MICROPROCESSOR
OVERCURRENT AND EARTH FAULT
RELAY

TYPE

"MC2-30T"

OPERATION MANUAL

CE

1. General Utilization and Commissioning Directions

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

1.1 - Storage and Transportation

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

1.2 - Installation

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

1.3 - Electrical Connection

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

1.4 - Measuring Inputs and Power Supply

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

1.5 - Outputs Loading

Must be compatible with their declared performance.

1.6 - Protection Earthing

When earthing is required, carefully check its effectiveness.

1.7 - Setting and Calibration

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

1.8 - Safety Protection

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

1.9 - Handling

Notwithstanding the highest practicable protection means used in designing 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 are completely safe from electrostatic discharge (8 KV IEC 255.22.2) when housed in their case; withdrawing the modules without proper cautions expose them to the risk of damage.

1.10 - Maintenance

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

1.11 - Waste Disposal of Electrical & Electronic Equipment

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

1.12 - Fault Detection and Repair

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

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

2. General

The main features of the relays are:

User friendly front face with hi-resolution graphic display (240x128), 10 signal Leds, 6 push-buttons (configurable) and four push-button for complete local managemen, USB for local communication.

Eight user programmable Output Relays.

Eight opto-isolated, self powered Digital Inputs.

RS485 communication port (independent from the USB port on front panel)

Input currents are supplied to 3 current transformers: measuring phase currents.
An additional internal CT directly measures the residual (Zero Sequence) current of the three inputs.
Current inputs can be 1 or 5A: selection between 1A or 5A is made by movable jumpers provided on the Relay card.

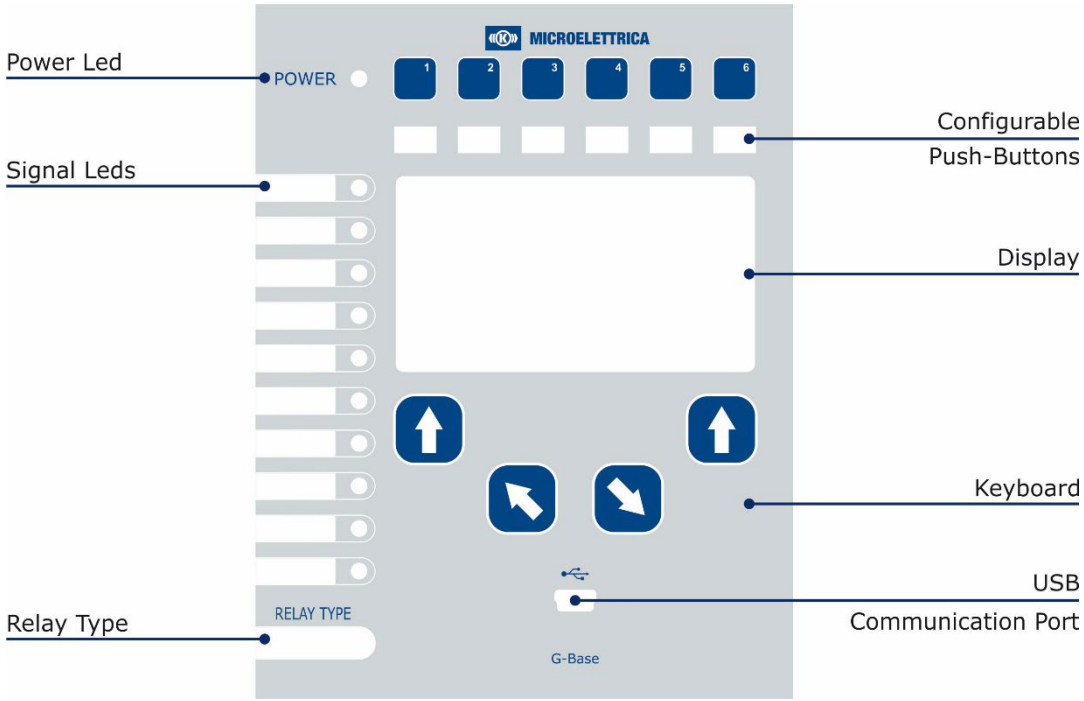
2.1 - Power Supply

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

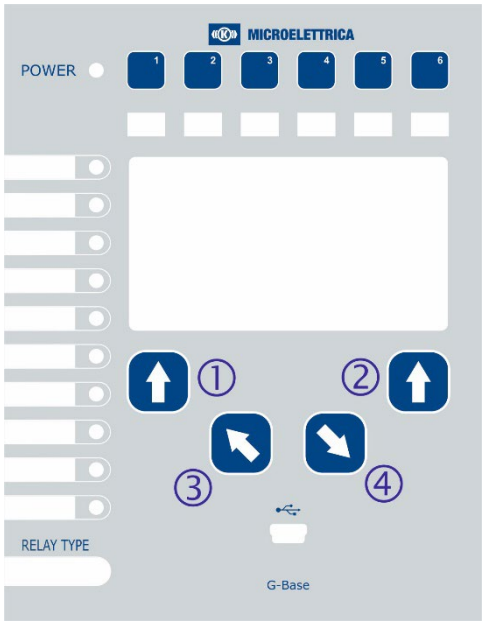
Type 1	24V(-20%) / 110V(+15%) a.c.	24V(-20%) / 125V(+20%) d.c.
Type 2	80V(-20%) / 220V(+15%) a.c.	90V(-20%) / 250V(+20%) d.c.

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

3. Front Panel



4. Keyboard and Display

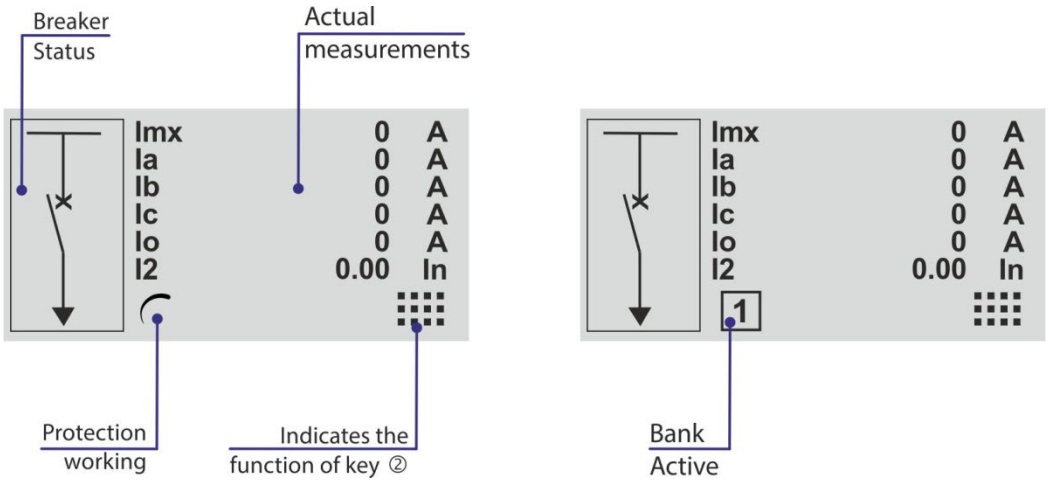


1 ↓ 6	**Push-buttons**	Programmable
	Navigation menu	By these buttons the options showed in correspondence on the display are selected.
	Increase	These buttons are used to scroll the items of the different menus (Local Control, Measurements, Energy metering etc).
	Decrease	

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 240x128 pixel hi-resolution LCD display the available information (menu, etc.).



5. Icons of Display

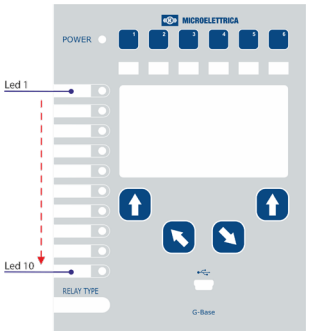
	LocalCmd	LOCAL COMMANDS
	Measure	ACTUAL MEASUREMENTS
	TripRec.	TRIP RECORDING
	Counter	PARTIAL COUNTERS (RESETTABLE COUNTER)
	ROCnt	TOTAL COUNTER (READ ONLY COUNTER)
	Events	EVENT RECORDING
	Setting	FUNCTION SETTINGS
	System	SYSTEM SETTINGS
	InfoStatus	INFORMATION STATUS
	TimeDate	TIME AND DATE
	Healthy	DIAGNOSTIC INFORMATION
	Dev.Info	RELAY VERSION

6. Signalization

Eleven signal leds are provided:

1	Led Power Supply	Not programmable	Green
10	Leds	Programmable (via software)	

N°	*Colours*	*Default*
1	Green	#####
2	Green	#####
3	Green	#####
4	Yellow	#####
5	Red	#####
6	Red	#####
7	Red	#####
8	Yellow	#####
9	Red	#####
10	Green	#####

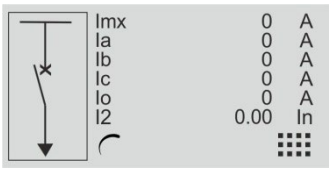


In case of auxiliary power supply failure the status of the leds is recorded and reproduced when power supply is restored.

6.1 - Leds Manual Reset

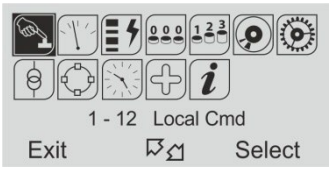
For Leds manual reset operate as follows:

1



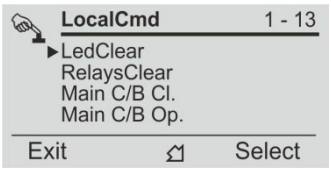
- Press "***Menu***" for access to the main menu with icons.

2



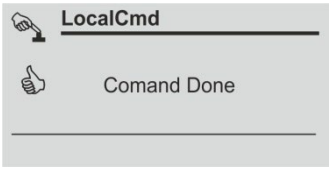
- Select icon "***LocalCmd***" .
- Press "***Select***",

3



- Select "***LedClear***"
- Press "***Select***" to execute the command.

4

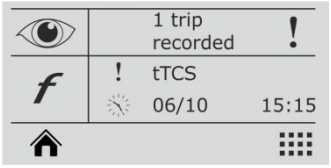


- When command has been executed the display shows "***Command Done***";

6.2 – Display of the last trip

Beside the signalization of the 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.

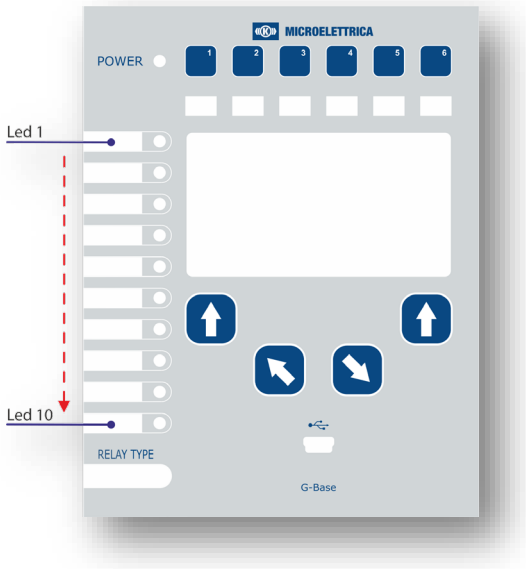
1



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

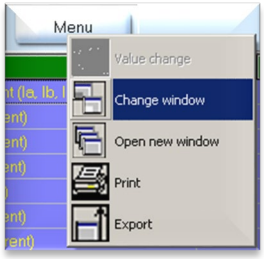
7. Leds Configuration

The relay manage up to 10 signal leds (Programmable), 1 led "Power" (green).



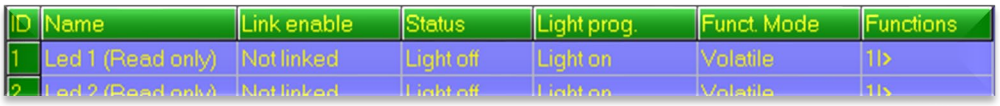
For Leds programming (only via software) operate as follows:

- Open the software program and connect to the relay.
- Select "Change Windows" from "Menu" button (options)



- Select "Led Setting"

The window for leds configuration will show:



7.1 - Name

Led name – for leds position see picture

7.2 - Link enable

Linked	=	Enable to operate
Not Linked	=	Disable

7.3 - Status

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

7.4 - Light Prog.

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

7.5 - Funct. Mode

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

7.6 - Functions

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

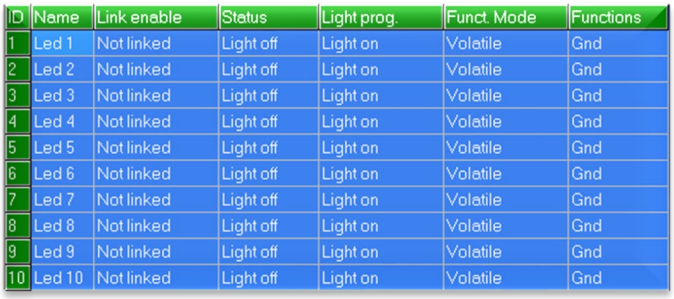
7.7 - Table 1

Tal T>	*Alarm* *Trip*	*Thermal Image T>*
1I> t1I>	*Start* *Trip*	First overcurrent element
2I> t2I>	*Start* *Trip*	*Second overcurrent element*
3I> t3I>	*Start* *Trip*	*Third overcurrent element*
1Io> t1Io>	*Start* *Trip*	*First earth fault element*
2Io> t2Io>	*Start* *Trip*	*Second earth fault element*
3Io> t3Io>	*Start* *Trip*	*Third earth fault element*
1Is> *t1Is>*	*Start* *Trip*	*First negative sequence current element*
2Is> *t2Is>*	*Start* *Trip*	*Second negative sequence current element*
tTCS		*Trip coil supervision*
IRF tIRF	*Start* *Trip*	*Internal Relay Failure*
BF		*BF (Breaker Failure)*
DskClean		*Disk near Full clean operation is required*
DskFull		*Disk Full Write should be lock*
DskWR		*Disk write in progress*
DskFRMT		*Disk Format in progress*
DskCHK		*Check disk in progress*
rDskAttach		*Removable disk usb attach*
rDskDetach		*Removable disk usb detach*
rDskDtchable		*Removable disk usb now detachable*
rDskClean		*Removable disk usb near to full clean operation is required*
rDskFull		*Removable disk usb full, write locked*
rDskWR		*Removable disk usb write in progress*
rDskFRMT		*Removable disk usb format in progress*
rDskCHK		*Removable disk usb check in progress*
manOpCmd		*Manual Open Command*
L/Rdisc		*Local/Remote signal Discrepancy*
CL-Cmd		*Close Command*
C/Bfail		*Circuit Breaker failure*
RCLf		*Automatic reclosure failed*
RCLRun		*Automatic reclosure in progress*
TwRCL		*Trip not enable for Automatic reclosure*
RCL-OK		*Successful Automatic reclosure*
ManCL-OK		*Successful manual closure*
BirCL		*Presence Automatic relosure input blocking*
Gr1to2		*Switch to Set up 2*
TripTimeR		*Trip Time Reduction Active*
Gen.Start Gen.Trip	*Start* *Trip*	*Generic*
OscilloTrigger Logic		*User Variable for Oscillographic Recording*
Gate1 to Gate25		*User Variable*
Vcc		*Reserved*
Gnd		*Reserved*
Reset		*Reset signal logic*
P1		*Push-button 1*
P2		*Push-button 2*
P3		*Push-button 3*
P4		*Push-button 4*
P5		*Push-button 5*
P6		*Push-button 6*
0.D1 0.D1Not to 0.D8 0.D8Not		*Digital Inputs*
0.R1 0.R2 0.R3 0.R4 0.R5 0.R6 0.R7 0.R8		*Output relays*

7.8 - Example: Change settings for "Led1"

Change settings for "**Led1**" : "Enable", "Flashing", "Latched", "1I>".

