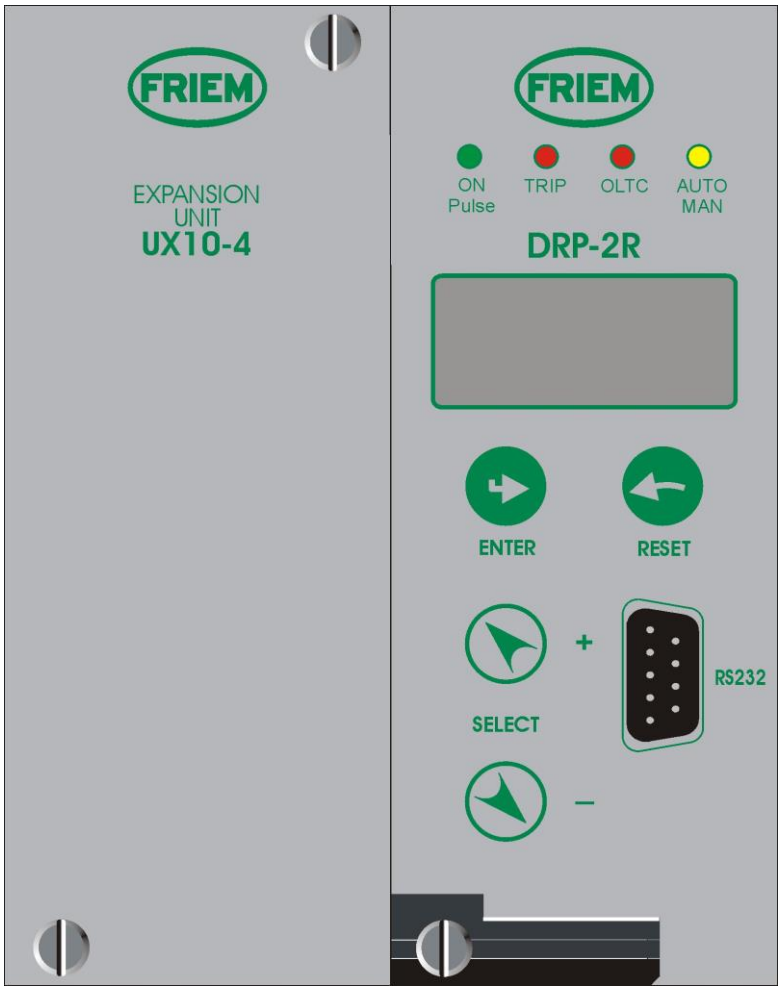
SATURABLE REACTORS

REGULATOR
TYPE
DRP-2R
(DRP-2R + UX10-4)

OPERATION MANUAL



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1. GENERAL UTILIZATION AND COMMISSIONING DIRECTIONS

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

1.1 - Storage and Transportation

must comply with the environmental conditions stated 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 - Protection Earthing

When earthing is required, carefully check its effectiveness.

1.7 - Setting and Calibration

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

1.8 - Safety Protection

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

1.9 - Handling

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

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.

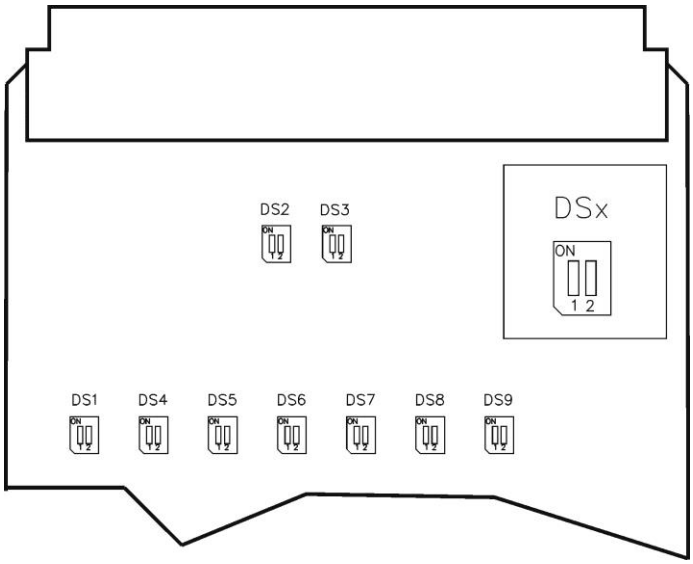
4 user programmable Output Relays.

12 optoisolated Digital Inputs.

RS485 communication port (independent from the RS232 port on front panel)

The device is made for drive the control winding of a saturable reactor.
A dual PWM output is suitable for controlling the “H” bridge, at 10 kHz of base frequency.
The load current can be regulated with high accuracy by means of a PID algorithm on the reactor and a tap changer (OLTC) on the primary side of transformer.

2.1 – Dip-switches configuration



Selected values in underlined Bold; Unused inputs in gray.

DS1	1	2	Scale

DS2	1	2	Scale
	off	off	30mAcc
	off	on	60mAcc
	on	**off**	**20mAcc**
	on	on	35mAcc

DS3	1	2	Scale
	off	off	30mAcc
	off	on	60mAcc
	on	**off**	**20mAcc**
	on	on	35mAcc

DS4	1	2	Scale

DS5	1	2	Scale

DS6	1	2	Scale
	off	off	30mAcc
	off	on	60mAcc
	on	**off**	**20mAcc**
	on	on	35mAcc

DS7	1	2	Scale

DS8	1	2	Scale

DS9	1	2	Scale

Please, make electric connections in conformity with the diagram reported on Regulator's enclosure.

2.2 - Power Supply

The auxiliary power is supplied by a built-in module fully isolated an self protected.

Two options are available:

a) - { 24V(-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 energising the unit, check that the supply voltage is within the allowed limits.

2.2 - Operation and Algorithms

2.2.1 - Reference Input Values

Hidden Parameters (reserved for service installation)						
IN2	*45.0*	***kA***	*Primary nominal value*	*0 - 99.9*	*0.1*	*kA*
IN2	*20.00*	***mA***	*Secondary nominal value*	*0 - 99.99*	*0.01*	*mA*
IN2	*0.0*	***kA***	*Primary start scale*	*0 - 99.9*	*0.1*	*kA*
IN2	*4*	***mA***	*Secondary start scale*	*0 - 9999*	*0.01*	*mA*
IN2	*20.00*	***mA***	*DRP-2R Input full scale*	*0 - 99.99*	*0.01*	*mA*
IN3	*45.0*	***kA***	*Primary nominal value*	*0 - 99.9*	*0.1*	*kA*
IN3	*20.00*	***mA***	*Secondary nominal value*	*0 - 99.99*	*0.01*	*mA*
IN3	*0.0*	***kA***	*Primary start scale*	*0 - 99.9*	*0.1*	*kA*
IN3	*4*	***mA***	*Secondary start scale*	*0 - 9999*	*0.01*	*mA*
IN3	*20.00*	***mA***	*DRP-2R Input full scale*	*0 - 99.99*	*0.01*	*mA*
IN6	*45.0*	***kA***	*Primary nominal value*	*0 - 99.9*	*0.1*	*kA*
IN6	*20.00*	***mA***	*Secondary nominal value*	*0 - 99.99*	*0.01*	*mA*
IN6	*0.0*	***kA***	*Primary start scale*	*0 - 99.9*	*0.1*	*kA*
IN6	*4*	***mA***	*Secondary start scale*	*0 - 9999*	*0.01*	*mA*
IN6	*20.00*	***mA***	*DRP-2R Input full scale*	*0 - 99.99*	*0.01*	*mA*

