Quasar SWITCH-MODE RECTIFIERS

Vega SWITCH-MODE RECTIFIERS

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SOFTWARE USER MANUAL:

ACRS_QV90_01.003_20210419

Applicable to all Software revisions:

QV90_01.003.xxx.xx

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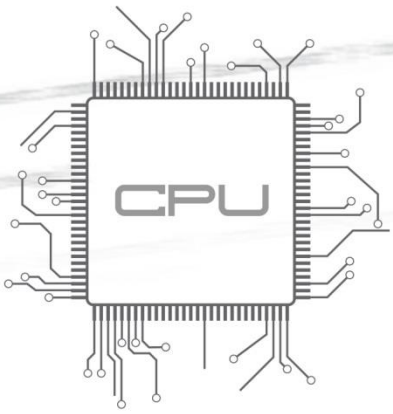

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CRS INDUSTRIAL POWER EQUIPMENT

INDEX

1 Introduction

Please ensure that you read the Software User Manual before start to use the rectifier.

This Manual describes the functions and the features of the software **QV90,** developed for **CPU090** to control the **Q-Series** and **Vega** rectifiers.

This generation of CPU090 & software QV90, compared with the previous CPU080 & software Q080, implements also a new functions and features:

- The Keypad has new name for keys commands, for details see *2.1 The Keypad.*

- It manages n. 2 RS485 communication ports: RS485#1 and RS485#2; the protocol RS232 is no more supported, for details see *2.2 Communication ports.*

- It manages the water flow sensor and the solenoid and measures the values of the water flow and temperature, for details see *3.14 Sensors Menu.*

- It manages the Ampere seconds counter, for details see *4.2 AH Menu.*

- All the errors are contemporary showed in the display, sent to the SCADA and stored in the LOG memory, stored in SD memory card (option on request) for details see *8.1 The list of messages.*

- It has the detection of the number of the power module units connected to the CPU, for details see *11. Detection of the number of half modules.*

The QV90 can be used to control a single rectifier, or more rectifiers operating in parallel, as a single machine. This system is called **Multi-Tower**.

The single rectifier or the multi-tower can be used to generate direct or reverse currents, pulses as short as 3ms and sinusoidal waves.

It is possible to control and program the rectifier in the following ways:

- by the front panel keypad,

- by the ACRS remote control: REM-8 or REM-8-E

- by an analog I/O PLC; in this case is necessary to install in the rectifier the analog interface card A080.

- by a PLC or a SCADA ; in this case, depending on the communication protocol used, it is necessary to install in the rectifier a network interface card. (Modbus and ASCII don't require the interface card).

ACRS supports every common protocols network, see SCADA interface setting in the Operating Configuration Menu.

When the rectifier is controlled by the keypad or by the ACRS REM the mode of control is called: **Local** , otherwise, if the control is made by PLC or SCADA, the mode of control is called: **Remote.**

2 Interfaces: keypad, communication ports

2.1 The Keypad

The keypad has new name for command keys, compared with the previous version of the software:

RUN replaces the command ON, **STANDBY** replaces the command OFF, **Remote** replaces the command Automatic and **Local** replaces the command Manual.

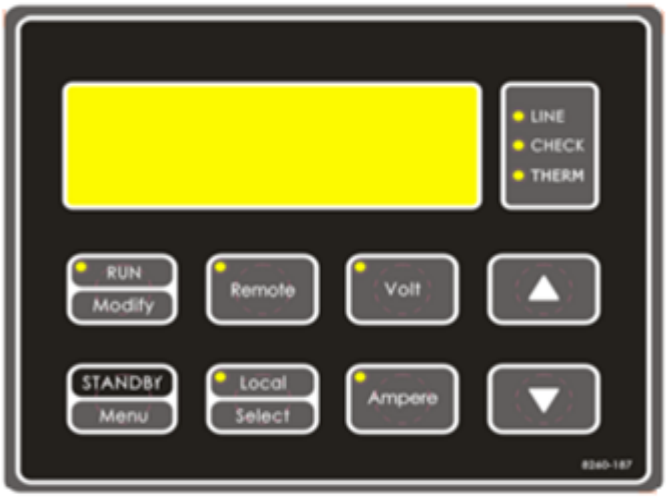


Figure 1: Keypad of the machine

(1) RUN *(ON)*/MODIFY	Function1:	Start the rectifier when it is in Local operating mode
	Function2:	Confirm data changed in a menu entry
	LED ON:	Machine started
	LED OFF:	Machine stopped (**STANDBY**)
(2) STANDBY *(OFF)*/MENU	Function1:	Machine stop **(STANDBY)**
	Function2:	Access the **Main Configuration Menu**
	Function3:	Leave a configuration menu
	Function4:	Reject changes in a menu entry
(3) Remote *(Automatic)*	Function:	The control of the machine is taken from PLC or SCADA
	LED ON:	Machine operating in **Remote**
	LED BLINKING:	The machine is receiving data from remote.
(4) Local *(Manual)*/SELECT	Function1:	The rectifier is controlled in **Local** by the Keypad or by the REM.
	Function2:	Sub-menu selection from menu top level
	Function3:	Make menu entry editable
	Function4:	Access the **Operating Mode Menu**
	LED ON:	Machine operatin in Local.
	LED BLINKING:	Data received by the machine if it is connected to a SCADA.

(5) VOLT	Function:	Manual selection of voltage driving mode *In water cooled machine with voltage mode control, press this button and keep it down to read the water flow rate and the temperature of the inlet water.*
	LED ON: LED BLINKING:	Machine in voltage driving mode Machine in voltage drive mode connected to REM08
(6) AMPERE	Function:	Manual selection of current driving mode *In water cooled machine with current mode control, press this button and keep it down to read the water flow rate and the temperature of the inlet water.*
	LED ON: LED BLINKING:	Machine in current driving mode Machine in current driving mode connected to REM08
(7) ▲	Function:	Increase value
(8) ▼	Function:	Decrease value
(9) LINE	LED ON:	Primary main voltage present
(10) CHECK	LED BLINKING:	Error detected. Check the display for the error message related to the fault
(11) THERM	LED ON:	Thermal protection activate

When the machine is switched ON from the main, the LED line light ON and the software starts the auto test. At the end of the test, in the display, appears a carousel with the name of the software and in the bottom of the display the type of the rectifier:

"VEGA AIR " or "VEGA WATER "

"Q-SERIES AIR " or "Q-SERIES WATER "

In this condition the machine is in STANDBY, in Local mode or in Remote mode, depending if the rectifier was in Local or Remote, when it was switched OFF.

2.2 Communication PORTS

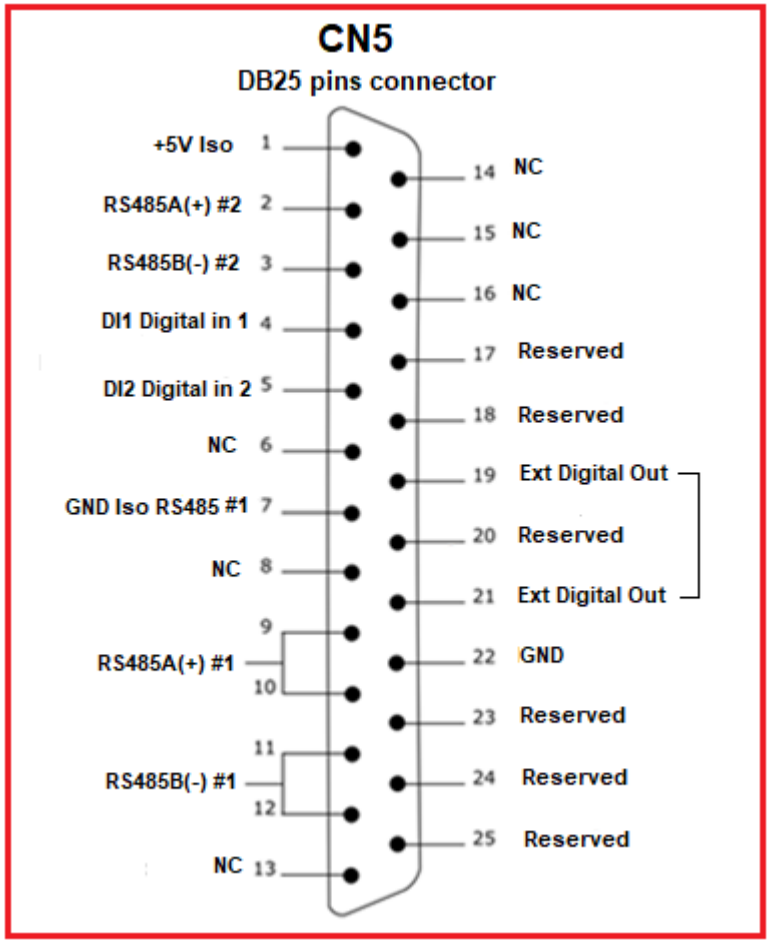
All Q-Series and Vega rectifiers are supplied with 2 male connectors: one is a standard DB25 pins connector, the second one is a standard DB9 pins connector.

These connectors are used for:

- Interface the rectifier with a RS485 based networks (Modbus or ACRS custom ASCII protocol).
- Interface the rectifier with a network card (The network card is installed in the rectifier when it is requested to connect the rectifier with a Field bus or Ethernet based network; for the available communication protocols refer to the Chapter 12.
- Connect the rectifier to ACRS REM.
- Provide two digital inputs to control the rectifier operation (for example an external START/STOP or an EMERGENCY Stop)
- Provide one digital output signal to interface the rectifier with other devices (like a pump, or an end of program alarm).
- Download the software in the CPU trough a special cable provided by ACRS. For this operation is necessary to install in a PC the M90 software manager. For more details please refer to the related M90 software user manual.

On the DB25 connectors it is also available a pin with an isolated voltage of 5V (5V Iso). This voltage is referred to the “GND Iso RS485#1” and must only be used as bias voltage for the pull up and pull down resistors in the RS485 network.

The images here below show the layout of the two ports available in the back of the rectifier:



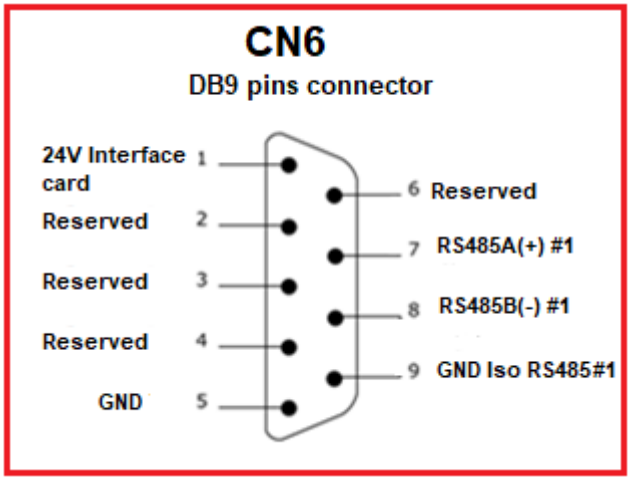


Figure 2: Pin assignment of DB25 (CN5) and DB9 (CN6) connectors

Signals in the CN5 (DB25) connector:

Pin	Function	Description
1	5V out Isolated Voltage	5V isolated for RS485#1 biasing. This 5V is referred to isolated ground on pin 7.
2	RS485 #2 bus	RS485 wire A (+)
3	RS485 #2 bus	RS485 wire B (-)
4	Digital input 1	The Digital input 1 is programmable by the software. The Digital inputs can be enabled by closing a dry contact between the pin 4 and the pin 22.
5	Digital input 2	The Digital input 2 is programmable by the software. The Digital inputs can be enabled by closing a dry contact between the pin 5 and the pin 22.
6	ND	NOT USED
7	GND Iso RS485#1	Insulated GND for RS485 #1 bus-connected also to pin 9 of the CN6
8	ND	NOT USED
9	RS485 #1 bus	RS485 wire A (+) (incoming cable)-connected also to pin 7 of the CN6
10	RS485 #1 bus	RS485 wire A (+) (outgoing cable)
11	RS485 #1 bus	RS485 wire B (-) (incoming cable)-connected also to pin 8 of the CN6
12	RS485 #1 bus	RS485 wire B (-) (outgoing cable)
13, 14, 15, 16	ND	NOT USED
17 - 18	Reserved	--
19 - 21	Digital output	Programmable digital output, **max ratings: 2A at 24V dc/ac**
20	Reserved	--
22	GND	GND (for digital inputs, RS485#2)
23	Reserved	--
24	24 V out Voltage	24 Vdc output voltage to supply REM08 (referred to GND)
25	Reserved	--

Note:

Incoming and outgoing pins are use full in a daisy chain connection of the rectifiers.

