MULTIFUNCTION MANAGER AND MOTOR PROTECTION RELAY

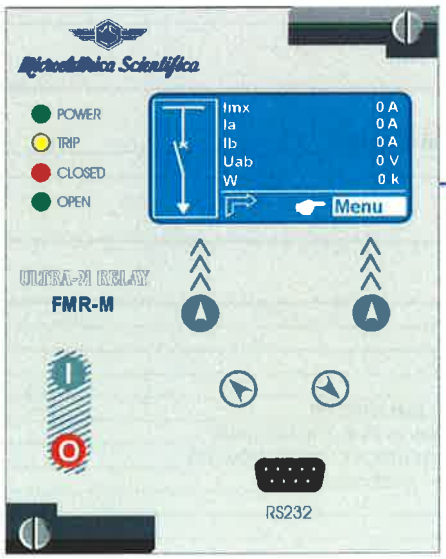
TYPE

UFM-M

(Multiple I/O Boards)

ULTRA Line

OPERATION MANUAL



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1. General Utilization and Commissioning Directions

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

1.1 - Storage and Transportation

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

1.2 - Installation

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

1.3 - Electrical Connection

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

1.4 - Measuring Inputs and Power Supply

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

1.5 - Outputs Loading

Must be compatible with their declared performance.

1.6 - Protection Earthing

When earthing is required, carefully check its effectiveness.

1.7 - Setting and Calibration

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

1.8 - Safety Protection

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

1.9 - Handling

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

1.10 - Maintenance

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

1.11 - 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 – Main Relay

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

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

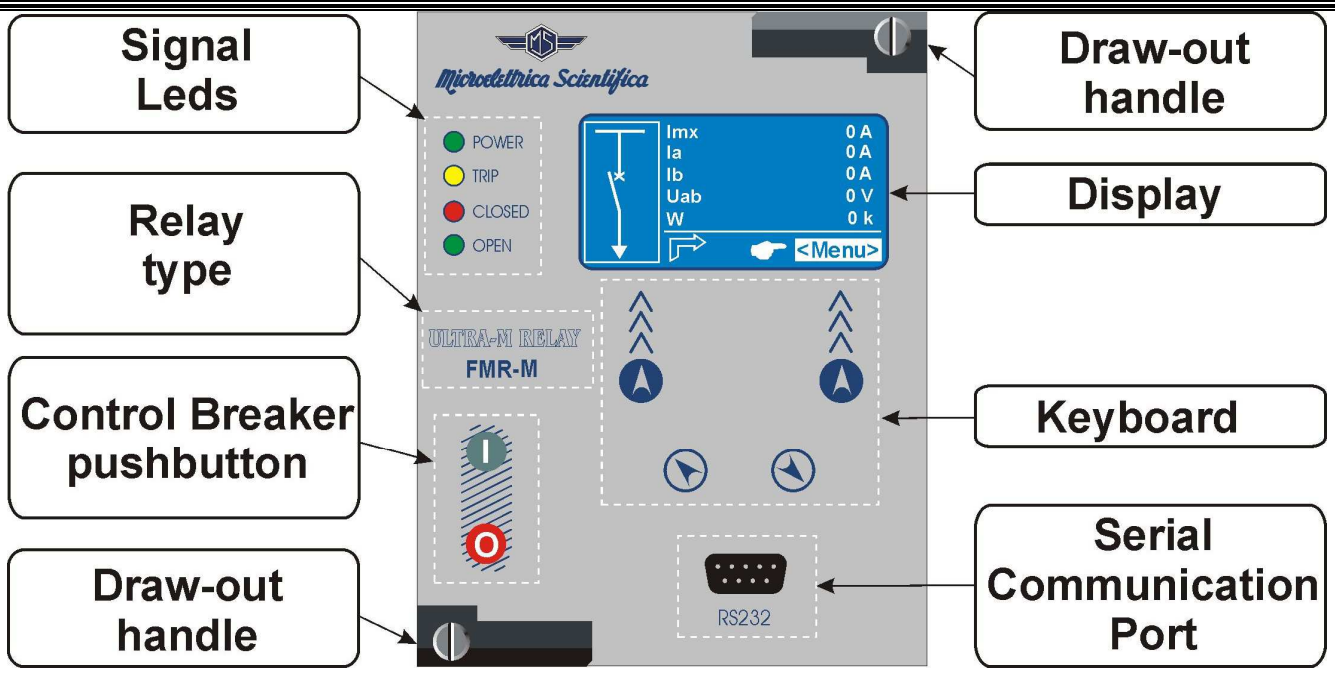
Type 2) - { 80V(-20%) / 220V(+15%) a.c. ; 90V(-20%) / 250V(+20%) d.c.

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

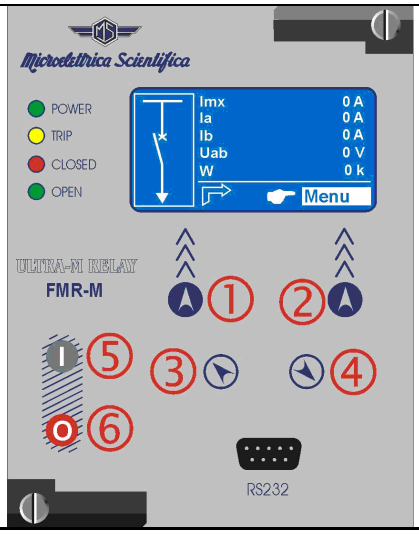
2.2 - Power Supply – Signalization Module (PSU) (Signalization module)

90 ÷ 125 (±20%) Vd.c.

3. Front Panel



4. Keyboard and Display

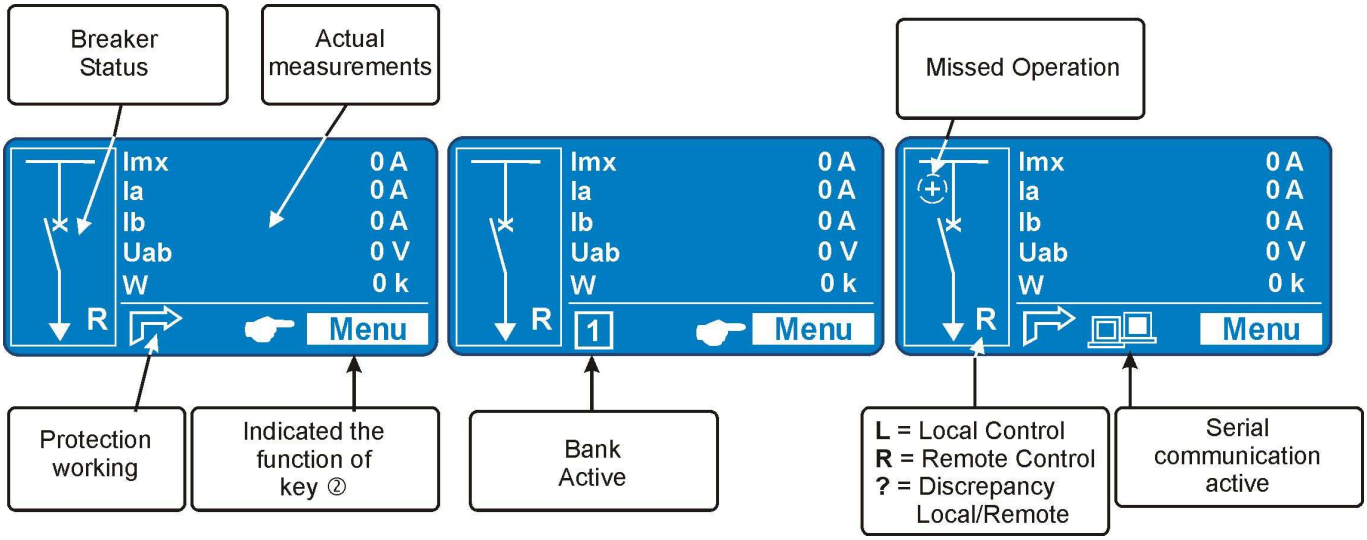


Navigation menu	By these buttons the options showed in correspondence on the display are selected.
Increase	These buttons are used to scroll the items of the different menus (Local Control, Measurements, Energy metering etc).
Decrease	
Open	these buttons (when enabled) operate Circuit Breaker Open/Close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

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

4.1 - Display

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

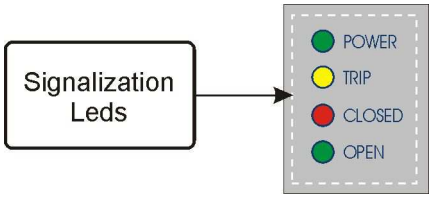


5. Icons of Display

	**Cmd**	Local Commands
	**Measure**	Actual Measurements
	**Energy**	Energy Measurements
	**LTrip**	Trips Recorded
	**Cnt**	Statistical Counters
	**RCE**	Recorder Chronological Events
	**Setting**	Function Settings
	**Sys**	System Parameters
	**TimeDate**	Time And Date
	**Healthy**	Diagnostic Information
	**Info**	Info Device

6. Signalization on Main Relay

Four signal leds are provided:



Green Led	POWER	❑ Illuminated ❑ Flashing	- Relay working properly. - Internal Relay Fault
Yellow Led	TRIP	❑ Off ❑ Illuminated ❑ Flashing	- No Trip - Trip occurred - Function Timing
		Reset from Illuminated status is manual (see § 6.1)	
Red Led	CLOSED	❑ Off ❑ Illuminated	- C/B Open - C/B Close
Green Led	OPEN	❑ Off ❑ Illuminated	- C/B Close - C/B Open

Both Flashing

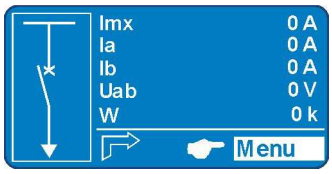
Operation of Trip Circuit Supervision element.

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

6.1 - Leds Manual Reset

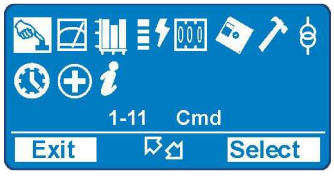
For Leds' manual reset operate as follows:

1



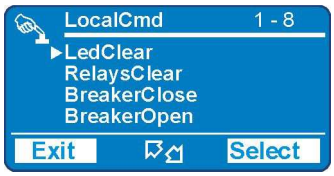
- Press "***Menu***" for access to the main menu with icons.

2



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

3



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

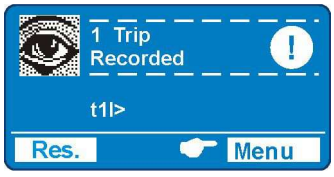
4

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

6.2 – Display of the last trip

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

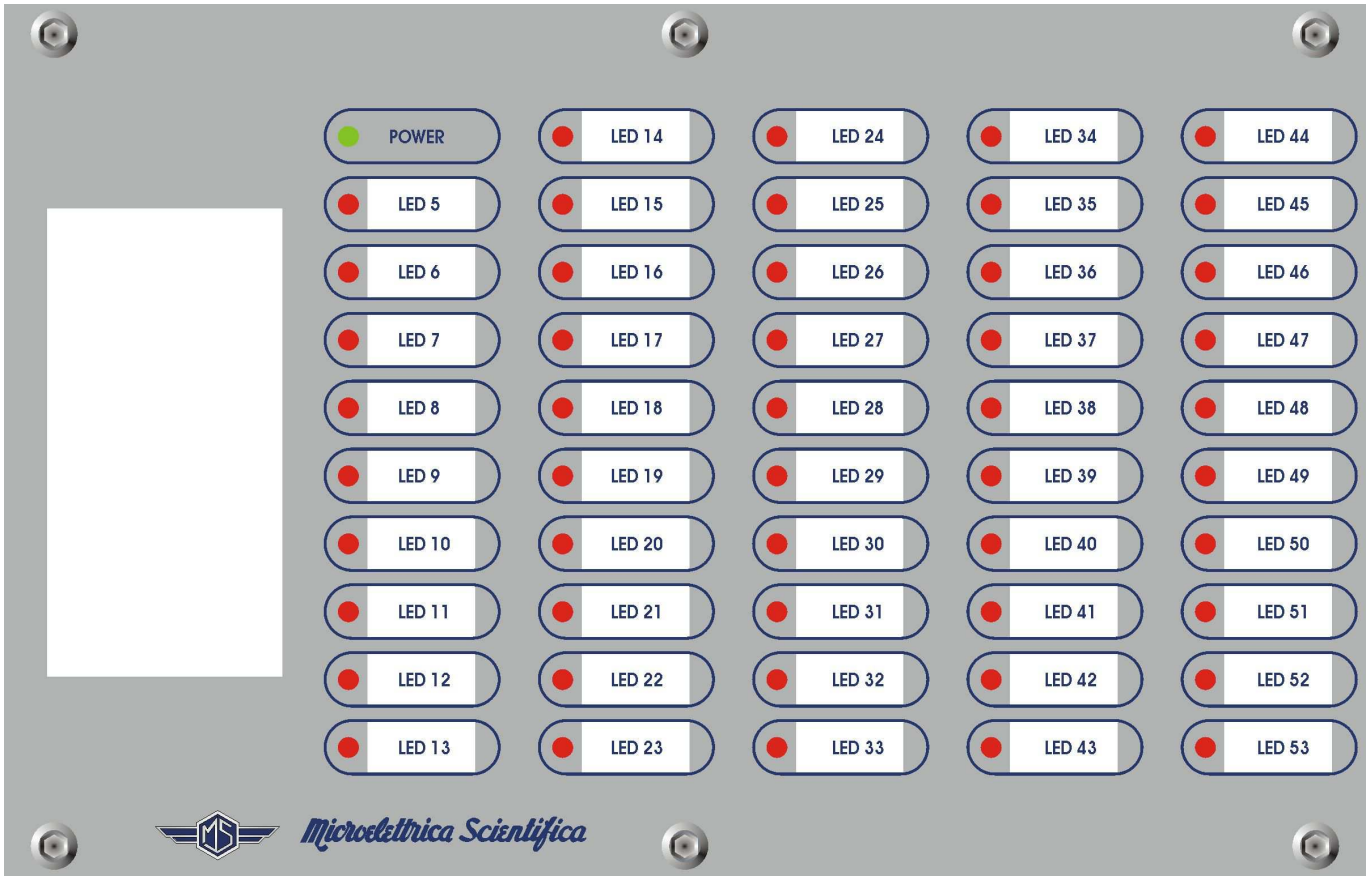
1



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

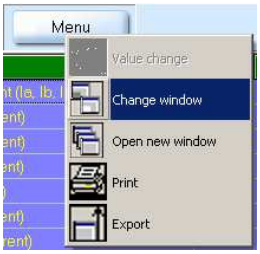
6. Signalization Module

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).



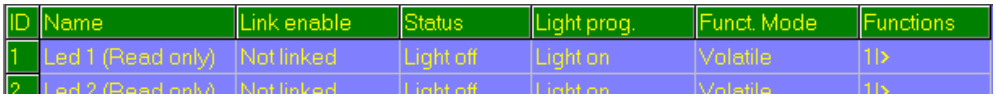
For Leds’ programming (only via MSCom2) operate as follows:

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



- Select “Led Setting”

The window for led configuration will show:



ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1 (Read only)	Not linked	Light off	Light on	Volatile	1|>
2	Led 2 (Read only)	Not linked	Light off	Light on	Volatile	1|>

Name

Led name – for leds position see picture

Link enable

Linked	=	Enable to operate
No Linked	=	Disable

Status

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

Light Prog.

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

Funct. Mode

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

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.

