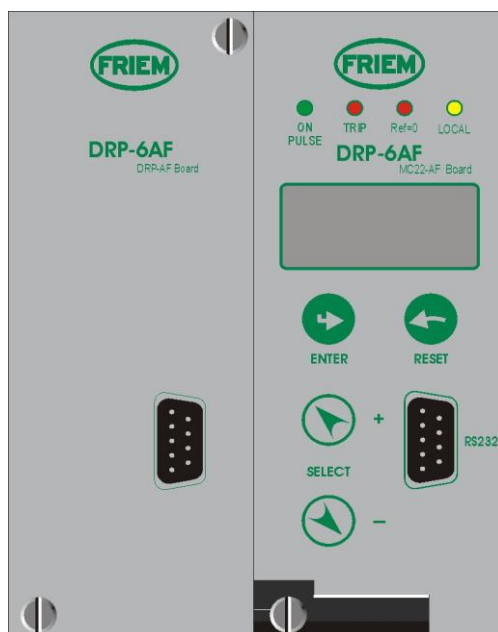


THREE PHASE
SCR
RECTIFIER REGULATOR FOR ARC FURNACE

OPERATION MANUAL
TYPE

DRP6-AF



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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 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.

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.

3 user programmable Output Relays.

5 optoisolated Digital Inputs.

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

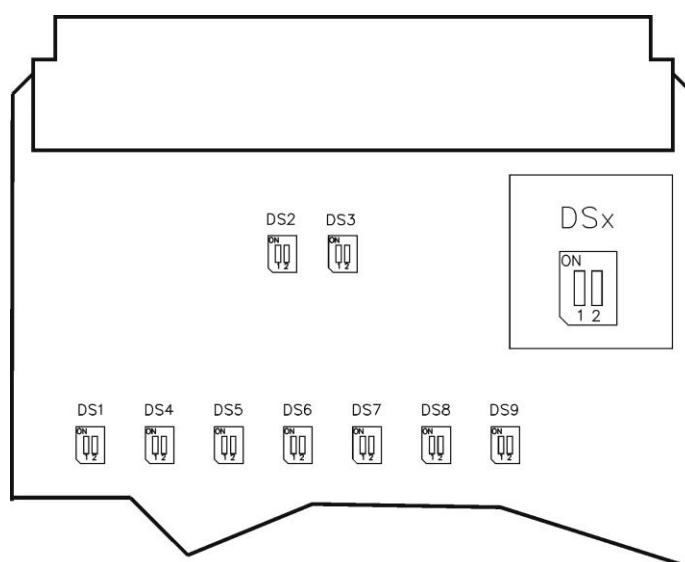
The device is made for control three phase SCR Rectifier Regulator for ARC FURNACE.

The output current can be very quickly regulate trough two PID algorithm;

In addition is available a threshold of current limitation that can work in parallel to the PIDs.

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

2.1 – Configuration Dip-switch



	1	2	Scale		1	2	Scale		1	2	Scale
DS1 (IN1)	off	off	120Vac	DS2 (IN2)	off	off	30mAcc	DS3 (IN3)	off	off	30mAcc
	off	on	150Vac		off	on	60mAcc		off	on	60mAcc
	on	off	67.5Vac		on	off	20mAcc		on	off	20mAcc
	on	on	74Vac		on	on	35mAcc		on	on	35mAcc
DS4 (IN4)	off	off	1.5Vcc	DS5 (IN5)	off	off	1.5Vcc	DS6 (IN6)	off	off	30mAcc
	off	on	15Vcc		off	on	15Vcc		off	on	60mAcc
	on	off	not used		on	off	not used		on	off	20mAcc
	on	on	not used		on	on	not used		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

In Bold-underline default value

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

2.2 - Power Supply

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

Two options are available:

- | | | | | | | | |
|----|---|---|------------------------------------|----|---|---|------------------------------------|
| a) | - | { | 24V(-20%) / 110V(+15%) a.c. | b) | - | { | 80V(-20%) / 220V(+15%) a.c. |
| | | { | 24V(-20%) / 125V(+20%) d.c. | | | { | 90V(-20%) / 250V(+20%) d.c. |

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

2.3 - Operation and Algorithms

2.3.1 - Reference Input Values

Display		Description	Setting Range	Step	Unit
I1	1 kA	Rated Primary current of phase C.T.	1 - 400	0.01	kA
I2	5 A	Rated Secondary current of phase C.T.	1 - 5	1/5	A
In	1 kA	Reference primary current of the relay	1 - 400	0.01	kA
V1	10 kV	Rated Primary voltage of phase V.T.	0.05 - 500	0.01	kV
V2	500 V	Rated Secondary voltage of phase V.T.	50 - 115	0.01	V
Freq	50 Hz	System rated frequency	50 - 60	10	Hz

Hidden Parameters (reserved for service installation)

Note: The nominal parameter of the transducers connected to the regulator must be set via dedicated serial port available on DRP-AF board.

VFR	1000 V	"V" Ref. Primary value Transducer	0 - 9999	1	V
VFR	20 mA	"V" Ref. Secondary value Transducer	0 - 999.9	0.1	mA
VFR	0 V	"V" Ref. Primary Start scale	0 - 9999	1	V
VFR	0 mA	"V" Ref. Secondary Start scale	0 - 999.9	0.1	mA
VFR	20 mA	"V" Ref. Input end scale DRP-T	0 - 9999	1	mA
IFR	2.5 kA	"I" Ref. Primary value Transducer	0 - 400	0.01	kA
IFR	20 mA	"I" Ref. Secondary value Transducer	0 - 999.9	0.1	mA
IFR	0 kA	"I" Ref. Primary Start scale	0 - 400	0.01	kA
IFR	0 mA	"I" Ref. Secondary Start scale	0 - 999.9	0.1	mA
IFR	20 mA	"I" Ref. Input end scale DRP-T	0 - 999.9	0.1	mA
FBI	2.5 kA	"I" Fdb. Primary value Transducer	0 - 400	0.01	kA
FBI	4 -	"I" Fdb. Secondary value Transducer	0 - 999.9	0.1	-
FBI	0 kA	"I" Fdb. Primary Start scale	0 - 400	0.01	kA
FBI	0 -	"I" Fdb. Secondary Start scale	0 - 999.9	0.1	-
FBI	15 -	"I" Fdb. Input end scale DRP-T	0 - 999.9	0.1	-
FBI	2.5 kA	"I" Fdb. Base value	0 - 400	0.01	kA
FBV	1000 V	"V" Fdb. Primary value Transducer	0 - 9999	1	V
FBV	50 -	"V" Fdb. Secondary value Transducer	0 - 999.9	0.1	-
FBV	0 V	"V" Fdb. Primary Start scale	0 - 9999	1	V
FBV	0 -	"V" Fdb. Secondary Start scale	0 - 999.9	0.1	-
FBV	60 -	"V" Fdb. Input end scale DRP-T	0 - 999.9	0.1	-
FBV	1000 V	"V" Fdb. Base value	0 - 9999	1	V
IP	1 kA	"IP" Primary value Transducer	0 - 400	0.01	kA
IP	50 -	"IP" Secondary value Transducer	0 - 999.9	0.1	-
IP	0 kA	"IP" Primary Start scale	0 - 400	0.01	kA
IP	0 -	"IP" Secondary Start scale	0 - 999.9	0.1	-
IP	60 -	"IP" Input end scale DRP-T	0 - 999.9	0.1	-
IP	1 kA	"IP" Base value	0 - 400	0.01	kA

"**FBI – FBV**" = Input channels used for feedback are user selectable via parameters "FBI" and "FBV" (see hidden settings).

"**IP**" = Input channel used for protection is user selectable via parameters "IP - Select Input for Protection" (see hidden setting).

2.3.2 – Analog Inputs

Signals Input - MC22-AF (Board 0)

Current 1	(terminals 4 – 5)	Input Current 1	See § Wiring Diagram
Current 2	(terminals 4 – 6)	Input Current 2	
Voltage R	(terminals 7)	Input Voltage R	
Voltage S	(terminals 8)	Input Voltage S	
Voltage T	(terminals 9)	Input Voltage T	

Signals Input – DRP-AF (Board 1)

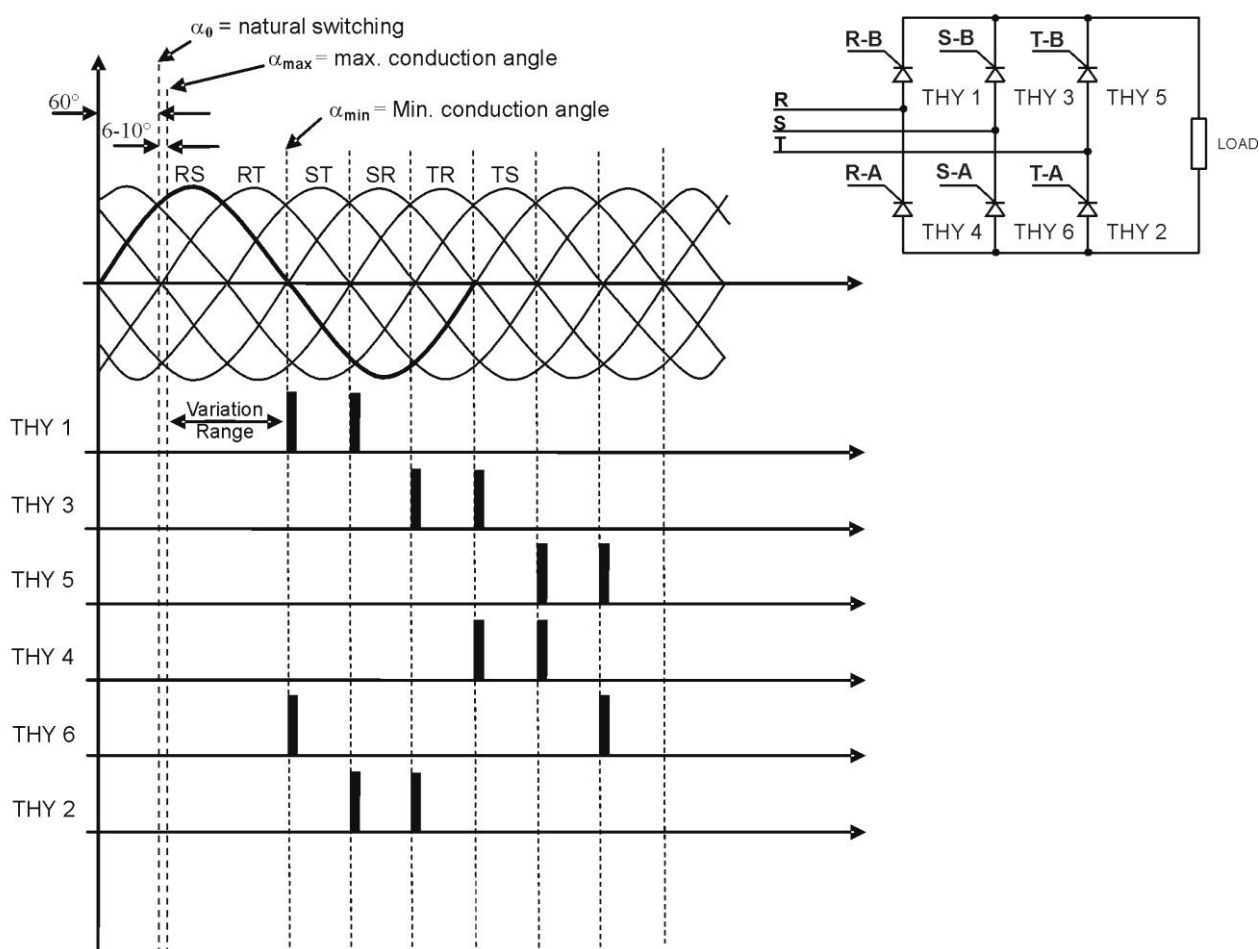
R	(terminals 159)		Synch. reference input	See § Wiring Diagram
S	(terminals 169)		Synch. reference input	
Ref. V	(terminals 158)	+	Voltage Input Reference	
	(terminals 157)	-		
Ref. I	(terminals 168)	+	Current Input Reference	
	(terminals 167)	-		
Lem / Rogowsky	(terminals 176)	+	Input Lem / Rogowsky	
Rogowsky / Lem	(terminals 175)	+	Available	
Shunt / Voltage Conv	(terminals 174)	+	Input Shunt / Voltage Conv	
Shunt	(terminals 156)	+	Available	
Lem / Rogowsky	(terminals 155)	+	Available	
Rogowsky / Lem	(terminals 154)	+	Available	
Com In	(terminals 187)	-	Common	