Signals in the CN6 (DB9) connector:

Pin	Function	Description
1	+24 Vdc	Power supply for the interface card
2	Reserved	Used by ACRS for the interface card
3	Reserved	Used by ACRS for the interface card
4	Reserved	Used by ACRS for the interface card
5	GND	Ground for interface cards -same GND of pin 22-CN5
6	Reserved	Used by ACRS for the interface card
7	RS485 #1 bus	RS485 wire A (+) –connected also to pin 9 of CN5
8	RS485 #1 bus	RS485 wire B (-) -connected also to pin 11 of CN5
9	GND Iso RS485#1	Insulated GND for RS485 bus-same GND iso of pin 7 -CN5

2.3 The IOW board

To ease the installation process it is possible to add a board on the rectifier back. This board is called IOW. It has a DB25 female connector to connect in the male connector of CN5 of the rectifier and screw terminals on the other side. Every screw terminal is connected to a pin on the DB25 port. This board is mandatory if the optional water flow meter and solenoid (**WFS**) is installed in Q-Series rectifier.

The board is compatible with previous version of CPU: CPU063 and CPU080.

There are two models of the IOW board, one suitable for Q500, Q300, Vega rectifiers, another smaller one for Q100, Q150 rectifier. On both models there are two connectors (CN1 and CN2) and a switch S1. A diagram of the board can be seen in the picture below:

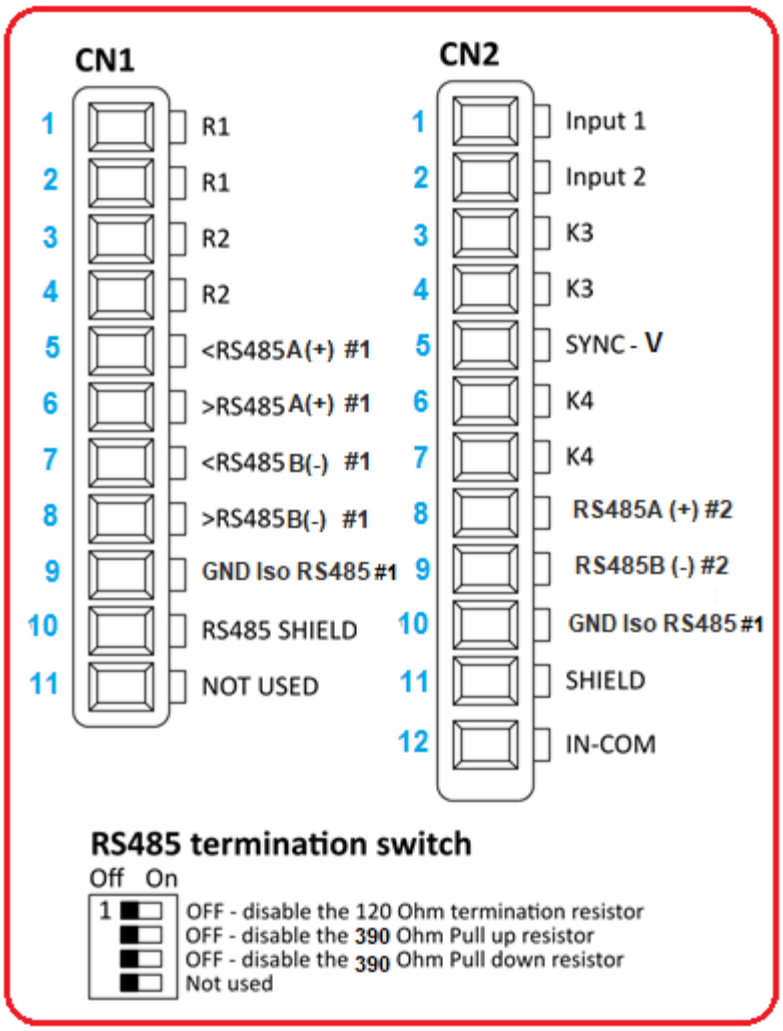


Figure 3: Diagram of the IOW board

Signals in the CN1 connector of the IOW:

Pin	Usage
1 – 2	Pull up resistor for the RS485 network.
3 – 4	Pull down resistor for the RS485 network.
5	Incoming wire A(+) of the RS485A (+) #1 bus
6	Outgoing wire A(+) of the RS485A (+) #1 bus.
7	Incoming wire B (-) of the RS485A (-) #1 bus
8	Outgoing wire B (-) of the RS485A (-) #1 bus.
9	GND Iso RS485#1
10	RS485 shield
11	NOT USED

Signals in the CN2 connector of the IOW board:

Pin	Usage
1	First digital input (connected to PIN4 of the DB25 port)(1)
2	Second digital input (connected to PIN5 of the DB25 port)
3 – 4	Programmable digital output (connected to PIN19 and 21 of the DB25 port)
5	24 Vdc output voltage to supply REM08 (referred to GND)
6 - 7	NOT USED
8	wire A (+) of the RS485A (+)#2 bus
9	wire B (-) of the RS485B (-)#2 bus
10	GND Iso RS485#1
11	Communication cable shield common
12	GND (for digital inputs, RS485#2)

(1): For the Q-Series rectifier, if the WFS is set to YES in the RECT HW CONF menu, the First Digital Input cannot be used. See Digital IN 1 FUNC in RECT OPER CONF menu.

On the board is also present a termination switch S1 that can be used to properly terminate the RS485#1 line.

Switch	Usage
1	Enable the 120 Ohm termination resistor
2	Enable the 390 Ohm pull up resistor
3	Enable the 390 Ohm pull down resistor
4	NOT USED

2.4 RS485 – bus characteristics

The CPU090 manages two RS485 connection bus called respectively **RS485 #1** and **RS485 #2.**

The RS485#1 is available in the CN5 and also in CN6 connector, the RS485#2 is available in the CN5 connector only (see the layout of the pins in CN5, CN6 communication ports).

The SCADA (with Modbus or ASCII protocol) must be always connected in the RS485#1.

The REM08 can be connected in the RS485#1 or in the RS485#2 port.

In case the rectifier has to be connect with the SCADA and to a ACRS REM, then the SCADA has to be connected in RS485#1 port and the REM in the RS485#2 port.

When the RS485 bus is used, the below guidelines should be followed:

- Max number of nodes on the network: 32
- Mode of operation: half duplex
- Max cable length (without repeaters): 600m

The above values and requirements are referred to a network properly designed and protected from electromagnetic noise. In case of doubts consult: *ACRS Technical Documents_RS485 Network*.

Notes on the RS485 network: on a RS485 network there should be one pull up resistor and one pull down resistor (biasing resistors). The suggested value for the pull up – pull down resistors is 390 Ohm. These resistors must be put only on one network node, usually on the first one or in the last one.

It is also required for RS485 network routing to put a termination resistor of 120 Ohm on the first and on the last network node. The termination resistor should be put between the positive and the negative lines of the RS485 bus.

In the IOW board it is possible to set the bias and termination resistors by the switch S1.

The same bias and termination resistors are also available on the CPU board and they can be enabled by the configuration parameter in MODBUS CONF or ASCII CONF menu.

If the termination resistors are enabled in the CPU then the bias and termination resistors have not be enabled in the IOW board.

When the REM is connected to the CPU, the bias and termination resistors are automatically enabled in the CPU.

3 Configuration parameters

The configuration parameters can be changed accessing in the configuration menus. In order to access in the configuration menus the machine has to be in STANDBY- in **Local** or **Remote mode.**

Procedure to enter in the configuration Menus:

Press and hold down the '**Menu**' button for 3 seconds, until the following list of menus appears in the LCD:

- **RECT HW CONF**
- **RECT MULTW CONF**
- **RECT OPER CONF**
- **DISPLAY CONF**
- **DATA /TIME CONF**
- **LOG ENTRIES**
- **SENSORS**(1)

(1) The menu Sensors will be showed only in Vega and in Q-Series water cooled rectifier with water flow sensor installed. The menu Sensors won't be displayed in case of Q-Series water cooled rectifier with WFS external kit.

- Use the arrow buttons to choose a Menu
- Press '**Select**' button to enter into the Menu: the 1st parameter will be displayed.

To scroll the parameters list and to modify the parameter value follow the below rules:

- Arrow buttons are used to scroll parameters list and to increment/decrement parameter values.
- Press the '**Select**' button to make a parameter editable. Editable parameters are enclosed in '<' and '>' brackets.
- Press the '**Modify**' button to confirm the modified parameter value (brackets '<' and '>' disappear).
- Press the '**Menu**' button to leave a parameter unchanged (if it is editable) or to leave the configuration menu.
  To leave completely the configuration Menus is necessary to press the **'Menu'** button until the carousel with the name of the software appears in the LCD.

- **The parameters in the menu: RECT HW CONF can be edited only if the rectifier is in SUPPORT MODE.**

The parameters in this menu are important hardware configuration of the machine and can be modified only for scope of service or maintenance of the machine.

To enter in SUPPORT MODE please request and refer to the procedure:
ACRS_CPU090_Service_Manual available from ACRS Service Offices.

- **The parameters in the others configuration Menus of the above list can be edited.**

Please Note:
To save the parameters after they have been changed is necessary: to leave completely from the

configuration Menu and then to cycle the main switch from the sequence: OFF –ON.

For some editable parameters it's not necessary to cycle the main switch from the sequence: OFF-ON.
Please check the in the next lists of parameters the ones that don't require to cycle the main switch.

Due to the capacitors assembled in the CPU, after the rectifier is switched OFF, it is recommended to wait about 30 seconds, before to switch ON again. As reference check the led line in the CPU is off.

3.1 RECT HW CONF menu

List ot the parameters that can be found in the "RECT HW CONF" menu. These parameters are related to the rectifier hardware configuration.

Please contact ACRS technical support for more details.