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*
	MotON		*Motor staus – ON*
	LR	*Start*	*Locked Rotor*
	tLR	*Trip*	*Locked Rotor*
	LimStNum		*Limitation of the number of startings*
	StSeqSucc		*Start Sequence Succesful*
	Itr		*Switch-over (transition) current*

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
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 - 14DI*
2.D1 2.D1Not --- 2.D15 2.D15Not		*Digital input on Expansion Board 2 - 14DI*
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 - 14DO-F*

Example: Change settings for "Led5"

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

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

Led 5 = are provided in signalization module

to

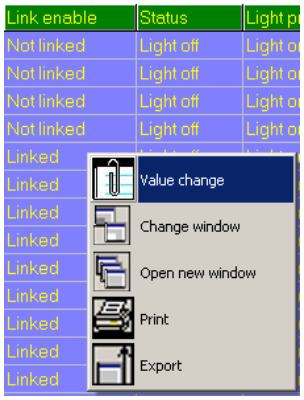
Led 53 =

Main Windows:

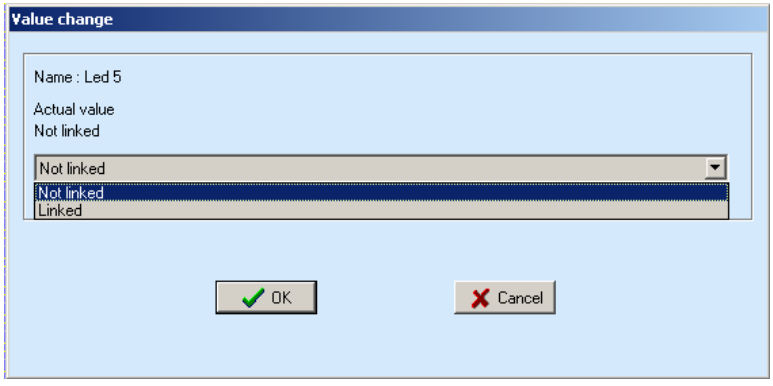
ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1I> (0)
2	Led 2 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1I> (0)
3	Led 3 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)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

"Enable"

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

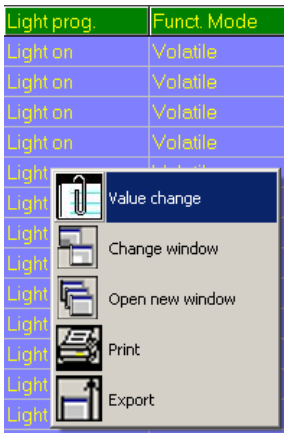


Select "**Linked**" from combo box and press "OK" (if Password is request, see § Password):

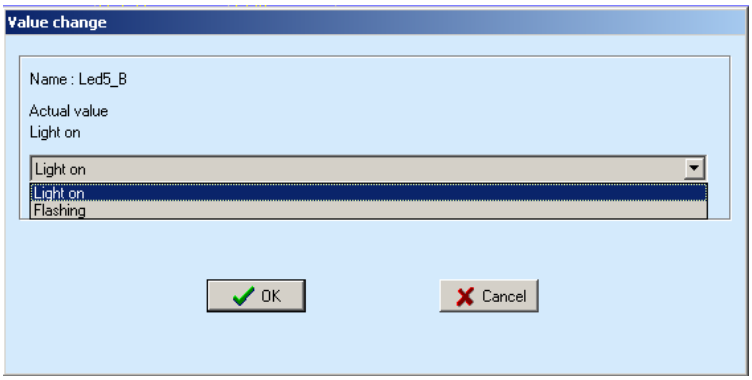


"Flashing"

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

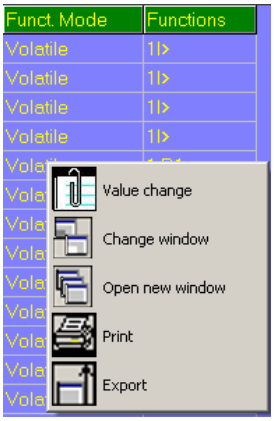


Select "**Flashing**" from combo box and press "OK" (if Password is request, see § Password):

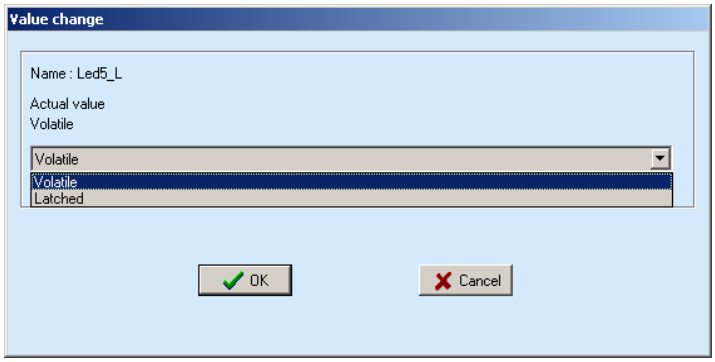


"Latched"

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

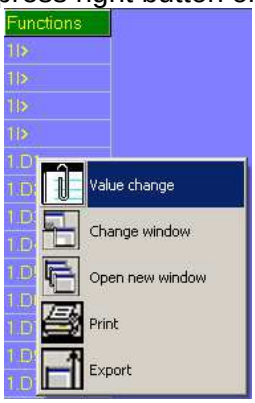


Select "**Latched**" from combo box and press "OK" (if Password is request, see § Password):

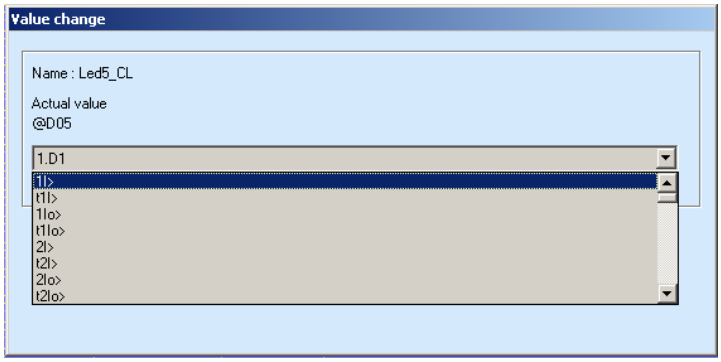


"Functions"

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):



6. 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

Name

Internal progressive name

User Descr.

Custom identification label for user variable

Linked functions

Selection functions

OpLogic

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

Timer

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

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”

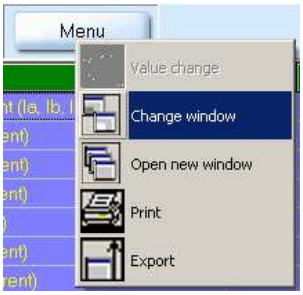
Logical status

“User Variable” Logical status

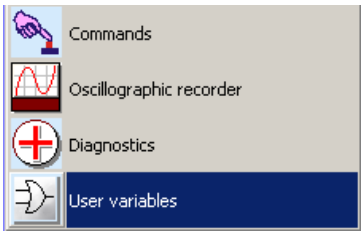
Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"

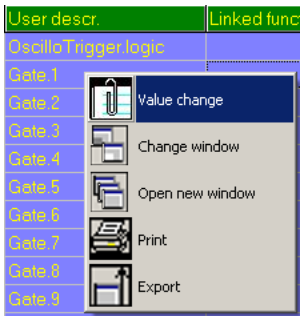


Setting for "**UserVar<0>**" : "**Current Trip**", "**1I>,2I>,3I>**", "**OR**", "**1**", "**Monostable**".

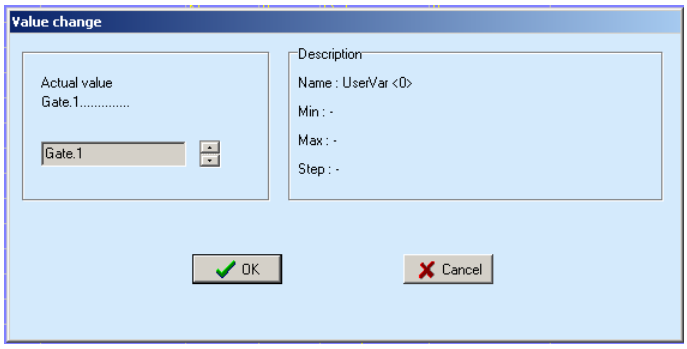
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	User Trigger Oscillo		None	0	Delay	0
2	UserVar <0>	Current trip	1I>,2I>,3I>,	OR	1	Monostable	0

"User description" (User descr.)

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



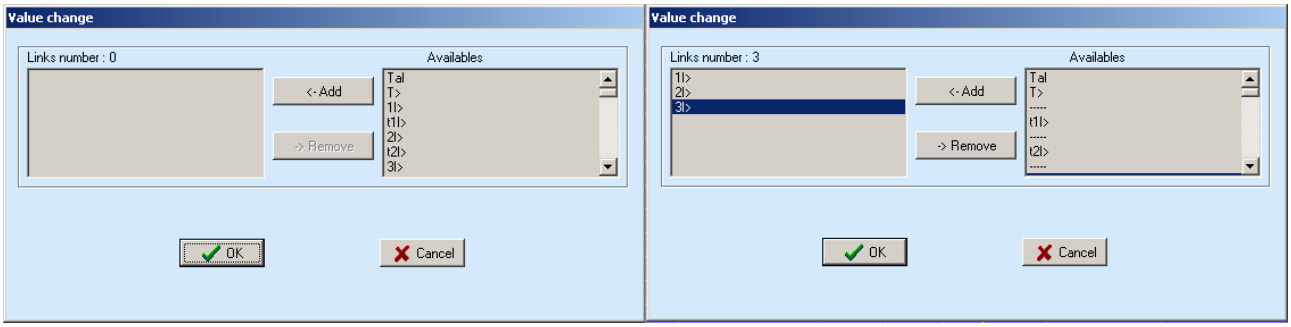
Insert "**Current Trip**" into box and press "OK":



"Linked Functions"

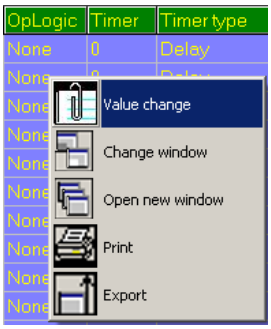
Select "**Linked Functions**" related to "UserVar<0>" and press right button on mouse, select "Value change":

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

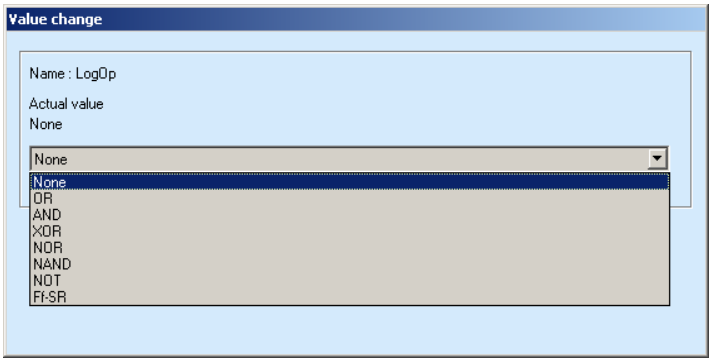


"Operation Logic" (Oplogic)

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



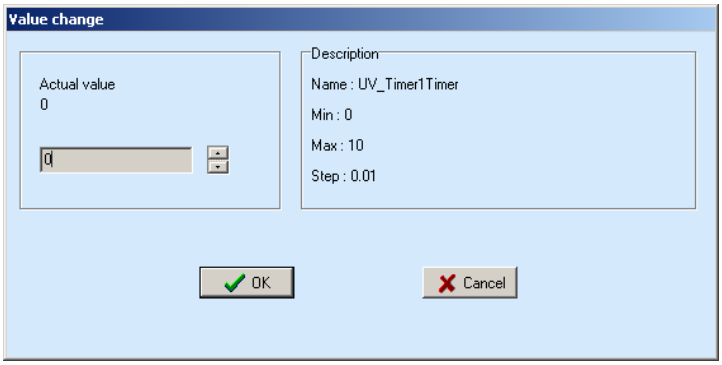
Insert "**OR**" into box and press "OK":



"Timer"

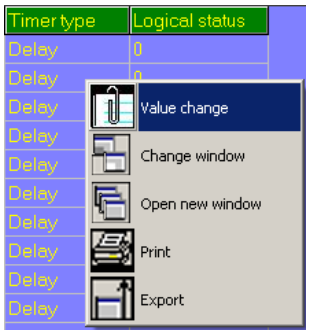
Select "**Timer**" related to "UserVar<0>" and press right button on mouse, select "Value change":

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

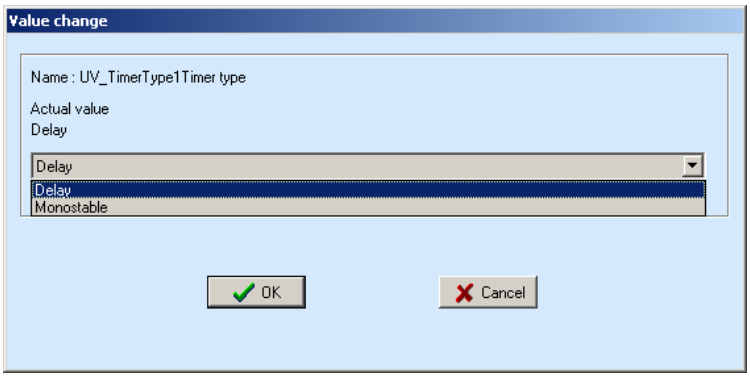


"Timer type"

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



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



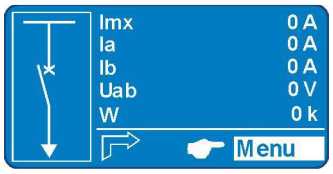
7. Cmd (Local Commands)

"***LOCAL 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
→ **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 (see § Oscillo)	Yes

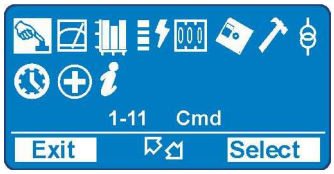
To operate one command by the Front Face Keyboard, proceed as follows (Led Reset in the present example).

1



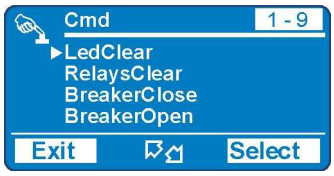
- Press "***Menu***" for access to the main menu with icons.

2



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

3



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

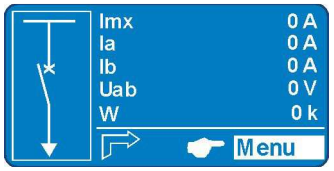
4

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

8. Measure

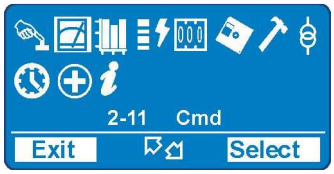
Real time values as measured during the normal operation.

1



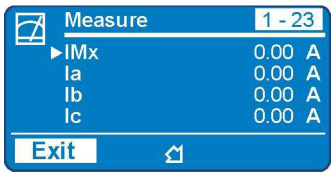
- Press "***Menu***" for access to the main menu with icons.

2



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

3



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

	Name	Range	Unit	*IEC 61850 protocol*	Description	Unit description
→	**Imx**	(0 ÷ 9999)	**A**		Largest phase current (Ia, Ib, Ic).	
→	**Ia**	(0 ÷ 9999)	**A**	*MMXU-MX-A-phsA*	Phase A current	(R.M.S. ampere)
→	**Ib**	(0 ÷ 9999)	**A**	*MMXU-MX-A-phsB*	Phase B current	(R.M.S. ampere)
→	**Ic**	(0 ÷ 9999)	**A**	*MMXU-MX-A-phsC*	Phase C current	(R.M.S. ampere)
→	**Io**	(0 ÷ 9999)	**A**	*MMXU-MX-A-neut*	Zero Sequence Current	(fundamental frequency value 3Io)
→	**I1**	(0.00 ÷ 99.99)	**In**	*MSQI-MX-SeqA-C1*	Positive sequence current	
→	**I2**	(0.00 ÷ 99.99)	**In**	*MSQI-MX-SeqA-C2*	Negative sequence current	
→	**Frq**	(0.00 ÷ 99.99)	**Hz**	*MMXU-MX-Hz*	Frequency	
→	**Uan**	(0 ÷ 999999)	**V**	*MMXU-MX-PhV-phsA*	Phase Voltage "A-N"	(R.M.S. value)
→	**Ubn**	(0 ÷ 999999)	**V**	*MMXU-MX-PhV-phsB*	Phase Voltage "B-N"	(R.M.S. value)
→	**Ucn**	(0 ÷ 999999)	**V**	*MMXU-MX-PhV-phsC*	Phase Voltage "C-N"	(R.M.S. value)
→	**Uab**	(0 ÷ 999999)	**V**	*MMXU-MX-PPV-phsAB*	Phase-to-phase Voltage "A-B"	(R.M.S. value)
→	**Ubc**	(0 ÷ 999999)	**V**	*MMXU-MX-PPV-phsBC*	Phase-to-phase Voltage "B-C"	(R.M.S. value)
→	**Uca**	(0 ÷ 999999)	**V**	*MMXU-MX-PPV-phsCA*	Phase-to-phase Voltage "C-A"	(R.M.S. value)
→	**Uo**	(0 ÷ 999999)	**V**	*MMXU-MX-PhV-neut*	Zero Sequence Voltage	(fundamental frequency value 3Vo)
→	**V1**	(0.00 ÷ 99.99)	**Vn**	*MSQI-MX-SeqV-C1*	Positive Sequence Voltage	
→	**V2**	(0.00 ÷ 99.99)	**Vn**	*MSQI-MX-SeqV-C2*	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 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**k**	*MMXU-MX-TotW*	Three Phase Active Power	(kW)
→	**VAr**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**k**	*MMXU-MX-TotVAr*	Three Phase Reactive Power	(kVAr)
→	**VA**	(0.00 ÷ 99.99 ÷ 999.9 ÷ 9999999)	**k**	*MMXU-MX-TotVA*	Three Phase Apparent Power	(kVA)
→	**Cos**	(0.000 ÷ 1.000)	**-**	*MMXU-MX-TotPF*	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.	
→	**tst**	(0 ÷ 9999.9)	**s**		Motor Starting time	
→	**Ist**	(0 ÷ 9999)	**A**		Maximum current motor starting	

9. Energy

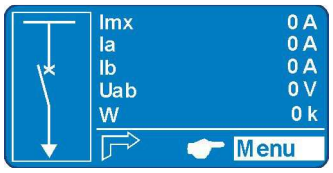
Real time energy measurements

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

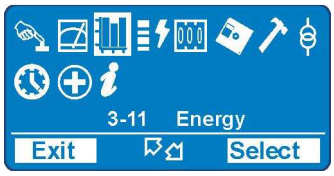
When the measurement exceed "9999999" the counters restart from "0".

1



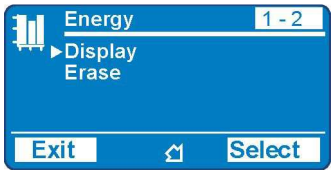
- Press "***Menu***" for access to the main menu with icons.

2



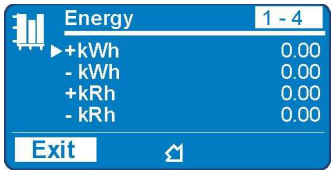
- Select "***Energy***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



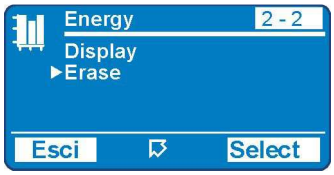
- Select "***Display***" *with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

4



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

5



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

6

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

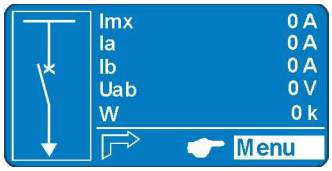
10. LTrip (Trips Recorded)

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

Display	→	Reading of recorded Trips.

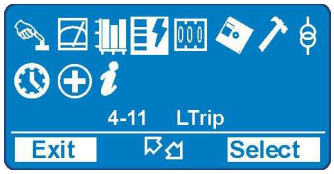
Erase	→	Clear all Trip recorded.

1



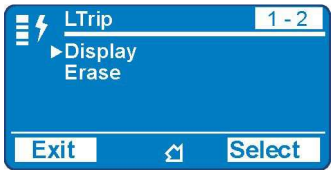
- Press "***Menu***" for access to the main menu with icons.