2.3.3 - Signal Outputs

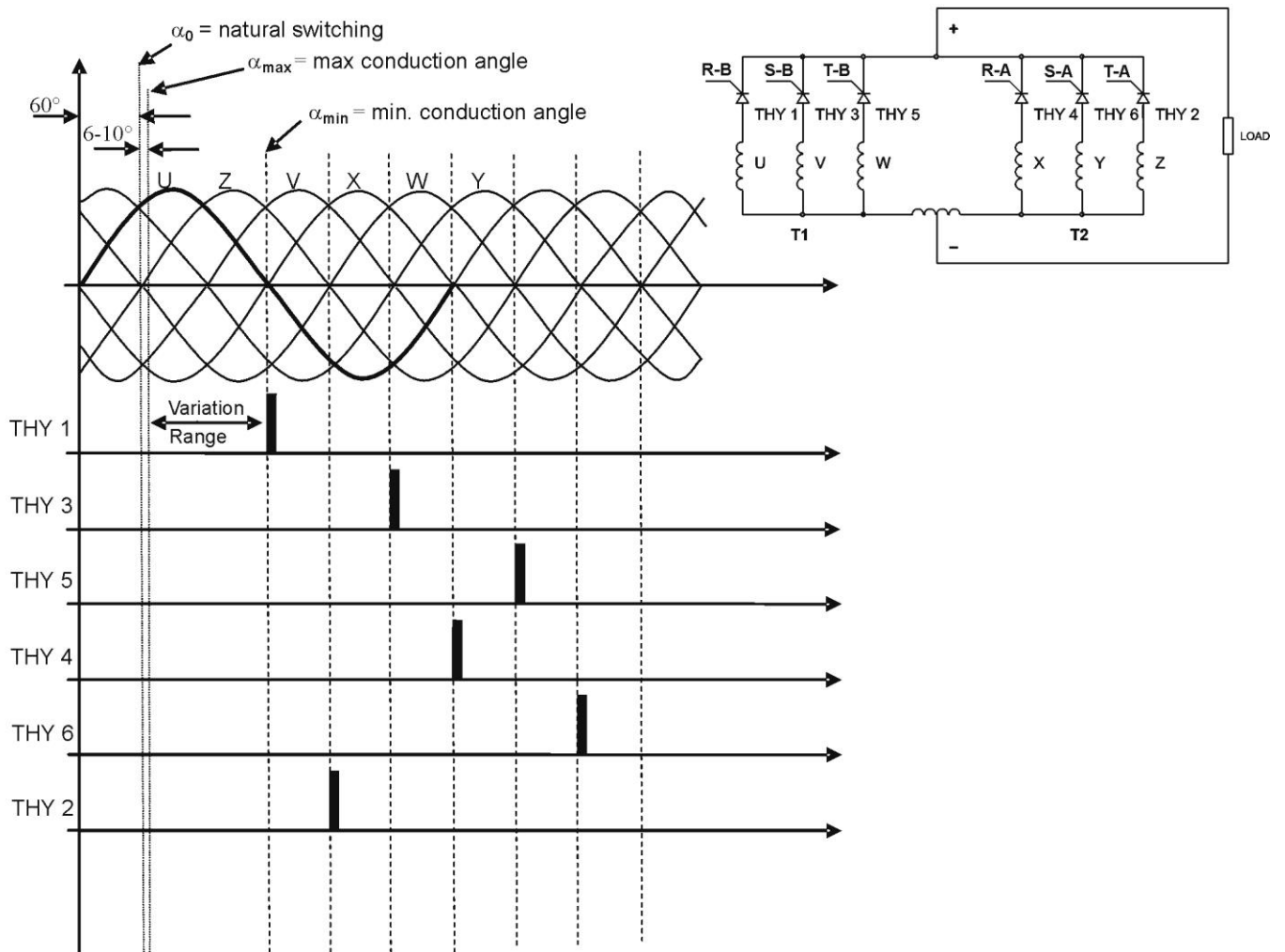
Signal Outputs – DRP-AF (Board 1)

R-A	(terminals 186)	Output THY4
R-B	(terminals 185)	Output THY1
R-COM	(terminals 184)	Common
S-A	(terminals 166)	Output THY6
S-B	(terminals 165)	Output THY3
S-COM	(terminals 164)	Common
T-A	(terminals 183)	Output THY2
T-B	(terminals 182)	Output THY5
T-COM	(terminals 163)	Common

Bridge Mode PH_3



Bridge Mode PH_6



2.3.4 - Input quantities

2.3.4.1 - Mains Frequency (Freq)

The DRP6AF module can operate ONLY in 50Hz systems.
The rated Mains Frequency “Freq” must be set accordingly.

2.3.4.2 - Algorithm of the time current curves

The Time Current Curves are generally calculated with the following equation :

$$(1) \quad t(I) = \left[\frac{A}{\left(\frac{I}{I_s} \right)^a - 1} + B \right] \cdot K \cdot T_s + t_r$$

where :

$t(I)$ = Actual trip time delay when the input current equals “I”

I = Maximum of the three input currents.

I_s = Set minimum pick-up level

$$K = \left(\frac{A}{2^a - 1} \right)^{-1}$$

T_s = Set time delay : $t(I) = T_s$ when $\frac{I}{I_s} = 2$

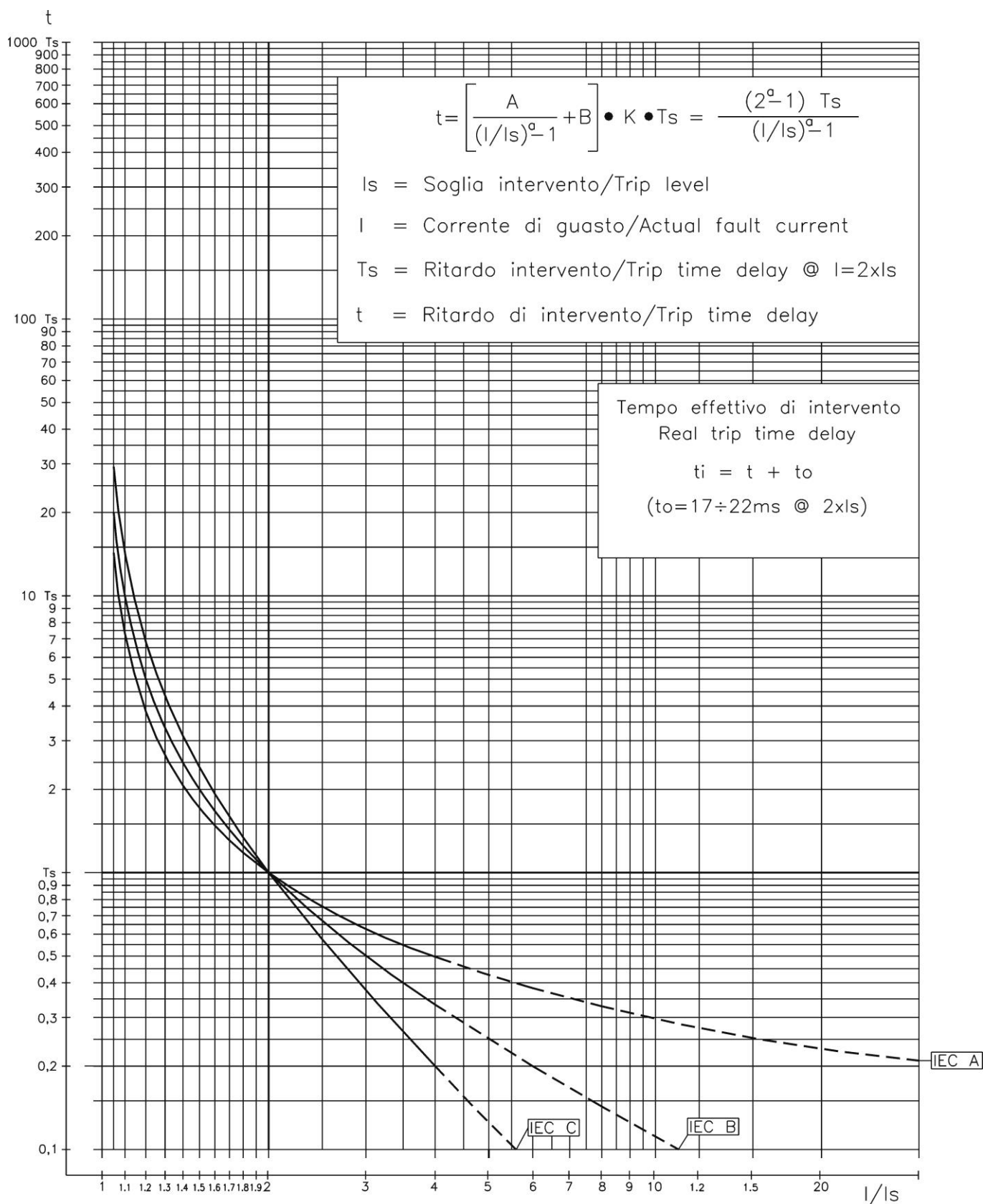
t_r = Operation time of the output relay on pick-up.

The parameters “A” and “a” have different values for the different Time Current Curves.

Curve Name	Curve Identifier	A	B	a
IEC A Inverse	A	0.14	0	0.02
IEC B Very Inverse	B	13.5	0	1
IEC C Extremely Inverse	C	80	0	2

The maximum measuring current is “3xIn” for phase elements.

