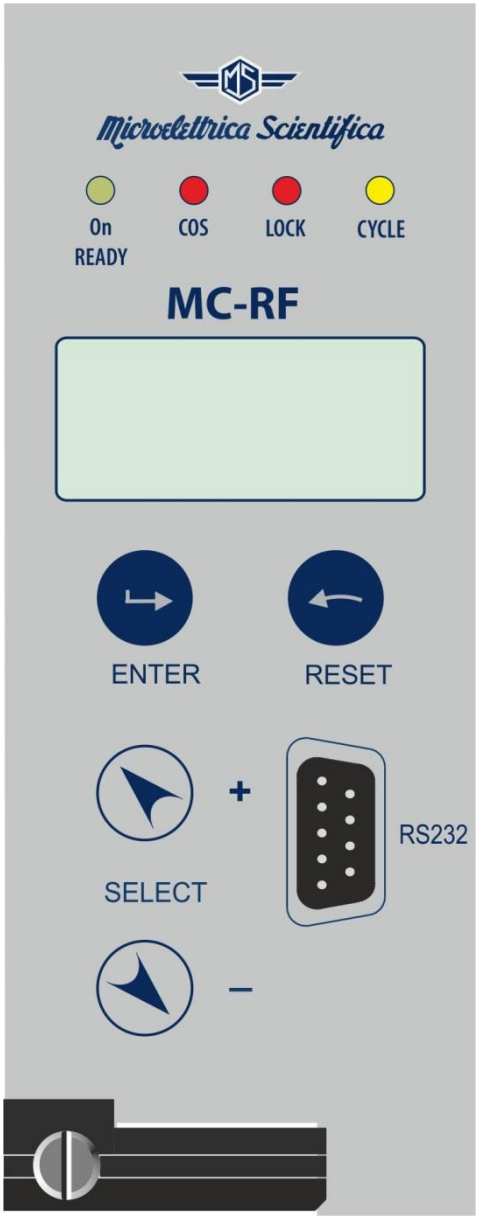
ELECTRONIC BRAKING CONTROLLER

MC-FR



CE

Control and Protection

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 on the product's instruction 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 - Protective Grounding

When Grounding is required, carefully check its effectiveness.

1.7 - Setting and Calibration

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

1.8 - Safety Protection

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

1.9 - Handling

Notwithstanding the highest practicable protection means used in designing electronic circuits, the electronic components and semiconductor devices mounted on the modules can be seriously damaged by electrostatic voltage discharge which can be experienced when handling the modules.
The damage caused by electrostatic discharge may not be immediately apparent but the design reliability and the long life of the product will have been reduced. The electronic circuits reduced by 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.

a. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
b. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit tracks or connectors.
c. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.
d. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.
e. Store or transport the module in a conductive bag.

More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 147-OF.

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.

1.2 - Power Supply

The auxiliary power is supplied by a built-in module fully isolated and self-protected.
Two options are available:

a) - 21V(-20%) / 110V(+15%) a.c.
24V(-20%) / 125V(+20%) d.c.

b) - 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. General Characteristics

Compact draw-out execution for Flush Mounting.

User friendly front face with 2x8 characters LCD Display, four signal Leds, four keys for complete local management and 9-pin socket for local RS232 serial communication.

I/O:

- 2 opto-isolated Digital Inputs
- Up to 4 output mechanical relays with UX-10/4 expansion module
- Up to 12 opto-isolated Digital Inputs with UX-10/4 expansion module

Two independent Modbus serial ports

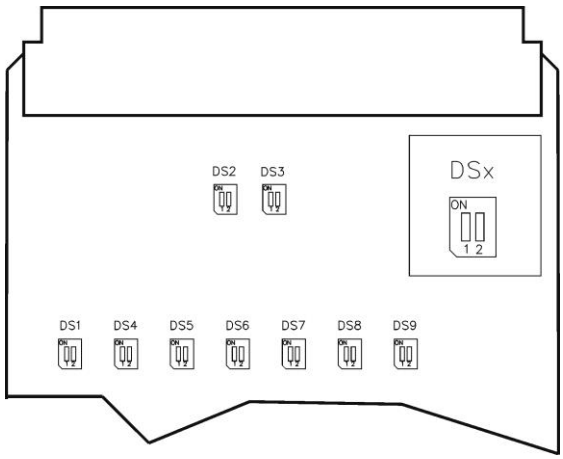
- RS485 communication port on the backplane
- RS232 port on front panel

4 user programmable Asymmetric Bipolar Output static relays, specially purposed for IGBT drivers Mosfet outputs can support ON/OFF or PWM output, for IGBT drivers boards.

MC-RF has the feature of two combinable PID algorithm.

Make electric connection in conformity with the diagram reported on relay's enclosure.

2.1 – Dip-Switches Configuration



	1	2	Scale		1	2	Scale		1	2	Scale
DS1 (IN1)	off	off	160Vac	**DS2 (IN2)**	off	off	30mAcc	**DS3 (IN3)**	off	off	30mAcc
	off	**on**	**200Vac**		off	on	60mAcc		off	on	60mAcc
	on	off	90Vac		**on**	**off**	**20mAcc**		**on**	**off**	**20mAcc**
	on	on	98,7Vac		on	on	35mAcc		on	on	35mAcc
DS4 (IN4)	off	off	1,5Vcc	**DS5 (IN5)**	**off**	**off**	**30mAcc**	**DS6 (IN6)**	**off**	**off**	**30mAcc**
	off	**on**	**15Vcc**		off	on	60mAcc		off	on	60mAcc
	on	off	not used		on	off	20mAcc		on	off	20mAcc
	on	on	not used		on	on	35mAcc		on	on	35mAcc
DS7 (IN7)	**off**	**off**	**30mAcc**	**DS8 (IN8)**	off	off	1,5Vcc	**DS9 (IN9)**	off	off	1,5Vcc
	off	on	60mAcc		**off**	**on**	**15Vcc**		**off**	**on**	**15Vcc**
	on	off	20mAcc		on	off	not used		on	off	not used
	on	on	35mAcc		on	on	not used		on	on	not used

Note: MC-RF values are shown in Bold+Underlined

2.3 - Operation and Algorithms

2.3.1 - Reference Input Values

Display			Description	Setting Range	Step	Unit
Pn	2000	kW	Power	0 - 9999	1	kW
Un	1000	V	Voltage	0 - 9999	1	V
In	2000	A	Current	0 - 9999	1	A

Hidden Parameters (reserved for service installation)						
IN1	*Vp	V	Primary nominal value	0 - 9999	1	V
IN1s	100	V	Secondary nominal value	0 - 9999	1	V
IN1	200	V	MC-RF Input full scale	0 - 9999	1	V
IN2	1600	V	Primary nominal value	0 - 9999	1	V
IN2s	20	mA	Secondary nominal value	0 - 99.99	0.01	mA
IN2	0	V	Primary start scale	0 - 9999	1	V
IN2	4	mA	Secondary start scale	0 - 9999	1	mA
IN2	20	mA	MC-RF Input full scale	0 - 99.99	0.01	mA
IN3	2000	A	Primary nominal value	0 - 9999	1	A
IN3s	20	mA	Secondary nominal value	0 - 99.99	0.01	mA
IN3	0	A	Primary start scale	0 - 9999	1	A
IN3	4	mA	Secondary start scale	0 - 9999	1	mA
IN3	20	mA	MC-RF Input full scale	0 - 99.99	0.01	mA
IN4	-	-	Primary nominal value	0 - 9999	1	-
IN4s	15	V	Secondary nominal value	0 - 99.99	0.01	V
IN4	-	-	Primary start scale	0 - 9999	1	-
IN4	0	V	Secondary start scale	0 - 9999	1	V
IN4	15	V	MC-RF Input full scale	0 - 99.99	0.01	V
IN5	-	-	Primary nominal value	0 - 9999	1	-
IN5s	20	mA	Secondary nominal value	0 - 9999	1	mA
IN5	-	-	Primary start scale	0 - 9999	1	-
IN5	4	mA	Secondary start scale	0 - 9999	1	mA
IN5	20	mA	MC-RF Input full scale	0 - 9999	1	mA
IN6	-	-	Primary nominal value	0 - 9999	1	-
IN6s	20	mA	Secondary nominal value	0 - 9999	1	mA
IN6	-	-	Primary start scale	0 - 9999	1	-
IN6	4	mA	Secondary start scale	0 - 9999	1	mA
IN6	20	mA	MC-RF Input full scale	0 - 9999	1	mA
IN7	2000	A	Primary nominal value	0 - 9999	1	A
IN7s	20	mA	Secondary nominal value	0 - 9999	1	mA
IN7	0	A	Primary start scale	0 - 9999	1	A
IN7	4	mA	Secondary start scale	0 - 9999	1	mA
IN7	20	mA	MC-RF Input full scale	0 - 9999	1	mA
IN8	-	V	Primary nominal value	0 - 9999	1	V
IN8s	15	V	Secondary nominal value	0 - 9999	1	V
IN8	-	V	Primary start scale	0 - 9999	1	V
IN8	0	V	Secondary start scale	0 - 9999	1	V
IN8	15	V	MC-RF Input full scale	0 - 9999	1	V
IN9	-	V	Primary nominal value	0 - 9999	1	V
IN9s	15	V	Secondary nominal value	0 - 9999	1	V
IN9	-	V	Primary start scale	0 - 9999	1	V
IN9	0	V	Secondary start scale	0 - 9999	1	V
IN9	15	V	MC-RF Input full scale	0 - 9999	1	V