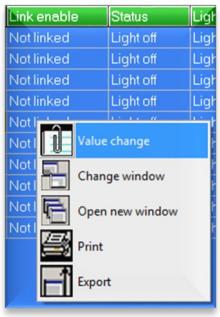
Main Windows:



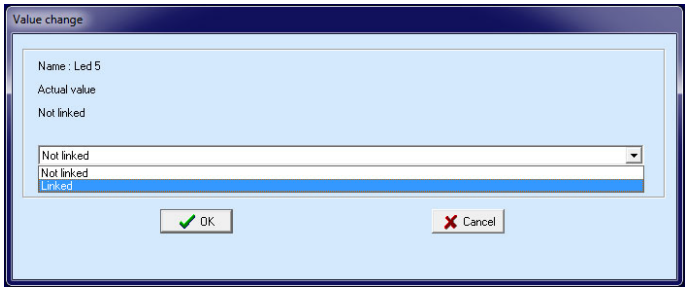
ID	Name	Link enable	Status	Light prog.	Funct. Mode	Functions
1	Led 1	Not linked	Light off	Light on	Volatile	Gnd
2	Led 2	Not linked	Light off	Light on	Volatile	Gnd
3	Led 3	Not linked	Light off	Light on	Volatile	Gnd
4	Led 4	Not linked	Light off	Light on	Volatile	Gnd
5	Led 5	Not linked	Light off	Light on	Volatile	Gnd
6	Led 6	Not linked	Light off	Light on	Volatile	Gnd
7	Led 7	Not linked	Light off	Light on	Volatile	Gnd
8	Led 8	Not linked	Light off	Light on	Volatile	Gnd
9	Led 9	Not linked	Light off	Light on	Volatile	Gnd
10	Led 10	Not linked	Light off	Light on	Volatile	Gnd

7.8.1 - "Link Enable"

Select "**Link enable**" related to "Led 1" and press right button on mouse, select "Value change":

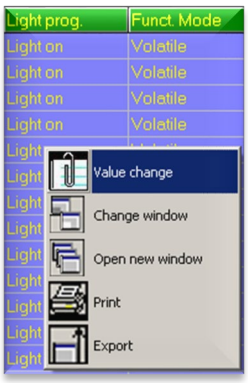


Select "**Linked**" and press "OK" (if Password is request, see § Password):

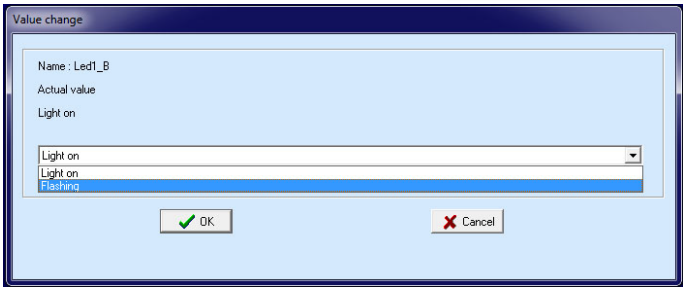


7.8.2 - "Flashing"

Select "**Light prog**" related to Led 1 and press right button on mouse, select "Value change":

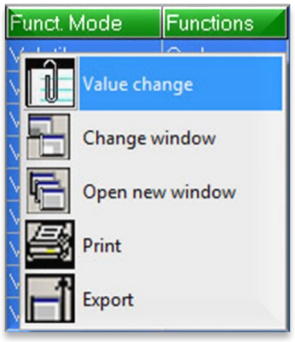


Select "**Flashing**" and press "OK" (if Password is request, see § Password):

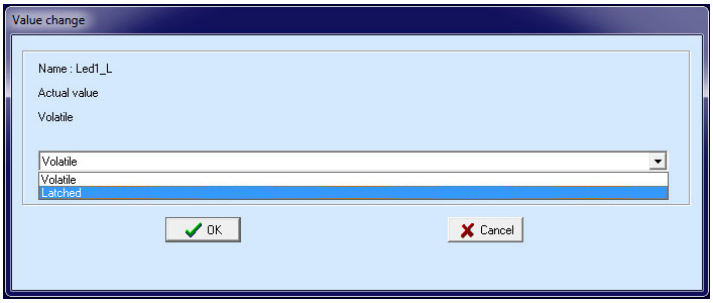


7.8.3 - "Funct.Mode"

Select "**Funct.Mode**" related to Led 1 and press right button on mouse, select "Value change":

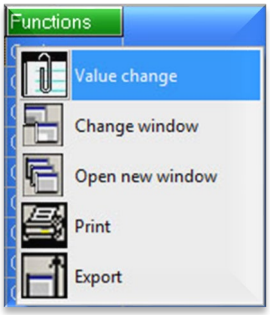


Select "**Latched**" and press "OK"
(if Password is request, see § Password):

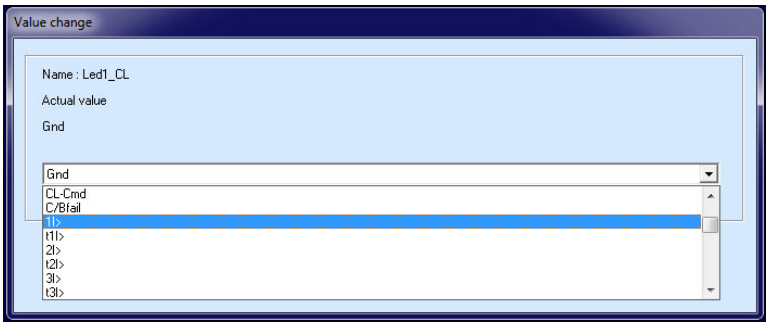


7.8.4 -"Functions"

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



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



8. User Variables

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

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

8.1 - Name

Internal progressive name

8.2 - User Descr.

Custom identification label for user variable

8.3 - Linked functions

Selection functions

8.4 - OpLogic

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

8.5 - Timer

Time delay (0-600)s, step 0.01s

8.6 - Timer type

Delay	=	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
Monostable P	=	Activated the output for the time "Timer"
Monostable N	=	Disactivated the output for the time "Timer".
Blinking	=	The output switches periodically at the frequency defined by "Timer".
Delay-Fall-Down	=	*Delay-Fall-Down*

8.7 – Extra

Extra Time (0 - 65000)s, step 1s

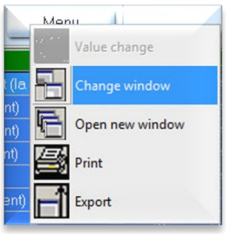
8.8 - Logical status

"User Variable" Logical status

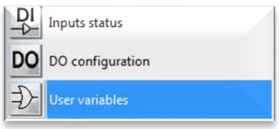
8.9 - Example: Setting "User Variable"

Open software program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"

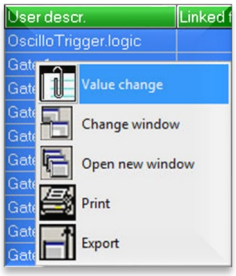


Setting for "**UserVar<0>**" : "Current Trip", "1I>,2I>,3I>", "OR", "1", "Monostable P", "10".

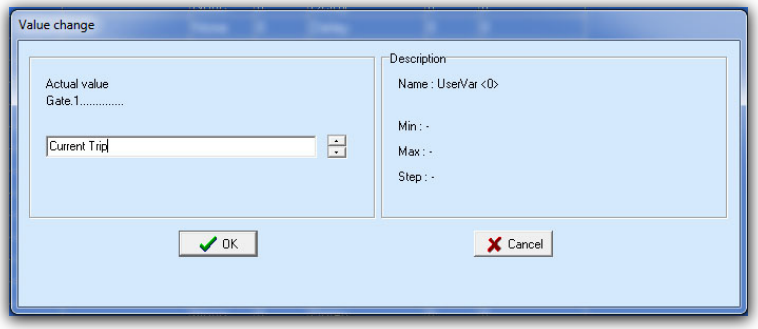
ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Extra	Logical status
1	UserTrigger Oscillo	OscilloTrigger.logic		None	0	Delay	0	0
2	UserVar <0>	Current Trip.....	1I>,2I>,3I>,	OR	1	Monostable P	10	0

8.9.1 - "User description" (User descr.)

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

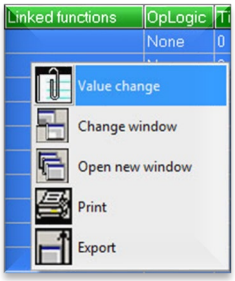


Insert "**Current Trip**" into box and press "OK":

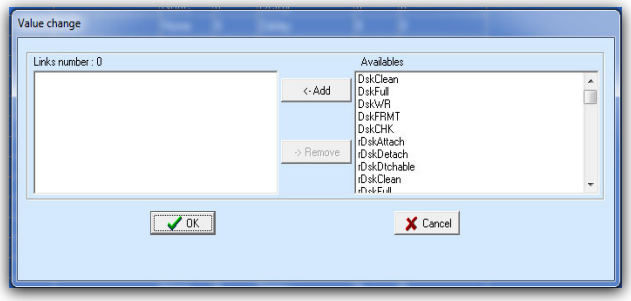


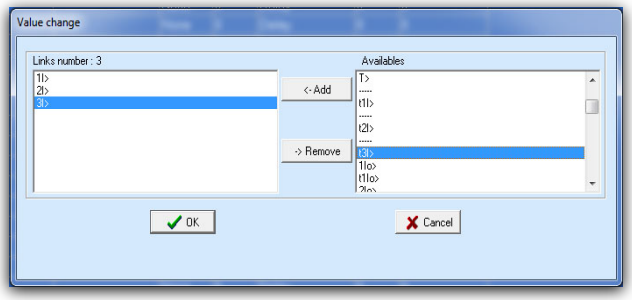
8.9.2 - "Linked Functions"

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



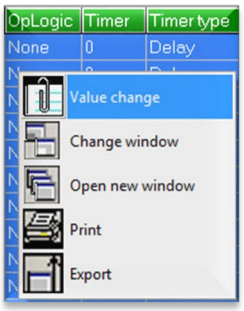
Select "**1I>, 2I>, 3I>**" from "Available" box via push-button "<Add", and press "OK".
For remove functions, use push-button ">Remove".



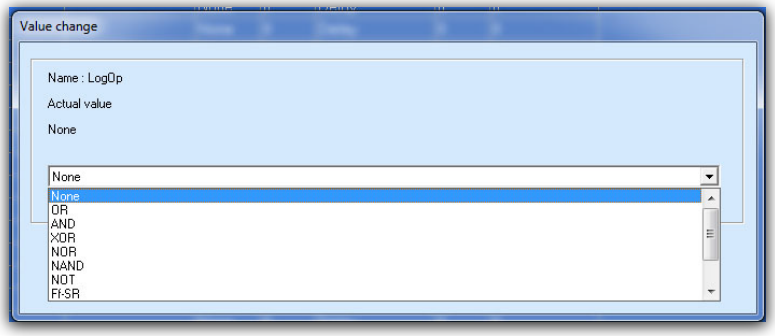


8.9.3 - "Operation Logic" (Oplogic)

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

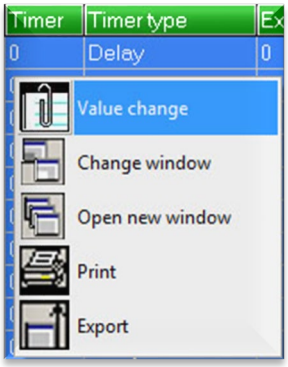


Insert "**OR**" into box and press "OK":

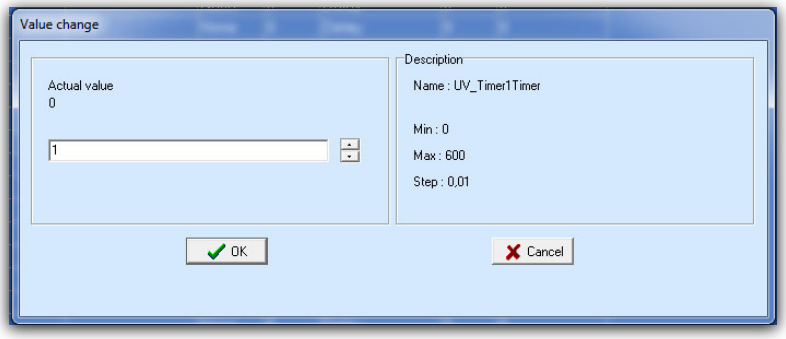


8.9.4 - "Timer"

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

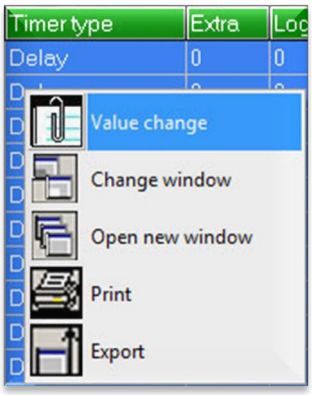


Select "**1**" into box and press "OK":

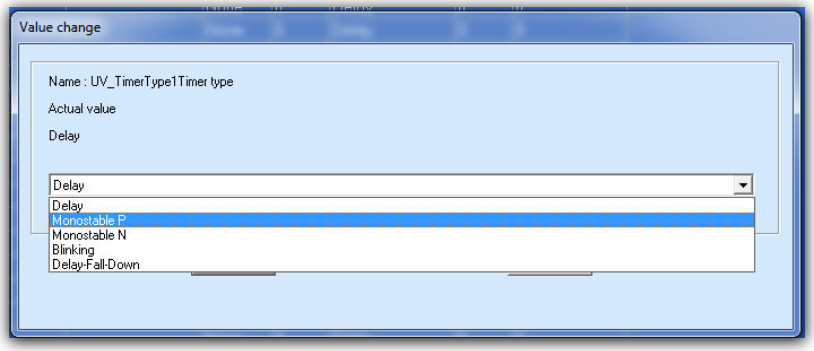


8.9.5 - "Timer type"

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

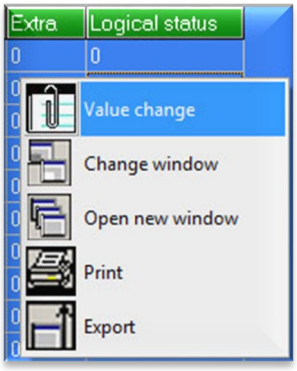


Select "**Monostable P**" into box and press "OK":

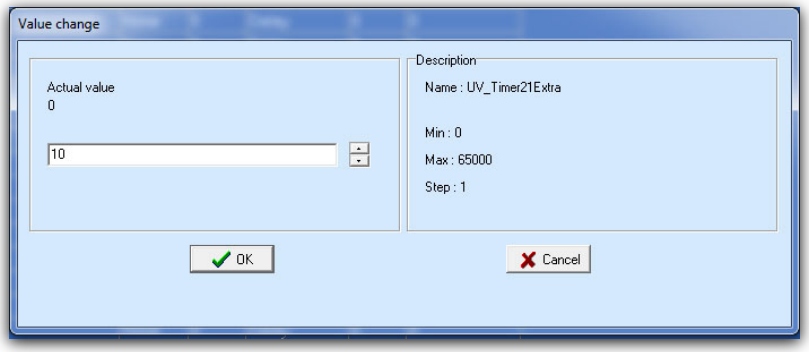


8.9.6 - "Extra"

Select "**Extra**" related to "UserVar<0>" and press right button on mouse,



Select "**10**" into box and press "OK":



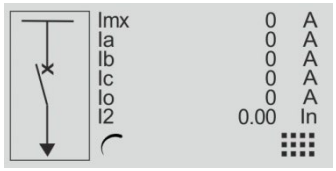
9. Local Commands

"***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*
→ main C/B	Cl.	Manual C/B closing (conditioned by Password)	Yes
→ main C/B	Op.	Manual C/B opening (conditioned by Password)	Yes
→ Event	Clear	Reset Events	Yes
→ LTrip	Clear	Reset Last Trip	Yes
→ Counter	Clear	Reset Counters	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 (only if T> is enable)	Yes
→ Leds	Test	Signal Leds test	*No*
→ Force	Osc	Force Oscillo Recording	Yes
→ Format	iDisk	Format internal disk	Yes
→ Check	iDisk	Check internal disk	Yes

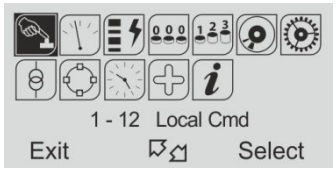
To operate one command by the Front Face Keyboard, proceed as follows (Led Clear in the present example).