2.3.5 - Time Current Curves IEC



Curve Type	A	B	K	a
IEC A	0.14	0	0.336632	0.02
IEC B	13.5	0	0.666667	1
IEC C	80	0	1.2375	2

Max. "I" Phase = $3 \times I_n$

2.3.6 - Functions and Settings (**Function**)

2.3.6.1 - **1I>** (**1F51**) - First overcurrent protection element (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	TCC D	[D / A / B / C]
TripLev	→	1I> 1.5	In (0.10 ÷ 2.00) step 0.01 In
Timers	→	t1I> 60	s (0.01 ÷ 60.00) step 0.01 s

☐ **FuncEnab** : If disable the function is deactivated

☐ **TCC** : Time current curves
 D = Independent Definite Time
 A = IEC A Inverse
 B = IEC B Very Inverse
 C = IEC C Extremely Inverse

☐ **1I>** : Minimum phase current pick-up level

☐ **t1I>** : Trip time delay

Trip when : Level "1I>" exceeded for time "t1I>"

When the function is tripped : *Regulator* = Is Blocked
 Signalization = Led "Trip" is illuminated
 Last Trip = Is recorded

Reset when : Returns in normal condition

2.3.6.2 - **2I>** (**2F51**) - Second overcurrent protection element (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	No Param	No Parameters
TripLev	→	2I> 1.75	In (0.10 ÷ 3.00) step 0.01 In
Timers	→	t2I> 5.00	s (0.05 ÷ 60.00) step 0.01 s

☐ **FuncEnab** : If disable the function is deactivated

☐ **2I>** : Minimum phase current pick-up level

☐ **t2I>** : Trip time delay

Trip when : Level "2I>" exceeded for time "t2I>"

When the function is tripped : *Regulator* = Is Blocked
 Signalization = Led "Trip" is illuminated
 Last Trip = Is recorded

Reset when : Returns in normal condition

2.3.6.3 - 3I> (3F51) - Third overcurrent protection element (DRP-AF)

FuncEnab	→	No Param	No Parameters
Options	→	No Param	No Parameters
TripLev	→ 3I>	2.00	In (1.00 ÷ 3.00) step 0.01 In
Timers	→ t3I>	0.00	s (0.00 ÷ 60.00) step 0.01 s
	→ td3I	0.00	s (0.00 ÷ 10.00) step 0.1 s

- ☐ **FuncEnab** : If disable the function is disactivated
- ☐ **3I>** : Minimum phase current pick-up level
- ☐ **t3I>** : Trip time delay
- ☐ **td3I** : Reset time

Trip when : Level “3I>” exceeded for time “t3I>”

When the function is tripped :

<i>Regulator</i>	=	Is Blocked
<i>Signalization</i>	=	Led “Trip” is illuminated
<i>Last Trip</i>	=	Is recorded

Reset when : Returns in normal condition

2.3.6.4 - 4I> (4F51) - Fourth overcurrent protection element (DRP-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	No Param	No Parameters
TripLev	→ 4I>	2.00	In (0.50 ÷ 3.00) step 0.01 In
	→ F_Ang	100.00	° (0.00 ÷ 180.00) step 0.01 °
Timers	→ tLT>	0.00	s (0.00 ÷ 10.00) step 0.01 s

- ☐ **FuncEnab** : If disable the function is disactivated
- ☐ **4I>** : Minimum phase current pick-up level
- ☐ **F_Ang** : Forced angle
- ☐ **tLT>** : Maximum time of forced angle operation

Trip when : Input current Level exceeded “4I>” (instantaneous)

When the function is tripped :

<i>Regulator</i>	=	Works with the forced angle set
<i>Signalization</i>	=	Not available
<i>Last Trip</i>	=	Not available

Reset when : The calculated PID angle exceed the force angle set [F_Ang] or, in any case, when the timer [tLT>] is expired.

2.2.6.5 - U> (F59) – Overvoltage element (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	No Param	No Parameters
TripLev	→ U>	1.20	Un (0.70 ÷ 1.50) step 0.1 Un
Timers	→ tU>	3.00	s (0.01 ÷ 600) step 0.01 s

- ☐ **FuncEnab** : If disable the function is deactivated
- ☐ **U>** : Trip level protection
- ☐ **tU>** : Trip time delay

Trip when : Level “U>” exceeded for time “tU>”

When the function is tripped : *Signalization* = Led “Trip” is illuminated
Last Trip = Is recorded

Reset when : Returns in normal condition

2.2.6.5 - U< (F27) – Undervoltage element (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	No Param	No Parameters
TripLev	→ U<	0.80	Un (0.80 ÷ 1.10) step 0.1 Un
Timers	→ tU<	0.03	s (0.01 ÷ 600) step 0.01 s

- ☐ **FuncEnab** : If disable the function is deactivated
- ☐ **U<** : Trip level protection
- ☐ **tU<** : Trip time delay

Trip when : Level “U<” exceeded for time “tU<”

When the function is tripped : *Signalization* = Led “Trip” is illuminated
Last Trip = Is recorded

Reset when : Returns in normal condition

2.2.6.6 - U2> (F46) – Phase Sequence (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	No Param	No Parameters
TripLev	→ U2>	0.20	Un (0.20 ÷ 1.00) step 0.1 Un
Timers	→ tU2>	0.10	s (0.01 ÷ 600) step 0.01 s

☐ **FuncEnab** : If disable the function is deactivated

☐ **U2>** : Trip level protection

☐ **tU2>** : Trip time delay

Trip when : Level “U2>” exceeded for time “tU2>”

When the function is tripped : *Signalization* = Led “Trip” is illuminated
Last Trip = Is recorded

Reset when : Returns in normal condition

2.2.6.7 – **PIDSC** – (SLOW Current) (MC22-AF)

FuncEnab	→	Enable	[Disable / Enable]					
Options	→	S/F	Field	[SCADA / Field / InpSel]				
TripLev	→	K_P	1.00	(0.00 ÷ 200)	step	0.01		
	→	K_I	1.00	(0.00 ÷ 99.99)	step	0.01		
	→	K_D	0.00	(0.00 ÷ 99.99)	step	0.01		
Timers	→	rRmSC	5.00	s	(0.08 ÷ 60)	step	0.01	s
	→	fRmSC	0.10	s	(0.01 ÷ 0.10)	step	0.01	s

□	S/F	:	[SCADA] = Reference input from SCADA [Field] = Reference input from FIELD [InpSel] = Reference input selected by digital input (see § digital input)
□	K_P	:	Proportional gain
□	K_I	:	Integrative gain
□	K_D	:	Derivative gain
□	rRmSC	:	Rise time slow current ramp
□	fRmSC	:	Fall time slow current ramp

FuncEnab	→	Enable	[Disable / Enable]					
Options	→	S/F	Field	[SCADA / Field / InpSel]				
TripLev	→	K_P	1.00	(0.00 ÷ 200)	step	0.01		
	→	K_I	1.00	(0.00 ÷ 99.99)	step	0.01		
	→	K_D	0.00	(0.00 ÷ 99.99)	step	0.01		
Timers	→	rRmFC	5.00	s	(0.08 ÷ 60)	step	0.01	s
	→	fRmFC	0.10	s	(0.01 ÷ 0.10)	step	0.01	s

- | | | | | | | | | | | | | |
|----------------|---------|---------------------|---------|---------------------|------|-------------------|-----|----------|-----|-----------|----|-----------|
| Copyright 2009 | MC22-AF | 1002.33.01.a | DRP-6AF | 1020.01.02.A | Date | 02.10.2009 | Rev | 0 | Pag | 19 | of | 51 |
|----------------|---------|---------------------|---------|---------------------|------|-------------------|-----|----------|-----|-----------|----|-----------|

2.2.6.9 – **Step** – (Regulation step handle) (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]				
Options	→	QFL	NoIFR	[NoIFR / IFR]			
TripLev	→	s2s1	0.80	Vn	(0.00 ÷ 2.00)	step	0.01 Vn
	→	s1s2	0.70	Vn	(0.00 ÷ 2.00)	step	0.01 Vn
	→	s3s2	0.50	Vn	(0.00 ÷ 2.00)	step	0.01 Vn
	→	s2s3	0.40	Vn	(0.00 ÷ 2.00)	step	0.01 Vn
Timers	→	ts2s1	5.00	s	(0.00 ÷ 120.00)	step	1 s
	→	ts1s2	5.00	s	(0.00 ÷ 120.00)	step	1 s
	→	ts3s2	10.00	s	(0.00 ÷ 120.00)	step	1 s
	→	ts2s3	10.00	s	(0.00 ÷ 120.00)	step	1 s
	→	tQOp	2.00	s	(0.10 ÷ 10.00)	step	0.1 s
	→	tQCL	2.00	s	(0.10 ÷ 10.00)	step	0.1 s

☐	FuncEnab	:	If disable the function is disactivated
☐	QFL	:	Q1-Q4 behavior on failure: [NoIRF] = Don't cause internal relay fault [IRF] = cause internal relay fault
☐	s2s1	:	Step 2 to Step 1 Level to rising Voltage
☐	s1s2	:	Step 1 to Step 2 Level to descend Voltage
☐	s3s2	:	Step 3 to Step 2 Level to rising Voltage
☐	s2s3	:	Step 2 to Step 3 Level to descend Voltage
☐	ts2s1	:	Start time Step 2 to Step 1 Level to rising Voltage
☐	ts1s2	:	Start time Step 1 to Step 2 Level to descend Voltage
☐	ts3s2	:	Start time Step 3 to Step 2 Level to rising Voltage
☐	ts2s3	:	Start time Step 2 to Step 3 Level to descend Voltage
☐	tQOp	:	Control time Open command Q1(Q4)
☐	tQCL	:	Control time Close command Q1 (Q4)

Hidden Parameters (reserved for service installation)

→	Q1-Q4 (default) init step	Step 1	[Step 1 / Step 2 / Step 3]
→	Q1-Q4 command behavior		[Exit on correct Q1(4) position / Wait control time expiration]

2.2.6.10 - **Fan** - (Fan Control) (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	No Param	No Parameters
TripLev	→	No Param	No Parameters
Timers	→ tFan	60.00	s (60 ÷ 600) step 10 s

- ☐ **FuncEnab** : If disable the function is deactivated
- ☐ **tFan** : Time for turn-off fan after stop command

This function command the start of the FAN each time the regulator is started and the stop of the FAN that is delayed of the time “tFan” after the regulator is stopped.

2.2.6.11 - **Test** - (Test) (MC22-AF)

FuncEnab	→	No Param	No Parameters
Options	→ Tst	Disable	[Disable / Ref. / TrigAng]
TripLev	→ LR_LC	0.00	% (0.00 ÷ 100.00) step 1 %
	→ LR_FC	0.00	% (0.00 ÷ 100.00) step 1 %
	→ Ang.T	0.00	dg (0.00 ÷ 359.99) step 0.01 dg
Timers	→	No Param	No Parameters

- ☐ **Tst** (Test Mode) : **Disable** : In this case the “Test” is disabled and apparatus work normally, receiving the signal reference via serial communication from the field.
- Rif** : In this case the regulator ignore the reference from the field (serial communication); the value of reference can be adjusted through keyboard of the relay or via serial communication (FriemCom) setting the parameter “L_Rif”.
- TrigAng** : In this case the regulator ignore the reference and the feedback from the field; and regulated and output pulse are generated according to the value of the parameter “TrigAng”, adjusted through keyboard of the relay or via serial communication (FriemCom).

- ☐ **LR_LC** : Slow Current Local reference
- ☐ **LR_FC** : Fast Current Local reference
- ☐ **Ang.T** : Arbitrary angle Test

2.2.6.12 - Osc - Oscillographic Recording (MC22-AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	Trg Trip	[Disable / Start / Trip / Ext.Inp. / DRPStar]
TripLev	→	No Param	No Parameters
Timers	→	tPre 5.00	s (5.00 ÷ 15.00) step 1 s
	→	tPost 10.00	s (10.00 ÷ 55.00) 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 the Digital Input D3 (dry contact) is closed
 - DRPStar* = Trigger on regulator start
- ☐ **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 60 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 (4 x 15 sec).

Any new event beyond the 60 sec capacity of the memory, cancel and overwrites the former records (FIFO Memory).

2.2.6.13 - LoadP – Load Profile (MC22-AF)

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** : If disable the function is deactivated
- ☐ **tLP** : Scan time

Every time that comes measured a value of current (> 2%) comes activated with a time of programmable scansion “tLP”, the recording of the load profile.

2.2.6.14 - I.R.F. - Internal Relay Failure (MC22-AF)

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).

2.2.6.15 - LCD – Display and Buzzer operation (MC22-AF)

FuncEnab	→	No Param	No Parameters
Options	→	Key BeepON	[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.

