

## Reactive Power Regulator mod. REQ/H 6-8-12

REQ/H is microprocessor based regulation unit for automatic power factor control systems, with relay outputs for driving up to 12 capacitor banks.

The unit has been designed to ensure high accuracy in power factor regulation and excellent utilization of capacitor banks and relays, even in presence of high environmental noise and strongly distorted current signals possibly present on industrial plants.

The regulator can be installed on three-phase 50/60 Hz networks with straight or quadrature insertion, through a CT (current transformer) to get the line current. It is also possible to apply the unit on mono-phase networks. All input circuits are internally galvanically insulated one respect each other.

The front panel is equipped with a 3-digits 7 segments display to show the present value of power factor, voltage and line current: it makes possible to avoid the installation of other panel meters (voltmeters and ammeters) on the power rack.

A complete set of panel leds notifies the device status, the capacitor banks inserted, the power factor region (ind/cap) and if the automatic regulation is active (C/K).

By means of four keys it is possible to display the measures, to setup the unit, to make manual operations on capacitor banks and reset alarms.

The regulator is provided with many protection features, through a continuous monitoring of the following quantities:

- line voltage: an alarm is issued when it exceeds the threshold programmed value for a time longer than 30 minutes;
- line current: an alarm is issued when it exceeds +20% more than nominal value;
- power factor: an alarm is issued if the power factor is not properly compensated within 15 minutes.

Alarms are automatically reset when the alarm condition disappears: nevertheless, if more than 3 alarms occur within one hour, a manual reset is requested, to notify an abnormal condition with a possible fault into the electrical system.

The **TPDS™** (True Phase Detection System) technology applied to voltage and current signals processing allows the regulator to operate accurately even with strongly distorted waveforms: using an advanced digital processing approach the unit is able to keep out from all harmonic components only the fundamental sinusoidal voltage and current waveforms, to evaluate the relative phase lag for the correct reactive power regulation.

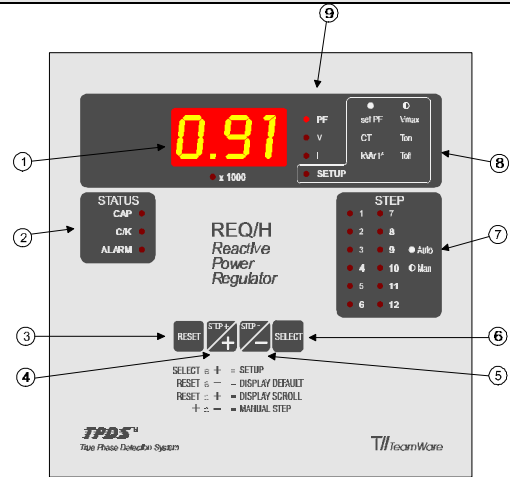
### 2 - Available Models

- REQ/H6 6 steps
- REQ/H8 8 steps
- REQ/H12 12 steps

### 3 - Main Specifications

- ABS case, 144 x 144 mm
- Auxiliary power supply 115/230 V~
- Voltage input 80/500 V~ at 50 Hz or 60 Hz
- Quadrature (three-phase networks) or straight (mono-phase) wiring
- Current input via standard CT /5A
- True RMS current and voltage measure even with harmonics
- Power factor setting range from 0.85ind. to 095cap.
- Primary current setting range from 5 A to 10000 A
- 1<sup>st</sup> capacitor bank setting range from 1 kVAR to 999kVAR
- insertion and disconnection times for capacitor banks independently programmable
- non volatile storing of setup parameters
- 3 digit display for power factor, line voltage, line current
- manual manoeuvres on capacitor banks with non volatile storing
- voltage alarm thresholds programmable
- current alarm thresholds fixed at +20 % of nominal current
- alarm relay output (NC)

