HITEKS
TELEMETRY AND ENERGY

INSTRUCTION MANUAL
HCR Regulator

MAN_0039_eng_HCR Regulator_ED.2.0_Nov 2022
(Valid Release Manual:2.0)

CE

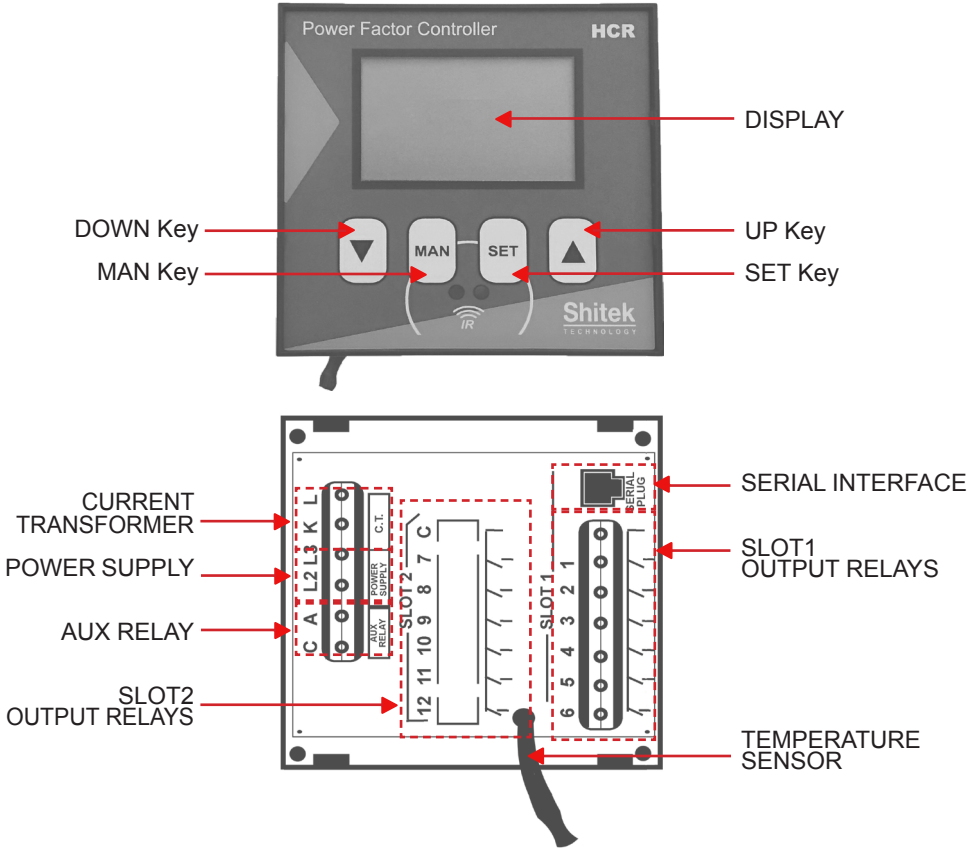
Index

Read this manual carefully: it provides needed information about safety, usage and maintenance.

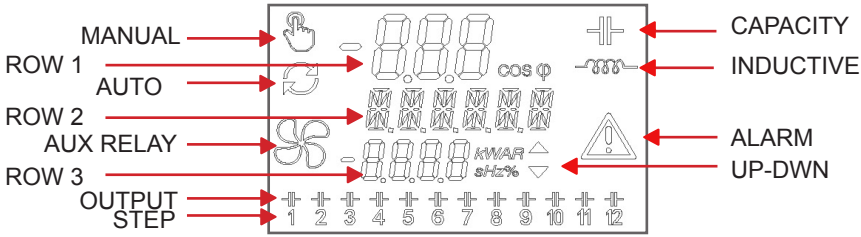
1. INTRODUCTION

HCR regulator allows the control and the regulation of the power factor on electric networks by measuring the electrical parameters such as voltage, current, Power factor,THDI(%),etc.
HCR regulator permits to adjust the power factor by connecting to the network some capacitor or inductive load using its 6 or 12 output relè.
A large LCD display and the four button keypad provide a simple and fast user interface.

2. DESCRIPTION



2.1 Display:



Manual Icon:
-Indicates if the manual mode is active.
Auto Icon:
-Indicates if the automatic mode is active.
Aux relay icon:
-Indicates the state of the auxiliary relay, if the icon is on, the Auxiliary relay is closed.
Output icons:
Indicates if the status of the correspondent output relay:
-Icon on - output relay is closed.
-Icon off- output relay is open.
-Icon Blink - Reconnection time state.
Step icons:
-Indicates if the power of the step is different from 0.
-Icon on – step power different form 0.
-Icon off- step power equal to 0.
Measure unit:
-Show the unit of measure of the data displayed in the Row 3: Measure.
Alarm Icon:
-Icon on-shows there are one or more alarms active.
-Icon off-no alarm.
Inductive icon:
-If it is on, the measured power factor is inductive.
Capacitive Icon:
-If it is on, the measured power factor is capacitive.
Up-down icon:
-If it is on, it is possible to change the setup.
-Row 1**:** normally shows the measured power factor, instead in setup menu shows the parameters code.
-Row 2**:** shows the name of the measure or parameter displayed in Row 3.
-Row 3**:** shows the measure or the parameter value.