2



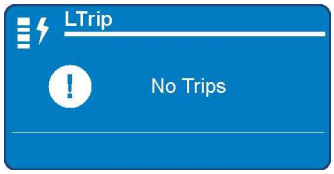
- Select "***TripRec.***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



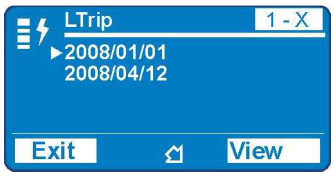
- Select "***Display***" *with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" go to "8"

4



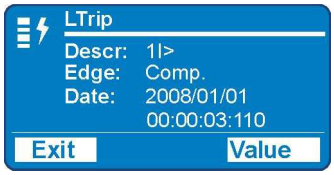
- If no trip is recorded the display shows "***! No Trips***".

5



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

6

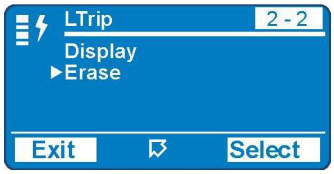


- Will be shown:
  "***Descr***" the function that caused the event (Example: t1I> = Trip)
  "***Edge***" if the function was tripped (Rise) or reset (Fall)
  "***Date***", date of trip, year/month/day, hour:minutes:seconds:milliseconds
- Press "***Value***", for reading the value of input quantities on tripping.

7

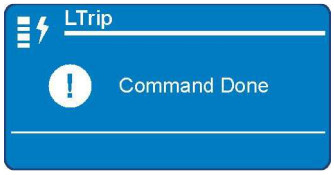
- Scroll with pushbuttons "***Increase***" or "***Decrease***" the available measurements.
- Select "***Exit***" to go back to "5" for another selection, or "2" go back to the main menu.

8



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

9



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

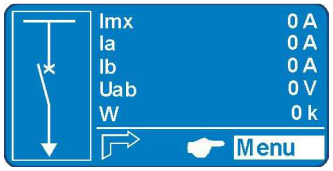
→ **Date**	*Date* : Year/Month/Day *Time* : hours/minutes/second/hundredths of seconds	
→ **Cause**	Indication of the protection function which caused the relay tripping.	
→ **Ia**	Phase A current	**A**
→ **Ib**	Phase B current	**A**
→ **Ic**	Phase C current	**A**
→ **Io**	Zero Sequence Current	**A**
→ **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**
→ **tst**	Motor Starting time	**s**
→ **Ist**	Maximum current motor starting	**A**

11. Cnt (Statistical Counters)

Counters of the number of operations for each of the relay functions.
By the interface program “MSCom 2” it is possible to individually reset the counters and set an initial starting number.

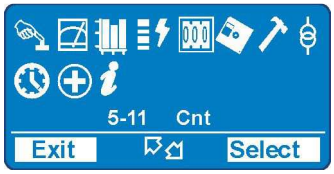
Display				
→ T>	0	Operations counters	Thermal Image
→ 1I>	0	Operations counters	First overcurrent element
→ 2I>	0	Operations counters	Second overcurrent element
→ 3I>	0	Operations counters	Third overcurrent element
→ 1Io>	0	Operations counters	First Earth Fault element
→ 2Io>	0	Operations counters	Second 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
→ IRF	0	Operations counters	Internal Relay Fault
→ U2>	0	Operations counters	Negative Sequence overvoltage element
→ U1<	0	Operations counters	Positive Sequence undervoltage element
→ TCS	0	Operations counters	Trip Circuit Supervision
→ BrkF	0	Operations counters	Breaker failure to open
→ Wi	0	Operations counters	Circuit Breaker maintenance alarm
→ motSt	0	Operations counters	Motor start
→ mStOV	0	Operations counters	Motor start overall counter
→ LockR	0	Operations counters	Locked Rotor
→ StNo	0	Operations counters	Start number
→ StSeq	0	Operations counters	Start sequence
→ 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 "***Menu***" for access to the main menu with icons.

2

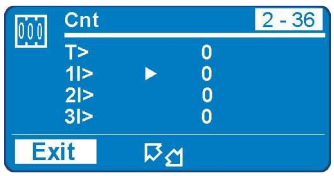


- Press "***Counter***" for access.

3

- Press "***Display***" for access.

4



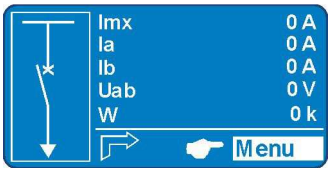
- Display of the number of operations of each individual function.
- With pushbuttons "***Increase***" or "***Decrease***" scroll the parameters
- Press "***Exit***" go back to "*3*".

12. RCE (Recording Chronological Events)

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

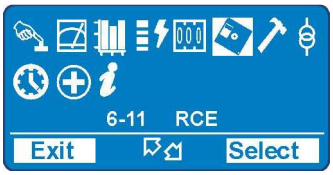
Display	→	Reading events recorded.
Erase	→	Clear all events recorded.

1



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

2

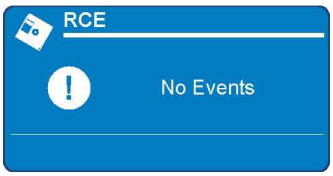


- Select "***Events***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3

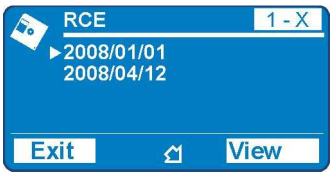
- Select "***Display***" *with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" go to "7"

4



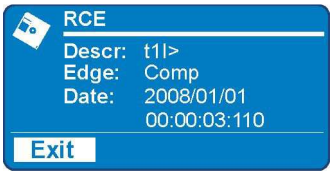
- If no event is recorded the display shows message "***! No Events***".

5



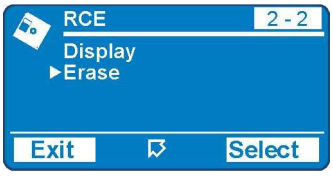
- If any event was recorded, select "***View***" to display the chronological list of the records.
- By the keys "***Increase***" or "***Decrease***" select the date of the record to be checked.

6



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

7



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

8

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

12.1 – 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	
1f<	1f<	*Start*	Rise		*First underfrequency element F81*
	t1f<	*Trip*	Rise	Fall	
2f<	2f<	*Start*	Rise		*Second underfrequency element F81*
	t2f<	*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		
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	
StSeq	ITR	*Trip*	Rise		*Start sequence*
	StartSeq.Success	*Trip*	Rise		*Start sequence success*
StNo	StNo	*Trip*	Rise	Fall	*Limitation of start number*

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*
	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*

13. System (System parameters)

Setting of system parameters.

CT&PTs	Phase CT	**Prim.**	→	1000	A	(1 ÷9999)	step	1	A	
		Sec.	→	1	A	(1 / 5)				(1)
	PT (Ph-Ph)	**Prim.**	→	10.00	kV	(0.10 ÷500.00)	step	0.01	kV	
		Sec.	→	100	V	(50 ÷150)	step	1	V	(2)(3)
	Neut. CT	**Prim.**	→	1000	A	(1÷9999)		1	A	
		Sec.	→	1	A	(1 / 5)				(1)

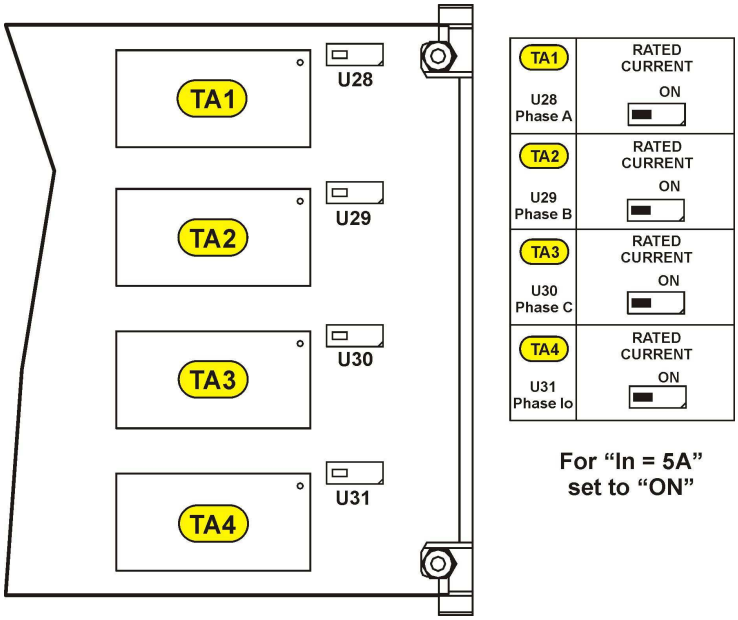
Nom.Val.	→	**Fn**	50	Hz	(50 / 60)	
(Nominal Values)	→	**In**	500	A	(1÷9999)	1 A
	→	**Un**	10.00	kV	(0.10 ÷500.00)	0.01 kV

Sys.Options	→	**OpMod**	IncomLine	[IncomLine / MeasBOX / Transf / Bus-Tie / IncMotBrk / IncMotCnt]

Setup Group	→	**Group**	1	(1 / 2)

- **Fn** : Nominal Frequency
- **In** : Nominal Current
- **Un** : Nominal Voltage
- **OpMod** : Operation mode:
  - *IncomLine* = Incoming Line
  - *MeasBOX* = Measure BOX
  - *Transf* = Transformer
  - *Bus-Tie* = Bus-Tie
  - *IncMotBrk* = Incoming Motor with Breaker
  - *IncMotCnt* = Incoming Motor with Contactor
- **Group** : Setting group active

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

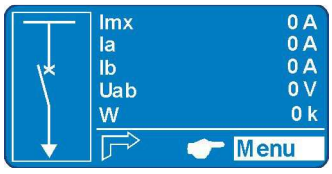


(2) Set the value of the phase-to-phase PT voltage.

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

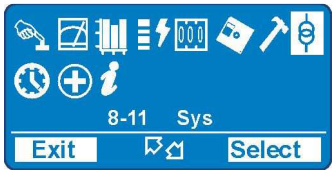
(3) Zero sequence voltage input is to be supplied by three system P.Ts. Y/Open Delta connected; the open delta connected secondary are rated 1/3 of the phase-to-phase secondary voltage (Example: 10000 / 100:√3 / 100:3).

1



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

2

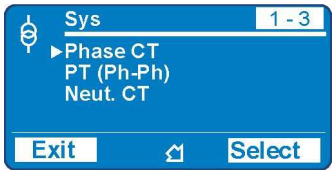


- Select "***System***" *icon with pushbuttons* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3

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

4



- Select "***Phase CT***".
- Press "***Select***" for access.

5

- Select "***Prim.***" to modify the primary value of Phase CT, or press "***Decrease***" and select "***Sec.***" to modify the secondary value of Phase CT.
- Press "***Modify***" to modify the parameter. (if Password is request, see § Password).

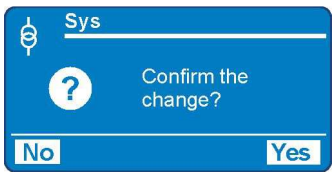
6

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

7

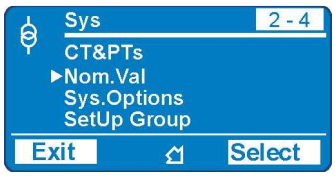
- The value is now set.
- To set a new value return to the point "5".
- Press "***Exit***".

8



- The display show "***Confirm the change?***".
- Choose "***Yes*** " to convalidate the changes.
- Choose "***No*** " to **not** confirm the changes.
- After set confirmation (or non confirmation) the display goes back to point "4".

9



- To modify the input quantities, select with pushbutton "***Decrease***", "***Nom.Val.***".
- Press "***Select***" for access.

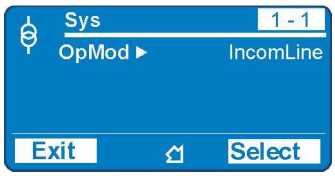
10

- To set the input quantities see points "5-6-7-8" .

11

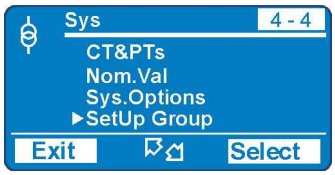
- To modify the operation mode, select with pushbutton "***Decrease***", "***Sys.Options***".
- Press "***Select***" for access.

12



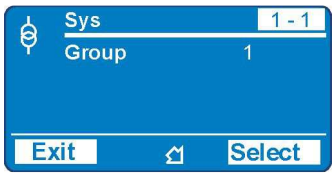
- To set the operation mode press "***Select***" , and see point "5-6-7-8".

13



- To select the Active Bank select and press "***SetUp Group***".

14

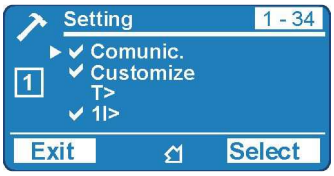


- Press "***Select***" and with pushbuttons "***Increase***" or "***Decrease***" select the Bank to be Active.

14. Settings

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

1



1 Indicates the Setting Bank that is actually being modified.

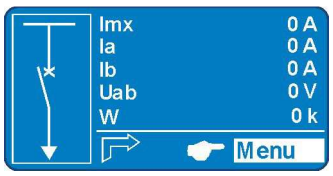
This symbol indicates that the function is enabled; symbol missing indicates that the function is disabled.

→ **Comunic.**	Serial communication parameters	
→ **LCD**	Human Machine Interface	
→ **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	
→ **TCS**	Setting variables for Trip Circuit Supervision	
→ **IRF**	Internal Relay Fault	
→ **MotSt**	Motor Start	
→ **LR**	Locked Rotor	
→ **StNo**	Limitation Start number	
→ **StSeq**	Stating sequence control	
→ **CB Manage**	C/B command Local / Remote setting	
→ **Oscillo**	Setting variables for Oscillographic recording	
→ **BreakerFail**	Setting variables for Breaker Failure detection	
→ **ExtResCfg**	Configuration for external reset input	

14.1 Modifying the setting of variables

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

1

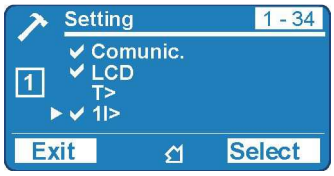


- Press "***Menu***" for access to the main menu with icons.

2

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

3

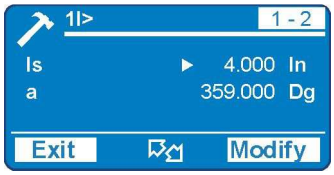


- Select by pushbuttons "***Increase***" or "***Decrease***" the parameter "***1I>***".
- Press "***Select***".

4

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

5



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

6

- The value appear as bold figure.

7

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

8

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

9

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

10

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

14.2. Password

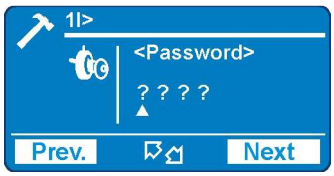
The password is requested any time the user wishes to modify any password protected parameter (example “1I>” menu “Setting”).

The factory default password is “ 1111 “.

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

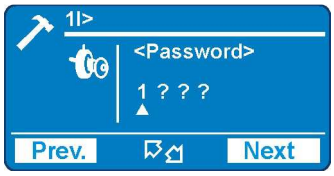
When password is requested, proceed as follows:

1



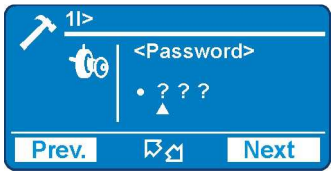
- Use the key “***Increase***” and “***Decrease***” and set the first digit of password.

2



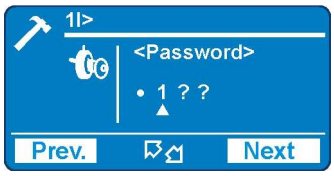
- Press “***Next***” to validate and go to the next digit.

3



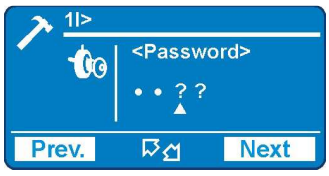
- Use the key “***Increase***” or “***Decrease***” to set second digit.

4



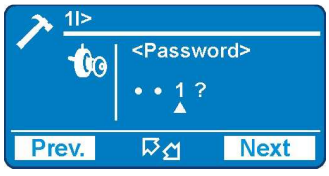
- Press “***Next***” to validate and go to the next digit.

5



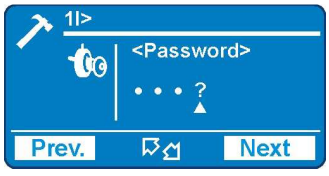
- Use the key “***Increase***” or “***Decrease***” to set the third digit.

6



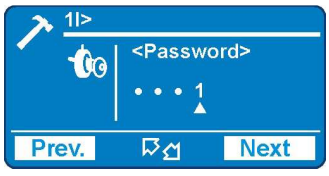
- Press “***Next***” to validate and go to the next digit.

7



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

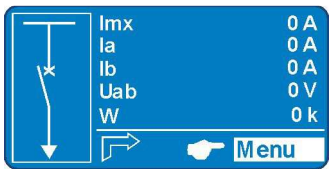
8



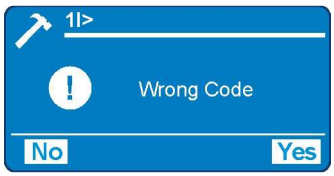
- Press “***Next***” to validate and go to modify the next parameter.