### 4 - Front Panel



- (1) Led display for power factor, voltage and current showing
- (2) Status Led: cap/ind power factor, C/K active, alarm
- (3) Manual reset
- (4) Increment setup parameter value / manual insertion of capacitor bank
- (5) Decrement setup parameter value / manual disconnection of capacitor bank
- (6) Select measure or setup parameter
- (7) Step status Led
- (8) Description table for setup parameters
- (9) Pointer Led to measure or setup parameter currently displayed

### 5 - Front Panel Display and Keys

MEASURE LED	
⊗ PF, V, I	Indicate the currently displayed measure (PF, voltage, current) (Note that the <i>SETUP</i> led is Off).
⊗ x 1000	Multiplier x 1000 for displayed value.

STATUS LED	
⊗ CAP	Capacitive PF indicator.
⊗ C/K	<b>On:</b> the line current has a value over the minimum to permit the automatic PF regulation. <b>Blink:</b> the line current is under the minimum value to permit the automatic PF regulation. In this case the steps condition remains unchanged. <b>Off:</b> line current is under the lowest current that the regulator can measure. In this case the capacitor banks are detached.
⊗ ALARM	Blinks together with the led corresponding to the alarmed measure, to indicate an alarm condition reached by one or more measures.

SETUP LED	
⊗ <b>set PF, V, I, Vmax, Ton, Toff</b>	Indicate the currently displayed setup parameter ( <i>note that the SETUP led is On</i> ): <ul style="list-style-type: none"> <li>1<sup>st</sup> level parameters (led On): PF set-point, CT primary current, 1<sup>st</sup> (lowest) step kVAR (referred to nominal voltage).</li> <li>2<sup>nd</sup> level parameters (led Blink): maximum voltage threshold, insertion time (seconds), disconnection time (seconds).</li> </ul>

KEYS	
(one key pressed)	
<b>RESET</b>	<ul style="list-style-type: none"> <li>during the normal operating mode, forces an alarm reset (kept pressed over 3 sec.);</li> <li>during a setup session, forces the default value for the currently displayed parameter.</li> <li>During the power on, forces the default value for all the parameters.</li> </ul>
<b>+</b>	<ul style="list-style-type: none"> <li>During a manual operation, inserts the selected capacitor bank. If pressed twice, the insertion will be permanently stored into non volatile memory (blinking led).</li> <li>During a setup session, increments the value of currently displayed parameter.</li> </ul>
<b>-</b>	<ul style="list-style-type: none"> <li>During a manual operation, disconnects the selected capacitor bank.</li> <li>During a setup session, decrements the value of currently displayed parameter.</li> </ul>
<b>SELECT</b>	<ul style="list-style-type: none"> <li>During the normal operating mode, selects the measure to be displayed.</li> <li>During a manual operation, selects the bank to be manually operated.</li> </ul>

SPECIAL KEYS	
(two keys pressed together)	
<b>SELECT with +</b>	If pressed for 5 sec., enter the setup session.
<b>RESET with -</b>	If pressed in normal operating mode, fix the currently displayed measure as default display after power on (default measure is PF).
<b>RESET with +</b>	If pressed in normal operating mode, they start a cyclic loop of the measures on display (loop time 3 sec.)
<b>+ with a -</b>	Force manual operation on capacitor banks.

## 6 - Programming the unit

To program the unit, press the keys **SELECT** and **+** together for a time longer than 5 sec. The regulator will disconnect recursively the connected capacitor banks and then will light on the setup led. The programmable parameters are the following:

### 1<sup>st</sup> level parameters (setup led ON):

- PF set-point (from 0.85 ind. to 0.95 cap.): default 0.90
- CT primary current (from 5 to 10000 A): default 500 A
- 1<sup>st</sup> (lowest) capacitor bank kVAR (from 1 to 999 kVAR), referred to voltage nominal value: default 5 kVAR

### 2<sup>nd</sup> level parameters (setup led blinking):

- maximum voltage threshold (from 80 to 540 V): default 418 V
- delay between two consecutive step insertions (when PF is below the set-point) (from 5 to 60 sec.): default 30 sec.
- delay between two consecutive step disconnections (when PF is over the capacitive limit) (from 5 to 60 sec.): default 5 sec.