1



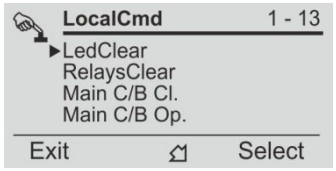
- Press "***Menu***" for access to the main menu with icons.

2



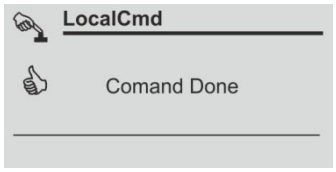
- Select "***LocalCmd***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



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

4

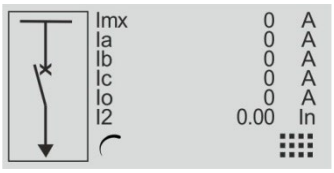


- When command has been executed the display shows "***Command Done***"; go to "*3*".

10. Measure

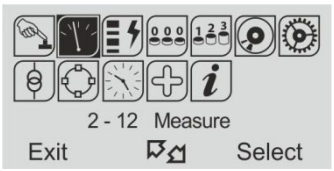
Real time values as measured during the normal operation.

1



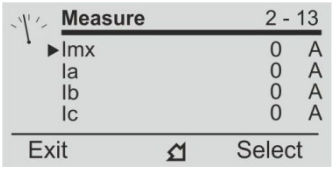
- Press "***Menu***" for access to the main menu with icons.

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.

Imx	(0 ÷ 99999)	A	Largest of the 3 phase-currents (Ia,Ib,Ic)
Ia	(0 ÷ 99999)	A	RMS value phase A current
Ib	(0 ÷ 99999)	A	RMS value phase B current
Ic	(0 ÷ 99999)	A	RMS value phase C current
Io	(0 ÷ 99999)	A	RMS value of Zero Sequence Current (RMS Secondary Amps)
I2	(0 ÷ 99999)	In	Negative Sequence current
Tem	(0 ÷ 99999)	%T	Thermal status as % of the full load continuous operation temperature Tn

11. Maximum Values (Only via software)

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

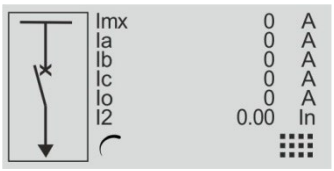
Imx	(0 ÷ 99999)	A	Largest of the 3 phase-currents (Ia,Ib,Ic)
Ia	(0 ÷ 99999)	A	RMS value phase A current
Ib	(0 ÷ 99999)	A	RMS value phase B current
Ic	(0 ÷ 99999)	A	RMS value phase C current
Io	(0 ÷ 99999)	A	RMS value of Zero Sequence Current (RMS Secondary Amps)
Tem	(0 ÷ 99999)	%T	Thermal status as % of the full load continuous operation temperature Tn

12. Trip Recording

Display of the function which caused the tripping of the relay plus values of the measurement at the moment of tripping. The last 30 events are recorded.
The memory buffer is refreshed at each new relay tripping (FIFO logic).

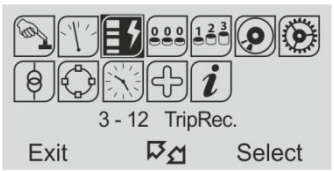
Display	→	Reading of recorded Trips.
Erase	→	Clear all Trips recorded.

1



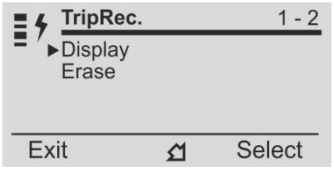
- Press "***Menu***" for access to the main menu with icons.

2



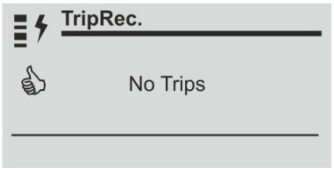
- Select "***TripRec.***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



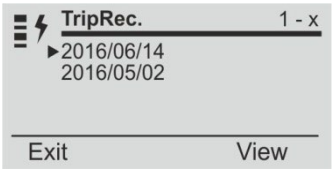
- Select "***Display***" *with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" go to "8"

4



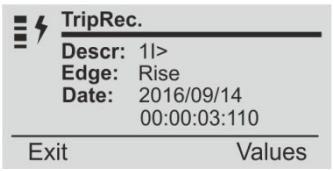
- If no trip is recorded the display shows "***No Trips***".

5



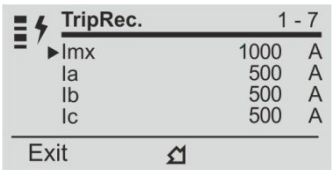
- If any trip was recorded, select "***View***" to display the chronological list of the records.
- By the keys "***Increase***" or "***Decrease***" select the date of the record to be checked.

6



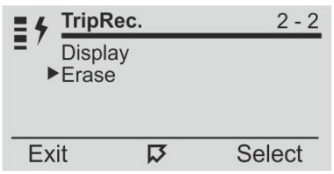
- Will be shown:
  "***Descr***" the function that caused the event (Example: t1I> = Rise)
  "***Edge***" if the function was tripped (Rise) or reset (Fall)
  "***Date***", date of trip, year/month/day, hour:minutes:seconds:milliseconds
- Press "***Value***", for reading the value of input quantities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

7



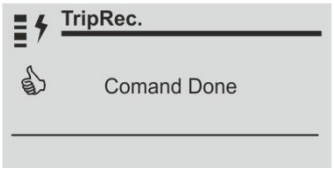
- Scroll with pushbuttons "***Increase***" or "***Decrease***" the available measurements.
- Select "***Exit***" to go back to "5" for another selection, or "2" go back to the main menu.

8



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

9



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

Imx	(0 ÷ 99999)	A	Largest of the 3 phase-currents (Ia,Ib,Ic)
Ia	(0 ÷ 99999)	A	RMS value phase A current
Ib	(0 ÷ 99999)	A	RMS value phase B current
Ic	(0 ÷ 99999)	A	RMS value phase C current
Io	(0 ÷ 99999)	A	RMS value of Zero Sequence Current (RMS Secondary Amps)
I2	(0 ÷ 99999)	In	Negative Sequence current
Tem	(0 ÷ 99999)	%T	Thermal status as % of the full load continuous operation temperature Tn

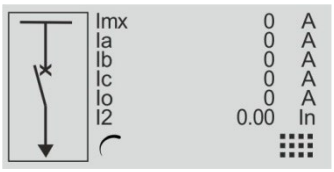
13. Partial Counters

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

Display	→ T>	0	Operations counters	Thermal Image
	→ 1I>	0	Operations counters	First overcurrent element
	→ 2I>	0	Operations counters	Second overcurrent element
	→ 3I>	0	Operations counters	Third overcurrent element
	→ 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 current element
	→ 2Is>	0	Operations counters	Second negative sequence current element
	→ RCLf	0	Operations counters	Automatic reclosure failed
	→ TwRCL	0	Operations counters	Trip non enable for automatic reclosure
	→ RCLok	0	Operations counters	Automatic reclosure successful
	→ MCLok	0	Operations counters	Manual reclosure cycle successful
	→ RCLBL	0	Operations counters	Automatic reclosure blocked (Lock-out)
	→ TCS	0	Operations counters	Trip Circuit Supervision
	→ IRF	0	Operations counters	Internal Relay Fault
	→ BrkF	0	Operations counters	Breaker failure
	→ AutOp	0	Operations counters	Automatic C/B Opening
	→ AutCL	0	Operations counters	Automatic C/B Closing
	→ ManOp	0	Operations counters	Manual C/B Opening
	→ ManCL	0	Operations counters	Manual C/B Closing
	→ OvrOp	0	Operations counters	Overall C/B Opening (Automatic + Manual)
	→ OvrCL	0	Operations counters	Overall C/B Closing (Automatic + Manual)

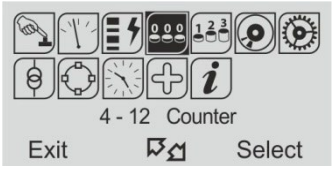
Erase	→	Reset all Counters (By the interface program software it is possible to individually reset the counters and set an initial starting number)

1



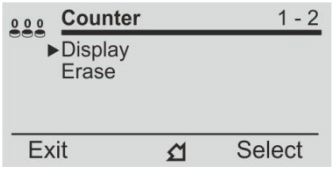
- Press "***Menu***" for access to the main menu with icons.

2



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

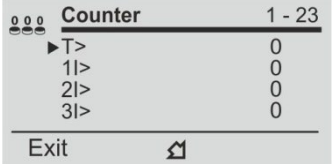
3



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

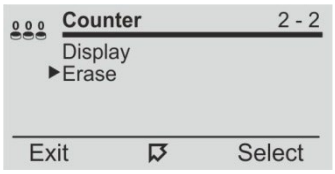
- For "***Erase***" to go to "5"

4



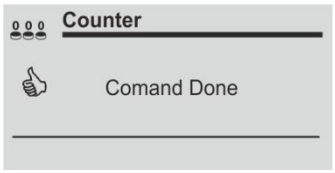
- Display of the number of operations of each individual function.
- With pushbuttons "***Increase***" or "***Decrease***" scroll the parameters
- Press "***Exit***" go back to "*3*".

5



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

6



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

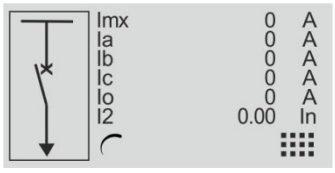
14. Total Counters

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

Display	T>	0	Operations counters	Thermal Image
	1I>	0	Operations counters	First overcurrent element
	2I>	0	Operations counters	Second overcurrent element
	3I>	0	Operations counters	Third overcurrent element
	1Io>	0	Operations counters	First earth fault element
	2Io>	0	Operations counters	Second earth fault element
	3Io>	0	Operations counters	Third earth fault element
	1Is>	0	Operations counters	First negative sequence current element
	2Is>	0	Operations counters	Second negative sequence current element
	RCLf	0	Operations counters	Automatic reclosure failed
	TwRCL	0	Operations counters	Trip non enable for automatic reclosure
	RCLok	0	Operations counters	Automatic reclosure successful
	MCLok	0	Operations counters	Manual reclosure cycle successful
	RCLBL	0	Operations counters	Automatic reclosure blocked (Lock-out)
	TCS	0	Operations counters	Trip Circuit Supervision
	IRF	0	Operations counters	Internal Relay Fault
	BrkF	0	Operations counters	Breaker failure
	AutOp	0	Operations counters	Automatic C/B Opening
	AutCL	0	Operations counters	Automatic C/B Closing
	ManOp	0	Operations counters	Manual C/B Opening
	ManCL	0	Operations counters	Manual C/B Closing
	OvrOp	0	Operations counters	Overall C/B Opening (Automatic + Manual)
	OvrCL	0	Operations counters	Overall C/B Closing (Automatic + Manual)

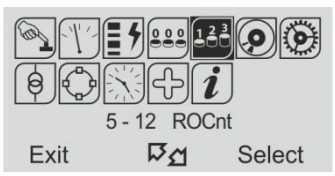
Erase	Reset all Counters (By the interface program software, it is possible to individually reset the counters and set an initial starting number)

1



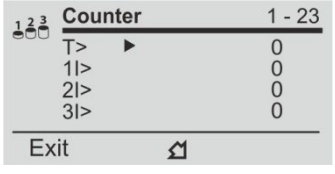
- Press "***Menu***" for access to the main menu with icons.

2



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

3



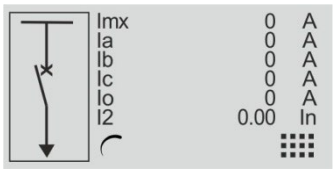
- With pushbuttons "***Increase***" or "***Decrease***" scroll the parameters.
- With pushbutton "***Exit***" to go back to the main menu.

15. 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 500 events are recorded at pick-up (rise) or drop-out (fall).
The memory buffer is updated at each new event.

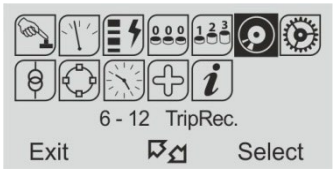
Display	Reading events recorded.
Erase	Clear all events recorded.

1



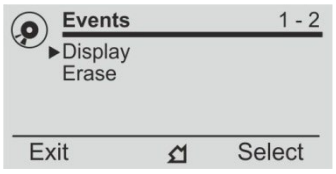
- Press "***Menu***" for access to the main menu with icons.

2



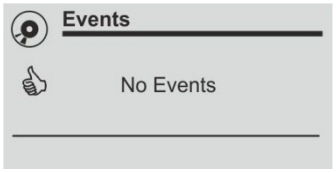
- Select "***Events***" *icon with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



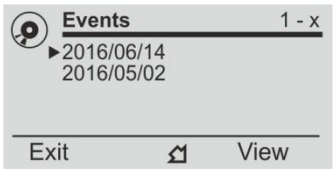
- Select "***Display***" *with pushbutton* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.
- For "***Erase***" go to "7"

4



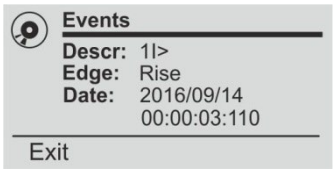
- If no event is recorded the display shows message "***No Events***".

5



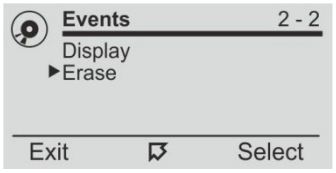
- If any event was recorded, select "***View***" to display the chronological list of the records.
- By the keys "***Increase***" or "***Decrease***" select the date of the record to be checked.

6



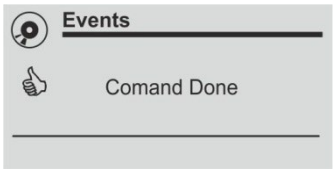
- Will be shown:
  "***Descr***" the function that caused the event
  (Example: 1I> = Start, t1I> = Trip)
  "***Edge***" if the function was tripped (Rise) or reset (Fall)
  "***Date***", date of trip, year/month/day, hour:minutes:seconds:milliseconds

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.

