "Function"

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

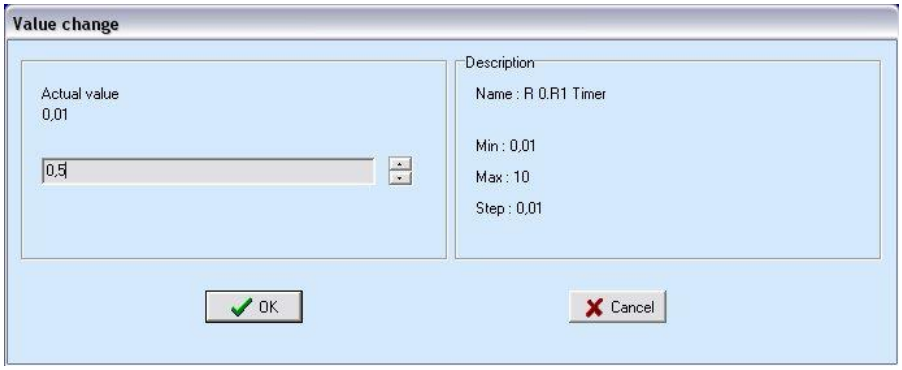
Select "**Manual reset**" from combo box and press "OK"
(if Password is request, see § Password):



18.4.2.5 - "tON"

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

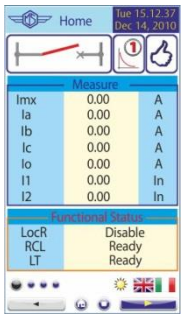
Set "**0.5**" and press "OK" (if Password is request, see § Password):



19. Tue 15.12.37 Dec 14, 2010 Date and Time

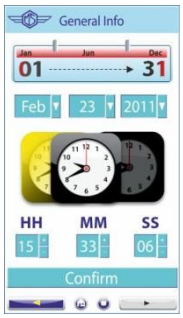
In this menu it is possible to configurate the Date and Time

1



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

2



Through this control is possible change the system "Date"

To change month

To change day

To change year

Through this control is possible change the system "Time"

To change hours

To change minutes

To change seconds

Press Confirm to apply change

19.1 - Clock synchronization

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

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

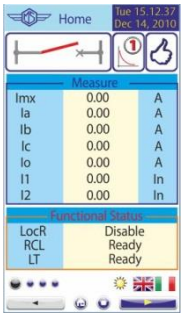
- Using the "MSCom 2" software or from the DCS with the Modbus RTU protocol.

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

20. 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

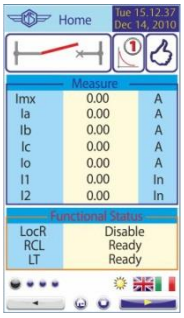
• Press "  " to access.

3

• In this menu is showed the status of device.

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

1



In Home page, is present a 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.

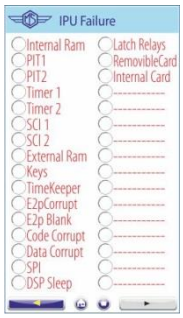
20.1 – Diagnostic Messages

20.1.1 - IPU

1

• Press "IPU" to access to the menu with diegnostic messages.

2



• In this menu is showed the status of device.

Internal Ram
PIT 1
PIT 2
Timer 1
Timer 2
SCI 1
SCI 2

External Ram
Keys
Timer Keeper
E2p Corrupt
E2p Blank
Code Corrupt
Data Corrupt

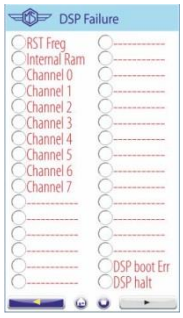
SPI
DSP Sleep
Latch Relays — If option is present
Removible Card — If option is present
Internal Card — If option is present

20.1.2 - DSP

1

• Press "DSP" to access to the menu with diegnostic messages.

2



• In this menu is showed the status of device.

RTS Freg
Internal Ram
Channel 0
Channel 1

Channel 2
Channel 3
Channel 4
Channel 5

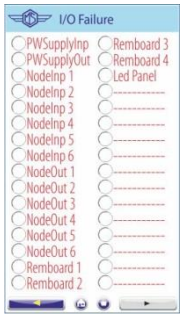
Channel 6
Channel 7
DSP boot Err
DSP halt

20.1.3 – I/O

1

• Press "I/O" to access to the menu with diegnostic messages.

