

D.C. SUBSTATION PROTECTIVE RELAY

TYPE





OPERATION MANUAL





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15.7.8 - "Relay Status" 15.7.9 - Functions - Operation Mode 15.7.10 - Example: Change settings for "0.R1" 16. UserVar 16.1 - Configuration - via MSCom2 software 16.1.1 - Name 16.1.2 - User Descr. 16.1.3 - Linked functions 16.1.4 - Oplogic 16.1.5 - Timer 16.1.6 - Timer type 16.1.7 - Logical status 16.1.8 - Example: Setting "User Variable" 17. Date and Time 17.1 - Clock synchronization 18. Battery 19. Maintenance 20. Power Frequency Insulation Test 21. Terminal Blocks (Wiring Diagram) 21.1 - Power Supply 21.1.1 - Main Unit power supply input 21.2 - Dedicated Remote Unit supply output (24V) 21.2 - Measurement Inputs 21.2.1 - Fiber Optic 21.2.2 - Voltage Tranducer 21.2.3 - Current Tranducer 21.2.4 - Frame-to-Ground Monitoring Input 21.5 - Output Relays 21.6 - Comunications terminals 21.6.1 - Main Unit	888 899 92 92 92 92 92 92 92 92 93 93 98 98 98 99 100 100 100 100 100 100 100 100 100
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15.7.8 - "Relay Status" 15.7.9 - Functions - Operation Mode 15.7.10 - Example: Change settings for "0.R1" 16. UserVar 16.1 - Configuration - via MSCom2 software 16.1.1 - Name 16.1.2 - User Descr. 16.1.3 - Linked functions 16.1.4 - OpLogic 16.1.5 - Timer 16.1.7 - Logical status 16.1.8 - Example: Setting "User Variable" 17. Date and Time 17.1 - Clock synchronization 18. Battery 19. Maintenance 20. Power Frequency Insulation Test 21. Terminal Blocks (Wiring Diagram) 21.1 - Power Supply 21.1.1 - Main Unit power supply input 21.1.2 - Dedicated Remote Unit supply output (24V) 21.2 - Measurement Inputs 21.2.1 - Fiber Optic 21.2.2 - Voltage Tranducer 21.2.3 - Current Tranducer 21.2.4 - Frame-to-Ground Monitoring Input 21.5 - Output Relays 21.6 - Comunications terminals 21.6.1 - Main Unit 21.6.2 - Remote Unit 21.6.2 - Remote Unit 21.6.3 - Ethernet port	888 899 92 92 92 92 92 92 92 92 92 92 93 98 98 98 99 100 100 100 100 100 100 100 100 100
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1. General Utilization and Commissioning Directions

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

1.1 - Storage and Transportation

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

1.2 - Installation

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

1.3 - Electrical Connection

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

1.4 - Measuring Inputs and Power Supply

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

1.5 - Outputs Loading

Must be compatible with their declared performance.

1.6 - Protection Earthing

When earthing is required, carefully check its effectiveness.

1.7 - Setting and Calibration

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

1.8 - Safety Protection

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

1.9 - Handling

Notwithstanding the highest practicable protection means used in designing M.S. electronic circuits, the electronic components and semiconductor devices mounted on the modules can be seriously damaged by electrostatic voltage discharge which can be experienced when handling the modules.

The damage caused by electrostatic discharge may not be immediately apparent, but the design reliability and the long life of the product will have been reduced. The electronic circuits produced by M.S. are completely safe from electrostatic discharge (8 kV IEC 255.22.2) when housed in their case; withdrawing the modules without proper cautions expose them to the risk of damage.

1.10 - Maintenance

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

1.11 - Waste Disposal of Electrical & Electronic Equipment

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

1.12 - Fault Detection and Repair

Internal calibrations and components should not be altered or replaced.

For repair please ask the Manufacturer or its authorized Dealers.

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



2. General

Input quantities are supplied via isolated converters with (0-20mA / 4-20mA / 12-20mA) output (overload 25mA).

It is also available two optical inputs for current (IL) and voltage (VL) for direct connection to Microelettrica MHIT converters series, without receivers.

For best accuracy and reliability, we recommend to use MHCO – MHIT measuring converters for supply of input.

2.1 - Current measurement

```
1 Input 0 - 20mA = 0 - 1In

1 Input 0 - 20(25)mA = 0 - 10(12.5)In

Measuring range 0 - 12,5 times the rated input current (12,5In)

Resolution 16 bits
```

Current analog input can be selectable:

0-20mA 4-20mA 12-20mA

The ratio from first and second current channel is programmable from 2 to 10.

2.2 - Line voltage measurement

```
1 Input 0 - 40mA = 0 - 2Un

Measuring range 0 - 2 times the rated input voltage (2xUn)

Resolution 12 bits
```

2.3 - Frame earth fault current measurement

```
1 Input 0 - 20mA (25mA) \equiv 0 - 1In (0 - 1,25In)
Measuring range 0 - 1 times the rated input current
Resolution 12 bits
```

2.4 - Frame voltage measurement

```
1 Input 0 - 40mA = 0 - 2Un

Measuring range 0 - 2 times the rated input voltage (2xUn)

Resolution 12 bits
```

Make electric connection in conformity with the diagram reported on relay's enclosure. Check that input currents and voltages are same as reported on the diagram and on the test certificate. The auxiliary power is supplied by a built-in fully isolated a self-protected unit.

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2.5 - Main Unit - 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.

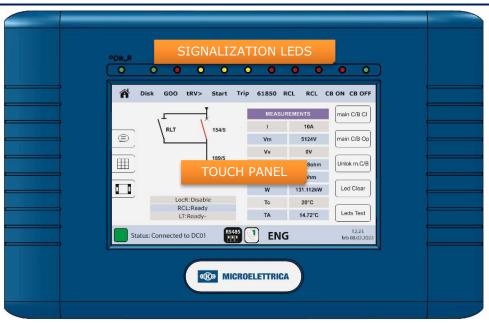
2.6 - Remote Unit - Power Supply

Type $15 \div 30 \text{ Vdc}$

The supply for remote MMI unit is available on the main relay (24Vdc - 30W max) on terminals **73 (-) and 74 (+)**.

3. Remote Unit

3.1 - Front View

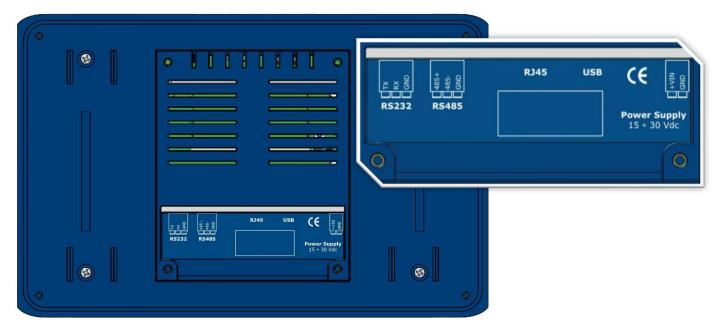


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3.2 – Rear View

RS232 Not Used
RS485 Connection to Main Unit
RJ45 Connection to Main Unit
USB Update Software - Remote Unit
Power Supply Power Supply



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3.3 - Touch home measures settings (available only via MSCom2)

Through this menu is possible to set the order of parameters (maximum 29) shows in the home page

3.3.1 - Example

Open "MSCOM2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "Touch home measures settings".



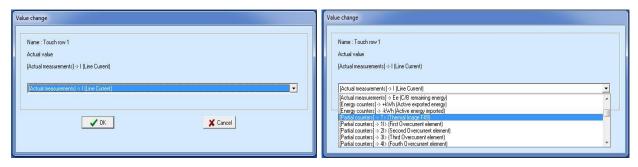
The window configuration will show:



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



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



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

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3.3.2 - Available parameters

	Stop	End Wiev List	
	Empty	Empty line	
	I	Line Current	
Actual Measurements	U	Line Voltage	
ne	W	Power	
rei	Tem	Thermal status	±
nse	Ig	Frame to Ground fault current	default
Мей	Ug	Frame to Ground fault voltage	def
al I	RS-G	Resistance Screen/Ground	
ctu	A/ms	Current rate of rise	
Ą	Rapp	Impedance monitoring	
	Wir	C/B residual interruption energy	
	+kWh	Active Exported energy	
	-kWh	Active Imported energy	
	Vv	C/B Downstream voltage	
	Vm	C/B Upstream voltage	
	Ei	C/B remaining energy	
	Ee	C/B remaining energy	
	RLin	Line resistance	
	T>	Thermal image	
	1I>	First overcurrent element	
	2I>	Second overcurrent element	
	3I>	Third overcurrent element	
	41>	Fourth overcurrent element	
	Iis>	Instantaneous current element	
	1dl	First current step element	
	2dl	Second current step element	
	1di/dt	First current rate of rise element	
	2di/dt	Second current rate of rise element	
	Rapp	Impedance monitoring di/dt dependence	
Partial Counters	Iapp	Current monitoring with di/dt dependence	
ınt	1Ig	First frame fault element	
CO	2Ig	Second frame fault element	
je.	RCL	Recloser	
arti	1U>	First Overvoltage element	
g	2U<	Second Overvoltage element	
	10<	First Undervoltage element	
	2U<	Second Undervoltage element	
	Ni	Trip number arcs interrupts operations	
	Ne	Trip number electrical contact operations	
	Nm	Trip number mechanical operations of circuit breacker	
	RT	Remote Trip	
	TCS	Trip circuit supervision	
	IRF BrkF	Internal Relay Fault	
		Breaker Failure	
	SelfTrip	Spontaneous protection trip	
	AutOp	Automatic C/B open	
	AutCl	Automatic C/B close	
	ManOp	Manual / Intentional C/B open	
	ManCl	Manual / Intentional C/B close Overall C/B copp. (automatic L Intentional)	
	OvrOp	Overall C/B open (automatic + Intentional)	
	OvrCl	Overall C/B close (automatic + Intentional) Line Test	
	LT RTX	Remote Trip	
	KIX	Kemote Trip	

	DiaCB1	Input position discremancy
	AnCB1	Operation Failure
	OpCB1	Opening operation
	CICB1	Closures operation
	OPrCB1	Overall operation (close + open)
	DiaCB2	Input position discremancy
	AnCB2	Operation Failure
	OpCB2	Opening operation
	CICB2	Closures operation
S	OPrCB2	Overall operation (close + open)
Partial Counters	DiaCB3	Input position discremancy
'n	AnCB3	Operation Failure
S	OpCB3	Opening operation
ial	CICB3	Closures operation
art	OPrCB3	Overall operation (close + open)
П	DiaCB4	Input position discremancy
	AnCB4	Operation Failure
	OpCB4	Opening operation
	CICB4	Closures operation
	OPrCB4	Overall operation (close + open)
	DiaCB5	Input position discremancy
	AnCB5	Operation Failure
	OpCB5	Opening operation
	CICB5	Closures operation
	OPrCB5	Overall operation (close + open)

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4. Signalization

4.1 – Leds on Main Unit

4 signal leds are provided:

N°	Colour	Default Status
Led 1	Green	Not Assigned
Led 2	Yellow	Not Assigned
Led 9	Red	Not Assigned
Led 10	Green	Not Assigned



Local leds settings corresponding at remote leds 1,2 and 9,10.

4.2 – Leds on Remote Unit

11 signal leds are provided:

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



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

Reset from Illuminated status is manual or automatic (see § Commands and § led configuration)

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4.3 - Leds Configuration

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

Open "MSCOM2" program and connect to the relay.

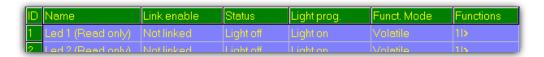
Select "Change Windows" from "Menu" button



Select "Led Setting"



The window for led configuration will show:



4.3.1 - Name

Led name – for leds position see picture

4.3.2 - Link enable

Linked	=	Enable to operate
No Linked	=	Disable

4.3.3 - Status

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

4.3.4 - Light Prog.

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

4.3.5 - Funct. Mode

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

4.3.6 - Functions

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

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4.3.7 - Table 1

T>	Tal _	(alarm)	Thermal element
1I>	T> 1I>	(trip) (Start)	
	t1I>	(Trip)	First overcurrent element
2I>	2I> t2I>	(Start) (Trip)	Second overcurrent element
3I>	3I> t3I>	(Start) (Trip)	Third overcurrent element
41>	4I>	(Start)	Fourth overcurrent element
Iis	t4I> tIis>	(Trip)	Instantaneous current
1dl	1dI	(Start)	First Current step element
2dl	t1dI 2dI	(Trip) (Start)	Second Current step element
1di/dt	t2dI 1di/dt	(Trip) (Start)	·
•	t1di/dt	(Trip)	First Current rate of rise element
2di/dt	2di/dt t2di/dt	(Start) (Trip)	Second Current rate of rise element
Rapp	Rapp	(Trip)	Impedance monitoring – di/dt dependance
Iapp	Iapp	(C+2 m+)	Current monitoring with di/dt dependence First instantaneous Frame Fault element
1Ig	1Ig t1Ig	(Start) (Trip)	First time delayed Frame Fault element
2Ig	2Ig t2Ig	(Start) (Trip)	Second Frame Fault element
RCL	RCL cmd	(Trip)	Reclosure Shot command
	ARP		Autoreclosure in progress
	ARF ARL		Autoreclosure Failure Autoreclosure Lock-out
	ARC		Autoreclosure Ok
	ARE		Autoreclosure Enable
	ARD		Autoreclosure Disable
1U>	1U> t1U>	(Start) (Trip)	First overvoltage element
2U>	2U>	(Start)	Second overvoltage element
1U<	t2U> 1U<	(Trip) (Start)	First undervoltage element
2U<	t1U< 2U<	(Trip) (Start)	•
UL<	t2U< UL<	(Trip)	Second undervoltage element
RT	RT	(Trip)	Line Voltage Presence First Instantaneous Remote Trip
	tRT	(Start)	First Time delayed Remote Trip
Wi	tWi>		Circuit breaker maintenance level
	Ni alNi		Maximum number of arc chute operation at nominal values Alarm maintenance level of arc chute operation
	Ne		Maximum number of arc contact operation at nominal values
	alNe		Alarm maintenance level of arc contact operation
	Nm		Maximum number of mechanical operation
TCC	alNm	(Tuis-)	Alarm maintenance level of mechanical operation
TCS IRF	tTCS	(Trip) (Start)	Time delayed Trip Circuit Supervision Time delayed Internal relay Fault
IRF	IRF tIRF	(Start) (Trip)	Instantaneous Internal relay Fault Instantaneous Internal relay Fault
RTX	RTX	(Trip)	Second Instantaneous Remote Trip
	tRTX	(Start)	Second Time delayed Remote Trip
CB-L	CB-L		C/B reclose Lock-out
BF	BFWb		Breaker Failure
Wh	+ Wh - Wh		Imported Energy counter Pulse Exported Energy counter Pulse
L/R CB	cmdOpCB		Open C/B command
Cmds	cmdClCB		Close C/B command
	LocRemInc		Local / Remote Inconsistency
	missCBOpe		Missed C/B opening (Digital input missing)
LT	LTPb		Output to operate an external flashing lamp signalling line test in progress
	LTP		Line Test in progress
	LTF LTOK		Line Test Failed Line Test OK
	LTB		Line Test Blocked
	LT cmd	(Trip)	Line Test Command
		· · · /	

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Gen.Start	Start Generic
Gen.Trip	Trip Generic
UserTriggerOscillo	User Variable for Oscillographic Recording
Gate<0> to	User Variable
Gate<98>	oser variable
MasterOp1	Modbus Master CB1 Open request
MasterCl1	Modbus Master CB1 Close request
MasterOp2	Modbus Master CB2 Open request
MasterCl2	Modbus Master CB2 Close request
MasterOp3	Modbus Master CB3 Open request
MasterCl3	Modbus Master CB3 Close request
MasterOp4 MasterCl4	Modbus Master CB4 Open request Modbus Master CB4 Close request
MasterOp5	Modbus Master CB5 Open request
MasterCI5	Modbus Master CB5 Close request
CB1Fail	CB1 Failure
CB2Fail	CB2 Failure
CB3Fail	CB3 Failure
CB4Fail	CB4 Failure
CB5Fail CB1missedOp	CB5 Failure CB1 Missed Operation
CB1missedOp CB2missedOp	CB2 Missed Operation
CB3missedOp	CB3 Missed Operation
CB4missedOp	CB4 Missed Operation
CB5missedOp	CB5 Missed Operation
SelfTrip	Spontaneous protection
t-SelfTrip	Self-Trip time delay
Vcc	Reserved
Gnd ResLog	Reserved Reset signal logic
P1	Push-button Open
P2	Push-button Close
0.D1	Digital Input "0.D1" activated
0.D1Not	Digital Input "0.D1" deactivated
to	
0.D4	Digital Input "0.D4" activated
0.D4Not 1.D1	Digital Input "0.D4" deactivated Digital Input "1.D1" activated
1.D1 1.D1Not	Digital Input "1.D1" activated Digital Input "1.D1" deactivated
to	Digital Tiput 1.D1 dedetivated
1.D15	Digital Input "1.D15" activated
1.D15Not	Digital Input "1.D15" deactivated
2.D1	Digital Input "2.D1" activated
2.D1Not	Digital Input "2.D1" deactivated
to 2.D15	Digital Input "2.D15" activated
2.D15 2.D15Not	Digital Input "2.D15" deactivated
0.R1	Digital Input 2.013 acatematea
to	Output relays
0.R6	,
1.R1	
to	Output relays
1.R14	
2.R1	Output rolous
2.R1 to	Output relays
2.R1 to 2.R14	' '
2.R1 to	Output relays Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked)
2.R1 to 2.R14 DskClean	Internal Disk Clean (disk near to full, clean operation is required)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk check procedure)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskAttach	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDetach	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk removible (USB Key)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDtchable rDskClean	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Check (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDetach	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Check (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDtchable rDskClean rDskFull	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDtchable rDskDtchable rDskFull rDskWR	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Check (active during internal disk format) External Disk Check (active during internal disk check procedure)
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDtchable rDskClean rDskFull rDskWR rDskFull rDskWR rDskFRMT	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date - time syncronization event (active during clock syncronization).
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDetach rDskUtchable rDskFull rDskWR rDskFWR rDskFWK Sync SNTP-DIA	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date – time syncronization event (active during clock syncronization).
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDetach rDskClean rDskFull rDskCHK Sync SNTP-DIA SNTP-KOD	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date - time syncronization event (active during clock syncronization). SNTP health status. Syncro lost by server, Kiss of death. Date-Time need syncro from another server.
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDtchable rDskClean rDskFull rDskWR rDskFRMT SNFRMT rDskCHK Sync SNTP-DIA SNTP-KOD	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) Reternal Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date - time syncronization event (active during clock syncronization). SNTP health status. Syncro lost by server, Kiss of death. Date-Time need syncro from another server. External analog transducer fail (if different from 0-20mA) istantaneous element.
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDetach rDskClean rDskFull rDskWR rDskFRMT Sync SNTP-DIA SNTP-KOD Dial tDial	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date – time syncronization event (active during clock syncronization). SNTP health status. Syncro lost by server, Kiss of death. Date-Time need syncro from another server. External analog transducer fail (if different from 0-20mA) istantaneous element.
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDtchable rDskClean rDskFull rDskWR rDskFRMT SNFRMT rDskCHK Sync SNTP-DIA SNTP-KOD	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) Reternal Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date - time syncronization event (active during clock syncronization). SNTP health status. Syncro lost by server, Kiss of death. Date-Time need syncro from another server. External analog transducer fail (if different from 0-20mA) istantaneous element.
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskAttach rDskDetach rDskDetach rDskClean rDskFull rDskWR rDskFRMT rDskFRMT rDskFRMT rDskFRMT rDskCHK Sync SNTP-DIA SNTP-KOD Dial tDial 1850Ready	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk removible (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date - time syncronization event (active during clock syncronization). SNTP health status. Syncro lost by server, Kiss of death. Date-Time need syncro from another server. External analog transducer fail (if different from 0-20mA) istantaneous element. External analog transducer fail (if different from 0-20mA) time delayed element. IEC61850 ready to work.
2.R1 to 2.R14 DskClean DskFull DskWR DskFRMT DskChk rDskDetach rDskDetach rDskDtchable rDskClean rDskFull rDskWR rDskFRMT rDskCHK Sync SNTP-DIA SNTP-KOD Dial tDial 1850Ready Charat1	Internal Disk Clean (disk near to full, clean operation is required) Internal Disk Full (disk full, write should be locked) Internal Disk Write (active during internal disk access) Internal Disk Format (active during internal disk format) Internal Disk Check (active during internal disk check procedure) Remote disk inserted (USB Key) Remote disk not inserted (USB Key) Remote disk removible (USB Key) External Disk Clean (disk near to full, clean operation is required) External Disk Full (disk full, write should be locked) External Disk Write (active during internal disk access) External Disk Format (active during internal disk format) External Disk Check (active during internal disk check procedure) Date – time syncronization event (active during clock syncronization). SNTP health status. Syncro lost by server, Kiss of death. Date-Time need syncro from another server. External analog transducer fail (if different from 0-20mA) istantaneous element. External analog transducer fail (if different from 0-20mA) time delayed element. IEC61850 ready to work. Characteristics 1 active

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4.4 - Example: Change settings for "Led5"

Change settings for "LED5": "Enable", "Flashing", "Latched", "1I>".