Parameter	Value	Description	Default	Editable	Save
1- NOMINAL VOLTAGE	V	This is the rectifier full scale voltage . This value is set by ACRS and shall never be changed.	depends by S/N	Support mode	SW OFF/ON
2- NOMINAL CURRENT	A	This is the rectifier full scale current. This value is set by ACRS and shall never be changed.	depends by S/N	Support mode	SW OFF/ON
3- LIMIT VOLTAGE	V	The maximum output voltage. This value cannot be higher than the NOMINAL VOLTAGE parameter.	depends by S/N	Support mode	SW OFF/ON
4- LIMIT CURRENT	A	The maximum output current when rectifier is operating in DC mode. This value cannot be higher than the NOMINAL CURRENT parameter.	depends by S/N	Support mode	SW OFF/ON
5- REVERSE MACHINE	Yes/No	Set Y if this rectifier is a DCR or PPR machine. Set N otherwise.	No	Support mode	SW OFF/ON
6- WFS KIT	No/ Water no WFS Kit/ Water with WFS Kit	**This parameter is settable only for Q-Series, without the internal flow sensor installed.** It permits to use the external water flow meter kit as a retro-compatibility with the old revision of Q-Series rectifiers. Set **<No>** if this rectifier is air cooled or equipped with the internal water flow sensor. Set **<Water no WFS kit>** for Q-Series water cooled without any flow meter or flow sensor installed. Set **<Water with WFS Kit>** for Q-Series with external water flow meter.	No	Support mode	SW OFF/ON
7- MODULE FREQ	KHz	The frequency of the synch PWM signal used by the power modules in **Q-Series rectifier**. This value is set by ACRS and shall never be changed. **This parameter is not used in Vega rectifier.**	27	Support mode	SW OFF/ON
8- P TYPE MACHINE	Yes/No	Set Y if this rectifier can be used to make pulses, N otherwise. This value is set by ACRS and shall never be changed.	No	Support mode	SW OFF/ON
9- S TYPE MACHINE	Yes/No	Set Y if this rectifier can be used to make sine waves, N otherwise. This value is set by ACRS and shall never be changed.	No	Support mode	SW OFF/ON
10- PID PROP GAIN	Gain	The gain of the proportional part of the PID loop. Range: 1 ÷ 32.	2	Support mode	SW OFF/ON
11- PID INTEG GAIN	Gain	The gain of the integral part of the PID loop. Range: 1 ÷ 255.	64	Support mode	SW OFF/ON
12- PID I MULTW GAIN	Gain	The gain of the integral part of the PID loop when the rectifier is operating in multi-tower configuration. Range: 1 ÷ 255. This parameter has effect only if it is changed in the Master tower, it hasn't any effect if it is changed in Slave towers. Reduce the value of this gain down to 4 to improve the voltage mode control at low output current.	9	Support mode	SW OFF/ON
13- PID I OPEN CIRC	Gain	The gain of the integral part of the PID loop when the rectifier is operating in open circuit mode. Range: 1 ÷ 255.	1	Support mode	SW OFF/ON

14- OVER VOLT THR	%	The default value set the over voltage warning alarm at 115% of the nominal main input voltage and the over voltage error at 120% of the nominal main input voltage. When an over voltage error occurs the output power is forced to 0.	100%	Support mode	SW OFF/ON
15- UNDER VOLT THR	%	The default value set the under voltage warning alarm at 80% of the nominal main input voltage and the under voltage error at 75% of the nominal main input voltage. When an under voltage error occurs the output power is forced to 0.	100%	Support mode	SW OFF/ON
16- HALF MODULES NUM	Num.	This value is set in ACRS factory and it corresponds to the n. of half modules assembled in the rectifier. If one or more modules have to be disconnected due to an issue, then to continue to work, the rectifier must be reconfigured with the new number of half modules connected. The detection of the half modules numbers can be disabled select **<check disabled>** . **Beware**: **with the module check disable**, in case of connection issues in one of the half modules, no any error is reported and as a consequence the rectifier can display wrong reading of the output current.	depends by S/N	Support mode	SW OFF/ON
17 - RECT SERIAL NUMBER		This is the serial number of the rectifier. The same number is printed in the label put in the rectifier back.	depends by S/N	Not editable	/
18 - POWER UP DATE		The date and time of the first time the rectifier was powered up after it left the factory. This data cannot be changed.	Y-M-D H:M	Not editable	/
19- CURR CALIB COEFF		This is the calibration coefficient for the current reading. If the CPU is replaced, this value shall be copied from the original CPU to the new one, or a new calibration shall be performed.	depends by S/N	Support mode	SW OFF/ON
20- VOLT CALIB COEFF		This is the calibration coefficient for the voltage reading. If the CPU is replaced, this value shall be copied from the original CPU to the new one, or a new calibration shall be performed.	depends by S/N	Support mode	SW OFF/ON
21- SD CARD	Yes/No	This parameter is set to Yes when an SD memory card is installed in the rectifier. With this parameter set to Yes a SD card menu is enabled.	No	Support mode	SW OFF/ON

3.2 RECT MULTW CONF menu

This menu is used to configure if the rectifier will operate as a single machine, or in a multi-tower configuration. In multi-tower mode more rectifiers can be put in parallel to offer a higher output current. When working in multi-tower mode one tower is called the master-tower. The scope of the master tower is to communicate with a SCADA or with the operator, and to control all the rectifiers.

Parameter	Value	Description	Default	Editable	Save
1- MULTW WORK MODE	• SINGLE MACHINE • MULTITOWER MASTER • MULTITOWER SLAVE	• SINGLE MACHINE: the tower is operating as a stand-alone machine not connected to other towers • MULTITOWER MASTER: the tower is operating in a multi-tower way, and this is the master tower. **Please note**: only the first or the last tower of the chain can be set as Master-Tower • MULTITOWER SLAVE: The tower is operating in a multi-tower way, and this is one of the slave towers. Please note: a switch must be activated on the last slave-tower in a multi-tower configuration.	SINGLE MACHINE	Allowed	SW OFF/ON
2- EN CUR DIV MODE	Yes/No	Setting to YES it is possible to activate the Current Division mode. See the paragraph dedicated to this feature for more details. This parameter has only meaning full in Master tower	No	Allowed	Esc from Conf. Menu
3- TOWER ADDRESS	0 – 26	In a multi-tower configuration, the master tower can automatically address the connected towers, or the address of every tower can be manually set. Leave this parameter to 0 to enable the automatic addressing, otherwise set the address of the tower. PLEASE NOTE: if the tower address will not follow the addressing rules explained in the multi-tower section, the multi-tower system will never work.	0	Allowed	SW OFF/ON
4- SLAVES NUMBER	0 – 25	In a multi-tower configuration, this parameter defines the number of Slave Towers connected. For example if the system is composed by 4 towers, this parameter must be set to 3 because one is the Master tower. This parameter is meaningful ONLY on the Master tower.	0	Allowed	SW OFF/ON

3.3 RECT OPER CONF menu

Parameter	Value	Description	Default	Editable	Save
1- SHORT CIRC LIMIT	%	The max allowed output current when the rectifier is operating in short circuit mode. This value is expressed as a percentage of the nominal current. Minimum settable value is 20%.	25	Allowed	Esc from Conf. Menu
2- SAVE SET POINT	YES/NO	This parameter is applicable only when the rectifier is operating in DC, local mode. If this parameter is set to Yes, the rectifier saves the set point when it is turned to standby from Run mode. The set point is restored once the rectifier is turned from standby to Run. If this parameter is set to No the set point is reset to "0" every time the rectifier is turned to standby. Please note: the set point is always reset to 0 if the rectifier is powered OFF.	NO	Allowed	Esc from Conf. Menu
3- LOCAL/REMOTE KBD ONLY	YES/NO	When the rectifier is in remote: it can be operated **only** from a remote control (i.e. using a SCADA). When the rectifier is in local, it can be operated **only** using the Keypad. Setting the parameter to "**YES**"- It is possible to select the mode: local or remote and vice versa from the keypad. The SCADA can't command the rectifier from local to remote. Setting the parameter to "**NO**" - The SCADA can command from local to remote if also the parameter: **17-SCADA REMOTE ENA** is set to "**YES".** For more details see the Chapter 10.	NO	Allowed	Esc from Conf. Menu
4- REM CONNECTED	✓ NOT USED ✓ RS485#1 ✓ RS485#2	It is possible to choose in which port to connect the REM. If the rectifier needs to be connected to the SCADA and to the REM, it is mandatory to connect the SCADA in the RS485#1 and the REM in RS485#2. NONE has to be selected if no any REM is connected. When the RS485 is selected the bias and termination resistors are automatically enabled in the CPU.	NONE	Allowed	Esc from Conf. Menu

5- SCADA INTERFACE	✓ NONE ✓ ASCII ✓ MODBUS ✓ PROFIBUS ✓ DEVICENET ✓ PROFINET ✓ ETHERNETIP ✓ MODBUS-TCP ✓ ANALOGUE	Select from the drop down list the communication protocol used by the rectifier. After a protocol has been chosen a menu is enabled to configure the parameters for this protocol. **Please note:** Profibus, Profinet, Devicenet, Ethernet IP, Modbus-TCP, need a special communication adapter. The analogue interface also requires the ANL08 card installed in the rectifier.	NONE	Allowed	Esc from Conf. Menu
6- COMM TIMEOUT	Seconds	In case a communication protocol is used, these are the number of seconds after the rectifier is turned to standby mode, if a new message hasn't been received by the rectifier in this interval of time. Max value: 240 s. Set this parameter to 0 to disable the Timeout	180	Allowed	Esc from Conf. Menu
7- AMPERE H/m/s	AMPERE Hours /Minutes / Seconds	Select from the drop down list if the rectifier measures Ampere/Hours or Ampere/Minutes or Ampere/seconds	AMPERE HOUR	Allowed	Esc from Conf. Menu
8- AH COUNT TYPE	✓ POS AH COUNTER ✓ NEG AH COUNTER ✓ POS/NEG AH COUNTER	Select during which phases the AH counters are updated: • POS AH COUNTER: the AH counters are updated only when a positive current is delivered • NEG AH COUNTER: the AH counters are updated only when a negative current is delivered • POS/NEG AH COUNTER: the AH counters are updated both when a positive and a negative current is delivered	POS AH COUNTER	Allowed	Esc from Conf. Menu
9- DIG IN 1 FUNC	✓ DIG INPUT DISABLED. ✓ EXT EMERGENCY. ✓ EXT START/STOP ✓ EXT START/STOP PB. ✓ EXT PAUSE.	This parameter is used to program the function of the first digital inputs available on the DB25 connector. Select from the drop down list the desired function: • DIG INPUT DISABLED: digital input is disabled • EXT EMERGENCY: the digital input is used as an emergency switch. If open the rectifier is immediately turned to Emergency mode (current is forced to 0 and no operation is allowed). **If the Emergency is active (external contact is open) it is possible to enter in the menus of the software only in the Support Mode.** • EXT START/STOP: the digital input is used as a start/stop switch. Closed = start the rectifier, Open = stop it (see also chapter 3.12 ext Start/Stop Mod). • EXT START/STOP PB: the digital input is connected to an external start – stop button. Close one time to start the rectifier, close another time to stop it (see also chapter 3.12 extStart/Stop Mod).	DIG INPUT DISABLED	Allowed	Esc from Conf. Menu

		• EXT PAUSE: the digital input is used to turn the rectifier to pause mode. Open= rectifier operates, Close = rectifier is paused. **NOTE: if the parameter: 6-WFS KIT in the "Rect HW conf menu" is set as <water with WFS Kit>, the Digital Input 1 functions cannot be used.**			
10- DIG IN 2 FUNC	Please see the above parameter	This parameter is used to select the function of the second digital input. See the above list for more details	DIG INPUT DISABLED	Allowed	Esc from Conf. Menu
11- DIG OUT FUNC	✓ DIG OUTPUT DISABLED ✓ EXTERNAL PUMP ✓ START/STOP SIGNAL ✓ CYCLE END SIGNAL ✓ REMOTE CONTROLLED	This parameter is used to program the function of the digital output available on the DB25 connector. Select the desired function from the drop-down list: ✓ DIG OUTPUT DISABLED: the digital output is disabled ✓ EXTERNAL PUMP: the digital output is connected to an external pump. The pump is activated by an ampere hour counter. Please check the paragraph 4.2 (AH Menu). ✓ START/STOP SIGNAL: the relay is closed when the rectifier turns in Run mode, it is opened when the rectifier is in standby. ✓ CYCLE END SIGNAL: in case a waveform is programmed, the relay is closed when the waveform is completed. To open the relay starts a new cycle or press the Standby button. -If a "19-MAINT VALUE" is programmed in the waveform menu, the relay is closed when the waveform is finished and the Maint value starts. In order to stop the maint value and open the relay is necessary press the button Standby. ✓ REMOTE CONTROLLED: the status of the digital output can be controlled by the SCADA using a special bit in the remote message.	DIG OUTPUT DISABLED	Allowed	Esc from Conf. Menu
12- FORCE COOLING	NO/YES/ON	Set "**YES**" to turn the cooling on even if the rectifier is in standby. The cooling will be automatically turned OFF after 5 minutes. Setting "**NO**" the cooling will be automatically activated by the rectifier when the output current is greater than 5% of the nominal current value. Setting "**ON**" the cooling will be automatically activated by the rectifier when it provides an output current.	ON for VEGA / **NO for Q-Series**	Allowed	Esc from Conf. Menu