2.2 Keyboard:
MAN key:
-Allows to select the operating mode manual or automatic.
-Allows to select the manual-connection menu.
SET key:
-Allows to scroll between pages of the same menu.
-Allows access to setup menu.
-In the setup menu allows to scroll the parameters and save it.
DOWN and UP keys:
-Allows to set the value in setup menu.

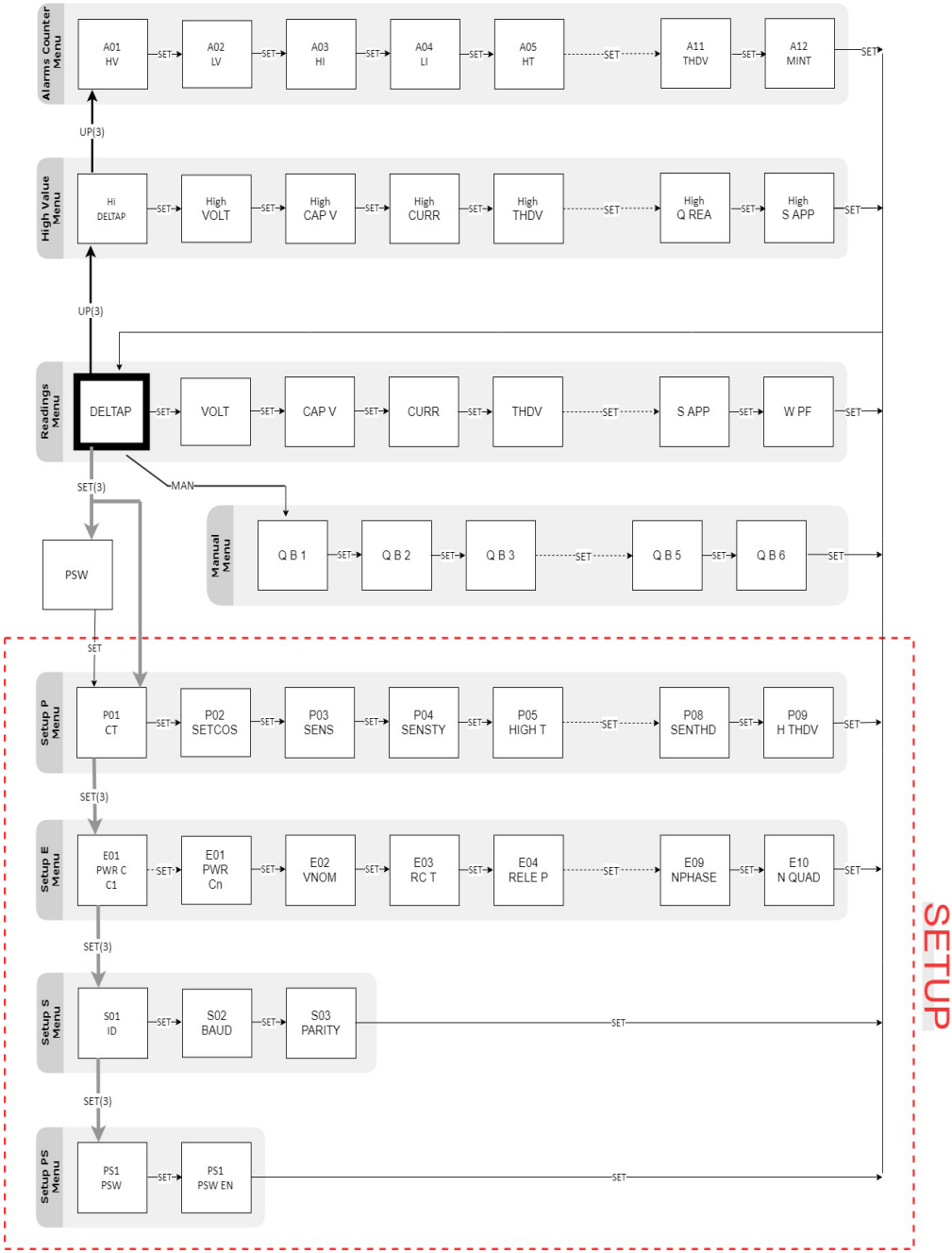
3. OPERATING MODES
HCR regulator allows to select the manual mode or the automatic mode.To change the operating mode it is sufficient to press for 3 sec the MAN key. Manual icon and Automatic icon show the selected operating mode.The selected operating mode is stored in the memory and will be set after every power on.