Main Windows:

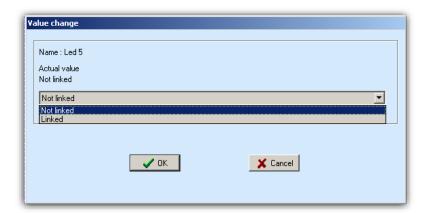
ID	Name	Link enable	Status	Light prog.	Funct, Mode	Functions
1	Led 1 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	11> (0)
2	Led 2 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	11> (0)
3	Led 3 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	11> (0)
4	Led 4 (Read only)	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	11> (0)
5	Led 5	Not linked (0)	Light off (0)	Light on (0)	Volatile (0)	1.D1

4.4.1 - "Enable"

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



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



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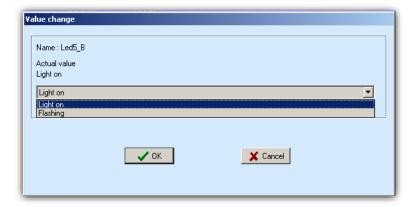


4.4.2 - "Flashing"

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



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



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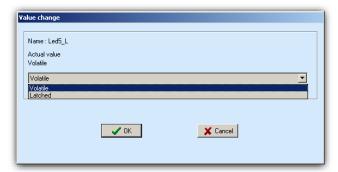


4.4.3 - "Latched"

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



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

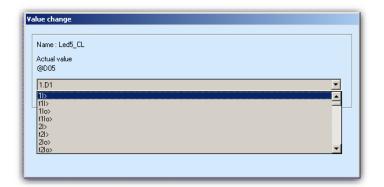


4.4.4 - "Functions"

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



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

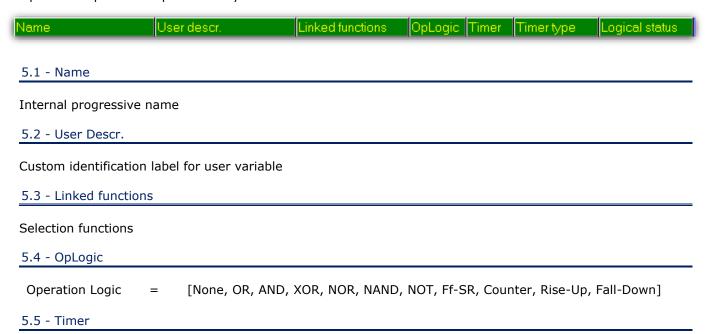


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5. User Variables

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



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

5.6 - Timer type

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

5.7 - Logical status

"User Variable" Logical status

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5.8 - Example: Setting "User Variable"

Open "MSCOM2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "USER VARIABLE"



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

ID	Name	User descr.	Linked functions	OpLogic	Timer	Timer type	Logical status
1	User Trigger Oscillo	User Trigger Oscillo		None		Delay	0
2	UserVar <0>	Current trip	11>,21>,31>,	OR	1	Monostable	0

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5.8.1 - "User description" (User descr.)

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



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

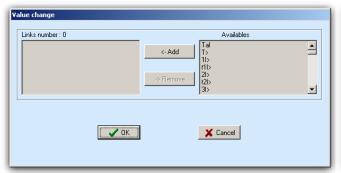


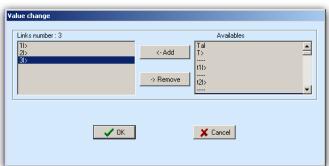
5.8.2 - "Linked Functions"

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



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





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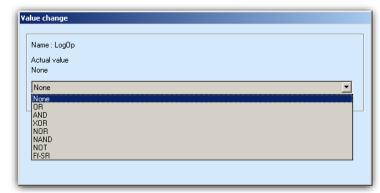


5.8.3 - "Operation Logic" (Oplogic)

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



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

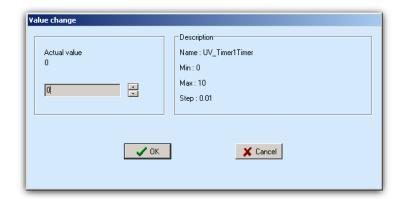


5.8.4 - "Timer"

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



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



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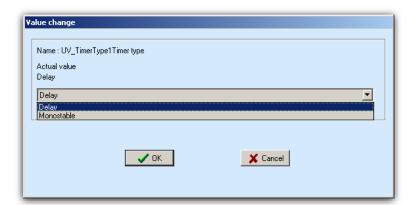


5.8.5 - "Timer type"

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



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



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6. Commands

Menu		Description	Password
Reset	Leds	Reset of signal Leds	Yes
Reset	Relays	Manual reset of output relays	Yes
Main breaker	Close	Manual C/B closing	Yes
Main breaker	Open	Manu al C/B opening	Yes
Main breaker	Unlock	Unlock the C/B reclosure	Yes
Reset	Event	Manual reset of Events	Yes
Reset	Last Trip	Manual reset of Last Trips	Yes
Reset	Counters	Manual reset of Counters	Yes
Reset	Energy Counters	Manual reset of Energy	Yes
Reset	Historical Fails	Reset of Internal Failure Historic records	Yes
Reset	Ei	Reset of arc chute energy register.	
Reset	Ee	Reset of arc contact energy register.	
Offset On field		External analog transducer offset calibration	
Reset	Term	Reset to zero of the accumulations relevant to	Yes
		Thermal Image and Interruption Energy.	
Test	Leds	Signal Leds test	No
Closure	Breaker C/B1	Closure Breaker CB1	Yes
Opening	Breaker C/B1	Opening Breaker CB1	Yes
Closure	Breaker C/B2	Closure Breaker CB2	Yes
Opening	Breaker C/B2	Opening Breaker CB2	Yes
Closure	Breaker C/B3	Closure Breaker CB3	Yes
Opening	Breaker C/B3	Opening Breaker CB3	Yes
Closure	Breaker C/B4	Closure Breaker CB4	Yes
Opening	Breaker C/B4	Opening Breaker CB4	Yes
Closure	Breaker C/B5	Closure Breaker CB5	Yes
Opening	Breaker C/B5	Opening Breaker CB5	Yes
Force Oscillo rec	ording	Asynchronous command for oscillographic recording	Yes
RS-G	Zero Set	Not used	Yes

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7. Maximum Values (available only via MSCom2)

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

I	Α	Line current
RLin	ohm	Line resistance
W	kW	Power
Tem	%T	Thermal status as % of the full load continuous operation temperature Tn
Ig	Α	Frame to ground fault current
Ug	V	Frame to ground fault voltage
Vm	V	C/B upstream voltage
A/ms		Current rate of rise
Rapp	ohm	Impedance monitoring
Ei	%	C/B arc chute remaining energy
Ee	%	C/B arc contact remaining energy

8. Energy

Real time energy measurements

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

9. Last Trip

Function which caused the tripping of the relay plus values of the measurement at the moment of tripping. The last 50 are always available on local – remote MMI interface (display or remote communication). The memory buffer is refreshed at each new relay tripping (FIFO logic). Each last trip record is also stored on internal / external disk without limits (except the disk capacity).

I	Α	Line current
RLin	ohm	Line resistance
W	kW	Power
Tem	%T	Thermal status as % of the full load continuous operation temperature Tn
Ig	Α	Frame to ground fault current
Ug	V	Frame to ground fault voltage
Vm	V	C/B upstream voltage
A/ms		Current rate of rise
Rapp	ohm	Impedance monitoring
Ei	%	C/B arc chute remaining energy
Ee	%	C/B arc contact remaining energy
DI-1	Α	First current step element
DI-2	Α	Second current step element

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10. Partial Counters

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

III First overcurrent element 312 Third overcurrent element 313 Third overcurrent element 314 Third overcurrent element 315 Fourth overcurrent element 316 Instantaneous overcurrent 317 Instantaneous overcurrent 318 Instantaneous overcurrent 319 Instantaneous overcurrent 310 Second current step element 310 Second current rets el reisement 311 Second current rets el reisement 312 Second current rets el reisement 313 Impedance monitoring (di/dt dependence) 314 Impedance monitoring with i/dt dependence) 315 First Frame Fault element 316 Carle insulation (Screen-Ground) 317 Frame Fault element 318 Second Frame Fault element 319 First Frame Fault element 310 Second Frame Fault element 310 Second Frame Fault element 311 Second Frame Fault element 312 Second Overvoltage element 312 Second Overvoltage element 313 Second Frame Fault element 314 Second Overvoltage element 315 Second Frame Fault element 316 Second Frame Fault element 317 First Undervoltage element 318 Second Remement Second Undervoltage element 319 Second Frame Fault element 310 Second Frame Fault element 319 Second Frame Fault element 310 Second Fault element	T>	Thermal Image
312 Second overcurrent element 413 Fourth overcurrent element 116 Instantaneous overcurrent 117 First current step element 118 Instantaneous overcurrent 119 First current step element 120 Second current step element 121 Second current step element 121 Second current rate of rise element 122 Impedance monitoring (d/d/d dependence) 132 Impedance monitoring (d/d/d dependence) 133 First Frame Fault element 134 Second Frame Fault element 135 Second Frame Fault element 136 Second Frame Fault element 137 Second Frame Fault element 138 Second Frame Fault element 139 Second Frame Fault element 140 Automatic Rectosure 140 Automatic Rectosure 141 Second Horavortage element 142 Second Horavortage element 143 First Undervoltage element 144 First Undervoltage element 145 Second Horavortage element 146 Second Horavortage element 147 First Undervoltage element 148 First Indervoltage element 149 Second Horavortage element 150 Circust Breaker maintenance alarm 151 First Horavortage element 152 Second Horavortage element 153 First Remote Second Horavortage element 154 Second Horavortage element 155 Second Horavortage element 156 Second Horavortage element 157 First Horavortage element 158 First Remote Second Horavortage element 159 Second Horavortage element 150 Second		•
11- Third overcurrent element 11s		
Fourth overcurrent element Is Instantaneous overcurrent IdI		
Ist Instantaneous overcurrent IdI First current step element Id/dt Second current step element Id/dt Second current rate of rise element Rapp Impedance monitoring (light dependence) Iapp Current monitoring with di/dt dependence Iapp Current monitoring with di/dt dependence Iapp First Frame Fault element Coll Second Overvillage element Ist Second Overvillage element IV First Overvoltage element IV First Undervoltage element<		
2d1 Second current step element 1di/dt First current step element 2di/dt First current rate of rise element Rapp Impedance monitoring (di/dt dependence) Iapp Current monitoring vith di/dt dependence Iapp Current monitoring vith di/dt dependence Iapp Second current Fault element Second current Fault element Second Frame Fault element Second Frame Fault element Second Frame Fault element Second Frame Fault element IU- First Overvoltage element IU- First Overvoltage element Second Overvoltage element IU- First Undervoltage element II- First II- Indervoltage element II- I		
Idu/dt Second current step element		
Jail/dt First current rate of rise element Rapp Impedance monitoring (di/dt dependence) Iapp Impedance monitoring (di/dt dependence) Iapp Current monitoring with di/dt dependence Iag First Frame Fault element RS-G Cable insulation (Screen-Ground) RCL Automatic Reclosure IUV First Overvoltage element Veryoritage veryorita		•
Zdi/dt Second current rate of rise element Rapp Impedance monitoring (lylid dependence) Inp Current monitoring with di/dt dependence Ing First Frame Fault element RS-G Cable insulation (Screen-Ground) RCL Automatic Reclosure IU> First Overvoltage element IU- First Undervoltage element IV First Undervoltage element Ni Trip number arcs interrupts operations Ne Trip number arcs interrupts operations Nm Trip number electrical contact operations Nm Trip number arcs interrupts operations ITF First Remote Trip RF First Remote Trip RF Breaker failure to open SelfTrip Spontaneous protection AutCL Automatic C/B Open Mancl Manual C/B Open ManCL Manual C/B Open (Automatic + Manual) <th< th=""><th></th><th>·</th></th<>		·
Impedance monitoring (di)dt dependence	•	
Tapp	-	
11g First Frame Fault element RS-G Cable insulation (Screen-Ground) RCL Automatic Reclosure 1U> First Overvoltage element 2U> Second Overvoltage element 1U First Undervoltage element 1U First Undervoltage element 1U First Undervoltage element Ni Trip number accs interrupts operations Ne Trip number electrical contact operations Nm Trip number electrical contact operations Nm Trip number mechanical operations of circuit breacker Vi Circuit Treaker maintenance alarm TCS Trip Circuit Supervision IRF Internal Relay Fault RT First Remote Trip BrKF Breaker failure to open SelfTrip Spontaneous protection AutCL Automatic C/B Open AutCL Automatic C/B Close Automatic C/B Close Automatic C/B Close Manual C/B Close Close (Automatic + Manual) OvrCL Overall C/B Close (Automatic + Manual) LT <td< th=""><th>• •</th><th></th></td<>	• •	
RS-G Cable insulation (Screen-Ground) RCL Automatic Reclosure IUV First Overvoltage element IUV First Overvoltage element IUV Second Overvoltage element IUV Second Undervoltage element IUV Second Undervoltage element IVV S		
INCL Automatic Reclosure First Overvoltage element 1U- First Overvoltage element 1U- First Undervoltage element Ni Trip number arcs interrupts operations Ne Trip number arcs interrupts operations Ne Trip number mechanical operations of circuit breacker Wi Circuit Breaker maintenance alarm TCS Trio Circuit Supervision IRF Internal Relay Fault RT Internal Relay Fault RT First Remote Trip RTX Second Remote Trip RTX Second Remote Trip RTY Second Remote Trip RTY Second Remote Copen AutOp Automatic C/B Open AutCL Automatic C/B Open AutCL Automatic C/B Open Manol Manual C/B Close Manol Manual C/B Close Manol Manual C/B Close Manol Coveral C/B Open (Automatic + Manual) OvrCL Overall C/B Close (Automatic + Manual) LT Automatic Line Test DiaCB1 CB1 Input position discrepancy AnCB1 CB1 Openings operation CICB1 CB1 CB1 Openings operation OprCB1 CB1 Openings operation OprCB2 CB2 Operation failure OpcB3 CB2 CB2 Input position discrepancy AnCB2 CB2 Operation failure OpcB3 CB3 Input position discrepancy AnCB3 CB2 CB2 Input position discrepancy AnCB4 CB2 CB2 Input position discrepancy AnCB5 CB2 CB2 Input position discrepancy AnCB6 CB2 CB2 Input position discrepancy AnCB6 CB2 CB3 Input position discrepancy AnCB6 CB2 CB3 CB4	2Ig	Second Frame Fault element
1U> First Overvoltage element 2U> Second Overvoltage element 1U First Undervoltage element 2U Second Undervoltage element Ni Trip number acts interrupts operations Ne Trip number electrical contact operations Nm Trip number mechanical operations of circuit breacker Circuit Freaker maintenance alarm Circuit Freaker maintenance alarm TCS Trip Circuit Supervision IRF Internal Relay Fault RTX Second Remote Trip BTX Second Remote Trip BTX Breaker failure to open SelfTrip Spontaneous protection Auton Automatic C/B Close Marcel Automatic C/B Close Manual C/B Open Automatic C/B Close Manual C/B Open Automatic C/B Close (Automatic + Manual) OvrOp Overall C/B Open (Automatic + Manual) CIB CB 1 Openation failu	RS-G	Cable insulation (Screen-Ground)
Second Overvoltage element	RCL	Automatic Reclosure
1U First Undervoltage element 2U Second Undervoltage element NI Trip number acts interrupts operations Ne Trip number electrical contact operations Nm Trip number mechanical operations of circuit breacker Wi Circuit Breaker maintenance alarm TCS Trip Circuit Supervision IRF Internal Relay Fault RT First Remote Trip RTX Second Remote Trip BrkE Breaker failure to open SelfTrip Spontaneous protection AutOp Automatic C/B Open AutCL Automatic C/B Open AutCL Automatic C/B Open AutCL Automatic C/B Open ManCL Manual C/B Open ManCL Manual C/B Open ManCL Manual C/B Open ManCL Automatic Line Test Jack Separation C/B Open Date Test Separa	1U>	First Overvoltage element
Second Undervoltage element	2U>	Second Overvoltage element
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Nm Trip number electrical contact operations Nm Trip number mechanical operations of circuit breacker Wi Circuit Breaker maintenance alarm TCS Trip Circuit Supervision IRF Internal Relay Fault RT First Remote Trip RTX Second Remote Trip BrkF Breaker failure to open SelfTrip Spontaneous protection AutOp Annol Annol C/B Open AanOp Manual C/B Open AanOp AanOp Annol C/B Open (Automatic + Manual) OvrCL Overall C/B Open (Automatic + Manual) LT Automatic Line Test DiaCB1 CB1 Input position discrepancy AnCB1 CB1 Operation failure OpCB1 CB1 CB1 Operation failure OpCB1 CB1 CB1 CB2 Operation OprCB1 CB1 CB2 CB2 Input position discrepancy AnCB2 CB2 Operation failure OpCB3 CB2 CB2 CB2 Operation CICB3 CB3 CB3 CB3 Operation CICB3 CB3 CB3 CB3 Uput position discrepancy AnCB3 CB3 CB3 CB3 Uput position discrepancy AnCB3 CB3	2U<	Second Undervoltage element
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Oprces CB5 Overall operation (Close + Open)		
	OprCB5	CB5 Overall operation (Close + Open)