Using the keys **SELECT**, **+**, **-**, select and modify the value of each parameter. The parameter currently being modified is marked by the corresponding led (for 2<sup>nd</sup> level parameters the led is blinking). Look at the description table on the front panel to have the name of setup parameters.

After 10 seconds from last key pressing, the setup session automatically finishes, the setup led lights off and the regulator will return back to operating mode.

## 7 - Selecting the line frequency

During the power on sequence, the unit prompts the line frequency established:

**F50** : 50 Hz (default)

**F60** : 60 Hz

It is possible to select the line frequency between 50 and 60 Hz. To program the line frequency, keep pressed during the power-on the keys **RESET** and **-**: the regulator alternatively toggles from 50 to 60 Hz frequencies.

The achieved selection is permanently stored into a non-volatile memory, until modified again.



*Note that it is absolutely required to set the regulator for the effective line frequency, otherwise an improper service will result.*

## 8 - Selecting the wiring type

During the power-on sequence, the unit prompts the wiring type:

**3 Ph** : three-phase wiring (quadrature) (default)  
**1 Ph** : mono-phase wiring (straight)

It is possible to select the wiring type between quadrature and straight. To program the wiring type, keep pressed during the power-on the keys **RESET** and **+**: the regulator alternatively toggles between three-phase and mono-phase wiring.

The achieved selection is permanently stored into a non-volatile memory, until modified again.



*Note that it is absolutely required to set the regulator for the wiring effectively performed, otherwise an improper service will result.*

## 9 - How the regulator operates

The regulator computes the true RMS measure of voltage and current signals and obtains the phase lag between their fundamental components. This measure is obtained from active (real) and reactive power values averaged on 5 seconds time, to guarantee accuracy and stability even with distorted waveforms.

Using the **SELECT** key it is possible to display the instantaneous values of PF, line voltage and current. The corresponding led indicates the displayed measure.

Pressing together the **RESET** and **+** keys, the display will make a cyclic scan of all the measures, with 3 sec. of pause time. Press any key to suspend the autoscan.

If the computed PF is capacitive, the led CAP lights on.

If there is no current or voltage signal, the PF cannot be evaluated. In this case the display prompts like this:

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If the computed PF results in a lower value than the required low threshold, the regulator will insert, after the programmed insertion time, the next available (if any) capacitor step. If the computed PF is over the upper threshold (see below), the regulator will detach (if any) the next capacitor step. If the PF remains within the low and high thresholds, the regulator keeps unchanged the capacitor banks configuration.

The upper PF threshold is fixed to 5 points over the programmed low set-point, as shown into the following table.

PF set-point (lower threshold)	Corresponding upper PF threshold
0.88 ind.	0.93 ind.
0.90 ind.	0.95 ind.
0.96 ind.	0.99 cap.
0.98 ind.	0.97 cap.
0.99 ind.	0.96 cap.
1.00	0.95 cap.
0.98 cap.	0.93 cap.

The attaching/detaching strategy always takes the first not-attached/detached capacitor step starting from bottom, according to the following diagram:

Step attaching sequence											
1	2	3	...	11	12						
X											
X	X										
X	X	X									
X	X	X									
X	X	X			X						
X	X	X			X	X					

Step detaching sequence											
1	2	3	...	11	12						
X	X	X		X	X						
	X	X		X	X						
		X		X	X						
				X	X						
				X	X						
					X						

## 10 - C/K operation

The automatic reactive power regulation is operated only if the measured line current exceeds the equivalent C/K value (reactive current equivalent to 1<sup>st</sup> capacitor bank load): in this case the **C/K led is ON**.

If the line current is below the C/K corresponding, the unit will keep unchanged the capacitor banks configuration: in this case the **C/K led is blinking**.