3.1 Manual mode:
In this mode HCR regulator allows to open and close manually the output relays.The manual mode allows the calculation and the viewing of all measures and alarms. Only the automatic connection function is disabled.
To open or close the output relays:
-Select the DELTA_P screen (see the MENU diagram for further details).
-Press shortly MAN key to select the Q B 1 screen.
-Press shortly SET key to select the step to connect / disconnect.
-Press at least 3 seconds the MAN key to connect / disconnect the selected step.

3.2 Automatic mode:
In automatic mode HCR regulator manages the output relays state to connect or disconnect the capacitive loads to reach the threshold setcosφ.The algorithm that manage the output relays state takes into account of all the measures and other parameters like the power and the number of operation of each step and the reconnection time.

4. MENU DIAGRAM

The image below shows the structure of the menus.



Each arrow correspond to a pressure of any key. At the centre of each arrow is described the type of key pressure. Pressing the keys may have different effects depending how long the keys are pressed; the following conventions will be used:

-MAN : press shortly (click) the MAN key.
-MAN(3): Press at least 3 seconds the MAN key.
-SET : press shortly (click) the SET key.
-SET(3): Press at least 3 seconds the SET key.
-UP : press shortly (click) the UP key.
-UP(3): Press at least 3 seconds the UP key.
-DOWN : press shortly (click) the DOWN key.
-DOWN (3): Press at least 3 seconds the DOWN key.

The main screen is the DELTAP screen; HCR regulator displays this screen after a power up, and after 30sec without any key pressure and without any active alarm. If there are some active alarms, press SET to scroll all the active alarms and to return to the DELTAP page.
If HCR regulator is showing another screen press MAN to return to the DELTAP screen. From the screen DELTAP it is possible to scroll all the measures of the Readings menu by pressing SET. When HCR regulator is showing the last measure of the readings menu press SET to return to the DELTAP screen. To select the High Value Menu to press UP(3) from the DELTAP screen. To select the Alarms Counter Menu press UP(3) from the HI DELTAP screen. To select the Setup Menu press SET(3) from the HI DELTAP screen. To select the Q B 1 screen press MAN from the DELTAP screen. To change from the Manual mode to the automatic mode and vice versa press MAN(3) from the DELTAP screen.

4.1 Readings menu:

The readings menu contains all the screens necessary to show the measures calculated from HCR regulator. In the following table are described all the screens of this menu:

Screen n°	Row 1	Row 2	Row 3	Unit	Note
1	cosφ	DELTAP	Measure value	Var	Missing reactive power to reach the Setcosφ setpoint
2	cosφ	VOLT	Measure value	V	Rms Voltage
3	cosφ	CAP V	Measure value	V	Rms calculated voltage in the capacitor
4	cosφ	CURR	Measure value	A	Rms current
5	cosφ	THDV	Measure value	%	Voltage total harmonic distortion
6	cosφ	THDI	Measure value	%	Current total harmonic distortion
7	cosφ	TEMP	Measure value	°C	Temperature
8	cosφ	P ACT	Measure value	W	Active power
9	cosφ	Q REA	Measure value	Var	Reactive power
10	cosφ	S APP	Measure value	VA	Apparent power
11	cosφ	W PF	Measure value		Weekly average power factor

4.2 High value menu

The High value menu contains all the screens that show the maximum value of each measures calculated from HCR regulator. In the following table are described the screens of this menu:

Screen n°	Row 1	Row 2	Row 3	Unit	Note
1	Hi	DELTAP	Measure value	Var	Maximum missing reactive power to reach the Setcosϕ
2	Hi	VOLT	Measure value	V	Maximum Rms Voltage
3	Hi	CAP V	Measure value	V	Maximum Rms calculated voltage in the capacitor
4	Hi	CURR	Measure value	A	Maximum Rms current
5	Hi	THDV	Measure value	%	Maximum Voltage total harmonic distortion
6	Hi	THDI	Measure value	%	Maximum Current total harmonic distortion
7	Hi	TEMP	Measure value	°C	Maximum Temperature
8	Hi	P ACT	Measure value	W	Maximum Active power
9	Hi	Q REA	Measure value	Var	Maximum Reactive power
10	Hi	S APP	Measure value	VA	Maximum Apparent power
11	Hi	W PF	Measure value		Maximum Weekly average power factor

4.3 Alarms counters menu

The Alarms counter menu contains the screens that show the number of registered alarms.
In the following table are described all the screens of this menu:

Screen n°	Row 1	Row 2	Row 3	Unit	Note
1	A01	HI V	Measure value	-	High voltage counter
2	A02	LOW V	Measure value	-	Low voltage counter
3	A03	HI I	Measure value	-	High current counter
4	A04	LOW I	Measure value	-	Low current counter
5	A05	HITEMP	Measure value	-	High temperature counter
6	A06	HITHDI	Measure value	-	High THDI counter
7	A07	THTHDI	Measure value	-	Thermal THD counter
8	A08	L COMP	Measure value	-	Low Compensation counter
9	A09	H COMP	Measure value	-	High compensation counter
10	A10	MAIN F	Measure value	-	Main failure counter
11	A11	HITHDV	Measure value	-	High THDV counter
12	A12	M INT	Measure value	-	Micro interruption counter

**to get detailed information of alarms description go to paragraph Alarms.*

4.4 Setup P menu

The Setup P menu contains all the screens of the parametric setup.
In the following table are described all the screens of this menu:

Screen n°	Row 1	Row 2	Row 3	Unit	Note	Range	Default value
1	P01	CT /5	Parameter value	-	Primary current transformer	5 → 25.0k	500
2	P02	SETCOS	Parameter value	-	Cosφ setpoint	0.500 Cap → 0.500 Ind	0.975 Ind
3	P03	SENS	Parameter value	sec	Action time	0.1 sec → 100.0sec	50.0
4	P04	SENSTY	Parameter value	-	Action time type	Nor → Act	Act
5	P05	T FAN	Parameter value	°C	Fan start temperature	20 → 80	35
6	P06	HIGH T	Parameter value	°C	High temperature Threshold	50 → 80	50
7	P07	T THD	Parameter value	%	Thermal THDI threshold	5 → 250	50
8	P08	HI THD	Parameter value	%	High THDI threshold	5 → 250	150
9	P09	SENS THD	Parameter value	Sec	Thermal THDI time	5 → 99	60
10	P10	H THDV	Parameter value	%	High THDV threshold	5 → 100	7

Parameter description:

Screen n°	Row 1	Row 2	Note	Function
1	P01	CT /5	Primary current transformer	Example: with a CT of 1000/5 set 100
2	P02	SETCOS	Cosφ setpoint	Desidered cosφ setpoin
3	P03	SENS	Action time	Maximum time between two consecutive action (connection, disconnection)*note1
4	P04	SENSTY	Action time type	The action type could be: Normal: the action time is always the same Act: Active, the action time change depending of the Delta Power value*note1
5	P05	T FAN	Fan start temperature	The output fan is closed if the measured temperature is higher than fan start temperature
6	P06	HIGH T	High temperature threshold	High temperature alarm Threshold
7	P07	T THD	Thermal THDI threshold	Thermal THDI alarm threshold*note2
8	P08	HI THD	High THDI threshold	High THDI alarm threshold*note2
9	P09	SENTHD	Thermal THDI time	Thermal THDI time*note2
10	P10	H THDV	High THDV threshold	High THDV alarm threshold

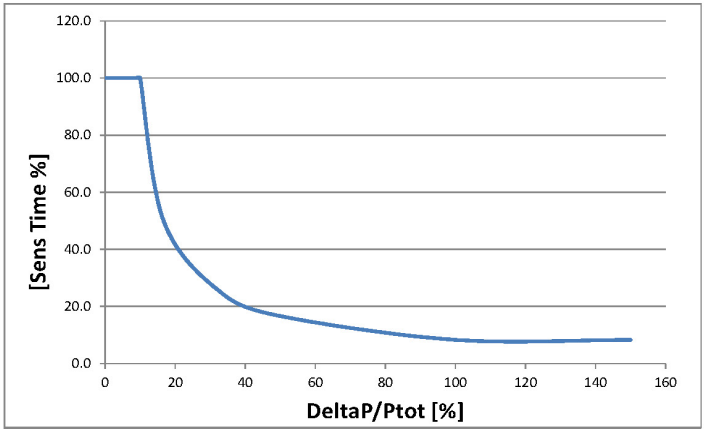
***note1 – P03 - SENS:**
SENS – Action time is the time interval that the HCR regulator have to wait between 2 consecutive operations.
For example if the regulator have to close n°2 output relays (connect n° 2 Capacitor banks) to reach the setcosϕ, this operations will be done waiting a SENS time interval between the first and the second operation.