*Note on optional input IN1:
Vp is the voltage read to the primary side of the substation transformer.
This input has the only scope to measure the deviation since the nominal value has been programmed.
i.e.: Scada sent SVR = 750V; IN1s measures Vp and assume Vp_{prev} = SVR.
After that assumption, any variation on IN1s will be reflected in % on Un value (Un=SVR*FC, where FC is $Vp_{act}./Vp_{prev}$). Vp value is oversampled in an averaging about 10 seconds of time.

General Programming Example:

For transducer with the following characteristics (0 ÷ 1000)V / (4 ÷20)mA set :

INx	*1000*	***V***	*Primary nominal value*
INx	*20*	***mA***	*Secondary nominal value*
INx	*0*	***V***	*Primary start scale*
INx	*4*	***mA***	*Secondary start scale*
INx	*20*	***mA***	*MC-RF Input full scale (to be set according to dip-switch configuration see § 2.1)*

2.3.3 - Functions and Settings Functions

a. "All the protection thresholds are expressed in p.u. (per unit) of the relevant transducer Primary nominal value.

*2.3.3.1 – Resistors **C1-C2-C4-C8** - Setting Window*

FuncEnab	→		--------	[Enabled]		
Options	→		--------	No Parameters		
C1	→	***ohm***	1.850	(0.000 ÷ 20.000)	step	0.001 ohm
C2	→	***ohm***	1.550	(0.000 ÷ 20.000)	step	0.001 ohm
C4	→	***ohm***	1.240	(0.000 ÷ 20.000)	step	0.001 ohm
C8	→	***ohm***	1.000	(0.000 ÷ 20.000)	step	0.001 ohm

- **FuncEnab** : This function is vital and can't be disabled
- **Cx** : Resistive value of braking resistor Cx

This window has the scope to trim the final and real value of braking resistors.
After the completion of installation, the real value of C1, C2, C4, C8 needs to be measured at the terminal blocks of the IGBT drivers.
Doing so, also the cabling and connections resistance will be kept in count.
The measured values have to be replaced in setting window.
Be careful!
These values are very important for the system.
Please use a precision four wires milliohm meter.
The measure needs to be done by a specialized personnel.

*2.3.3.4 - **COS** – **ARF** **C**ritical **O**vervoltage **S**hutdown element*

FuncEnab	→		Enabled		[Permanent Enabled]	
Options	→		No Param		No Parameters	
TripLev	→	***COS***	**91**	**%Un**	90 – 100%	Steps 1%
Timers	→	***tCOS***	10	**s**	(0.00 – 30.00)	Steps 0,1sec.

- ***FuncEnab*** : This function is vital and can't be disabled
- **COS** : Trip level
- **tCOS** : Delay before shut down

Trip when : threshold level is exceeded; signal provided from internal comparator

When the function trips :
Regulator = Closes C1+C2+C8 (step12)
Signalization = Led "Trip" flashes fast for tCOS"
Last Trip = Recorded

Reset when : After when the IN2 measured voltage has gone down the TripLev value, a new standard step calculation will be done and the result output to the IGBTs.
The effect of the COS function is the sudden output of the step 12 and it is overpassed by a new step calculation result, if Vc goes low before tCOS. Otherwise, step 0 is forced and relay 1.R3 is activated.

*2.3.3.5 - **Vb+** – Start Braking threshold*

FuncEnab	→		Enable		[Enable]	
Options	→		No Param		No Parameters	
TripLev	→	***Vb+***	1.1	**Un**	(1.01 ÷ 1.20)	step 0.01
Timers	→	***tVb+***	0.00	**s**	(0.00)	No step

- ***FuncEnab*** : This function is vital and can't be disabled
- ***Vb+*** : Start level
- ***tVb+*** : Trip time delay

Start when : threshold level is exceeded

When the function starts :
Regulator = Follows Braking algorithm
Signalization = According algorithm
Last Trip = Is recorded

Reset when : When V measured below Vb+. The output of this function is managed by the Braking algorithm.

2.3.3.9 – ***dPID***

→	**Vpd**	800	**V**	(500 ÷ 910)	step	1

PIDf

FuncEnab	→		No Param		No Parameters	
Options	→		No Param		No Parameters	
TripLev	→	**K_P**	50.00		(0.00 ÷ 300.00)	step 0.01
	→	**K_I**	10.00		(0.00 ÷ 300.00)	step 0.01
	→	**K_D**	0.00		(0.00 ÷ 300.00)	step 0.01
Insensitivity	→	**Rins**	1	**%Un**	(0 ÷ 2)	step 0.01

PIDs

FuncEnab	→		No Param		No Parameters	
Options	→		No Param		No Parameters	
TripLev	→	**K_P**	10.00		(0.00 ÷ 300.00)	step 0.01
	→	**K_I**	100.00		(0.00 ÷ 300.00)	step 0.01
	→	**K_D**	0.00		(0.00 ÷ 300.00)	step 0.01
Insensitivity	→	**Rins**	1	**%Un**	(0 ÷ 2)	step 0.01

BOTH:

❑	***FuncEnab***	:	If “disable” the function is off
❑	**K_P**	:	Proportional gain
❑	**K_I**	:	Integrative gain
❑	**K_D**	:	Derivative gain
❑	**Vpd**	:	Regulation point reference level
❑	**Rins**	:	Insensitivity

The dPID function merges two identical PIDs in one output.

The one is more regulating, this is the PID selected for output.

Doing so, we have an immediate and improved damping to fast transients, subsequently replaced by a smooth regulation for the rest of braking phase.

Each of two PIDs can be fast or slow, according to the settings. By convention we define PID1 as faster and PID2 as slower.

*2.3.3.2 – **I>> - Ibp- ARF** Overcurrent protection*

FuncEnab	→		Disable		[Disable / Enable]			
Options	→		No Param		No Parameters			
TripLev	→	***IbP>***	0.50	**In**	(0.10 ÷ 1.00)	step	0.05	In
Timers	→	***tIB>***	0.5	**s**	(0.00 ÷ 100.00)	step	0.1	s

- ***FuncEnab*** : If “disable” the function is off
- **I>>** : Trip level
- **tI>>** : Trip time delay

Trip when : The overcurrent trip level is exceeded for time tIB>

When the function trips :

Regulator	=	Blocked after the completion of the cycle, if active.
Signalization	=	Led “Trip” is lit
Output	=	Relay 1.R4 active
Last Trip	=	Recorded

Reset when : Returns in normal condition and/r Reset push-button is pressed, according with the reset settings.