15.1 – Events on display

Functions	Events Displayed			Events Description	Status	
T>	Tal T>	*Tal* *T>*	*Alarm* *Trip*	*Thermal Image*	Rise Rise	 Fall
1I>	1I>* t1I>	*1I>* *t1I>*	*Start* *Trip*	*Fist overcurrent element*	Rise Rise	 Fall
2I>	2I>* t2I>	*2I>* *t2I>*	*Start* *Trip*	*Second overcurrent element*	Rise Rise	 Fall
3I>	3I>* t3I>	*3I>* *t3I>*	*Start* *Trip*	*Third overcurrent element*	Rise Rise	 Fall
1Io>	1Io>* t1Io>	*1Io>* *t1Io>*	*Start* *Trip*	*Fist earth fault element*	Rise Rise	 Fall
2Io>	2Io>* t2Io>	*2Io>* *t2Io>*	*Start* *Trip*	*Second earth fault element*	Rise Rise	 Fall
3Io>	3Io>* t3Io>	*3Io>* *t3Io>*	*Start* *Trip*	*Third earth fault element*	Rise Rise	 Fall
1Is>	1Is>* t1Is>	*1Is>* *t1Is>*	*Start* *Trip*	*First negative sequence current*	Rise Rise	 Fall
2Is>	2Is>* t2Is>	*2Is>* *t2Is>*	*Start* *Trip*	*Second negative sequence current*	Rise Rise	 Fall
TCS	TCS tTCS	*TCS* *tTCS*	*Start* *Trip*	*Trip Coil Supervision*	Rise Rise	 Fall
IRF	IRF tIRF	*IRF* *tIRF*	*Start* *Trip*	*Internal Relay Failure*	Rise Rise	
Disk	TimeSincro			*Time synchronization*	Rise	
	DskClean			Disk near to full clean operation is required	Rise	
	DskFull			Disk full write should be lock	Rise	
	L/R disc			Local/Remote signal Discrepancy	Rise	
C/B	manOpKey			Circuit Breaker intentional open by key	Rise	
	manOpLocC			Circuit Breaker intentional open by local command	Rise	
	manOpRemC			Circuit Breaker intentional open by remote command	Rise	
	manOpExtIn			Circuit Breaker intentional open by external input	Rise	
	ExterManOp			Circuit Breaker intentional external open	Rise	
	manClKey			Circuit Breaker intentional close by key	Rise	
	manClLocC			Circuit Breaker intentional close by local command	Rise	
	manClRemC			Circuit Breaker intentional close by remote command	Rise	
	manClExtIn			Circuit Breaker intentional close by external input	Rise	
	ExterManCh			Circuit Breaker intentional external close	Rise	
	CB-Fail			Circuit Breaker (C/B Failure)	Rise	Fall
Reclosure	79 X			Recloser command	Rise	
	FR			Recloser Failure	Rise	
	CRC			Recloser cycle in progress	Rise	
	TWR			Trip without recloser	Rise	
	ReclDone			Recloser succesfull	Rise	
	StartTnExt			Start reclaim time [TrExt] on external lockout	Rise	
	Stop TrExt			Reclaim time expiration [TrExt] on external lockout	Rise	
	RCLInterr.			RCL interrupted by setUp cause (no trip Enable)	Rise	
	CH-Riusc.			Manual close succesfull	Rise	
	BiRCL			Presence Reclosure external lockout cause (input/CB Failure)	Rise	Fall
	Start R1			Start first (1°) recloser cycle (Start t1)	Rise	
	Start R2			Start second (2°) recloser cycle (Start t2)	Rise	
	Start R3			Start third (3°) recloser cycle (Start t3)	Rise	
	Start R4			Start fourth (4°) recloser cycle (Start t4)	Rise	
	StartTr-d1			Start Reclaim&Discrim. time on 1° close (tr1-td1)	Rise	
	CRIntScDis			Cycle blocked by not reclosing trip	Rise	
	CRIntApInt			Cycle blocked byintentional CB open	Rise	
	CRIntBinp			Cycle interrupted by external cause	Rise	
	StartTr-d2			Start Reclaim&Discrim. time on 2° close (tr2-td2)	Rise	
	StartTr-d3			Start Reclaim&Discrim. time on 3° close (tr3-td3)	Rise	
	StartTr4			Start Reclaim time on 4° close (tr4)	Rise	
	CRCInChCB			Cycle blocked intentional CB Close	Rise	
	StartRChM			Start manual recloser cycle	Rise	
	FrLTr			Trip in last reclaim time available	Rise	
	Gr1-Gr2			Switch to SetUp Group2	Rise	Fall
	RCLInterr.			RCL interrupt by persistent fault	Rise	
	SeqC			Sequence Coordination (Start new/next RCL cycle)	Rise	

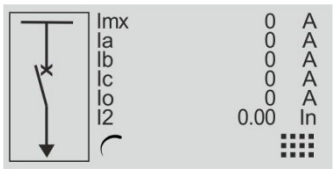
	Gen.Trip	General Trip	Rise	
	Gen.Start	General Start	Rise	
Digital Inputs	0.D1	*Digital Input D1*	Rise	Fall
	0.D2	*Digital Input D2*	Rise	Fall
	0.D3	*Digital Input D3*	Rise	Fall
	0.D4	*Digital Input D4*	Rise	Fall
	0.D5	*Digital Input D5*	Rise	Fall
	0.D6	*Digital Input D6*	Rise	Fall
	0.D7	*Digital Input D7*	Rise	Fall
	0.D8	*Digital Input D8*	Rise	Fall
Output Relays	0.R1	*Output relays R1*	Rise	Fall
	0.R2	*Output relays R2*	Rise	Fall
	0.R3	*Output relays R3*	Rise	Fall
	0.R4	*Output relays R4*	Rise	Fall
	0.R5	*Output relays R5*	Rise	Fall
	0.R6	*Output relays R6*	Rise	Fall
	0.R7	*Output relays R7*	Rise	Fall
	0.R8	*Output relays R8*	Rise	Fall

16. System (System parameters)

Setting of system parameters.

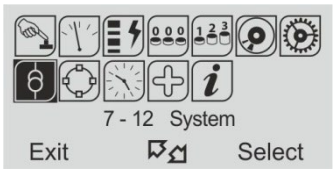
CTs&PTs	*Phase CT*	*Primary*	Prim.	→	1000	A	(1 ÷ 9999)	step 1	A
		Secondary	Sec.	→	1	A	(1 / 5)		
	Neutral CT	*Primary*	Prim.	→	1000	A	(1 ÷ 9999)	step 1	A
		Secondary	Sec.	→	1	A	(1 / 5)		
	Sys.Ratings		Fn	→	50	Hz	(50 / 60)		
			Nominal Frequency						
			In	→	100	A	(1 ÷ 9999)	step 1	A
			Nominal Current						
Setting Group			Group	→	1		(1 / 2)		

1



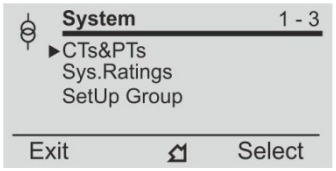
- Press "***Menu***" for access to the main menu with icons.

2



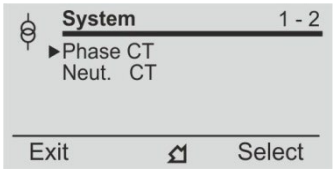
- Select "***System***" *icon with pushbuttons* "***Increase***" or "***Decrease***".
- Press "***Select***" for access.

3



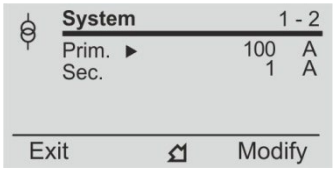
- Select "***CTs&PTs***".
- Press "***Select***" *for access.*

4



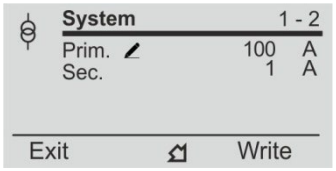
- Select "***Phase CT***".
- Press "***Select***" *for access.*

5



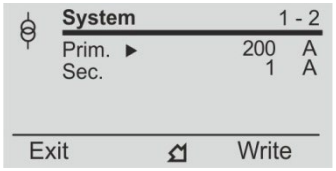
- Select "***Primary***" to modify the value, or press "***Decrease***"
- Press "***Modify***" to modify the parameter.
  (if Password is request, see § Password).

6



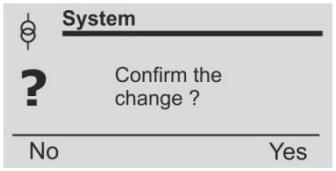
- Appear  icon.
- Use pushbuttons "***Increase***" or "***Decrease***" to set the value.
- Press "***Write***" to confirm the value

7



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

7

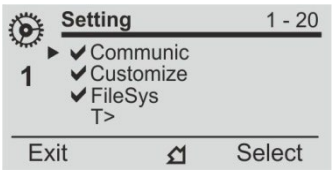


- The display show "***Confirm the change?***".
- Choose "***Yes*** " to confirm the changes.
- Choose "***No*** " to **not** confirm the changes.
- After set confirmation (or non-confirmation) the display goes back to point "3".

17. Settings

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

1



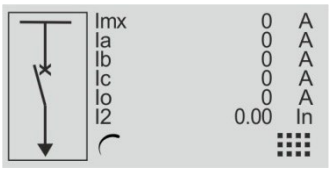
1	Indicates the Setting Group that is actually being modified.
✔	This symbol indicates that the function aside is enabled; symbol missing indicates that the function is disabled.

Group#1	*Group#2*	*Descriptions*
Communic.		Serial communication parameters
Customise	Customise	Visualization parameters
FileSys	FileSys	File Systems and disks management
T>	T>	Thermal Image
1I>	1I>	First Overcurrent Element
2I>	2I>	Second Overcurrent Element
3I>	3I>	Third Overcurrent Element
1Io>	1Io>	First Earth Fault Element
2Io>	2Io>	Second Earth Fault Element
3Io>	3Io>	Third Earth Fault Element
1Is>	1Is>	First Negative Sequence Current Element
2Is>	2Is>	Second Negative Sequence Current Element
Reclos	Reclos	Automatic Reclosure
tTripRd	tTripRd	Trip Time Reduction
TCS	TCS	Setting variables for Trip Circuit Supervision
IRF	IRF	Internal Relay Fault
BrkFail	BrkFail	Setting variables for Breaker Failure detection
Oscillo	Oscillo	Setting variables for Oscillographic recording
CB-Mngn	CB-Mngn	C/B command Local / Remote setting
ExtReset	ExtReset	Configuration for external reset input

17.1 - Modifying the setting of variables

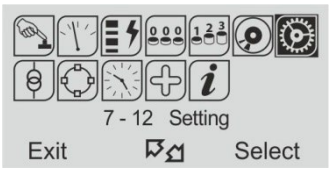
To modify any variable setting by the keyboard proceed as follows:
(example: change setting of element "***1I>***", from "**Is *1.000* In**" to "**Is *3.500* In**")

1



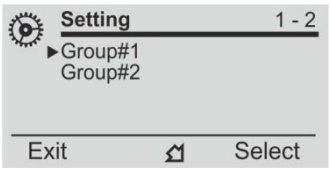
- Press "***Menu***" for access to the main menu with icons.

2



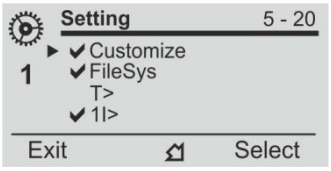
- Select icon "***Setting***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3



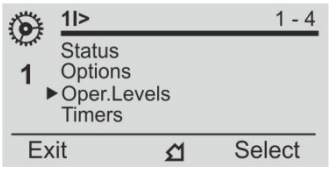
- Select by pushbuttons "***Group#1***"
- Press "***Select***".

4



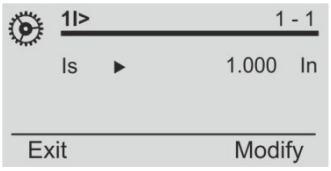
- Select by pushbuttons "***Increase***" or "***Decrease***" the parameter "***1I>***".
- Press "***Select***".

5



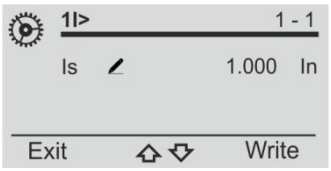
- Select by buttons "***Increase***" or "***Decrease***" the menu "***Oper.Levels***".
- Press "***Select***".

6



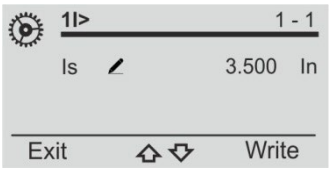
- The arrow aside "***Is***" shows the parameter selected for changing
- Press "***Modify***".
- If Password is request, see § Password

7



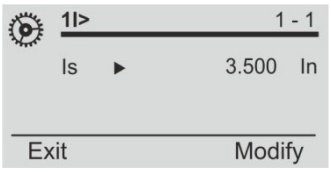
- Appear  icon.

8



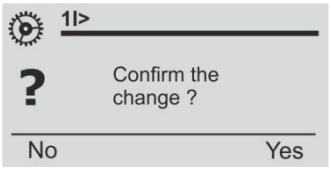
- Set new values pushbuttons "***Increase***" or "***Decrease***" buttons
- Press "***Write***".

9



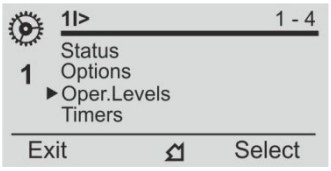
- If the change of parameters is completed, press "***Exit***".

10



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

11



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

17.2 - Password

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

The factory default password is " 1111 ".

The password is only modifiable with the software.

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

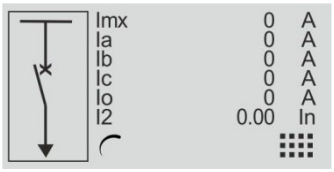
- Use the key "***Increase***" or "***Decrease***" to set the fourth digit.

8

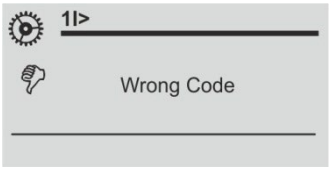
- Press "***Next***" to validate and go to modify the next parameter.

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

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

Options	→	**BRRem**	19200	[9600 / 19200 / 38400]
	→	**PRRem**	MODBUS	[MODBUS / IEC103]
Node Address	→	**Addr.**	1	[1 ÷ 250]

17.3.1 – Description of variables

BRRem	:	USB (Front Panel) serial communication speed
PRRem	:	Remote Protocol
Addr.	:	Identification number for the connection on serial communication bus

17.3.2 – Front Panel USB serial communication port (RS232)

A Mini-USB socket is available on Relay's front face for connection.
Through this port - and by the interface program for Windows XP/7 – it is possible connect a Personal Computer to download all available information, operate any control and program the relay; the protocol used is "Modbus RTU".
To avoid electronic damage, apply ESD caution.

17.3.3 – Cable for connection from Relay to Personal Computer

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

17.3.4 – Main serial communication port (RS485)

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

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

Options	→	**Lang**	English		[English / Loc.Lang]	
	→	**Light**	On		[Auto / On]	
Timers	→	**tBckL**	20	**s**	(5÷120)	step 1 s

17.4.1 – Description of variables

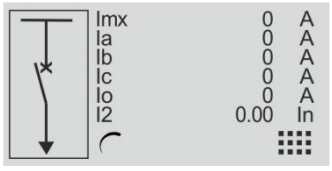
Lang	:	Set Language
Light	:	Set Display backlight
tBckL	:	Set Display backlight time

This menu allows to customize the Language and the Display.

The Display backlight can be programmed always on "ON" or switched-on "Automatically" for a few second (set parameter "tBckL") at any operation of the keyboard.

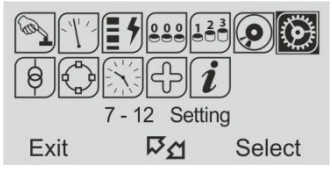
Example: set Local Language.

1



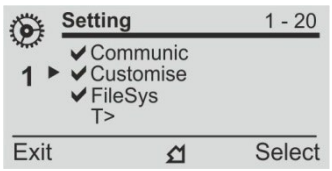
- Press "***Menu***" for access to the main menu with icons.

2



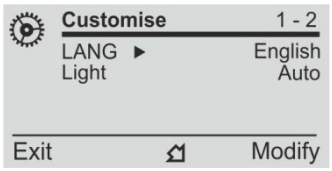
- Select icon "***Setting***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3



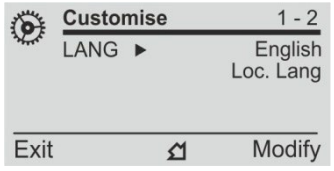
- Select "***Group 1***" or "***Group 2***"
- Select "***Customize***"
- Select "***Options***".
- Press "***Select***".

4



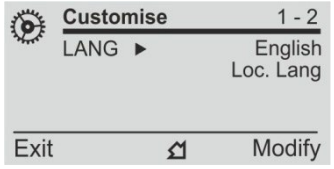
- Select "***Lang***"
- Press "***Modify***".

5



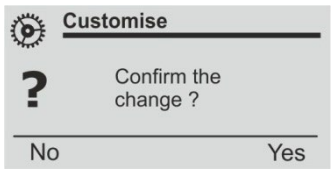
- Select "***Loc.Lang***".
- Press "***Write***"
- If Password is requested, see § Password

6



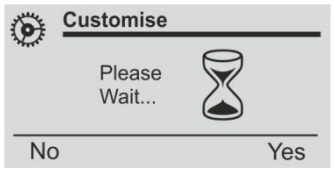
- Press "***Exit***"

7



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

8



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

*17.5 - Function: **FileSys** (File system and Disk management)*

Options	→	**iDwr**	enable	[enable / disable]
	→	**OniDF**	StopWrite	[StopWrite / DelOldFiles]
	→	**eJrn**	enable	[enable / disable]
		eTrip	enable	[enable / disable]
	→	**eOsc**	enable	[enable / disable]

17.5.1 - Description of variables

iDwr	:	Internal Disk write
	Enable	: Protection log file write enabled
	Disable	: Protection log file write disabled
OniDF	:	Write policy on internal full disk condition
	StopWrite	: Write disable
	DelOldFiles	: Delete older folder and write
eJrn	:	Journal log file
	Enable	: Journal file write enabled
	Disable	: Journal file write disabled
eTrip	:	Faults log file
	Enable	: Faults file write enabled
	Disable	: Faults file write disabled
eOsc	:	Oscillo comtrade file
	Enable	: Oscillo file write enabled
	Disable	: Oscillo file write disabled

17.5.2 – Download file informations

Files related to "Journal" - "Fault log" - "Oscillo" are available in the relay internal memory.