Erase

See § Commands

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

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11. Total Counters

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

_	
T>	Thermal Image
1I>	First overcurrent element
2I>	Second overcurrent element
3I>	Third overcurrent element
4I>	Fourth overcurrent element
Iis	Instantaneous overcurrent
1dI	First current step element
2dI	Second current step element
1di/dt	First current rate of rise element
2di/dt	Second current rate of rise element
Rapp	Impedance monitoring (di/dt dependence)
Iapp	Current monitoring with di/dt dependence
1Ig	First Frame Fault element
2Iq	Second Frame Fault element
RS-G	Cable insulation (Screen-Ground)
RCL	
	Automatic Reclosure
1U>	First Overvoltage element
2U>	Second Overvoltage element
1U<	First Undervoltage element
2U<	Second Undervoltage element
Ni	Trip number arcs interrupts operations
Ne	Trip number electrical contact operations
Nm	Trip number mechanical operations of circuit breacker
Wi	Circuit Breaker maintenance alarm
TCS	Trip Circuit Supervision
IRF	Internal Relay Fault
RT	First Remote Trip
RTX	Second Remote Trip
BrkF	Breaker failure to open
SelfTrip	Spontaneous protection
AutOp	Automatic C/B Open
AutCL	Automatic C/B Close
ManOp	Manual C/B Open
ManCL	Manual C/B Close
OvrOp	Overall C/B Open (Automatic + Manual)
OvrCL	Overall C/B Close (Automatic + Manual)
LT	Automatic Line Test
DiaCB1	CB1 Input position discrepancy
AnCB1	CB1 Operation failure
OpCB1	CB1 Openings operation
CICB1	CB1 Closures operation
OprCB1	CB1 Overall operation (Close + Open)
DiaCB2	CB2 Input position discrepancy
AnCB2	CB2 Operation failure
OpCB2	CB2 Openings operation
•	
CICB2	CB2 Closures operation
OprCB2	CB2 Overall operation (Close + Open)
DiaCB3	CB3 Input position discrepancy
AnCB3	CB3 Operation failure
OpCB3	CB3 Openings operation
CICB3	CB3 Closures operation
OprCB3	CB3 Overall operation (Close + Open)
DiaCB4	CB4 Input position discrepancy
AnCB4	CB4 Operation failure
OpCB4	CB4 Openings operation
CICB4	CB4 Closures operation
OprCB4	CB4 Overall operation (Close + Open)
DiaCB5	CB5 Input position discrepancy
AnCB5	CB5 Operation failure
OpCB5	CB5 Openings operation
CICB5	CB5 Closures operation
OprCB5	CB5 Overall operation (Close + Open)
_	

Erase See § Commands

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

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12. Events

Function which caused any of the following events: - Status change of digital Inputs/Outputs. - Start of protection functions - Trip of protection function - Function reset - system information.

The last 500 events are always available on local – remote MMI interface (display or remote communication). The memory buffer is refreshed at each new relay event (FIFO logic).

Each event is also stored on internal / external disk without limits (except the disk capacity)

Erase

→ See § Commands

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12.1 - Events

Functions	Events Displayed	Events Description MScom2	Stat	:us
T>	Tal	Tal (Alarm – Thermal Image T>)	Rise	- "
1I>	T> 1I>	T> (Trip - Thermal Image T>)	Rise	Fall
11>	t1I>	1I> (Start - Fist overcurrent element F50-51) 1I> (Trip - Fist overcurrent element F50-51)	Rise Rise	Fall
2I>	2I>	2I> (Start – Second overcurrent element F50-51)	Rise	i dii
	t2I>	2I> (Trip - Second overcurrent element F50-51)	Rise	Fall
3I>	3I>	3I> (Start - Third overcurrent element F50-51)	Rise	
	t3I>	3I> (Trip - Third overcurrent element F50-51)	Rise	Fall
4I>	4I>	4I> (Start - Fourth overcurrent element F50-51)	Rise	E. II
Tic	t4I> Iis	4I> (Trip - Fourth overcurrent element F50-51) Iis (Trip - Instantaneous overcurrent)	Rise	Fall
Iis 1dI	1dI	1dI (Start - First Current Step Element)	Rise	Fall
101	t1dI	1dI (Trip - First Current Step Element)	Rise	Fall
2dI	2dI	2dI (Start - Second Current Step Element)	Rise	Fall
	t2dI	2dI (Trip - Second Current. Step Element)	Rise	Fall
1di/dt	1di/dt	1di/dt (Start - First Current Rate of Rise Element)	Rise	Fall
	t1di/dt	1di/dt Trip - (First Current Rate of Rise Element)	Rise	Fall
2di/dt	2di/dt	2di/dt (Start - Second Current Rate of Rise Element)	Rise	Fall
Dann	t2di/dt	2di/dt (Trip - Second Current Rate of Rise Element)	Rise	Fall
Rapp Iapp	Rapp Iapp	Rapp (Trip - Impedance monitoring-di/dt dependence) Iapp (Trip - Current monitoring-di/dt dependence)	Rise Rise	Fall Fall
1Ig	1Iq	1Iq (Start - First Frame Fault Element)	Rise	Fall
119	t1Ig	t1Ig (Trip - First Frame Fault Element)	Rise	Fall
2Ig	2Iq	2Ig (Start - Second Frame Fault Element)	Rise	Fall
3	t2Ĭg	t2Ig (Trip - Second Frame Fault Element)	Rise	Fall
RCL	RCLcmd	RCL (Autoreclosure shot)	Rise	
	ARP	ARP (Autoreclosure in Progress)	Rise	
	ARF	ARF (Autoreclosure Failed)	Rise	
1.7	ARL	ARL (Autoreclosure Lockout)	Rise	
LT	LTcmd	LT (Line Test Command)	Rise	
1U>	1U> t1U>	1U> (Start - First Overvoltage Element F59) 1U> (Trip - First Overvoltage Element F59)	Rise Rise	
2U>	2U>	2U> (Start - Second Overvoltage Element F59)	Rise	
207	t2U>	2U> (Trip - Second Overvoltage Element F59)	Rise	
1U<	1U<	1U< (Start - First Undervoltage Element F59)	Rise	
	t1U<	t1U< (Trip - First Undervoltage Element F59)	Rise	
2U<	2U<	2U< (Start - Second Undervoltage Element F59)	Rise	
	t2U<	t2U< (Trip - Second Undervoltage Element F59)	Rise	
Wi	tWi>	Circuit breaker maintenance level	Rise	
	Ni alNi	Maximum number of arc chute operation at nominal values Alarm maintenance level of arc chute operation		
	Ne	Maximum number of arc contact operation at nominal values		
	alNe	Alarm maintenance level of arc contact operation		
	Nm	Maximum number of mechanical operation		
	alNm	Alarm maintenance level of mechanical operation		
TCS	TCS	TCS (Start - trip coil supervision)	Rise	
	tTCS	tTCS (trip coil supervision)	Rise	Fall
IRF	IRF	IRF (Start - Internal Relay Failure)	Rise	
DT	tIRF	tIRF (Trip - Internal Relay Failure) RT (Start - First element Remote Trip)	Rise	
RT	Start RT Trip RT	tRT (Start - First element Remote Trip) tRT (Trip - First element Remote Trip)	Rise Rise	
RTX	Start RTX	RTX (Second element Remote Trip)	Rise	
	Trip RTX	tRTX (Trip - Second element Remote Trip)	Rise	
BF	BF	BF (Breaker Failure)	Rise	Fall
SelfTrip	SelfTrip	Spontaneous trip		
	t-SelfTr.	Self-Trip time delay		
L/R CB Hdl	cmdOpC/B	Circuit Breaker (CB) intentional open	Rise	
	cmdClC/B	Circuit Breaker (CB) intentional close	Rise	
LT	LocRemInc LTPb	Local Remote inconsistent Output to operate an external flashing lamp signalling line test in	Rise <i>Rise</i>	
LI	LIFU	progress	NISE	
	LTP	Line Test in progress	Rise	
	LTF	Line Test Failed	Rise	
	LTOK	Line Test OK	Rise	
	LTB	Line Test Blocked	Rise	
	LT cmd	Line Test command	Rise	

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13. Systems (System Parameters)

Setting of system parameters.

13.1 – System Parameters

System Rated Current	In	4000	Α	(1 ÷9999)	step	1	Α
System Rated Voltage	Un	1000	V	(100 ÷10000)	step	10	V
System Rated Ground Current	Ign	1000	Α	(1÷9999)	step	1	Α
System Rated Ground Voltage	Ugn	1000	V	(100÷10000)	step	10	V
Line Test resistance	Rtest	1	ohm	(1÷500)	step	1	ohm

13.2 – Configuration Espansions

UX-10-4 Input modules Number	2	(0-2)	
14DI Input modules Number	0	(0-2)	
14DO Input modules Number	0	(0-2)	

13.3 - General Comunication parameters

Node Address	1	(1÷250)	step	1
Password	1111	(1111÷9999)	step	1
SetUp Group	1	(1/2/3/4)		
Date				

13.4 - Ethernet Comunication parameters

IP Address Mode	0.0.0.0	Static IP / Dynamic IP / DHCP
IPv4 address	0.0.0.0	STD Ethernet
IPv4 Subnet Mask Address	0.0.0.0	STD Ethernet
IPv4 Gateway Address	0.0.0.0	STD Ethernet
IPv4 NTP server1 Address	0.0.0.0	-
IPv4 NTP server2 Address	0.0.0.0	-
IPv4 NTP server3 Address	0.0.0.0	-
Host Name	XXXXXX	-

13.6 – Information parameters

Protection Description IPU version IAU version Serial Number

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13.7 – Input channel characteristics

DSPiChFact	10		(2÷10)	step	1
currR	0÷20	mA	(0÷20 / 4÷20 / 12÷20)		
currC	single		(single / dual)		
ADSEL	Analog		(Analog / Digital)		
pwmCard	1		(0 / 1)		
fibIP	Direct		(Direct / Invert)		
fibVP	Direct		(Direct / Invert)		
stI>ifBlk	Signal Disable		(Enable / Disable)		

13.7.1 – Description of variables

DSPiChFact	:	Ratio from first current analog channel and second analog channel (external transducer properties).
currR	:	Input characteristic of first and second current analog channel (external transducer properties).
currC	:	Single or dual channel external analog transducer (if single the second channel is not activated).
AdSel	:	Analog or digital source for Current (I) and voltage (Vm), digital source is provided directly on fiber optic inputs from MHIT Microelettrica transducers; The others channels (Vv, Ig, Ug) continue to work in analog mode.
fibIP	:	Digital current (I) measure direct or inverted (polarity).
fibVP	:	Digital voltage (Vm) measure direct or inverted (polarity).
stI>ifBlk	:	If enable Overcurrent instantaneous element are permanently locked when programmed block input is activated; If disable Overcurrent instantaneous element are delayed for [tBF] seconds when programmed block input is activated;

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14. Settings

Four complete banks of settings of the programmable variables are available in the "SETTING" menu. Both "Characteristic-1" and "-2; -3; -4" include the hereunder listed variables.

нмі	Visualization parameters					
USB	USB properties.					
IP Protocols	Internet protocol properties.					
IEC850 Protocol						
	IEC61850 protocol settings.					
Modbus TCP Protocol	Modbus on TCP protocol properties.					
NTP	Time date synchronization settings					
Time Zone/DayLight	Time zone settings.					
File system and Disk	File system an disk management.					
management						
T>	Thermal Image					
1I>	First overcurrent Element					
2I>	Second overcurrent Element					
3I>	Third overcurrent Element					
4I>	Fourth overcurrent Element					
Iis	Instantaneous overcurrent					
1dI	First current step element					
2dI	Second current step element					
1di/dt	First current rate of rise element					
2di/dt	Second current rate of rise element					
Rapp	Impedance monitoring - di/dt dependence					
Iapp	Current monitoring with di/dt dependence					
1Ig	First Frame Fault element					
2Ig	Second Frame Fault element					
RCL	Automatic Reclosure					
1U>	First Overvoltage Element					
2U>	Second Overvoltage Element					
1U<	First Undervoltage Element					
2U<	Second Undervoltage Element					
UL<	Line voltage presence					
Wi	Amount of Energy to reach the C/B maintenance level					
TCS	Setting variables for Trip Circuit Supervision					
IRF	Internal Relay Fault					
RT	First Remote Trip					
RTX	Second Remote Trip					
BrkFail	Setting variables for Breaker Failure detection					
Dia-I	Diagnostic analog input currents					
Wh	Energy counter Pulse					
SelfTrip	Spontaneous trip					
Oscillo	Setting variables for Oscillographic recording					
L/R CB Cmds	C/B command Local / Remote setting					
CB-L	Locks C/B reclosure					
LT	Line Test					
ExtResCfg	Configuration for external reset input					
Dia C/B	Diagnostic C/B, switches position and statistic					
Auxiliary C/B	Auxiliary C/B remote commands					
, , , =	, ,					

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14.1 - Password

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

The factory default password is "1111".

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

14.2 - Menu: Comm. (Serial Communication protocols options)

Options	\rightarrow	BRRem	19200	[9600 / 19200 / 38400]
	\rightarrow	PRRem	Modbus	[Modbus / IEC103]

14.2.1 - Description of variables

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

PRRem : Remote communication protocol:

Modbus = Modbus RTU

IEC103 = IEC 103

14.2.2 -USB port (mini-USB port on main unit)

A Mini-USB socket is available on Relay's main unit for composite connection.

CDC service serial interface connection:

Program available from Microelettrica Scientifica S.p.A. (MSCom2 for Windows XP/Vista/7) – it is possible connect a Personal Computer to download all available information's, operate any control and program the relay; the protocol used is "MODBUS RTU".

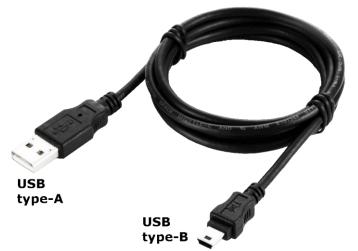
MSD service interface connection:

Direct access on internal and external disk of the unit to manage files and records.

This port is also used for FW upgrade of the main unit.

14.2.3 - Cable for connection from Relay to Personal Computer

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



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14.2.4 - Rear serial communication port (RS485)

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

The communication interface allows programming all settings, operating all commands and downloading all information and records.

The physical connection can be via a normal pair of wires (RS485) or, on request, via fiber optic.

14.2.5 - Rear communication port (Ethernet)

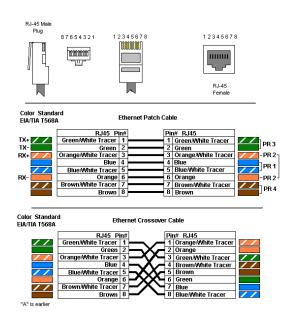
Three Ethernet connection is available for communication on the Relay's back.

The Ethernet connector is a standard RJ45 and can be connected to a PC with a Ethernet "Cross" cable, or it can be connected to a switch with a Ethernet "Patch" cable.

These ports have simultaneous multi-protocol functionality (each communication protocol is always available on each port).

- Modbus On TCP
- IEC61850
- Internet protocol IPV4
- UDP (Network device discover Service server).
- TELNET (Remote protection Monitor server).
- FTP Protocol (File transfer server).
- NTP protocol (Network time protocol client).
- HTTP protocol (web server).

14.2.6 - Wiring the Ethernet Communication



The back Ethernet connector is a standard RJ45 connector and can be wired with a normal Ethernet UTP cable in class 5 minimum.

The relay can be connected directly to a PC with a Ethernet "Cross" cable, or it can be connected to a switch with a Ethernet "Patch" cable.





14.3 - Menu: HMI (Human Machine Interface)

14.3.1 - Leds (Number)

In this configuration, you can select the number of led (10 led STD on remote MMI).

Leds → 10

[10 / 17 / 24 / 31 / 38 / 45 / 52 / 59]

Leds : Configuration Leds number

14.3.2 - WirCB scheme - Scheme configuration

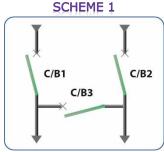
In this configuration, you can select the scheme that appears on the Home page (Remote Unit).

Wir → Scheme 1

[Scheme 1 / Scheme 2 / Scheme 3 / Scheme 4 / Scheme 5]

Wir : Circuit Breaker wiring selector

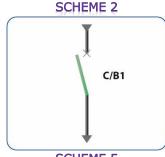
14.3.2.1 - Scheme types

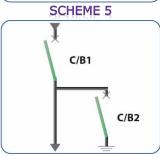


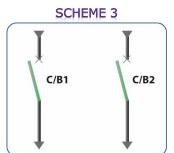
SCHEME 4

C/B1

C/B2







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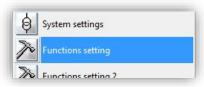
14.3.3 - Example - Configuration with MScom2 software

Open "MSCom2" program and connect to the relay.