If the SENSTY is set as normal, the SENS - Action time will be in any case equal to the set value.
If the SENSTY is set as Act, the SENS - Action time will change depending on the DELTAP value, with an inversely proportional relationship.
High Deltap → Low SENS

Low DeltaP → High SENS
The HCR regulator will work quickly if the DELTAP is high, will work slowly if the DELTAP is low.
For example:

-If the DELTAP is higher than the sum of the capacitor banks power (Ptot) the SENS – Action time will be divided by 12. (SENS = 50s → Action time = 4.1sec)
-If the DELTAP is higher than the Ptot/2 the SENS – Action time will be divided by 6. (SENS = 50s → Action time = 8.3sec)
-If the DELTAP is higher than the Ptot/3 the SENS – Action time will be divided by 4. (SENS = 50s → Action time = 12sec)
-If the DELTAP is higher than the Ptot/6 the SENS – Action time will be divided by 2. (SENS = 50s → Action time = 25sec)
-If the DELTAP is lower than the Ptot/6 the SENS – Action time will be divided by 1. (SENS = 50s → Action time = 50sec)

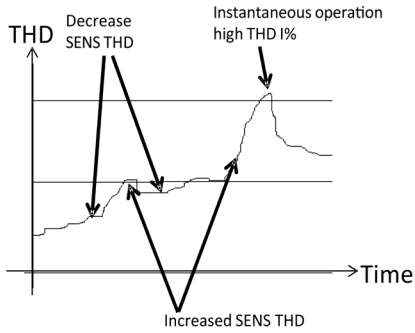
The relationship between the SENS – Action time and the DELTAP measure is shown it the chart below.



***note2 - P07 T THD:**
HCR regulator continuously monitors the total harmonic distortion of the current.
If the instantaneous THDI is greater than the threshold T THD, the system decreases the value of SENS THD.

-The SENS THD is decreased of 1 every second that the measured THDI is higher than the T THD parameter.
-The SENS THD is encreased of 1 every second that the measured THDI is lower than the T THD parameter.

If the SENS THD reach the value 0, the alarm Therm thd will be generated.
This algorithm allows to simulate a warming of the capacitor due to harmonics.
HCR regulator will disconnect the capacitor banks in case of Therm thd alarm, avoiding dangerous overheating and protecting the capacitors.
The Hi THD parameter is the High THDV alarm threshold. If the measured THDI go up to the Hi THD parameter instantaneously HCR regulator will disconnect the capacitor banks.



The Setup E menu contains all the screens of the extended parametric setup.
In the following table are described all the screens of this menu:

4.5 Setup E Menu

Screen n°	Row 1	Row 2	Row 3	Unit	Note	Range	Default value
1	E01	PWR C	Parameter value	Var	Power of the capacitors	0 → 1000k *note1	R1 50.0k R1 50.0k R1 50.0k R1 50.0k R1 100.0k R1 100.0k
2	E02	VNOM	Parameter value	V	Capacitors nominal voltage	80 → 65000	450
3	E03	RC T	Parameter value	sec	RC time	1 sec → 100sec	30
4	E04	RELE P	Parameter value	-	Auxiliary relay function	FAn – A nO – A nC	A nO
5	E05	EXT VT	Parameter value	-	External voltage transformer presence	En – Dis	Dis
6	E06	RAT VT	Parameter value	-	Voltage transformer ratio	0.1 → 1000.0	1.0
7	E07	RAT MT	Parameter value	-	MT ratio	0.1 → 1000.0*note2	1.0
8	E08	FREQ	Parameter value	Hz	Network frequency	50 - 60	50
9	E09	NPHASE	Parameter value	-	Network type	1 (single) – 3 (3-phase)	3
10	E10	NQUAD	Parameter value	-	Quadrant type	2 – 4	2

Parameter description:

Screen n°	Row 1	Row 2	Note	Function
1	E01	PWR C	Power of the capacitors	Setup of the power or other particular function of each capacitor bank. *note1
2	E02	VNOM	Capacitors nominal voltage	Capacitors nominal voltage
3	E03	RC T	RC time	Minimum time to wait between the disconnection of a capacitor bank and a subsequent reconnection.
4	E04	RELE P	Auxiliary relay function	Auxiliary relay could be setup as: • A nO : Alarm relay normally Open*note2 • A nC: Alarm relay normally Close • FAn: Fan output, the contact will be closed if the • measured temperature is higher than T FAN parameter
5	E05	EXT VT	External voltage transformer presence	External Voltage transformer presence: • En: transformer present • diS: not present
6	E06	RAT VT	Voltage transformer ratio	Ratio between primary voltage and secondary voltage of the voltage transformer.
7	E07	RAT MT	MT ratio	*note3
8	E08	FREQ	Network frequency	Network frequency, 50 or 60Hz
9	E09	NPHASE	Network type	Select the type of network between mono phase and three phase
10	E10	NQUAD	Quadrant type	If the plant have a cogenerator or a photovoltaic system select 4 quadrants, otherwise select 2 quadrants

***note1 – E02 PWR C**
In this screen it is possible to setup the reactive power of each capacitor banks.
Using Up and Down keys it is possible to increase or decrease the reactive power.
It is possible to set each output relays as “fixed”.
The fixed outputs will hold the state (open or close) set in the MAN screen.
To set an output relay as fixed it is necessary to set the power to 0.0Var, and press a new time the down key.
Using the Set key it is possible to save the parameter and move from the setup of the actual output relay to the next one.