Connect the USB cable to the relay and wait a few moments.

17.5.2.1 – Journal file

Example:

Directory				**Descriptions**
DATALOG	2016			Year
	Jul			Month
		03		Day
			Jrnl_03.07.2016.txt	Journal File

Jrnl_03.07.2016.txt			
Date	**Time**	**Event**	
2016/07/03	*18:42:07:100*	*Vcc*	*Rise*
2016/07/03	*18:42:07:100*	*L/Rdisc*	*Rise*
2016/07/03	*18:42:07:110*	*IPU boot*	*Rise*

17.5.2.2 – Faults log file

Example:

Directory					Descriptions
TRIPS	2016				Year
		Jul			Month
			15		Day
				Trips_15.06.2016.txt	Trips log File

Trips_15.06.2016.txt			
Date	**Time**	**Event**	**Values**
2016/06/15	08:17:27:200	tCS	Imx=0.0; Ia=0.0; Ib=0.0; Ic=0.0; Io=0.0; I2=0.00; Tem=0
2016/06/15	10:31:03:901	tCS	Imx=0.0; Ia=0.0; Ib=0.0; Ic=0.0; Io=0.0; I2=0.00; Tem=0

17.5.2.3 – Oscillographic file

Example:

Directory					Descriptions
OSCILLO	2016				Year
		Jul			Month
			15		Day
				fault1_2016.05.04.15.56.45.cfg fault1_2016.05.04.15.56.45.dat	Oscillographic Comtrade File

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

Status	→	**Enab.**	No		[No / Yes]			
Oper.Levels	→	**Tal**	50	**%Tb**	[10 ÷ 100]	step	1	%Tb
	→	**Tres**	50	**%Tb**	[10 ÷ 100]	step	1	%Tb
	→	**Is**	1	**In**	[0.5 ÷ 1.5]	step	0.01	In
	→	**Kt**	60	**min**	[1 ÷ 600]	step	0.01	min

17.6.1 - Description of variables

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

17.6.2 - Trip and Alarm

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

17.6.2.1 – Trip time of the Thermal Image Element

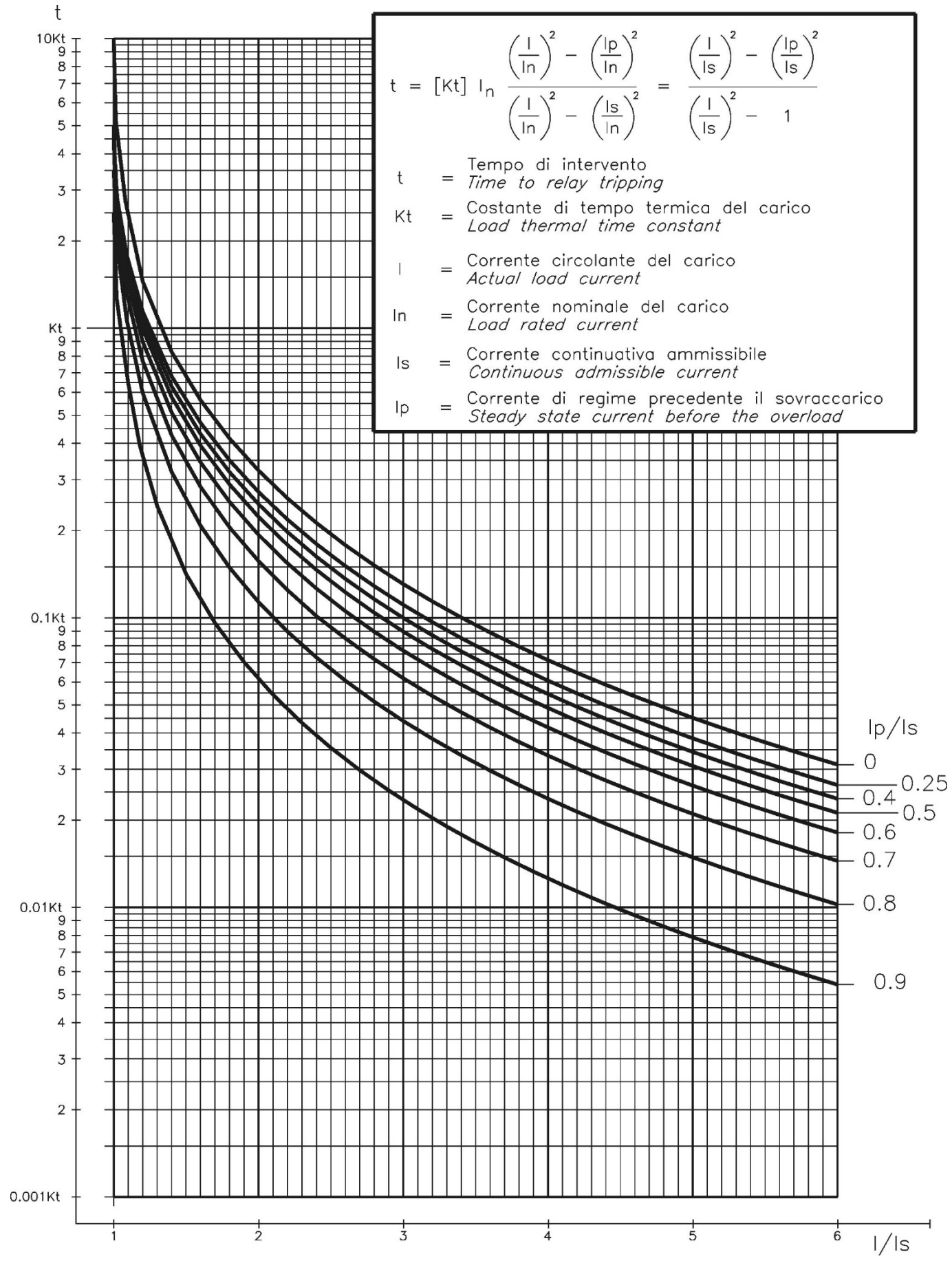
The trip time of the Thermal Image Element is a function of the current "I" flowing into the load and depends on its warming-up Time Constant "Kt", on the previous thermal status "Ip" and on the maximum admissible continuous current "Is" according to the equation:

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

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

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

17.6.2.2 – Thermal Image Curves (TU1024 Rev.1)



*17.7 - 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]			
Oper. Levels	→	**Is**	1	**In**	(0.1 ÷ 4)	step	0.01	In
Timers	→	**ts**	5	**s**	(0.02 ÷ 100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05 ÷ 0.75)	step	0.01	s

17.7.1 - Description of variables

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

17.7.2 – Blocking Logic (BO-BI)

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

17.7.2.1 – Output Blocking signal "BO"

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

17.7.2.2 – Blocking Input "BI"

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

17.7.3 - Automatic doubling of Overcurrent thresholds on current inrush

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

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

Status	→	**Enab.**	Yes		[No / Yes]			
Options	→	**tBI**	Off		[Off / 2tBO]			
	→	**2xI**	Disable		[Disable / Enable]			
Oper. Levels	→	**Is**	1	**In**	(0.1÷40)	step	0.01	In
Timers	→	**ts**	5	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
	→	**t2xI**	2	**s**	(0.02÷100)	step	0.01	s
	→	**td2xI**	0.06		Fixed			

17.8.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
tBI	:	Blocking input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
2xI	:	Automatic doubling of trip level on inrush
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.
t2xI	:	Maximum time of automatic threshold doubling on inrush
td2xI	:	Time for calculation of current rate of rise.

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

Status	→	**Enab.**	Yes		[No / Yes]			
Options	→	**tBI**	Off		[Off / 2tBO]			
	→	**2xI**	Disable		[Disable / Enable]			
Oper. Levels	→	**Is**	1	**In**	(0.1÷40)	step	0.01	In
Timers	→	**ts**	5	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s
	→	**t2xI**	2	**s**	(0.02÷100)	step	0.01	s
	→	**td2xI**	0.06		Fixed			

17.9.1 - Description of variables

Enab.	:	Function enabling (No = Disable / Yes = Enable)
tBI	:	Blocking input reset time *Off* = Permanent block *2tBO* = Set 2xtBO.
2xI	:	Automatic doubling of trip level on inrush
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.
t2xI	:	Maximum time of automatic threshold doubling on inrush
td2xI	:	Time for calculation of current rate of rise.

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

Status	→ **Enab.**	Yes		[No / Yes]			
Options	→ **f(t)**	Type - D		[D / A / B / C / I / VI / EI / MI / SI]			
	→ **tBI**	Off		[Off / 2tBO]			
Oper.Levels	→ **Is**	1	**On**	(0.01÷4)	step	0.01	On
Timers	→ **ts**	5	**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.

17.10.1 - 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.

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

Status	→ **Enab.**	Yes		[No / Yes]			
Options	→ **tBI**	Off		[Off / 2tBO]			
Oper.Levels	→ **Is**	1	**On**	(0.01÷9.99)	step	0.01	On
Timers	→ **ts**	5	**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.

17.11.1 - Description of variables

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

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

Status	→	**Enab.**	Yes		[No / Yes]			
Options	→	**tBI**	Off		[Off / 2tBO]			
Oper.Levels	→	**Is**	1	**On**	(0.01÷9.99)	step	0.01	On
Timers	→	**ts**	5	**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.

17.12.1 - Description of variables

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

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

Status	→	**Enab.**	Yes		[No / Yes]			
Options	→	**t(t)**	Type-D		[D / A / B / C / I / VI / EI / MI / SI]			
	→	**tBI**	Off		[Off / 2tBO]			
Oper.Levels	→	**Is**	1	**In**	(0.1÷4)	step	0.01	In
Timers	→	**ts**	5	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.13.1 - 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.

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

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

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

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

Status	→	**Enab.**	Yes		[No / Yes]			
Options	→	**tBI**	Off		[Off / 2tBO]			
Oper.Levels	→	**Is**	1	**In**	(0.1÷4)	step	0.01	In
Timers	→	**ts**	5	**s**	(0.02÷100)	step	0.01	s
	→	**tBO**	0.75	**s**	(0.05÷0.75)	step	0.01	s

17.14.1 - Description of variables

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

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

Status	→	**Enab.**	Yes		[No / Yes]
Options	→	**ShNum**	1		[0 - 1 - 2 - 3 - 4]
	→	**R 1I>**	1+2+3+4	→	Recl. Dis = Automatic Reclosure (AR) disable 1 = AR Enable on shot 1 2 = AR Enable on shot 2 1+2 = AR Enable on shot 1+2 3 = AR Enable on shot 3 1+3 = AR Enable on shot 1+3 2+3 = AR Enable on shot 2+3 1+2+3 = AR Enable on shot 1+2+3 4 = AR Enable on shot 4 1+4 = AR Enable on shot 1+4 2+4 = AR Enable on shot 2+4 1+2+4 = AR Enable on shot 1+2+4 3+4 = AR Enable on shot 3+4 1+3+4 = AR Enable on shot 1+3+4 2+3+4 = AR Enable on shot 2+3+4 1+2+3+4 = AR Enable on shot 1+2+3+4 (*) see example
	→	**R 2I>**	1+2+3+4		Same as above
	→	**R 3I>**	1+2+3+4		Same as above
	→	**R 1Io>**	1+2+3+4		Same as above
	→	**R 2Io>**	1+2+3+4		Same as above
	→	**R 3Io>**	Recl. Dis.		Same as above
	→	**GR1-2**	Disable		[Disable / Shot1 / Shot2 / Shot3 / Shot4]
	→	**SeqC**	Disable		[Disable / Enable]

Timers	→	**tSeqC**	0	**s**	(0.00 ÷ 5.00)	step	0.01	s
	→	**t1**	2	**s**	(0.10 ÷ 200)	step	0.1	s
	→	**Tr1**	5	**s**	(5.00 ÷ 200)	step	1	s
	→	**Td1**	0	**s**	(0.00 ÷ 5.00)	step	0.1	s
	→	**t2**	4	**s**	(0.10 ÷ 1000)	step	0.1	s
	→	**Tr2**	5	**s**	(5.00 ÷ 200)	step	1	s
	→	**Td2**	0	**s**	(0.00 ÷ 5.00)	step	0.1	s
	→	**t3**	6	**s**	(0.10 ÷ 1000)	step	0.1	s
	→	**Tr3**	5	**s**	(5.00 ÷ 200)	step	1	s
	→	**Td3**	0	**s**	(0.00 ÷ 5.00)	step	0.1	s
	→	**t4**	8	**s**	(0.10 ÷ 1000)	step	0.1	s
	→	**Tr4**	5	**s**	(5.00 ÷ 200)	step	1	s
	→	**TrCL**	5	**s**	(5.00 ÷ 200)	step	1	s
	→	**ThExt**	5	**s**	(5.00 ÷ 200)	step	1	s

17.15.1 - Description of variables

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

17.15.2 – Definitions

Shot Number (ShNum = 0, 1, 2, 3, 4):

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

Set Group Change-over (GR1-2):

Determines the reclosure shot in a cycle after switch the relay automatically switches from setting group 1 to setting group 2.
At the end of the reclaim time "Tr" the setting group 1 is automatically restored.

Sequence Coordination (SeqC), (tSeqC):

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

Reclosure time (t1, t2, t3, t4):

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

Reclaim time (Tr1, Tr2, Tr3, Tr4):

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

Discrimination time (Td1, Td2, Td3):

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

Reclaim time after manual closure (TrCL):

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

Holding time of the external lock-out signal (ThExt):

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

17.15.2.1 - Example

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

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

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

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

17.15.3 - Operation

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

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

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

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

Any time the Circuit Breaker (C/B) is manually closed the Reclaim time "TrCL" is started.
Any time the C/B is reclosed by one AR shot (Sh1, 2, 3, 4) the relevant reclaim time (Tr1, Tr2, Tr3, Tr4) and the discrimination time (Td1, Td2, Td3) are started.
After a manual closure of the C/B, tripping of any of the relay protection elements during "TrCL" makes the relay enter into the Lock-Out status (L.O.). In the L.O. status the relay, after breaker opening, does not produce any command for automatic reclose ; in this situation the "RCL" display indicates "Failed" Reclosure; if programmed the output relay (RCLf) is operated.
Reset from the L.O. status take place when C/B manually closed or when the digital input "ExtReset" (if programmed) is activated.
If none of the relay protection elements trips during "TrCL" after a manual closure of the C/B, the relay is ready to start the Automatic Reclose Sequence;
the display indications are : RCL = Ready, LRC = Manual Close.
The tripping of any element programmed for the operation of the next reclosure during the reclaim time "Trx" makes the relay proceed with the reclosing cycle.
After "Trx" is expired the relay is ready for a new AR Cycle.
N.B.
For operation of the Autoreclose Function C/B trip must be controlled by output relay "R1", and C/B close must be controlled by relay "R2".

17.15.4 - Reclose Command

As soon as the C/B is opened due to tripping of one of the relay's elements programmed to initiate the next automatic reclose the relevant reclose, the relevant time delay (t1, t2, t3, t4) is started and at the end of this time the reclose command is issued by the relay.