In case of very low current (lower than 5% of C/K current), the regulator will detach all the steps: in this case the **C/K led is OFF**.

## 11 - Manual operation

It is possible to operate manually on capacitor banks: pressing together the keys **+** and **-** the regulator prompts on the display the step to be manually controlled, starting from the first:

BO1

Use the **SELECT** key to select which is the bank to be manually operated and the **+** or **-** keys to attach or detach it.

Pressing twice the key **+** the manual insertion becomes permanently stored (even after a power down): this case is represented by the corresponding blinking led. Use the key **-** to remove the bank.

## 12 - Alarms

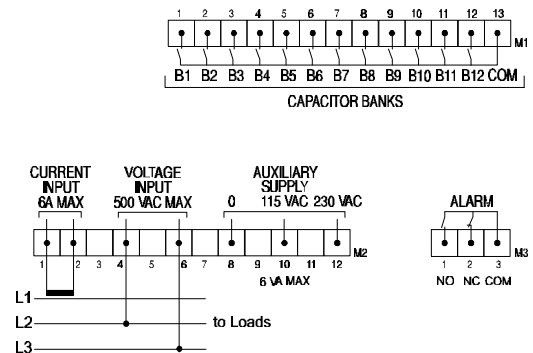
In case of alarm, the regulator acts as follows:

- **maximum voltage alarm** (voltage level exceeds the programmed threshold for a time longer than 30 min.): the unit disconnects all the steps (including the ones manually inserted), lights on the alarm led, opens the alarm relay contact, and forces to blink the voltage led;
- **current overload alarm** (line current beyond 6 A into the current circuit for more than 3 sec.): the unit lights on the alarm led, opens the alarm relay contact, and forces to blink the current led;
- **not compensated PF alarm** (PF compensation not achieved within 15 min.): the unit lights on the alarm led, opens the alarm relay contact, and forces to blink the PF led, but continuing the normal operation.

When the alarm event disappears, the regulator automatically exits from alarm condition: however if more than 3 alarms occur within one hour, the unit will require a manual reset of alarm, to notify an abnormal condition with possible fault into the electrical plant system.

To manually reset the alarm, press the **RESET** key for 3 seconds.

## 13 - Wiring diagram



*The unit must be installed, disinstalled, wired to mains circuit only by qualified personnel, aware of involved risks.*

*During the installation and disinstallation of the unit, remove voltage from electric circuit.*

*Respect carefully the wiring diagram, because a wrong insertion can produce damage to device and persons or an improper service. The maximum contacts load for each relay is 5A: in case of loads with power greater than 5 A, **it is indispensable** to use power contactors connected to relay contacts.*

#### 14 - Technical Specifications

Power supply	110/230 Vac $\pm$ 10%
Frequency	50/60 Hz
Power consumption	6 VA
Voltage input	80/500 Vac
Current input (insulated)	From CT /5 A permanent overload +20% consumption 0.01 VA
Current input range	1-100% of nominal current
PF setting range	from 0.85 ind to 0.95 cap accuracy $\pm$ 1 digit
Display	3 digits - 7 segments led type
Leds	Signalling of: <ul style="list-style-type: none"><li>▪ inserted steps</li><li>▪ measure displayed</li><li>▪ unit status</li></ul>
Step insertion time	from 5 to 60 sec.
Step disconnection time	from 5 to 60 sec.
Step relays number	6/8/12 depending on model
Relay contacts	5 A – 250 Vac resistive load transients suppressor included
Connection terminals	Plug in connectors
Alarm relay	NC type, 5 A - 250 Vac contacts
Working temperature	0 $\div$ 55 °C
Storing temperature	-10 $\div$ 70 °C
Protection class	IP41 no cover
Standards	EN61010-1, EN50081-2, EN50082-2
Weight	1.0 kg
Size	144x144x90 mm

*(Specifications subject to change without notice)*

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