The last output relay (n°6 or n° 12) can be configured as:
-A nO : Alarm relay normally Open
-A nC: Alarm relay normally Close
-FAn: Fan output, the contact will be closed if the measured temperature is higher than T FAN parameter
-A Au: Alarm relay, closed if HCR regulator is in manual mode, open if HCR regulator is in automatic mode.

***note2 - E04 RELE P**
The alarm relay is active if at least one of these alarms is active:
-High voltage
-Low voltage
-High current
-High temperature
-High THDI
-High THDV
-Thermal THDI
-High compensation
-Low compensation
-Main failure
-Microinterruption*

note3 – E07 RAT MT
Where the reading of the voltage occurs upstream of a medium voltage transformer (using a TV as described above) but the capacitor banks are connected downstream, it becomes necessary to set the ratio of medium voltage through the parameter RATIO_MT. (see 8.3 paragraph)

4.6 Setup S menu

The Setup E menu contains the screens of the extended parametric setup. In the following table are described all the screens of this menu:

Screen n°	Row 1	Row 2	Row 3	Unit	Note	Range	Default value
1	SE01	Id	Parameter value	-	Modbus slave address	0 → 255	1
2	S02	bAUd	Parameter value	Bps	Baud rate	1200 – 4800 – 9600 – 19200 – 38400 - 115200	9600
3	S03	PArITY	Parameter value	-	Parity	None – Even - Odd	None

The Setup E menu contains the screens of the extended parametric setup.
In the following table are described all the screens of this menu:

Screen n°	Row 1	Row 2	Row 3	Unit	Note	Range	Default value
1	PS1	PSW	Parameter value	-	Insert Password	0000 →9999	0001
2	PS2	PSW	Parameter value	-	Password enable	En - dIS	dIS

Parameter description:

Screen n°	Row 1	Row 2	Note	Function
1	PS1	PSW	Parameter value	Insert the password*note1
2	PS2	PSW	Parameter value	Enable or disable the password request to access to setup menu*-note1

***note1 – PS1 PSW**

Default: password = 0001, Disabled.
Using Up and Down keys it is possible to increase or decrease the digit value.
Using the Set key it is possible to select the next digit.
Using the Man key it is possible to select the previous digit.
If the password request is disabled in the PS1 screen it is necessary to insert the password and press the SET key to select the PS2 screen.
In the PS2 screen it is possible to enable or disable the request of the password before to access to setup menu.If the password request is enabled, user have to insert the password to access to the setup menu.
If the password request is enabled, in the screen PS1 it is possible to insert a new password, and pressing the SET Key, when the last digit is selected, automatically the HCR regulator save the new password and delete the old password.

5. ALARMS

The following table describes the various types of alarms:

Alarm N.	Row 1	Row 2	Alarm relay activation	Output relay Disconnection	Alarm description	Alarm condition	Alarm delay [s]
1	A01	HI V	yes	Yes	High voltage	CAP V > 110% VNOM	60.0
2	A02	LOW V	Yes	Yes	Low voltage	CAP V < 80% VNOM	5.0
3	A03	HI I	Yes	Yes	High current	CURR > 5A * (CT /5)	60.0
4	A04	LOW I	No	Yes	Low current	CURR < 0.1A * (CT /5)	30.0
5	A05	HITEMP	Yes	Yes	High temperature	TEMP > T FAN	30.0
6	A06	HITHDI	Yes	Yes	High THDI	THDI > HI THD	0.0
7	A07	THTHDI	Yes	Yes	Thermal THD	THDI > T THD (details on Paragraph 4.4)	Depends on par SENTHD
8	A08	L COMP	Yes	No	Low Compensation	COSφ < SETCOS	900.0
9	A09	H COMP	Yes	Yes	High compensation	COSφ > SETCOS	120.0
10	A10	MAIN F	Yes	Yes	Main failure	CAP V < 10% VNOM	1.0
11	A11	HITHDV	Yes	Yes	High THDV	THDV > H THDV	0.0
12	A12	M INT	Yes	Yes	Micro interruption	Hole in the Voltage sine wave with duration > 0.5 Period	0.0

When an alarm occours, HCR regulator turn on the alarm icon, and visualize the corresponding alarm screen. To scroll the active alarms screens press the SET key.
When the alarms screens queue is ended, the HCR regulator return to the DELTAP screen.
After 30s, if there are active alarms, HCR regulator visualize a new time the Alarm screens.