Select "CHANGE WINDOWS" from "Menu" button



Select "FUNCTION SETTING"



Select "HMI" function

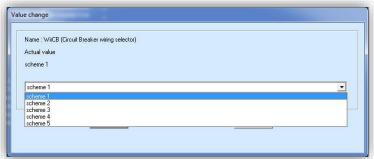


Select "CIRCUIT BREAKER WIRING SELECTOR"

TUA SEFERIAD

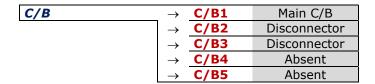
And select scheme





14.3.4 - Configuration - Close Braker

In this configuration, you can select the Main (C/B) in the sheme selected



Load Break / Disconnector / Earthing switch High speed Earthing switch / Main C/B (Circuit breaker) / Absent

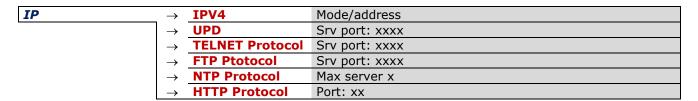
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14.4 - USB

USB	\rightarrow	USB-Device	CDC/MSD (Composite)
	\rightarrow	USB-Host	Stick disk 4GB (or less)

14.5 - IP Protocols



IPV4 : Internet Protocol

UPD : Network Device Discover Service Server

TELNET Protocol : Remote Protection Monitor Server **FTP Ptotocol** : File Transfer Server

NTP Protocol : Network Time Protocol Client

HTTP Protocol : Web Server

14.6 - IEC61850 Protocol

IEC61850	\rightarrow	IEC61850	Protocol Disable
	\rightarrow	IEC61850	Warnings + Error

IEC61850 : Type:

Protocol Disable (acquired at start-up)
Protocol Enable (acquired at start-up)

IEC61850 : Log Level (info class stored on internal HD):

Only info
Only warnings
Only errors
Warnings + errors
Info + Warnings + errors
Disable

14.7 - Modbus TCP Protocol

14.8 - NTP (Time/Date synchronization parameters)

NTP	\rightarrow	Enab	Enable]	[Enable/Disable]			
	\rightarrow	tSNTP	60	min	[1 ÷ 3600]	step	1	min

Enab : Enable date and time synchronization **tSNTP** : Periodic synchronization time

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14.9 - Time Zone/DayLight (Options)

NTP	\rightarrow	GMT	GMT+1.00h					
	\rightarrow	SumT	Europe					
	\rightarrow	toffs	0	min	$[0 \div 600]$	step	1	

GMT : Time Zone
SumT : Isummer Time

toffs : Synchronizing time offset, added if summer time is disable

14.10 - File system and disks management

File System	\rightarrow	updIAU	External disk
	\rightarrow	Log	Protection log file on internal disk
	\rightarrow	OniDF	Write Disable
	\rightarrow	OneDF	Write Disable
	\rightarrow	FTPvo	Internal disk

updIAU	IAU (Intelligent acquisition unit) FW update source: Disabled: No IAU FW update procedure activated on PWR ON. External disk (USB stick): FW update enabled from USB stick Internal disk:): FW update enabled from USB stick
Log	Enable log files: Protection log file disabled Protection log file on internal disk Protection log file on external disk
OniDF	Write policy on internal full disk condition: Write disable Delate older folder and write
OneDF	Write policy on external full disk condition: Write disable
FTPvo	FTP exported volume: Internal disk External disk (USB stick) Both disks

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

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
				-				
Levels	<i>→</i>	Tal	50	%Tn	$[10 \div 100]$	step	1	%Tn
	\rightarrow	Tres	50	%Tb	$[10 \div 100]$	step	1	%Tb
	\rightarrow	Is	1	In	$[0.5 \div 1.5]$	step	0.01	In
	\rightarrow	Kt	300	min	[1 ÷ 600]	step	0.01	min

14.11.1 - Description of variables

Status : Function enabling (Disable / Enable)

Tal : Temperature prealarm level

Tres: Temperature reset (drop-off temperature)

Is : Continuous admissible current

Kt : Warming-up Time Constant of the load

14.11.2 - Trip and Alarm

The algorithm compares the amount of heat accumulated "T" (\equiv i²•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, and remain in trip condition until the temperature "T" is over the reset temperature "Tres".

14.11.1.1 - 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

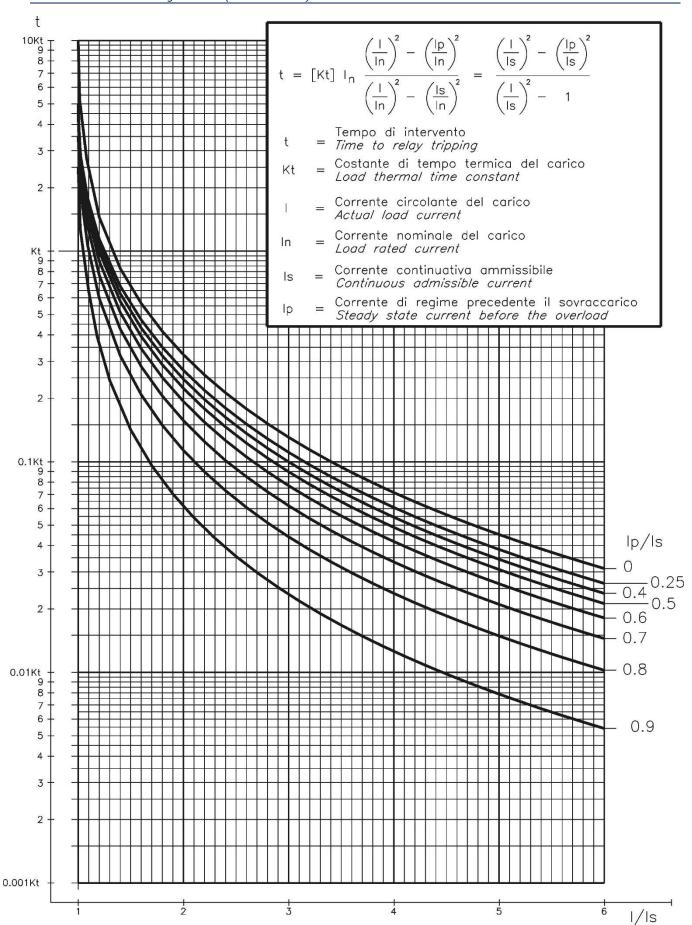
$$t = Kt \cdot \ell_n \frac{\left(\frac{I}{ln}\right)^2 - \left(\frac{lp}{ln}\right)^2}{\left(\frac{I}{ln}\right)^2 - \left(\frac{ls}{ln}\right)^2}$$

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.

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14.11.1.2 - Thermal Image Curves (TU1024 Rev.1)



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

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
Options	$\begin{array}{c} \rightarrow \\ \rightarrow \\ \rightarrow \\ \rightarrow \end{array}$	f(t) tBI f(a) RCL	Type - D Disable Fw No		[D / A / B / C] [Disable / 2tBO] [Disable / Fw / Rev] [No / Yes]			
Levels	\rightarrow	Is	1	In	(0.1÷4)	step	0.01	In
Timers	$\overset{\rightarrow}{\rightarrow}$	ts tBO		s s	(0.01÷100) (0.05÷0.75)	step step	0.01 0.01	s s

14.12.1 - Description of variables

6 1. 1		F
Status		Function enabling (Disable / Enable)
f(t)	:	Operation characteristic (Time/Current curve): (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C
tBI	:	Blocking input reset time: Disable = Permanent block 2tBO = Set 2xtBO.
f(a)	:	Operation mode: Disable = Non Directional Fw = Directional Forward Rev = Directional Reverse
RCL	:	If "RCL = Yes", after tripping of the element "1I>" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Is	:	Minimum operation level
ts	:	Trip time delay
tBO	:	Time to reset of the Blocking Output after expiring of the Trip time delay. "tBO" is also the trip time delay of the Breaker Failure function.

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14.12.2 - Algorithm of the time current curves

The Time Current Curves are generally calculated with the following equation

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

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

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

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

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

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

Curve Name	Curve Identifier	Α	В	а
IEC A Inverse	А	0.14	0	0.02
IEC B Very Inverse	В	13.5	0	1
IEC C Extremely Inverse	С	80	0	2

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

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

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

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

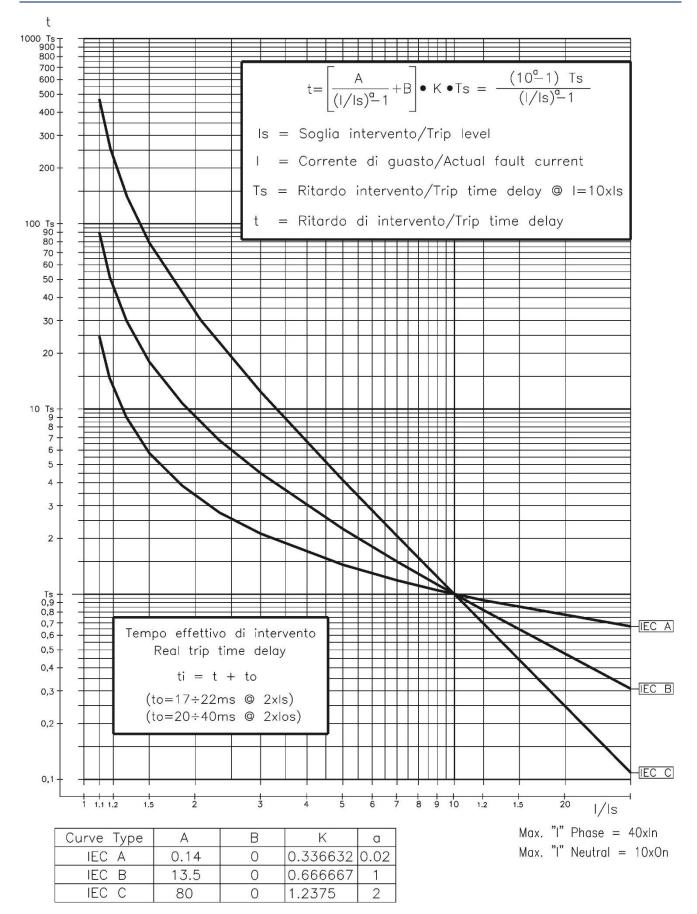
The maximum measuring current is "40xIn" for phase elements and "10xOn" for the neutral elements.

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

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14.12.3 - IEC Curves





14.12.4 - Blocking Logic (BO-BI)

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

14.12.4.1 - Output Blocking signal "BO"

All the protection functions that can be programmed to operate in the blocking logic mode, element, have an instantaneous element (beside the time delayed) which is operated as soon as the controlled quantity exceeds the set trip level (I > [Is] for current, etc..) and is instantaneously reset when the input quantity drops below the reset level (normally 0.95Is).

The instantaneous element can control one of the user programmable output relays that, by its contacts, makes the signal available for blocking an external element (BO = Blocking Output).

In case, "tBO" sec after the set trip time "ts" has expired, the Protection function is still in operation (current above trip level), the Blocking Output relay (instantaneous element) is anyhow reset to eventually remove the Blocking signal from a back-up protection.

18.6.4.2 - Blocking Input "BI"

For all the functions controllable by the Blocking Logic, it is possible to inhibit the time delayed tripping by an external signal that activates a Digital Input programmed for this functionality.

The programmed Digital Input gets activated by an external cold contact closing across its terminals.

With the variable "tBI" set to "OFF" (tBI=OFF), the tripping of the delayed function is blocked as long as the Blocking Input signal is present at the terminals of the Digital Input.

With the variable "tBI" set to "2xtBI" (tBI=2xtBI), 2xtBI seconds after the set trip time delay of the function has expired the blocking input is anyhow ignored and the function enabled to trip.

14.12.5 - Automatic doubling of Overcurrent thresholds on current inrush

For some of the phase Overcurrent functions it is possible to have the set trip level [Is] automatically doubled when strong inrush current is detected.

If at circuit Breaker switch-on (i.e. when the input current rises from zero to a minimum measurable value) the current increases from 0 to 1.5 times the rated value [In] in less than 60ms, the set minimum pick-up level [Is] is dynamically doubled ([Is] \rightarrow [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.



14.13 - Function: **2I>** (Second Overcurrent Element F50/51)

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
Options	\rightarrow	f(t) tBI f(a) RCL	Type - D Disable Disable No		[D / A / B / C] [Disable / 2tBO] [Disable / Fw / Rev] [No / Yes]			
Levels	\rightarrow	Is	1	In	(0.1÷4)	step	0.01	In
Timers	$\begin{array}{c} \rightarrow \\ \rightarrow \\ \rightarrow \end{array}$	ts tBO	100 0.75	s s	(0.01÷100) (0.05÷0.75)	step step	0.01 0.01	s s

14.13.1 - Description of variables

f(t) : Operation characteristic (Time/Current curve): (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C tBI : Blocking input reset time Disable = Permanent block 2tBO = Set 2xtBO. f(a) : Operation mode: Disable = Non Directional Fw = Directional Forward
Disable = Permanent block 2tBO = Set 2xtBO. f(a) : Operation mode: Disable = Non Directional
Disable = Non Directional
Rev = Directional Reverse
RCL : If "RCL = Yes", after tripping of the element "2I>" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Is : Minimum operation level
ts : Trip time delay
tBO : Time to reset of the Blocking Output after expiring of the Trip time delay. "tBO" is also the trip time delay of the Breaker Failure function.

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

Status	→ Enab.	Disable		[Disable / Enable]			
Options		Disable Disable Disable No		[Disable / 2tBO] [Disable / Fw / Rev] [Disable / Enable] [No / Yes]			
Levels	→ Is	1	In	(0.1÷10)	step	0.01	In
Timers	→ <u>ts</u>	100	s	(0.01÷100)	step	0.01	S
	→ tCoF	0.05	S	$(0.02 \div 0.2)$	step	0.01	S
	→ tBO	0.75	S	(0.05÷0.75)	step	0.01	S

14.14.1 - Description of variables

Status		Function enabling (Disable / Enable)
	•	-
tBI	٠	Blocking input reset time Disable = Permanent block
		2tBO = Set 2xtBO.
£(-)		
f(a)	•	Operation mode: Disable = Non Directional
		Fw = Directional Forward
		Rev = Directional Reverse
CoF	:	If "CoF = Enable", any time the circuit breakers status changes from open to close the "3I>" element is enabled to trip instantaneously if the current exceeds
		the set value "Is" within the time "tCoF". (Close On Fault Function)
RCL	:	If "RCL = Yes", after tripping of the element "3I>" and Opening of the Circuit
		Breaker, the relay starts an automatic Line Test and a reclosure cycle.
		If "RCL = No" no test and no reclosure is started.
Is	:	Minimum operation level.
ts	:	Trip time delay
tCoF	:	Maximum duration of the Close on Fault function.
tBO	:	Time to reset of the Blocking Output after expiring of the Trip time delay. "tBO"
		is also the trip time delay of the Breaker Failure function.

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

Status	→ Enab	. Disable		[Disable / Enable]			
Options	$\begin{array}{ccc} \rightarrow & \textbf{tBI} \\ \rightarrow & \textbf{f(a)} \\ \rightarrow & \textbf{CoF} \\ \rightarrow & \textbf{RCL} \end{array}$	Disable Disable Disable No		[Disable / 2tBO] [Disable / Fw / Rev] [Disable / Enable] [No / Yes]			
Levels	→ Is	10	In	(0.1÷10)	step	0.01	In
Timers	→ <u>ts</u>	100	s	(0.01÷100)	step	0.01	s
	$\rightarrow tCoF$ $\rightarrow tBO$	0.05 0.75	s	(0.02÷0.2) (0.02÷0.2)	step step	$0.01 \\ 0.01$	S S

14.15.1 - Description of variables

Disable		Function enabling (Disable / Enable)
	•	
tBI	:	Blocking input reset time Disable = Permanent block 2tBO = Set 2xtBO.
f(a)	:	Operation mode: Disable = Non Directional Fw = Directional Forward Rev = Directional Reverse
CoF	:	If "CoF = Enable", any time the circuit breakers status changes from open to close the "4I>" element is enabled to trip instantaneously if the current exceeds the set value "Is" within the time "tCoF". (Close On Fault Function)
RCL	:	If "RCL = Yes", after tripping of the element "4I>" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Is	:	Minimum operation level.
ts	:	Trip time delay
tCoF	:	Maximum duration of the Close on Fault function.
tBO	:	Time to reset of the Blocking Output after expiring of the Trip time delay. "tBO" is also the trip time delay of the Breaker Failure function.

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

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

14.16.1 - Description of variables

Disable	: Function enabling (Disable / Enable)
RCL	: If "RCL = Yes", after tripping of the element "Iis" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
f(a)	: Operation mode: Disable = Non Directional Fw = Directional Forward Rev = Directional Reverse
Is	: Minimum operation level.

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

Status	\rightarrow	Enab.	Disable] [[Disable / Enable]			
Options	\rightarrow	RCL	No]	[No / Yes]			
Levels	$\begin{array}{c} \longrightarrow \\ \longrightarrow \\ \end{array}$	DI di	1000 200	A A/ms	(100÷9990) (4÷400)	step step	10 1	A A/ms
Timers	\rightarrow	tDI tdi	100	ms ms	(0÷500) (0÷100)	step step	1 1	ms ms

14.17.1 - Description of variables

Status	:	Function enabling (Disable / Enable)
RCL	:	If "RCL = Yes", after tripping of the element "1dI" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
DI	:	Current step trip level
di	:	Minimum di/dt level to start "ΔΙ" evaluation and detection reset level
tDI	:	Trip time delay
tdi	:	Detection reset time delay

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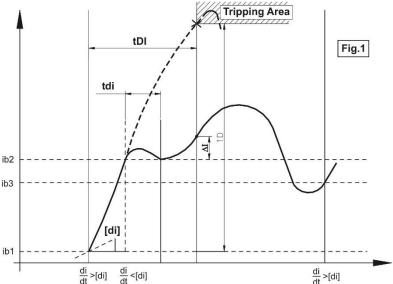


14.17.2 - Operation of the Current step monitoring element

The timely detection of a current step allow to clear a near short circuit long before the current can reach the prospective peak value.

<u>Protection Function Operation</u> (see Fig. 1):

- Any time a current rate of rise exceeding the set value [di] is detected the value of the current " i_{1b} " is recorded as reference basic value to evaluate the current step " $\Delta I = i i_{1b}$ " and the timer "tDI" is started. " ΔI " is evaluated every 1ms.
- If during [tDI] the rate of rise "di/dt" never goes below the set level [di] for a time longer than [tdi], when [tDI] expires, the difference $\Delta l = i i_{1b}$ is measured and if " $\Delta I \geq [DI]$ " the protection function trips.



- If during [tDI] the rate of rise "di/dt" goes below the set level [di] for a time longer than [tdi], a new value of the current i_{2b} is recorded and, when [tDI] expires. If the difference $\Delta l = l - i_{2b}$ measured is greater than [DI], the protection function trips.