2.2.3 - Functions and Settings

2.2.3.1 – **PID_I** (PWM Regulator settings)

FuncEnab	→		No Parameters		[Disable / Enable]				
Options	→		An_I		[An_I / Rem] Reference input				
Settings	→	**K_P**	0.00		(0.00 ÷ 300.00)	step	0.01		
	→	**K_I**	1.00		(0.00 ÷ 300.00)	step	0.01		
	→	**K_D**	0.00		(0.00 ÷ 300.00)	step	0.01		
	→	***Tr***	1.00	**s**	(0.00 ÷ 100.00)	step	0.1	s	

Timers	→	**Ts**	5	**s**	(0.00 ÷ 300.00)	step	0.1	s

	Options	:	An_I: Field Ref.; Rem: Network Ref.

	K_P	:	Proportional gain
	K_I	:	Integrative gain
	K_D	:	Derivative gain

	Ts	:	PWM ON/OFF waiting timer
	Tr	:	Reference Ramp Rise/Fall time

2.2.3.2 - **Test** (Regulator test)

FuncEnab	→		No Param		No Parameters				
Options	→	**Tst**	Disab		[Disable / L_Ref / PWM_Val]				
TripLev	→	**L_RIF**	0.00	**%**	(0.0 ÷ 200)	step	1	%	
	→	**P_PWM**	50.00	**%**	(0.0 ÷ 100)	step	1	%	
Timers	→		No Param		No Parameters				

	Tst	:	*Test*	:	*Disable*	: Test Disable
					L_Ref	: Local Reference
					PWM_Val	:
	L_RIF	:	*Closed loop test*	:	When test is enabled, Regulator ignores any reference input; the value L_RIF can be adjusted through the keyboard or via serial communication.	
	P_PWM	:	*Open loop test*	:	When test is enabled, with this option regulator ignores the reference inputs and the feedback from the field; PWM output is direct controlled according to this value, adjusted through the local interface (panel or serial).	

2.2.3.3 – ***OLTC*** *(Step regulator settings)*

FuncEnab	→		Disab		[Disable / Enable]			
Options	→		No Param		No Parameters			
Settings	→	**SL_P**	90	**%**	(55 ÷ 99)	step	1	%
	→	**SL_N**	10	**%**	(1 ÷ 45)	step	1	%
Timers	→	**T0**	5	**s**	(1.00 ÷ 10.00)	step	0.1	s
	→	***T1***	1	**s**	(0.5 ÷ 2.00)	step	0.1	s
	→	***T2***	10	**s**	(1.00 ÷ 20.00)	step	1	s

	SL_P	:	PWM Positive saturation threshold (Livsat+)
	SL_N	:	PWM Negative saturation threshold (Livsat-)
	T0	:	Saturation (SL_P and SL_N) length discrimination Timer
	T1	:	ON duration of relays 1.R3 and 1.R4
	T2	:	Waiting timer after T1

2.2.3.4 – ***TH_F*** *- (TH_Fault - Digital alarm from bridge controller)*

FuncEnab	→		Enable		[Disable / Enable]
Options	→		No Param		No Parameters
TripLev	→		No Param		No Parameters
Timers	→		No Param		No Parameters

FuncEnab : When disable the function is deactivated

TH Fault Trips when	:	*Digital Input 0.D1*	=	Is not supplied (OFF)
When the function is tripped	:	*PWM Regulator*	=	Is Blocked
		Signalization	=	Led “TRIP” is illuminated
		Last Trip	=	Is recorded
Reset when	:	*Digital Input 0.D1*	=	Returns in normal condition.

2.2.3.5 – ***I_max*** *- (Digital alarm from bridge controller)*

FuncEnab	→		Enable		[Disable / Enable]
Options	→		No Param		No Parameters
TripLev	→		No Param		No Parameters
Timers	→		No Param		No Parameters

	FuncEnab	:	When “disable” the function is deactivated

Trip when	:	*Digital Input 0.D2*	=	Not supplied (OFF)
When the function is tripped	:	*PWM Regulator*	=	Is Blocked
		Signalization	=	Led “TRIP” is illuminated
		Last Trip	=	Is recorded
Reset when	:	*Digital Input 0.D2*	=	Returns in normal condition

2.2.3.6 – ***I>>*** - *Overcurrent protection 2*

FuncEnab	→		Disable		[Disable / Enable]			
Options	→		No Param		No Parameters			
TripLev	→	***I>>***	2	**In**	(0.80 ÷ 3)	step	0.1	In
Timers	→	***tI>>***	0.00	**s**	(0.00 ÷ 99.90)	step	0.1	s

	FuncEnab	:	When “disable” the function is deactivated
	I>>	:	Trip level
	tI>>	:	Trip time delay

Trip when	:	The overcurrent trip level I>> is exceeded for time tI>>			
When the function is tripped	:	*PWM Regulator*	=	Goes to zero (50%) immediately	
		Signalization	=	Led “Trip” is illuminated and 1.R2 is activated	
		Last Trip	=	Recording	
Reset when	:	Returns in normal condition and Reset push-button is pressed			

2.2.3.7 - ***Osc*** - *Oscillographic Recording*

FuncEnab	→		Disable		[Disable / Enable]			
Options	→	**Trg**	Disable		[Disable / Start / Trip / Ext.Inp / DRPStar]			
TripLev	→		No Param		No Parameters			
Timers	→	**tPre**	5.00	**s**	(0.50 ÷ 10.00)	step	0.1	s
	→	**tPost**	10.00	**s**	(5.00 ÷ 30.00)	step	0.1	s

	FuncEnab	:	If disable the function is deactivated		
	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 1.D9 falls from supply (9V – 24V)
			DRPStar	=	Trigger on start of regulation (start command)
	tPre	:	Recording time before Trigger		
	tPost	:	Recording time after Trigger		

The “Osc” Function includes the waveform 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 can not 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).

2.2.3.8 - **LoadP** – Load Profile

FuncEnab	→		Disable		[Disable / Enable]			
Options	→		No Param		No Parameters			
TripLev	→		No Param		No Parameters			
Timers	→	***tLP***	1.00	**m**	(1.00 ÷ 650)	step	1	m

	FuncEnab	:	When disable the function is deactivated
	tLP	:	Scan time Every time the load current overcome 1%, Function records samples with a time of programmable scansion “tLP”.

2.2.3.9 - **IRF** - Internal Regulator Failure (Factory settled)

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

	Opz	:	The function IRF is permanent enabled; the variable “ Opz“ can be associated to the output relay R1 (Opz = TRIP) or not (Opz = NoTRIP). R1 is a normally energized relay; Independently by Opz, R1 ever trips when power supply falls.

2.2.3.10 - **LCD** – Display operation

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

	BkL	:	LCD Backlight is switched on when operating on Keyboard buttons; If BKL “on”, LCD backlight is permanent lighted.