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

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

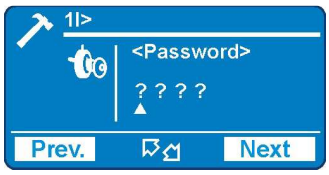


1



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

2



- The display will repeat the initial interrogation

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

Options	→ **BRLoc**	38400	[9600 / 19200 / 38400 / 57600]
	→ **BRRem**	19200	[9600 / 19200 / 38400]
Node Address	→ **Indir.**	1	[1 ÷ 255]

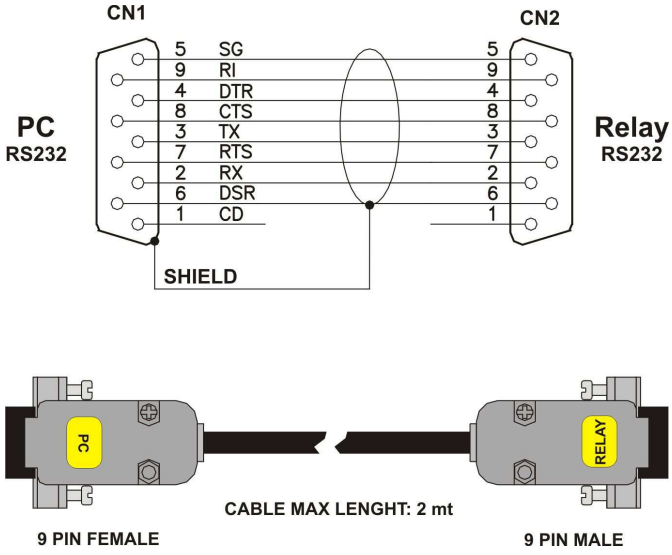
14.3.1 – Description of variables

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

14.3.2 – Front Panel serial communication port (RS232)

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

14.3.3 – Cable for direct connection of Relay to Personal Computer



14.3.4 – Rear communication port (Ethernet with IEC 61850 protocol)

Relay's back Ethernet connection is available for communication with a IEC 61850 Client program, the Ethernet connector is a standard RJ45 and can be connected to a PC with a Ethernet "Crossover" cable, or it can be connected to a switch with a Ethernet "Patch" cable.
The default communication IP address is **192.168.0.121**, but it can be modified by the network configuration software.
The time synchronization is available via SNTP protocol, the request is done to a SNTP server to IP address **192.168.0.20**, as default, but it can be modified by the network configuration software.

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

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

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

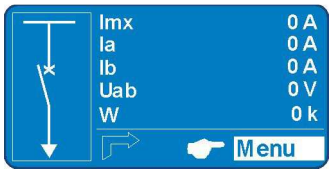
14.4.1 – Description of variables

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

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

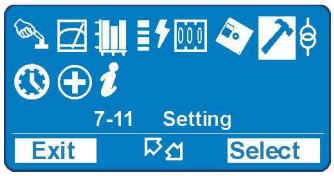
Example: set Local Language.

1



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

2

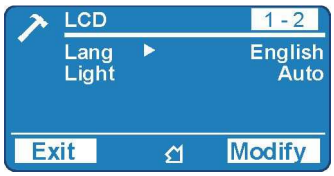


- Select icon "***Setting***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3

- Select "***Group 1***" or "***Group 2***"
- Select "***LCD***"
- Select "***Options***".
- Press "***Select***".

4



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

5

- Press "***Modify***".
- Select "***Loc.Lang***".
- Press "***Write***"
- Press "***Exit***"

6

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

7

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

8

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

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**OPMOD**	I1 I2		[I1 I2 – Imax]			
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

14.5.1 - Description of variables

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

14.5.2 - 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

14.5.2.1 – Operation mode "Imax"

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

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

14.5.2.2 – 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:

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

14.5.2.3 – Trip time of the Thermal Image Element

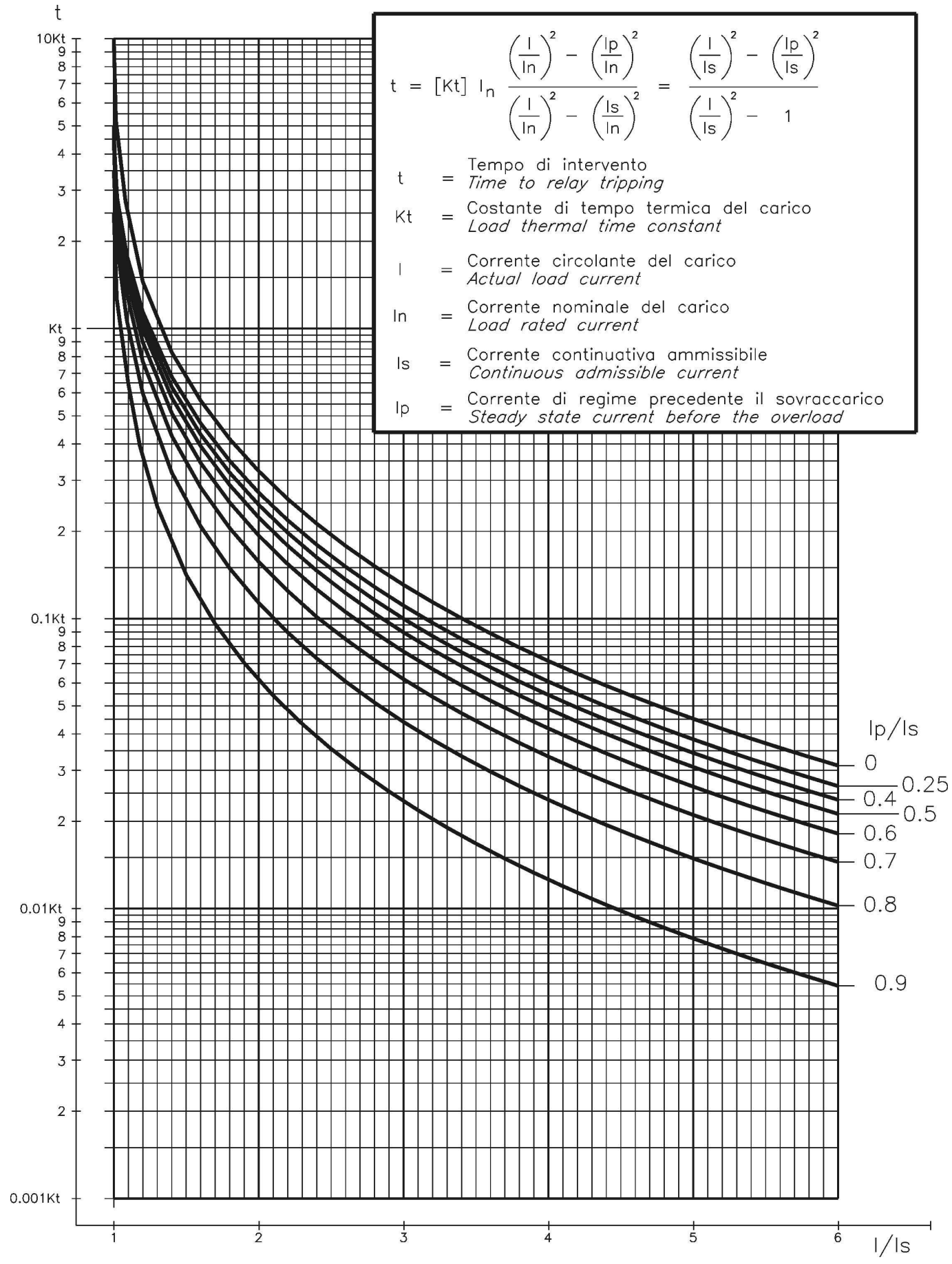
The trip time of the Thermal Image Element is a function of the current "I" flowing into the load and depends on its warming-up Time Constant "Kt", on the previous thermal status "Ip" and on the maximum admissible continuous current "Is" according to the equation:

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

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.

14.5.2.4 – Thermal Image Curves (TU1024 Rev.1)



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

Status	→	**Enab.**	No		[No / Yes]				
Options	→	**f(t)**	Type - D		[D / A / B / C / I / VI / EI / MI / SI]				
	→	**tBI**	Off		[Off / 2tBO]				(1)
	→	**f(a)**	Disable		[Disable / Sup / Dir]				
	→	**f(U)**	Disable		[Disable / Enable]				
Oper. 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	(1)

14.6.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **f(t)** : Operation characteristic (Time/Current curve):
  - (D) = Independent definite time
  - (A) = IEC Inverse Curve type A
  - (B) = IEC Very Inverse Curve type B
  - (C) = IEC Extremely Inverse Curve type C
  - (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
- **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.

14.6.2 - 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:

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

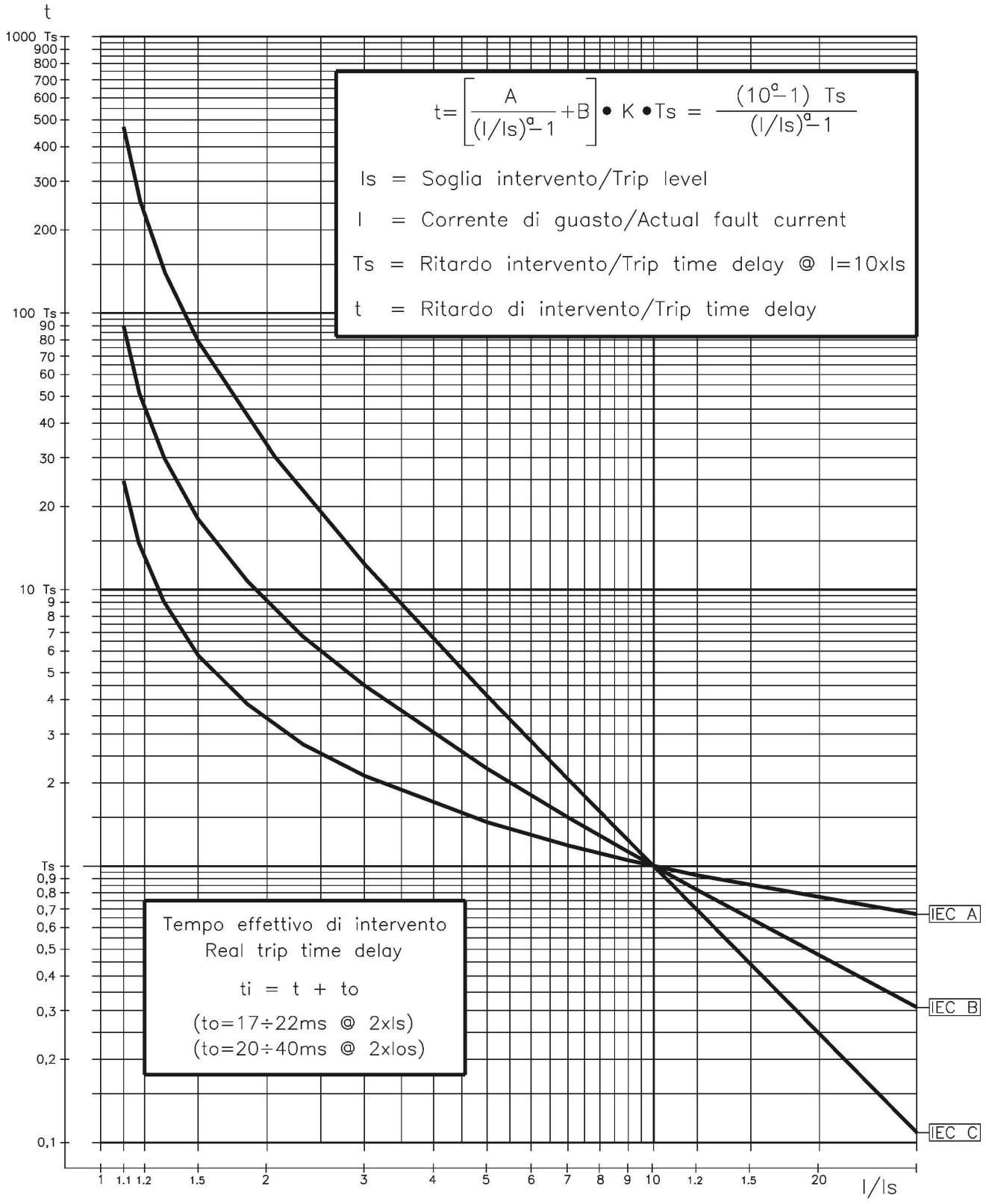
Where $Kt = (10^{a}-1)Ts$ is the time multiplier

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".

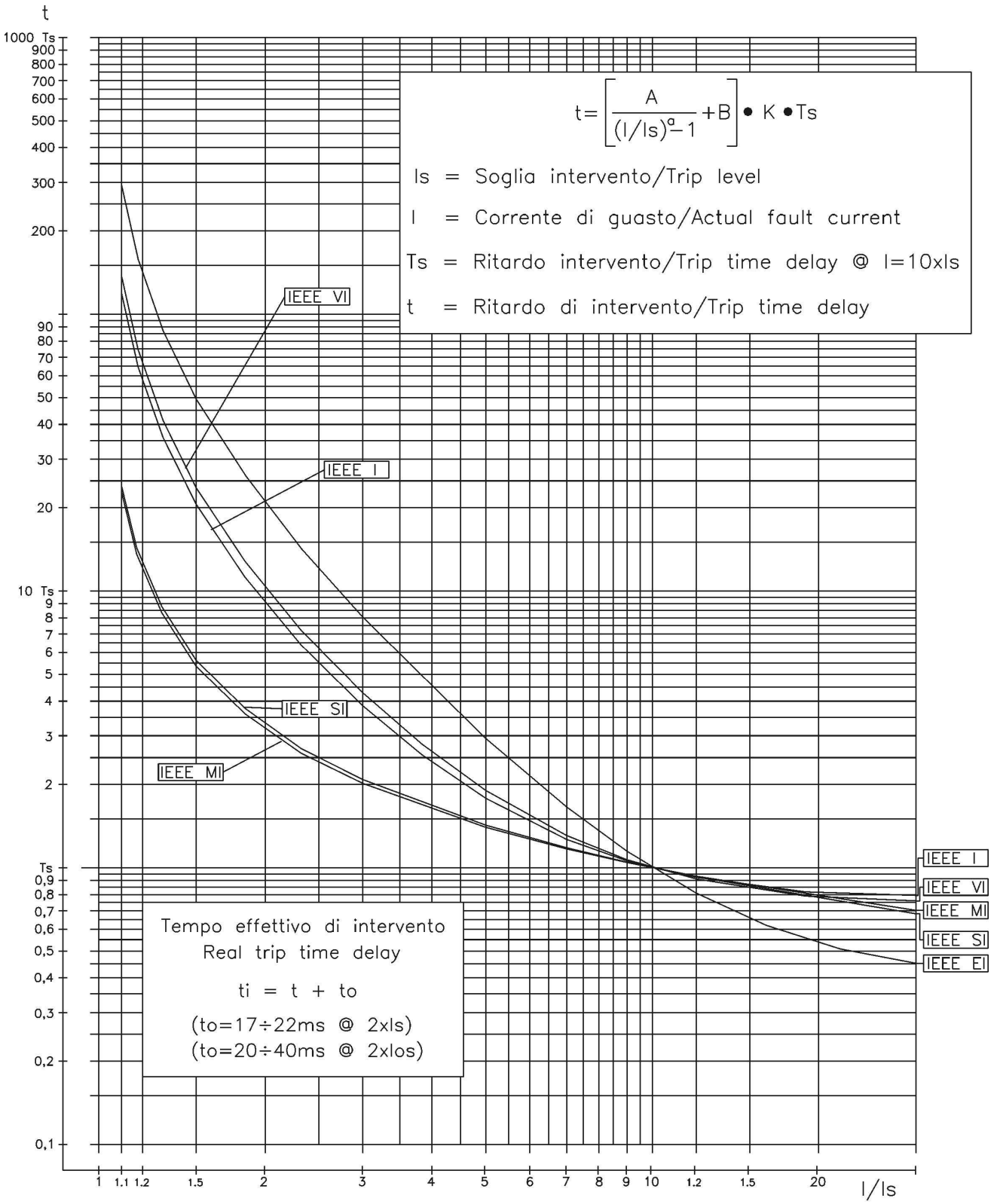
14.6.3 - IEC Curves



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

14.6.4 – 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

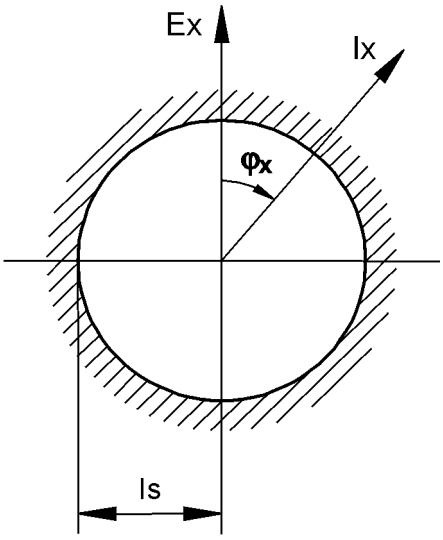
Max. "I" Phase = 40xIn
Max. "I" Neutral = 10xOn

14.6.5 – 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".

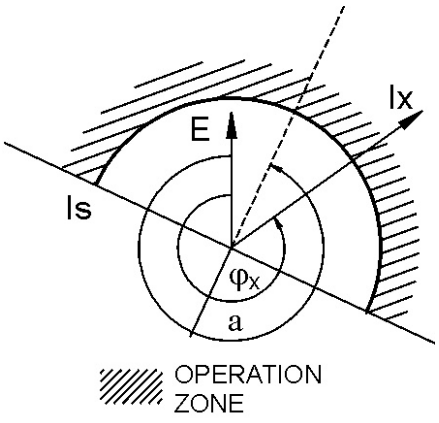
A) Set f(a) = Disab.



Ix>[Is]

The overcurrent element operates independently from the current direction.

B) Set f(a) = Sup.



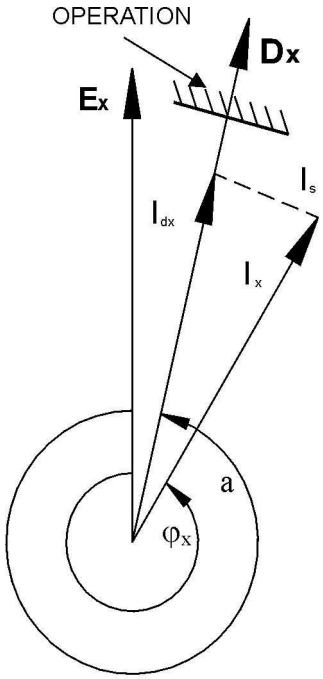
The Overcurrent element only supervises the direction of the current:

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".

$$(a - 90^\circ) < \varphi_x < (a + 90^\circ)$$

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).