2.2.6.16 - **Comm** – Communication Parameters (MC22-AF)

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

2.2.6.17 – **VEST** – Enable to Start **DRP-2DS**

FuncEnab	→	No Param	No Parameters
Options	→	No Param	No Parameters
Trip Level	→ Vb>	0.5	(0.5 ÷ 1.5) step 0.01 Vn
	→ Vb<	0.2	(0.2 ÷ 1) step 0.01 Vn
Timers	→ tVb	0 s	(0 ÷ 100.00) step 0.1 s

- ☐ **Vb>** : Level
- ☐ **Vb<** : Level
- ☐ **tVb** : Time delay

Enable when : $[Vb<] < VBF < [Vb>]$ after time $[tVb]$ and activate logic output "tVb>".

2.2.6.18 – **I<** – Output current = 0 (Hidden Parameters - Reserved for service installation) (DRP-AF)

FuncEnab	→	No Param	No Parameters
Options	→	No Param	No Parameters
TripLev	→ I<	0.03	In (0.03 ÷ 1.00) step 0.01 In
Timers	→ tl<	0.05	s (0.05 ÷ 40.00) step 0.01 s

- ☐ **I<** : Level for zero current
- ☐ **tl<** : Acknowledgement delay time

When the function is tripped : Signalization = Via serial communication or output relay

Reset when : Returns in normal condition

2.2.6.19 – **FBI** – Current Feedback - (Hidden Parameters - Reserved for service installation)

Options	→ FBI	Input_4	[Input_4 / Input_5 / Input_6 / Input_7 / Input_8 / Input_9 / Idc]
----------------	--------------	---------	---

- ☐ **FBI** : Input_4 = Feedback from input 4
Input_5 = Feedback from input 5
Input_6 = Feedback from input 6
Input_7 = Feedback from input 7
Input_8 = Feedback from input 8
Input_9 = Feedback from input 9
Idc = Feedback from input Idc

2.2.6.20 – **FBV** – Voltage Feedback - (Hidden Parameters - Reserved for service installation)

Options	→ FBV	Input_4	[Input_4 / Input_5 / Input_6 / Input_7 / Input_8 / Input_9]
----------------	--------------	---------	---

- ☐ **FBV** : Input_4 = Feedback from input 4
Input_5 = Feedback from input 5
Input_6 = Feedback from input 6
Input_7 = Feedback from input 7
Input_8 = Feedback from input 8
Input_9 = Feedback from input 9

2.2.6.21 – IP – “Select Input for Protection” (Hidden Parameters - Reserved for service installation)

Options	→ IP	Input_4	[Input_4 / Input_5 / Input_6 / Input_7 / Input_8 / Input_9 / Idc]
----------------	-------------	---------	---

☐	IP	:	Input_4	=	Feedback from input 4
			Input_5	=	Feedback from input 5
			Input_6	=	Feedback from input 6
			Input_7	=	Feedback from input 7
			Input_8	=	Feedback from input 8
			Input_9	=	Feedback from input 9
			Idc	=	Idc

2.2.6.22 – BrM – Bridge mode (Hidden Parameters - Reserved for service installation)

Options	→ BrM	Bridge	[Bridge / Double Star]
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☐	BrM	:	Bridge	=	For 3-Phase rectifier
			Double Star	=	For 6-Phase rectifier

2.2.6.23 – Ass – Lack of pulse (Hidden Parameters - Reserved for service installation)

FuncEnab	→	No Param	No Parameters
Options	→	No Param	No Parameters
TripLev	→ NotU	Reserved	
Timers	→	No Param	No Parameters

When the function is tripped : Signalization = Led “Trip” is illuminated and displayed “Ass” on display.

Reset when : Returns in normal condition

2.2.6.24 – OpMd – Operation Mode (Hidden Parameters - Reserved for service installation)

Options	→ OpMd	Master Mode	[Master Mode DRP6 / Master/Slave Mode DRP6+6]			
	→ Idc	5	(1 ÷ 10)			
	→ IFB	5	(1 ÷ 10)			
	→ VFB	5	(1 ÷ 10)			
Timers	→ tVca	0.2	s	(0.00 ÷ 2.00)	step 0.01	s

- ☐ **OpMd** : Operative Mode
- ☐ **Idc** : Number of Average of Idc
- ☐ **IFB** : Number of Average of IFB
- ☐ **VFB** : Number of Average of VFB
- ☐ **tVca** : Trip time delay Vca Failure

2.2.6.25 – DCBSC – DC Bus Short circuit (Hidden Parameters – Reserved for service installation) (DRP-AF)

FuncEnab	→	No Param	No Parameters			
Options	→ DCBSC	0	Vn	(0.00 ÷ 1.00)	step 0.01	Vn
Timers	→ tDCB	0	s	(0.00 ÷ 10.00)	step 0.01	s
	→ tMin	0	s	(0.00 ÷ 2.00)	step 0.01	s

- ☐ **DCBSC** : DC Bus Short circuit Level
- ☐ **tDCB** : Time DC Bus short circuit
- ☐ **tMin** : Minimum time DC Bus short circuit Logical output signal

Trip when : Level “DCBSC” exceeded for time “tDCB”

When the function is tripped :

<i>Regulator</i>	=	Is Blocked
<i>Signalization</i>	=	Led “Trip” is illuminated
<i>Last Trip</i>	=	Is recorded

Reset when : Returns in normal condition

2.2.6.26 – VFB> – V Feedback overvoltage (Hidden Parameters-Reserved for service installation)(DRP-6AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	VFB> 0.50	Vn (0.50 ÷ 1.50) step 0.01 Vn
Trip Level	→	OpMd Master Mode	[Master Mode DRP6 / Master/Slave Mode DRP6+6]
	→	Idc 5	(1 ÷ 10)
	→	IFB 5	(1 ÷ 10)
Timers	→	tVFB> 0	s (0.00 ÷ 10.00) step 0.01 s

- ☐ **VFB>** : Overvoltage Level V Feedback
- ☐ **tVFB>** : Trip time overvoltage V Feedback

Trip when : Level “VFB>” exceeded for time “tVFB>”

When the function is tripped :

<i>Regulator</i>	=	Is Blocked
<i>Signalization</i>	=	Led “Trip” is illuminated
<i>Last Trip</i>	=	Is recorded

Reset when : Returns in normal condition

2.2.6.27 – VFB< – V Feedback undervoltage (Hidden Parameters-Reserved for service installation)(DRP-6AF)

FuncEnab	→	Disable	[Disable / Enable]
Options	→	VFB< 0.20	Vn (0.20 ÷ 1.00) step 0.01 Vn
TripLev	→	No Param	No Parameters
Timers	→	tVFB< 0	s (0.00 ÷ 10.00) step 0.01 s
	→	tStrt 0	s (0.00 ÷ 100.00) step 0.1 s
	→	tMin 0	s (0.00 ÷ 2.00) step 0.1 s

- ☐ **VFB<** : Undervoltage Level V Feedback
- ☐ **tVFB<** : Trip time Undervoltage V Feedback
- ☐ **tStrt** : Time Lock VFB< on start command
- ☐ **tMin** : Minimum time VFB Undervoltage Logical output signal

Trip when : Level “VFB<” exceeded for time “tVFB<”

When the function is tripped :

<i>Regulator</i>	=	Is Blocked
<i>Signalization</i>	=	Led “Trip” is illuminated
<i>Last Trip</i>	=	Is recorded

Reset when : Returns in normal condition

3. Output Relays

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 Relay 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).

Available in the Regulator - MC22-AF (Board 0)

R1 : Lack of pulse

R2 : Fan

R3 : Protection Trip

4. Digital Input

Available in the - MC22-AF (Board 0)

0.D1	(terminals 22 - 19)	:	<i>Close</i> select current reference from field <i>Open</i> select current reference from Scada	The Digital Input is activated when its terminals are shorted by a dry contact ($R \leq 3k\Omega$).
0.D2	(terminals 22 - 21)	:	<i>Close</i> select voltage reference from field <i>Open</i> select voltage reference from Scada	
0.D3	(terminals 22 - 20)	:	Trigger Oscillographic recording (see § Osc). Note: the input is active when the contact is close.	

Available in the DRP-AF (Board 1)

D1	(terminals 177 - 179)	:	Start/Stop	The Digital Input is activated when its terminals are shorted by a dry contact ($R \leq 3k\Omega$).
D2	(terminals 177 - 178)	:	Reserved don't connect	

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 E²Prom.
- DSP general operation (Power, Routines, etc.)
- Lamp test (only on manual test).
- Canbus supervision

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 E²Prom.

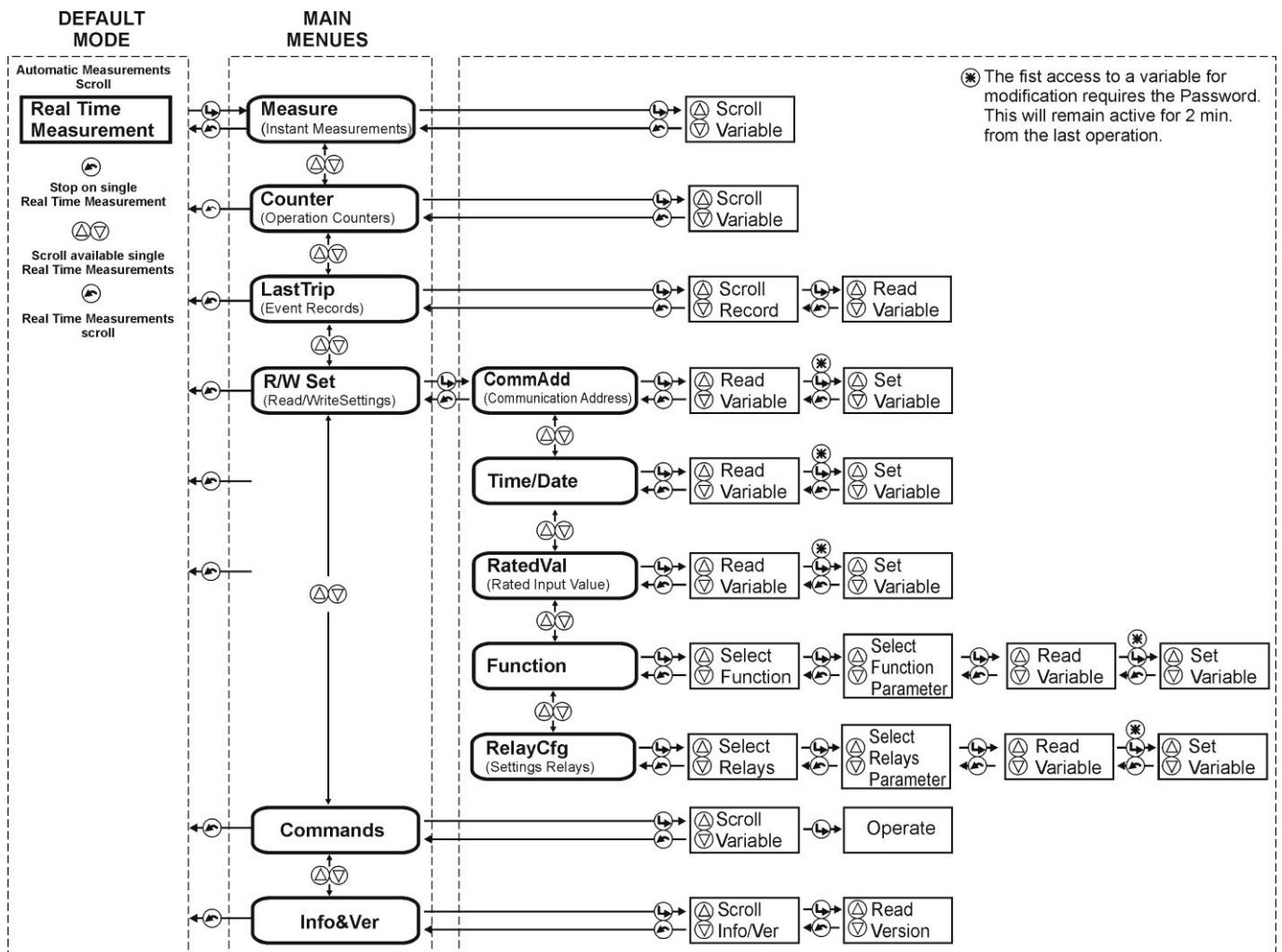
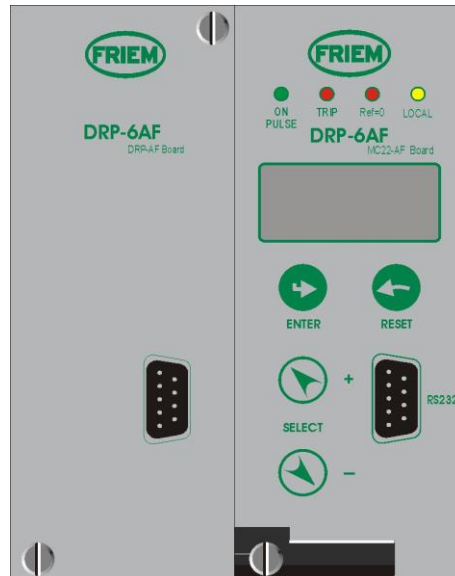
If during the test any Relay Internal Failure (I.R.F) is detected:

- If “ I.R.F. “ is programmed to “ Trip “, the programmed output relay is activated, the same as on tripping of any protection function. It 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 herebelow.



7. Signalizations

Four signal leds are available on the Front Face Panel:



a)	Green LED	ON Pulse	☐ Off	: Internal Fault
			☐ Flashing	: When regulator is active.
			☐ Illuminated	: When regulator is stopped.
b)	Red LED	TRIP	☐ Off	: Normal status
			☐ Flashing	: When a timed function starts to operate.
			☐ Illuminated	: When any protection function trips.
b)	Red LED	Ref=0	☐ Off	: Reference $\neq$ 0
			☐ Flashing	: -----
			☐ Illuminated	: Reference = 0
d)	Yellow LED	LOCAL	☐ Off	: From SCADA or Analog Input
			☐ Flashing	: -----
			☐ Illuminated	: LOCAL Reference

8. Keyboard

	Enter	Give access to any menu or convalidate any programming changement.
	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 (MC22-AF)

This port is accessible via the terminals 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 / IEC60870-5-103.

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 (FriemCom) for windows 95/98/NT4 SP3 (or later) is available.

Please refer to the FriemCom instruction manual for more information.

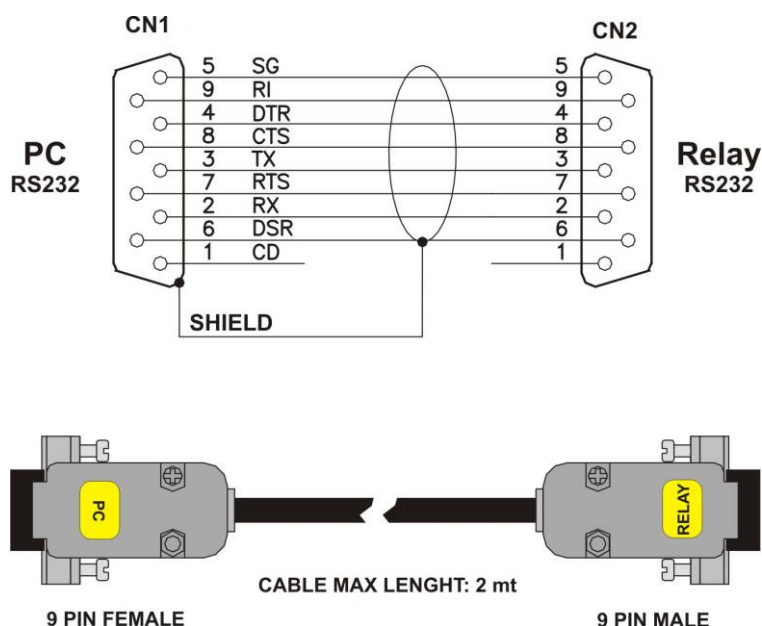
Maximum length of the serial bus can be up to 200m.

9.2 - Communication Port on Front Face Panel – MC22-AF & DRP-AR

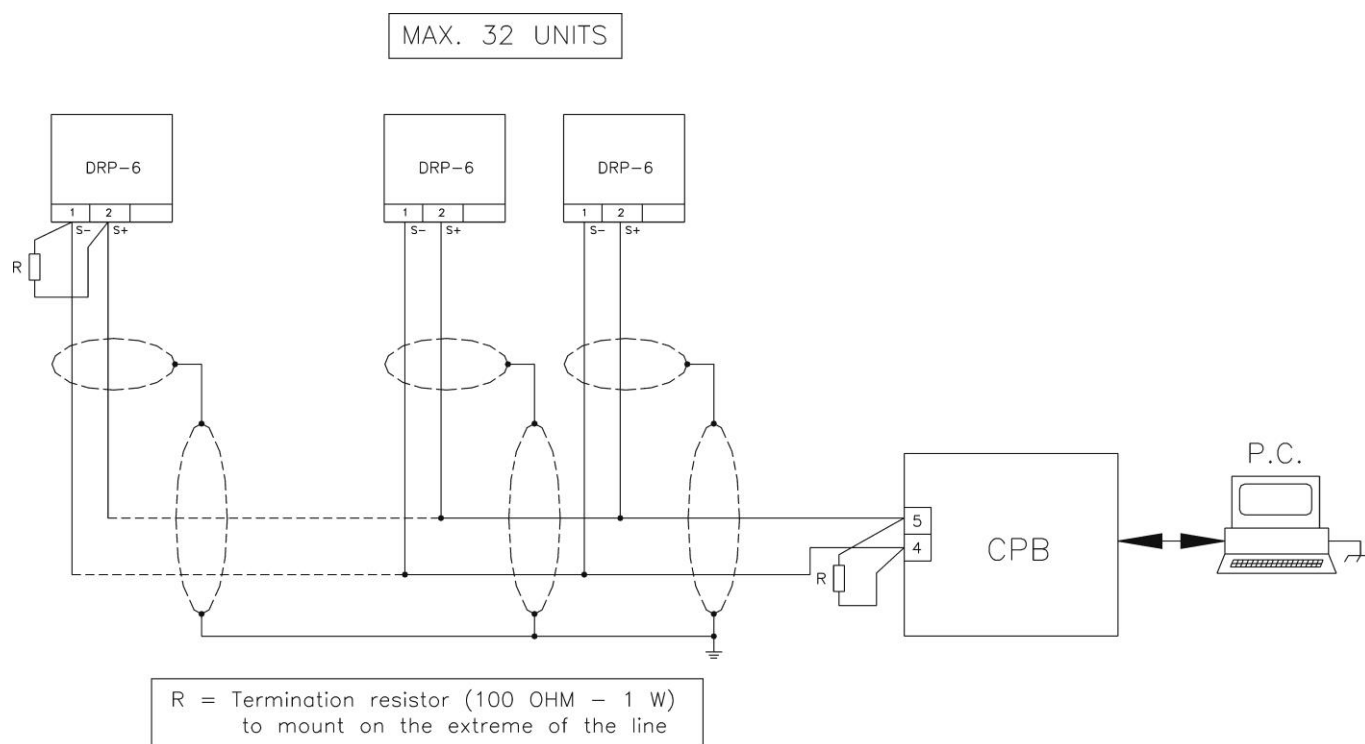
This port is used for communication through the Front Face Panel between a local Lap-top PC.

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.

IMPORTANT : DON'T CONNECT SERIAL COMMUNICATION LOCAL PORT ON DRP-6AF MODULE DURING REGULATION (Decrease the time response of closed loop regulation).



9.3 – 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 and the different available measurements can be selected by the buttons.

Display			Description
VA	= 0 – 65535	V	AC Voltage phase A
VB	= 0 – 65535	V	AC Voltage phase B
VC	= 0 – 65535	V	AC Voltage phase C
Idc	= 0 – 650	kA	DC current feedback measured by CTs (*)
FCR	= 0 – 650	kA	FAST Current Reference set point from Field (on input 3)
SCR	= 0 – 650	kA	SLOW Current Reference set point from Field (on input 2)
sFC	= 0 – 325	%	FAST Current Reference set point from SCADA (serial communication)
sSC	= 0 – 325	%	SLOW Current Reference set point from SCADA (serial communication)
IFB	= 0 – 650	kA	DC Load Current (Feedback measured by transducer on input)
VFB	= 0 – 65535	V	DC Load Voltage (Feedback measured by transducer on input)
V1	= 0 – 65535	%	AC Direct voltage sequence
V2	= 0 – 65535	%	AC Inverse voltage sequence
aT	= 180 – 70	dg	Trigger shot angle

(*) Idc – Is the load current (DC) calculated, measured by CTs connected on the input of the rectifier.

10.2 - Measure (Instantaneous Measurements)

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

- “ Real Time Meas “
- “ Meas “
- “ 1st Measurement other measurements
- to go back to “ Meas “

Display			Description
VA	= 0 – 65535	V	AC Voltage phase A
VB	= 0 – 65535	V	AC Voltage phase B
VC	= 0 – 65535	V	AC Voltage phase C
Idc	= 0 – 650	kA	DC current feedback measured by CTs
FCR	= 0 – 650	kA	FAST Current Reference set point from Field (on input 3)
SCR	= 0 – 650	kA	SLOW Current Reference set point from Field (on input 2)
sFC	= 0 – 325	%	FAST Current Reference set point from SCADA (serial communication)
sSC	= 0 – 325	%	SLOW Current Reference set point from SCADA (serial communication)
IFB	= 0 – 650	kA	DC Load Current (Feedback measured by transducer on input)
VFB	= 0 – 65535	V	DC Load Voltage (Feedback measured by transducer on input)
V1	= 0 – 65535	%	AC Direct voltage sequence
V2	= 0 – 65535	%	AC Inverse voltage sequence
aT	= 180 – 70	dg	Trigger shot angle

10.3 - Counter (Operation Counters)

The operation of any of the function herebelow reported, is counted and recorded in the menu “Counters “.