2.2.3.11 - **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 interface Baud Rate setting (Front panel RS232 connector)
	RBd	:	Remote interface Baud Rate setting (Rear panel RS485 terminal blocks)
	Mod	:	Remote interface mode (communication parameters) **Note**: Any change of these settings become valid after the next power on
	RPr	:	Remote Protocol choice

*2.2.3.12 – **PWM locked** Function (Hidden - Factory settled)*

FuncEnab			→		No parameters		Enabled	
Options			→		No parameters			
Settings	→	***IoutP***			1		**%**	0,01In
Condition	→	***PWMlock***			(STOP)AND(IoutP tripped)AND(PWM1=0%)AND(PWM2=0%)		**false/true**	out on 1.R1

	FuncEnab	:	Permanent enabled
	IoutP	:	Threshold of “zero” measure

PWMLock Trips when	:	Condition is TRUE		
When the function is tripped	:	*1.R1*	=	Energized
Reset when	:	START		

2.2.3.13 - Password

FuncEnab	→		No Param		No Parameters
Options	→		No Param		No Parameters
Settings	→		1111		0000 – 9999
Timers	→		No Param		No Parameters

	Settings	:	The Factory default password is 1111

3. OUTPUT RELAYS

Four user programmable Output Relays: 1.R1, 1.R2, 1.R3, 1.R4, are available on additional expansion module UX10-4, controlled via CAN-Bus. 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 De-energized (energized on tripping of the controlling Functional Element) or Normally Energized (De-energized on tripping of the controlling Functional Element). R1 relay is internally driven.

Available on the Regulator (Board 1)					
R1	Digital output R1	terminals 163, 183, 182	IRF / Imax / TH Fault	dual N.O.	Normally Energized

Available on the Expansion Module (UX10-4 – Board 2)					
1.R1	Digital output R1	terminals 288, 287,289	PWM Locked	dual N.O.	Settings are available on the interface program FriemCom
1.R2	Digital output R2	terminals 278, 277,279	Overload	dual N.O.	
1.R3	Digital output R3	terminals 268, 267,269	OLTC INC	changeover	
1.R4	Digital output R4	terminals 258, 257,259	OLTC DEC	changeover	

4. DIGITAL INPUT

The firmware can manage up to 12 digital inputs that are available on additional expansion module UX10-4, controlled via CAN-Bus.
Among these, 2 digital inputs, are available on the main regulator module.

Available on the Regulator (Board 1)				
0.D1	Digital Input “D1”	(terminals 177 - 179)	TH Fault input	(+15V off, 0V on)*
0.D2	Digital Input “D2”	(terminals 177 - 178)	Imax input	(+15V off, 0V on)*

Available on the Expansion Module (UX10-4 – Board 2) Settings are available on the interface program FriemCom				
1.D1	Digital Input “D1”	(terminals 252 – 262)	PWM INC	(+24V on, 0V off)*
1.D2	Digital Input “D2”	(terminals 253 – 263)	PWM DEC	(+24V on, 0V off)*
1.D3	Digital Input “D3”	(terminals 254 – 264)	AUT/MAN	(+24V on, 0V off)*
1.D4	Digital Input “D4”	(terminals 255 – 265)	Start / Stop	(+24V on, 0V off)*
1.D5	Digital Input “D5”	(terminals 256 – 266)	Available	(+24V on, 0V off)*
1.D6	Digital Input “D6”	(terminals 272 – 282)	OLTC INC	(+24V on, 0V off)*
1.D7	Digital Input “D7”	(terminals 273 – 283)	OLTC DEC	(+24V on, 0V off)*
1.D8	Digital Input “D8”	(terminals 274 – 284)	Available	(+24V on, 0V off)*
1.D9	Digital Input “D9”	(terminals 275 – 285)	Oscillographic trigger	(+24V on, 0V off)*
1.D10	Digital Input “D10”	(terminals 276 – 286)	Available	(+24V on, 0V off)*

Note: *= external supplied Digital Inputs.

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.)
	Led lamps test (only on manual test).
	I/O board supervision (CANBus)

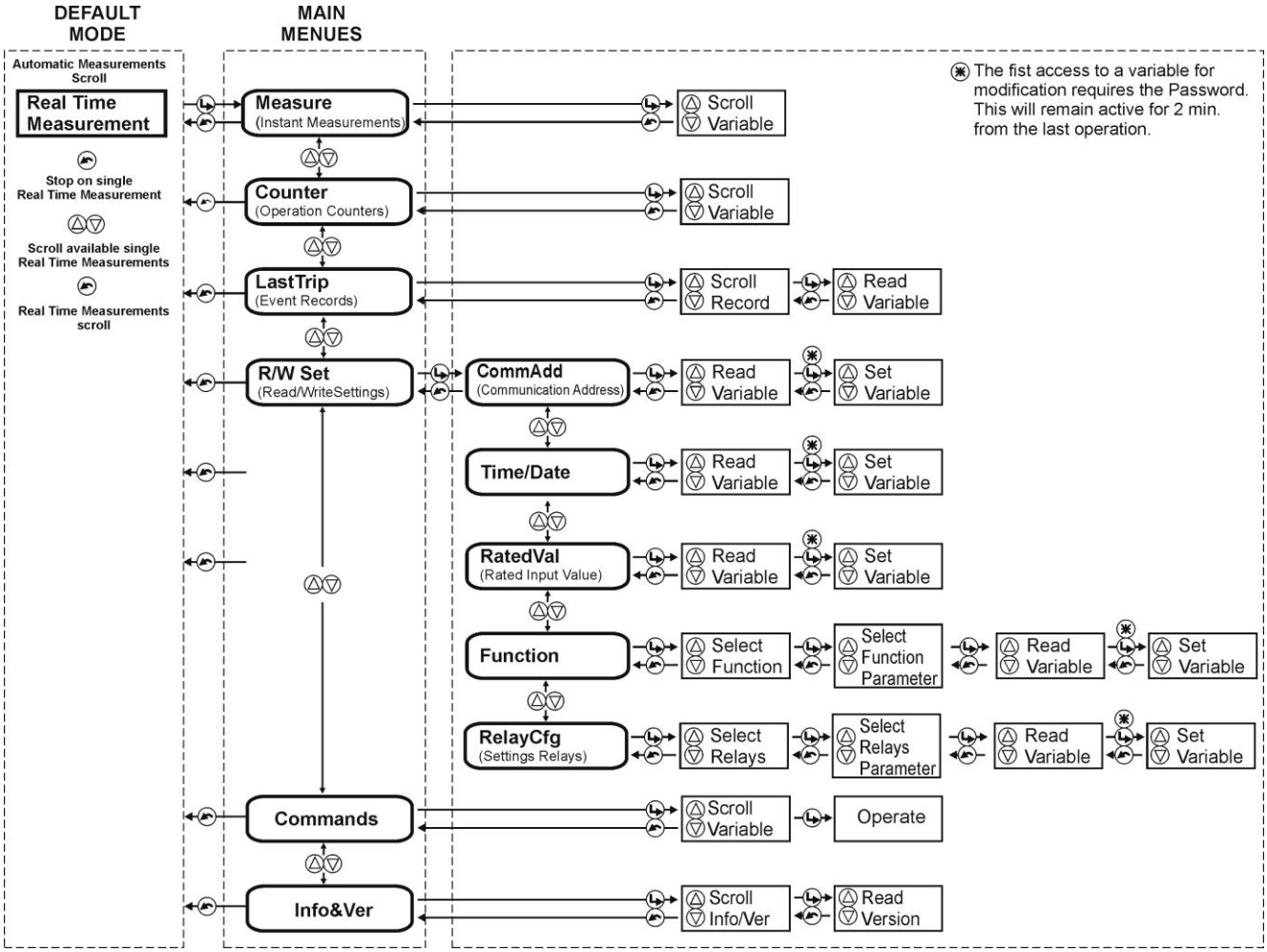
Any time Power is switched on, a complete test is run; then, during normal operation, some tests are running continuously; checksum is calculated each time a parameter is stored into permanent memories. If during the test something wrong is detected:

	If " I.R.F. " is programmed to " Trip ", the output relay R1 is operated. Event is stored in the " Last Trip " buffer; the signal led "ON " 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, regulator is blocked and IRF relay isn't operated. Due to the state of R1, normally energized, in case of lack of power supply this relay trips all the same.

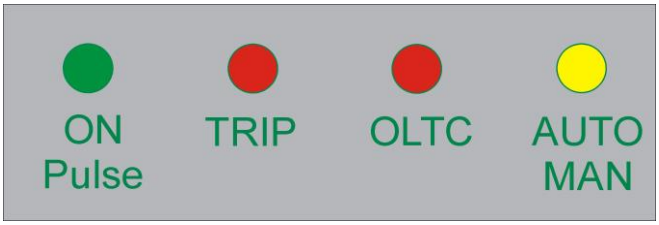
6. REGULATOR MANAGEMENT

The regulator can be managed locally, either by the RS232 communication port or by the 4 key buttons and the LCD display. The regulator is also managed via the communication bus RS485 at the rear terminal blocks. The 2 line x 8 characters LCD display shows the available information.
Key buttons operate according to 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 regulation is active.
				Lit up	:	When regulation is stopped.
b)	Red LED	**TRIP**		Off	:	Normal status
				Flashing	:	When a timed function starts to operate.
				Lit up	:	When any protection function trips. (Blocking or Stopping the regulator).
c)	Red LED	**OLTC**		Off	:	OLTC is inactive
				Flashing	:	OLTC is in T2 state
				Lit up	:	OLTC is in T0-T1 state
d)	Yellow LED	**AUTO MAN**		Off	:	DRP-2R is in Manual state
				Flashing	:	Simultaneous reference active (only in AUTO mode)
				Lit up	:	DRP-2R is in Automatic state

8. KEYBOARD

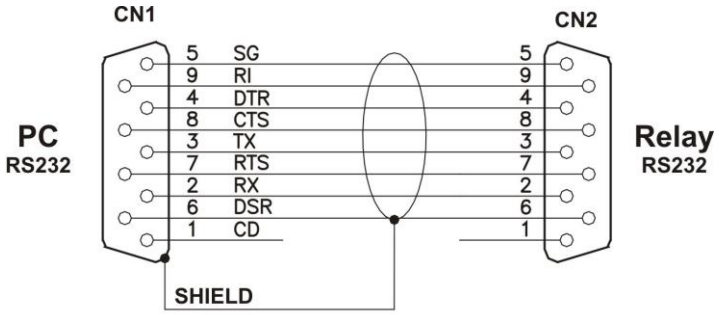
	Enter	Give access to any menu or validates any programming change.
	Reset	Return from the actual selected menu to the former menu.
	Select +	Scrolls variables available in the different menus or increases/decreases setting values.
	Select -	

9. SERIAL COMMUNICATION PORTS

9.1 - Communication Port on Front Face Panel

This port is used for LOCAL communication, typically with a 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.



9.2 - Main RS485 Serial Communication Port

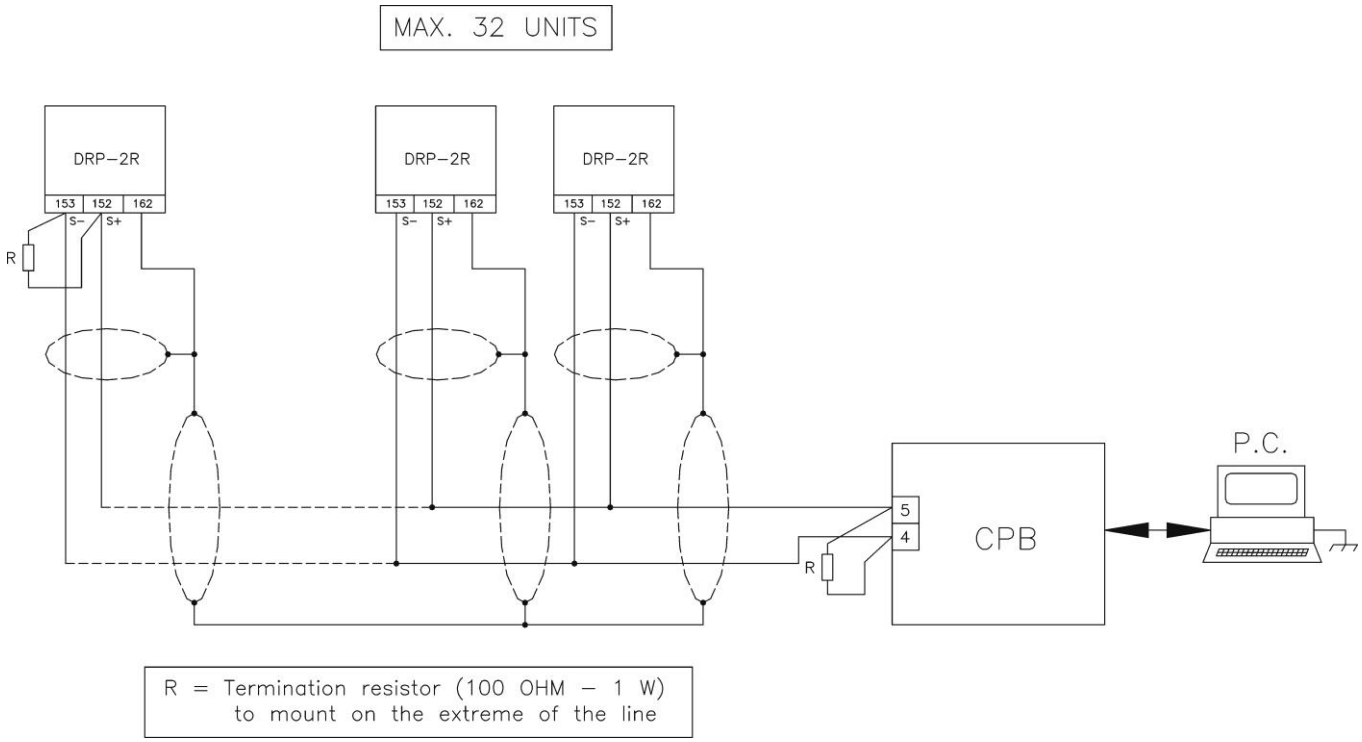
This port is accessible via the terminals 152 – 153, that are provided on the relay terminal blocks.
When connected to CPB interface, CPB is supplied by terminal blocks 165 (+) and 164 (-).
Pin 164 is connected together pin 162, the common reference of serial link.
CPB interfaces up to 31 DRP units with the Central Supervision System (SCADA, DCS…) by means of Profibus protocol.
The serial bus of DRP-2R is linked with a shielded twisted pair cable to the CPB unit.
RS485 is the physical link of DRP-2R and his Communication Protocol is MODBUS/RTU.
The configuration of transmission parameters is selectable as following:

	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 regulator is identified by its address code (NodeAd) and can be called from a P.C.
A proprietary communication software (FriemCom) is available for Windows based machines.
Please refer to the FriemCom instruction manual for more information.
Maximum length of the serial bus can be up to 200m, when correctly linked and terminated.