2



• In this menu is showed the status of device.

PWSupplyInp
PWSupplyOut
NodeInp 1
NodeInp 2
NodeInp 3
NodeInp 4
NodeInp 5

NodeInp 6
NodeOut 1
NodeOut 2
NodeOut 3
NodeOut 4
NodeOut 5
NodeOut 6

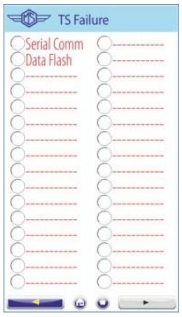
Remboard 1
Remboard 2
Remboard 3
Remboard 4
Led Panel

20.1.4 – TS

1

• Press "  " to access to the menu with diegnostic messages.

2



• In this menu is showed the status of device.

Serial Comm

Data Flash

20.1.5 – FW (example)

1

• Press "  " to access to the menu with diegnostic messages.

2

• In this menu is showed the status of fault.

3

If the firmware (IPU) is not compatible with that touch screen (TS), an icon "  " will appears close to the two firmwares.

21. Info (Device Information)

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

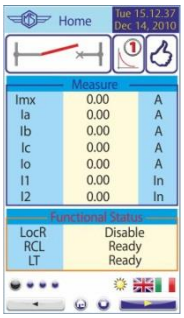
Line Name	Line identification label.	(1)
Station Name	Build identification label.	(1)
Serial Number	Relay Serial Number	Not modifiable
U-MLE-PLS	Protection Type	Not modifiable

(1) This information can only be modified by the interface program "MSCom 2"

22. SW Version (Software Version)

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

1



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

2

• Press "●" to next page.

3

• Press "■" to access.

4

• In this menu is showed the informations of device.

Type Relay		Type Relay	**FMR-PL-Ts**
IPU		Firmware number	**0700.30.01**
DSP		Firmware number	**022.01.A**
Touch Screen		Firmware number	**0700.02.01**

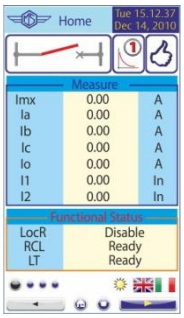
Application Software

MSCom 2	1.03.42 or later

23. Display Cal. (Display Calibration)

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

1

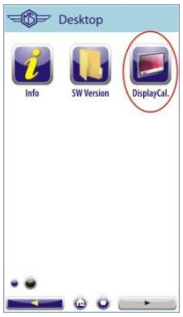


• Press "▬" or "●"to access to the "Desktop" menu with icons.

2

• Press "●" for next page.

3

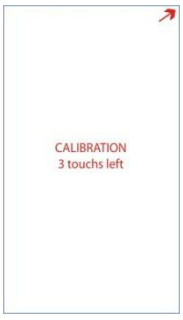


• Press "▣" to calibration.

4

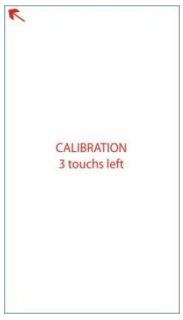
• Touch to continue.

5



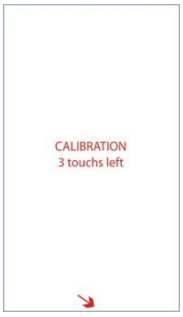
• 3 Touches Right-up.

6



• 3 Touches Left-up.

7



• 3 Touches Middle point down.

8

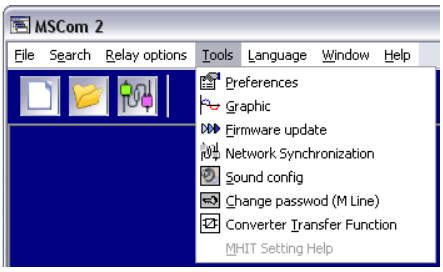
• Calibration Done.

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

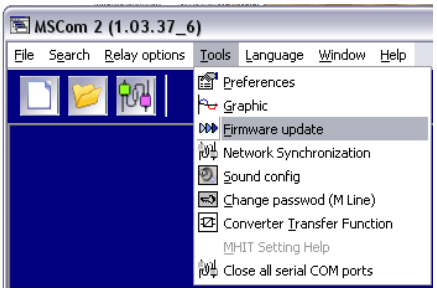
Insert USB cable in the front face connector.