2.3.3.11 - **Test** - (Test)

FuncEnab	→		No Param	No Parameters	
Options	→	**Tst**	Disable	[Disable / Enable]	
Objects	→	**C1**	Disable	[Disable / Enable]	
	→	**C2**	Disable	[Disable / Enable]	
		C4	Disable	[Disable / Enable]	
		C8	Disable	[Disable / Enable]	
Timers	→		No Param	No Parameters	

- **Tst** : *Disable* : In this case the “Test” is disabled and apparatus work normally.
- **C1…C8** : *Disable* : If enabled, when Tst enabled, related output is forced ON.

*2.3.3.7 – **Vx1** – Auxiliary Voltage Monitor IN8*

FuncEnab	→	Disable		[Disable / Enable]		
Options	→	No Param		No Parameters		
TripLev	→ ***Vx1>***	1	**Vn**	(0.50 ÷2.00)	step	0.1
Timers	→ ***tVx1***	0.5	**s**	(0.0 ÷ 10.0)	step	0.1s

❑ ***FuncEnab*** : If “disable” the function is off

The functions “Vx” control the power supply of the circuits of command of the transducers and the cards of IGBT drivers.
Full scale measurement: 2*Vn.

Trip when	:	V(IN8) > “Vx1>” for tVx1		
When the function trips	:	*Regulator*	=	Stop or Stop after braking completion
		Signalization	=	Led “Trip” is lit
		Last Trip	=	Is recorded
		Output	=	Modbus
Reset when	:	V(IN8) < “Vx1>”		

2.3.3.7 – ***Vx2*** – Auxiliary Voltage Monitor IN9

FuncEnab	→	Disable		[Disable / Enable]		
Options	→	No Param		No Parameters		
TripLev	→ ***Vt***	1	**Vn**	(0.50 ÷2.00)	step	0.1
Timers	→ ***tVt***	0.5	**s**	(0.0 ÷ 10.0)	step	0.1s

❑ ***FuncEnab*** : If “disable” the function is off

The functions “Vx” control the power supply of the circuits of command of the transducers and the cards of IGBT drivers.
Full scale measurement: 2*Vn.

Trip when	:	V(IN9) > “Vx2>” for tVx1		
When the function trips	:	*Regulator*	=	Stop or Stop after braking completion
		Signalization	=	Led “Trip” is lit
		Last Trip	=	Is recorded
		Output	=	Modbus
Reset when	:	V(IN9) < “Vx2>”		

*2.3.3.20 - **Osc** - Oscillographic Recording*

FuncEnab	→		Disable		[Disable / Enable]			
Options	→	**Trg**	Disable		[Disable / Start / Trip / Ext.Inp.]			
TripLev	→		No Param		No Parameters			
Timers	→	**tPre**	5.00	**s**	(5.00 ÷ 15.00)	step	1	s
	→	**tPost**	10.00	**s**	(10.00 ÷ 65.00)	step	0.1	s

❑	**FuncEnab**	:	If “disable” the function is off
❑	**Trg**	:	*Disable* = Function Disable (no recording) *Start.* = Trigger on time start of protection functions *Trip* = Trigger on trip (time delay end) of protection functions *Ext.Inp.* = Trigger when Digital Input 0.D2 (dry contact) is opened
❑	**tPre**	:	Recording time before Trigger
❑	**tPost**	:	Recording time after Trigger

The “Osc” Function includes the wave Form Capture of the output quantities (I, V) and can totally store a record of 70 seconds.

The number of events recorded depends on the duration of each individual recording (tPre + tPost). In any case the number of event stored cannot exceed ten (10 x 7 sec).

Any new event beyond the 70 sec capacity of the memory, cancel and overwrites the former records (FIFO Memory).

*2.3.3.21 - **LoadP** – Load Profile*

FuncEnab	→		Disable		[Disable / Enable]			
Options	→		No Param		No Parameters			
TripLev	→		No Param		No Parameters			
Timers	→	***tLP***	1	**m**	(1 ÷ 650)	step	1	m

- **FuncEnab** : If “disable” the function is off
- **tLP** : Scan time

Every time that a value of current > 5%In is detected, comes activated with a time of programmable scansion “tLP”, the recording of the load profile.

*2.3.4.22 - **I.R.F.** - Internal Regulator Failure*

FuncEnab	→		No Param	No Parameters
Options	→	**Opz**	NoTrip	[NoTrip / Trip]
TripLev	→		No Param	No Parameters
Timers	→		No Param	No Parameters

- **Opz** : The variable “ Opz“ can be programmed to trip the output relays same as the other protection functions (Opz = TRIP), or to only operate the “ IRF “ signal led without tripping the output relays (Opz = NoTRIP).

*2.3.3.23 - **LCD** – Display and Buzzer operation*

FuncEnab	→		No Param	No Parameters
Options	→	***Key***	BeepOFF	[BeepOFF / BeepON]
	→	***BkL***	Auto	[Auto / On]
TripLev	→		No Param	No Parameters
Timers	→		No Param	No Parameters

- ***Key*** : Buzzer “Beep” on operation of Keyboard buttons.
- ***BkL*** : LCD Backlight continuously “ON” or switched-on Automatically on operation of Keyboard buttons.

*2.3.3.24 - **Comm** – Communication Parameters*

FuncEnab	→	No Param	No Parameters
Options	→ ***LBd***	9600	[9600 / 19200 / 38400 / 57600]
	→ ***RBd***	9600	[9600 / 19200]
	→ ***Mod***	8,n,1	[8,n,1 / 8,o,1 / 8,e,1]
	→ ***RPr***	Modbus	[Modbus]
TripLev	→	No Param	No Parameters
Timers	→	No Param	No Parameters

- ***LBd*** : Local Baud Rate (Front panel RS232 communication speed)
- ***RBd*** : Remote Baud Rate
  (Rear panel terminal blocks RS485 communication speed)
- ***Mod*** : Remote mode (communication parameters)
  Note: Any change of this setting becomes valid at the next power on
- ***RPr*** : Remote Protocol

3. Output Relays

Four user programmable Output Relays are normally available 1.R1, 1.R2, 1.R3, 1.R4.
Each of them can be programmed (see § RelayCfg) to be controlled by any element (instantaneous or time delayed) of any of the Regulator Functions including Internal Regulator Fault.
Moreover, the operation of each of the output relays can be programmed to be either Normally Deenergized (energized on tripping of the controlling Functional Element) or Normally Energized (Deenergized on tripping of the controlling Functional Element).

4. Digital Input

The firmware can manage up to 12 digital inputs and 4 output relays; among these, 2 digital inputs are available on the main regulator module, the remaining are available on additional expansion (UX10-4) modules controlled via the CAN-Bus communication channel.

Available in the Expansion Module (UX10-4 – Board 2)					
1.D1	Digital Input “D1”	(terminals 252 – 262)	Available	(+24V)	By the interface program “MSCom II” it is possible to Activate/Deactivate the functions.
1.D2	Digital Input “D2”	(terminals 253 – 263)	Available	(+24V)	
1.D3	Digital Input “D3”	(terminals 254 – 264)	Available	(+24V)	
1.D4	Digital Input “D4”	(terminals 255 – 265)	Available	(+24V)	
1.D5	Digital Input “D5”	(terminals 256 – 266)	Available	(+24V)	
1.D6	Digital Input “D6”	(terminals 272 – 282)	Available	(+24V)	
1.D7	Digital Input “D7”	(terminals 273 – 283)	Available	(+24V)	
1.D8	Digital Input “D8”	(terminals 274 – 284)	Available	(+24V)	
1.D9	Digital Input “D9”	(terminals 275 – 285)	Available	(+24V)	
1.D10	Digital Input “D10”	(terminals 276 – 286)	Available	(+24V)	

5. Self-Diagnostic

The regulator incorporates a sophisticated self-diagnostic feature that continuously checks the following elements:

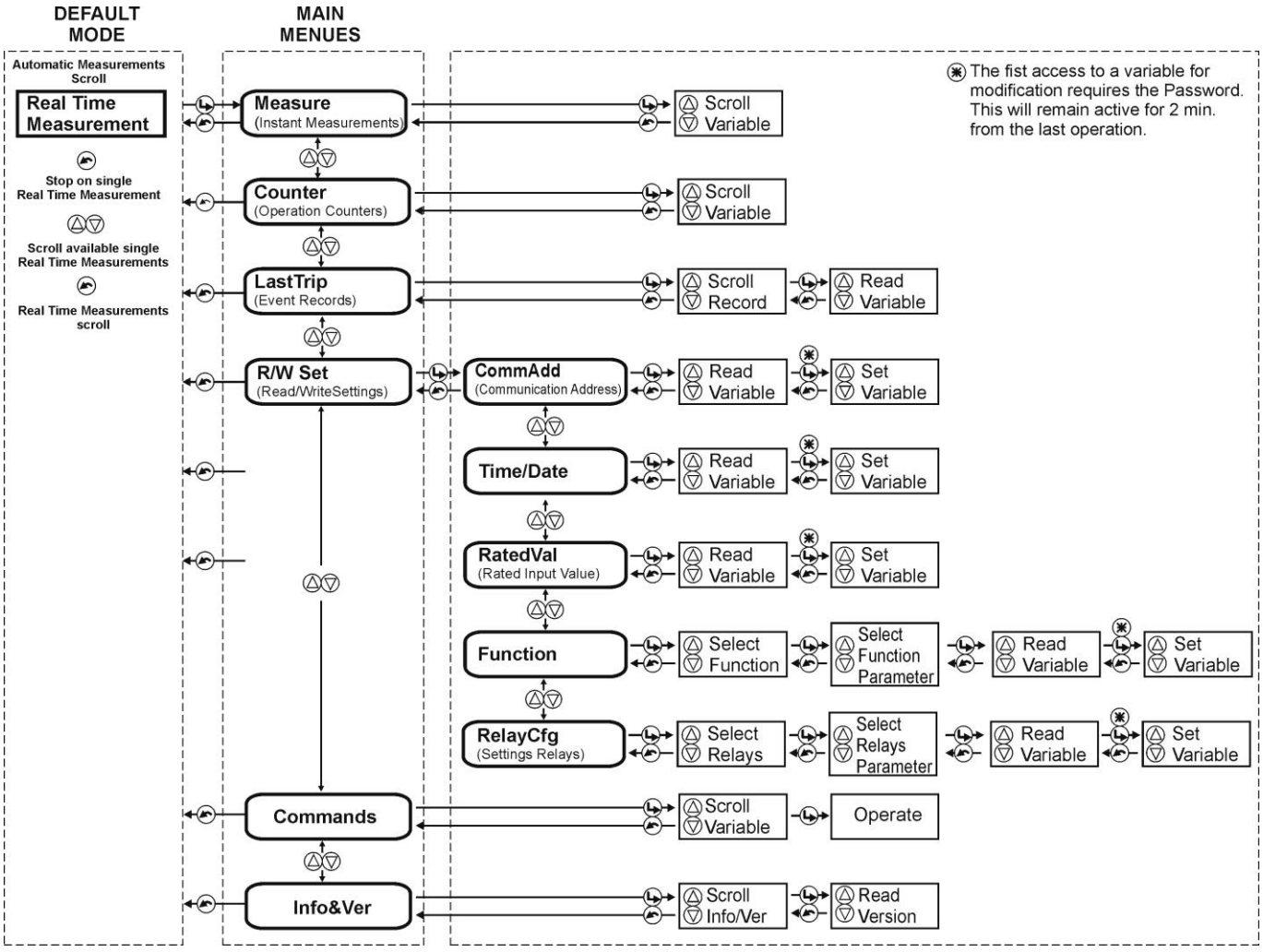
- A/D conversion
- Checksum of the settings stored into E^2Prom.
- DSP general operation (Power, Routines, etc.)
- Lamp test (only on manual test).
- I/O board supervision (CANBus)

Any time Power is switched on, a complete test is run; then, during normal operation, the test runs continuously and the checksum is done any time a parameter is stored into E^2Prom.
If during the test any Internal Regulator Failure (I.R.F) is detected:

- If “ I.R.F. “ is programmed to “ Trip “, the programmed output relays are operated same as on tripping of any protection function operation, is stored in the “ Last Trip “ and the signal led “ON PULSE “ is switched off , and the regulator is blocked.
- If “ I.R.F. “ is programmed to “NO Trip”, the signal led “ON PULSE “ is switched off.

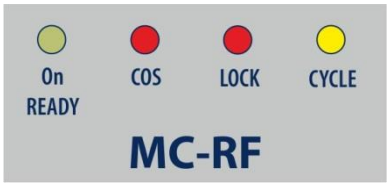
6. Regulator Management

The regulator can be totally managed locally, either by the RS232 communication port or by the 4 key buttons and the LCD display, or remotely via the communication bus RS485 connected to the rear terminal blocks. The 2 line x 8 characters LCD display shows the available information.
Key buttons operate according to the flow-chart here below.



7. Signalizations

Four signal leds are available on the Front Face Panel:



a)	Green LED	**ON Pulse**	❑ Off	:	Internal Fault
			❑ Flashing	:	When regulator is ready
			❑ Lit	:	When regulator is stopped
b)	Red LED	**COS**	❑ Off	:	Normal status
			❑ Flashing	:	-----
			❑ Lit	:	COS is active
c)	Red LED	**LOCK**	❑ Off	:	Normal status
			❑ Flashing	:	When a timed function starts to operate
			❑ Lit	:	When LOCK input active or any protection function trips (Blocking or Stopping the regulator)
d)	Yellow LED	**CYCLE**	❑ Off	:	When out of cycle
			❑ Flashing	:	When CYCLE is running
			❑ Lit	:	END

8. Keyboard

	**Enter**	Gives access to any menu or validate any programming change.
	**Reset**	Return from the actual selected menu to the former menu.
	**Select +**	Scrolls variables available in the different menus or increases/decreases setting values.
	**Select -**	

9. Serial Communication Port

9.1 - Main RS485 Serial Communication Port

This port is accessible via the terminals 152 – 153 – 162 provided on the relay terminal board.
It is used for connection to a serial bus interfacing up to 31 units with the Central Supervision System (SCADA, DCS, ecc).
The serial bus is a shielded pair of twisted cables connecting in parallel (Multi Drop) the different units (slaves) by the relevant terminals.
The physical link is RS485 and the Communication Protocol is MODBUS/RTU
The configuration of transmission parameters is selectable.

❑	Baud Rate	:	9600/19200 bps	9600/19200 bps	9600/19200 bps
❑	Start bit	:	1	1	1
❑	Data bit	:	8	8	8
❑	Parity	:	None	Odd	Even
❑	Stop bit	.	1	1	1

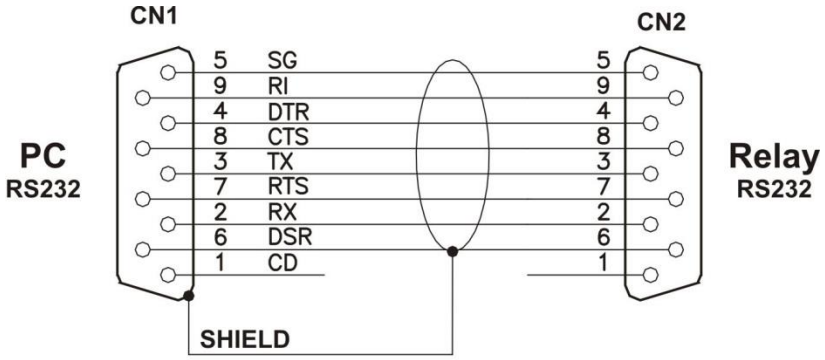
Note: any change of this setting becomes valid at the next power on.

Each relay is identified by its programmable address code (NodeAd) and can be called from the P.C.
A dedicated communication software (MSCom) for windows 95/98/NT4 SP3 (or later) is available.
Please refer to the MSCom instruction manual for more information.
Maximum length of the serial bus can be up to 200m.