9.2.1 - Termination resistor



10. MENU AND VARIABLES

10.1 - Real Time Measurements

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;
The different available measurements can be selected by the △▽ buttons.

Display					Description
R_R	Remote Reference	=	0 – 999.9	%	Remote Reference
R_A	Single Ref	=	0 – 999.9	kA	Stand alone Regulation set point
R_B	Simultaneous Ref	=	0 – 999.9	kA	Shared Regulation set point
FDB	I feedback	=	0 – 999.9	kA	Load Current (DC mean value)
PWM	PWM output	=	0 – 999.9	%	Output state

10.2 - Measure (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	△▽	other measurements
-	↶	to go back to " Meas "		

Display					Description
R_R	Remote Reference	=	0 – 999.9	%	Remote Reference
R_A	Single Ref	=	0 – 999.9	kA	Stand alone Regulation set point
R_B	Simultaneous Ref	=	0 – 999.9	kA	Shared Regulation set point
FDB	I feedback	=	0 – 999.9	kA	Load Current (DC mean value)
PWM	PWM output	=	0 – 999.9	%	Output state

10.3 - Counter (Operation Counters)

Each counter stores total operations number of related function.

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

Display			Description
Oinc	=	0 - 65535	Number of increments of OLTC
Odec	=	0 - 65535	Number of decrements of OLTC
TH_F	=	0 – 65535	Number of TH faults
Imax	=	0 – 65535	Number of Imax faults
I>>	=	0 – 65535	Number of 2nd Overcurrent protection element trip
IRF	=	0 – 65535	Number of Internal Faults
HR	=	0 – 65535	Number of HW recovery operations

10.4 – Last Trip (Event Recorder)

The regulator 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;		
-	↶	to go back to " Rec # ",		
-	↶	to go back to " Real Time Meas ".		

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:			
				-	**I>>**	=	Overcurrent protection
				-	**Imax**	=	Input signal from Reactor IGBT Driver
				-	**TH_F**	=	Input signal from Reactor IGBT Driver
				-	**IRF**	=	Internal regulator fault
Date	=	YYYY/MM/GG		Date: Year/Month/Day			
Time	=	hh:mm:ss:cc		Time: hours/minutes/second/hundredths of seconds			
R_R	=	0 – 999.9	**%**	Remote Reference			
R_A	=	0 – 999.9	**kA**	Stand alone Regulation set point			
R_B	=	0 – 999.9	**kA**	Shared Regulation set point			
FDB	=	0 – 999.9	**kA**	Load Current (DC mean value)			
PWM	=	0 – 999.9	**%**	Output state			

10.5 - R/W Set (Programming / Reading Settings)

-	↳	" Main Menu "		
-	△▽	select " Function "	↳	
-	△▽	select among following sub menus:		

10.5.1 - CommAdd (Communication Address setting)

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

10.5.2 - 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		

10.5.3 - 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!

10.5.4 – Functions

-	△▽	" Function ",		
-	↳	1st function,		
-	△▽	to scroll available Functions,		
-	↳	to Read/Write setting of the selected function,		
-	△▽	to select the different definable fields	FuncEnab	TripLev
			Options	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!	

10.6 - Info&Ver

The menu displays the Regulator 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 "		

10.7 - 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 and select “Link”. The list of the available functions is displayed. Scrolling the list by the “+” and “-“ keys, the function is selected and than assigned by the key “Enter”. The assignation is confirmed by the function indication that change from blinking to steady.
Any of the Output Relays operation mode can be programmed in two different modes:

N.D. Normally De-energized Relay is energized on trip of the associated functions
N.E. Normally Energized Relay is de-energized on trip of the associated functions

10.7.1 - Programming Table

Relay on DRP-2R

Display				Description	Setting Range	Step
Relay	Type		Default Value			
R1	Link	→	TH_Faul, I_max, IRF,	Association of functions with output relay R1	Test, OLTC_INC, OLTC_DEC, PosSat, NegSat, TH_F, I_max, I>>, tI>>, IRF, HwRecov, PWM_Loc, AUTO, OL_Cans.	-
	OpMode	→	N.D.	N.D. (Normally De-energized) N.E. (Normally Energized)	N.D./N.E.	-

Relays on UX10-4

Display				Description	Setting Range	Step
Relay	Type		Default Value			
1.R1	Link	→	PWM Loc	Association of functions with output relay 1.R1	Test, OLTC_INC, OLTC_DEC, PosSat, NegSat, TH_F, I_max, I>>, tI>>, IRF, HwRecov, PWM_Loc, AUTO, OL_Cans.	-
	OpMode	→	N.D.	N.D. (Normally De-energized) N.E. (Normally Energized)	N.D./N.E.	-
1.R2	Link	→	tI>>	Association with functions to output relay 1.R2	Test, OLTC_INC, OLTC_DEC, PosSat, NegSat, TH_F, I_max, I>>, tI>>, IRF, HwRecov, PWM_Loc, AUTO, OL_Cans.	-
	OpMode	→	N.D.	N.D. (Normally De-energized) N.E. (Normally Energized)	N.D./N.E.	-
1.R3	Link	→	OLTCInc	Association with functions to output relay 1.R3	Test, OLTC_INC, OLTC_DEC, PosSat, NegSat, TH_F, I_max, I>>, tI>>, IRF, HwRecov, PWM_Loc, AUTO, OL_Cans.	-
	OpMode	→	N.D.	N.D. (Normally De-energized) N.E. (Normally Energized)	N.D./N.E.	-
1.R4	Link	→	OLTCDec	Association with functions to output relay 1.R4	Test, OLTC_INC, OLTC_DEC, PosSat, NegSat, TH_F, I_max, I>>, tI>>, IRF, HwRecov, PWM_Loc, AUTO, OL_Cans.	-
	OpMode	→	N.D.	N.D. (Normally De-energized) N.E. (Normally Energized)	N.D./N.E.	-

Test	:	Regulator Test
OLTCInc	:	OLTC Increment
OLTCDec	:	OLTC Decrement
PosSat	:	Positive saturation
NegSat	:	Negative saturation
TH_F	:	Digital alarm from bridge controller (TH_Fault)
I_max	:	Digital alarm from bridge controller
I>>	:	Overcurrent Protection 2 (Start)
tI>>	:	Overcurrent Protection 2 (Trip)
IRF	:	Internal regulator fault
HWRecov	:	Hardware recovery
PWM_Loc	:	PWM Locked
AUTO	:	Automatic position of regulator
OL_Cans	:	CanBus fault

10.8 – Remote and local 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 (only when start digital input 1.D4 is supplied)
Start	:	Start regulation (only when start digital input 1.D4 is supplied)
Simul	:	Set Regulator on "Simultaneous" Reference
Single	:	Set Regulator on "Single" Reference
PWM_inc	:	Increases PWM output by one step (only in Manual mode)
PWM_dec	:	Decreases PWM output by one step (only in Manual mode)
OLTC_inc	:	Cause one pulse of relay 1.R3 (only in Manual mode)
OLTC_dec	:	Cause one pulse of relay 1.R4 (only in Manual mode)
Auto	:	Set Regulator in Automatic mode
Man	:	Set Regulator in Manual mode

These are a minimal set available on front panel interface.
MS-Com interface could provide a broader set of commands and signals.