In terms of equation the protection function operation is as follow:

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

$$\Rightarrow \begin{cases} \frac{di}{dt} \geq \big[di \big] during \ tdi \Rightarrow Trip \ if \quad \Delta = i - i_{1b} \geq \big[DI \big] \ after \ tDI \\ \frac{di}{dt} < \big[di \big] \ during \ tdi \Rightarrow New \ Value \ of \ Current \ i_{2b} \ is \ recorded \Rightarrow Trip \ if \quad \Delta = i - i_{2b} \geq \big[DI \big] \ after \ tDI \end{cases}$$

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

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

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

14.18.1 - Description of variables

Disable : Function enabling (Disable / Enable)

RCL : If "RCL = Yes", after tripping of the element "2dI" and Opening of the Circuit Breaker,

the relay starts an automatic Line Test and a reclosure cycle.

If "RCL = No" no test and no reclosure is started.

DI : Current step trip level

di : Minimum di/dt level to start "\DI" evaluation and detection reset level

tDI : Trip time delay

tdi : Detection reset time delay

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

Status	→ Enab.	Disable	[Disable / Enable]			
Options	→ RCL	No	[No / Yes]			
Levels	→ G	20 A/ms	(4÷400)	step	1	A/ms
Timers	$ ightarrow footnote{tG} \rightarrow footnote{tRes}$	20 ms 0 ms	(2÷500) (0÷500)	step step	1 1	ms ms

14.19.1 - Description parameters

Disable : Function enabling (Disable / Enable)

RCL : If "RCL = Yes", after tripping of the element "1di/dt" and Opening of the Circuit

Breaker, the relay starts an automatic Line Test and a reclosure cycle.

If "RCL = No" no test and no reclosure is started.

G : di/dt trip level
tG : Trip time delay
tRes : Reset time delay

14.19.2 - Operation of the current rate of rise monitoring element

This function is used to detect remote faults

Current is sampled at 5kHz, is measured as the average of 15 samples are stored in a buffer from which every 1ms the relay computes the average rate of rise in the set time delay:

$$\frac{di}{dt} = \frac{I_{(t+[tG])} - I_{(t)}}{tG}$$

if
$$\frac{di}{dt} \ge [G]$$
 the relay trip

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

Status	\rightarrow	Disable	X		[X Disable / Enable]			
Options	\rightarrow	RCL	No]	[No / Yes]			
Levels	\rightarrow	G	20	A/ms	(4÷400)	step	1	A/ms
Timers	$\begin{array}{c} \rightarrow \\ \rightarrow \end{array}$	tG tRes	20 0	ms ms	(2÷500) (0÷500)	step step	1 1	ms ms

14.20.1 - Description parameters

Status : Function enabling (No = Disable / Yes = Enable)

RCL : If "RCL = Yes", after tripping of the element "1di/dt" and Opening of the Circuit

Breaker, the relay starts an automatic Line Test and a reclosure cycle.

If "RCL = No" no test and no reclosure is started.

G : di/dt trip level
tG : Trip time delay
tRes : Reset time delay

14.20.2 - Operation of the current rate of rise monitoring element

This function is used to detect remote faults

Current is sampled at 5kHz, is measured as the average of 15 samples and stored in a buffer from which every 1ms the relay computes the average rate of rise in the set time delay:

$$\frac{di}{dt} = \frac{I_{(t+[tG])} - I_{(t)}}{tG}$$

if
$$\frac{di}{dt} \ge [G]$$
 the relay trip

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

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
Options	\rightarrow	RCL	No		[No / Yes]			
Levels	\rightarrow	Va	400	v	(0÷800)	step	1	V
	\rightarrow	Ri	0.1	Ω	(0÷0.25)	step	0.001	Ω
	\rightarrow	Rt	1	Ω	(0.001÷2.5)	step	0.001	Ω
	\rightarrow	Li	0.005	Н	(0.001÷0.01)	step	0.001	Н
	\rightarrow	Lt	0.01	Н	(0.002÷0.05)	step	0.001	Н
	\rightarrow	R*	50	Ω	(0÷100)	step	0.01	Ω
	\rightarrow	g	50	A/ms	(10÷500)	step	1	A/ms
Timers	\rightarrow	tr	50	ms	(0÷100)	step	1	ms

14.21.1 - Description of variables

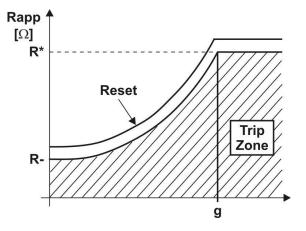
		- · · · · · · · · · · · · · · · · · · ·
Status	:	Function enabling (Disable / Enable)
RCL	:	I If "RCL = Yes", after tripping of the element "Rapp" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Va	: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

14.21.2 - Operation the Impedance monitoring element

The protection element shall trip if the impedance "Rapp" calculated as the ratio of the line voltage to the line current drops below the calculated value with the current rate of rise exceeding the level as reported on the trip characteristics. Trip takes place if the situation lasts longer than the set time delay "tr".

$$Rapp = \left\lceil V - \frac{Ri(V - Va)}{Rt} + \left(\frac{Lt}{Rt} \cdot Ri - Li\right)g \right\rceil : \left(\frac{V - Va}{Rt} - \frac{Lt}{Rt} \cdot g\right)$$

Reset takes place when "Rapp" is 10% higher than the trip value.



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

Status	\rightarrow	Enab.	Disable		[Disable / Enab	le]		
Options	\rightarrow	RCL	No]	[No / Yes]			
Levels	\rightarrow	IA	1500	Α	(500÷5000)	step	10	Α
	\rightarrow	I*	500	Α	(400÷1500)	step	10	Α
	\rightarrow	g	50	A/ms	(30÷500)	step	1	A/ms
	\rightarrow	Res	90	%	(80÷100)	step	1	%Iapp
Timore	`	+	0.1	۱.	(0.5)	cton	0.01	c
Timers	\rightarrow	tr	0.1	S	(0÷5)	step	0.01	S

14.22.1 - Description of variables

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

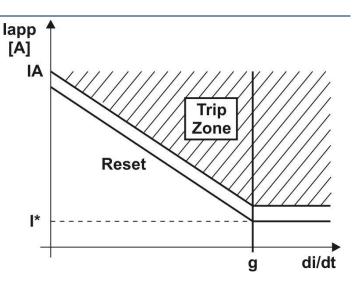
14.22.2 - Operation of the "Iapp" element

The protection shall trip if current measured exceeds the value [Iapp] calculated as hereunder showed for longher than the set time "tr" reset takes place as soon as the current drops below

$$[lapp] \cdot \frac{Res}{100}$$

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

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



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14.23 - Function: 11g (First Frame Fault Element)

Status	\rightarrow	Enab.	Disable]	[Disable / Enable]			
Options	$\begin{array}{c} \rightarrow \\ \rightarrow \\ \rightarrow \end{array}$	f(t) V(t) RCL	Type - D Type - D No		[D / A / B / C] [D / EN] [No / Yes]			
Levels		Is Us	1 0.2	Ign Ugn	(0.00÷2) (0.00÷1)	step step	0.01 0.01	Ign Ugn
Timers	\rightarrow	ts	20	s	(0.02÷100)	step	0.01	S

14.23.1 - Description of variables

Status	Function enabling (Disable / Enable)	
f(t)	Operation characteristic (Time/Current curve): (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C	
V(t)	Operation characteristic (Time/Current curve): (D) = Independent definite time (EN50122-1) = Inverse Curve	
RCL	If "RCL = Yes", after tripping of the element "1Ig" and Opening of the Circ Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.	uit
Is	Minimum operation level of frame to earth current.	
Us	Minimum operation level of frame to earth voltage.	
ts	Trip time delay	

14.23.2 - Operation

Trip takes places if, for larger than the set time delay [ts], both the ground fault current "Ig" and the Voltage to ground "Ug" exceed the set values [Is] and [Us]. If "Is = 0" the relay shall consider "Ug" only, viceversa if "Ug = 0" the relay shall consider "Ig" only.

Setting		Tripping condition
Is	Us	
≠0	≠0	Ig>[Is] & Ug>[Us]
≠0	=0	Ig>[Is]
=0	≠0	Ug>[Us]

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14.24 - Function: 2Ig (Second Frame Fault Element)

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
Options	$\begin{array}{c} \rightarrow \\ \rightarrow \\ \rightarrow \\ \rightarrow \end{array}$	f(t) V(t) RCL	Type - D Type - D No		[D / A / B / C] [D / EN] [No / Yes]			
Levels	_	Is Us	1 0.2	Ign Ugn	(0.00÷2) (0.00÷1)	step step	0.01 0.01	Ign Ugn
Timers	\rightarrow	ts	20	s	(0.02÷100)	step	0.01	S

14.24.1 - Description of variables

Status	: Function enabling (Disable / Enable)
f(t)	: Operation characteristic (Time/Current curve): (D) = Independent definite time (A) = IEC Inverse Curve type A (B) = IEC Very Inverse Curve type B (C) = IEC Extremely Inverse Curve type C
V(t)	: Operation characteristic (Time/Current curve): (D) = Independent definite time (EN50122-1) = Inverse Curve
RCL	: If "RCL = Yes", after tripping of the element "2Ig" and Opening of the Circuit Breaker, the relay starts an automatic Line Test and a reclosure cycle. If "RCL = No" no test and no reclosure is started.
Is	: Minimum operation level of frame to earth current.
Us	: Minimum operation level of frame to earth voltage.
ts	: Trip time delay

14.24.2 - Operation

Trip take place if, for larger than the set time delay [ts], both the ground fault current "Ig" and the Voltage to ground "Ug" exceed the set values [Is] and [Us]. If "Is = 0" the relay shall consider "Ug" only viceversa if "Ug = 0" the relay shall consider "Ig" only.

Set	ting	Tripping condition
Is	Us	
≠0	≠0	Ig>[Is] & Ug>[Us]
≠0	=0	Ig>[Is]
=0	≠0	Ug>[Us]

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14.25 - Function: RCL (Automatic Reclosure)

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
Options	$\neg \rightarrow \\ \neg \rightarrow$	ShNum Test	2 Yes		[1 / 2 / 3 / 4] [No / Yes]			
		rest	163	_	[NO / Tes]			
Timers	\rightarrow	tr	10	s	(1÷200)	step	1	s
	\rightarrow	t1	0.3	s	(0.1÷1000)	step	0.1	S
	\rightarrow	t2	1	s	(0.1÷1000)	step	0.1	S
	\rightarrow	t3	3	s	(0.1÷1000)	step	0.1	S
	\rightarrow	t4	10	s	$(0.1 \div 1000)$	step	0.1	S
	\rightarrow	tCHK	0.4	s	(0.2÷3)	step	0.1	S
	\rightarrow	tCHRT	100	s	(1÷600)	step	1	S

14.25.1 - Description of variables

Status	: Function enabling (Disable / Enable)
ShNum	: Number of reclosure shots to Lock-out
Test	: "Yes" - Before any reclosure the Line Test is started and the reclosure is operated only after a successful Line Test is carried-out. "No" - Reclosure is operated without Line-Test.
tr	: Reclaim time. Any new trip during "tr" after a successful reclosure shot starts the next shot of the cycle. Any new trip after "tr" restarts a complete cycle.
tCHK	: Time check C/B operation if any protection function trip except RT/RTX; if one or more protection elements doesn't reset before "tCHK" expire the RCL goes into Lock status.
tCHRT	: Time check C/B operation if RT/RTX Trip; If RT/RTX doesn't reset before "tCHRT" expire the RCL goes into Lock status.

14.25.2 - Operation

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

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

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

After a <u>manual</u> closure of the C/B, operation time start or tripping of any of the relay protection elements during "tr", makes the relay enter into the Lock-Out status (L.O.). In the L.O. status the relay, after breaker opening, does not produce any command for automatic reclose; the lock-out status is shows on the display.

Reset from the L.O. status takes place when the C/B is opened and then <u>manually</u> reclosed or by operating the external reset command.

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

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

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

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

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

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

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

14.26.1 - Description of variables

Status: Function enabling (Disable / Enable)

Us : Minimum operation level

ts : Trip time delay

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

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

14.27.1 - Description of variables

Status: Function enabling (Disable / Enable)

Us : Minimum operation level

ts : Trip time delay

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

Status	→ Ena	b. Disable		[Disable / Enable]			
Levels	→ Us	0.70	Un	(0.05÷1)	step	0.01	Un
Timers	→ ts	10	s	(0÷650)	step	1	S

14.28.1 - Description of variables

Status: Function enabling (Disable / Enable)

Us : Minimum operation level

ts : Trip time delay

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

Status	→ Enab.	Disable		[Disable / Enable]			
Levels	→ Us	0.70	Un	(0.05÷1) step 0.01		Un	
Timers	→ ts	10	s	(0÷650)	step	1	S

14.29.1 - Description of variables

Status : Function enabling (Disable / Enable)

Us : Minimum operation level

ts : Trip time delay

14.30 - Function: **UL<** (Line Voltage Presence)

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
Levels		UL <int UL<ric< th=""><th>0.9 1.1</th><th>Un Un</th><th colspan="2">(</th><th>Un Un</th></ric<></int 	0.9 1.1	Un Un	(Un Un	
Timers	\rightarrow	tUL<	0.2	s	(0.2÷200)	step	1	S

14.30.1 - Description of variables

Status : Function enabling (Disable / Enable)
UL<int : Minimum operation pickup level
UL<Ric : Minimum operation dropoff level

tUL< : Trip time delay

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

Status	\rightarrow	Enab.	Disable		[Disable / Enable]			
				_				
Levels	\rightarrow	Ni	1.000		(10÷1000)	step	1	
	\rightarrow	alNi	80	%	(5÷95)	step	1	
	\rightarrow	Ne	1.000		(10÷99999)	step	1	
	\rightarrow	alNe	80	%	(5÷95)	step	1	
	\rightarrow	Nm	1.000		(10÷99999)	step	1	
	\rightarrow	alNm	900		(10÷99999)	step	1	
	\rightarrow	Ii	3.000	Α	(100÷9999)	step	1	Α
				_				
Timers	\rightarrow	ti	20	ms	(10÷40)	step	1	ms
	\rightarrow	tr	8	ms	(0÷50)	step	1	ms

14.31.1 - Description of variables

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

14.31.2 - Operation (Accumulation of the interruption Energy)

The relay computes the Circuit Breaker interruption Energy.

On the relay is possible to set the total level of energy that the breaker is able to interrupt.

During each C/B operation the remain energy is calculated.

The operation of this function is based on the following principle:

Arc chute:

Any time the Circuit Breaker opens, the relay accumulate the square value of the current measured from the instance of the circuit breaker opening to the instant when the current expire.

The opening instant is detected by the change of status from closed to open of digital input connected to normally open contact of the C/B; it is compensated by the parameter "tr":

$$Ei = \sum_{n=1}^{n} [i^2]$$

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

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

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

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

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

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

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

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

Arc contact:

Any time the Circuit Breaker opens, the relay record the value of the current measured at the instance of the circuit breaker opening.

The opening instant is detected by the change of status from closed to open of digital input connected to normally open contact of the C/B; it is compensated by the parameter "tr":

$$Ee = [i^2]$$

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

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

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

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

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

When the remaining energy value goes below the ${f AlNe}$ threshold an alarm is generated .

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

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

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

Mechanical operations:

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

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

When the mechanical operations counter $[\mathbf{OVrOP}]$ value exceed the \mathbf{Nm} threshold another alarm is generated .

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

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

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14.32 - Function: TCS (Trip Circuit Supervision)

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

14.32.1 - Description of variables

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

14.32.2 - Operation

The relay includes a complete Circuit Breaker Trip Circuit Supervision unit that is associated to the Contact "19-20" of the "R1" Output Relay.

The contact of "R1" is used to trip the C/B as reported in the drawing here below.

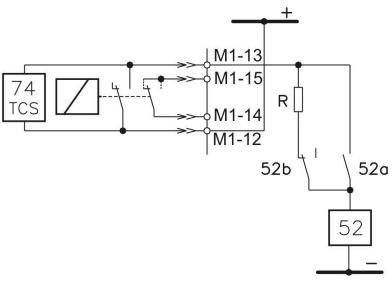
The supervision works when the C/B is closed and recognizes the Trip Circuit as sound as far as the current flowing exceeds "1mA".

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 $[k\Omega]$

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



Tripping of the function operates a user programmable output relay.

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14.33 - Function: IRF (Internal Relay Fault)

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

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

14.33.1 - Description of variables

Status : Function enabling (No = Disable / Yes = Enable)

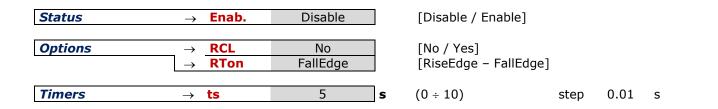
tIRF : Trip time delay

14.33.2 - Operation

Tripping of the function operates a user programmable output relay.

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

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



14.34.1 - Description of variables

Status: Function enabling (Disable / Enable)

RCL : If "RCL = Yes", after tripping of the element "RT" and Opening of the Circuit Breaker,

the relay starts an automatic Line Test and a reclosure cycle.

If "RCL = No" no test and no reclosure is started.

RTon : Remote trip Edge selector

ts : Trip time delay

14.34.2 - Operation

Tripping of the function operates a user programmable output relay.

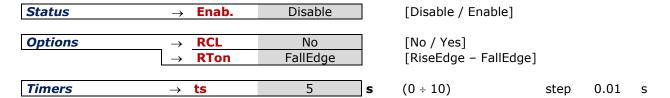
When Remote Trip is enabled to initiate a reclosure shot, the relevant input signal must be cleared within the time-out "to1" (1000ms); if the signal stays for longer than "to1" the reclosure function goes into the lock-out status giving an External Fail signal.

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14.35 - Function: RTX (Second Element Remote Trip)

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



14.35.1 - Description of variables

Status: Function enabling (Disable / Enable)

RCL : If "RCL = Yes", after tripping of the element "RTX" and Opening of the Circuit Breaker,

the relay starts an automatic Line Test and a reclosure cycle.

If "RCL = No" no test and no reclosure is started.

RTon : Remote trip Edge selector

ts : Trip time delay

14.35.2 - Operation

Tripping of the function operates a user programmable output relay.

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

14.36 - Function: BrKFail (Breaker Failure)

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

14.36.1 - Description of variables

Status : Function enabling (Disable / Enable)

tBF : Trip time delay

14.36.2 - 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,

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14.37 - Function: **Dia-I** (Diagnostic analog inputs current)

Status	→ Enab.	Disable	[Disable / Enable]			
Timers	→ tDiaI	60	s (1÷180)	step	1	S

14.37.1 - Description of variables

Status : Function enabling (Disable / Enable)
tDiaI : Time delay current measurement channel failure

14.37.2 - Operation

Tripping of the function operates a user programmable output relay.

Function dedicated to transducers with zero live (4-20mA , 12-20mA); if the reading current value goes to zero .

- If the reading current goes to zero for a time longer than [tDiaI], the protection function trips.