- “ Real Time Meas “ 
- “Counter “ 
- “ 1st counters  other counters
-  to go back to “Counter “

Display			Description	
1I>	=	0 – 65535	Number of 1 st Overcurrent	(time delayed) trip
2I>	=	0 – 65535	Number of 2 nd Overcurrent	(time delayed) trip
3I>	=	0 – 65535	Number of 3 rd Overcurrent	(time delayed) trip
I<	=	0 – 65535	Number of Undercurrent	
U>	=	0 – 65535	Number of Overvoltage	(time delayed) trip
U<	=	0 – 65535	Number of Undervoltage	(time delayed) trip
U2>	=	0 – 65535	Number of Negative Sequence	
IRF	=	0 – 65535	Number of Internal Relay Faults	
HR	=	0 – 65535	Number of HW recovery operations	
Ass	=	0 – 65535	Lack of synch.	
DcB	=	0 – 65535	DC Bus Short circuit	
VFB	=	0 – 65535	V Feedback Under/Over voltage	

10.4 - 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	Description
Func xxxxx	Indication of the protection function which caused the relay tripping. For indication of the TRIP Cause the following acronyms are used:
	- 1I> = 1st Overcurrent element - 2I> = 2nd Overcurrent element - 3I> = 3rd Overcurrent element - U> = Overvoltage element - U2> = Phase Sequence element - U< = Undervoltage element - IRF = Internal Relay Faults - Ass = Lack of synch. - DCBSC = DC Bus Short circuit - VFB> = V Feedback overvoltage - VBF< = V Feedback undervoltage
Date : YYYY/MM/GG	Date: Year/Month/Day
Time : hh:mm:ss:cc	Time: hours/minutes/second/hundredths of seconds
VA = 0 – 65535 V	Voltage phase A
VB = 0 – 65535 V	Voltage phase B
VC = 0 – 65535 V	Voltage phase C
Idc = 0 – 650 kA	DC current feedback measured by CTs
IFB = 0 – 650 kA	Current Feedback
VFB = 0 – 65535 V	Voltage Feedback

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

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

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

10.5.1 - 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	-

10.5.2 - Time/Date (Time/Date)

-   "Time/Date "
-  "YY/..... "   Date: Current Date, Time: Current time
-  "XX/MM "   to set year,
-  "XX/XX/DD "   to set month,
-  "XX/XX/XX "   to set day,
-  "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!

Display	Description	Setting Range	Step	Unit
I1 1 kA	Rated Primary current of phase C.T.	1 - 400	0.01	A
I2 5 A	Rated Secondary current of phase C.T.	1 - 5	1/5	A
In 1 kA	Reference primary current of the relay	1 - 400	0.01	A
V1 10 kV	Rated Primary voltage of phase V.T.	0.05 - 500	0.01	kV
V2 500 V	Rated Secondary voltage of phase V.T.	50 - 115	0.01	V
Freq 50 Hz	System rated frequency	50 - 60	10	Hz

10.5.4 - Function (Functions)

- “ Function “,
 - 1st function,
 - to scroll available Functions,
 - to Read/Write setting of the selected function,
 - to select the different definable fields
 - 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!

- FuncEnab
- Options

- TripLev
- Timers

Display						Description	Setting Range	Step
Function	Type		Variable	Default Setting	Unit			
Password = 0000-9999 1111 -						Password for programming enable (see § Password)		
1I>	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	TCC	D		Time current curves	D,A,B,C	-
	TripLev	→	1I>	1.5	In	Trip level	0.10 – 2.00	0.01
	Timers	→	t1I>	60	s	Trip time delay	0.01 – 60.00	0.01
2I>	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	2I>	1.75	In	Trip level	0.10 – 3.00	0.01
	Timers	→	t2I>	5.00	s	Trip time delay	0.05 – 60.00	0.01
3I>	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→	3I>	2.00	In	Trip level	1.00 – 3.00	0.01
	Timers	→	t3I>	0.00	s	Trip time delay	0.00 – 60.00	0.01
			td3I	0.00	s	Reset time	0.00 – 10.00	0.1
4I>	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→	3I>	2.00	In	Trip level	1.00 – 3.00	0.01
			F_Ang	100.00	°	Forced angle	0.00 – 180.00	0.01
	Timers	→	t3I>	0.00	s	Trip time delay	0.00 – 60.00	0.01
U>	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	U>	1.20	Un	Trip level	0.70 - 1.50	0.1
	Timers	→	tU>	3.00	s	Trip time delay	0.01 – 600	0.01
U<	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	U<	0.80	Un	Trip level	0.80 - 1.10	0.1
	Timers	→	tU<	0.03	s	Trip time delay	0.01 – 600	0.01
U2>	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	U2>	0.20	Un	Trip level	0.20 - 1.00	0.1
	Timers	→	tU2>	0.10	s	Trip time delay	0.01 – 600	0.01
PIDSC	FuncEnab	→	Enable			Enable or Disable function	Disable/Enable	-
	Options	→	S/F	Field		Reference form SCADA or Field	SCADA/Field/InSel	-
	TripLev	→	K_P	1.00	-	Proportional gain	0.00 – 200	0.01
			K_I	0.00	-	Integrative gain	0.00 - 99.99	0.01
			K_D	0.00	-	Derivative gain	0.00 - 99.99	0.01
	Timers	→	rRmSC	5.00	s	Rise time slow current ramp	0.08 – 60	0.01
		fRmSC	0.10	s	Fall time slow current ramp	0.01 - 0.10	0.01	
PIDFC	FuncEnab	→	Enable			Enable or Disable function	Disable/Enable	-
	Options	→	S/F	Field		Reference form SCADA or Field	SCADA/Field/InSel	-
	TripLev	→	K_P	1.00	-	Proportional gain	0.00 - 200	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	→	rRmFC	5.00	s	Rise time fast current ramp	0.08 - 60
			fRmFC	0.10	s	Fall time fast current ramp	0.01 - 0.10	0.01

Step	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	QFL		NoIFR	Q1-Q4 behavior on failure	NoIFR / IFR	-
	TripLev	→	s2s1	0.80	Vn	Step 2 to Step 1 Level to rising Voltage	0.00 – 2.00	0.01
		→	s1s2	0.70	Vn	Step 1 to Step 2 Level to descend Voltage	0.00 – 2.00	0.01
		→	s3s2	0.50	Vn	Step 3 to Step 2 Level to rising Voltage	0.00 – 2.00	0.01
		→	s2s3	0.40	Vn	Step 2 to Step 3 Level to descend Voltage	0.00 – 2.00	0.01
	Timers	→	ts2s1	5.00	s	Start time Step 2 to Step 1 Lev. to rising Volt.	0.00 – 120.00	1
		→	ts1s2	5.00	s	Start time Step 1 to Step 2 Lev. to desc.Volt.	0.00 – 120.00	1
		→	ts3s2	10.0	s	Start time Step 3 to Step 2 Lev. to rising Volt.	0.00 – 120.00	1
		→	ts2s3	10.0	s	Start time Step 2 to Step 3 Lev. to desc. Volt.	0.00 – 120.00	1
→		tQOp	2.00	s	Control time Open command Q1(Q4)	0.10 – 10.00	0.1	
→		tQCL	2.00	s	Control time Close command Q1 (Q4)	0.10 – 10.00	0.1	
Fan	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	tFan	60.00	s	Time for turn-off fan after stop command	60 - 600	10
	Test	FuncEnab	→	No Param			No Parameters	
Options		→	Tst	Disable		Test Mode	Disab/Rif/TrigAng	-
TripLev		→	LR_FC	0.00	%	Fast Current Local reference	0.00 - 100	0.01
		→	LR_SC	0.00	%	Slow Current Local reference	0.00 - 100	0.01
		→	Ang.T	0.00	g	Test arbitrary angle	0.00-359.99	0.01
Timers		→	No Param			No Parameters		
Osc	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	Trg	Disable		select command for Trigger (start recording):	Disable Start Trip Ext.Imp.	-
	TripLev	→	No Param			No Parameters		
	Timers	→	tPre	5	s	Recording time before Trigger	5 – 15	1
		→	tPost	10	s	Recording time after Trigger	0.10 – 1.50	0.1
LoadP	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	No Param			No Parameters		
	Timers	→	tLP	1.00	m	Scan time	1.00 – 650	1
IRF	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	Opz	NoTrip		Internal Failure Trip=Trip; NoTrip=No Trip	Trip-NoTrip	-
	TripLev	→	No Param			No Parameters		
	Timers	→	No Param			No Parameters		
VEST	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	No Param			No Parameters		
	TripLev	→	Vb>	0.5	Vn	Level	0.5 – 1.5	0.01
		→	Vb<	0.2	Vn	Level	0.2 - 1	0.01
	Timers	→	tVb	0	s	Time delay	1.00 – 650	1
LCD	FuncEnab	→	No Param			No Parameters		
	Options	→	Key	BeepON		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	-	-
	TripLev	→	No Parameters					
	Timers	→	No Parameters					

Settings can also be programmed via the serial communication ports.

(Hidden Parameters - Reserved for service installation)

Display						Description	Setting Range	Step
Function	Type		Variable	Default Setting	Unit			
I<	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→	I<	0.03	In	Trip level	0.03 – 1.00	0.01
	Timers	→	ti<	0.05	s	Trip time delay	0.05 – 40.00	0.01
Ass	FuncEnab	→	No Param			No Parameters		
	Options	→	No Param			No Parameters		
	TripLev	→	NotU	Reserved				
	Timers	→	No Param			No Parameters		
FBI	Options	→	FBI	Input_4		[Input_4 / Input_5 / Input_6 / Input_7 / Input_8 / Input_9 / Idc]		
FBV	Options	→	FBV	Input_4		[Input_4 / Input_5 / Input_6 / Input_7 / Input_8 / Input_9]		
IP	Options	→	FBI	Input_4		[Input_4 / Input_5 / Input_6 / Input_7 / Input_8 / Input_9 / Idc]		
BrM	Options	→	BrM	Bridge		[Bridge / Double star]		
OpMd	FuncEnab	→	No Param			No Parameters		
	Options	→	OpMd	Master Mode		Operation Mode: - Master Mode DRP-6AF	-	-
		→	Idc	0		Number Average of Icc	1 - 10	1
		→	IFB	0		Number Average of IFB	1 - 10	1
		→	VFB	0		Number Average of VFB	1 - 10	1
	TripLev	→	No Param			No Parameters		
	Timers	→	tVca	0.20	s	Trip time delay Vca Failure	0.00 – 2.00	0.01
DCBSC	FuncEnab	→	No Param			No Parameters		
	Options	→	DCBSC	0	Vn	DC Bus Short circuit Level	0.00 – 1.00	0.01
	TripLev	→	No Param			No Parameters		
	Timers	→	tDCB	0	s	Time DC Bus short circuit	0.00 – 10.00	0.01
		→	tMin	0	s	Minimum time DC Bus short circuit Logical output signal	0.00 - 2.00	0.01
VFB>	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	VFB>	0.50	Vn	Overvoltage Level V Feedback	0.50 – 1.50	0.01
	TripLev	→	No Param			No Parameters		
	Timers	→	tVFB>	0	s	Trip time overvoltage V Feedback	0.00 - 10.00	0.01
VFB<	FuncEnab	→	Disable			Enable or Disable function	Disable/Enable	-
	Options	→	VFB<	0.20	Vn	Undervoltage Level V Feedback	0.20 – 1.00	0.01
	TripLev	→	No Param			No Parameters		
	Timers	→	tVFB<	0	s	Trip time Undervoltage V Feedback	0.00 - 10.00	0.01
		→	tStrt	0	s	Time Lock VFB< on start command	0.00 – 100.00	0.1
		→	tMin	0	s	Minimum time VFB Undervoltage Logical output signal	0.00 – 2.00	0.1

10.6 - 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” instead of “Link”.