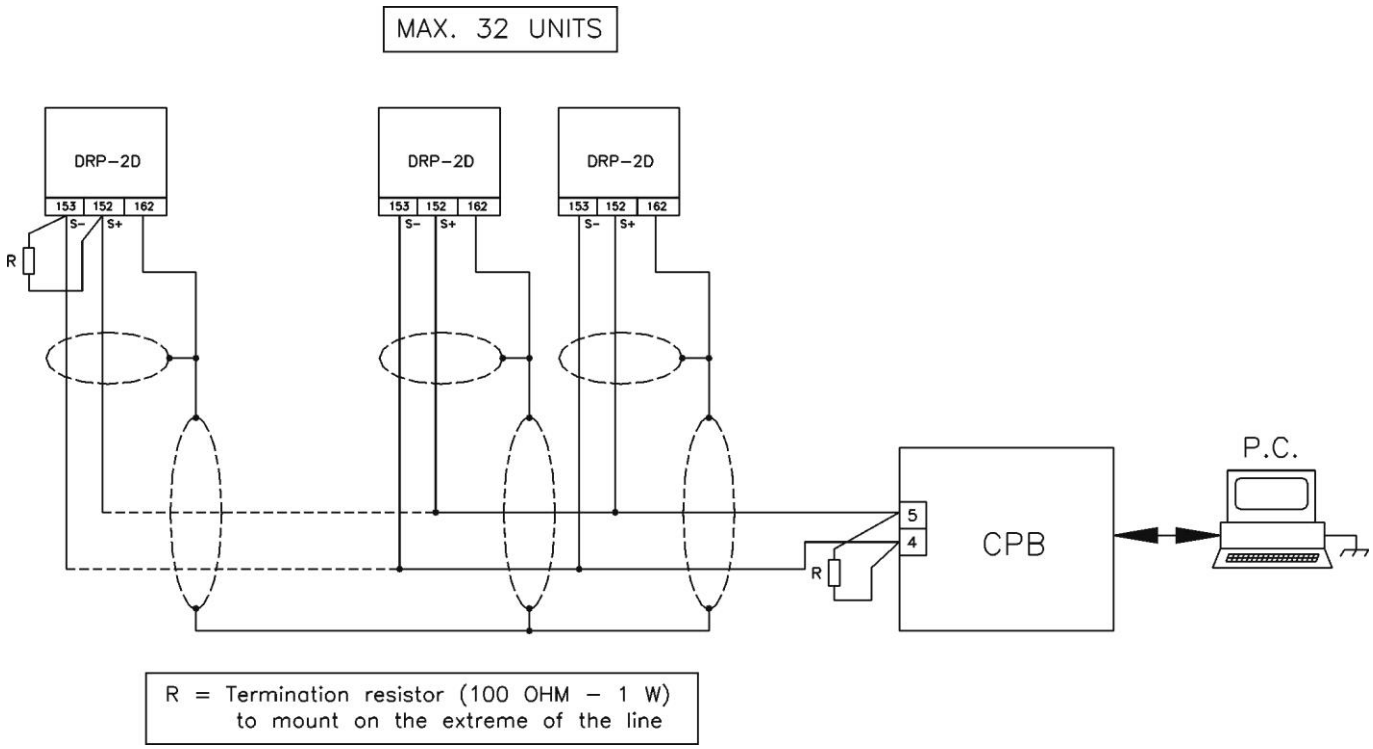
9.2 - Communication Port on Front Face Panel

This port is used for communication through the Front Face Panel between a local Lap-top PC.

The physical link is RS232 by the standard female 9-pin D-sub connector available on the Front Face Panel. Via this Port complete Relay management and data acquisition is possible.



9.3 – Termination resistor



10. Menu and Variables

10.1 – Nominal parameters input

Scrolling display of the Real Time Measurements is the Default operation.
Scrolling can be stopped at any of the measurements and restarted by pressing the Reset button.
When stopped on one variable, ✱ appears aside the measurement and the different available measurements can be selected by the △▽ buttons.

Display				Description
Ib	=	0 – 65535	**A**	Braking current
Vc	=	0 – 65535	**V**	Catenary Voltage
Ir	=	0 – 65535	**A**	Rectifier Current
Vb+	=	0 – 65535	**V**	Trigger Voltage
Vpd	=	0 – 65535	**V**	dPID set point
Pwr	=	0 – 65535	**kW**	Global power dissipated in the resistive complex

10.1.1 – Measures (Instantaneous Measurements)

Real time measurements can be frozen at any moment selecting the menu " Instant Measure ":

- " **R**eal **T**ime **M**eas "
- " Meas "
- " 1st Measurement
- to go back to " Meas "

other measurements

Display				Description
Ib	=	0 – 65535	**A**	Braking current
Vc	=	0 – 65535	**V**	Catenary Voltage
Ir	=	0 – 65535	**A**	Rectifier Current
Vb+	=	0 – 65535	**V**	Trigger Voltage
Vpd	=	0 – 65535	**V**	dPID set point
Pwr	=	0 – 65535	**kW**	Global power dissipated in the resistive complex

10.1.2 - RatedVal (Rated Input Values)

- △▽ "RatedVal "
- 1st Variable
- △▽ to scroll variables
- to modify selected variable
- " Password ???? " (if not yet entered) or #??? (if not yet entered; see § Password)
- △▽ to set variable value,
- to validate. Set Done!

Display			Description	Setting Range	Step	Unit
Un	750	**V**	Base Voltage	0 - 9999	1	V
In	2000	**A**	Base Current	0 - 9999	1	A

10.2 - Counter (Operation Counters)

The operation of any of the function here below reported, is counted and recorded in the menu "Counters ".

- " **R**eal **T**ime **M**eas "
- "Counter "
- " 1st counters   other counters
- to go back to "Counter "

Display			Description
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of
	=	0 – 65535	Number of

10.3 - LastTrip (Event Recording)

The regulator records any tripping and stores the information relevant to the last 20 tripping of protection functions (FIFO).
Each event recording includes the following information.

- " Real Time Meas " 
- " LastTrip " 
-  1st event,
-  to scroll available events,
-  to " Rec # " selected,
-  to select the different fields;

Display				Descrlption
Func		xxxxx		Indication of the protection function which caused the relay tripping. For indication of the TRIP Cause the following acronyms are used: - = - = - = - = - = - = - = - = - = - = - = - = - = - = - = - = - =
Date	:	YYYY/MM/GG		Date: Year/Month/Day
Time	:	hh:mm:ss:cc		Time: hours/minutes/second/hundredths of seconds
Ib	=	0 – 65535	**A**	Braking Current
Vc	=	0 – 65535	**V**	Catenary Voltage
Ir	=	0 – 65535	**A**	Rectifier current
Vb+	=	0 – 65535	**V**	Trigger voltage
Vpd	=	0 – 65535	**V**	dPID regulation Reference

-  to go back to " Rec # ",
-  to go back to " Real Time Meas ".

10.4 - R/W Set (Programming / Reading the Relay Settings)

- " Main Menu "
- select " Function "
- select among following sub menus:

10.4.1 - CommAdd (Communication Address)

- " Common "
- " Add: # "
- " Password ???? " (if not yet entered; see § Password)
- to select the Address (1-250)
- to validate. Set Done!

The default address is 1.

Display	Description	Setting Range	Step	Unit
Add: 1	Identification number for connection on serial communication bus	1 - 250	1	-

10.4.2 - Time/Date (Time/Date)

- " Time/Date " Date: Current Date, Time: Current time
- " YY/…… " to set year,
- " XX/MM " to set month,
- " XX/XX/DD " to set day,
- " XX/XX/XX "
- " hh/mm " to set hour,
- " XX/mm " to set minutes,
- To validate Set Done!
- Exit

10.4.3 - Function (Functions)

- ▲▼ " Function ",
- ↵ 1st function,
- ▲▼ to scroll available Functions,
- ↵ to Read/Write setting of the selected function,
- ▲▼ to select the different definable fields
  - FuncEnab
  - Options
  - TripLev
  - Timers
- ↵ to access the selected field and read the actual setting of the relevant variable
- ↵ to modify the actual setting;
- ▲▼ to set the new value.
- ↵ to validate. Set Done!