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

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

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

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

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

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

Status	→	**Enab.**	No		[No / Yes]			
Timers	→	**tHold**	0.00	**s**	(0.00÷180)	step	1	s
	→	**tC1 I**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC2 I**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC3 I**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC1 Io**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC2 Io**	0.02	**s**	(0.02÷100)	step	0.01	s
	→	**tC3 Io**	0.02	**s**	(0.02÷100)	step	0.01	s

17.16.1 - Description of variables

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

17.16.2 - Operation

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

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

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

18.17.1 - Description of variables

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

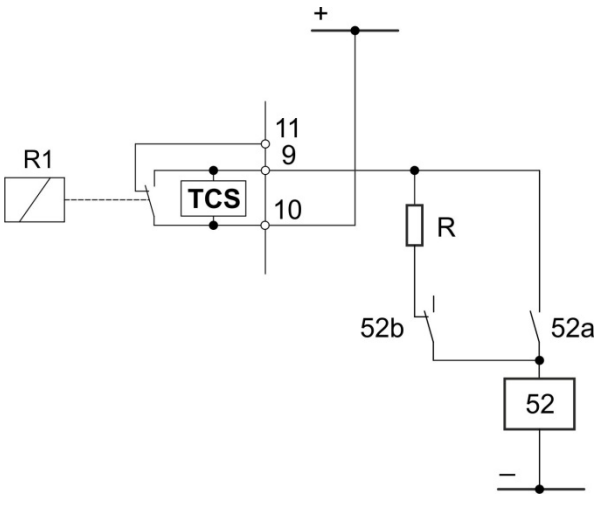
17.17.2 - Operation

The relay includes a complete Circuit Breaker Trip Circuit Supervision unit that is associated to the Contact "9-10" of the "R1" Output Relay.
The contact of "R1" is used to trip the C/B as reported in the drawing here below.
The supervision works when the C/B is closed and recognizes the Trip Circuit as sound as far as the current flowing exceeds "1mA".
In case of Trip Circuit Fault detection, the diagnostic relay is operated and the Led starts flashing (see § Signalization).
To have Supervision also with the C/B open one N/C contact (52b) from the C/B and an external resistor "R" are needed.

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

V = Trip Circuit Voltage

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



Tripping of the function operates a user programmable output relay.

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

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

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

17.18.1 - Description of variables

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

17.18.2 - Operation

Tripping of the function operates a user programmable output relay.

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

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

17.19.1 - Description of variables

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

17.19.2 - Operation

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

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

Status	→	**Enab.**	No		[No / Yes]			
Options	→	**Trig**	Trip		[Start / Trip / OnCmd / REUserLg / FEUserLg]			
Timers	→	**tPre**	0.5	**s**	(0.01÷2)	step	0.01	s
	→	**tPost**	0.5	**s**	(0.01÷8)	step	0.01	s

17.20.1 - 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 *OnCmd* = On Asynchronous Force trigger command *REUserLg* = On rising edge of "User Logic" (see § "User Trigger Oscillo") *FEUserLg* = On falling edge of "User Logic"
tPre	:	Recording time before Trigger
tPost	:	Recording time after Trigger

17.20.2 - Operation

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

The "Oscillo" Function includes the oscillographic recorder of input quantities able to store up to 10 seconds for each record.
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 40 (40 x 1 sec).
Any new event exciting the memory capability, cancels and overwrites the former records (FIFO Memory).

Example:

tPre = 0.5s *tPost* = 0.5s	=	1s	→	40	Oscillographic recording
tPre = 2s *tPost* = 8s	=	10s	→	4	Oscillographic recording

17.20.3 – Available on software

Internal Disk	DskClean		*Disk near Full clean operation is required*		
	DskFull		*Disk Full Write should be lock*		
	DskWR		*Disk write in progress*		
	DskFRMT		*Disk Format in progress*		
	DskCHK		*Check disk in progress*		
Removable Disk	rDskAttach		*Removable disk usb attach*		
	rDskDetach		*Removable disk usb detach*		
	rDskDtchable		*Removable disk usb now detachable*		
	rDskClean		*Removable disk usb near to full clean operation is required*		
	rDskFull		*Removable disk usb full, write locked*		
	rDskWR		*Removable disk usb write in progress*		
	rDskFRMT		*Removable disk usb format in progress*		
	rDskCHK		*Removable disk usb check in progress*		
T>	Tal	*Alarm*	*Thermal Image T>*		
	T>	*Trip*			
1I>	1I>	*Start*	*First overcurrent element F50-51*		
	t1I>	*Trip*			
2I>	2I>	*Start*	*Second overcurrent element F50-51*		
	t2I>	*Trip*			
3I>	3I>	*Start*	*Third overcurrent element F50-51*		
	t3I>	*Trip*			
1Io>	1Io>	*Start*	*First earth fault element F50N-51N*		
	t1Io>	*Trip*			
2Io>	2Io>	*Start*	*Second earth fault element F50N-51N*		
	t2Io>	*Trip*			
3Io>	3Io>	*Start*	*Third earth fault element F50N-51N*		
	t3Io>	*Trip*			
1Is>	1Is>	*Start*	*First negative sequence current element F46*		
	t1Is>	*Trip*			
2Is>	2Is>	*Start*	*Second negative sequence current element F46*		
	t2Is>	*Trip*			
TCS	TCS	*Start*	*trip coil supervision*		
	tTCS	*Trip*			
IRF	IRF	*Start*	*Internal Relay Failure*		
	tIRF	*Trip*			
Reclosure	RCLf		*Autoreclosure failed*		
	RCLrun		*Autoreclosure in progress*		
	TwRCL		*Trip not enabled for Automatic Reclosure*		
	RCL-OK		*Successful Automatic Reclosure*		
	ManCL-OK		*Manual Closure*		
	BiRCL		*Presence Reclosure external lockout cause (input/CB Failure)*		
	TripTimeR		*Trip time reduction active*		
C/B	Gr1to2		*Switch to SetUp Group2*		
	BF		*Breaker Failure*		
	manOpCmd		*Manual Open Command*		
	CL-Cmd		*Close Command*		
	C/Bfail		*Circuit Breaker failure*		
	L/Rdisc		*Local/Remote signal Discrepancy*		
	Gen.Start		*Start Generic*		
	Gen.Trip		*Trip Generic*		
	OscilloTriggerLogic		*User Variable for Oscillographic Recording*		
	UserVar<0> to UserVar<24>		*User Variable*		
	Vcc		*Reserved*		
	Gnd		*Reserved*		
	ResLog		*Reset signal logic*		
	P1 to P6		*Push-button*		
	0.D1		*Digital Input "0.D1"*	*activated*	*Digital Inputs*
	0.D1Not		*Digital Input "0.D1"*	*deactivated*	
	to				
	0.D8		*Digital Input "0.D8"*	*activated*	
	0.D8Not		*Digital Input "0.D8"*	*deactivated*	

17.20.4 – Setting "User Trigger Oscillo"

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

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

17.20.4.1 - Name

Internal name

17.20.4.2 - User descr.

Fixed

17.20.4.3 - Linked functions

Selection functions

17.20.4.4 - OpLogic

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

17.20.4.5 - Timer

Time delay (0-600)s, step 0.01s

17.20.4.6 - Timer type

Delay	=	Add a delay on output activation. The "Timer" is edge triggered on rise edge.
Monostable P	=	Activated the output for the time "Timer"
Monostable N	=	Disactivated the output for the time "Timer".
Blinking	=	The output switches periodically at the frequency defined by "Timer".
Delay-Fall-Down	=	*Delay-Fall-Down*

17.20.4.7 – Extra

Extra Time (0-65000)s, step 1s

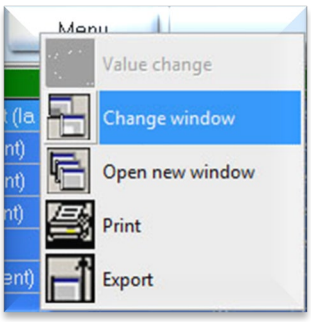
17.20.4.8 - Logical status

"User Trigger Oscillo" Logical status

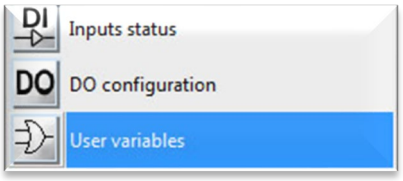
17.20.5 – Example: Setting "Oscillo Trigger Logic"

Open software program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"



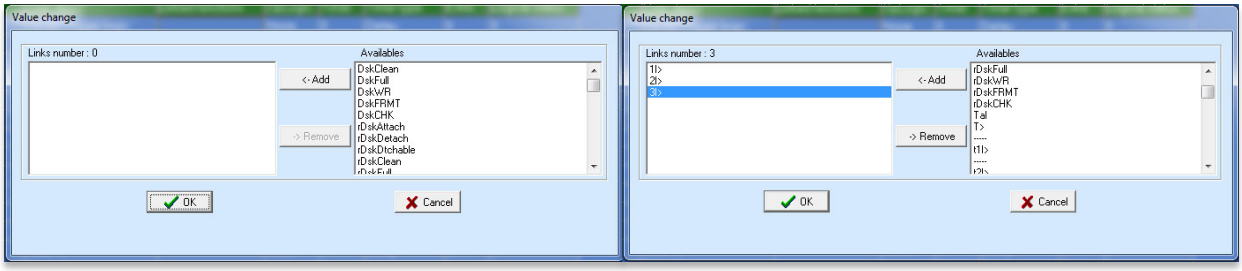
Setting for "User Trigger Oscillo" : "**1I>/2I>/3I>**", "**AND**", "**1**", "**Monostable**", "**10**".

Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Extra	Logical status
UserTrigger Oscillo	OscilloTrigger.logic	1I>,2I>,3I>,	AND	1	Monostable P	10	0
UserVar <0>	Gate.1.....		None	0	Delay	0	0

17.20.5.1 – "Linked Functions"

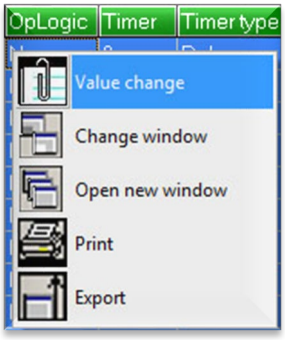
Select "**Linked Functions**" related to "User Trigger Oscillo" and press right button on mouse, select "Value change":

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

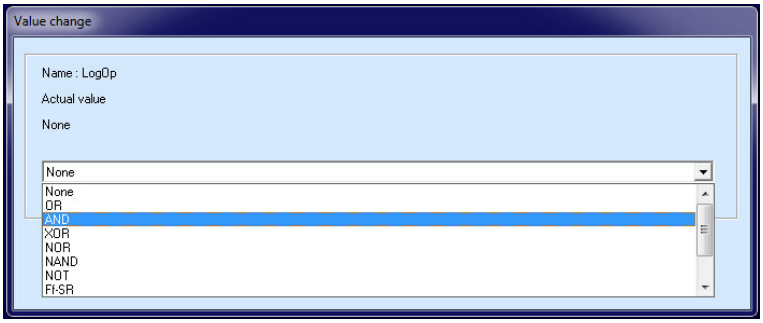


17.20.5.2 – "Operation Logic" (Oplogic)

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

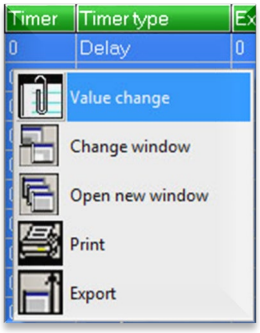


Insert "**AND**" into box and press "OK":

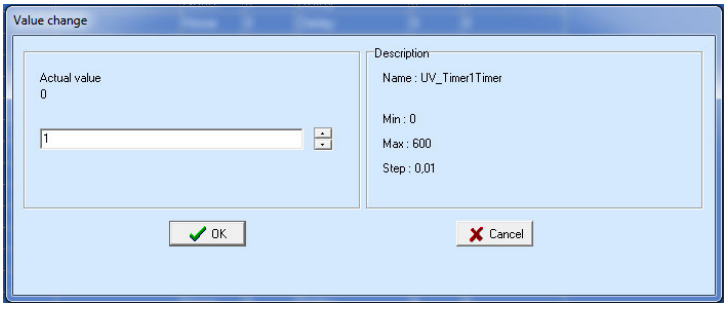


17.20.5.3 – "Timer"

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

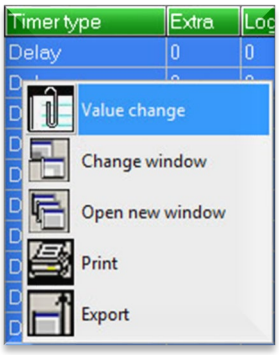


Select "**1**" into box and press "OK":

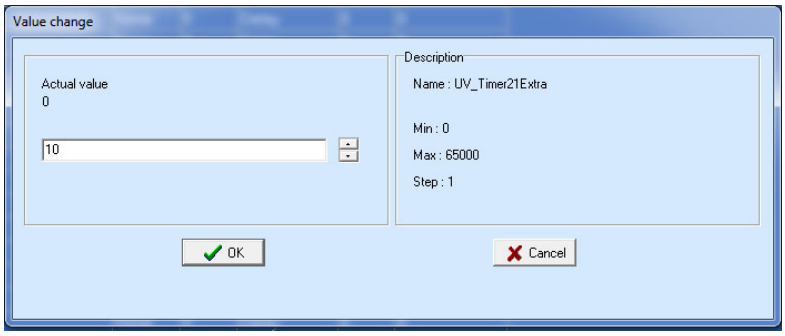


17.20.5.4 – "Timer type"

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

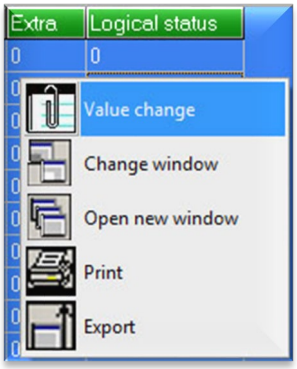


Select "**Monostable P**" into box and press "OK":

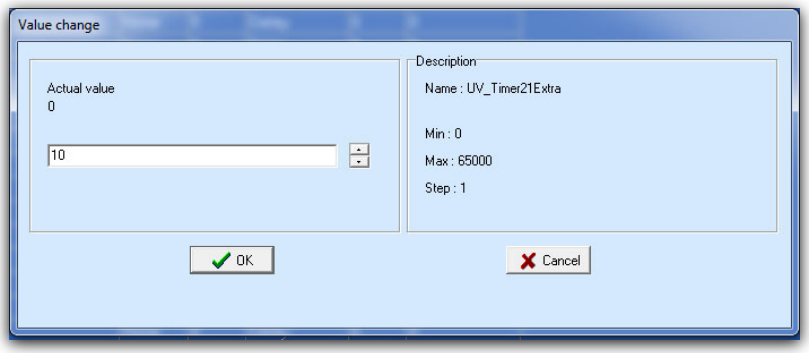


17.20.5.5 – "Extra"

Select "**Extra**" related to "User Trigger Oscillo" and press right button on mouse,



Select "**10**" into box and press "OK":



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

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

Status	→	**Enab.**	Enable		Fixed			
Options	→	**L/R**	Ignored		[Ignored / Active]			
	→	**KeyE**	Enable		[Disable / Enable]			
	→	**Key0**	None		[None / P1 / P2 / P3 / P4 / P5 / P6]			
	→	**KeyC**	None		[None / P1 / P2 / P3 / P4 / P5 / P6]			
Timers	→	**tL/R**	0.05	**s**	(0.05 ÷ 1)	step	0.05	s
	→	**tC/Bs**	0.5	**s**	(0.05 ÷ 1)	step	0.05	s

17.21.1 - Description of variables

L/R	:	Selection of Local/Remote C/B operation mode Ignored or Active
KeyE	:	*Disable* = The pushbuttons on Front Panel are disabled; *Enable* = The pushbuttons on Front Panel are Enable
Key0	:	Configure a Key as C/B Open
KeyC	:	Configure a Key as C/B Close
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.

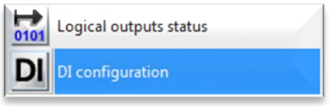
17.21.2 – Push-Buttons (Programmable only via software)

It is possible to program up to six buttons on front of the relay, assigning any action / function.

Example: "**OPEN C/B**" to "**P1**" and "**CLOSE C/B**" to "**P2**".