Open MSCom2 software:

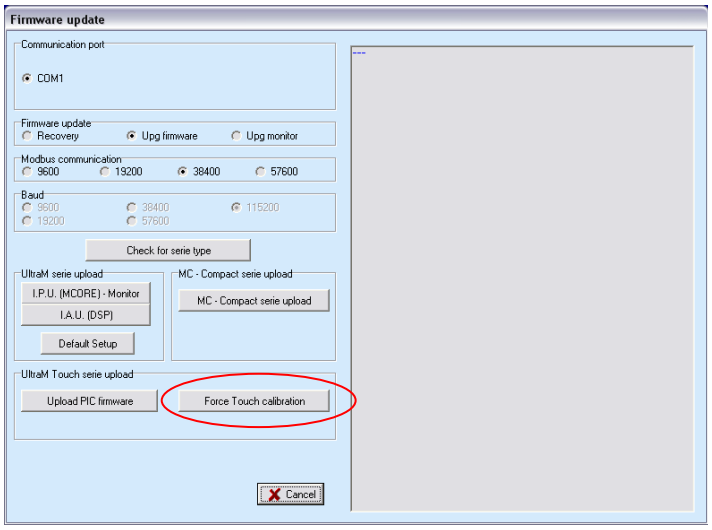
Select "**Tools**" on main menu:



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



Press "**Force Touch calibration**":



24. Battery

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

Attention!! Use only battery specified.

Instruction for replacement the battery:

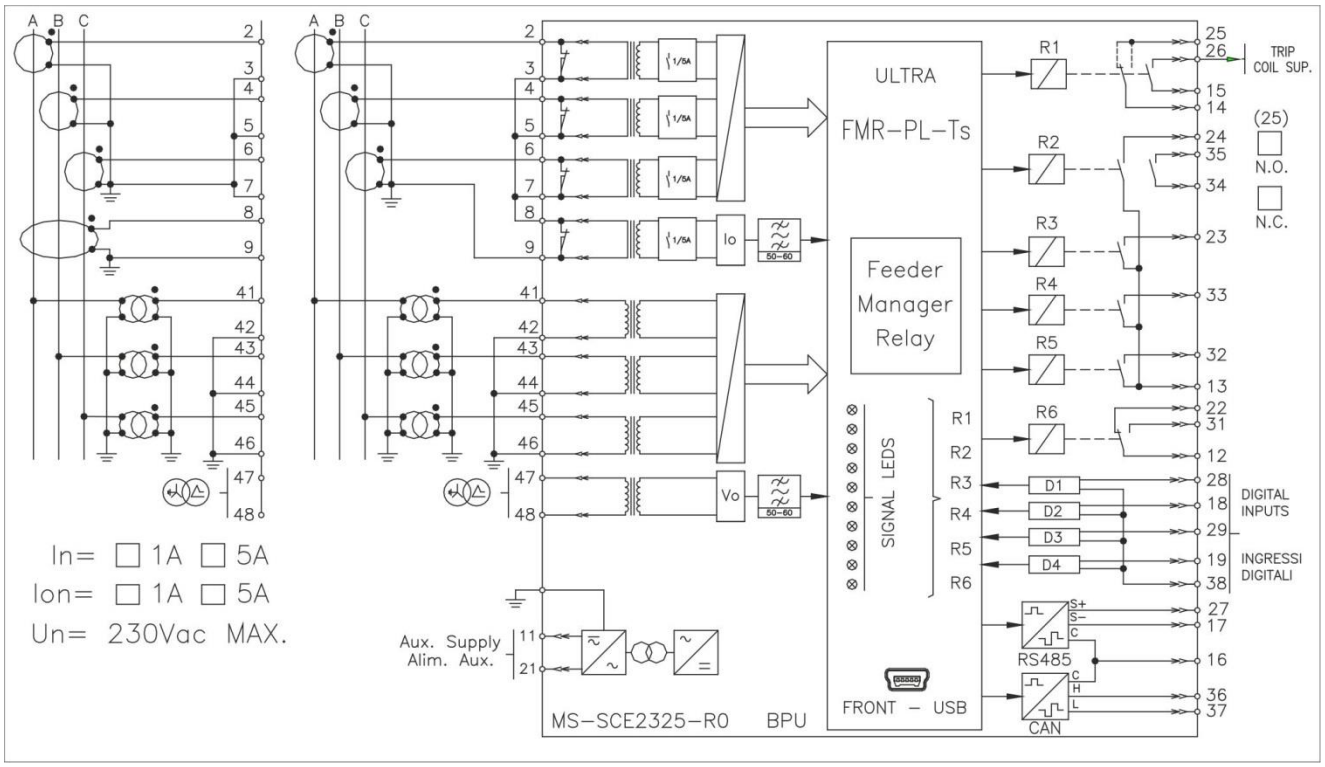
25. Maintenance

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

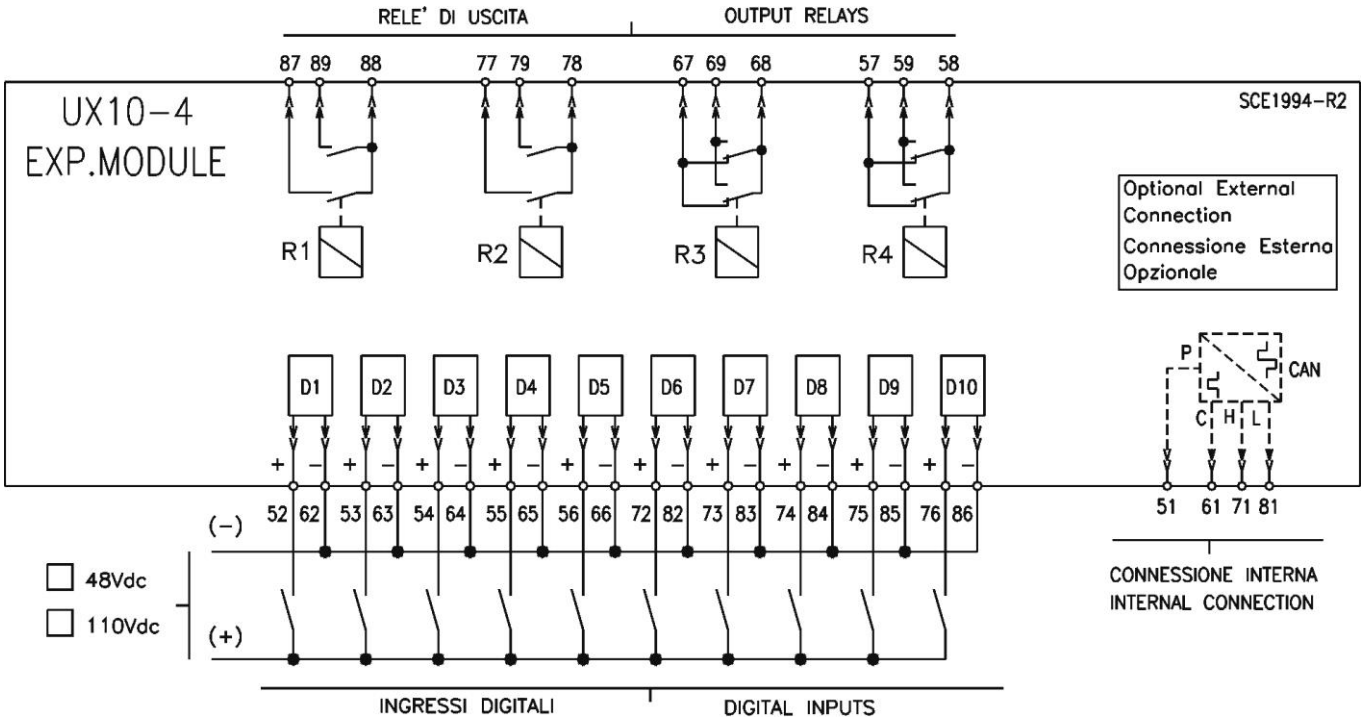
26. Power Frequency Insulation Test

Every relay individually undergoes a factory insulation test according to IEC255-5 standard at 2kV, 50Hz 1min. Insulation test should not be repeated as it unusefully stresses the dielectrics.
When doing the insulation test, the terminals relevant to serial output, digital inputs and RTD input must always be short circuited to ground. When relays are mounted in switchboards or relay boards that have to undergo the insulation tests, the relay should be isolated. This is extremely important as discharges eventually tacking place in other parts or components of the board can severely damage the relays or cause damages not immediately evident to the electronic components.