*10.8.1 – **RESET** – Command*

Inputs	→		No param		No Parameters (Local interface)
Options	→		No Param		No Parameters
Function	→		Cancel Trips		No Parameters
Timers	→		No Param		No Parameters

	Function	:	When Reset is issued, all trips are cancelled and signalizations go out. This command could be also received from local serial link.

*10.8.2 – **CLEAR** – Command*

Inputs	→		No param		Local interface
Options	→		No Param		No Parameters
Function	→		Erase events and counters		No Parameters
Timers	→		No Param		No Parameters

	Function	:	When Clear is issued, the story of regulator is erased. This command could be also received from local serial link.

*10.8.3 – **TEST** – Command*

Inputs	→		No param		Local interface
Options	→		No Param		No Parameters
Function	→		Active leds and display		No Parameters
Timers	→		No Param		No Parameters

	Function	:	When Test is issued, local interface is tested. This command could be also received from local serial link.

*10.8.4 – **START / STOP** – Command and functions*

Inputs	→		No param		Input 1.D4; Serial link; Local interface
Options	→		STOP		[START / STOP]
Function	→		Start and enable serial commands		No Parameters
Timers	→		Debounce		Fixed 100ms on digital inputs

	Function	:	When input 1.D4 is supplied, Regulation is active; in this status, start/stop commands could be also received from serial link or local interface. When input 1.D4 isn't supplied or left open, regulator is permanently stopped; commands from serial link or local interface are ignored.

*10.8.5 – **AUT / MAN** – Command and functions*

Inputs	→		No param		Input 1.D3; Serial link; Local interface
Options	→		MAN		[AUT / MAN]
Function	→		Set operating modes		No Parameters
Timers	→		Debounce		Fixed 100ms on digital inputs

	Function	:	When input 1.D3 is supplied, Regulator is in AUTO state. AUT/MAN commands could be also received, in any state, from serial link or local interface.

*10.8.6 – **SIMULTANEOUS/SINGLE** – Command*

Inputs	→		No param		Input 1.D8; Serial link; Local interface
Options	→		SINGLE		[SIMULTANEOUS / SINGLE]
Function	→		Select reference reading		No Parameters
Timers	→		Debounce		Fixed 100ms on digital inputs

	Function	:	When input 1.D8 is supplied, SIMULTANEOUS reference is read. SIMULTANEOUS/SINGLE commands could also be received, in any state, from serial link or local interface.

*10.8.7 – **PWM INC** – Command and functions*

Inputs	→		No param		Input 1.D1; Serial link; Local interface
Options	→		No Param		No Parameters
Function	→		Increase PWM		No Parameters
Timers	→		No Param		No Parameters

	Function	:	When input 1.D1 is supplied command is acknowledged. This command could be also received from serial link or local interface. This command increase PWM for a step.

*10.8.8 – **PWM DEC** – Command and functions*

Inputs	→		No param		Input 1.D2; Serial link; Local interface
Options	→		No Param		No Parameters
Function	→		Decrease PWM		No Parameters
Timers	→		No Param		No Parameters

	Function	:	When input 1.D2 is supplied command is acknowledged. This command could be also received from serial link or local interface. This command Decrease PWM for a step.

*10.8.9 – **OLTC INC** – Command*

Inputs	→		No param		Input 1.D6; Serial link; Local interface
Options	→		No Param		No Parameters
Function	→		Drives 1.R3		No Parameters
Timers	→		T0		Defined in OLTC function

	Function	:	When input 1.D6 is supplied command is acknowledged. In MAN state 1.R3 is energized for T0 time. This command could be also received from serial link or local interface.

*10.8.10 – **OLTC DEC** – Command*

Inputs	→		No param		Input 1.D7; Serial link; Local interface
Options	→		No Param		No Parameters
Function	→		Drives 1.R4		No Parameters
Timers	→		T0		Defined in OLTC function

	Function	:	When input 1.D7 is supplied command is acknowledged. In MAN state 1.R4 is energized for T0 time. This command could be also received from serial link or local interface.

11. 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 all the first times you enter the “Settings” and/or “Commands” menus.
The “password” remains valid for 2 minutes from the last operation of the programming buttons or decay when 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.

11.1 - MS-Com Password

This password is requested anytime the user wants to send to the regulator a setting parameters modification or to issue a command to the regulator itself. The user can decide whether inserting his password (see MS-Com Operational Manual) or disabling the password just clicking on the OK button when the password is requested.