Display						Description	Setting Range	Step
Function	Type		Variable	Default Setting	Unit			
Password		=	0000-9999	1111	-	Password for programming enable (see § Password)		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	**T>**	90.00		Trip level (Cooling water temperature)	0.00 – 320.00	1
	Timers	→	**tT>**	1.00	**s**	Trip time delay	0.00 – 100.00	0.01
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	**I>>**	0.80		Trip level	0.10 – 1.50	0.1
	Timers	→	**tOFF**	1.00	**s**	Trip time delay	0.00 – 100.00	0.01
	FuncEnab	→	Enable			If "disable" the function is off	Disable/Enable	-
	Options	→		tdo_10s	**Tds**	Drop-out time delay	tdo_10s / tdo_20s / tdo_30s /	-
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	**V>**	1.20	**Un**	Trip level	0.10 - 1.20	0.05
	Timers	→	**tV>**	1.00	**s**	Trip time delay	0.00 – 100	0.1
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	**Vb+**	1.10	**Un**	Trip level	0.80 - 1.20	0.05
	Timers	→	**tVb+**	3.00	**s**	Trip time delay	0.00 – 100	0.1
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	**Vb-**	0.40	**Un**	Trip level	0.40 - 1.00	0.05
	Timers	→	**tVb-**	1.00	**s**	Trip time delay	0.00 – 100	0.1
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	**I>**	0.02	**In**	Current trip level	0.01 – 0.10	0.01
			V<	0.05	**Un**	Voltage trip level	0.01 – 0.10	0.01
	Timers	→	**tSh**	0.01	**s**	Trip time delay	0.01 – 10.00	0.01

Display						Description	Setting Range	Step
Function	Type		Variable	Default Setting	Unit			
	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→						
			K_P	0.00	**-**	Proportional gain	0.00 – 200.00	0.01
			K_I	1.00	**-**	Integrative gain	0.00 - 99.99	0.01
			K_D	0.00	**-**	Derivative Gain	0.00 - 99.99	0.01
	Timers	→	No Param			No Parameters		
	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→	**K_P**	0.00	**-**	Proportional gain	0.00 – 300.00	0.01
			K_I	1.00	**-**	Integrative gain	0.00 – 300.00	0.01
			K_D	0.00	**-**	Derivative Gain	0.00 – 300.00	0.01
	Timers	→	No Param			No Parameters		
	FuncEnab	→	No Param			No Parameters		
	Options	→	**Tst**	Disable		Test Mode	Disab/Rif/PWM_Val	-
		→						
	Timers	→	No Param			No Parameters		
	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→						
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
	FuncEnab	→	Disable			If "disable" the function is off	Disable/Enable	-
	Options	→	**Trg**	Disable		Select command for Trigger (start recording):	Disable / Start Trip / Ext.Imp.	-
	TripLev	→	No Param			No Parameters		
	Timers	→	**tPre**	5.00	**s**	Recording time before Trigger	5.00 – 15.00	1
		→	**tPost**	10.00	**s**	Recording time after Trigger	10.00 – 65.00	0.1

Display						Description	Setting Range	Step
Function	Type		Variable	Default Setting	Unit			
LoadP	**FuncEnab**	→	Disable			If “disable” the function is off	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	**tLP**	1.00	**m**	Tempo di scansione	1.00 – 650	1
IRF	**FuncEnab**	→	Disable			If “disable” the function is off	Disable/Enable	-
	Options	→	**Opz**	NoTrip		Internal Failure Trip=Trip; NoTrip=No Trip	Trip-NoTrip	-
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
LCD	**FuncEnab**	→	No Param			No Parameters		
	Options	→	**Key**	BeepOFF		Buzzer “Beep” on operation of Keyboard buttons.	BeepON-BeepOFF	-
			BkL	Auto		LCD Backlight continuously “ON” or switched-on Automatically on operation of Keyboard buttons.	Auto - On	-
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
Comm	**FuncEnab**	→	No Parameters					
	Options	→	**LBd**	9600		Local Baud Rate (Front panel RS232 communication speed)	9600 - 19200 38400 - 57600	-
			RBd	9600		Remote Baud Rate (Rear panel terminal blocks RS485 communication speed)	9600 - 19200	-
			Mod	8,n,1		Remote mode (communication parameters) ***Note**: any change of this setting became valid at the next power on*	8,n,1 8,o,1 8,e,1	-
			Rpr	Modbus		Remote Protocol	Modbus	-
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		

Settings can also be programmed via the serial communication ports.

10.5 - RelayCfg (Relay Configuration)

To associate one of the Output Relays to one or more functions (see § Password): enter the menu "R/W Set", select "Relay Cfg", select the "Relay #" to be programmed, select "Link"; at this stage the list of the available functions is displayed. Scrolling the list by the "+" and "-" keys the function is selected and then assigned by the key "Enter". The assignation is confirmed by the function indication that switches from blinking to steady.
Any of the Output Relays can be programmed to work in two different modes:

- **N.D.** Normally Deenergized Relay is energized on trip of the associated functions
- **N.E.** Normally Energized Relay is deenergized on trip of the associated functions

Programming of working mode is made as above selecting "OpMode" istead of "Link".

Display				Description	Setting Range	Step
Relay	Type		Default Value			
1.R1	Link	→	Ready	Association of functions to output relay R1		-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-
1.R2	Link	→	CycON	Association of functions to output relay R2		-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-
1.R3	Link	→	CosAL	Association of functions to output relay R2		-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-
1.R4	Link	→	tCOS	Association of functions to output relay R3		-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-

10.6 - Commands

- " Commands "
- 1st Control,
- to select other available control,
- to operate selected control.

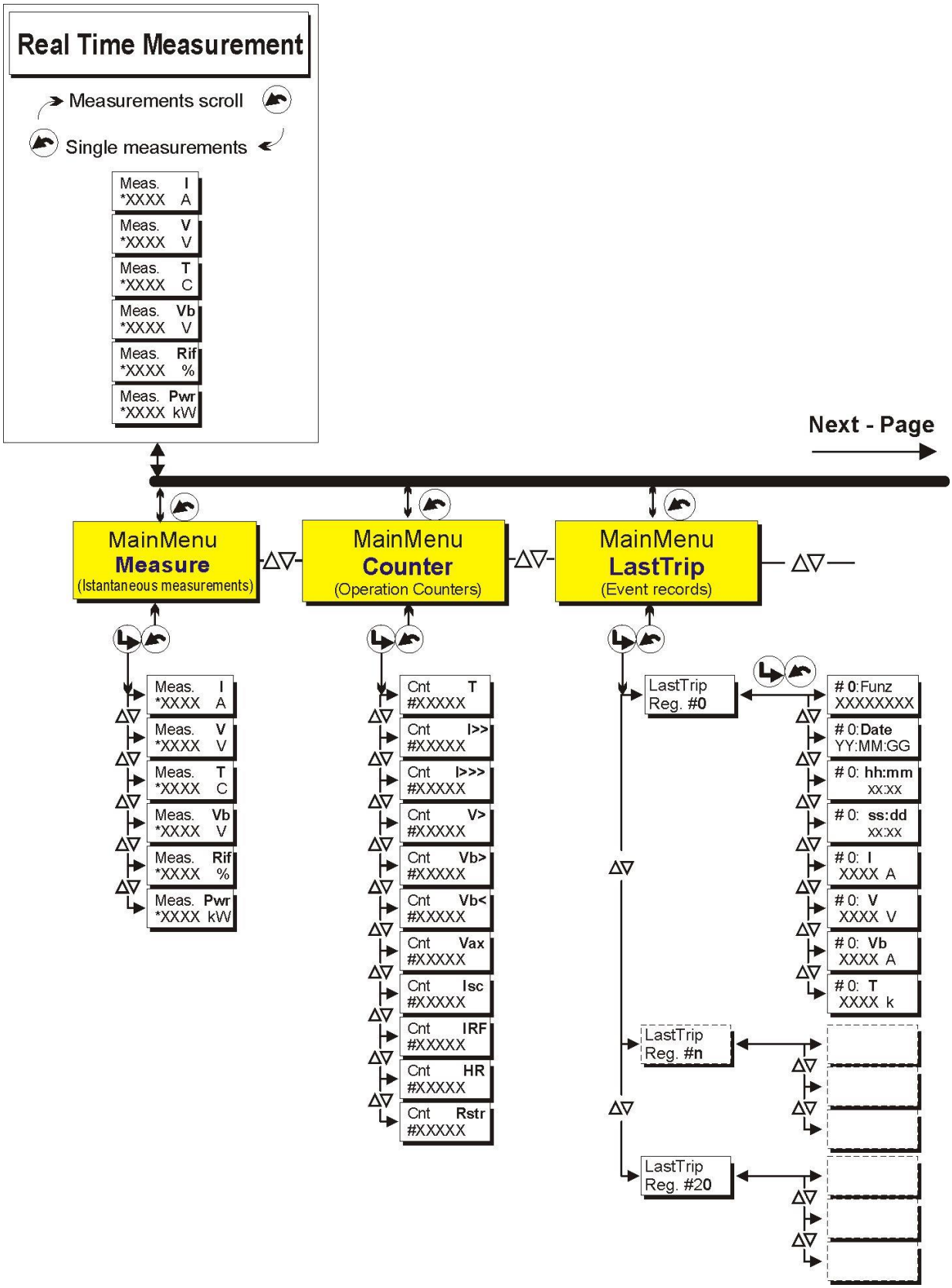
Display		Description
Clear	:	Erase memory of Trip Counters, Event Records.
Test	:	Starts a relay diagnostic test
Reset	:	Reset after trip
Stop	:	Stop regulation
Start	:	Start regulation (only when start digital input 1.D4 is supplied)