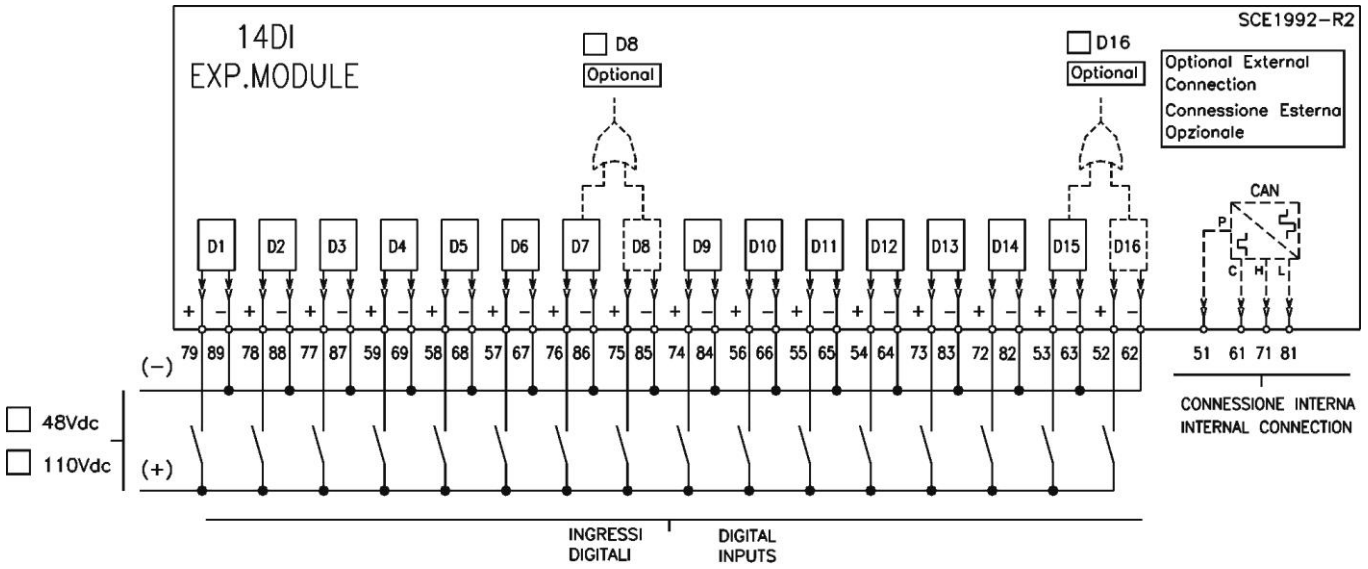
27. Basic Relay - Wiring Diagram



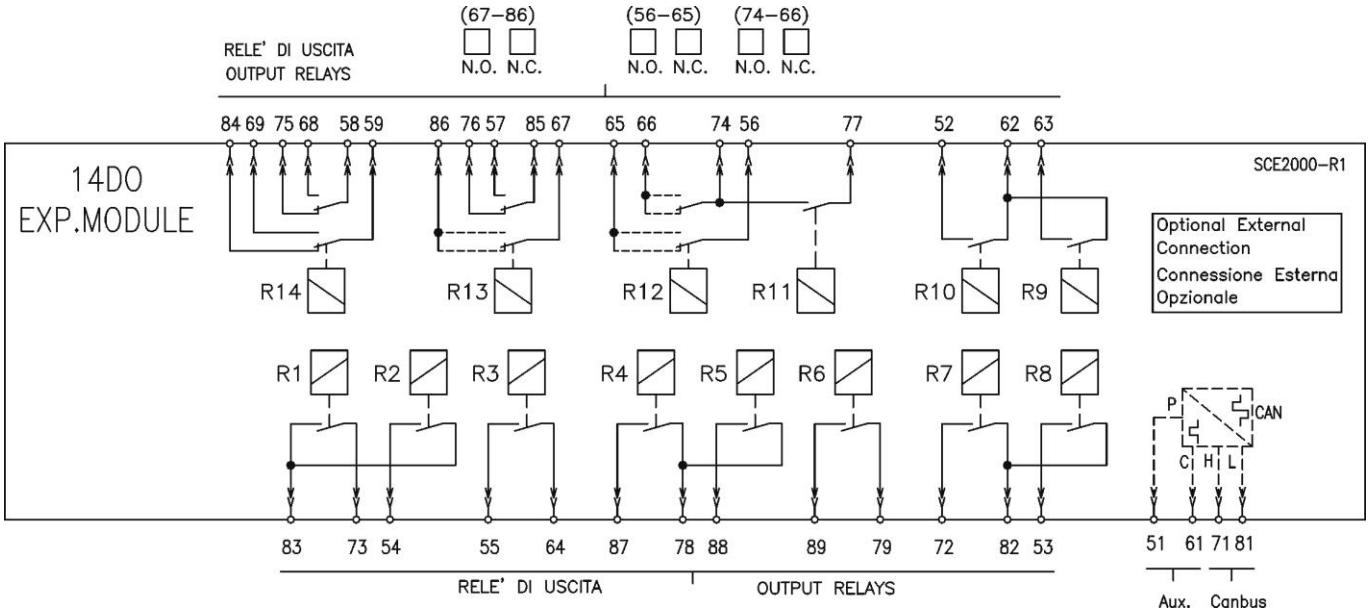
*27.1 – **UX10-4** - Expansion Module - Wiring Diagram (10 Digital Inputs + 4 Output Relays)*