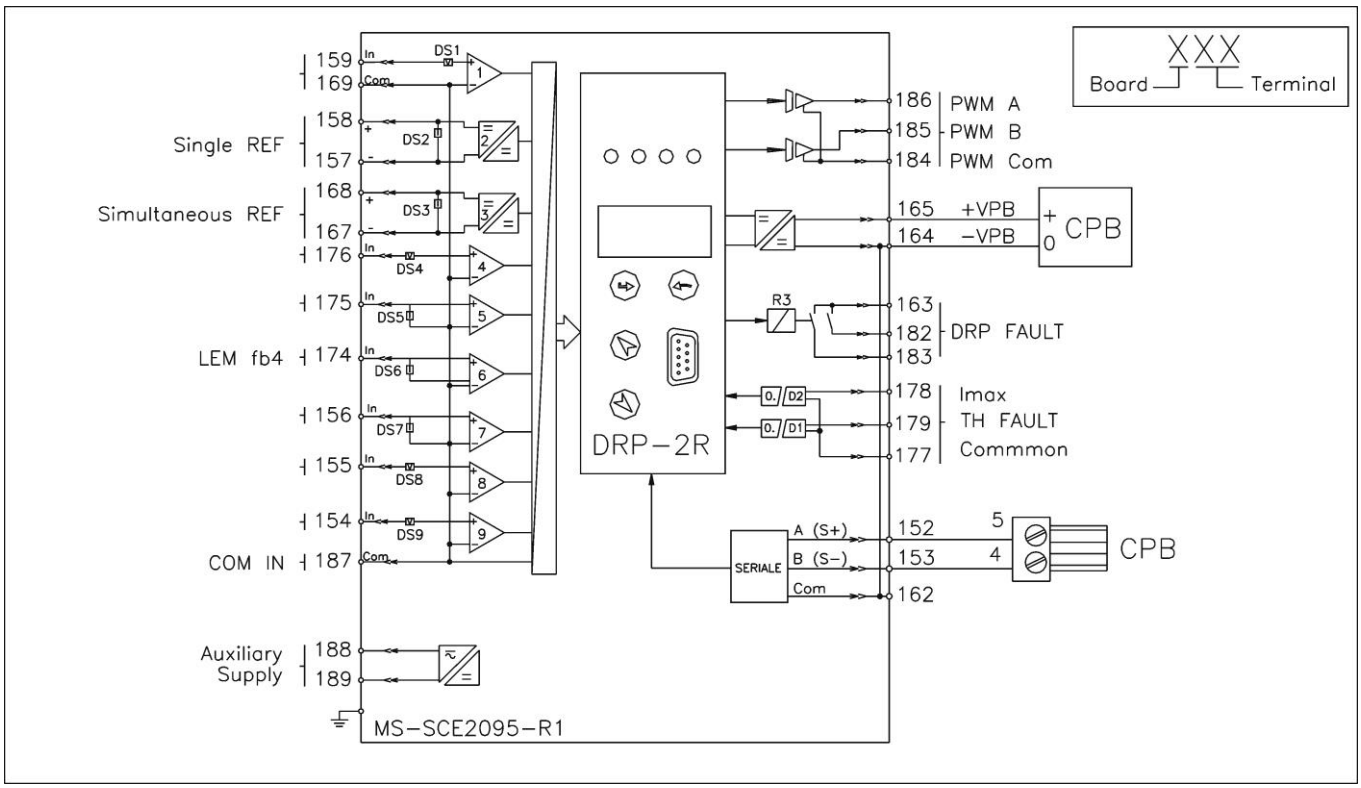
12. MAINTENANCE

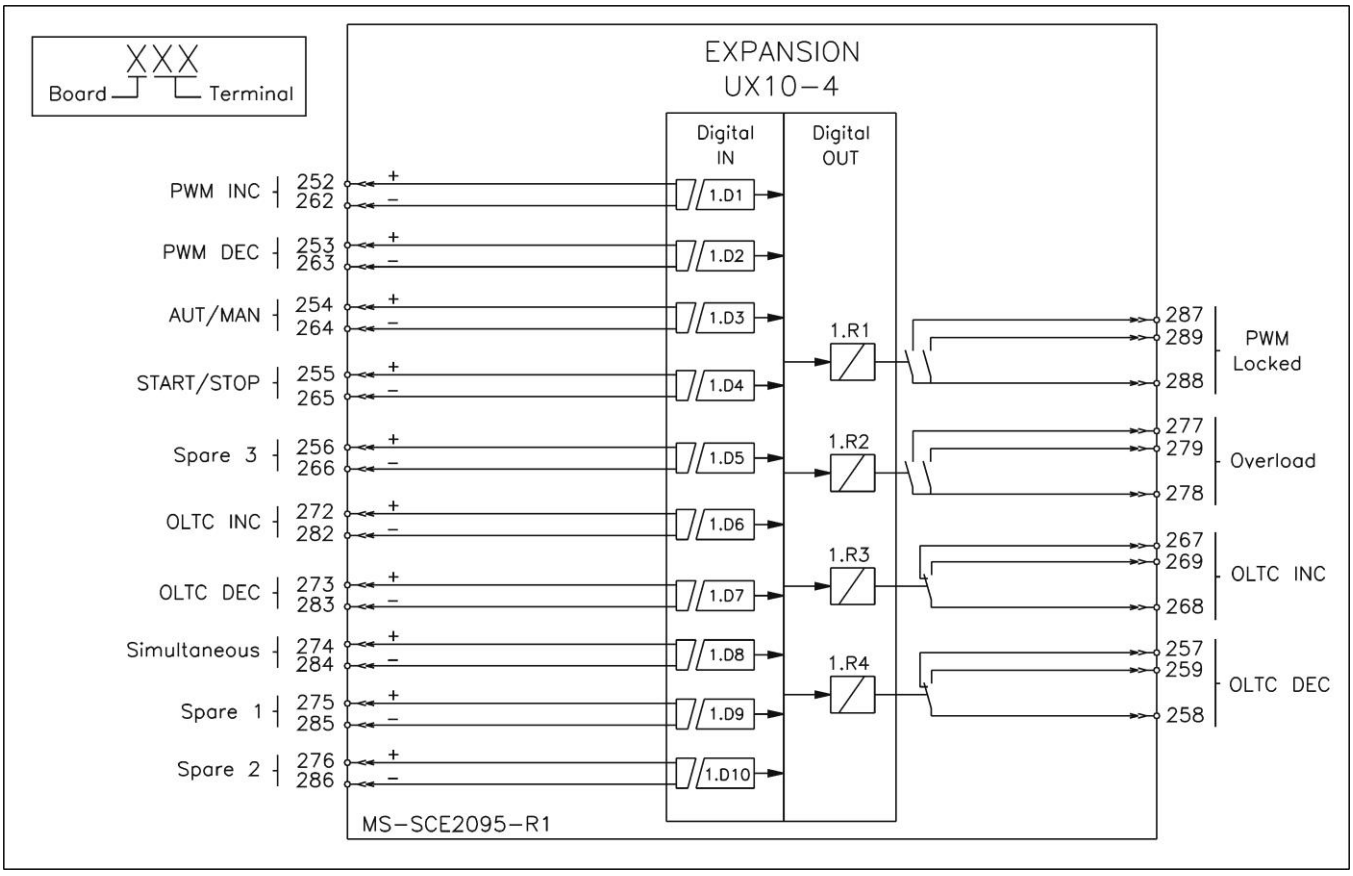
No maintenance is required. In case of malfunctioning please contact FRIEM Service or the local Authorised Dealer mentioning the Regulator's Serial No reported in the label on Regulators enclosure.

13. POWER FREQUENCY INSULATION TEST

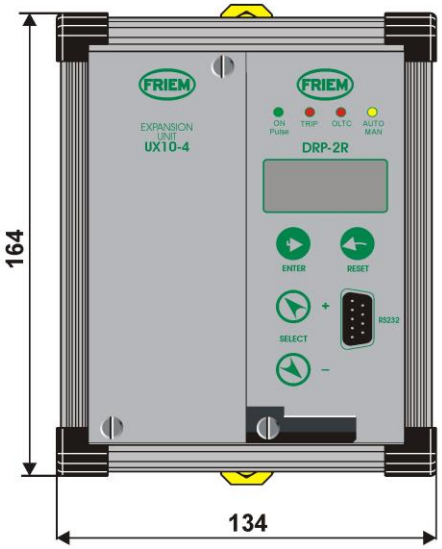
Each regulator undergoes a factory insulation test according to IEC255-5 standard at levels of 2 kV, 50 Hz 1min. Insulation test at these levels shouldn’t be repeated as it unsafely stresses the dielectrics.
When doing the insulation test, the terminal blocks relevant to serial output, analogue inputs and RTD input must always be short circuited to ground. When regulators are mounted on switchboards or Regulator boards that have to undergoing the insulation tests, the regulator should be isolated.
This is extremely important, because discharges eventually taking place in other parts, could severely damage the regulator or could cause damages to the electronic components.