6. TECHNICAL CHARACTERISTICS

Power supply	
Maximum rated voltage	85 → 490Vac
Operating voltage range	85 → 490Vac
Frequency	50 / 60Hz
Power consumption	10VA
Recommended fuse	0.5A

Voltage measure	
Measuring range	85 → 490Vac
Frequency range	45 → 65Hz
Input impedance	6MΩ

Current measure	
Maximum rated current	6.0A
Operating current range	0.1 - 5.0A
Input type	Shunt for external C.T.
Power consumption	< 1VA

Relay output	
Quantity	7
Maximum rated voltage, open contacts	440V
Maximum rated current	8A → 250Vac (AC1)
Maximum current common terminal	10A
Maximum power	2kW
Electrical Life	1*105
Mechanical working life	2*107

User interface	
Display	LCD with back light
Backlight color	White
Keypad	4 keys

Optical interface	
Standard	IEC 62056
Protocol	Modbus-RTU
Baud rate	9600bps
Parity	None
Stop bit	1

Serial plug*	
Type	RS232 TTL
Protocol	Modbus-RTU
Baud rate	1200 → 115200bps
Parity	None – Even - Odd
Stop bit	1

*Optional communication module:
-RS485/RS232
-USB
-ETHERNET

Environment operating condition	
Operating temperature	-20 → +55°C
Storage temperature	-30 → +60°C
Relative humidity (non-condensing)	< 80%

Mechanical characteristics	
Dimensions	96*96*57mm
Weight	280g
Enclosure	Self-extinguishing V0 plastic
Mounting type	Panel Flush mount
Protection degree	IP54 front IP20 rear
Panel Cutout	92*92mm

Connection	
Type	Plug in – removable
Diameter of wire	0.5mm → 2.0 mm

7. Location of the current transformer

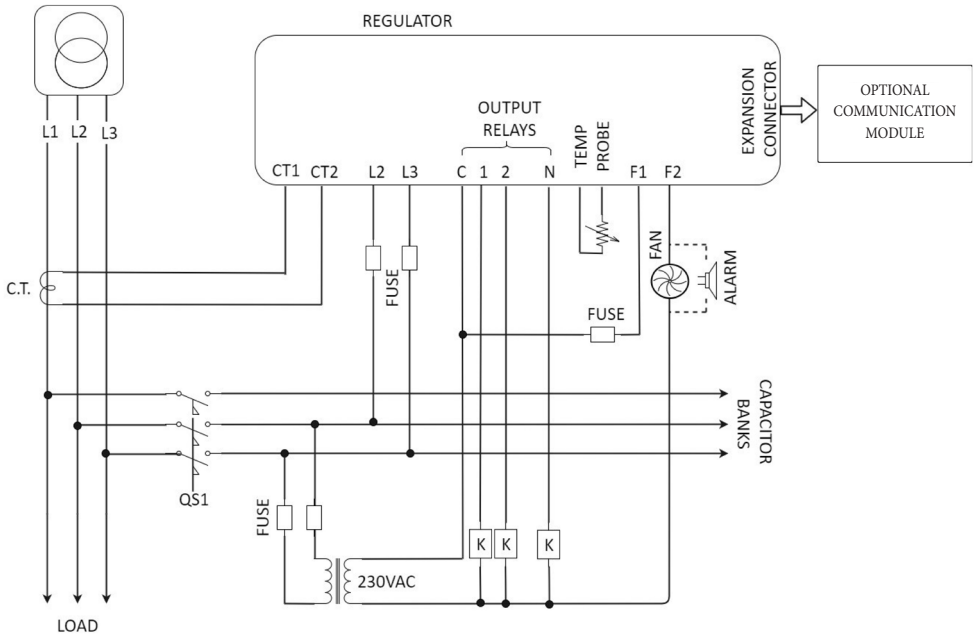
The current transformer have to measure the sum of the load current and the capacitors current as shown in the next image.