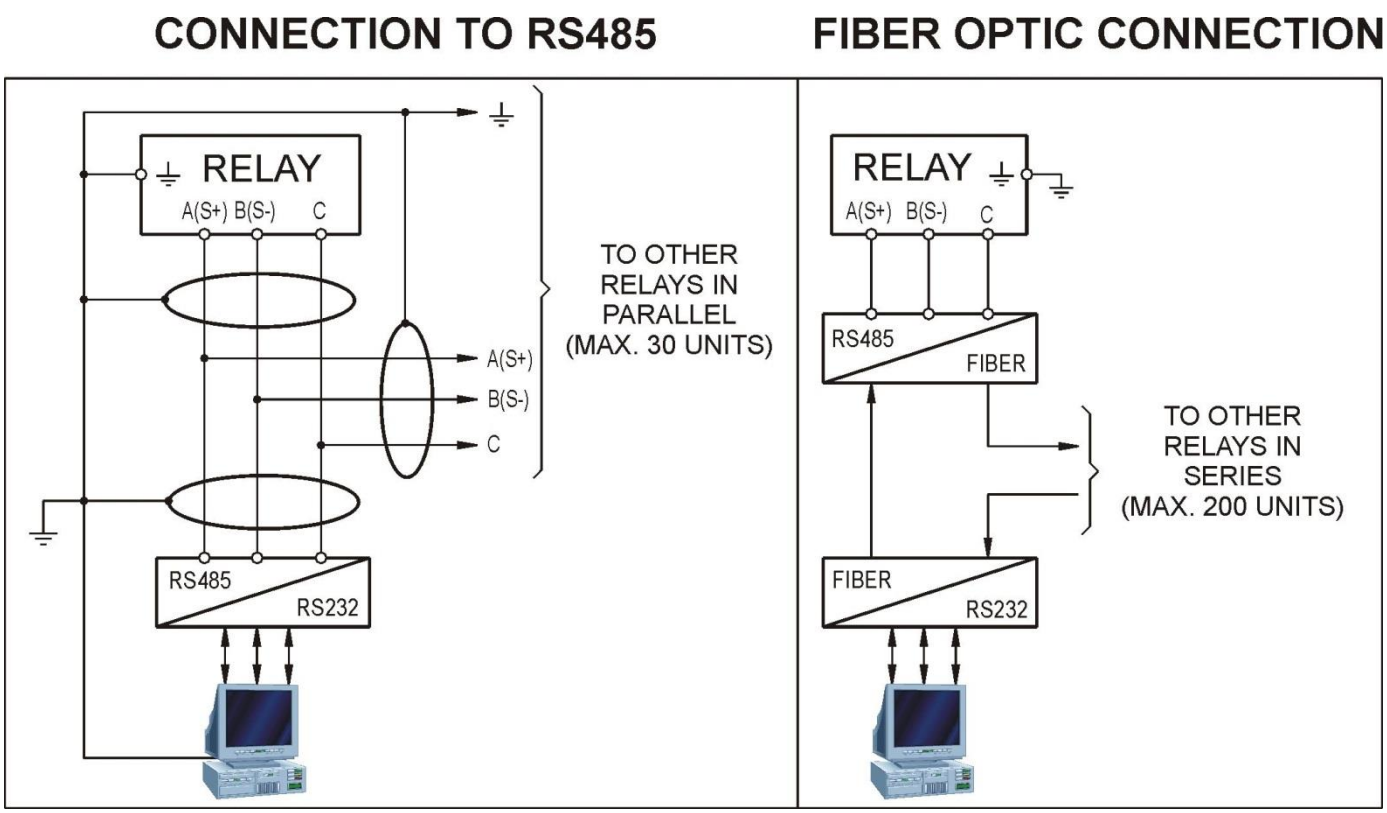
*27.2 – **14DI** - Expansion Module - Wiring Diagram (14 Digital Inputs)*