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

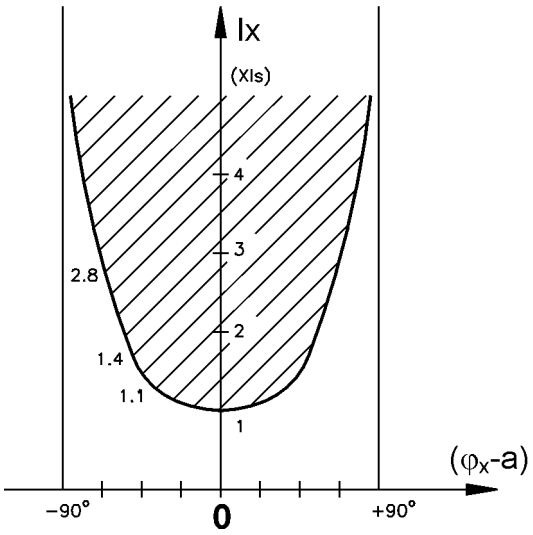
The overcurrent starts to operate when the component "Idx" of the input current in the direction "Dx" (versor displaced of "a°" from the phase-to-neutral voltage "Ex") exceeds the set level "Is".

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

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.

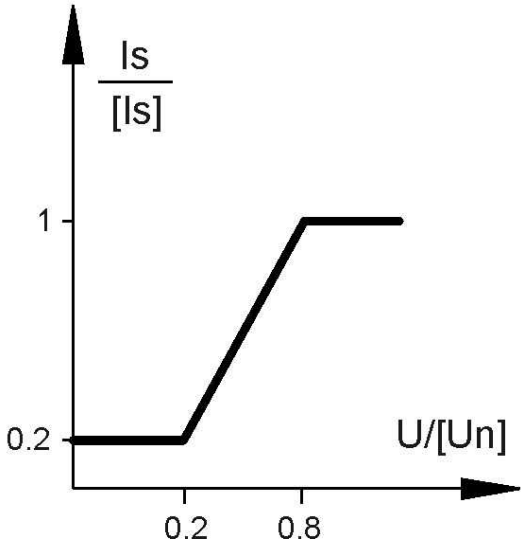


Recommended Reference angles for different applications:

- 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°

14.6.6 – 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] $\frac{Is}{[Is]} = 1$

14.6.7 – 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.

14.6.7.1 – 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.

14.6.7.2 – 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.

14.6.8 - 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.

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

Stats	→	**Enab.**	No		[No / Yes]			
Options	→	**tBl**	Off		[Off / 2tBO]			
	→	**f(a)**	Disable		[Disable / Sup / Dir]			
	→	**2xI**	Disable		[Disable / Enable]			
	→	**f(U)**	Disable		[Disable / Enable]			
Oper. 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			

14.7.1 – Description of variables

- ❑ **Enab.** : Function enabling (No = Disable / Yes = Enable)
- ❑ **tBl** : 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
- ❑ **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.

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

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**tBl**	Off		[Off / 2tBO]			
	→	**f(a)**	Disable		[Disable / Sup / Dir]			
	→	**2xI**	Disable		[Disable / Enable]			
Oper. 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			

14.8.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **tBl** : 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

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

Status	→ **Enab.**	No		[No / Yes]				
Options	→ **f(t)**	Type - D		[D / A / B / C / I / VI / EI / MI / SI]				
	→ **tBI**	Off		[Off / 2tBO]				
	→ **f(a_o)**	Disable		[Disable / Dir]				
Oper. Levels	→ **Is**	0.010	**On**	(0.01÷4.00)	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	

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

14.9.1 - Description of variables

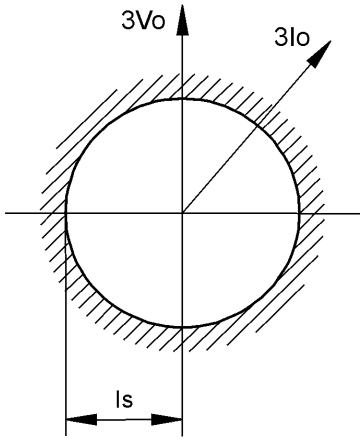
- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **f(t)** : Operation characteristic (Time/Current curve):
  - (D) = Independent definite time
  - (A) = IEC Inverse Curve type A
  - (B) = IEC Very Inverse Curve type B
  - (C) = IEC Extremely Inverse Curve type C
  - (I) = IEEE Inverse 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
- **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.

14.9.2 – 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".

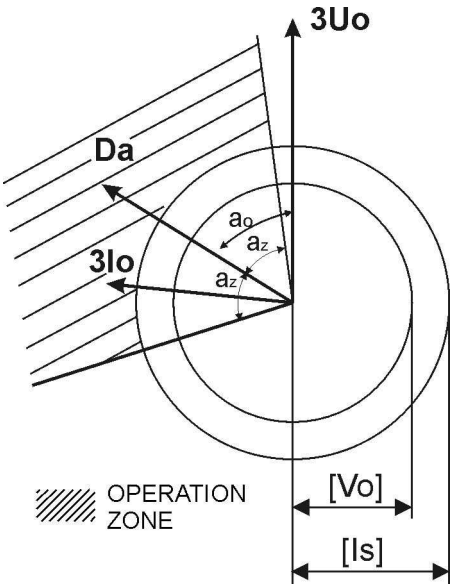
- Operation starts when : 3Io ≥ [Is]

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 "$\pm a_z$" from "a"

$$(a_o - a_z) \leq \varphi_o \leq (a_o + a_z)$$



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

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

Status	→ **Enab.**	No		[No / Yes]				
Options	→ **tBI**	Off		[Off / 2tBO]				
	→ **f(a_o)**	Disable		[Disable / Dir]				
Oper. 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	

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

14.10.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **tBI** : Blocking Input reset time
  Off = Permanent block
  2tBO = Set 2xtBO.
- **f(a_o)** : Operation mode:
  Disable = Non Directional
  Dir. = Total Directional
- **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.

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

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**tBl**	Off		[Off / 2tBO]			
	→	**f(a_o)**	Disable		[Disable / Dir]			
Oper. 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

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

14.11.1 - Description parameters

- ❑ **Enab.** : Function enabling (No = Disable / Yes = Enable)
- ❑ **tBl** : Blocking Input reset time
  Off = Permanent block
  2tBO = Set 2xtBO.
- ❑ **f(a_o)** : Operation mode:
  Disable = Non Directional
  Dir. = Total Directional
- ❑ **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.

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

Status	→ **Enab.**	No		[No / Yes]				
Options	→ **t(t)**	Type-D		[D / A / B / C / I / VI / EI / MI / SI /]				
	→ **tBI**	Off		[Off / 2tBO]				
Oper. 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	

14.12.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **f(t)** : Operation characteristic (Time/Current curve):
  - (D) = Independent definite time
  - (A) = IEC Inverse Curve type A
  - (B) = IEC Very Inverse Curve type B
  - (C) = IEC Extremely Inverse Curve type C
  - (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.
- **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.

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

the relay measures the Negative Sequence component "I_2" 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

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

Status	→ **Enab.**	No		[No / Si]			
Options	→ **tBI**	Off		[Off / 2tBO]			
Oper. 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

14.13.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]				
Oper. Levels	→ **Us**	90.000	**%Un**	(10÷190)		step	1	%Un
Timers	→ **ts**	100.00	**s**	(0.02÷100)		step	0.01	s

14.14.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]				
Oper. Levels	→ **Us**	90.000	**%Un**	(10÷190)		step	1	%Un
Timers	→ **ts**	100.00	**s**	(0.02÷100)		step	0.01	s

14.15.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	90.000	**%Un**	(10÷190)	step	1	%
Timers	→ **ts**	100.00	**s**	(0.02÷100)	step	0.01	s

14.16.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	90.000	**%**	(10÷190)	step	1	%
Timers	→ **ts**	100.00	**s**	(0.02÷100)	step	0.01	s

14.17.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→ **ts**	10.00	**s**	(0.02÷100)	step	0.01	s

14.18.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→ **ts**	10.00	**s**	(0.02÷100)	step	0.01	s

14.19.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→ **ts**	10.00	**s**	(0.02÷100)	step	0.01	s

14.20.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **fs**	40.000	**Hz**	(40÷70)	step	0.01	Hz
Timers	→ **ts**	10.00	**s**	(0.02÷100)	step	0.01	s

14.21.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	1.000	**%Un**	(1÷100)	step	1	%Un
Timers	→ **ts**	100.00	**s**	(0.02÷100)	step	0.01	s

14.22.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	1.000	**%Un**	(1÷100)	step	1	%Un
Timers	→ **ts**	100.00	**s**	(0.02÷100)	step	0.01	s

14.23.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	90.000	**%Un**	(10÷190)	step	1	%Un
Timers	→ **ts**	100.00	**s**	(0.02÷100)	step	0.01	s

14.24.1 - Description of variables

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

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

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **Us**	90.000	**%Un**	(10÷190)	step	1	%Un
Timers	→ **ts**	100.00	**s**	(0.02÷100)	step	0.01	s

14.25.1 - Description of variables

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

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

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

14.26.1 - 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.

14.26.2 - 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 "***Local Cmd***" (Reset Term).

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

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

14.27.1 - Description of variables

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

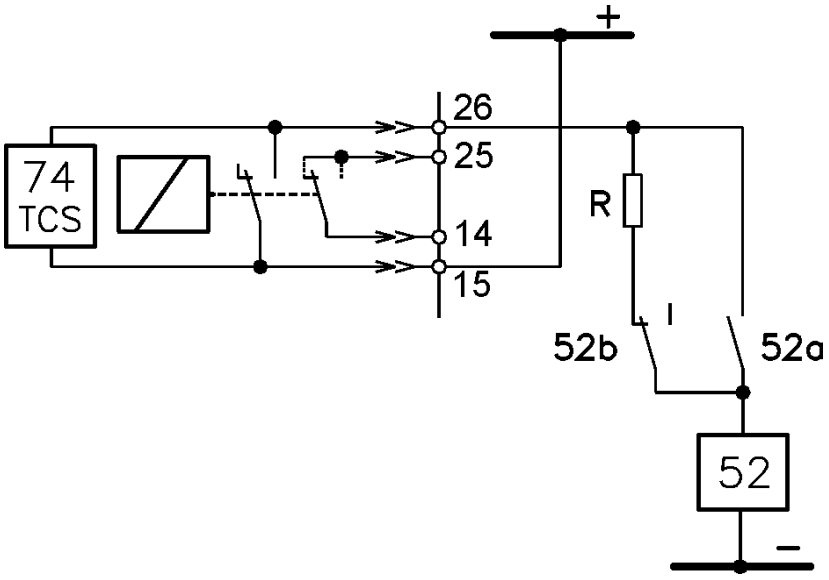
14.27.2 - Operation

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.

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

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

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

14.28.1 - Description of variables

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

14.28.2 - Operation

Tripping of the function operates a user programmable output relay.

*14.29 - Function: **MotSt** (Motor Starts)*

Oper. Levels	→ **Is**	0.100	**In**	(0.05÷1)	step	0.01	In
Timers	→ **tfSt**	0.10	**s**	(0.02÷1)	step	0.01	s
	→ **tst**	120	**s**	(10÷120)	step	0.01	s

14.29.1 - Description of variables

❑	**Is**	:	Minimum level for motor ON
❑	**tfSt**	:	Motor start filter time
❑	**tst**	:	Motor Starting time

*14.30 - Function: **LR** (Locked Rotor - Rotor jam)*

Status	→ **Enab.**	No		[No / Yes]			
Oper. Levels	→ **ILR**	1.00	**In**	(1÷5)	step	0.01	In
Timers	→ **tLR**	120	**s**	(1÷120)	step	0.01	s

14.30.1 - Description of variables

❑	**Enab.**	:	Function enabling (No = Disable / Yes = Enable)
❑	**ILR**	:	Trip level of Locked rotor
❑	**tLR**	:	Trip time delay of Locked Rotor element during run

14.30.2 - Operation

At motor starting this function is disabled for the set time " **2xtSt "** (see § MotSt) : when this time has elapsed, if current exceeds the set level " **ILR** ", the relay trips with a delay of " **tLR** ".

14.31 - Function: **StNo** (Limitation Start Number)

Status	→ **Enab.**	No		[No / Yes]				
Oper. Levels	→ **StNo**	10		(1÷60)	step	1		
Timers	→ **tstNo**	600	**s**	(60÷3600)	step	10	s	
	→ **tBst**	600	**s**	(60÷3600)	step	10	s	

14.31.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **StNo** : Maximum Number of starting allowed within the time tStNo
- **tstNo** : Time into which the StNo is counted
- **tBst** : Restart inhibition time after tripping StNo

14.32 - Function: **StSeq** (Starting Sequence Control)

Status	→ **Enab.**	No		[No / Yes]				
Oper. Levels	→ **ITr**	10	**In**	(0.1÷1)	step	0.1	In	
Timers	→ **tTr**	20	**s**	(0.50÷50)	step	0.1	s	

14.32.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **ITr** : Switch-over current of motor starter
- **tTr** : Trip time delay of LR during run

14.32.2 - Operation

During start-up of the motor, the unit can control an output relay used to operate the switch-over of motor starter (star-delta, resistance or impedance, autotransformer, etc...) thus allowing to automatically manage the starting transition by controlling the parameters “ITr”, “tTr”.

At motor start counting of “tTr” begins. If during “tTr” the motor current drops below “ITr”, switching-over is operated; if motor current stays above “ITr” longer than “tTr”, the Locked Rotor element is activated.

14.33 - Function: **I<** *(No load running)*

Status	→ **Enab.**	No		[No / Yes]				
Oper. Levels	→ **I<**	10	**In**	(0.15÷1)	step	0.01	In	
Timers	→ **tI<**	30	**s**	(0.10÷90)	step	0.01	s	

14.33.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **I<** : Operation level
- **tI<** : Trip time delay

14.33.2 - Operation

This function performs the protection against no-load running: it is activated by motor under current.

*14.34 - Function: **CB Manage** (Control C/B)*

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

Options	→	**L/R**	Ignored		[Ignored – Active]			
	→	**Key**	Enable		[Disable – 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

14.34.1 - Description of variables

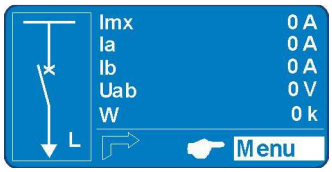
- **L/R** : Selection of Local/Remote C/B operation mode Ignored or Active
- **Key** : Disable = The pushbuttons on Front Panel are disabled; the operation of the C/B can be controlled by;
  1 - serial bus commands
  2 - commands available in the menu "***Local Cmd***" (Password protected).
  3 - Digital Inputs.

  Enable = The C/B can be controlled also by the pushbuttons available on Relay's Front Face.
- **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.

14.34.2 - Display Message

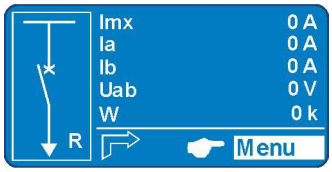
1



- L

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

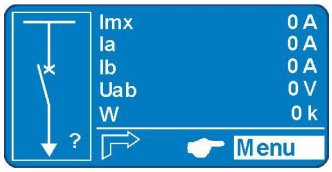
2



- R

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

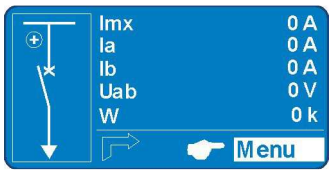
3



- ?

If the symbol "**?**" show up the relay is in discrepancy Local/Remote.
The commands can be send from "Local" or "Remote".

4



- ⊕

This symbol indicates the CB breaker failure (example: C/B closing failure)

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

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

16.35.1 - Description of variables

- **Enab.** : Function enabling (No = Disable / Yes = Enable)
- **Trig** : Selection of the Trigger command source (start recording):
  - *Start* = Trigger on time start of protection functions
  - *Trip* = Trigger on trip (time delay end) of protection functions
  - *OnCom* = External Trigger from Digital Input
  - *REUserLg* = Rising Edge of "User Logic" (see § Setting
  - *FEUserLg* = Falling Edge of "User Logic" "User Trigger Oscillo")
- **tPre** : Recording time before Trigger
- **tPost** : Recording time after Trigger

14.35.2 - Operation

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

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

The "Oscillo" Function includes the wave Form Capture of the input quantities (IA, IB, IC, Io, EA, EB, EC, Eo) 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).

14.35.3 – Setting "User Trigger Oscillo"

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

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

Name

Internal name

User descr.

Fixed

Linked functions

Selection functions

OpLogic

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

Timer

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

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"

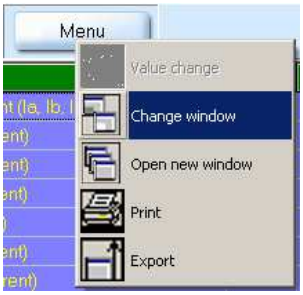
Logical status

"User Trigger Oscillo" Logical status

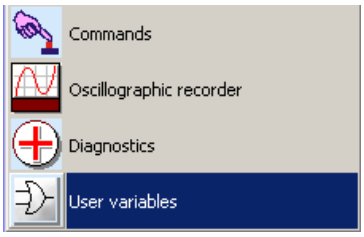
Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"

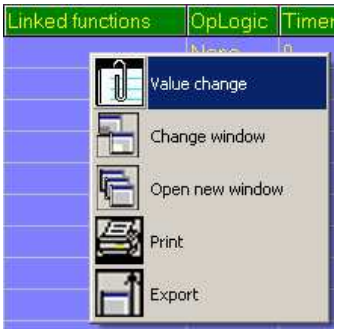


Setting for "User Trigger Oscillo" : "**1I>/2I>/3I>**", "**AND**", "**1**", "**Monostable**".