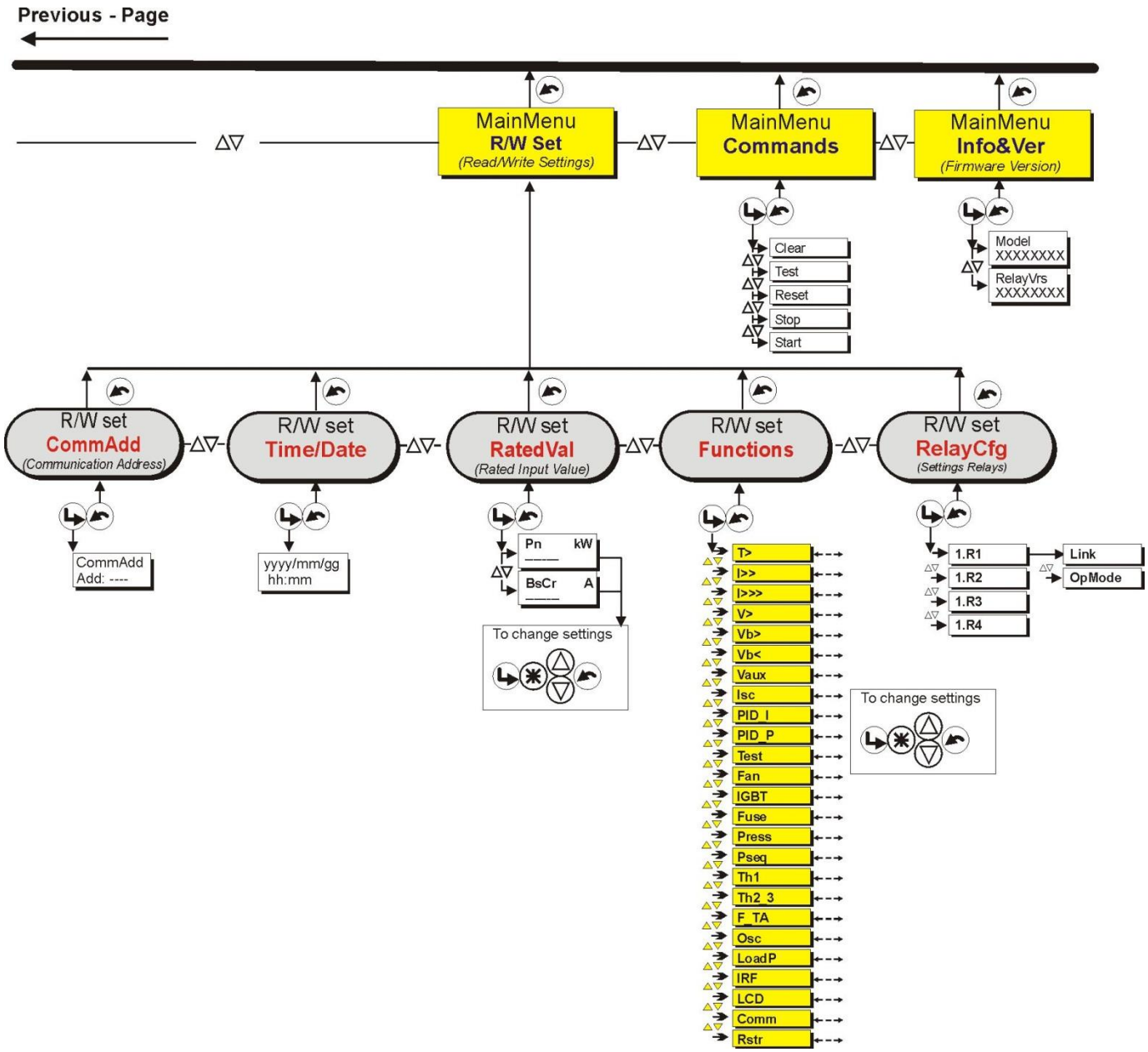
10.7 - Info&Ver

The menu displays the Relay Model and the Firmware Version

- " **R**eal **T**ime **M**eas "
- " Info/Ver ",
- " Model XXXXXX ", Model Relay
- " RelayVrs ###.#.#*X* ", Firmware Version
- to go back to " Info&Ver ".
- to go back to " **R**eal **T**ime **M**eas "

11. KEYBOARD OPERATIONAL DIAGRAM





12. Password

This password is requested anytime the user wants to write in the “Settings” menu a command of the “Commands” menu.

The default password is “ 1111 “

When password is required, proceed as follows

The Display shows the message “ Password ???? “

- ▲▼ to select 1st digit (1-9) ↵ to validate
- ▲▼ to select 2nd digit (1-9) ↵ to validate
- ▲▼ to select 3rd digit (1-9) ↵ to validate
- ▲▼ to select 4th digit (1-9) ↵ to complete procedure.

The “ password “ is required any time you attempt to modify one of the programmable variables at the first entrance in the “Settings” and/or “Commands” menus.
The “ password “remains valid for 2 minutes from the last operation of the programming buttons or until the ↶ button is pressed to return to the default display (Real time Measure).
Once the Password has been entered, a “ # “ appears before the variable that can be modified.

12.1 - MS-Com Password

This password is requested anytime the user wants to send to the relay a setting parameters modification or to issue a command through the relay itself using the managing software MSCom.
The user can decide whether inserting his own password (see MS-Com Operational Manual) or keeping the password disabled just clicking on the OK button when the password is requested.