8. Wiring diagram

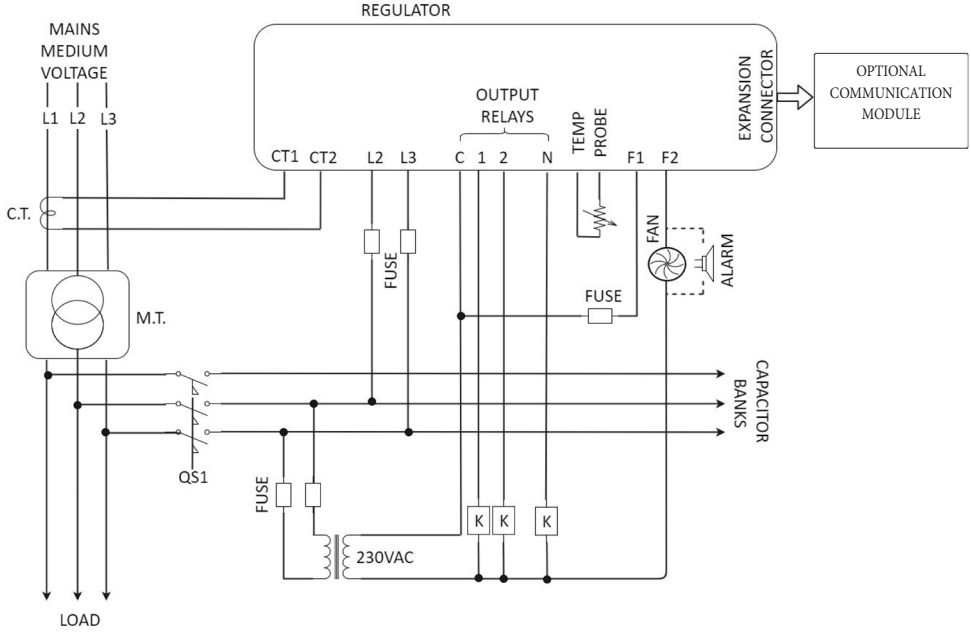
WARING:

-HCR regulator has to be installed by qualified personnel.
-Before any maintenance operation on the device remove the power supply from voltage input and from output relays.
-If it is necessary to remove the terminals from the HCR regulator, short circuit the C.T. terminal to avoid to damage it.
-The manufacturer cannot be held responsible for electrical safety in case of improper use of the HCR regulator.

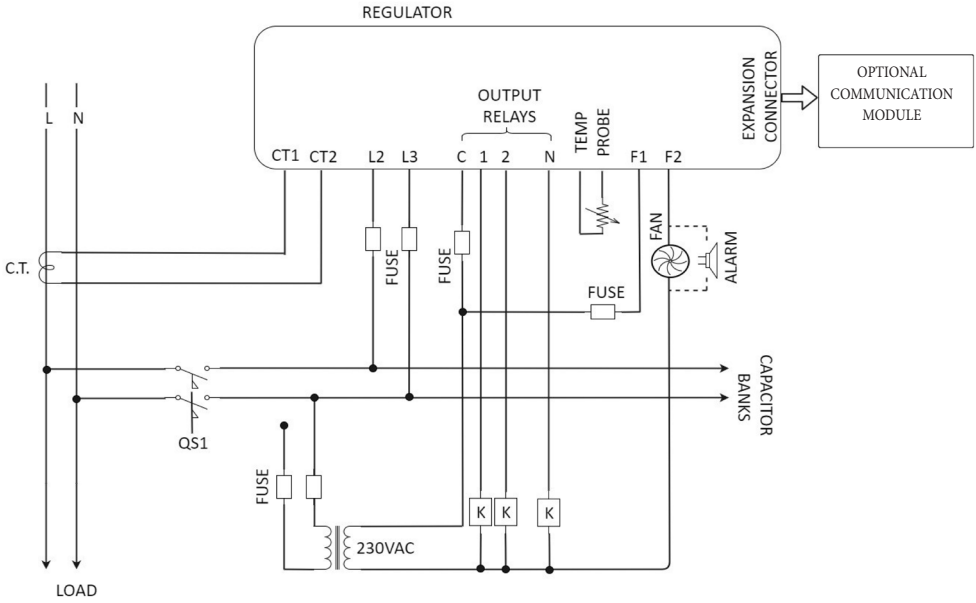
8.1 Standard connection:



8.2 MT connection:



8.3 Single phase connection:



9. WARRANTY

Shitek Technology s.r.l warranty its products for 12 months from purchase date.
Technical speci ications are valid under normal operating conditions as speci ied in this document. We do not accept any responsibility for any use of the product and cannot be held liable for indirect or consequential damages.

10. CERTIFICATIONS

Compliance to:

-2014/35/EU (Low Voltage)
-2014/30/EU (Electromagnetic compatibilliity)
2011/65/CE (RoHS directive)
-2015/863/CE
-2017/2102/CE
-2012/19/CE (RAEE directive)

Reference standards:

-EN 61010-1:2010+A1:2019
-EN 61326-1:2013
-EN 61000-6-2:2019
-EN 61000-6-3:2007+A1:2011

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Guarantee
Due to the continuous development of its products, Shitek Technology Srl reserves the right to make changes to the technical data and functions without prior notice.
The consumer is guaranteed against defects in conformity of the product according to the European Directive 1999/44/c as well as the document on the manufacturer's warranty policy. On request, the full warranty text is available from the seller on www.shitek.it

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