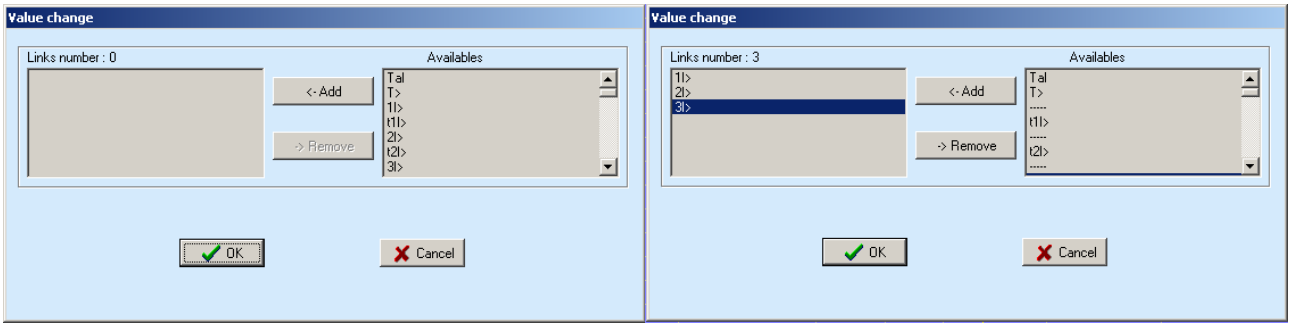
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	OscilloTrigger.logic		None	0	Delay	0
2	UserVar <0>	Gate.1		None	0	Delay	0

"Linked Functions"

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



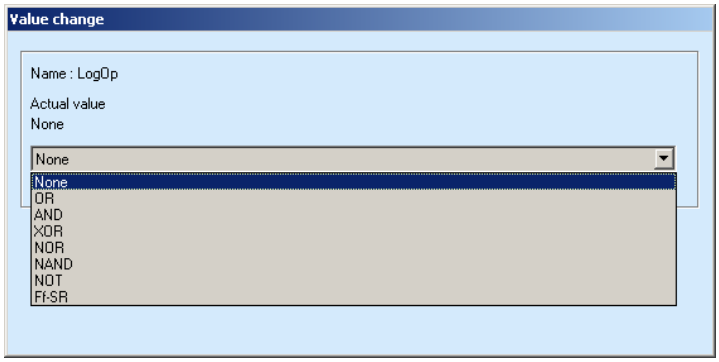
Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".



"Operation Logic" (Oplogic)

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

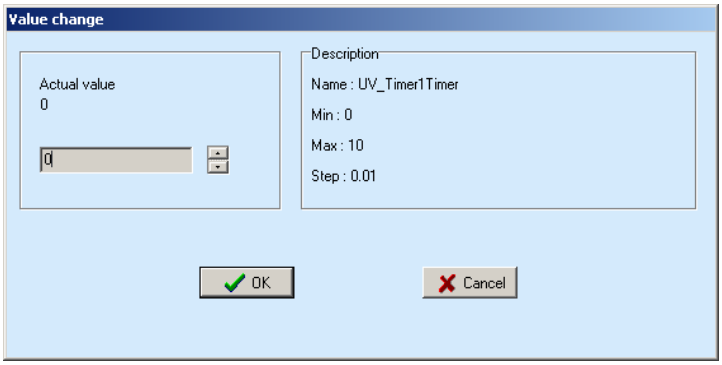
Insert "**AND**" into box and press "OK":



"Timer"

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

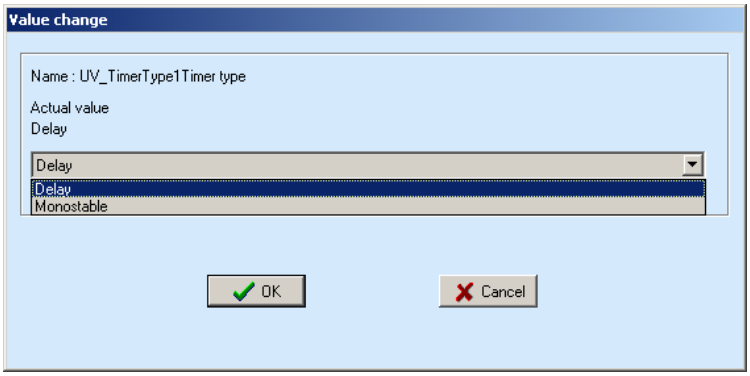
Select "**1**" into box and press "OK":



"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":



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

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

16.35.1 - Description of variables

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

14.35.2 - 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,

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

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

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

14.36.1 - Description of variables

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

15. Input – Output (via software MSCom2)

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

14DI Module (Board 1) = 14 Digital Imputs
14DI Module (Board 2) = 14 Digital Imputs
14DO-F Module (Board 3) = 14 Outputs Relay

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

15.1 – Digital Input

→ **0.D1**	Programmable (D1)	When the relevant terminals are open and get activated when the relevant terminals are shorted by an external cold contact.	*Available in the FMR relay*
→ **0.D2**	Programmable (D2)		
→ **0.D3**	Programmable (D3)		
→ **0.D4**	Programmable (D4)	Reserved - dont use	
→ **1.D1** → **1.D--** → **1.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board 1 - 14DI*	Any digital input of the expansion modules is active when the relevant terminals (see wiring diagram) are shorted.
→ **2.D1** → **2.D--** → **2.D15**	Inputs "D8", "D16" not available	*Digital input on Expansion Board 2 - 14DI*	

15.2 – "DI" Configuration (via MSCom2 software)

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

Bi1I>	Blocking input to the	1I>
Bi2I>	Blocking input to the	2I>
Bi3I>	Blocking input to the	3I>
Bi1Io>	Blocking input to the	1Io>
Bi2Io>	Blocking input to the	2Io>
Bi3Io>	Blocking input to the	3Io>
Bi1Is>	Blocking input to the	1Is>
Bi2Is>	Blocking input to the	2Is>
Bi1U>	Blocking input to the	1U>
Bi2U>	Blocking input to the	2U>
Bi1U<	Blocking input to the	1U<
Bi2U<	Blocking input to the	2U<
B1Uo>	Blocking input to the	1Uo>
B2Uo>	Blocking input to the	2Uo>
BiU1<	Blocking input to the	U1<
BiU2>	Blocking input to the	U2>
Circuit Breaker	Indication of the Open/Close status of the C/B	
Local State	Local mode operation	
Remote State	Remote mode operation	
C/B Open command	C/B open command	
C/B Closecommand	C/B close command	
ExtR	External Reset input	
Group 1-2	Selection of the setting Group 1 or 2.	

Example

ID	Name	Status	OpLogic	Functions

Name

Logical Input name

Status

Logical Input status

OpLogic

Not Used

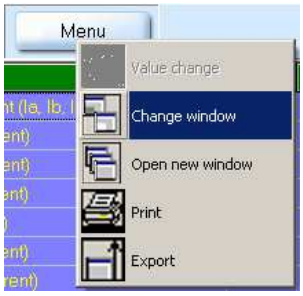
Functions

Selection function

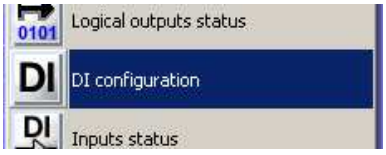
Example: Setting “Digital Input”

Open “MSCom2” program and connect to the relay.

Select “Change Windows” from “Menu” button



Select “DI configuration”



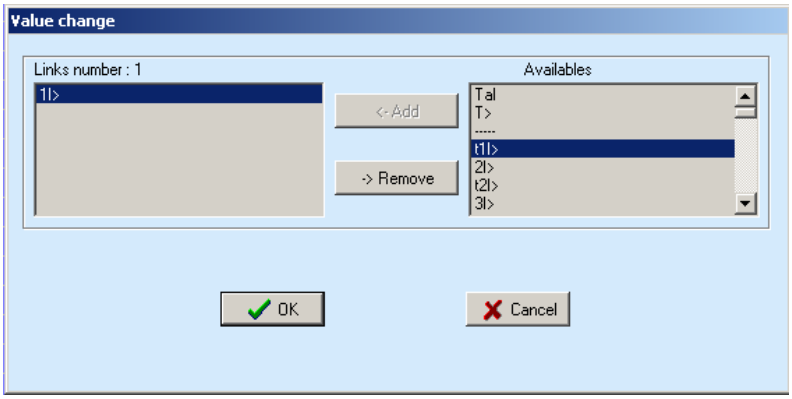
Setting for “**Bi1I>**” : “**1I>**”.

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

"Functions"

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

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



15.3 – Outputs Relay

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

→ **0.R1**	Programmable (R1)	*Available in the FMR relay*
→ **0.R2**	Programmable (R2)	
→ **0.R3**	Programmable (R3)	
→ **0.R4**	Programmable (R4)	
→ **0.R5**	Programmable (R5)	
→ **0.R6**	Programmable (R6)	
→ **1.R1**	Programmable	*Output Relays on Expansion Board 3 - 14DO-F*
→ **1.R--**		
→ **1.R14**		

15.4 - "DO" Configuration

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

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
	MotON		Motor staus – ON
	LR tLR	Start Trip	Locked Rotor
	LimStNum		Limitation of the number of startings
	StSeqSucc		Start Sequence Succesful
	ITr		Switch-over (transition) current
	Gen.Start	Start	Generic Start
	Gen.Trip	Trip	Generic Trip
	manOpCmd		Manual Open Command
	L/Rdisc		Local/Remote signal Discrepancy
	CL-Cmd		Close Command
	C/Bfail		Circuit Breaker failure
	OscilloTriggerLogic		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
	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 - 14DI
	2.D1 2.D1Not --- 2.D15 2.D15Not		Digital input on Expansion Board 2 - 14DI
	0.R1 0.R2 0.R3 0.R4 0.R5 0.R6		Output relay on Main Relay
	1.R1 ---- 1.R14		Output relay on Expansion Board 3 - 14DO-F

Example

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

Relay

Relay internal name

Linked function

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

Operation Logic

Not Used

Logical Status

Relay Logical status

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.

tON - Operation Time

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

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

Relay Status

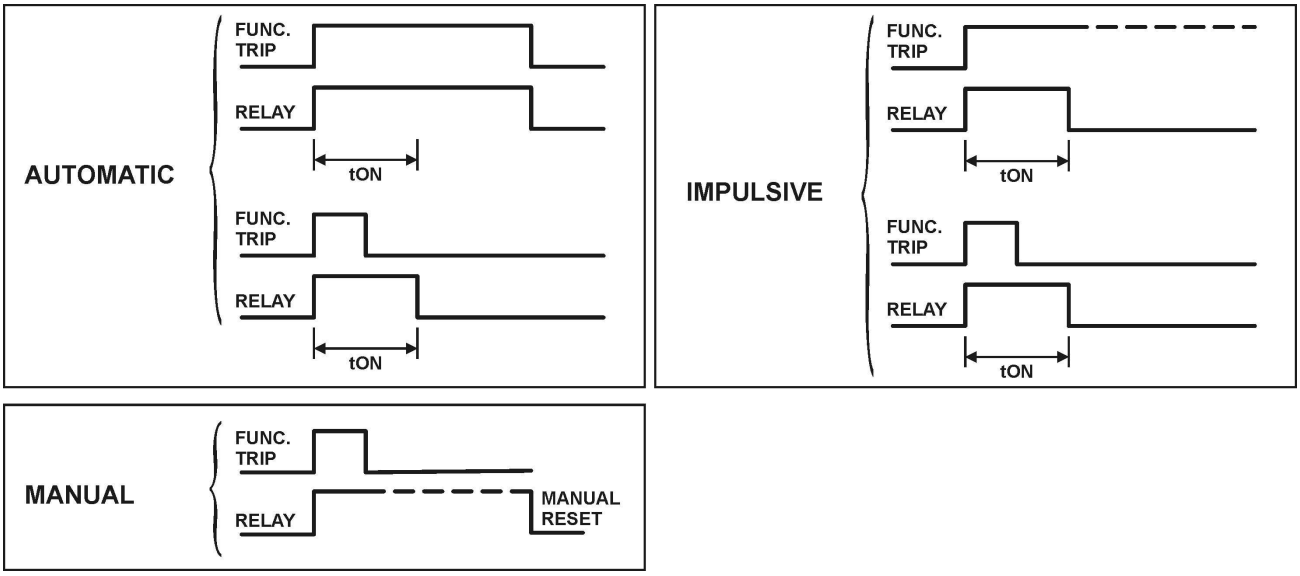
Relay – Physical status

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)

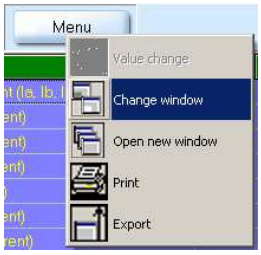
Manual : In this mode the output relay is “operated” when the controlling Functional Output is activated and remains in the operated condition until a manual reset command is issued by the FMR keyboard (local commands menu) or via the serial communication. In this mode the timer “tON” has no effect.

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

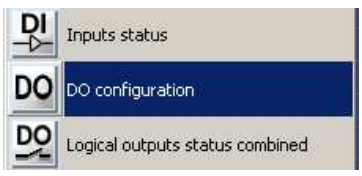


Open “MSCom2” program and connect to the relay.

Select “Change Windows” from “Menu” button



Select “DO Configuration”



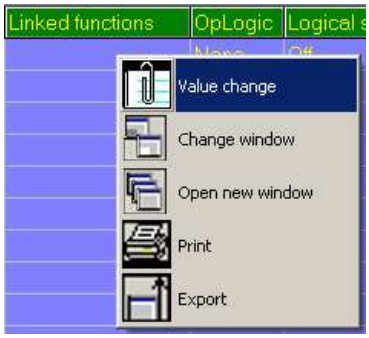
Example: Change settings for "0.R1"

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

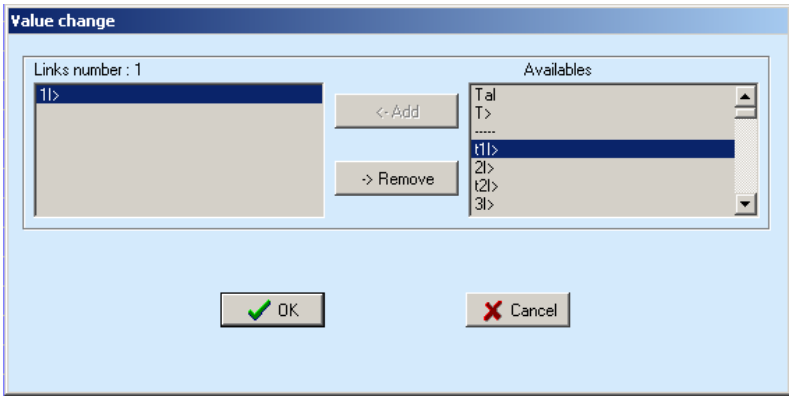
ID	Relay	Linked functions	OpLogic	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]		None	Off	Normally open	Automatic reset	0.1	Off
2	0.R2 [Master board, R:2]		None	Off	Normally open	Automatic reset	0.1	Off

"Linked Functions"

Select "**Linked Functions**" related to 0.D1 and press right button on mouse, select "Value change":

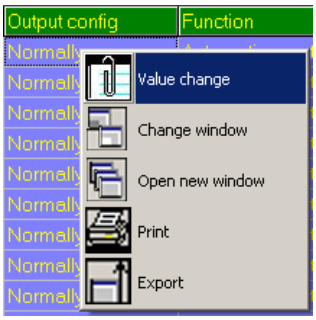


From box "Available", select "1I>" and press "Add".
Press "OK" for confirmation. (if Password is request, see § Password)

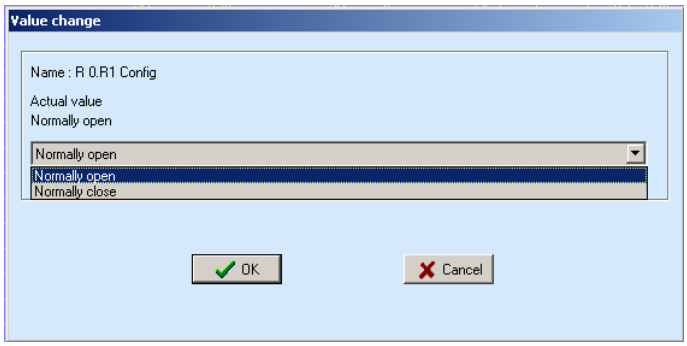


"Output Config"

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

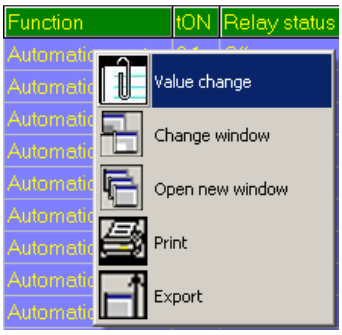


Select "**Normally Close**" from combo box and press "OK" (if Password is request, see § Password)

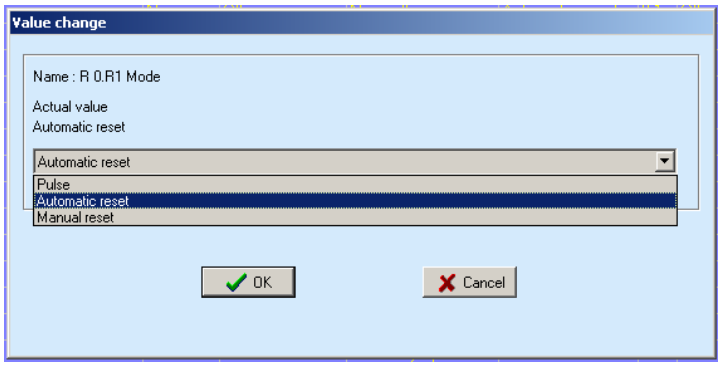


"Function"

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



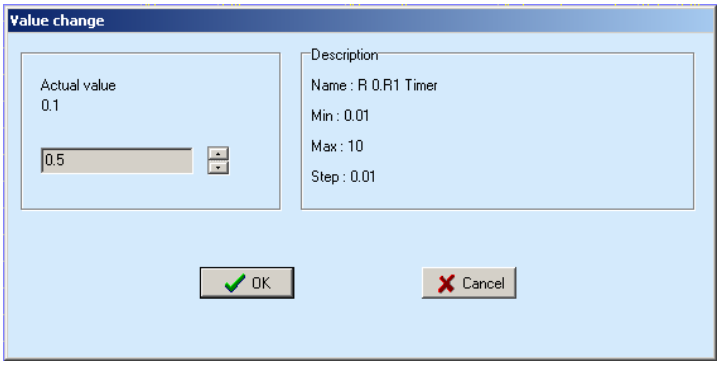
Select "**Pulse**" from combo box and press "OK" (if Password is request, see § Password):



"tON"

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

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

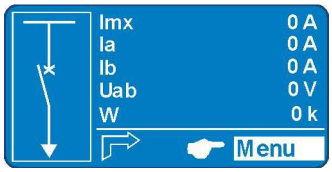


16. DATE and TIME

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

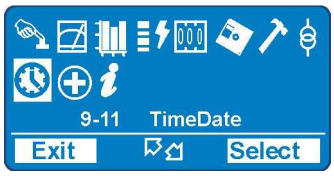
Date:	20YY	/	MM	/	DD	(2000/01/01 ÷ 2099/12/31) YY = Year / MM = Month / DD = Day
Time:	HH	:	MM	:	00	HH = hour / MM = Minutes / 00
DofW:	Day					Es: Wednesday

1



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

2

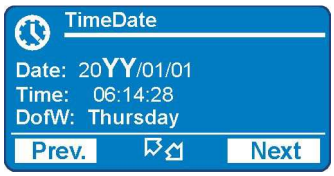


- Select icon "***TimeDate***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3

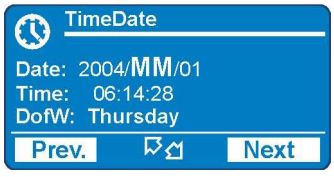
- Press "***Modify***".