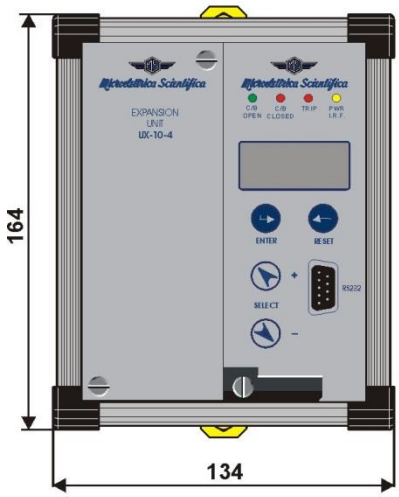
13. Maintenance

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

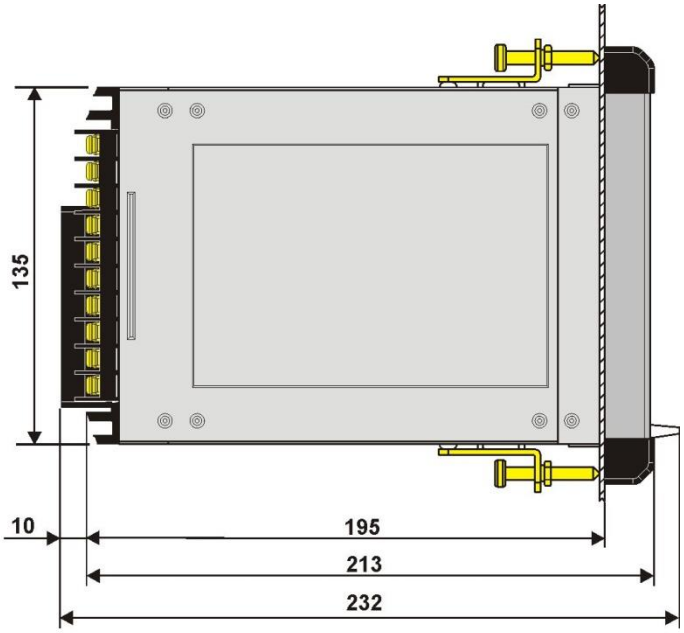
14. Power Frequency Insulation Test

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.

16. Overall Dimensions (mm)



PANEL CUT-OUT
115x137 (LxH)



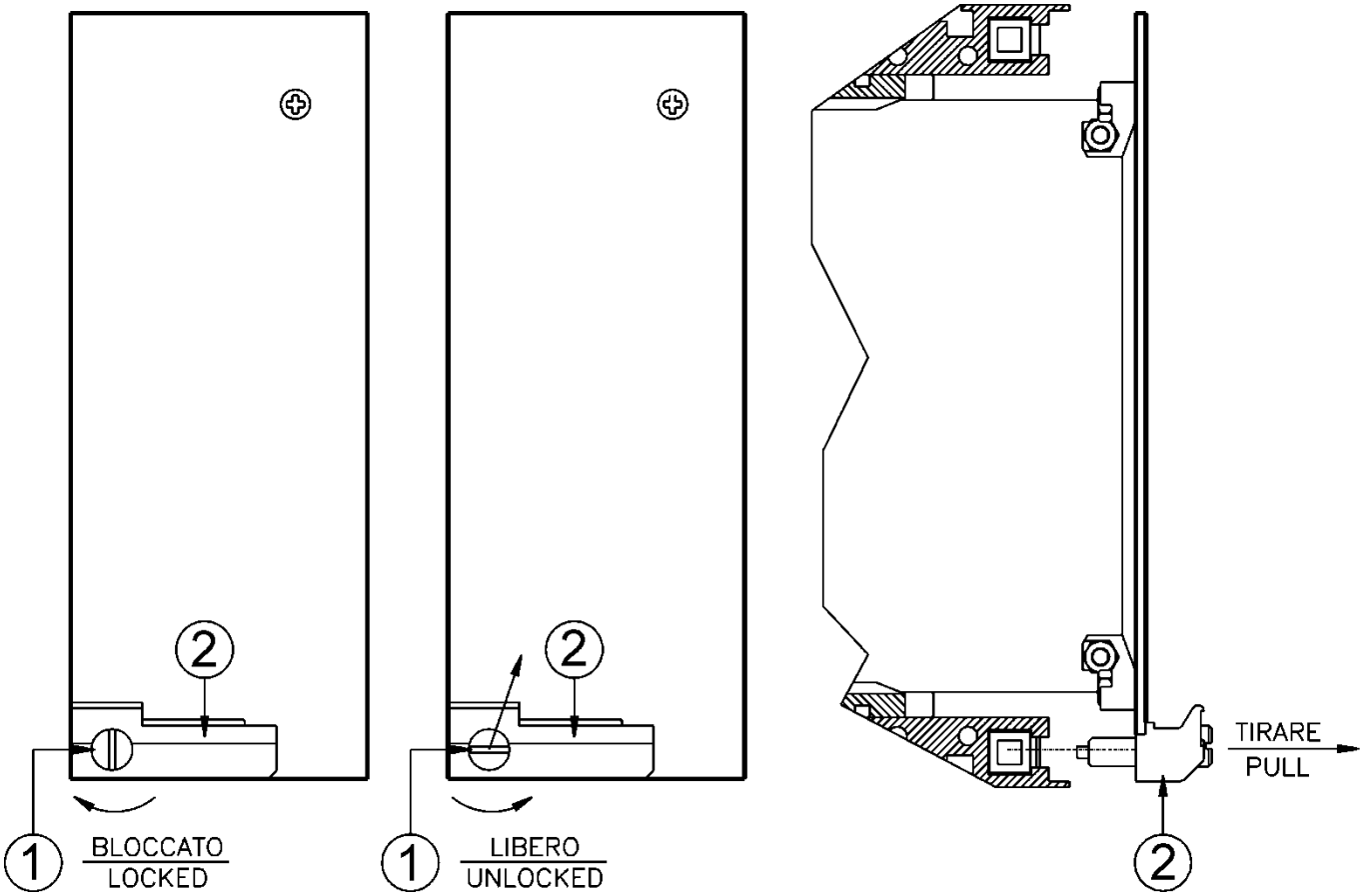
17. Direction for Pcb's Draw-Out and Plug-In

17.1 - Draw-Out

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

17.2 - Plug-In

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



18. Electrical Characteristics

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

❑ Dielectric test voltage		IEC 60255-5	2kV, 50/60Hz, 1 min.
❑ Impulse test voltage		IEC 60255-5	5kV (c.m.), 2kV (d.m.) – 1,2/50μs
❑ Insulation resistance		> 100MΩ	
Environmental Std. Ref. (IEC 60068**)**			
❑ Operation ambient temperature		-10°C / +55°C	
❑ Storage temperature		-25°C / +70°C	
❑ Environmental testing	(Cold)	IEC60068-2-1	
	(Dry heat)	IEC60068-2-2	
	(Change of temperature)	IEC60068-2-14	
	(Damp heat, steady state)	IEC60068-2-78	RH 93% Without Condensing AT 40°C

CE EMC Compatibility (EN50081-2 - EN50082-2 - EN50263**)**				
❑ Electromagnetic emission	EN55022	industrial environment		
❑ Radiated electromagnetic field immunity test	IEC61000-4-3	level 3	80-2000MHz	10V/m
	ENV50204		900MHz/200Hz	10V/m
❑ Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
❑ Electrostatic discharge test	IEC61000-4-2	level 4	6kV contact / 8kV air	
❑ Power frequency magnetic test	IEC61000-4-8		1000A/m	50/60Hz
❑ Pulse magnetic field	IEC61000-4-9		1000A/m, 8/20μs	
❑ Damped oscillatory magnetic field	IEC61000-4-10		100A/m, 0.1-1MHz	
❑ Immunity to conducted common mode disturbance 0Hz-150KHz	IEC61000-4-16	level 4		
❑ Electrical fast transient/burst	IEC61000-4-4	level 3	2kV, 5kHz	
❑ HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC60255-22-1	class 3	400pps, 2,5kV (m.c.), 1kV (d.m.)	
❑ Oscillatory waves (Ring waves)	IEC61000-4-12	level 4	4kV(c.m.), 2kV(d.m.)	
❑ Surge immunity test	IEC61000-4-5	level 4	2kV(c.m.), 1kV(d.m.)	
❑ Voltage interruptions	IEC60255-4-11			
❑ Resistance to vibration and shocks	IEC60255-21-1 - IEC60255-21-2 10-500Hz 1g			

ELECTRIC RATED VALUE	
❑ Accuracy on regulation	1% F.s.
❑ Average power supply consumption	≤ 7 VA
❑ Output relays	rating 6 A; Vn = 250 V A.C. resistive switching = 1500VA (400V max) make = 30 A (peak) 0,5 sec. - break = 0.3 A, 110 Vcc, L/R = 40 ms (100.000 op.)

COMMUNICATION PARAMETER	
❑ RS485 (Back)	9600/19200/38400/57600 bps – 8,n,1 - 8,e,1 - 8,o,1 – Modbus RTU
❑ RS232 (Front)	9600/19200 – 8,n,1 – Modbus RTU

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