14.38 - Function: Wh (Energy counter Pulse)

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

Status	\rightarrow	Enab.	Disable]	[Disable / Enable]			
Levels	\rightarrow	WpP	100	kW	(10 ÷ 1000)	step	10	kW
Timers	\rightarrow	Pulse	1	s	(0.1 ÷ 2)	step	0.01	s

14.38.1 - Description of variables

Disable: Function enabling (Disable / Enable)

WpP : Energy counter Pulse Level

Pulse : Pulse duration

14.38.2 - Operation

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

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

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

Status	→ Enab.	Disable	[Disable / Enable]			
Options	→ RCL	No	[No / Yes]			
Timers	→ ts	5 s	(0 ÷ 10)	step	0.01	s

14.39.1 - Description of variables

Disable : Function enabling (Disable / Enable)

RCL : Reclosure

ts : Self-Trip time delay

14.39.2 - Operation

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

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14.40 - Function: Oscillo (Oscillographic Recording)

Status	→ Enab.	Disable		[Disable / Enable	e]		
Options	→ Trig	Start		[Start / Trip / Or FEUserLG]	nCmd / REUse	erLg /	
Timers	→ tPre	0.50	s	(0.01÷2)	step	0.01	s
	→ tPost	0.50	s	(0.01÷8)	step	0.01	S

14.40.1 - Description of variables

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

14.40.2 - Operation

In the options: "Trig = Start" and "Trig = Trip", the oscillographic recording starts respectively when any protection function starts operating or trip (provided the function was programmed "TrigEnab").

T>	1I>	1dI	Rapp	Wi	1U>
	2I>	2dI	Iapp	RT	2U>
	3I>	1di/dt	1Ig	RTX	1U<
	41>	2di/dt	2Iq		2U<

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

The "Osc" Function includes the wave Form Capture of the input quantities (I, U, Ig, Ug).

The waveforms of the oscillographic recording are always available for direct access (communication) on the memory of the relay, the maximum record time available for direct access is 40 seconds.

The number of events recorded depends on the duration of each individual recording (tPre + tPost). In any case the number of event stored can not exceed ten (10 x 0.6 sec).

Any new event beyond the 40 sec capacity of the memory, cancels and overwrites the former records (FIFO Memory).

Example: "10x4s" or "5x8s" etc.

Each oscillographic record is also stored in COMTRADE format on internal/external disk;

There is no limit to the records stored on disk (except the disk space), the length of each event, in any case, is maximum 10 seconds.

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14.40.3 - Available on MSCom2

T>	Tal	(alarm)	Thermal element
	T>	(trip)	memai element
1I>	1I>	(Start)	First accompany stars at
	t1I>	(Trip)	First overcurrent element
2I>	2I>	(Start)	
	t2I>	(Trip)	Second overcurrent element
275	3I>		
3I>		(Start)	Third overcurrent element
	t3I>	(Trip)	
4I>	4I>	(Start)	Fourth overcurrent element
	t4I>	(Trip)	
Iis	tIis>	(Start)	Instantaneous Current Element
1dl	1dI	(Start)	First Compart story alamant
	t1dI	(Trip)	First Current step element
2dl	2dI	(Start)	
	t2dI	(Trip)	Second Current step element
1di/dt	1di/dt	(Start)	
zui, ut	t1di/dt	(Trip)	First Current rate of rise element
24: /44			
2di/dt	2di/dt	(Start)	Second Current rate of rise element
_	t2di/dt	(Trip)	
Rapp	Rapp	(Trip)	Impedance monitoring – di/dt dependence
Iapp	Iapp		Current monitoring with di/dt dependence
1Ig	1Ig	(Start)	First instantaneous Frame Fault element
	t1Ig	(Trip)	First time delayed Frame Fault element
2Ig	2Ig	(Start)	
	t2Ig	(Trip)	Second Frame Fault element
RCL	RCL cmd	(Trip)	Reclosure Shot command
	ARP	(,	Autoreclosure in progress
	ARF		Autoreclosure Failure
	ARL		Autoreclosure Lock-out
	AROk		Autoreclosure Ok
	ARE		Autoreclosure Enable
	ARD		Autoreclosure Disable
1U>	1U>	(Start)	First overvoltage element
	t1U>	(Trip)	Tilst overvoitage element
2U>	2U>	(Start)	Cocond even altage element
	t2U>	(Trip)	Second overvoltage element
1U<	1U<	(Start)	
	t1U<	(Trip)	First undervoltage element
2U<	2U<	(Start)	
201	t2U<	(Trip)	Second undervoltage element
UL<	UL<	(IIIP)	Line Voltage processes
			Line Voltage presence
Wi	Ni		Maximum number of arc chute operation at nominal values
	alNi		Alarm maintenance level of arc chute operation
	Ne		Maximum number of arc contact operation at nominal values
	alNe		Alarm maintenance level of arc contact operation
	Nm		Maximum number of mechanical operation
	alNm		Alarm maintenance level of mechanical operation
TCS	tTCS	(Trip)	Time delayed Trip Circuit Supervision
IRF	IRF	(Start)	Time delayed Internal relay Fault
	tIRF	(Trip)	Instantaneous Internal relay Fault
RT	RT	(Trip)	First Instantaneous Remote Trip
	tRT	(Start)	First Time delayed Remote Trip
RTX			
KIA	RTX	(Trip)	Second Time delayed Remote Trip
D'- T	tRTX	(Start)	Second Time delayed Remote Trip
Dia-I	Dial	(Trip)	Diagnostic analog inputs current
	tDial	(Start)	Delay current measurement channel failure
CB-L	CB-L		C/B reclose Lock-out
BF	BF		Breaker Failure
Wh	+ Wh		Exported Energy counter Pulse
	- Wh		Imported Energy counter Pulse
SelfTrip	SelfTrip		Spontaneous trip
	t-SelfTr.		Self-Trip time delay
L/R CB Hdl	cmdOpCB		Open C/B command
	cmdClCB		Close C/B command
	LocRemInc		
			Local / Remote Inconsistency
Chave should!	missCBOpe		Missed C/B opening (Digital input missing)
Characteristiscs			Characteristic 1
	Charat 2		Characteristic 2
	Charat 3		Characteristic 3
	Charat 4		Characteristic 4
LT	LTPb		Output to operate an external flashing lamp signalling line test in progress
	LTP		Line Test in progress
	LTF		Line Test Failed
			Line Test OK
	11()K		
	LTOK		
	LTOK LTB LT cmd	(Trip)	Line Test Blocked Line Test command

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10E0D	TECC10E0 was do to word:
I850Ready	IEC61850 ready to work.
Sync	Date – time syncronization event (active during clock syncronization).
SNTP-Dia	SNTP health status.
SNTP-Kod	Syncro lost by server, Kiss of death. Date-Time need syncro from another server.
DskClean	External Disk Clean (disk near to full, clean operation is required)
DskFull	External Disk Full (disk full, write should be locked)
DskWr	External Disk Write (active during internal disk access)
DskFRMT	External Disk Format (active during internal disk format)
DskCHK	External Disk Check (active during internal disk check procedure)
rDskAttach	Remote disk inserted (USB Key)
rDskDetach	Remote disk not inserted (USB Key)
rDskDtchable	Remote disk removible (USB Key)
rDskClean	External Disk Clean (disk near to full, clean operation is required)
rDskFull	External Disk Full (disk full, write should be locked)
rDskWr	External Disk Write (active during internal disk access)
rDskFRMT	External Disk Format (active during internal disk format)
rDskCHK	External Disk Check (active during internal disk check procedure)
CB1Fail	CB1 Failure
CB2Fail	CB2 Failure
CB3Fail	CB3 Failure
CB4Fail	CB4 Failure
CB5Fail	CB5 Failure
CB1missedOp	CB1 Failure
CB2missedOp	CB2 Failure
CB2missedOp	CB3 Failure
CB3fffissedOp	CB3 Failure CB4 Failure
·	CB5 Failure
CB5missedOp	
MasterOp1	Modbus Master CB1 Open request
MasterCL1	Modbus Master CB1 Close request
MasterOp2	Modbus Master CB2 Open request
MasterCL2	Modbus Master CB2 Close request
MasterOp3	Modbus Master CB3 Open request
MasterCL3	Modbus Master CB3 Close request
MasterOp4	Modbus Master CB4 Open request
MasterCL4	Modbus Master CB4 Close request
MasterOp5	Modbus Master CB5 Open request
MasterCL5	Modbus Master CB5 Close request
Gen.Start	General start
Gen.Trip	General Trip
Vcc	Reserved
Gnd	Reserved
ResLog	Reset signal logic
P1	Push-button Open (Not used with remote MMI)
P2	Push-button Close (Not used with remote MMI)
P3	Push-button Reset (Not used with remote MMI)
UserTriggerOscillo	User Variable for Oscillographic Recording
UserVar<0>	
to	User Variable
UserVar<98>	

Only for "DIGITAL INPUT"

0.D1	Digital Input "0.D1"	activated	
	<i>y</i> ,		
0.D1Not	Digital Input "0.D1"	deactivated	
to			
0.D4	Digital Input "0.D4"	activated	
0.D4Not	Digital Input "0.D4"	deactivated	
1.D1	Digital Input "1.D1"	activated	
1.D1Not	Digital Input "1.D1"	deactivated	
to	2.g.ta. 1pat 1121	acada racea	
1.D15	Digital Input "1.D15"	activated	
1.D15Not	Digital Input "1.D15"	deactivated	
	· ·		
2.D1	Digital Input "2.D1"	activated	
2.D1Not	Digital Input "2.D1"	deactivated	
to			
2.D15	Digital Input "2.D15"	activated	
2.D15Not	Digital Input "2.D15"	deactivated	

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14.40.4 - Setting "Oscillo Trigger Logic"

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

Name	User descr.	Linked functions	OpLogic Timer	Timer type	Logical status
14.40.4.1 - Name					
Internal name	:				
14.40.4.2 - User d	lescr.				
Fixed					
14.40.4.3 - Linked	functions				
Selection func	tions				
14.40.4.4 - OpLog	nic				
Operation Log	ic = [None, O	R, AND, XOR, NOR, NAN	ID, NOT, Ff-SR]		
14.40.4.5 - Timer					
Time delay (0	-10)s, step 0.01s				
<u> 14.40.4.6 - Timer</u>	type				
Timer =	Delay	: Add a delay on ou	tput activation. Je triggered on rise	edge.	
	Monostable P	: Monostable Positiv		cagei	

Monostable Negative pulse time

Time added on falling output edge

When selected output is a 50% duty cycle square wave

14.40.4.7 - Logical status

Monostable N

Delay Fall-Down

Blinking

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[&]quot;OscilloTriggerLogic" Logical status



14.40.4.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "User Variable"



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

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

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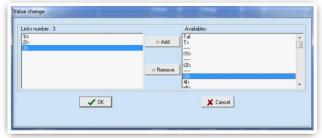
14.40.4.9 - "Linked Functions"

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



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



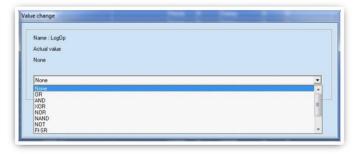


14.40.4.10 - "Operation Logic" (Oplogic)

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



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



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14.40.4.11 - "Timer"

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



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

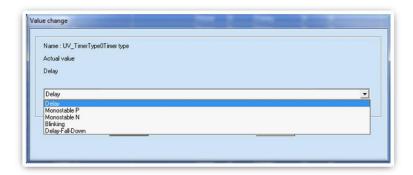


14.40.4.12 - "Timer type"

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



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

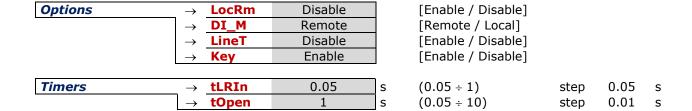


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14.41 - Function: L/R CB Cmds (Local Remote Close Breaker Command)

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



14.41.1 - Description of variables

LocRm	:	Enable/Disable [Local/Remote] Digital input.
LineT	:	Line Test Enable/Disable If Enabled = Line Test will by started any time C/B Close control is activated.
DI_M	:	Local/Remote digital input management
Key	:	Enable = The C/B can be controlled by the pushbuttons available on Relay's Front Face as well as by commands sent via the serial communication bus. Disable = The C/B can be commands on Front Panel are disabled; the operation of the C/B can be controlled either by the serial bus commands or by (password protected) commands available in the menu "Commands".
tLRIn	:	Local/Remote inconsistent time.
tOpen	:	C/B operation time-out.

11.42 - Function: CB-L (CB Lock)

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

Options	→ Lock	Enable		[Enable / Disable]			
Timers	→ tLTBk	1	S	$(0.1 \div 10)$	step	0.1	S

14.42.1 - Description of variables

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

Disable = Disabling of the close command lock-out.

Line Test progress blink time

14.42.2 - Operation

If the variable "Lock" is set to "Enable", reclosing of the C/B is inhibited after a "Failed reclosure" or after a "Failed Line Test" The reset from the Lock-out status can be operated either by the keyboard via the "CB Unlock" command available in the menu "Commands" (§ Commands) or by an external command via the Digital Input programmed for "Ext.Reset".

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

Options	\rightarrow \rightarrow	TNum Fast	1 No	-	[0 / 1 / 2 / 3] [No / Yes]			
	\rightarrow	Rem	No		[No / Yes]			
Levels	\rightarrow	V/I	Voltage	1	(Voltage / Current)			
	\rightarrow	Vv<	0.5	Vn	(0÷1)	step	0.001	Vn
	\rightarrow	Vm<	0.5	Vn	(0÷1)	step	0.001	Vn
	\rightarrow	Vlock	0.05	Vn	(0.05÷1)	step	0.01	Vn
	\rightarrow	Rr<	100	Ω	(0÷500)	step	0.1	Ω
	\rightarrow	VFast	0.5	Vn	$(0.5 \div 1)$	step	0.1	Vn
				_				
Timers	\rightarrow	tp	3	s	$(0 \div 30)$	step	0.1	S
	\rightarrow	tt	3	s	$(0.1 \div 10)$	step	0.1	S
	\rightarrow	tcy	10	s	(1÷180)	step	1	S
	\rightarrow	t	3	s	(0÷10)	step	0.1	S

14.43.1 -	De	scription of variables
TN		No make an afficient and consequently back
TNum Fast		Number of tests after an unsuccessful test. Yes : When set to "YES" if the voltage measured during the set pre-closing time [tp] exceeds the set level [VFast], the C/B is closed immediately without the Line Test; If the voltage measured doesn't exceeds the [Vfast] level and exceeds the set level [Vlock] the line test fail output and the C/B lock-out was performed; Finally if the line voltage drops below the set level [Vlock] normal line test with check of line resistance value is normally carried out. STD : When set to "STD" if the voltage measured during the set pre-closing time [tp] exceeds the set level [VFast], the C/B is closed immediately without the Line Test. MIN : When set to "MIN" if the voltage measured during the set pre-closing time [tp] drops below the set level [VFast] the line test fail output and the C/B lock-out was performed. Otherwise normal line test with check of line resistance value is normally carried out. No : If set "No" test is normally carried out.
Rem	:	Remote line test; if "Yes" Line Test can be started by the logical output RCL
V/I	:	 Current: Line resistance is calculated using Line Current and Line Voltage, in this case the algorithm don't use [Vv] measure. Voltage: Line resistance is calculated using the difference from [Vm] and [Vv] and the rated value "Rtest" (line test resistor value).
Vv<	:	Minimum downstream voltage level to allow C/B close
Vm<		Minimum upstream voltage level to allow C/B close
Vlock	:	Maximun line voltage to allow Line Test in Yes mode
Rr<	:	Minimum Residual Resistance level to allow C/B closing.
VFast		Minimum Line Voltage level to allow C/B closing without Line Test.
tp tt		Waiting time after C/B closing command request to start the line test cycle. Duration of the Line Test.
		Wait time between two consecutive tests.
tcy		Wait time to start reclosing after success fine test.
	•	wait time to start redosting after success fine test.

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14.43.2 - Operation

The Line Test is started by a request of Automatic Reclosure or Manual Closure of the C/B (see \S "RCL" and \S "L/R C/B Cmds").

It is also possible to start the Line Test by activating a Digital Input programmed for this purpose (see § Remote Line Test control).

Voltage working:

Test is considered successful depending on "Vv<", "Vm<"and "Rr<" measurement according to programming.

	Setting		Test condition
Vm<	Vv<	Rr<	
≠0	≠0	≠0	$Vv \ge [Vv<] \& Vm \ge [Vm<] \& Rr \ge [Rr<]$
≠0	≠0	=0	$Vv \ge [Vv<] \& Vm \ge [Vm<]$
=0	=0	≠0	Rr≥ [Rr<]

If the test was unsuccessful:

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

Current working:

Test is considered successful depending on "Vr<" and "Rr<" measurement according to programming.

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

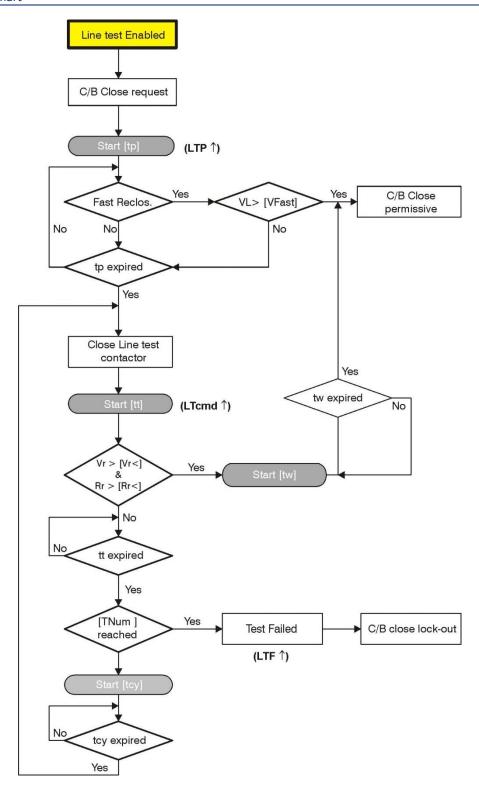
If the test was unsuccessful:

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

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14.43.3 - Flow chart



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14.44 - 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.

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]

14.44.1 - Description of variables

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

FallEdge Active on Fall Edge (Digital Input open).