Available in the MC22-AF Module

Relay	Display			Description	Setting Range	Step
	Type		Default Value			
Relay1 (0.R1)	Link	→	BldDRPm	Association of functions to output relay R1	See Table 1	-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-
Relay2 (0.R2)	Link	→	Fan_On	Association of functions to output relay R2	See Table 1	-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-
Relay3 (0.R3)	Link	→	t1I>, t2I>, t3I>, tU>, tU2>, tU<.	Association of functions to output relay R3	See Table 1	-
	OpMode	→	N.D.	N.D. (Normally Deenergized) N.E. (Normally Energized)	N.D./N.E.	-

Table 1

1I>	Start – First Overcurrent protection level	(instantaneous)
t1I>	Trip – First Overcurrent protection level	(time delayed)
2I>	Start – Second Overcurrent protection level	(instantaneous)
t2I>	Trip – Second Overcurrent protection level	(time delayed)
3I>	Start – Third Overcurrent protection level	(instantaneous)
t3I>	Trip – Third Overcurrent protection level	(time delayed)
I<	Start – Undercurrent protection level	(instantaneous)
tI<	Trip – Undercurrent protection level	(time delayed)
U>	Start – Overvoltage protection level	(instantaneous)
tU>	Trip – Overvoltage protection level	(time delayed)
U2>	Start – Phase sequence	(instantaneous)
tU2>	Trip – Phase sequence	(time delayed)
U<	Start – Undervoltage protection level	(instantaneous)
tU<	Trip – Undervoltage protection level	(time delayed)
SatSC>	Slow Current Saturation >	
SatSC<	Slow Current Saturation <	
SatFC>	Fast Current Saturation >	
SatDC<	Fast Current Saturation <	
Q1	Command Q1 contactor	
Q2	Command Q2 contactor	
Q3	Command Q3 contactor	
Q4	Command Q4 contactor	
St-s2s1	Start step 2 to step 1	
Tr-s2s1	Trip step 2 to step 1	
St-s1s2	Start step 1 to step 2	
Tr-s1s2	Trip step 1 to step 2	
St-s3s2	Start step 3 to step 2	
Tr-s3s2	Trip step 3 to step 2	
St-s2s3	Start step 2 to step 3	
Tr-s2s3	Trip step 2 to step 3	
Step1	Step 1 (Vfb > 2400)	
Step2	Step 2 (Vfb > 1800)	
Step3	Step 3 (Vfb > 600)	
Fan_On	Fan command	
BlcDRPm	DRP pulse block (Lack of Pulse)	required (I>,I>>,faults, external alarms)
VcaFail	Vca Failure	
RegAct	Regulation Active	On when pulse is active
tRegAct	Time delay for Regulation Active	
InpPID1s-f	Input PID-V from field	
InpPID2s-f	Input PID-I from field	
FailDRP	Failure DRP	
Test	Test	
IRF	Internal Regulator Fault	
HwRecov	Hardware Recovery	
AssSyn	Start - Lack Synchronism	
tAssSyn	Trip - Lack Synchronism	
GenStart	General Starts	
GenTrip	General Trip	
DCBSC	DC Bus Short circuit	
tVb>	Enable start DRP-2DS	
VFB<>	Under/Over Feedback	
GenTripF	General Trip Frozed	
AnTrasnd	Transducer Fail	

10.7 - Commands

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

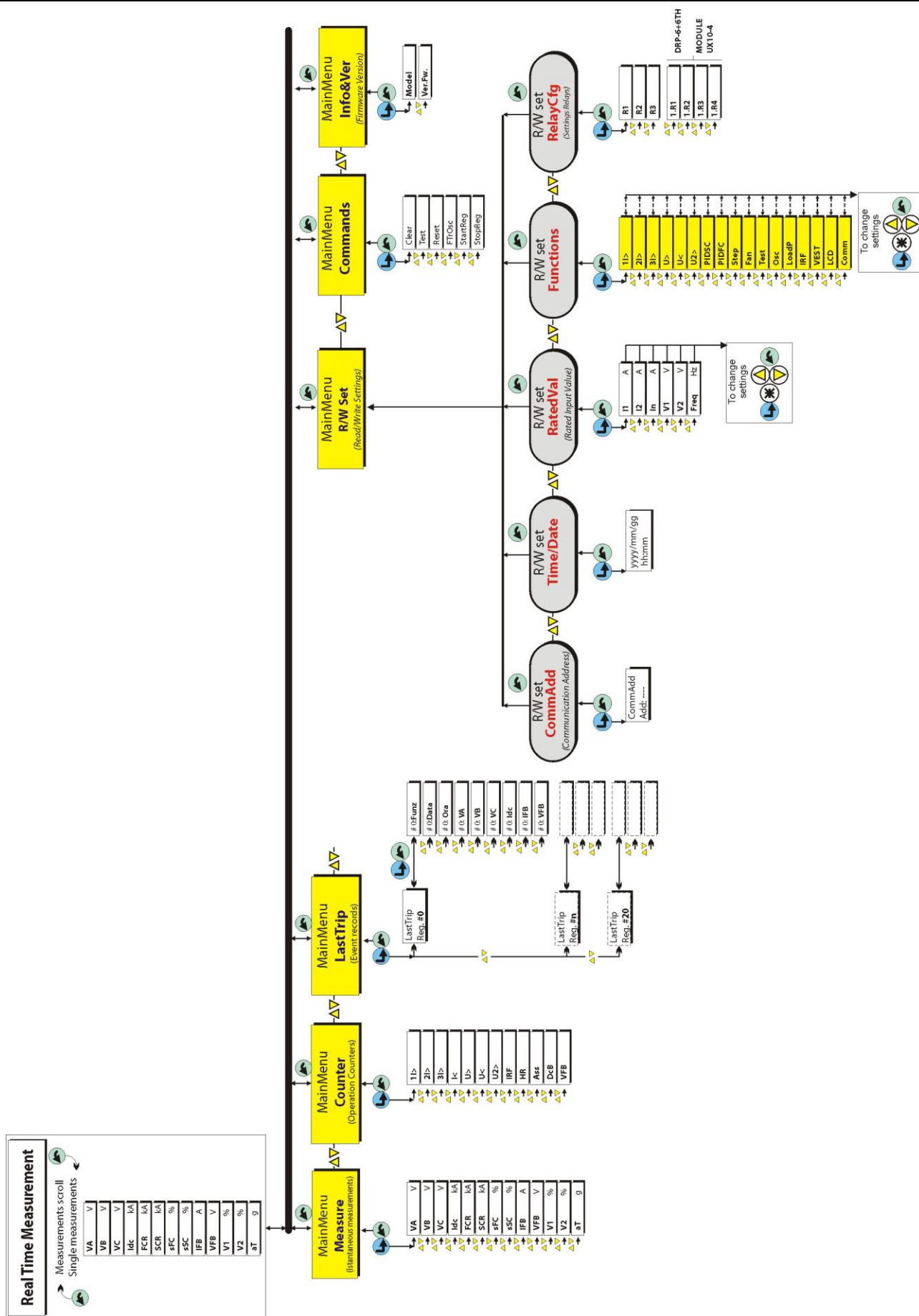
Display	Description
Clear	: Erase memory of Trip Counters, Event Records.
Test	: Starts a relay diagnostic test
Reset	: Reset after trip
FTrOsc	: Force Oscillographic Trigger
StartReg	: Start Regulation
StopReg	: Stop Regulation
Zero_Idc	: Reset of Idc current measurement
Restart	: Restart DRP can protocol (Hidden Parameters - Reserved for service installation)
User	: User Select Q1-Q4 step (Hidden Parameters - Reserved for service installation)

10.8 - Info&Ver

The menu displays the Relay Model and the Firmware Version

- " Real Time Meas " 
-  " Info/Ver ",
-  " Model XXXXXX ", Model Relay
-  " RelayVrs ###.##X ", Firmware Version
-  to go back to " Info&Ver ".
-  to go back to " Real Time Meas "

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 1 st digit (1-9) |  | to validate |
| - |  | to select 2 nd digit (1-9) |  | to validate |
| - |  | to select 3 rd digit (1-9) |  | to validate |
| - |  | to select 4 th 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 (RT Meas).

Once the Password has been entered, a “ # “ appears before the variable that can be modified.

12.1 – FriemCom - 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 FriemCom.

The user can decide whether inserting his own password (see FriemCom Operational Manual) or keeping the password disabled just clicking on the OK button when the password is requested.

13. Maintenance

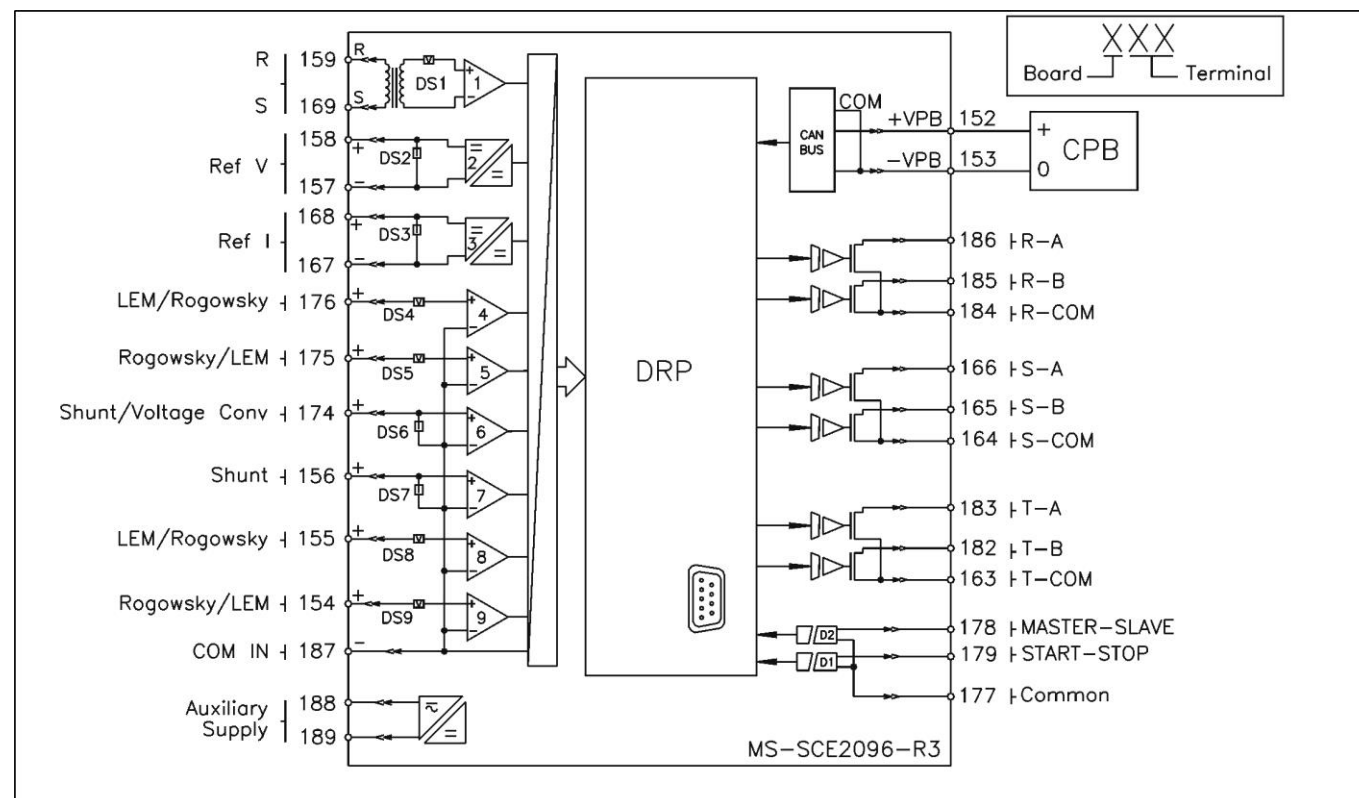
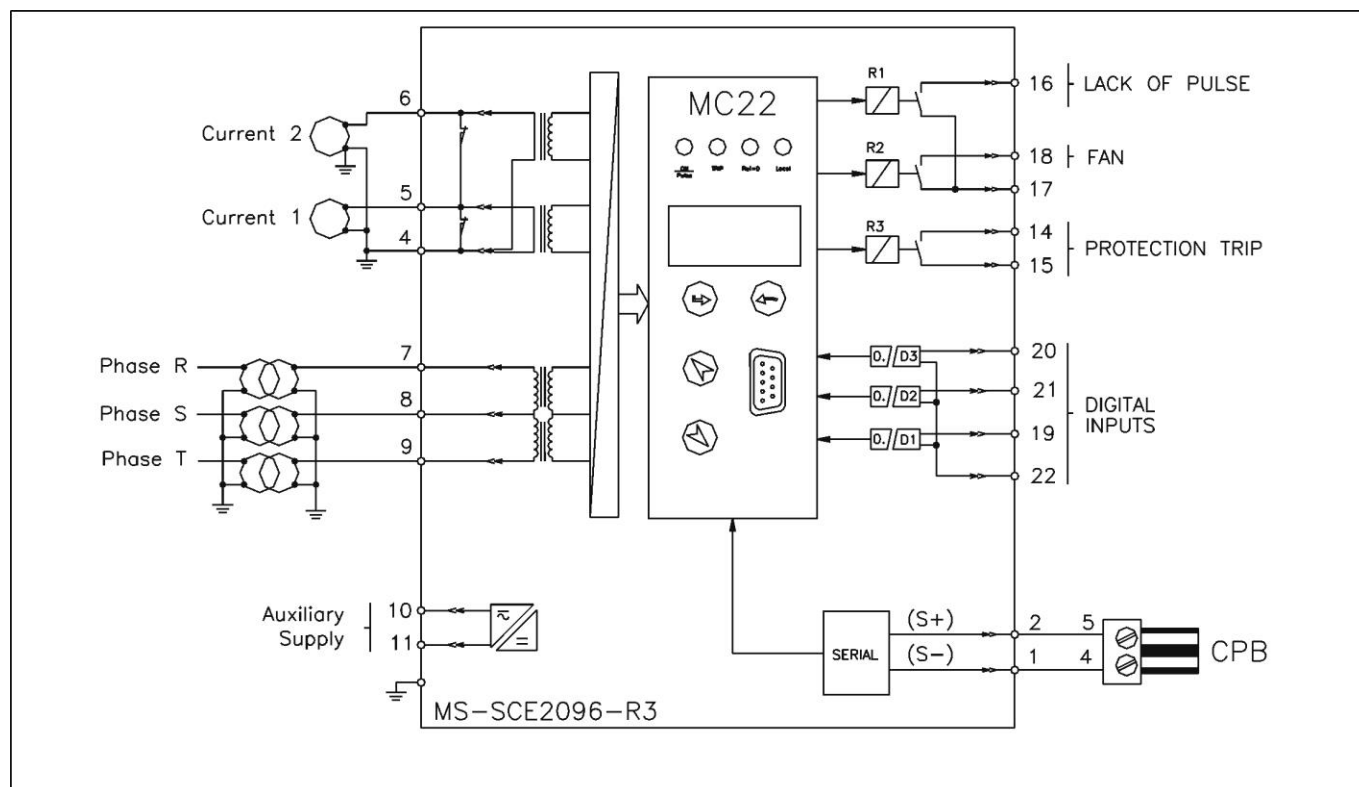
No maintenance is required. In case of malfunctioning please contact FRIEM Service or the local Authorised Dealer mentioning the relay's Serial No reported in the label on relays enclosure.