4



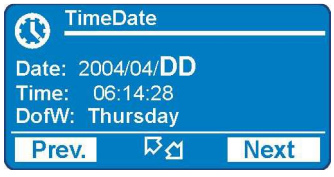
- The last two figures of the Year will appear in bold character; by pushbuttons "***Increase***" or "***Decrease***" set the new figures.
- Press "***Next***" to go to the next setting.

5



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

6

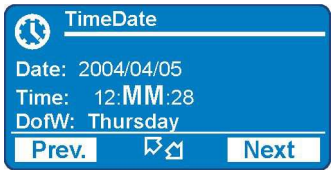


- As above for changing the "Day"
- Press "***Next***" to go to the next setting.

7

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

8



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

9

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

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

16.1 – 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.

17. Healthy (Diagnostic Information)

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

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

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

18. Dev.Info (Relay Version)

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

SW Version	**AcqUnit-I/O**	→	####.##.##.#	Firmware version of acquisition unit
	ProtectUnit	→	####.##.##.#	Firmware version of CPU unit
Protect.Model		→	FeederManager	Protection Type
Serial Number		→	###I##I##I####	Relay Serial Number
User Tag		→	FMR-PL	Relay identification label.
Build		→	###########	Build identification label.
Line		→	###########	Line identification label.

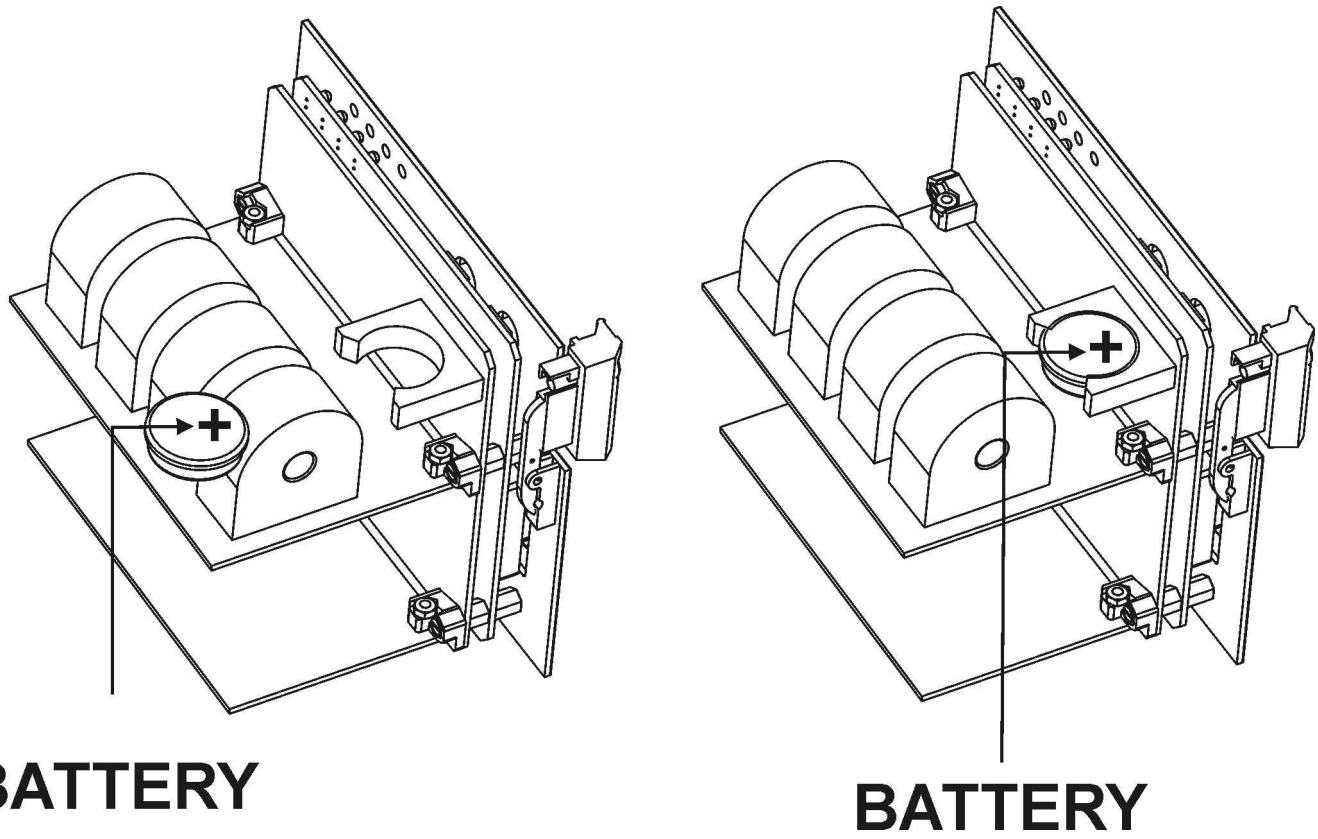
This information can only be modified by the interface program "MSCom2" and allows the user to give to the relay any suitable denomination.

19. 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:



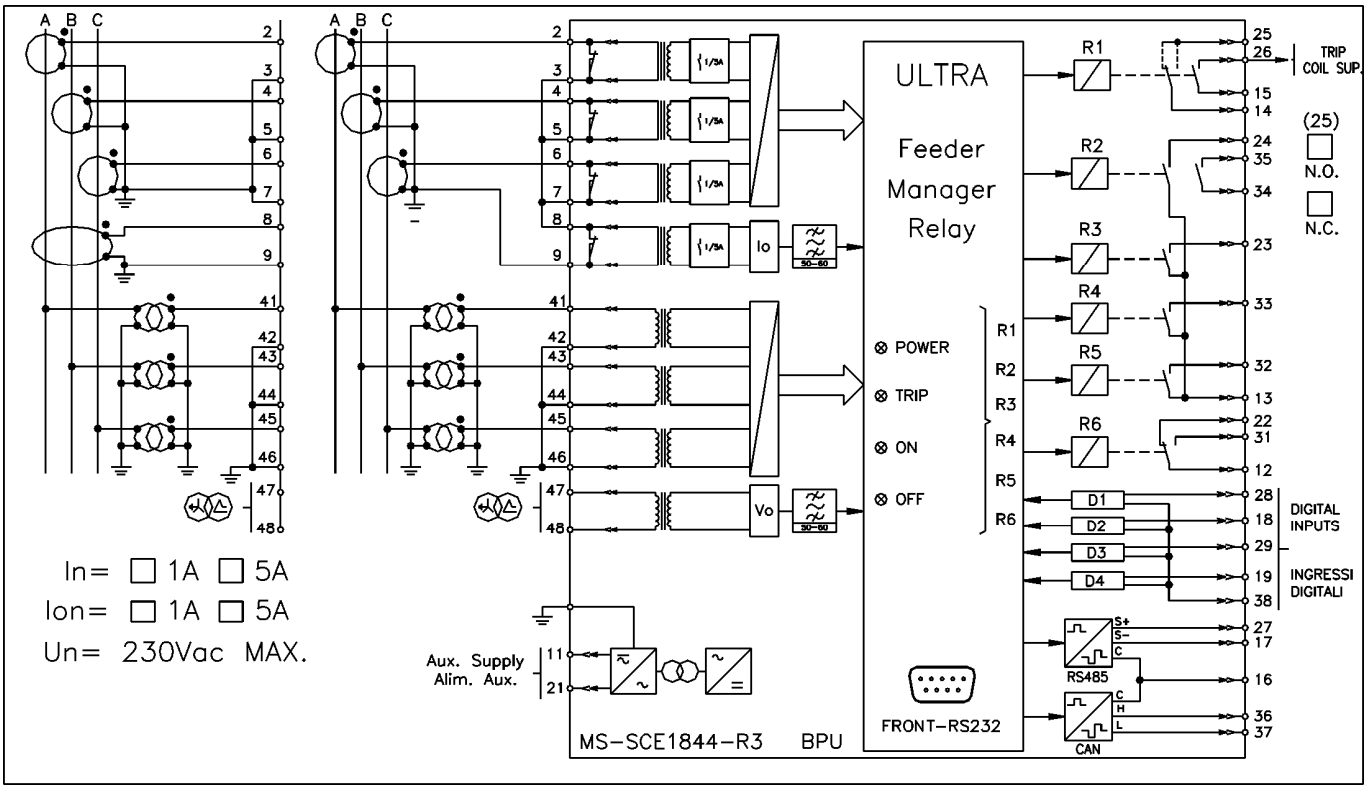
20. Maintenance

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.

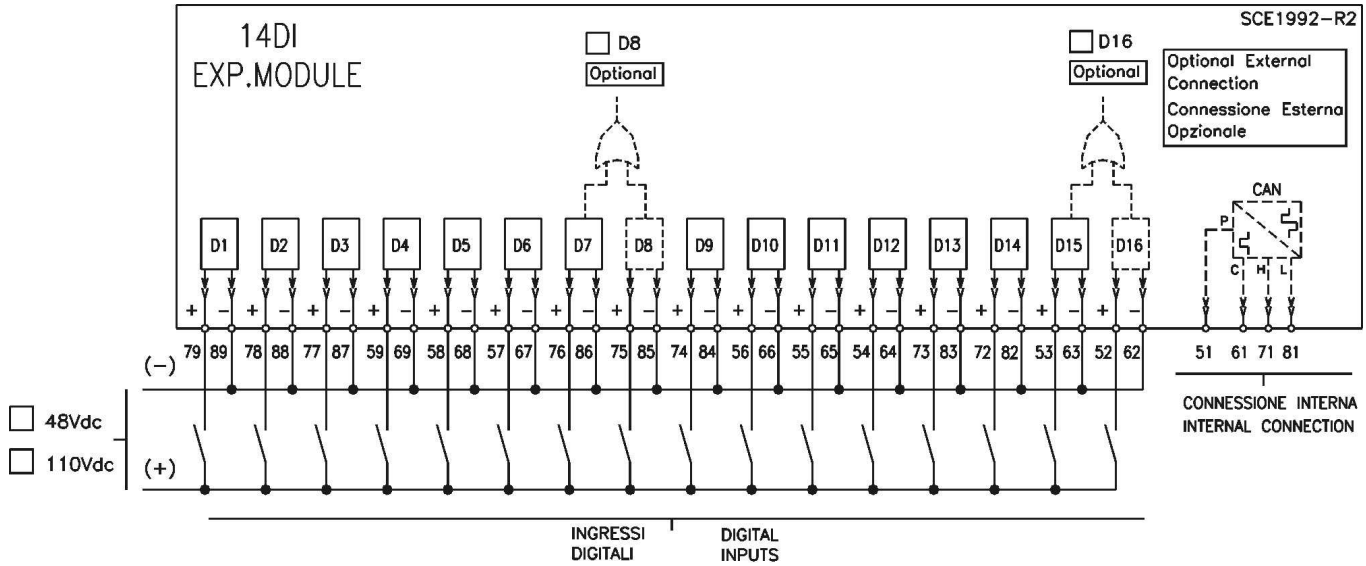
21. Power Frequency Insulation Test

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

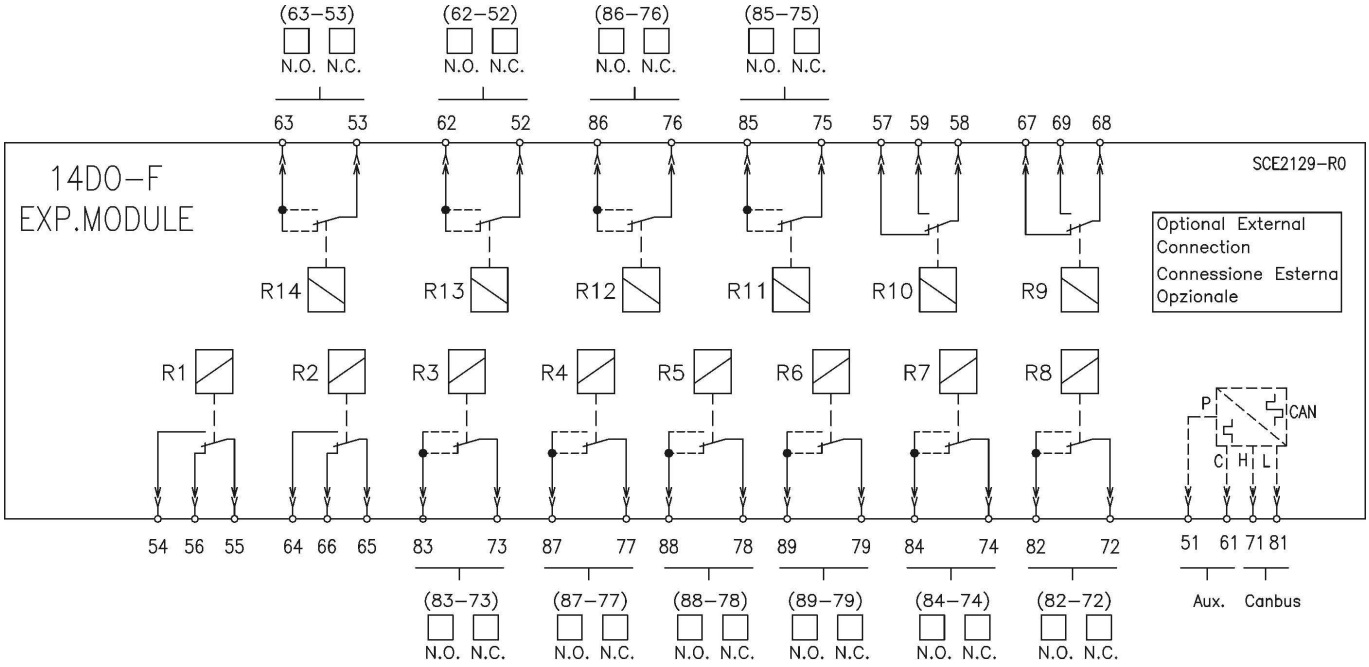
22. Basic Relay - Wiring Diagram



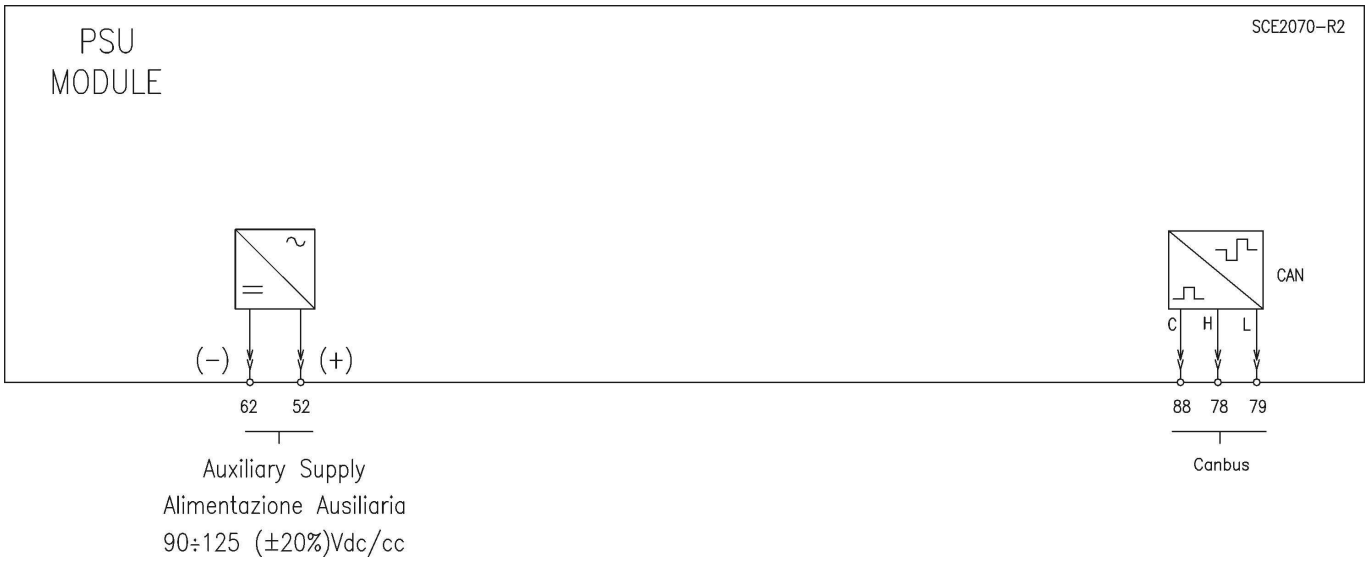
*22.1 – **14DI** - Expansion Module - Wiring Diagram (14 Digital Inputs)*