13- SET REV DELAY	Ms (0 – 20ms)	When the rectifier is generating pulses, it is possible to program a fixed delay every time the output is inverted. During this delay the output is reversed, but no current is generated. This delay is needed when the bath behaves like a capacitor, and the accumulated energy has to be dissipated before proceeding with the next pulse. Set 0 to disable this function.	0	Allowed	Esc from Conf. Menu
14- TURN OFF CURRENT	A	With this function is possible to set a maximum limit current. If the Current requested is above this limit the rectifier turns in standby automatically. The value can be minor or equal to the LIMIT CURRENT in the hardware Conf. parameters. Set 0 to disable this function.	0	Allowed	SW OFF/ON
15- TURN OFF VOLTAGE	V	With this function is possible to set a maximum limit Voltage. If the Voltage requested is above this Limit the rectifier turns in standby automatically. The value can be minor or equal to the LIMIT VOLTAGE in the hardware Conf. parameters. Set 0 to disable this function.	0	Allowed	SW OFF/ON
16- CMD NOT REC TOUT	Seconds	With this function is possible to control the rectifier in local mode in case the network or the SCADA is suddenly disconnected. The parameter permits to set a timeout. If the remote command is not received by the rectifier within the time set in the parameter, the message: "Network not conn" is displayed in the rectifier; at this point it is possible to press the button local in the rectifier and take the control of it in local mode. The minimum time can be set is 1s; the maximum time is 240s. Set this parameter to 0 the timeout is disabled.	6	Allowed	Esc from Conf. Menu
17-SCADA REMOTE ENA	NO/YES	With this parameter it is possible to put the rectifier from local to remote mode by a command sent from the SCADA. To allow it, the parameter SCADA REMOTE ENA has to set YES and the parameter: "3-MAN/AUTO KBD ONLY" has to set "NO". See Chapter 10 for more details.	YES	Allowed	Esc from Conf. Menu

3.4 DISPLAY MENU

This menu is used to configure which information will be displayed when the rectifier is operating. Different information can be programmed depending if the rectifier is working in DC mode, in waveform mode, or in remote mode. The rectifier is equipped with a 4 line display. The first line always shows the measured current and voltage. The remaining 3 line can be programmed to show different information.

Parameter	Value	Description	Default	Editable	Save
1- DC LOCAL 2nd LN	✓ MEASURED VALUES ✓ WORK MODE ✓ SET POINT ✓ TOTAL AH/Am ✓ TOTAL PUMP AH/Am ✓ PARTIAL AH/Am ✓ ELAPSED TIME ✓ PHASE REM TIME ✓ TEMP AND FLOW ✓ EMPTY LINE	Select the information displayed on the second line when the rectifier is operating in DC mode. The available options are: • MEASURED VALUES: the measured current and voltage. This information is already displayed on the first line • WORK MODE: the rectifier operating mode (DC, sinusoidal or pulse mode) • SET POINT: the programmed set point. • TOTAL AH/Am/As: the total ampere hour/minute/second meter. This counter is used to measure the current fed to the load. It can be reset by the user. • TOTAL PUMP AH/Am/As: the total pump ampere hour/minute/second meter. This counter is used to activate the pump available on the digital output. It is automatically reset when the pump is activated. If the pump function is enabled the value of the counter and the pump limit are toggled every 3 seconds • PARTIAL AH/Am/As: the partial ampere hour/minute/second meter. This counter is reset every time the rectifier is turned in Run. It can be used to automatically turn the rectifier in standby. If a limit is set on this counter, the measured value and the limit are toggled every 3 seconds • ELAPSED TIME: the time elapsed since the rectifier was turned in Run mode. A limit can be set to automatically turn the rectifier in standby when the programmed interval has elapsed. In case a limit is programmed the elapsed time and the remaining time are toggled every 3 seconds • PHASE REM TIME: in case a waveform is programmed, it is displayed the time remaining before the current phase is completed. • TEMP AND FLOW: in case of water cooled rectifier with internal water flow sensor it is displayed the temperature of the input water	DISPLAY_ SET_POINT	Allowed	Esc from Conf. Menu

		and water flow rate in run mode and standby(1). *(1) In standby, independently if the water valve is installed or not, it is possible to show the values of the temperature and water kept pressed the button Ampere, if the rectifier is in Ampere mode, or kept pressed the button Volt, if it is in Volt mode.* The Temp and Flow rate reading are not showed in Q-Series rectifier equipped with WFS. • EMPTY LINE: the line is left empty			
2- DC LOCAL 3rd LN	See the first entry in this table	The information displayed on the 3rd line when the rectifier is operating in DC mode	DISPLAY_ TOTAL_AH	Allowed	Esc from Conf. Menu
3- DC LOCAL 4th LN	See the first entry in this table	The information displayed on the 4th line when the rectifier is operating in DC mode	DISPLAY_ ELAPSED_ TIME	Allowed	Esc from Conf. Menu
4- WAVE LOCAL 2nd LN	See the first entry in this table	The information displayed on the 2nd line when the rectifier is operating in Waveform mode	DISPLAY_ SET_POINT	Allowed	Esc from Conf. Menu
5- WAVE LOCAL 3rd LN	See the first entry in this table	The information displayed on the 3rd line when the rectifier is operating in Waveform mode	DISPLAY_ PHASE_REM _TIME	Allowed	Esc from Conf. Menu
6- WAVE LOCAL 4th LN	See the first entry in this table	The information displayed on the 4th line when the rectifier is operating in Waveform mode	DISPLAY_ ELAPSED_ TIME	Allowed	Esc from Conf. Menu
7- REMOTE MODE 2nd LN	See the first entry in this table	The information displayed on the 2nd line when the rectifier is operating in remote mode	DISPLAY_ WORK_ MODE	Allowed	Esc from Conf. Menu
8- REMOTE MODE 3rd LN	See the first entry in this table	The information displayed on the 3rd line when the rectifier is operating in remote mode	DISPLAY_ SET_POINT	Allowed	Esc from Conf. Menu
9- REMOTE MODE 4th LN	See the first entry in this table	The information displayed on the 4th line when the rectifier is operating in remote mode	DISPLAY_ ELAPSED_ TIME	Allowed	Esc from Conf. Menu
10 – RESET DISPLAY	YES / NO	Select "Yes" to restore the default configuration of the display.	NO	Allowed	Esc from Conf. Menu

3.5 DATE/TIME MENU

This menu is used to adjust the internal real time clock. This clock is used when events are logged.

Parameter	Value	Description	Default	Editable	Save
1- CURRENT DATE/TIME	YYYY/MM/SS HH:MM	This entry shows the date/time of the RTC. This entry cannot be edited.	Data/Time set in ACRS factory	Not editable	/
2- CHANGE YEAR	YYYY	Use this parameter to set the year of the RTC		Allowed	Esc from Conf. Menu
3- CHANGE MONTH	MM	Use this parameter to set the month of the RTC		Allowed	Esc from Conf. Menu

4- CHANGE DAY	DD	Use this parameter to set the day of the RTC		Allowed	Esc from Conf. Menu
5- CHANGE HOUR	HH	Use this parameter to set the hour of the RTC		Allowed	Esc from Conf. Menu
6- CHANGE MINUTE	MM	Use this parameter to set the minutes of the RTC		Allowed	Esc from Conf. Menu

3.6 ASCII CONF menu

This menu is enabled only if the ASCII protocol has been selected. The ASCII protocol is a custom ACRS protocol that can be used to control the rectifier from remote. This protocol can be used only on the RS485 bus.

Parameter	Value	Description	Default	Editable	Save
1- RECTIFIER ADDRESS	Min: 0 Max: 245	The address of the rectifier	0	Allowed	Esc from Conf. Menu
2- BAUD RATE	✓ 4800 ✓ 9600 ✓ 19200 ✓ 38400 ✓ 57600	Select the communication baud rate from the drop down list	4800	Allowed	Esc from Conf. Menu
3- PARITY	✓ PARITY NONE ✓ PARITY ODD ✓ PARITY EVEN	Set the parity on the RS485 port	PARITY NONE	Allowed	Esc from Conf. Menu
4- BIT NUMBER	✓ SEVEN BITS ✓ EIGHT BITS	Set the number of bits used for every byte	SEVEN BITS	Allowed	Esc from Conf. Menu
5- CHECKSUM TYPE	✓ USE SUM ✓ USE XOR	Select the checksum used on the message	USE SUM	Allowed	Esc from Conf. Menu
6- TERMINATION	YES/NO	This option is used to enable the termination and the pull up and pull down resistors on the RS485 bus. If this parameter is set to Yes, a 120 Ohm resistor will be added between the A and B wires, and two 470 Ohm will be added as a pull up and pull down on the RS485 bus. Set this option to No, to leave the bus wires untouched. When a REM is connected these resistors are automatically enabled.	NO	Allowed	Esc from Conf. Menu

3.7 MODBUS CONF menu

This menu is enabled only if the Modbus protocol has been selected. This protocol can be used only on the RS485 bus.

Parameter	Value	Description	Default	Editable	Save
1- RECTIFIER ADDRESS	Min: 0 Max: 245	The address of the rectifier	0	Allowed	Esc from Conf. Menu
2- BAUD RATE	✓ 4800 ✓ 9600 ✓ 19200 ✓ 38400 ✓ 57600	Select the communication baud rate from the drop down list.	4800	Allowed	Esc from Conf. Menu
3- PARITY	✓ PARITY NONE ✓ PARITY ODD ✓ PARITY EVEN	Set the parity on the RS485 port.	PARITY NONE	Allowed	Esc from Conf. Menu
4- TERMINATION	Yes/No	This option is used to enable the termination and the pull up resistors on the RS485 bus. If this parameter is set to Yes, a 120 Ohm resistor will be added between the A and B wires, and two 470 Ohm will be added as a pull up and pull down on the RS485 bus. Set this option to No, to leave the bus wires untouched. When a REM is connected these resistors are automatically enabled.	NO	Allowed	Esc from Conf. Menu
5- DATA MAP	✓ STANDARD MEMORY MAP ✓ OLD MODBUS DC MAP	Select which data map will be used: • STANDARD MEMORY MAP: the new memory data map should be used whenever it is possible. This data map has been designed to offer an unique interface even when the rectifier is operating in different ways or using different protocols. • OLD MODBUS DC MEMORY MAP: this is the memory map used by Modbus DC/DCR rectifiers. This data map shall be used only if the rectifier is replacing an old CPU063.	STANDARD MEMORY MAP	Allowed	Esc from Conf. Menu

6- LITTLE ENDIAN	YES/NO	Data is transmitted using the little endian format. The default format for the data is Big Endian, but some PLCs vendor use the little endian data format as the default one. Set this option to "Yes" to enable the little endian format. PLEASE NOTE: the possibility to select the endianness of the protocol works only with the new data map. If old data maps are used, the endianness would be the one that was originally used in the protocol.	NO	Allowed	Esc from Conf. Menu
7- DATA MAP ADD-ON	None 1 2	This parameter add some more data/command to be read/written by PLC/SCADA. These data are called ADD-ON and are added to the last address of the standard memory map, depending on the working mode used (DC, Pulse or Sin)	None	Allowed	Esc from Conf. Menu

3.8 ETHERNET-IP / PROFINET / MODBUS-TCP CONF menu

This menu is enabled only if the Ethernet IP, Profinet or Modbus TCP protocol has been selected. All these protocols are based on Ethernet networks.