14.45 - Function: **Dia C/B** (Diagnostic C/B position)

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

Status	→ E	nab.	Disable		[Disable / Enable]			
				_				
Timers	→ <u>t(</u>	CB1f	3	s	$(0 \div 10)$	step	0.1	S
	→ t (CB1A	2	s	$(0 \div 10)$	step	0.1	S
	→ t (CB2f	3	s	$(0 \div 10)$	step	0.1	S
	→ t (CB2A	2	s	$(0 \div 10)$	step	0.1	S
	→ t (CB3f	3	s	$(0 \div 10)$	step	0.1	S
	→ t (СВЗА	2	s	$(0 \div 10)$	step	0.1	S
	→ t (CB4f	3	s	$(0 \div 10)$	step	0.1	S
	→ t (CB4A	2	s	$(0 \div 10)$	step	0.1	S
	→ t (CB5f	3	s	$(0 \div 10)$	step	0.1	S
	→ t (CB5A	2	s	$(0 \div 10)$	step	0.1	s

14.45.1 - Description of variables

tCB1f	•	C/B1 Diagnostic position discrepancy filter time
tCB1A		C/B1 operation control time
tCB2f		C/B2 Diagnostic position discrepancy filter time
tCB2A		C/B2 operation control time
tCB3f		C/B3 Diagnostic position discrepancy filter time
tCB3A		C/B3 operation control time
tCB4f	:	C/B4 Diagnostic position discrepancy filter time
tCB4A	:	C/B4 operation control time
tCB5f	:	C/B5 Diagnostic position discrepancy filter time
tCB5A	:	C/B5 operation control time

14.45.2 - Operation

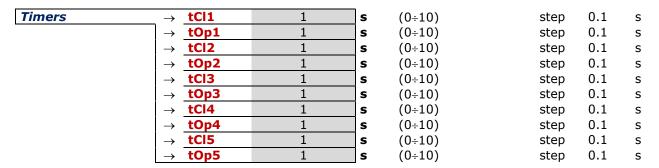
For each auxiliary CB is possible set the incongruence status of its auxiliary contact (1NO e 1 NC). In case the two contacts are in the same status (open are close) for a time longer then tCBxf, a variable (linkable) is set.

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14.46 - Function: auxRCmds (Auxiliary Remote Commands)

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



14.46.1 - Description of variables

tCl1	:	Master close breaker 1 command duration
tOp1	:	Master open breaker 1 command duration
tCl2	:	Master close breaker 2 command duration
tOp2	:	Master open breaker 2 command duration
tCl3	:	Master close breaker 3 command duration
tOp3	:	Master open breaker 3 command duration
tCl4	:	Master close breaker 4 command duration
tOp4	:	Master open breaker 4 command duration
tCI5	:	Master close breaker 5 command duration
tOp5	:	Master open breaker 5 command duration

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15. Input – Output (via software MSCom2)

The firmware can manage up to 28 digital inputs and 24 output relays; among these, 4 digital inputs and 6 output relays are available on the relay module, the remaining are available on additional expansion modules controlled via the CAN-Bus communication channel:

```
14DI Module (Board 1) = 14 Digital Inputs
14DO Module (Board 2) = 14 Outputs Relay
UX10-4 Module (Board 3) = 10 Digital Inputs - 4 Outputs Relay
```

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

15.1 - Digital Input

$\begin{array}{c} \rightarrow \\ \rightarrow \end{array}$	0.D1 0.D2 0.D3 0.D4	Programmable (D1) Programmable (D2) Programmable (D3) Programmable (D4)	When the relevant terminals are open and get activated when the relevant terminals are shorted by an external cold contact.	Available in the relay This are self-powered.
\rightarrow	1.D1 1.D 1.D15	Inputs "D8", "D16" not available	Digital input on Expansion Board 1	Any digital input of the expansion modules is active
\rightarrow	2.D1 2.D 2.D15	Inputs "D8", "D16" not available	Digital input on Expansion Board 2	when the relevant terminals (see wiring diagram) are shorted.

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

The operation of the Input "0.D4" is dependent on the value "R" of resistance of the external circuit connected to its terminals (24-25/26):

- Activated if "R < $50\Omega''$ or "R > $3000\Omega''$. - Deactivated if " $50\Omega \le R \le 3000\Omega''$.

Therefore, if the terminals "24-25/26" are open-circuited, the input "0.D4" is activated; for using "0.D4" as A normal Digital Input simply controlled by an external cold contact, it is necessary to permanently connect across the terminal's "24-25/26" (in parallel to the external contact) a load resistor of value between 50 and 3000Ω (example $1000\Omega - 0.5W$).

15.2 - "DI" Configuration paremeter available (via keyboard or MSCom2 software)

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

C/B1-Close Close position status C/B1-Open Open position status C/B2-Close Close position status C/B2-Open Open position status C/B2-I/D Insertion status C/B2-I/D Insertion status C/B3-Close Close position status C/B3-Close Close position status C/B3-I/D Insertion status C/B4-I/D Insertion status C/B4-Close Close position status C/B4-Open Open position status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Close Close position status C/B5-I/D Insertion status C/B5-I/D Insertion status C/B5-I/D Insertion status Bill> Blocking input to the 1I> Bi2I> Blocking input to the 3I> Bi3I> Blocking input to the 3I> Bi4I> Blocking input to the 4I> BiRCL Reclosure lock-out RCL Bypass-LT Line test bypass		
C/B1-I/D Insertion status C/B2-Close Close position status C/B2-Open Open position status C/B3-Close Close position status C/B3-Close Close position status C/B3-Open Open position status C/B3-I/D Insertion status C/B4-Close Close position status C/B4-Close Close position status C/B4-Open Open position status C/B4-Open Open position status C/B5-Close Close position status C/B5-Close Close position status C/B5-I/D Insertion status C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Blocking input to the 3I> Bi31> Blocking input to the 4I> Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B1-Close	Close position status
C/B2-Close C/B2-Open Open position status C/B2-I/D Insertion status C/B3-Close Close position status C/B3-Open Open position status C/B3-I/D Insertion status C/B4-Close Close position status C/B4-Open Open position status C/B4-I/D Insertion status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Close Close position status C/B5-I/D Insertion status C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Bi31> Blocking input to the 31> Bi41> Blocking input to the 41> BiRCL Reclosure lock-out RCL	C/B1-Open	Open position status
C/B2-Open Open position status C/B2-I/D Insertion status C/B3-Close Close position status C/B3-Open Open position status C/B3-I/D Insertion status C/B4-Close Close position status C/B4-Open Open position status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Close Close position status C/B5-Upen Open position status C/B5-I/D Insertion status C/B5-I/D Insertion status Bi11> Blocking input to the 11> Bi21> Blocking input to the 21> Bi31> Blocking input to the 31> Bi41> Blocking input to the 41> Bi41> Blocking input to the 41> BiRCL Reclosure lock-out RCL	C/B1-I/D	Insertion status
C/B2-I/D Insertion status C/B3-Close Close position status C/B3-Open Open position status C/B3-I/D Insertion status C/B4-Close Close position status C/B4-Open Open position status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Open Open position status C/B5-I/D Insertion status C/B5-I/D Insertion status Bi11> Blocking input to the 11> Bi21> Blocking input to the 21> Bi31> Blocking input to the 31> Bi41> Blocking input to the 41> BiRCL Reclosure lock-out RCL	C/B2-Close	Close position status
C/B3-Close C/B3-Open C/B3-I/D C/B3-I/D C/B4-Close C/B4-Close C/B4-Clopen C/B4-I/D C/B4-I/D C/B4-I/D C/B5-Close Close position status C/B5-Open C/B5-Open C/B5-I/D C/B	C/B2-Open	Open position status
C/B3-Open Open position status C/B3-I/D Insertion status C/B4-Close Close position status C/B4-Open Open position status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Open Open position status C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Blocking input to the 2I> Bi31> Blocking input to the 3I> Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B2-I/D	Insertion status
C/B3-I/D Insertion status C/B4-Close Close position status C/B4-Open Open position status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Open Open position status C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Blocking input to the 2I> Bi31> Blocking input to the 3I> Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B3-Close	Close position status
C/B4-Close C/B4-Open C/B4-I/D C/B5-Close C/B5-Close C/B5-Open C/B5-I/D C/B5	C/B3-Open	Open position status
C/B4-Open Open position status C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Open Open position status C/B5-I/D Insertion status Bi1I> Blocking input to the 1I> Bi2I> Blocking input to the 2I> Bi3I> Blocking input to the 3I> Bi4I> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B3-I/D	Insertion status
C/B4-I/D Insertion status C/B5-Close Close position status C/B5-Open Open position status C/B5-I/D Insertion status Bi11> Blocking input to the 11> Bi21> Blocking input to the 21> Bi31> Blocking input to the 31> Bi41> Blocking input to the 41> BiRCL Reclosure lock-out RCL	C/B4-Close	Close position status
C/B5-Close Close position status C/B5-Open Open position status C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Blocking input to the 2I> Bi31> Blocking input to the 3I> Bi4I> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B4-Open	Open position status
C/B5-Open Open position status C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Blocking input to the 2I> Bi31> Blocking input to the 3I> Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B4-I/D	Insertion status
C/B5-I/D Insertion status Bi11> Blocking input to the 1I> Bi21> Blocking input to the 2I> Bi31> Blocking input to the 3I> Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B5-Close	Close position status
Bill> Blocking input to the 1I> Bi2I> Blocking input to the 2I> Bi3I> Blocking input to the 3I> Bi4I> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B5-Open	Open position status
Bi2I> Blocking input to the 2I> Bi3I> Blocking input to the 3I> Bi4I> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	C/B5-I/D	Insertion status
Bi31> Blocking input to the 3I> Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	Bi1I>	Blocking input to the 1I>
Bi41> Blocking input to the 4I> BiRCL Reclosure lock-out RCL	Bi2I>	Blocking input to the 2I>
BiRCL Reclosure lock-out RCL	Bi3I>	Blocking input to the 3I>
	Bi4I>	Blocking input to the 4I>
Bypass-LT Line test bypass	BiRCL	Reclosure lock-out RCL
	Bypass-LT	Line test bypass

Bi1U<	Blocking input to the 1U<
Bi2U<	Blocking input to the 2U<
Main C/B CL.Status	Circuit breaker status
RT	Remote Trip input
RTX	Second Remote Trip input
BiLT	Line Test blocking inputs
Bi1didt	Blocking input 1di/dt
Bi2didt	Blocking input 2di/dt
Local	Local mode operation
Remote	Remote mode operation
Open CB	Open C/B Command
Close CB	Close C/B Command
RemLT	Remote line test input
Ext Reset	External Reset input
BOpCB	Blocking input open CB
BCICB	Blocking input close CB
Group1	Setting Group 1
Group2	Setting Group 2
Group3	Setting Group 3
Group4	Setting Group 4

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15.3 – Function available

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

T>	Tal	(alarm)	Thermal element
	T>	(trip)	memar demen
1I>	1I>	(Start)	First overcurrent element
27.	t1I>	(Trip)	
2I>	2I>	(Start)	Second overcurrent element
3I>	t2I> 3I>	(Trip) (Start)	
31>	t3I>	(Start) (Trip)	Third overcurrent element
4I>	4I>	(Start)	
417	t4I>	(Trip)	Fourth overcurrent element
Iis	tIis>	(Start)	Instantaneous Current Element
1dl	1dI	(Start)	
	t1dI	(Trip)	First Current step element
2dl	2dI	(Start)	Cocond Current aton element
	t2dI	(Trip)	Second Current step element
1di/dt	1di/dt	(Start)	First Current rate of rise element
	t1di/dt	(Trip)	- This carrene rate of rise cientene
2di/dt	2di/dt	(Start)	Second Current rate of rise element
Dann	t2di/dt	(Trip)	Transdama manitarina di (dh. danan danan
Rapp Iapp	Rapp	(Trip)	Impedance monitoring – di/dt dependence Current monitoring with di/dt dependence
1Ig	Iapp 1Ig	(Start)	First instantaneous Frame Fault element
9	t1Ig	(Trip)	First time delayed Frame Fault element
2Ig	2Ig	(Start)	
-9	t2Ig	(Trip)	Second Frame Fault element
RCL	RCL cmd	(Trip)	Reclosure Shot command
	ARP		Autoreclosure in progress
	ARF		Autoreclosure Failure
	ARL		Autoreclosure Lock-out
	AROk		Autoreclosure Ok
	ARE		Autoreclosure Enable
4105	ARD	(C+= -+)	Autoreclosure Disable
1U>	1U> t1U>	(Start) (Trip)	First overvoltage element
2U>	2U>	(Start)	
207	t2U>	(Trip)	Second overvoltage element
1U<	1U<	(Start)	
	t1U<	(Trip)	First undervoltage element
2U<	2U<	(Start)	Cocond undervoltage element
	t2U<	(Trip)	Second undervoltage element
UL<	UL<		Line Voltage presence
Wi	Ni		Maximum number of arc chute operation at nominal values
	alNi		Alarm maintenance level of arc chute operation
	Ne alNe		Maximum number of arc contact operation at nominal values Alarm maintenance level of arc contact operation
	Nm		Maximum number of mechanical operation
	alNm		Alarm maintenance level of mechanical operation
TCS	tTCS	(Trip)	Time delayed Trip Circuit Supervision
IRF	IRF	(Start)	Time delayed Internal relay Fault
	tIRF	(Trip)	Instantaneous Internal relay Fault
RT	RT	(Trip)	First Instantaneous Remote Trip
	tRT	(Start)	First Time delayed Remote Trip
RTX	RTX	(Trip)	Second Instantaneous Remote Trip
Die T	tRTX	(Start)	Second Time delayed Remote Trip
Dia-I	Dial tDial	(Trip)	Diagnostic analog inputs current Delay current measurement channel failure
CB-L	tDial CB-L	(Start)	Delay current measurement channel failure C/B reclose Lock-out
BF	BF		Breaker Failure
Wh	+ Wh		Exported Energy counter Pulse
	- Wh		Imported Energy counter Pulse
SelfTrip	SelfTrip		Spontaneous trip
	t-SelfTr.		Self-Trip time delay
L/R CB Hdl	cmdOpCB		Open C/B command
	cmdClCB		Close C/B command
	LocRemInc		Local / Remote Inconsistency
Chaus at a date.	missCBOpe		Missed C/B opening (Digital input missing)
Characteristiscs			Characteristic 1
	Charat 2 Charat 3		Characteristic 2 Characteristic 3
	Charat 4		Characteristic 3 Characteristic 4
LT	LTPb		Output to operate an external flashing lamp signalling line test in progress
-	LTP		Line Test in progress
	LTF		Line Test Failed
	LTOK		Line Test OK
	LTB		Line Test Blocked
	LT cmd	(Trip)	Line Test command

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IOEODoody	IECC10E0 ready to work
I850Ready	IEC61850 ready to work.
Sync	Date – time syncronization event (active during clock syncronization).
SNTP-Dia	SNTP health status.
SNTP-Kod	Syncro lost by server, Kiss of death. Date-Time need syncro from another server.
DskClean	External Disk Clean (disk near to full, clean operation is required)
DskFull	External Disk Full (disk full, write should be locked)
DskWr	External Disk Write (active during internal disk access)
DskFRMT	External Disk Format (active during internal disk format)
DskCHK	External Disk Check (active during internal disk check procedure)
rDskAttach	Remote disk inserted (USB Key)
rDskDetach	Remote disk not inserted (USB Key)
rDskDtchable	Remote disk removible (USB Key)
rDskClean	External Disk Clean (disk near to full, clean operation is required)
rDskFull	External Disk Full (disk full, write should be locked)
rDskWr	External Disk Write (active during internal disk access)
rDskFRMT	External Disk Format (active during internal disk format)
rDskCHK	External Disk Check (active during internal disk check procedure)
CB1Fail	CB1 Failure
CB2Fail	CB2 Failure
CB3Fail	CB3 Failure
CB4Fail	CB4 Failure
CB5Fail	CB5 Failure
CB1missedOp	CB1 Failure
CB2missedOp	CB2 Failure
CB3missedOp	CB3 Failure
CB4missedOp	CB4 Failure
CB5missedOp	CB5 Failure
MasterOp1	Modbus Master CB1 Open request
MasterCL1	Modbus Master CB1 Close request
MasterOp2	Modbus Master CB2 Open request
MasterCL2	Modbus Master CB2 Close request
MasterOp3	Modbus Master CB3 Open request
MasterCL3	Modbus Master CB3 Close request
MasterOp4	Modbus Master CB4 Open request
MasterCL4	Modbus Master CB4 Close request
MasterOp5	Modbus Master CB5 Open request
MasterCL5	Modbus Master CB5 Close request
Gen.Start	General start
Gen.Trip	General Trip
Vcc	Reserved
Gnd	Reserved
ResLog	Reset signal logic
P1	Push-button Open (Not used with remote MMI)
P2	Push-button Close (Not used with remote MMI)
P3	Push-button Reset (Not used with remote MMI)
UserTriggerOscillo	User Variable for Oscillographic Recording
UserVar<0>	
to	User Variable
UserVar<98>	

Only for "DIGITAL INPUT"

1.0	D1	Digital Input "0.D1"	activated
1.0	D1Not	Digital Input "0.D1"	deactivated
to			
1.0	D4	Digital Input "0.D4"	activated
1.0	D4Not	Digital Input "0.D4"	deactivated
1.0	D1	Digital Input "1.D1"	activated
1.[D1Not	Digital Input "1.D1"	deactivated
to			
1.0	D15	Digital Input "1.D15"	activated
1.0	D15Not	Digital Input "1.D15"	deactivated
2.[D1	Digital Input "2.D1"	activated
2.[D1Not	Digital Input "2.D1"	deactivated
to			
2.0	D15	Digital Input "2.D15"	activated
2 [D15Not	Digital Input "2.D15"	deactivated

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15.4 - "DI" Configuration - via MSCom2 software

15.4.1 - Example

Name Status Functions

15.4.2 - Name

Logical Input name

15.4.3 - Status

Logical Input status

15.4.4 - Functions

Function available. (for multiple association use "User Variable")

15.4.5 - Example: Setting "Digital Input"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "DI CONFIGURATION"



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

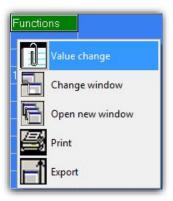
Name		Functions
Bi11> (Blocking Input 11>)	Not active	11>,

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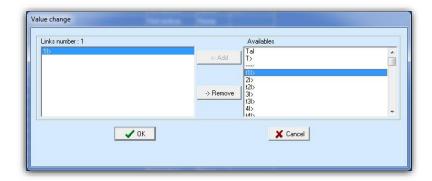
15.4.6 - "Functions"

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



From box "Available", select "1I>" and press "Add".

Press "OK" for confirmation. (if Password is request, see § Password)



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15.5 - Outputs Relay

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)
          Programmable (R5)
→ 0.R5
→ 0.R6
          Programmable (R6)
→ 1.R1
          Programmable
   to
   1.R14
   2.R1
   to
          Programmable
   2.R14
```

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

15.6 – Analog output

Four analogue output are available to transmit input quantities to external instruments.