17.21.2.1 – "DI Configurations" (Digital Inputs)

Select "**DI configuration**":



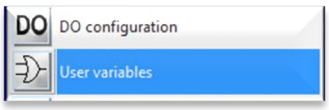
Assign to:

Type	*Functions*	
Main C/B CloseSts	0.D1	digital input
Local State	0.D3	digital input
Remote State	0.D4	digital input

ID	Name	Status	Functions
1	Group 1-2	Gruppo-1 (0)	
2	ExtR (external reset input)	Not active	
3	Local State	ACTIVE	0.D3,
4	Remote State	Not active	0.D4,
5	C/B Open command	Not active	
6	C/B Close command	Not active	
7	Main C/B CloseSts (Main Circuit Breaker CLOSE position status)	Not active	0.D1,

17.21.2.2 – "User Variables"

Select "**User Variable**":



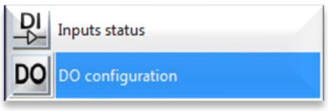
Assign to:

Type		*Linked Functions*	
UserVar(0)	Gate.1	manOpCmd,Gen.Trip	*Manual Open Command, Generic Trip*
UserVar(0)	Gate.2	CL-Cmd	*Close Command*

ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Extra	Logical status
1	UserTrigger Oscillo	OscilloTrigger.logic		None (0)	0	Delay (0)	0	0
2	UserVar <0>	Gate.1	manOpCmd,Gen.Trip,	OR (1)	0	Delay (0)	0	0
3	UserVar <1>	Gate.2	CL-Cmd,	None (0)	0	Delay (0)	0	0

17.21.2.3 – "DO Configuration"

Select "**DO Configuration**":



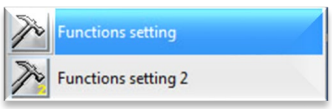
Assign to:

Type	*Linked Functions*
0.R1	Gate.1
0.R2	Gate.2

ID	Relay	Linked functions	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]	Gate.1	Off	Normally Denergized	Automatic reset	0,1	Off
2	0.R2 [Master board, R:2]	Gate.2	Off	Normally Denergized	Automatic reset	0,1	Off
3	0.R3 [Master board, R:3]		Off	Normally Denergized	Automatic reset	0,1	Off

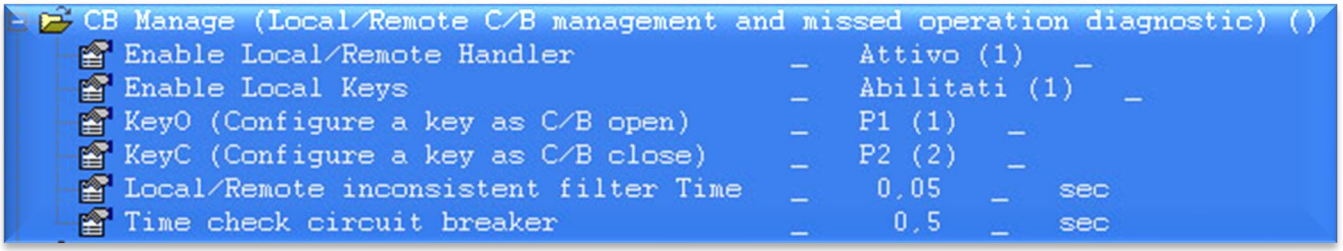
17.21.2.4 – "Function Setting"

Select "**Function Setting**":



Assign to "CB Manage":

Type	*Settings*
Enable Local/remote	Active
Enable Local Keys	Enable
KeyO	P1
KeyC	P2



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

This menu allows to select the edge polarity of the signal on the digital input configured to reset the relay after a trip (see 17.2 input ExtReset).
The reset input will reset all the output relays configured as manual reset (latched), the signalisation of the trip on the display and the indication of the LED are cleared also.

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

17.22.1 - Description of variables

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

18. Input – Output (via software)

The firmware can manage up to 8 digital inputs and 8 output relays.

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

18.1 – Digital Input

0.D1	Programmable (D1)
0.D2	Programmable (D2)
0.D3	Programmable (D3)
0.D4	Programmable (D4)
0.D5	Programmable (D5)
0.D6	Programmable (D6)
0.D7	Programmable (D7)
0.D8	Programmable (D8)

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

18.2 – "DI" Configuration (via software)

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

Bi1I>	Blocking input	First overcurrent element
Bi2I>	Blocking input	Second overcurrent element
Bi3I>	Blocking input	Third overcurrent element
Bi1Io>	Blocking input	First earth fault element
Bi2Io>	Blocking input	Second earth fault element
Bi3Io>	Blocking input	Third earth fault element
Bi1Is>	Blocking input	First negative sequence current element
Bi2Is>	Blocking input	Second negative sequence current element
Group 1-2	Selection of the setting Group 1 or 2.	
Circuit Breaker	Status Circuit Breaker	
ExtR	External Reset input	
Blocking of reclosing functions	Blocking of reclosing functions	
Dig.Input for reduction of trip time	Digital Input for reduction of trip time	
Local state	Locate state	
Remote state	Remote state	
C/B open command	Open C/B Command	
C/B close command	Close C/B Command	

18.2.1 – Example

18.2.2 – Name

Logical Input name

18.2.3 – Status

Logical Input status

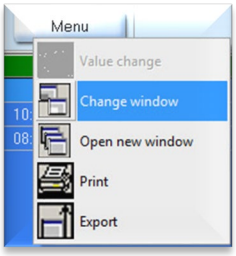
18.2.4 – Functions

Selection function

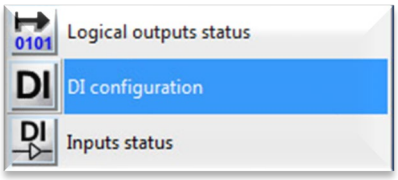
18.2.5 – Example: Setting "Digital Input"

Open software program and connect to the relay.

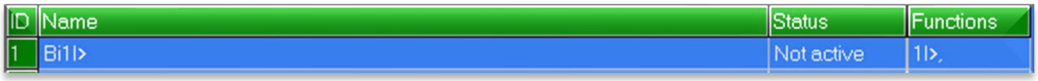
Select "Change Windows" from "Menu"



Select "DI configuration"

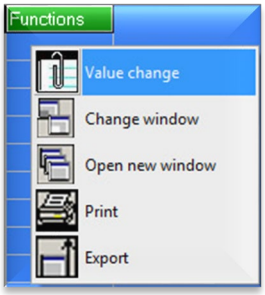


Setting for "**Bi1I>**" : "**1I>**".

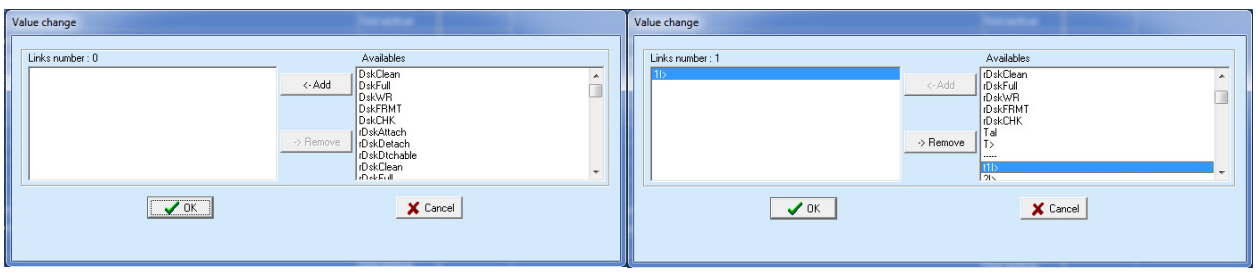


18.2.5.1 – "Functions"

Select "**Functions**" related to "**BiR1I>**" and press right button on mouse, select "Value change":



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



18.3 – Physical Outputs

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

0.R1	Programmable (R1)
0.R2	Programmable (R2)
0.R3	Programmable (R3)
0.R4	Programmable (R4)
0.R5	Programmable (R5)
0.R6	Programmable (R6)
0.R7	Programmable (R7)
0.R8	Programmable (R8)

Available in the relay

18.4 - "DO" Configuration

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

18.4.1 - Example configuration

ID	Relay	Linked functions	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]	Gate.1,	Off	Normally Denergized	Automatic reset	0,1	Off
2	0.R2 [Master board, R:2]	Gate.2,	Off	Normally Denergized	Automatic reset	0,1	Off

18.4.1.1 - Relay

Relay internal name

18.4.1.2 - Linked function

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

18.4.1.3 - Operation Logic

Not Used

18.4.1.4 - Logical Status

Relay Logical status

18.4.1.5 - Output Configuration

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

18.4.1.6 - tON (Operation Time)

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

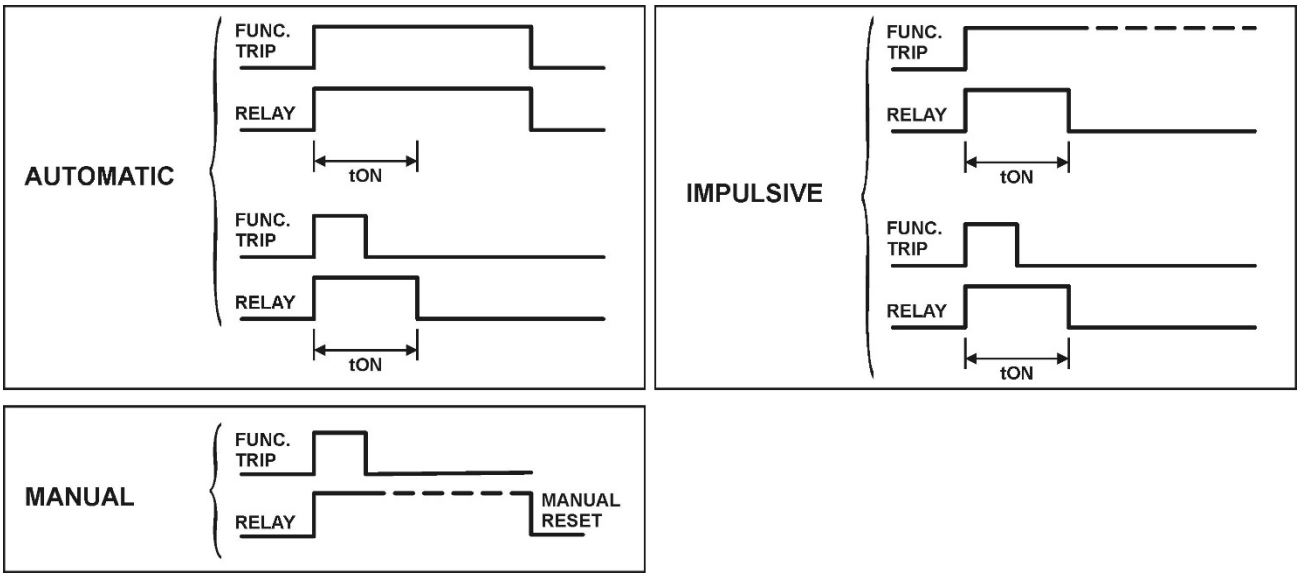
tON : 0 (0.01-10)s, step 0.01s

18.4.1.7 - Relay Status

Relay – Physical status

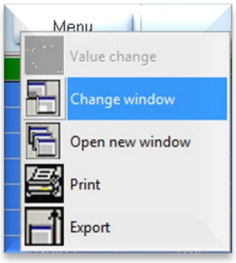
18.4.2 - Functions - Operation Mode

Automatic	:	In this mode the output relay is "operated" (energized if "N.D.", denergized if "N.E.") when the controlling Functional Output is activated and it is reset to the "non operated" condition when the Functional Output gets disactivated but, anyhow, not before the time "tON" has elapsed (minimum duration of the operation time)
Manual	:	In this mode the output relay is "operated" when the controlling Functional Output is activated and remains in the operated condition until a manual reset command is issued by the relay keyboard (local commands menu) or via the serial communication. In this mode the timer "tON" has no effect.
Impulsive	:	In this mode the output relay is "operated" when the controlling Functional Output is activated and it remains in the "operated" condition (energized if "N.D.", denergized if "N.E.") for the set time "tON" independently from the status of the controlling Functional Output.

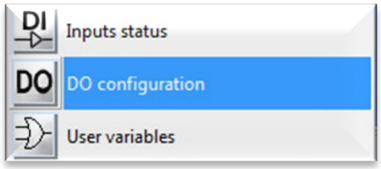


Open software program and connect to the relay.

Select "Change Windows" from "Menu"



Select "DO Configuration"



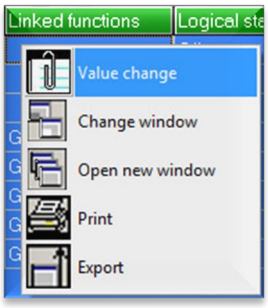
18.4.2.1 - Example: Change settings for "0.R1"

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

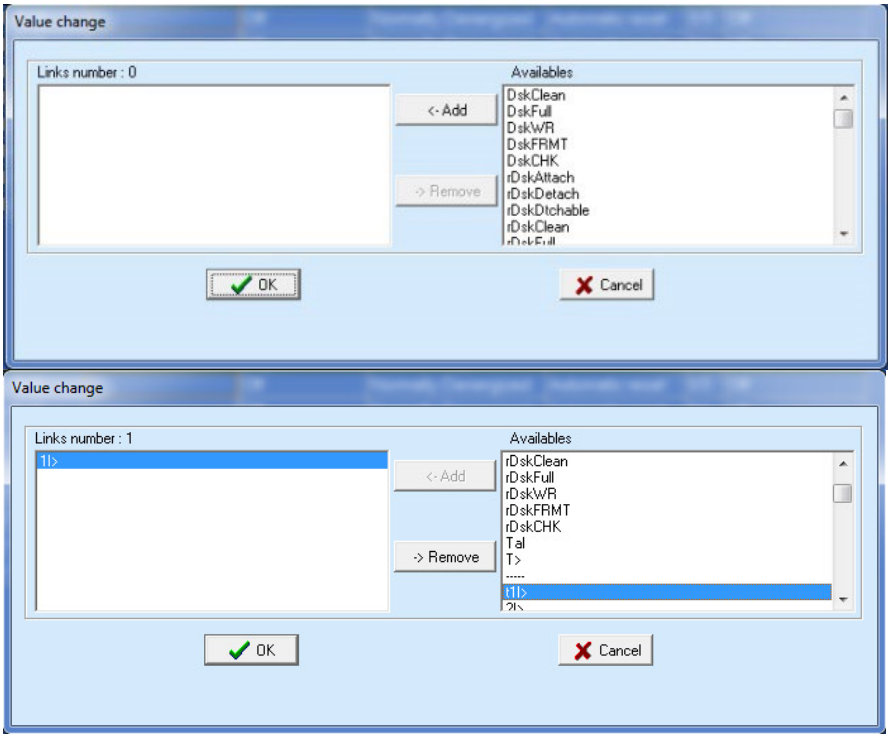
ID	Relay	Linked functions	Logical status	Output config	Function	tON	Relay status
1	0.R1 [Master board, R:1]	1I>,	Off	Normally Denergized	Automatic reset	0,5	Off
2	0.R2 [Master board, R:2]		Off	Normally Denergized	Automatic reset	0,1	Off

18.4.2.2 - "Linked Functions"

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

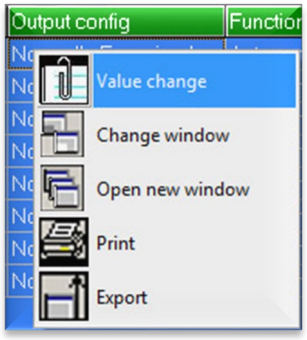


From box "Available", select "1I>" and press "Add".
Press "OK" for confirmation. (if Password is request, see § Password)

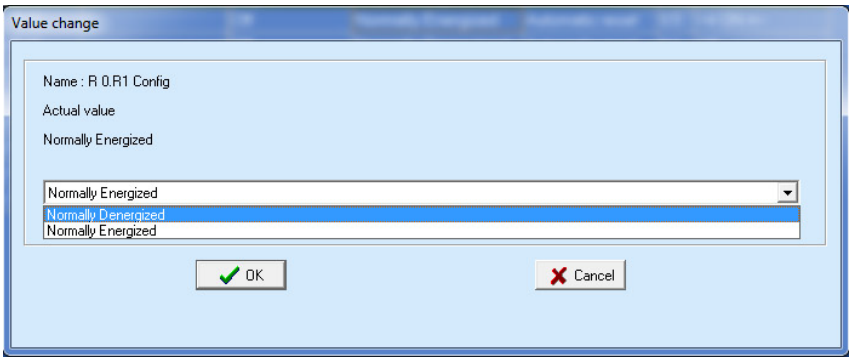


18.4.2.3 - "Output Config"