Parameter	Value	Description	Default	Editable	Save
1- IP ADDRESS 1st	Min: 0 Max: 255	Rectifier IP address, first byte.	0(1)	Allowed	SW OFF/ON
2- IP ADDRESS 2nd	Min: 0 Max: 255	Rectifier IP address, second byte.	0(1)	Allowed	SW OFF/ON
3- IP ADDRESS 3rd	Min: 0 Max: 255	Rectifier IP address, third byte.	0(1)	Allowed	SW OFF/ON
4- IP ADDRESS 4th	Min: 0 Max: 255	Rectifier IP address, fourth byte.	0(1)	Allowed	SW OFF/ON
5- SUBNET MASK 1st	Min: 0 Max: 255	Subnet mask, first byte.	0	Allowed	SW OFF/ON
6- SUBNET MASK 2nd	Min: 0 Max: 255	Subnet mask, second byte.	0	Allowed	SW OFF/ON
7- SUBNET MASK 3rd	Min: 0 Max: 255	Subnet mask, third byte.	0	Allowed	SW OFF/ON

8- SUBNET MASK 4th	Min: 0 Max: 255	Subnet mask, fourth byte.	0	Allowed	SW OFF/ON
9- GW ADDRESS 1st	Min: 0 Max: 255	Gateway address, first byte.	0	Allowed	SW OFF/ON
10- GW ADDRESS 2nd	Min: 0 Max: 255	Gateway address, second byte.	0	Allowed	SW OFF/ON
11- GW ADDRESS 3rd	Min: 0 Max: 255	Gateway address, third byte.	0	Allowed	SW OFF/ON
12- GW ADDRESS 4th	Min: 0 Max: 255	Gateway address, fourth byte.	0	Allowed	SW OFF/ON
13- ENABLE DHCP	Yes/No	Set Y to enable the support to DHCP. Set N to disable its support.	No	Allowed	SW OFF/ON
14- ENABLE WEB SRV	Yes/No	Set Y to enable the internal web server. Set N to disable the internal web server.	No	Allowed	SW OFF/ON
15- ENABLE FTP SRV	Yes/No	Set Y to enable the internal FTP server. Set N to disable the internal FTP server.	No	Allowed	SW OFF/ON
16- DATA AREA SIZE	Min: 2 Max: 254	Set the data area size (**data sent to the plc**). The amount of the data read from the rectifier can be different, in according to the operating mode. In case certain functions are not needed a smaller memory area size can be set. The default value is automatically updated once the "add on" is set. The data area size is updated in according to the operative mode: DC, Sin or Pulse	64	Allowed	SW OFF/ON
17- CMD AREA SIZE	Min: 2 Max: 254	Set the command area size (**command from the plc**). The amount of the data used to control the rectifier can be different, in according to the operating mode. In case certain functions are not needed a smaller memory area size can be set. The default value is automatically updated once the "add on" is set. The cmd are size is updated in according to the operative mode: DC, Sin or Pulse.	64	Allowed	SW OFF/ON
18- DATA MAP	✓ STANDARD MEMORY MAP OLD ✓ PFN/EIP MEMORY MAP	Select which data map will be used: • STANDARD MEMORY MAP: the new memory data map should be used whenever it is possible. This data map has been designed to offer an unique interface even when the rectifier is operating in different ways or using different protocols. • OLD PFN/EIP MEMORY MAP: this is the memory map used by Profinet / EthernetIP DC/DCR rectifiers. This data map shall be used only if the	STANDARD MEMORY MAP	Allowed	SW OFF/ON

		rectifier is replacing an old CPU063.			
19- LITTLE ENDIAN	YES/NO	Data is transmitted using the little endian format. The default format for the data is Big Endian, but some PLCs vendor use the little endian data format as the default one. Set this option to "Yes" to enable the little endian format. **For the EthernetIP protocol set the Little Indian to YES.** PLEASE NOTE: the possibility to select the endianness of the protocol works only with the new data map. If old data maps are used, the endianness would be the one that was originally used in the protocol.	NO	Allowed	Esc from Conf. Menu
20- MAC ADDRESS	Board MAC-ADDRESS	This is the MAC address of the installed Ethernet board. This value cannot be edited.	It is displayed when an Eth adapter card is connected.	Not editable	/
21 - DATA MAP ADD-ON	None 1 2	This parameter adds some additional data/command to be read/written by PLC/SCADA. These data are called ADD-ON and are added to the last address of the standard memory map, depending on the working mode used.	None	Allowed	Esc from Conf. Menu

Note (1): if the rectifier is connected to the Profinet Network the **IP address** can be written by the PLC.

3.9 PROFIBUS CONF menu

This menu is enabled only if the Profibus protocol has been selected.

Parameter	Value	Description	Default	Editable	Save
1- PROFIBUS ADDRESS	Min: 0 Max: 125	Rectifier Profibus address	0	Allowed	SW OFF/ON

2- DATA AREA SIZE	Min: 2 Max: 254	Set the data area size (**data sent to the plc**). The amount of the data read from the rectifier can be different, in according to the operating mode. In case certain functions are not needed a smaller memory area size can be set. The default value is automatically updated once the "add on" is set. The data are size is updated in according to the operative mode: DC, Sin or Pulse.	64	Allowed	SW OFF/ON
3- CMD AREA SIZE	Min: 2 Max: 254	Set the command area size (**command from the plc**). The amount of the data used to control the rectifier can be different, in according to the operating mode. In case certain functions are not needed a smaller memory area size can be set. The default value is automatically updated once the "add on" is set. The cmd are size is updated in according to the operative mode: DC, Sin or Pulse.	64	Allowed	SW OFF/ON
4- DATA MAP	✓ STANDARD MEMORY MAP ✓ OLD DVN/PDP DC MAP	Select which data map will be used: • STANDARD MEMORY MAP: the new memory data map should be used whenever it is possible. This data map has been designed to offer an unique interface even when the rectifier is operating in different ways or using different protocols. • OLD DVN/PDP MEMORY MAP: this is the memory map used by Devicenet/Profibus DC/DCR rectifiers. This data map shall be used only if the rectifier is replacing an old CPU063.	STANDARD MEMORY MAP	Allowed	SW OFF/ON
5- LITTLE ENDIAN	YES/NO	Data is transmitted using the little endian format. The default format for the data is Big Endian, but some PLCs vendor use the little endian data format as the default one. Set this option to "Yes" to enable the little endian format. PLEASE NOTE: the possibility to select the endianness of the protocol works only with the new data map. If the old data map is used, the endianness would be the one that was originally used in the protocol.	NO	Allowed	Esc from Conf. Menu
6- DATA MAP ADD-ON	None 1 2	This parameter add some data/command to be read/written by PLC/SCADA. These data are called ADD-ON and are added to the last address of the standard memory map depending on the working mode used.	None	Allowed	Esc from Conf. Menu

3.10 DEVICENET CONF menu

This menu is enabled only if the Devicenet protocol has been selected.

Parameter	Value	Description	Default	Editable	Save
1- DEVICENET ADDRESS	Min: 0 Max: 63	Rectifier Devicenet address	0	Allowed	SW OFF/ON
2- DATA RATE	125 K 250 K 500 K	The data rate of the Devicenet bus	125k	Allowed	SW OFF/ON
3- DATA AREA SIZE	Min: 2 Max: 254	Set the data area size (**data sent to the PLC**). The amount of the data read from the rectifier can be different, in according to the operating mode. In case certain functions are not needed a smaller memory area size can be set. The default value is automatically updated once the "add on" is set. The data are size is updated in according to the operative mode: DC, Sin or Pulse.	64	Allowed	SW OFF/ON
4- CMD AREA SIZE	Min: 2 Max: 254	Set the command area size (**command from the plc**). The amount of the data to control the rectifier can be different, in according to the operating mode. In case certain functions are not needed a smaller memory area size can be set. The default value is automatically updated once the "add on" is set. The cmd are size is updated in according to the operative mode: DC, Sin or Pulse.	64	Allowed	SW OFF/ON
5- DATA MAP	✓ STANDARD MEMORY MAP ✓ OLD DVN/PDP DC MAP	Select which data map will be used: • STANDARD MEMORY MAP: the new memory data map should be used whenever it is possible. This data map has been designed to offer an unique interface even when the rectifier is operating in different ways or using different protocols. • OLD DVN/PDP MEMORY MAP: this is the memory map used by Devicenet/Profibus DC/DCR rectifiers. This data map shall be used only if the rectifier is replacing an old CPU063.	STANDARD MEMORY MAP	Allowed	SW OFF/ON
6- LITTLE ENDIAN	Yes/No	Data is transmitted using the little endian format. The default format for the data is Big Endian, but some PLCs vendor use the little endian data format as the default one. Set this option to "Yes" to enable the little endian format.	No	Allowed	SW OFF/ON

		For this Protocol it is recommended to set the Little Indian to Yes. PLEASE NOTE: the possibility to select the endianness of the protocol works only with the new data map. If old data maps are used, the endianness would be the one that was originally used in the protocol.			
7- DATA MAP ADD-ON	None 1 2	This parameter add some more data/command to be read/written by PLC/SCADA. These data are called ADD-ON and are added to the last address of the standard memory map depending on the working mode used.	None	Allowed	Esc from Conf. Menu

3.11 ANALOGUE CONF menu

This menu is enabled only if the Analogue interface has been selected.

Parameter	Value	Description	Default	Editable	Save
1- ANALOG SIG MODE	✓ 0 - 10V ANL SIG ✓ 4 - 20mA ANL SIG	Select the type of analog IOs signal: 0-10V or the 4-20mA signals.	0 – 10V ANL SIG	Allowed	Esc from Conf. Menu
2- ANALOG SIG FUNC	✓ SINGLE SET POINT ✓ DUAL SET POINT	The analogue card is equipped with 2 analogic inputs: AI1, AI2 Single Set Point: only the first analogic input (AI1) is used to adjust the set point. When the rectifier is operating in voltage mode, the AI1 is used to adjust the voltage set point. When the rectifier is operating in current mode, the AI1 is used to adjust the current set point. Dual Set Point: both analogic inputs (AI1, AI2) are used to adjust the set point. When the rectifier is operating in voltage mode AI1 is used to adjust the voltage set point and the AI2 is used to adjust the current limit. When the rectifier is operating in current mode, the AI1 is used to adjust the voltage limit and the AI2 is used to adjust the current set point.	SINGLE SET POINT	Allowed	Esc from Conf. Menu
3- ENABLE PRESET	YES/NO	If the pre-set option is activated, the rectifier shows on the display the programmed set point, when it is in	NO	Allowed	Esc from Conf. Menu

		remote and standby mode. In this way it is possible to check what the output voltage and current will be, before to turn the rectifier in run mode.			
4- ANALOG SW VERSION		In this field is reported the Analog card software version. **This parameter is read only and cannot be edited.**		Not Editable	

3.12 Ext START/STOP menu

When the user enables a digital input, to be used as external start/stop or push button switch, (RECT OPER CONF MENU- Dig IN 1 or Dig IN 2), a new menu Ext START/STOP MOD becomes visible in the main menu . In this menu the user can choose three different operative modes for the external start/stop.

Parameter	Value	Description	Default	Editable	Save
1- Ext START/STOP MOD	✓ LOCAL ONLY	Start-Stop is controlled by external signal on DB25 connector only when rectifier is operating in local mode.	LOCAL ONLY	Allowed	Esc from Conf. Menu
	✓ REMOTE ONLY	Start-Stop is controlled by external signal on DB25 connector only when rectifier is operating in remote mode.		Allowed	Esc from Conf. Menu
	✓ LOCAL & REMOTE	Start-Stop is always controlled by the external signal on DB25 connector.		Allowed	Esc from Conf. Menu

This menu selection is common for both **Dig IN 1 FUNC** and **Dig IN 2 FUNC** and it is not possible to select a different operating mode for each one.

3.13 LOG ENTRIES menu

In this Menu is possible to check the LOG detected by the rectifier during the operation.