*27.3 – **14DO** - Expansion Module - Wiring Diagram (14 Output Relays)*



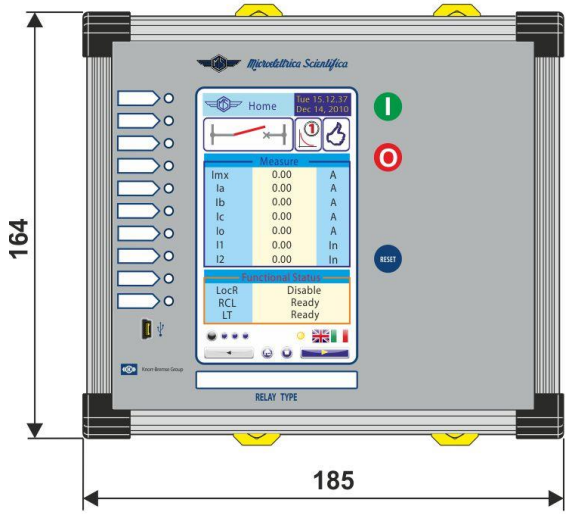
28. Wiring the Serial Communication Bus



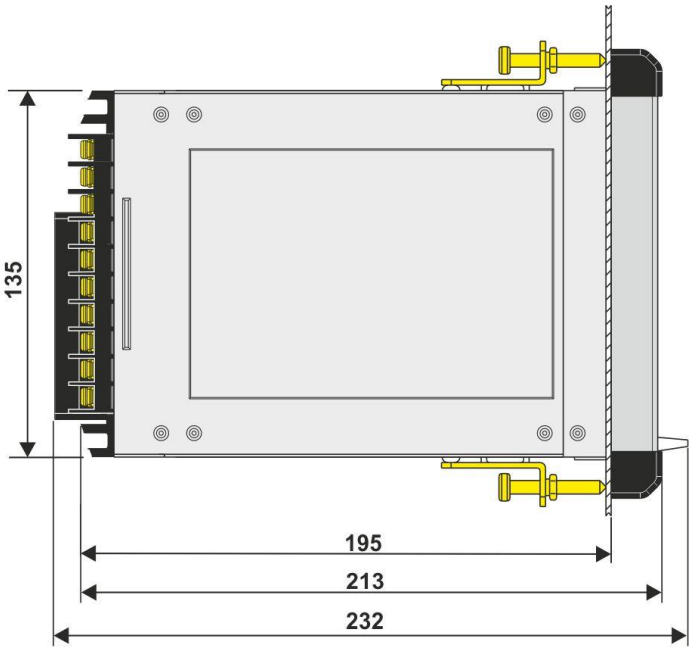
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCom2) for Windows 9x/2000/XP (or later) is available.
Please refer to the MSCom2 instruction manual for more information.
Maximum length of the serial bus can be up to 200m. For longer distance and for connection of up , to 250 Relays, optical interconnection is recommend (please ask Microelettrica for accessories).

29. Overall Dimensions

Flush mounting protection degree: IP44 (54 on request).



PANEL CUT-OUT 165x137 (LxH)



29. Electrical Characteristics

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

Characteristics	
❑ Accuracy at reference value of influencing factors	1% In – 0.1%On for measure 2% + to (to=20÷30ms @ 2xIs) for times
❑ Rated Current	In = 1 or 5A - On = 1 or 5A
❑ Current overload	80 In for 1 sec; 4 In continuous
❑ Burden on current inputs	Phase : 0.01VA at In = 1A; 0.2VA at In = 5A Neutral : 0.01VA at In = 1A ; 0.2VA at In = 5A
❑ Rated Voltage	Un = (100 ÷125)Vac
❑ Voltage Overload	2Un permanent
❑ Burden on voltage inputs	0,1VA at Un
❑ 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 Parameters	
❑ Rear serial port	RS485 – 9600 to 38400 bps – 8,n,1 – Modbus RTU – IEC60870-5-103
❑ Front serial port	RS232 – 9600 to 57600 bps – 8,n,1 – Modbus RTU

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