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

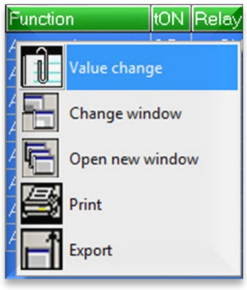


Select "**Normally Denergized**" from combo box and press "OK"
(if Password is request, see § Password)

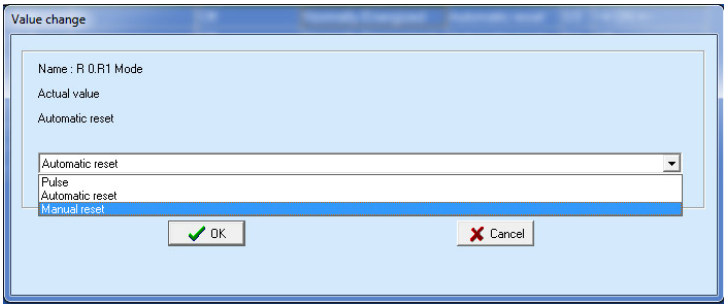


18.4.2.4 - "Function"

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

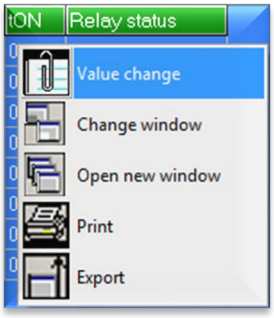


Select "**Manual reset**" from combo box and press "OK"
(if Password is request, see § Password):

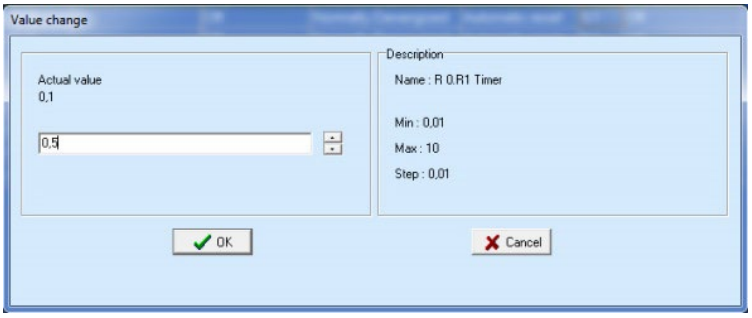


18.4.2.5 - "tON"

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



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



19. InfoStatus

In this menu is showed the status of relay

Options	→	**LocR**	Disable
	→	**LRC**	NotAvail
	→	**RCL**	WaitCBcl

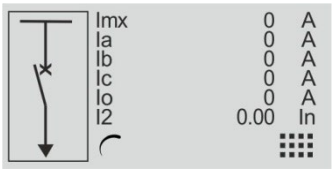
LocR	:	Local and Remote Status		
			Disable	
			Local	
			Remote	
			Discrepancy Status	
LRC	:	Last reclose cycle status		
			NotAvail	Not available
			Success	Recloser success
			ManClose	Manual reclos. success
			Failed	Recloser Failed
			Blocked	Recloser blocked
			TwRCL	Trip without recloser
			Process	Result processing
RCL	:	Reclosure Status		
			WaitCBcl	Wait for CB close..
			Ready	Recloser ready
			Progress	Reclos.cycle in progress
			LockOut	Reclosure LockOut
			Disable	Recloser Disable

20. Date and Time

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

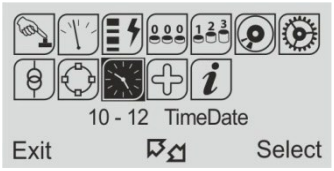
Date:	20YY / MM / DD	(2000/01/01 ÷ 2099/12/31) YY = Year / MM = Month / DD = Day
Time:	HH : MM : 00	HH = hour / MM = Minutes / 00
DofW:	Day	Es: Wednesday

1



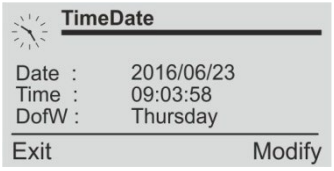
- Press "***Menu***" for access to the main menu with icons.

2



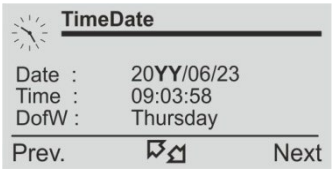
- Select icon "***TimeDate***" by pushbuttons "***Increase***" or "***Decrease***".
- Press "***Select***".

3



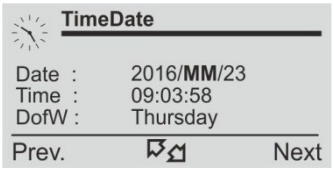
- Press "***Modify***".

4



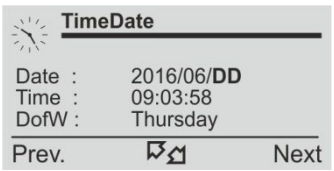
- The last two figures of the Year will appear in bold character; by pushbuttons "***Increase***" or "***Decrease***" set the new figures.
- Press "***Next***" to go to the next setting.

5



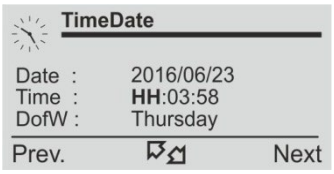
- As above for changing the "Month"
- Press "***Next***" to go to the next setting.

6



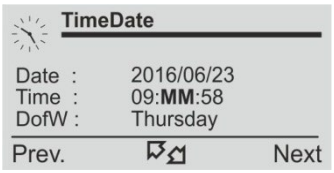
- As above for changing the "Day"
- Press "***Next***" to go to the next setting.

7



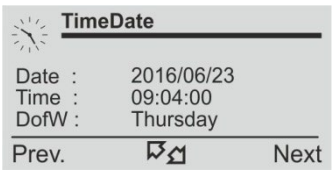
- As above for changing the "Hours"
- Press "***Next***" to go to the next setting.

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.

20.1- Clock synchronization

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

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

- ❑ Using the standard "Time Synchronization" procedure of the "IEC870-5-103" protocol.
- ❑ Using the software or from the DCS with the Modbus RTU protocol.

22. Healthy (Diagnostic Information)

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

Device	→	**No Fail**	→	No Fail
		Fail	→	Fail present
		MinorFail	→	Minor Fail
		HistoricalFail	→	Cleared Fail
		IAU FW notC	→	Firmware MPUs not compatible

Boards	→	**Int.Ram**	→	Internal RAM fault
		SCI 1	→	Serial comm. Controller 1
		SCI 2	→	Serial comm. Controller 2
		SDRAM	→	SDRAM fault
		Keys	→	Keyboard failure
		TK stop/fail	→	Time Keeper to sync or stopped/failure
		E2pCorrupt	→	E2P Corrupt
		SRAM	→	SRAM Corrupt
		Code Corrupt	→	Code Corrupt
		Data Corrupt	→	Data Corrupt
		SPI	→	Serial peripheral interface
		IIC	→	I2C bus failure

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

23. Dev.Info (Relay Version)

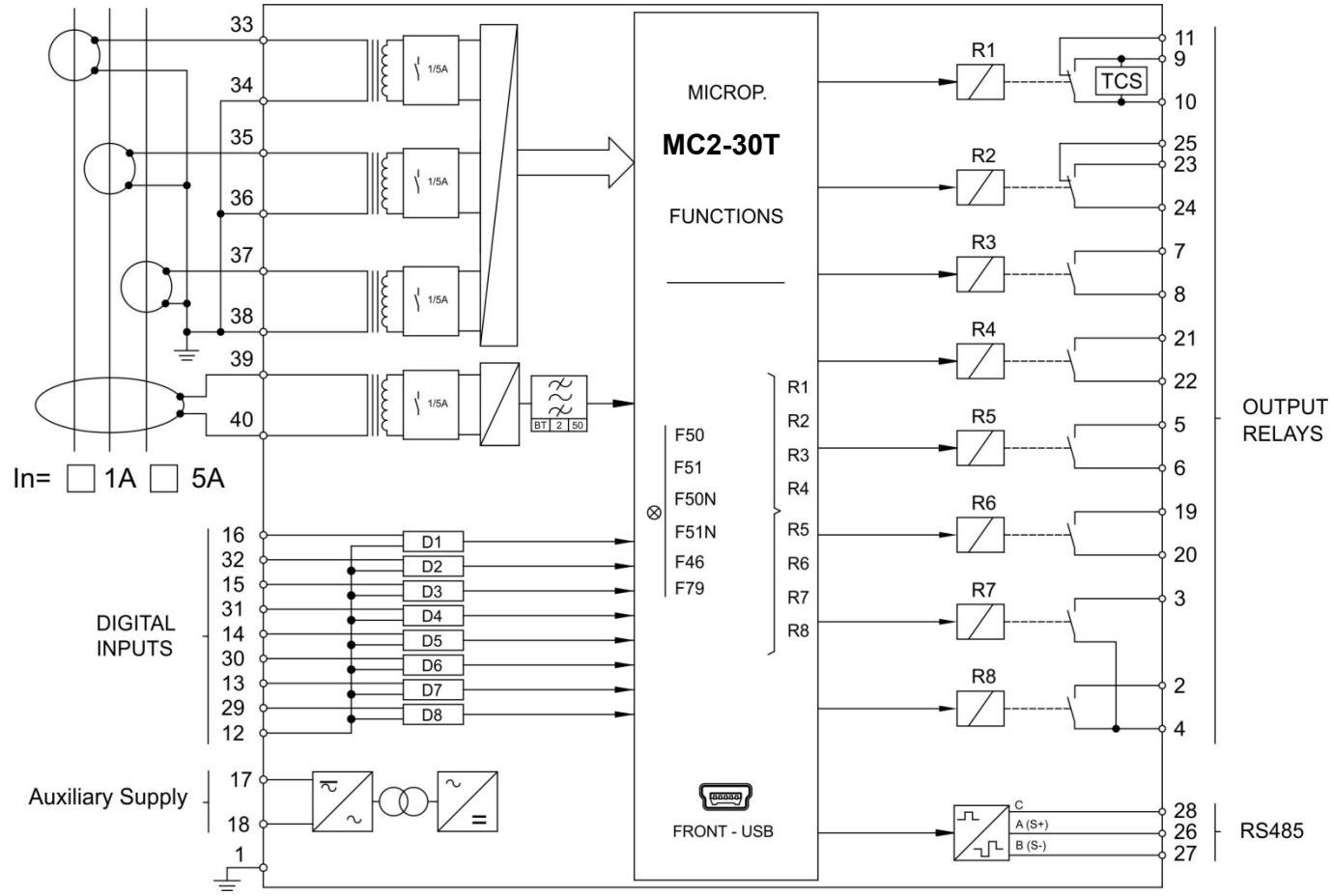
In this menu it is possible to read the information relevant to relay unit.

SW Version	**IPU-R**	→	####.##.##.#	Firmware version
Protect.Model		→	xxxxxx	Protection Type
Serial Number		→	###/##/##/####	Relay Serial Number
User Tag		→	xxxxxxx	Relay identification label. This information can only be modified by the interface program software and allows the user to give to the relay any suitable denomination.
Build		→	###########	Build identification label.
Line		→	###########	Line identification label.

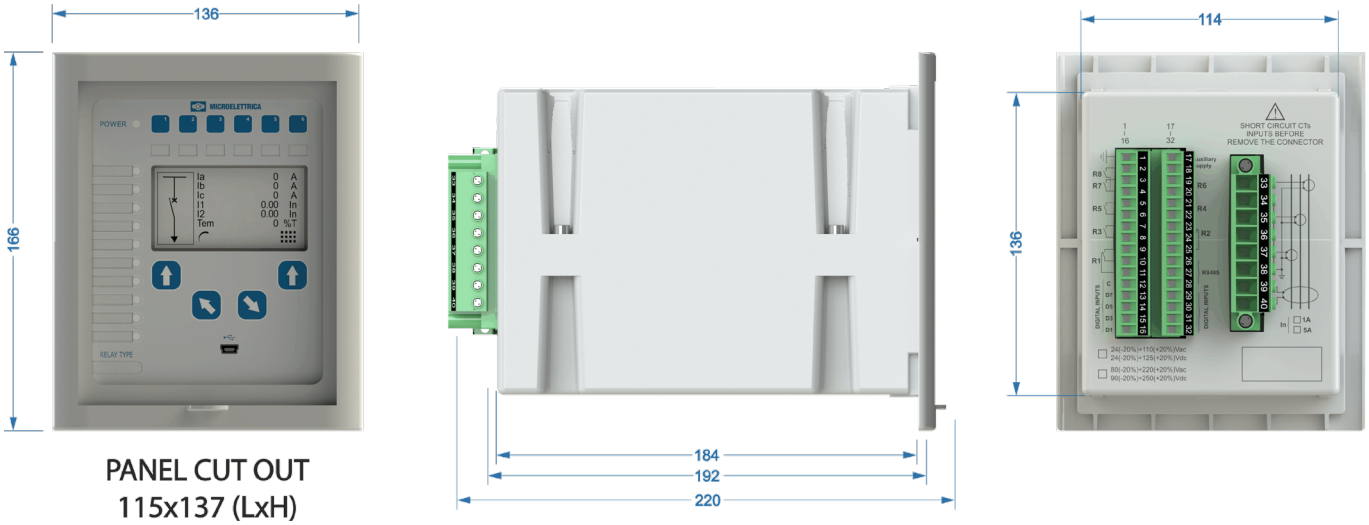
24. Maintenance

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

25. Wiring Diagram



26. Overall Dimensions



27. Electrical Characteristics

APPROVAL: CE					
REFERENCE STANDARDS	*IEC 60255 - CE Directive - EN/IEC61000 - IEEE C37*				
Dielectric test voltage		IEC 60255-5	2kV, 50/60Hz, 1 min.		
Impulse test voltage		IEC 60255-5	5kV (c.m.), 2kV (d.m.) – 1,2/50μs		
Insulation resistance		> 100MΩ			

Environmental Std. Ref. (IEC 60068)			
Operation ambient temperature		-10°C / +55°C	
Storage temperature		-25°C / +70°C	
Environmental testing	(Cold)	IEC60068-2-1	
	(Dry heat)	IEC60068-2-2	
	(Change of temperature)	IEC60068-2-14	
	(Damp heat, steady state)	IEC60068-2-78	RH 93% Without Condensing AT 40°C

CE EMC Compatibility (EN61000-6-2 - EN61000-6-4 - EN50263)				
Electromagnetic emission	EN55011	industrial environment		
Radiated electromagnetic field immunity test	IEC61000-4-3	level 3	80-2000MHz	10V/m
	ENV50204		900MHz/200Hz	10V/m
Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
Electrostatic discharge test	IEC61000-4-2	level 3	6kV contact / 8kV air	
Power frequency magnetic test	IEC61000-4-8		1000A/m	50/60Hz
Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs	
Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz	
Immunity to conducted common mode disturbance 0Hz-150KHz	IEC61000-4-16	level 4		
Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz	
HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)	
Oscillatory waves (Ring waves)	IEC61000-4-12	level 4	4kV(c.m.), 2kV(d.m.)	
Surge immunity test	IEC61000-4-5	level 4	2kV(c.m.), 1kV(d.m.)	
Voltage interruptions	IEC60255-4-11			
Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 10-500Hz 1g			

CARACTERISTICS		
Accuracy at reference value of influencing factors	1% In	for measure
	2% + to (to=20÷30ms @ 2xIs)	for times
Rated Current	In = 1 or 5A - On = 1 or 5A	
Current Overload	100 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	
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 (Terminal Blocks)	RS485 – 9600 to 38400 bps – 8,n,1 – Modbus RTU – IEC60870-5-103
Front serial port (USB)	RS232(virtual) – 9600 to 57600 bps – 8,n,1 – Modbus RTU

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