A LOG is detected every time the rectifier is: switched ON from the main line, put in Run, put in Standby, an error occurs or it is cleared.

In the LOG Menu is displayed a character “A” or “C”, the numerical error code, the description and the time of the event: YYYY-MM-DD, Hours Minutes.

The character “A” indicates when the error has been Activated and the character “C” when the error has been cleared.

The LOGs are stored in the non-volatile memory (EEPROM), when the rectifier is turned from Run mode to Standby.

The maximum LOG can be stored in the EEPROM are n. 80.

The LOG: (80 + 1)th will be overwrite in the 1th LOG has been detected.

The LOG can be also downloaded directly from the CPU, in .csv format, connecting a PC to the rectifier.

The software used to download the LOG, from the rectifier in the PC, is the M090 Software Manager.

For this scope please request to ACRS the M090 Software Manager installer and consult the document: M090_Manager_User_Manual.

If the rectifier has the SD card option, the LOG files are stored also in the SD card.

In the LOGs downloaded from the memory of the CPU rectifier, or stored in the SD card, can be seen others additional information:

- ✓ the number of the tower has the log,
- ✓ the status of the rectifier: Run (R) or Standby (S),
- ✓ the type of command: Local (L) or Remote (R),
- ✓ the mode of control; Ampere (A) or Volt (V),
- ✓ the current and voltage set point,
- ✓ the measured voltage and current,
- ✓ the output of the DAC converter of the CPU,
- ✓ the measured level of the auxiliary voltage that supply the CPU,
- ✓ the Partial Ah, the Total Ah and the Gt Ah (only for the I19 St-by Log).

The Logs cannot be deleted by users.

The completed list of the messages with LOG stored in the memory is reported in the paragraph: *8.1 The list of the messages*

3.14 SENSORS menu

Parameter	Value	Description	Default	Editable	Save
1- FLOW METER FSCALE	1÷100 1/min	This parameter refers the full scale of the water flow sensor installed in the rectifier expressed in l/min (liter per minute) It can be set in steps of 0,1 l/min	32 l/min	Allowed	Esc from Conf. Menu
2- LFLOW ALM THR	50÷100 %	With this parameter it is possible to set the threshold of the water flow error alarm. The threshold is expressed as percentage of the required water flow rate **Qreq**(1). When the water flow is lower than the threshold the rectifier displays water flow error alarm and the output power is set to 0.	60%	Allowed	Esc from Conf. Menu
3- LFLOW WNG THR	50÷100 %	With this parameter it is possible to set the threshold of the water flow warning alarm. The threshold is expressed as percentage of the required water flow	70%	Allowed	Esc from Conf. Menu

		rate **Qreq**[(1)]. When the water flow is lower than the threshold the rectifier displays water flow warning alarm.			
4- NOMINAL FLOW	1÷100 l/min	It is the value of the Nominal Flow in l/min (liter per minute). This value is the same as reported in the label of the machine and it is set in ACRS factory. It can be set in steps of 0,1 l/min	Depends b the S/N	Allowed	Esc from Conf. Menu
5- TEMP °C/°F	✓ °C ✓ °F	This parameter permits to set the unit of measurement of the inlet water temperature displayed: °C or °F	°C	Allowed	Esc from Conf. Menu
6-LOW TEMP WNG THR	✓ 8 - 36 °C ✓ 47 - 97 °F	This parameter set the lower threshold of the inlet water temperature. When the inlet temperature water is under this threshold a warning alarm is displayed in the machine.	17 °C	Allowed	Esc from Conf. Menu
7- PRESSURE ALM THR	✓ 0-100%	NOT IMPLEMENTED	0	Allowed	Esc from Conf. Menu
8- PRESSURE WNG THR	✓ 0-100%	NOT IMPLEMENTED	0	Allowed	Esc from Conf. Menu
9-WATER VALVE	✓ YES ✓ NO	This parameter is set to Yes in the rectifier equipped with the solenoid valve. The solenoid valve will open according to the Force Cooling parameter, i.e : if the Force Cooling is set to ON then the water valve opens as soon as the output current is requested.	No	Allowed	Esc from Conf. Menu

(1) The required water flow rate (Q_{req}) is calculated inaccording to the output current delivered to the load; i.e at 80% of the maximum output current the Q_{req} shall be 80% of Q_{nom}. The minimum Q_{req} is 50% of Q_{nom}.

Practical example: for a rectifier 16 V 2000 A the Nominal flow Q_{nom} is: 10 l/minute.
If the rectifier runs the full current = 2000 A, Q_{req} =Q_{nom}=10 l/minute the Warning Threshold will be 7 l/minute and the Alarm Threshold will be 6 l/minute.

With running current =1600 A, the Q_{req} is 80% Q_{nom}=8 l/minute. The Warning Threshold will be 5,6 l/minute and the Alarm Threshold will be 4,8 l/minute.

3.15 SD CARD menu

Parameter	Value	Description	Default	Editable	Save
1- EJECT SD CARD	Yes/No	This parameter is used to make a safely remove of the SD memory card.	NO	Allowed	Esc from Conf. Menu
2- INSERT SD CARD	Yes/No	This parameter allows to insert the SD memory card again after an eject operation.	NO	Allowed	Esc from Conf. Menu

4 Operating parameters

When the rectifier is operating in Local , it can be programmed to perform some tasks.

These tasks can be programmed using a special menu, called the "**Operating Menu**". To access to this menu follow the below steps:

- When the rectifier is in stand-by and in local mode, press and hold the Local button for 3 seconds, until the first menu: "LOCAL OPERATING MODE' is displayed.
- Use the arrow keys to select one of the available menus
- Press 'Local/Select' key to enter into the selected menu: the 1st parameter will be displayed.

To scroll the parameter list and to modify the parameter values follow the below rules:

- Arrow keys are used to scroll parameter list and to increment/decrement parameter values.
- Press the 'Local/Select' key to make a parameter editable. Editable parameters are enclosed in '<' and '>' brackets.
- Press the 'RUN/Modify' key to confirm the modified parameter value (brackets '<' and '>' disappear).
- Press the 'STANDBY/Menu' key to leave a parameter unchanged or to leave the configuration menu.

4.1 LOCAL OPERATING MODE menu

Note: all the parameters in the menus and sub menus of the Operating Mode are editable. To save the parameter in the flash memory of the CPU090, it is necessary to leave from the Operating Mode menus, until the carousel with the name of the software is displayed in the LCD.

When the rectifier is in local, it can be programmed to execute a waveform, or the output current and voltage can be adjusted using the up and down arrow keys. This menu is used to select in which way the rectifier shall operate when it is in local mode.

Parameter	Value	Description	Default
1- OPERATING MODE	1) DC MODE 2) WAVEFORM MODE 3) CURR PULSED WFM	• DC MODE: the arrow keys are used to adjust the output set point. The "Volt" and "Ampere" buttons can be used to select if the rectifier will operate in voltage or current mode. It is possible to program a time threshold or an ampere hour threshold, after	DC MODE

	4) VOLT PULSED WFM 5) CURR SIN WFM 6) VOLT SIN WFM	which the rectifier will be automatically turned to standby mode • WAVEFORM MODE: the rectifier can be programmed to make a DC waveform. Every phase can have a voltage or current set point. The minimum duration of a phase in a DC waveform is 1 second • CURR PULSED WFM: the rectifier will operate in current mode, generating a pulsed waveform. Pulsed waveforms can make pulses down to 3ms of duration. The rectifier must be a pulsed rectifier. • VOLT PULSED WFM: the rectifier will operate in voltage mode, generating a pulsed waveform. Pulsed waveforms can make pulses down to 3ms of duration. The rectifier must be a pulsed rectifier. • CURR SIN WFM: the rectifier will generate a sinusoidal waveform in current mode. The rectifier must be a sine wave rectifier. • VOLT SIN WFM: the rectifier will generate a sinusoidal waveform in voltage mode. The rectifier must be a sine wave rectifier.	

4.2 AH menu

This menu allows the user to handle the AH counters.

Parameter	Value	Description	Default
1- GRAND TOTAL	AH	The GRAND TOTAL counter. This counter counts the AH delivered to the load since the rectifier has been assembled. It cannot be reset by the user.	AH
2- TOTAL COUNTER	AH / Am /As	This counter is used to count the current supplied to the load since the last time the counter was reset. This counter can be reset any time from the user. The maximum value of this counter is 100.000.000. When the Total is reached the value is saved in the LOG (message I50)	AH
3- RESET TOT COUNT?	Yes/No	Select Yes to reset the total counter. When the total counter is reset the Total count is saved in the LOG (message I40). Note: The Total counter is saved and reset also in case UOM is changed (message I40).	No
4- TOTAL PUMP COUNT	AH / Am /As	This counter is used to run a pump when a programmed AH/Am/As threshold is reached. This counter can be reset by the user, or it is	0 AH

		automatically reset when the pump is activated. The digital output of the CPU must be programmed to "EXTERNAL PUMP" to be controlled by this counter. The maximum value of this counter is 100.000.000. In case of overflow no warning message is generated. The counter is incremented continuously if the "external pump" function is not activated.	
5- TOTAL PUMP LIMIT	AH / Am /As	This is the A/H threshold to activate the pump. When the Digital output is programmed to "EXTERNAL PUMP", the relay on the digital output is enabled when the TOTAL PUMP COUNT reaches this threshold.	0 AH
6- PUMP ON	Secs	The number of seconds the pump will run after it is activated.	0
7- RESET PUMP COUNT?	Yes/No	Select Yes to reset the total pump counter	No
8- PARTIAL COUNTER	AH / Am /As	This is the value of the partial counter. This counter is reset every time the rectifier is switched from Standby to Run.	0 AH

4.3 DC MODE menu

This menu is enabled only if the "DC MODE" operating mode has been selected in the "LOCAL OPERATING MODE" menu.

Parameter	Value	Description	Default
1- DC TIMER LIMIT	HH:MM:SS	If this timer is programmed with a value above 0, the rectifier will be automatically turned to standby mode when this timer elapses	0
2- DC AH/m/s LIMITS	AH / Am /s	If this threshold is set to a value above 0, the rectifier will be automatically turned to stand-by mode if the partial AH counter reaches this threshold	0

4.4 DC WAVEFORM menu

This menu is enabled only if the "WAVEFORM MODE" operating mode has been selected in the "LOCAL OPERATING MODE" menu. In this mode the rectifier can be programmed to execute up to 6 DC phases. The minimum duration of a phase is 1 sec. After executing the waveform the rectifier is automatically switched to standby mode if the parameter: "WVF TOTAL TIME" and "AH/m/s LIMITS" are set to 0. Otherwise the waveform is repeated again and again until one of the two limits is reached. Every phase of the waveform can be programmed with a voltage or a current set point.

To change a phase mode between current and voltage, press the "VOLT" button or the "AMPERE" button when the parameter "x- PHASE x VALUE" is displayed. This parameter is the phase set point during the steady phase.