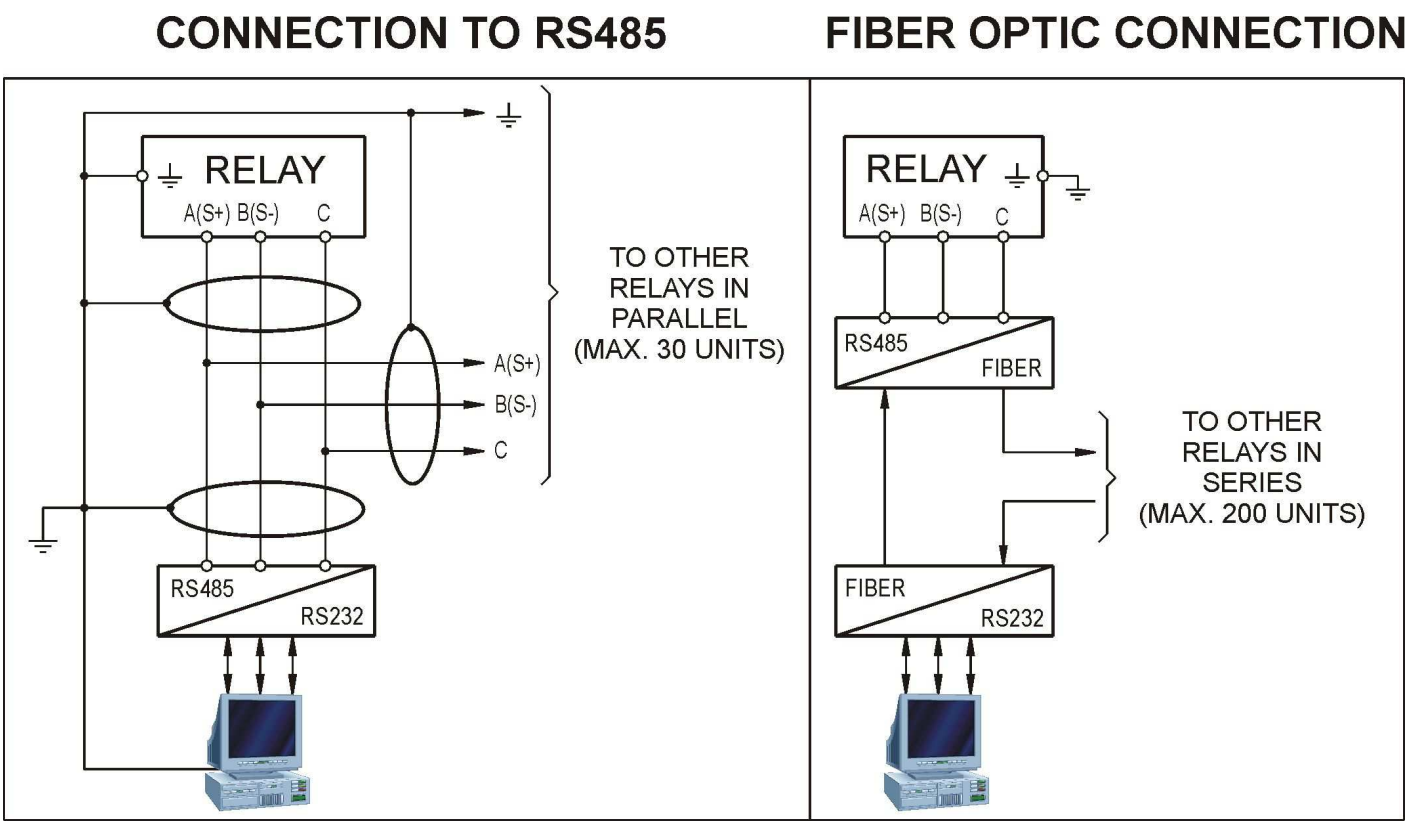
*22.2 – **14DO-F** - Expansion Module - Wiring Diagram (14 Digital Outputs)*



*22.3 – **PSU** – Power Supply for Expansion Module - Wiring Diagram*

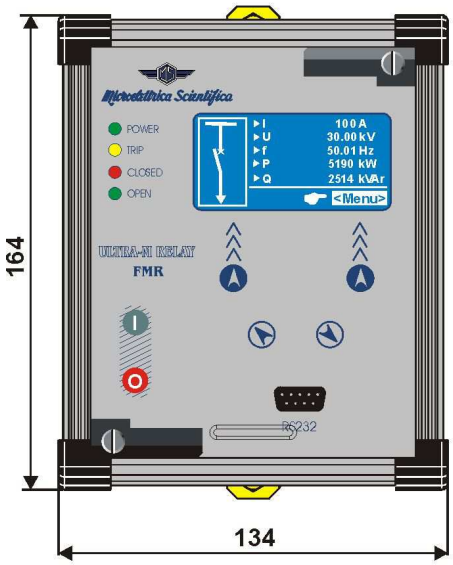


23. Wiring the Serial Communication Bus

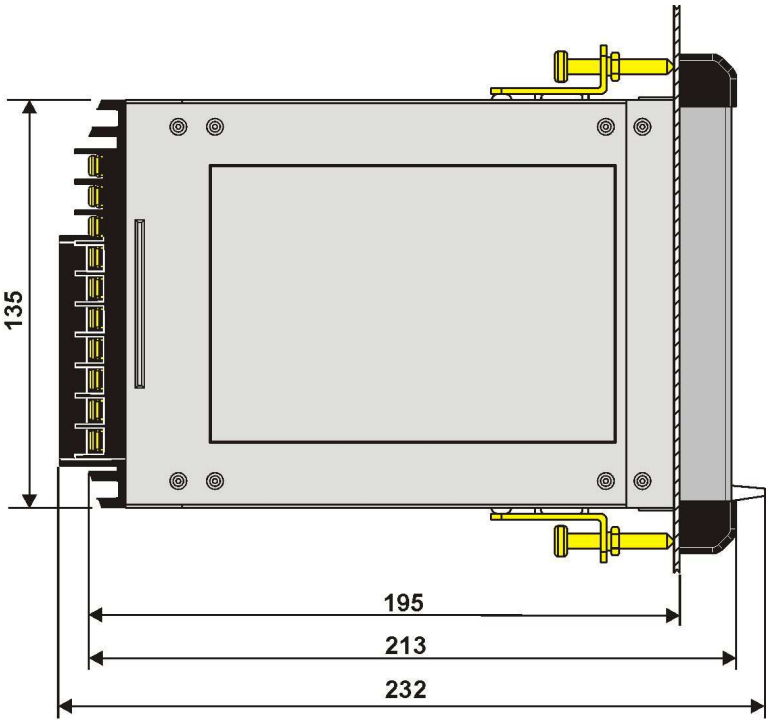


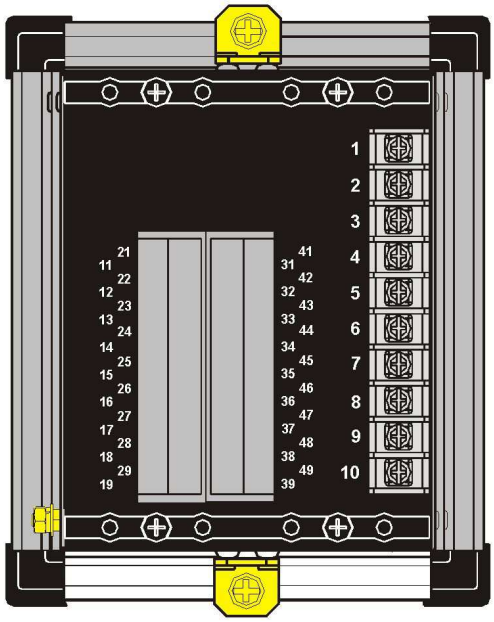
Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCom2) for Windows 9x/2000/XP (or later) is available.
Please refer to the MSCom2 instruction manual for more information.
Maximum length of the serial bus can be up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

24. Basic Relay - Overall Dimensions



PANEL CUT-OUT
115x137 (LxH)

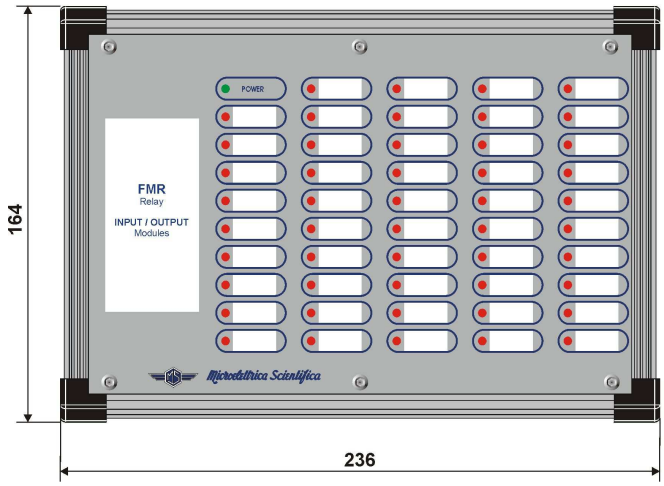




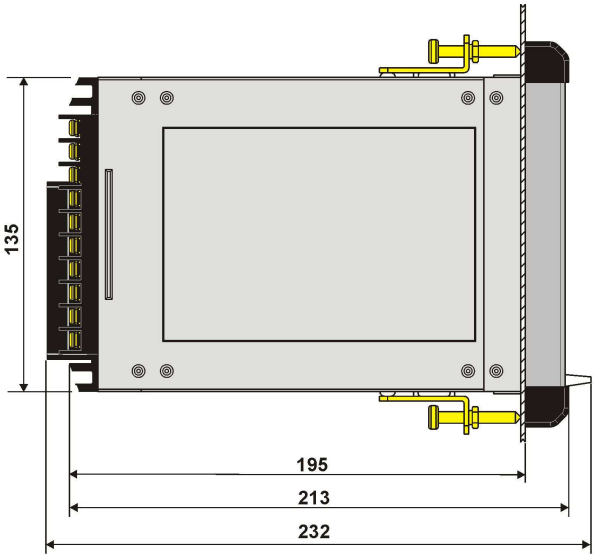
TERMINAL CONNECTION

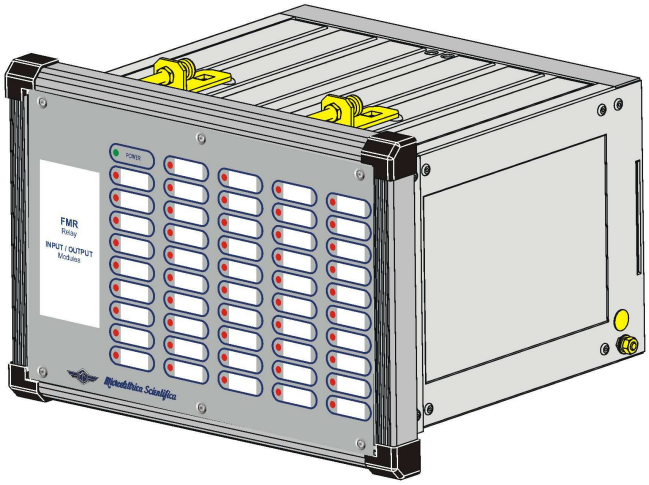
Flush mounting protection degree: IP44 (54 on request).

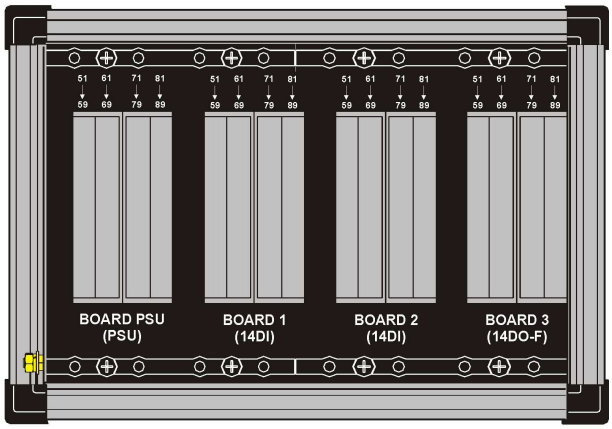
24.1 - Expansion Module - Overall Dimensions



PANEL CUT-OUT
217x137 (LxH)







TERMINAL CONNECTION

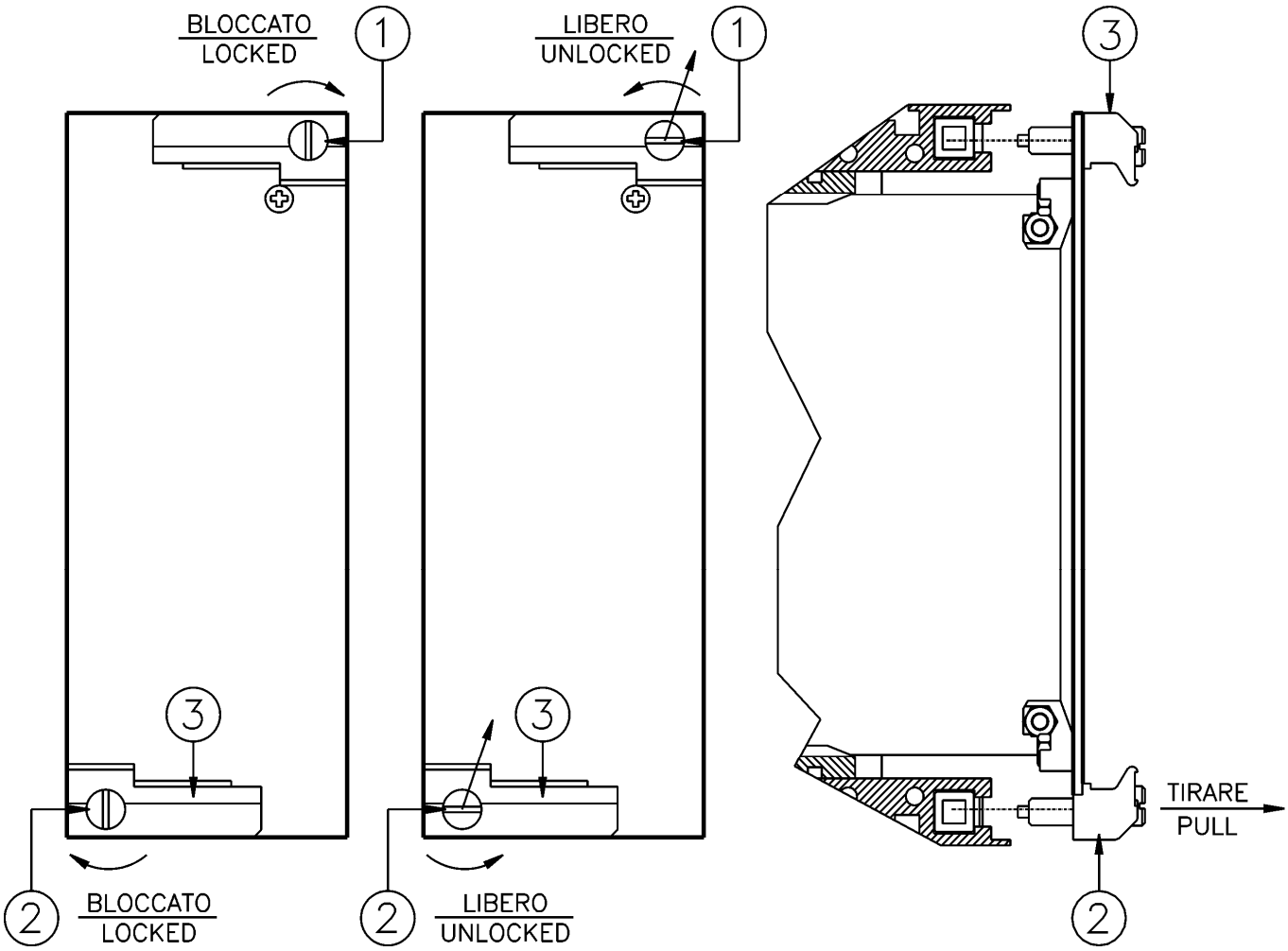
25. Direction for Pcb's Draw-Out and Plug-In

25.1 - Draw-out

Rotate clockwise the screws ① and ② in the horizontal position of the screw-driver mark.
Draw-out the PCB by pulling on the handles ③

25.2 – Plug-in

Rotate clockwise the screws ① and ②in the horizontal position of the screw-driver mark.
Slide-in the card on the rails provided inside the enclosure.
Plug-in the card completely and press the handle to the closed position.
Rotate anticlockwise the screws ① and ② with the mark in the vertical position (locked).



26. 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℃ / +55℃			
❑ Storage temperature		-25℃ / +70℃			
❑ 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℃		
CE EMC Compatibility (EN61000-6-2 - EN61000-6-4 - EN50263)					
❑ Electromagnetic emission		EN55011	industrial environment		
❑ Radiated electromagnetic field immunity test		IEC61000-4-3 ENV50204	level 3	80-2000MHz 900MHz/200Hz	10V/m 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			

CARATTERISTICHE

❑ 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 PARAMETER

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

27. Software & Firmware Version

Firmware for version

IAU (Intelligent Acquisition Unit)	0.14.01.X
IPU (Processor Unit)	0321.23.02.X

Application Software

MSCom 2	1.03.23