14. WIRING DIAGRAM

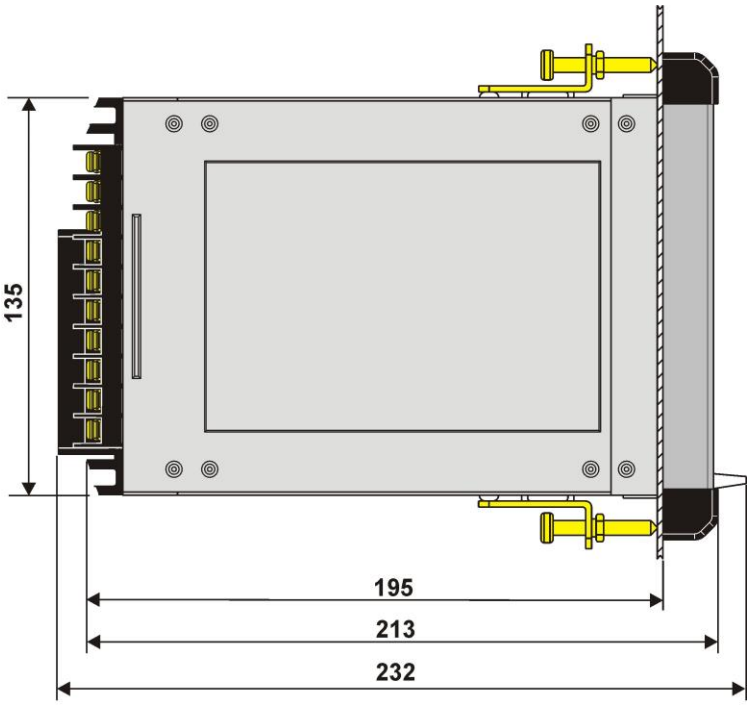


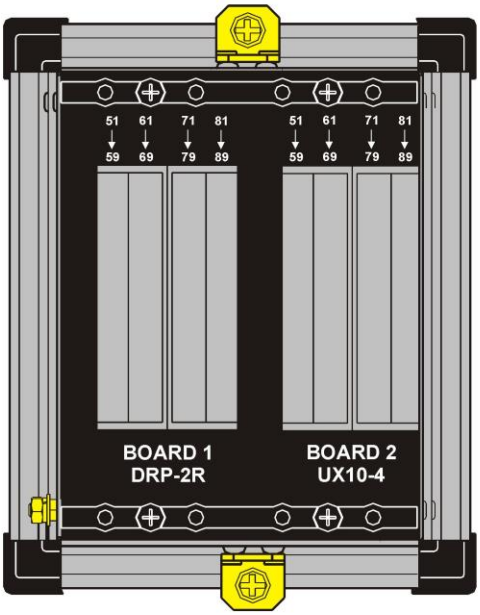


15. OVERALL DIMENSIONS (mm)



PANEL CUT-OUT
115x137 (LxH)





VIEW OR REAR - TERMINAL CONNECTION

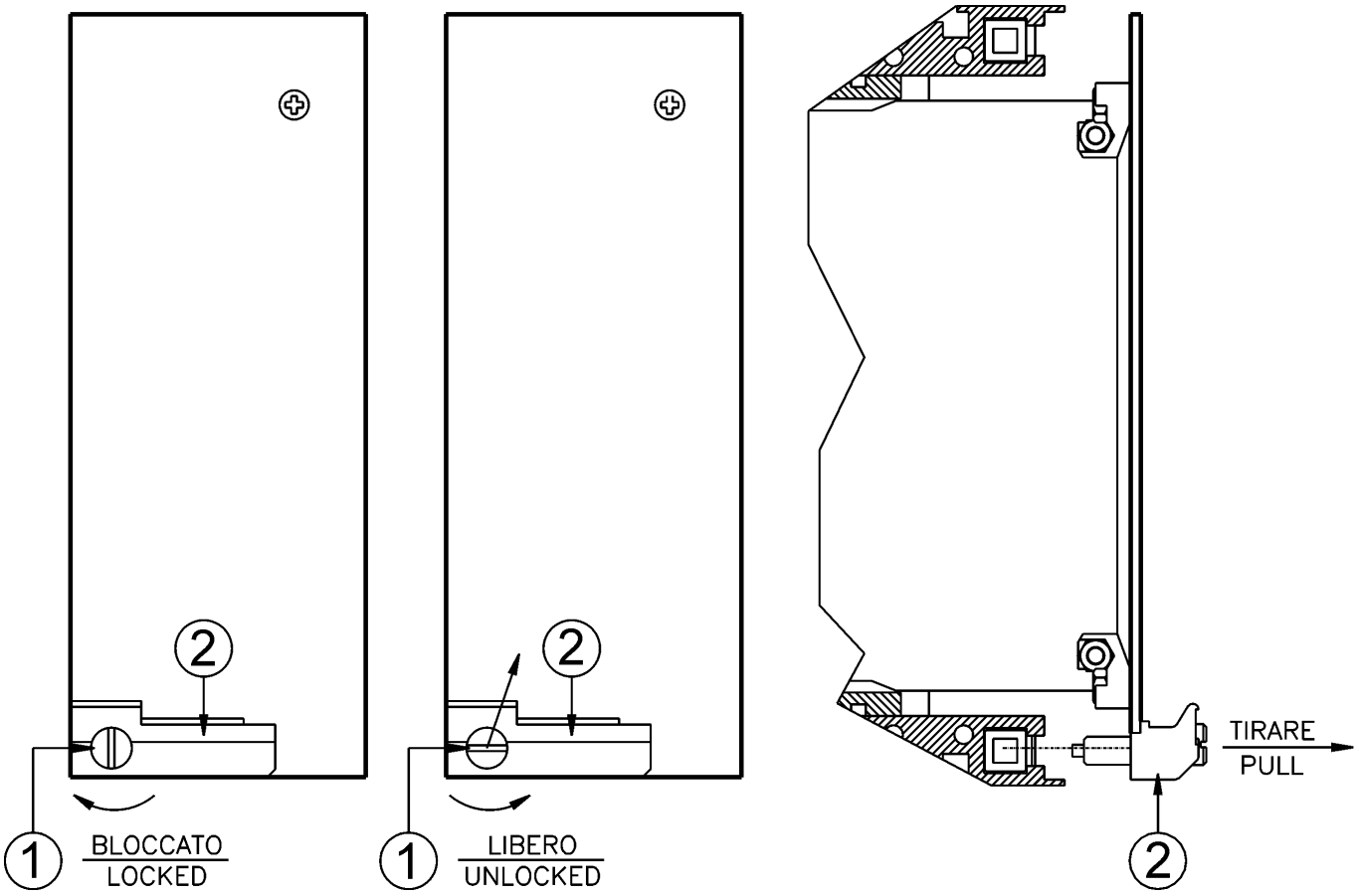
16. DIRECTION FOR PCB'S DRAW-OUT AND PLUG-IN

16.1 - 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

16.2 - 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).



17. 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 at nominal value		<0.5% F.s.	Feedback dc current (Chopper Iout A and B)		
		<0.5% F.s.	Voltage dc bus (Vbus dc)		
		<0.5% F.s..	Voltage dc output (Chopper Vout)		
		<0.5% F.s..	Cooling water Temperature (Temperature)		
		2% + to (to=20÷30ms @ 2xIs)	for time		
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			

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