Parameter	Value	Description	Default
x- RAMP x DURATION	HH:MM:SS Max: 10 hours 1 second steps	For every one of the six available phases, this is the duration of the ramp time. Max duration of this phase is 10 hours.	0
x- PHASE x VALUE	Ampere or Volt	For every one of the six available phases, this is the set point in ampere or volt (depends if this is a voltage or current phase).	0
x- PHASE x DURATION	HH:MM:SS Max: 10 hours 1 second steps	For every one of the six available phases, this is the duration of the steady phase. Max duration of this phase is 10 hours. If this entry is programmed to 0, this phase and all following phases will be ignored.	0
19- MAINT VALUE	Ampere or volt	If this entry is programmed with a value above 0, at the end of the waveform, the rectifier won't be switched to standby mode, instead this DC current/voltage set point will be used.	0
20- WVF TOTAL TIME	HH:MM:SS Max: 50 hours 1 second steps	If this entry is programmed with a value above 0, the waveform execution will be interrupted when this timer elapses. The max value for this entry is 50 hours. If a "MAINT VALUE" is programmed, then the Total Time has to be calculated as the sum of: the waveform time set and the desiderate Maint Value time. Pressing the button Standby, before the Total Time is elapsed, the waveform will be Stopped. If the "CYCLE END SIGNAL" is programmed and the Total time is elapsed, to Stop the END SIGNAL is necessary to press the button Standby.	0
21- AH/m/s LIMITS	AH / m /s Max:10.000 Ah/m/s 1 AH/m/s steps	If this entry is programmed with a value above 0, the waveform execution will be interrupted if the partial AH counter reaches this value. The max value for this entry is 10.000 Ah/m/s.	0 AH

4.5 PULS CURR WFM menu

This menu is enabled only if the "CURR PULSED WFM" operating mode has been selected in the "LOCAL OPERATING MODE" menu. In this mode the rectifier can be programmed to execute up to 6 pulsed phases. **The minimum duration of a pulsed phase is 3 msec**. The waveform will be repeated again and again, until the WVF TOTAL TIME timer expires, or the partial AH/m /s counter pass the AH/m /s limit. Leave

both parameters "WVF TOTAL TIME" and "AH/m/s LIMITS" to 0 to repeat the pulse waveform forever.

Parameter	Value	Description	Default
x- PHASE x VALUE	Ampere	For every one of the six available phases, this is the set point of the phase.	0
x- PHASE x DURATION	Milliseconds Max: 10 seconds 0,1 ms steps	For every one of the six available phases, this is the duration of the phase in ms. If this entry is set to 0, this phase and the following will not be executed.	3(1)
13- RAMP DURATION	HH:MM:SS Max: 10 hours 1 second steps	The ramp time applied to the pulse current waveform	0
14- LIMIT VALUE	Volt	The maximum output voltage during the execution of the pulses. By default this parameter is set to the rectifier max output voltage.	--
15- WVF TOTAL TIME	HH:MM:SS Max: 50 hours 1 second steps	The duration of the waveform. The programmed pulses will be repeated until this timer expires.	0
16- AH/m LIMITS	AH/m Max: 10.000 AH/m /s 1 AH/m /s step	The waveform AH/m /s limit. The programmed pulses will be repeated until the partial AH/m/s counter overcomes this threshold.	0

(1): 3ms is the default duration of the first phase, the next phases have a default duration = 0 ms.

4.6 PULS VOLT WFM menu

This menu is enabled only if the "VOLT PULSED WFM" operating mode has been selected in the "LOCAL OPERATING MODE" menu. In this mode the rectifier can be programmed to execute up to 6 pulsed phases. **The minimum duration of a pulsed phase is 3 msec**. The waveform will be repeated again and again, until a timer expires or the partial AH/m/s counter pass a AH/m/s threshold. Leave both parameters WVF TOTAL TIME and AH/m/s LIMITS to 0 to repeat the pulse waveform forever.

Parameter	Value	Description	Default
x- PHASE x VALUE	Volt	For every one of the six available phases, this is the set point of the phase.	0
x- PHASE x DURATION	Milliseconds Max: 10 seconds 0,1 ms steps	For every one of the six available phases, this is the duration of the phase in ms. If this entry is set to 0, this phase and the following will not be executed.	3(1)
13- RAMP DURATION	HH:MM:SS Max: 10 hours 1 second steps	The ramp time applied to the pulse voltage waveform.	0
14- LIMIT VALUE	Ampere	The maximum output current during the execution of the pulses. By default this parameter is set to the rectifier max output current.	--
15- WVF TOTAL TIME	HH:MM:SS Max: 50 hours 1 second steps	The duration of the waveform. The programmed pulses will be repeated until this timer expires.	0
16- AH/m /s LIMITS	AH/m/s Max:10.000	The waveform AH/m /s limit. The programmed pulses will be repeated until the partial AH/m/s	0

	AH/m/s 1 AH/m /s step	counter overcomes this threshold.	

(1): 3ms is the default duration of the first phase, the next phases have duration = 0 ms.

4.7 SIN CURR WFM menu

This menu is enabled only if the "CURR SIN WFM" operating mode has been selected in the "LOCAL OPERATING MODE" menu. In this mode the rectifier can be programmed to execute a sinusoidal wave. The sinusoid will be repeated until the programmed WVF TOTAL TIME timer expires, or the partial AH/Am/As counter passes the AH/m/s LIMITS parameters. If both WVF TOTAL TIME and AH/m /s LIMITS are set to 0, the sine wave will be repeated forever.

Parameter	Value	Description	Default
1- POS RMS VALUE	Ampere	The RMS current of the positive phase of the sinusoid. **Max rms value**: $\frac{Limit\ Current}{\sqrt{2}}$	0
2- POS DURATION	Ms Min: 5ms Max: 25ms	The duration of the positive phase of the sinusoid	5
3- NEG RMS VALUE	Ampere	The RMS current of the negative phase of the sinusoid. **Max rms value**: $\frac{Limit\ Current}{\sqrt{2}}$	0
4- NEG DURATION	Ms Min: 5ms Max: 25ms	The duration of the negative phase of the sinusoid	5
5- CURRENT OFFSET	Ampere	An offset that can be applied to the sinusoid. If an offset is programmed, the sinusoid must lie in the positive plane (if the offset is positive) or in the negative plane (if the offset is negative). **The OFFSET must be ≤ (Limit Current – rms value * $\sqrt{2}$)**	0
6- LIMIT VALUE	Volt	The max output voltage during the execution of the sinusoid. If the rms value of the output voltage is higher than this value then the output voltage is limited. By default this parameter is equal to the rectifier Limit Voltage.	--
7- RAMP DURATION	HH:MM:SS Max: 10 hours 1 second step	The ramp time applied to the sinusoid	0
8- WVF TOTAL TIME	HH:MM:SS Max: 50 hours 1 second step	The duration of the sinusoidal wave.	0
9- AH/m/s LIMITS	AH/m / s Max:10.000 AH/m/s 1 Ah/m/s step	The programmed sinusoidal wave will be repeated until the partial AH/m/s counter overcomes this threshold.	0

4.8 SIN VOLT WFM menu

This menu is enabled only if the "VOLT SIN WFM" operating mode has been selected in the "LOCAL OPERATING MODE" menu. In this mode the rectifier can be programmed to execute a sinusoidal wave. The sinusoid will be repeated until the programmed WVF TOTAL TIME timer expires, or the partial AH/m/s counter passes the AH/m/s LIMITS parameters. If both WVF TOTAL TIME and AH/m/s LIMITS are left to 0, the sine wave will be repeated forever.

Parameter	Value	Description	Default
1- POS RMS VALUE	Volt	The RMS voltage of the positive phase of the sinusoid. **Max rms value**: $\frac{Limit\ Volt}{\sqrt{2}}$	0
2- POS DURATION	Ms Min: 5ms Max: 25ms	The duration of the positive phase of the sinusoid	5
3- NEG RMS VALUE	Volt	The RMS voltage of the negative phase of the sinusoid. **Max rms value**: $\frac{Limit\ Volt}{\sqrt{2}}$	0
4- NEG DURATION	Ms Min: 5ms Max: 25ms	The duration of the negative phase of the sinusoid	5
5- VOLTAGE OFFSET	Volt	An offset that can be applied to the sinusoid. If an offset is programmed, the sinusoid must lie in the positive plane (if the offset is positive) or in the negative plane (if the offset is negative). **The OFFSET must be ≤ (Limit Volt – rms value * $\sqrt{2}$)**	0
6- LIMIT VALUE	Ampere	The max output current during the execution of the sinusoid. If the rms value of the output current is higher than this value then the output current is limited. By default this parameter is equal to the rectifier Limit Current.	--
7- RAMP DURATION	HH:MM:SS Max: 10 hours 1 second step	The ramp time applied to the sinusoid	0
8- WVF TOTAL TIME	HH:MM:SS Max: 50 hours 1 second step	The duration of the sinusoidal wave.	0
9- AH/m/s LIMITS	AH/m/s Max:10.000 AH/m/s 1 AH/m/s step	The waveform AH/m/s limit. The programmed sinusoidal wave will be repeated until the partial AH/m/s counter overcomes this threshold.	0

5 Programming a waveform

To program and run a waveform proceed with the following steps:

1) When the rectifier is in standby mode, press the Local/Select button for few seconds until the MAIN OPERATING MENU is entered.
2) In the Main Operating Menu there are 3 sub-menu:
   <LOCAL OPERATING MODE>
   <AH MENU >
   <DC MODE MENU >
3) Select the first menu: LOCAL OPERATING MODE and press the Local/Select button to enter.
4) Press again the Local/Select button to make the OPERATING MODE entry editable (<> brackets should appear around the value of this parameter)
5) Using the UP and DOWN arrow keys select the operating mode:

   a. DC MODE: In this mode the rectifier doesn't execute any waveform. The "Volt" and "Ampere" buttons are used to select if the rectifier will operate in voltage or current mode and the arrow keys to change the set point. Press the RUN button to run output current and the STANDBY button to stop the output current and turns the rectifier in standby.
   b. WAVEFORM MODE: the rectifier can be programmed to make a DC waveform. Every phase has a ramp time, voltage or current set point and phase duration. The minimum duration of a phase is 1 second
   c. CURR PULSED WFM: the rectifier will operate in current mode, generating a pulsed waveform. Pulsed waveforms can make pulses as small as 3ms. The rectifier must be a pulsed machine to program a pulsed waveform.
   d. VOLT PULSED WFM: the rectifier will operate in voltage mode, generating a pulsed waveform. Pulsed waveforms can make pulses as small as 3ms. The rectifier must be a pulsed machine to program a pulsed waveform.
   e. CURR SIN WFM: the rectifier will generate a sinusoidal waveform in current mode. The rectifier must be a sine wave machine to program a sine waveform.
   f. VOLT SIN WFM: the rectifier will generate a sinusoidal waveform in voltage mode. The rectifier must be a sine wave machine to program a sine waveform.
6) Press the "RUN" button to confirm the entered value (<> should disappear) and press the STANDBY button to leave this menu
7) Depending on the OPERATING MODE selected (the default is DC MODE), the last menu in the MAIN OPERATING MODE menu will change accordingly:
   a. DC MODE MENU:In this menu is possible to program a timeout or a AH threshold but the set point must be adjusted from Local or Remote.
   b. DC WAVEFORM: the menu to program a DC waveform.
   c. PULS CURR WFM MENU and PULS VOLT WFM MENU: the menu to program a pulsed waveform.
   d. SIN CURR WFM MENU and SIN VOLT WFM MENU: the menu to program a sine wave.
8) Using the DOWN arrow keys select the last menu, press the Local/Select button to enter into this menu and to program the parameters according to the function needed
9) After programming the parameters press twice the STANDBY button to go back to standby mode.
10) If a waveform has been programmed, the message "**Waveform Programmed**" will be shown on the display when the rectifier is in standby mode
11) Press the RUN button to start the waveform execution. During a waveform execution the keys VOLT/AMPERE – Local/Remote – UP / DOWN are disabled.

6 Multitower configuration

The ACRS rectifiers can be connected together to operate as a single machine; this system is called Multi-Tower.

In a Multi-tower system one tower has to be configured as Master and the others towers have to be configured as slave.

Only the Master Tower is connected to a SCADA, to a REM, to an Analog PLC or controlled using the front panel keypad.

All the slave towers are controlled by the master tower.

Up to 10(1) towers can be connected together, with the output bars connected directly in parallel or with the output bars not connected in parallel, this depending by the layout of the load.

The Multi-Tower can be made by towers with the same power or can be made by towers with different power.

For the assembly of a Multi Tower system it is necessary to respect the following rules:

-All the towers have to be of the same type:

all DC / all DCR / all PP / all PPR /all Sinusoidal

-In case the towers have the output bars connected together in parallel they have to be the same output voltage.