14. Power Frequency Insulation Test

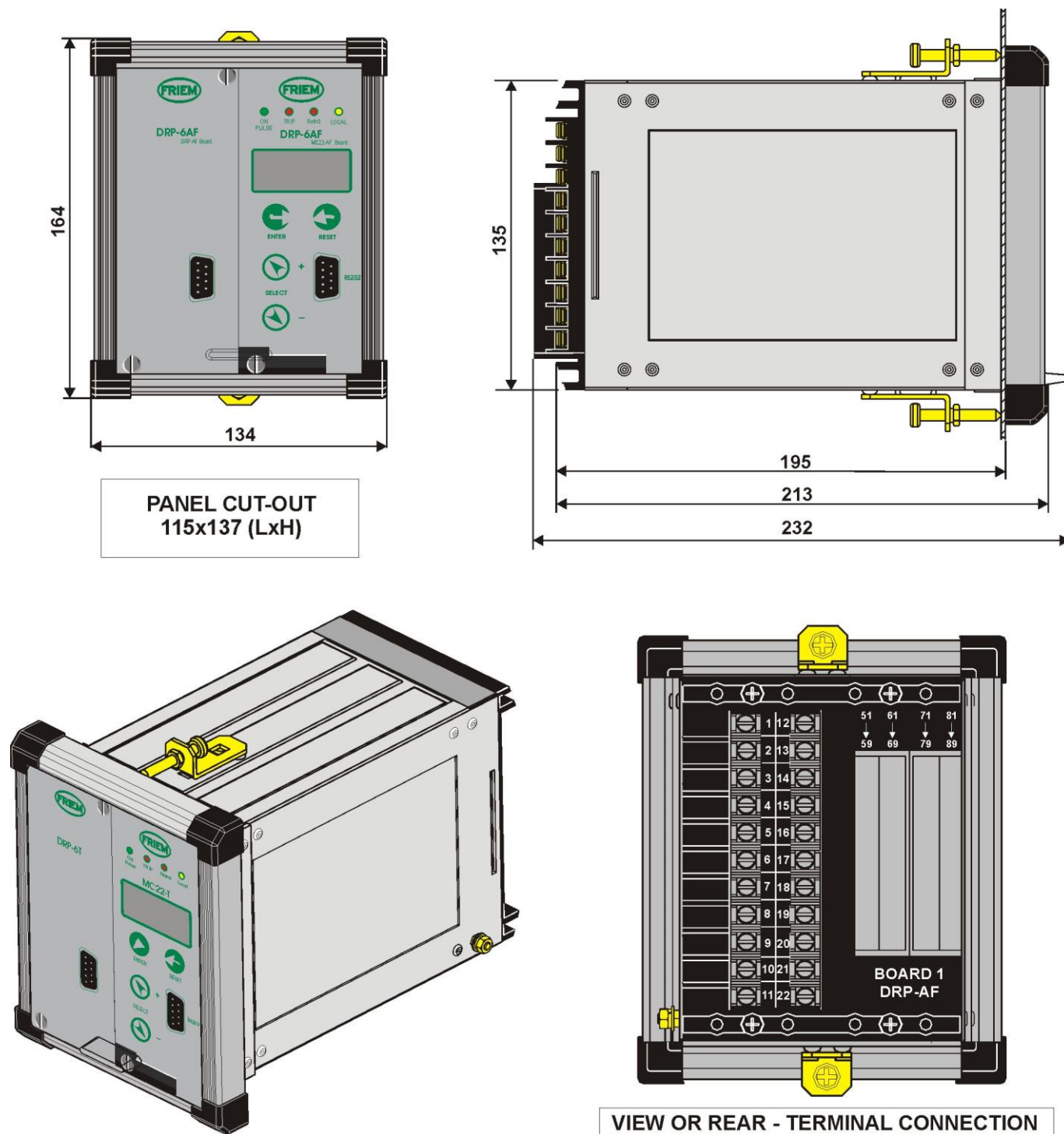
Every relay individually undergoes a factory insulation test according to IEC255-5 standard at 2 kV, 50 Hz 1min. Insulation test should not be repeated as it unusefully stresses the dielectrics.

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.

15. DRP-6AF - Wiring Diagram



16. DRP-6AF - Overall Dimensions (mm)



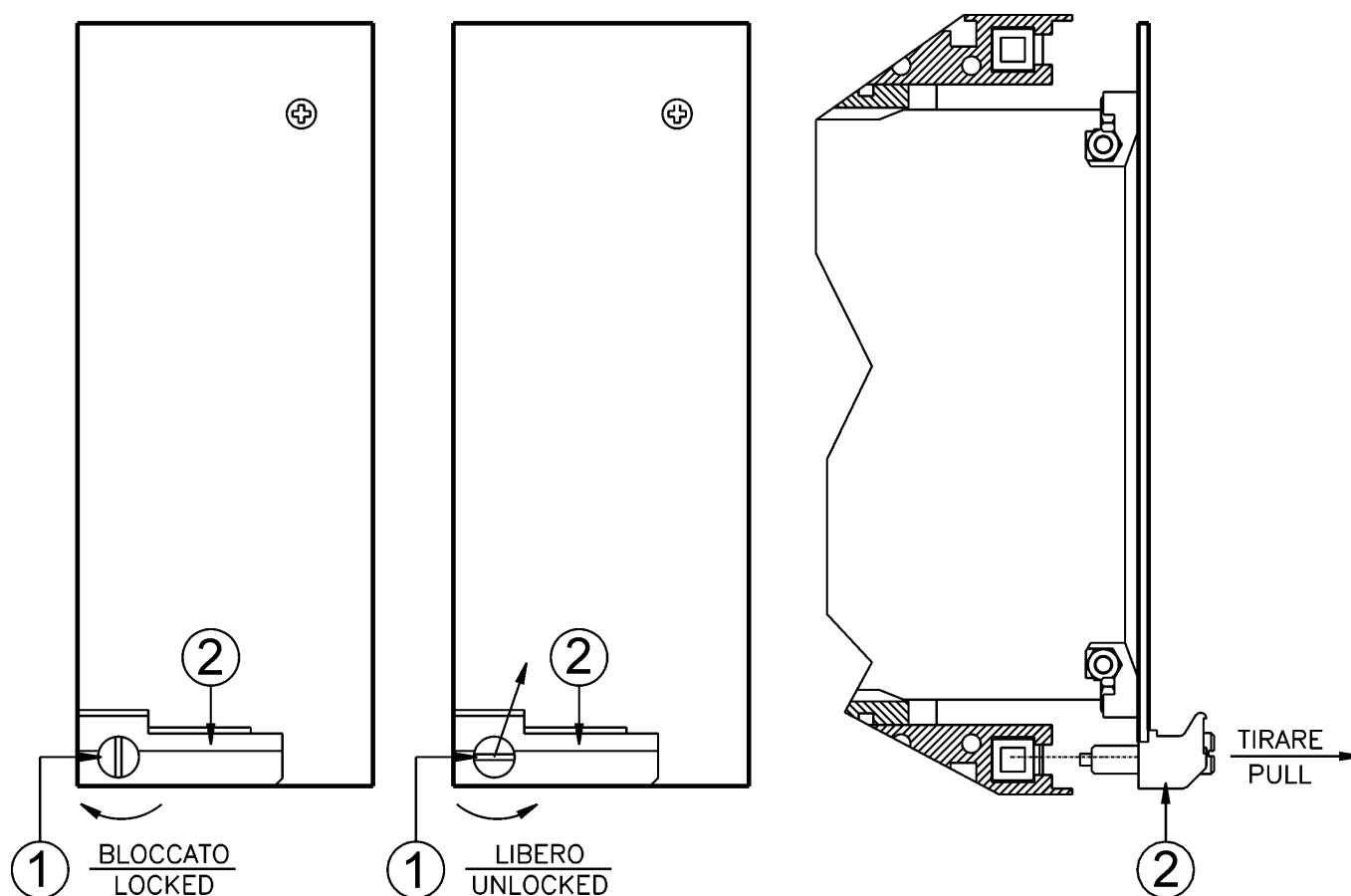
17. Direction for Pcb's Draw-Out and Plug-In

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 ENV50204	level 3	80-2000MHz 900MHz/200Hz	10V/m 10V/m
☐ Conducted disturbances immunity test	IEC61000-4-6	level 3	0.15-80MHz	10V
☐ Electrostatic discharge test	IEC61000-4-2	level 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	<3% F.s. for regulation <2% F.s. for measure	
	2% + to (to=20÷30ms @ 2xIs)	for time
☐ Accuracy on regulation	3% 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