```
    → AN1-A Current monitoring (I)
    → AN2-A Voltage monitoring (V)
    → AN3-A Available
    → AN4-A Available
```

Output range:

```
Current [I] : 0-20mA / 0 -In ( Full scale 1.2 In) . Voltage [Vm] : 0-20mA / 0 -Vn ( Full scale 1.2 Vn) .
```

Response time of analog output = 100ms.

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15.7 - "OutCfg" Outputs Configuration - via MSCom2 software

15.7.1 - "Example"

Relay Linked functions Logical status Output config Function tON Relay status

15.7.2 - "Relay"

Relay internal name

15.7.3 - "Linked function"

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

15.7.5 - "Logical Status"

Relay Logical status

15.7.6 - "Output Configuration"

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

15.7.7 - "tON - Operation Time"

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

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

15.7.8 - "Relay Status"

Relay - Physical status

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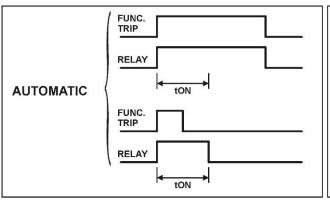
Impulsive

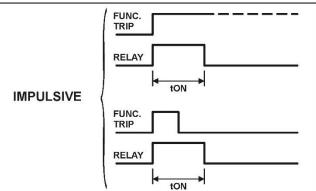
15.7.9 - Functions - Operation Mode

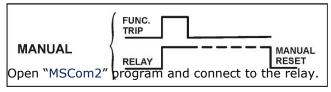
Automatic : In this mode the output relay is "operated" (energized if "N.D.", deenergized if "N.E.") when the controlling Functional Output is activated and it is reset to the "non operated" condition when the Functional Output gets disactivated but, anyhow, not before the time "TON" has elapsed (minimum duration of the operation time)

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

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



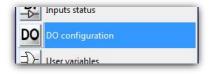




Select "Change Windows" from "Menu" button



Select "DO CONFIGURATION"

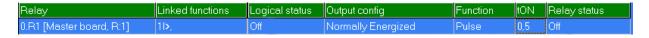


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15.7.10 - Example: Change settings for "0.R1"

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



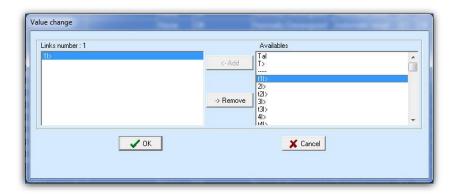
15.7.10.1 - "Linked Functions"

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



From box "Available", select "1I>" and press "Add".

Press "OK" for confirmation. (if Password is request, see § Password)



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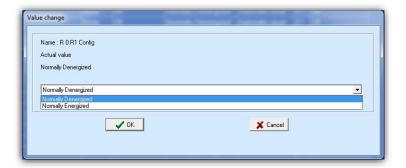


15.7.10.2 - "Output Config"

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



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



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15.7.10.3 - "Function"

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



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



15.7.10.4 - "tON"

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



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



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16. UserVar

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

16.1 - Configuration - via MSCom2 software

Name	User descr.	Linked functions	OpLogic Timer	Timer type	Extra	Logical status
16 1 1 Name	_					
16.1.1 - Name	2					
Internal pro	gressive name					
16.1.2 - User	Descr.					
Custom ide	ntification label for	user variable				
16.1.3 - Linke	d functions					
Selection fu	ınctions					
16.1.4 - OpLo	gic					
Operation L	oaic = [None.	OR, AND, XOR, NOR, NA	ND NOT Ff-SR (Counter Rise	-Un. Fal	I-Down1

16.1.5 - Timer

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

16.1.6 - Timer type

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

16.1.7 - Logical status

"User Variable" Logical status

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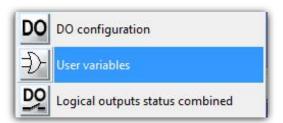
16.1.8 - Example: Setting "User Variable"

Open "MSCom2" program and connect to the relay.

Select "Change Windows" from "Menu" button



Select "USER VARIABLE"



Setting for "UserVar<0>":

"Start Overcurrent Element", "1I>, 2I>, 3I>", "OR", "1", "Monostable P".

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

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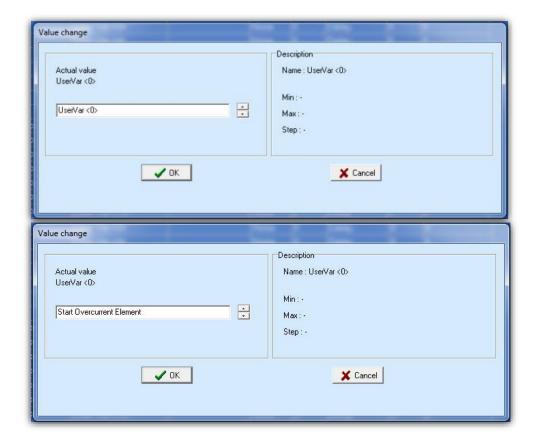


16.1.8.1 - "User description" (User descr.)

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



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



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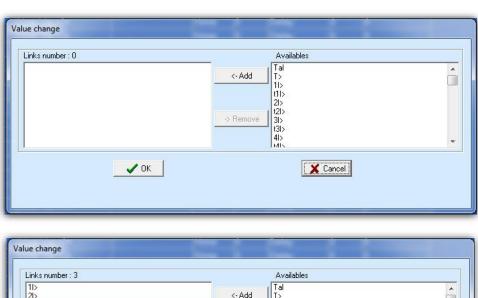


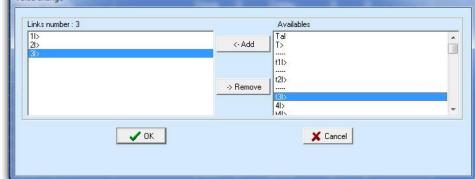
16.1.8.2 - "Linked Functions"

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



Select "11>, 21>, 31>" from "Available" box via push-button "<Add", and press "OK". For remove functions, use push-button ">Remove".



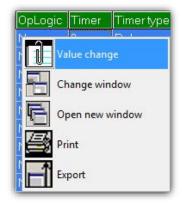


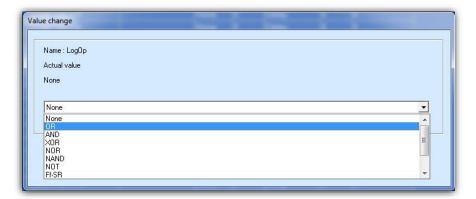
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16.1.8.3 - "Operation Logic" (Oplogic)

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





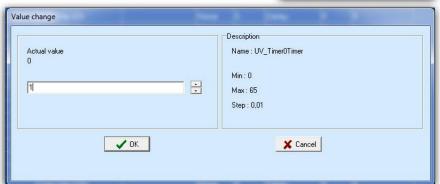
Insert "OR" into box and
press "OK":

19.1.8.4 - "Timer"

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



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



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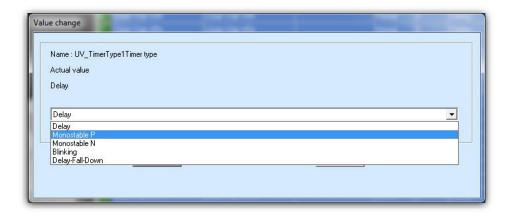


16.1.8.5 - "Timer type"

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



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



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17. Date and Time

17.1- Clock synchronization

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

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

- □ Using the "MSCom2" software or from the DCS with the Modbus RTU protocol.
- ☐ Through the NTP protocol, maximum 3 SNTP servers;
 The relay synchronize the clock to first server available on the list "IPV4 NP server address ".

 $\underline{\textit{Note}}$: On power supply failure an internal battery supports the internal clock for over two years.

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18. Battery

The relay is equipped with a lithium battery type "CR2032 3V", to support the internal clock and the oscillographic recording memory in case of programmed lack of power.

The expected minimum duration without power exceed 2 years.

ATTENTION!! Use only battery specified.

19. Maintenance

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

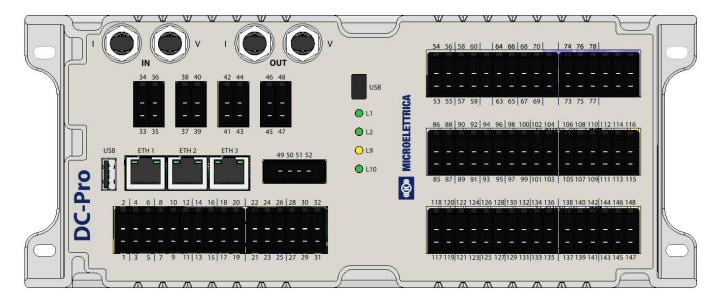
20. Power Frequency Insulation Test

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

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21. Terminal Blocks (Wiring Diagram)



21.1 - Power Supply

21.1.1 – Main Unit power supply input

A 1 **A** 2 **Earth** 3

21.1.2 - Dedicated Remote Unit supply output (24V)

A 74 (+) **A** 73 (-)

21.2 – Measurement Inputs

21.2.1 - Fiber Optic

In I, V (input from MHIT transducers) Out I, V (output = input on fiber repeated)

21.2.2 - Voltage Tranducer

VL 37 (+), 38 (-) **VV** 39 (+), 40 (-)

21.2.3 - Current Tranducer

In 33 (+), 34 (-) **10In** 35 (+), 36 (-)

21.2.4 - Frame-to-Ground Monitoring Input

Vg 43 (+), 44 (-) **Ig** 41 (+), 42 (-)

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21.3 - Digital Inputs

Type (Self-Powered)						
0.D1	25/26	21				
0.D2	25/26	22				
0.D3	25/26	23				
0.D4	25/26	24				

Type	(-)	(+)
2.D1	85	86
2.D2	87	88
2.D3	89	90
2.D4	91	92
2.D5	93	94
2.D6	95	96
2.D7	97	98
2.D8	99	100
2.D9	101	102
2.D10	103	104

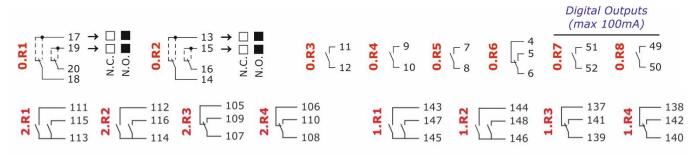
_		
Туре	(-)	(+)
1.D1	117	118
1.D2	119	120
1.D3	121	122
1.D4	123	124
1.D5	125	126
1.D6	127	128
1.D7	129	130
1.D8	131	132
1.D9	133	134
1.D10	135	136

21.4 - Analogic Outputs

Туре	(-)	(+)
AN1-A	53	54
AN2-A	55	56
AN3-A	57	58
AN4-A	59	60

Туре	(-)	(+)
reserved	63	64
reserved	65	66
reserved	67	68
reserved	69	70

21.5 - Output Relays



21.6 - Comunications terminals

21.6.1 - Main Unit

RS485		
A (S+)	27	
B (S-)	28	
C	29	

Canbus		
Н	31	
L	32	
С	29	

Connection to	Remote Unit
Α	75
В	76
(Z)	77
(Y)	78

21.6.2 - Remote Unit

RS485 485+ 485-GND

21.6.3 - Ethernet port

ETH 1	RJ45	ETH 2	RJ45	ETH 3	RJ45
-------	------	-------	------	-------	------

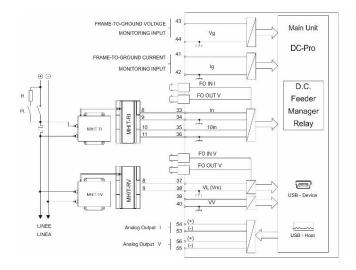
21.6.4 - USB

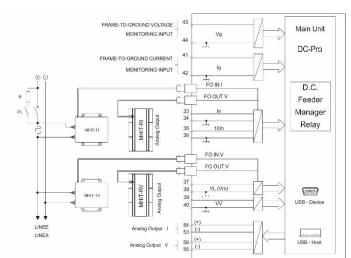
21.0.7	038		
Туре	Α	Туре	Mini

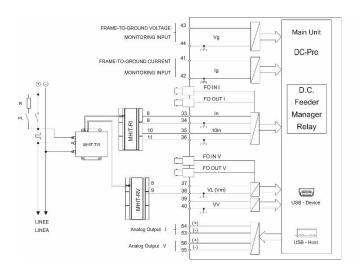
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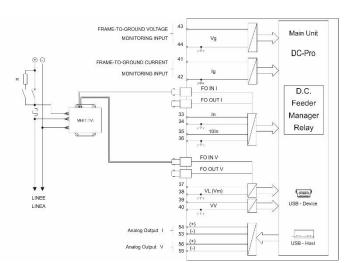


21.6.5 - Insertion Diagram (Example)





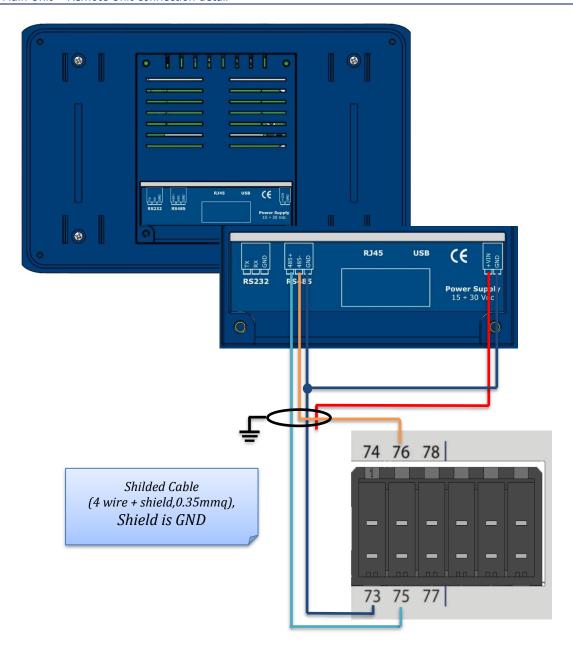


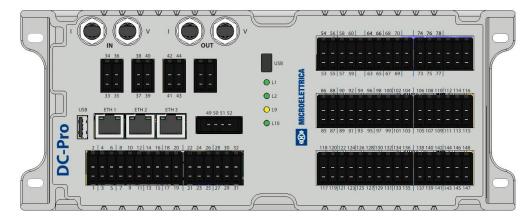


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21.6.6 - Main Unit - Remote Unit connection detail



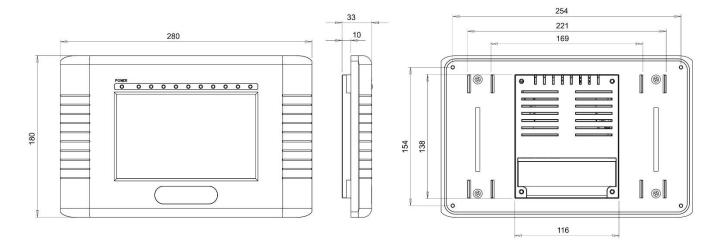


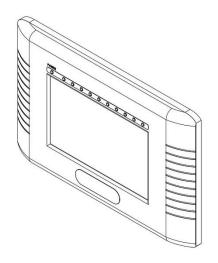
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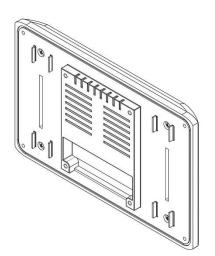


22. Overall Dimensions

22.1 - Remote Unit



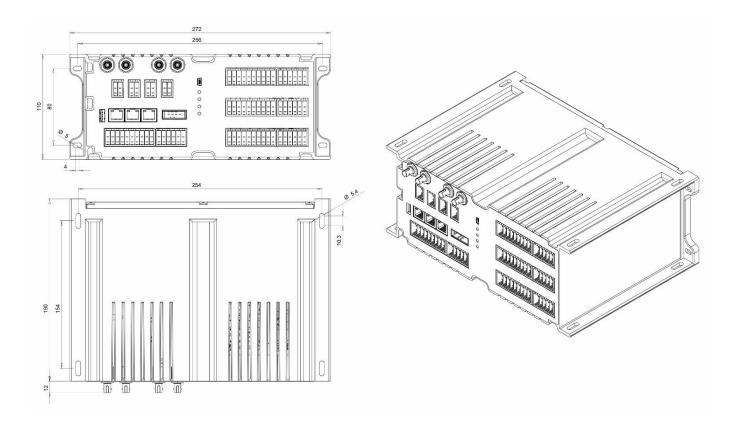




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22.2 - Main Unit



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23. Spare Parts

23.1 - Main Unit

	DYNAMIC D-3500 REC HSG 6P	1318095-1	
나라	DYNAMIC D-3500 REC HSG 4P	175363-2	
	DYNAMIC D-3500 REC HSG 2P	175362-1	Connectivity
	DYNAMIC 3100 REC HSG 4P	1-178288-4	
	DYNAMIC D-3 REC CONT 3L 16-14	1-353715-5	

23.1 - Remote Unit

FMC 1,5 3-ST-3,5	1952270	ГЛРНŒNIX
FMC 1,5 2-ST-3,5	1952267	CONTACT

24. Tools

113	MINI SAHT D3000-3L	2255149-1	_= TE
- Common of the	EXTRACTION TOOL (DYNAMIC D-3)	234168-1	connectivity

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25. Electrical Characteristics

APPROVAL: CE

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

Dielectric test voltage IEC 60255-5 2kV, 50/60Hz, 1 min. Impulse test voltage IEC 60255-5 5kV (c.m.), 2kV (d.m.) – 1,2/50 μ s Insulation resistance > $100M\Omega$

Environmental Std. Ref. (IEC 60068)

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

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

Electromagnetic emission	EN55022	industrial	environment
Radiated electromagnetic field immunity test	IEC61000-4-3	level 3	80-2000MHz 10V/m
	ENV50204		900MHz/200Hz 10V/m
Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz 10V
Electrostatic discharge test	IEC61000-4-2	level 4	6kV contact / 8kV air
Power frequency magnetic test	IEC61000-4-8		1000A/m 50/60Hz
Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs
Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz
Immunity to conducted common mode	IEC61000-4-16	level 4	
disturbance 0Hz-150KHz			
Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz
HF disturbance test with damped oscillatory wave	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)
(1MHz burst test)			
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	- IEC6025	5-21-2 10-500Hz 1g

Electric Rated Value

Accuracy at reference value of influencing factors	1% In for measure 2% + to (to=20÷30ms @ 2xIs) for times		
Rated Current	$0 - \pm 20 \text{mA} (\pm 40) \equiv 0 - \text{In} (2 \text{In})$		
Rated Voltage	$0 - 20mA (40) \equiv 0 - Vn (2Vn)$		
Average power supply consumption	< 20 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.)		

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