If the output of the towers aren't connected in parallel, the output voltage of the towers can be different.

The physical characteristics of the Multi-Tower system is:

- ✓ The total output current is the sum of the current of each rectifier
- ✓ The total output voltage is the voltage measured by the Master Tower.
- ✓ The Master tower will compensate in case the current is missing in a slave tower.

Notes:

(1) In case is necessary to connect more than 10 towers, please contact the ACRS technical Service.

6.1 Setting the multi-tower communication bus

Each tower in a Multi-tower system is equipped with two RJ45 connectors (fig. 4): IN and OUT that must be used to interconnect them. Towers are connected in a daisy-chain method, with an RJ45 cable going from the first tower to the second, from the second tower to the third, from the third tower to the fourth and so on.

Figure 4: the RJ45 plugs needed when the rectifiers have to work in multi-tower mode, the part number of the RJ45 plug is MTK02A

In the Fig. 5 is reported an example of Multi- Tower System composed by 4 towers: 1 Master and 3 Slave.

The **Master tower** must be at the beginning of the multi-tower chain. The last salve tower, at the end of the chain, is called **1st slave.**

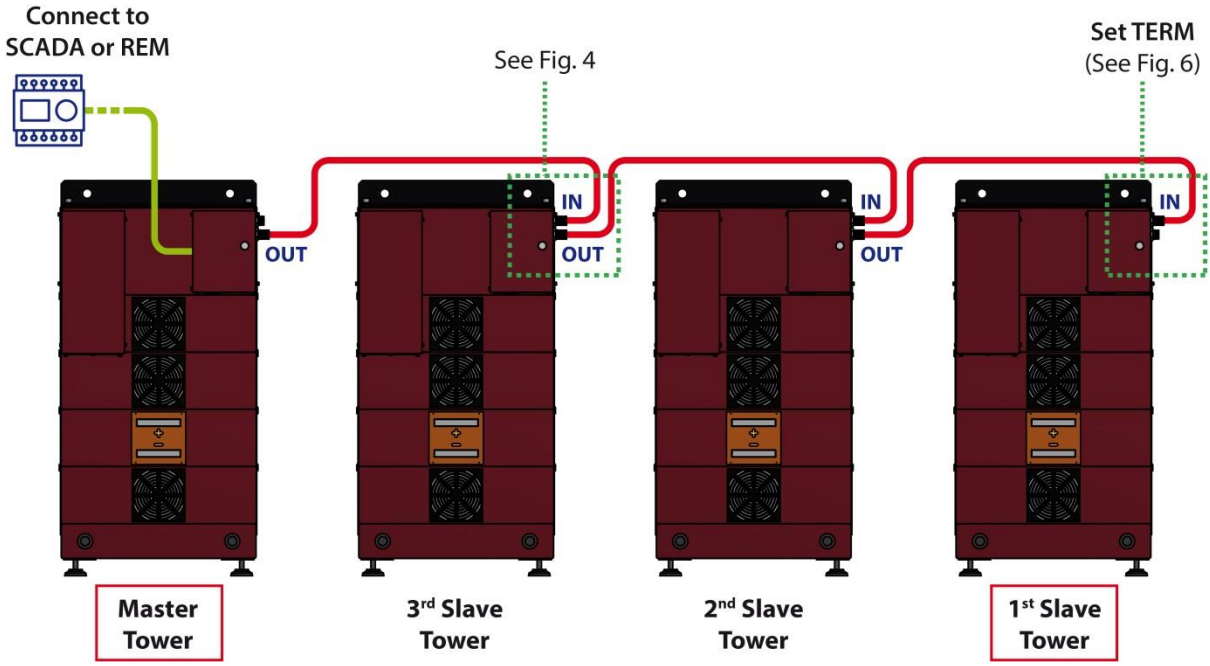


Figure 5: a multi-tower system made of 4 towers

In the 1st slave the termination switch, available in the card inside the connector box, must be set to

"TERM", as it can be seen in the below picture:

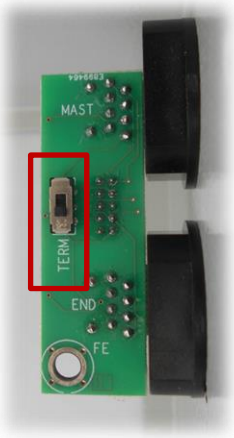


Figure 6: set the switch to TERM only on the first SLAVE tower.

Starting from the **1st slave** tower an Ethernet cable must be put between the RJ45 IN port of this one and the RJ45 OUT port of the **2nd slave** tower.

Then another Ethernet cable must be connected between the RJ45 IN port of the **2nd slave**, and the RJ45 OUT port of the **3rd slave**, and so on until all towers are connected to the bus.

The 1st slave tower is the only one that has a cable connected to its RJ45 IN port and no cable connected to its RJ45 OUT port.

The Master Tower is the only tower that has a cable connected to its "OUT" port, but no cable connected to its "IN" port.

The RJ45 in / out plugs are protected with IP 67 cable gland.

6.2 Configuring the machines

After preparing the network, the rectifiers must be configured to operate in Multi-Tower.

- On the master tower the parameter: **1- MULTW WORK MODE** in "RECT MULTW CONF" menu must be set to "**MULTITOWER MASTER"**
- On all remaining slaves towers the parameter: **1- MULTW WORK MODE** in "RECT MULTW CONF" menu must be set to "**MULTITOWER SLAVE".**

All the rectifiers have now to be powered off and on. At startup, on the display of the Master tower, will be shown a message with the number of towers addressed, the total output current, the total output voltage and if the rectifiers can operate in reverse mode or not.

During the start up the slave towers will be automatically enumerated, starting from the **1st slave.**

The **1st slave will display: address 1, the** 2nd slave the address 2 and so on until all the slaves connected are automatically addressed.

If the initialization process is successfully completed the Master tower displays: Rectifier OK and the Slave displays: Rectifier OK and the address of the tower.

In the Slave towers the Led in the Remote button and the Led in the Local button of the keypad are blinking.

The Slave tower with the termination will show "T" in the bottom right of the display

6.3 Information displayed when the rectifiers are working in multi-tower mode

In the Master tower: the first line displays the measured voltage and current of the multi-tower system. The second line will show the measured voltage and current of the master tower. The remaining two lines are available to be programmed by the user. This can be done entering in the DISPLAY CONF MENU.

Note: to program the 3th line of the display of the Master is necessary to select the choices in the 2nd line of the DISPLAY CONF MENU and to program 4th line of the display of the Master is necessary to select the choices in the 3th line of the DISPLAY CONF MENU

In a Slave tower: the first line displays the measured current and voltage of the Slave tower. On the second line the time elapsed since the rectifier started to run. On the third line the Partial Ah counter. On the fourth line the tower address.

6.4 The current division mode operation.

When rectifiers are working in parallel, some technical characteristics like the achievable precision or the minimum output current required to operate, are calculated summing the characteristics of every rectifier. For example if the multi-tower configuration is made of two towers, each 1000A, and the minimum output current of every tower is 10A, the minimum output current of both towers working together will be 20A.

Sometimes the same multi-tower system can be connected to different loads with very different characteristics. Some could require small currents but with high accuracy; others could require higher currents with a lower accuracy.

To overcome this limits the current division mode has been introduced. When this feature is enabled, in a multi-tower configuration, are enabled only those towers that are needed to provide the required current. For example: a multi-tower system is made of two towers, one is 50A the second one 450A. The total output current of the system is 500A. If the current of 40A is required, and the standard working mode is used, the first tower will deliver 4A, and the second one 36A. In current division mode the 40A will be all delivered by the first tower. Using only one tower, it is possible to adjust the current with a higher precision: for example in this case it would be possible to set a current of 45.2A, using one decimal digit. Also the minimum current will be lower.

<u>The drawbacks are:</u>

1) Some of the towers will work more than others, and hence needing more maintenance (for example the master tower is always run).

2) **It is recommended don't use the current division mode in applications where the current set point is changed, for example in waveform made by different steps of set point current.**
When the current set point is changed, and more or less towers are needed, there could be an under peak of current, when one tower is activate and an over current peak, when one tower is deactivated.

6.4.1 How to properly configure a system that operates in current division mode

Towers cannot be turned on in a random way. The master tower is always enabled. If more current is required, the tower next to the master tower is enabled, and so on until all towers are enabled. This means that to achieve the best resolution, a system designed to work in current division mode, should have the master tower as the smallest tower in the system. The slave tower following the master tower should be more powerful than the master tower but smaller than the following slave, and so on with the first slave tower being the biggest one.

For example in a multi-tower system made of 3 towers, the first one of 50A, the second one of 150A and the third one of 400A, they should be arranged in this way:

1. First slave tower: 400A
2. Second slave tower: 150A
3. Master tower: 50A

In this way if a current below 50A is required the master tower is used. If a current between 50A and 200A is required the master tower and the second slave tower are enabled. If more current is required all towers are enabled.

When 2 or more towers are enable each of the tower will provide respectively an amount of current in proportion to its max current. Taking the above example if a current of 100 A is requested the Master will provide 25 A and the Second Slave 75 A. If a current of 300 A is requested: the Master will provide 25 A the Second slave 75 A and the first slave 200 A.

6.4.2 System working in voltage mode

If the multi-tower system is working in voltage mode and controlled in **Remote** it is still possible to select how many towers will be operating.

Using the current limit field and setting a current limit lower than the sum of the maximum current provided by the multi-tower machine, it is possible to limit the number of enabled towers.

Note: the current limit value has not been changed during the execution of programmed waveform, this to avoid under current peak or over current peak when the towers are activated or deactivated.

Taking again the example of the three towers introduced in the previous paragraph. If the required output voltage is 12V, and the current limit is set to 50A or below, only the master tower will be activated. If the current limit is set between 50A and 200A, the master tower and the second slave tower will be enabled. If the current limit is set to 0A or above 200A, all towers will be enabled.

6.4.3 How to enabled the current division mode

To work in current division mode, option "**EN CUR DIV MODE**" must be set to 'Y' in the Master Tower.

With the rectifier in Local (using the keypad or the REM) the current division will be enabled only when the rectifier is operating in current mode. The rectifier will adjust the output current according to the programmed set point.

When operating in **Remote** (rectifier controlled from a SCADA) the option "**EN CUR DIV MODE**" must be set to 'Y', moreover a specific command bit must be set to 1. This additional bit allows to switch from a "current division mode" to a "standard mode" from remote and vice versa, without the need to change the rectifier options.

See paragraph "The COMMAND area map".

7 The AH/Am/As counters

The rectifier is equipped with four independent ampere meters: Grand Total, Total, Total Pump, Partial.

The Grand Total meter is in Ampere hour.

The Total, Total Pump and Partial can be programmed to operate in "Ampere hour", in "Ampere minute" or in "Ampere seconds" and can be updated: only when a positive current is delivered, only when a negative current is delivered, or both on positive and negative currents.

The unit of the counters: **AH, Am or As** can be selected in the "RECT OPER CONF menu.

If parameter "**AH COUNT TYPE**" in "RECT OPER CONF" menu is set to "POS AH COUNTER", the counters will be updated only when the current delivered is positive. If the parameter is set to "NEG AH COUNTER", the counters will be updated only when the current delivered is negative. If the parameter is set to "POS/NEG AH COUNTER", the counters will be updated in any case.

The AH/Am/As counters are accessible through the "**AH menu**" available in the **Operating parameter Menu**. Through AH Menu it is possible to check the value of the counters, reset their values and set their operating thresholds.

In Multi-Tower system every towers have to be set with the same counter type and with the same counter unit: all with positive AH counter or all negative AH or all POS/NEG AH COUNTER; all in AH or all in Am or all in As.

7.1 GRAND TOTAL AH

This counter is provided only for service purpose. This counter operates only in AH, and it is incremented both when the current is positive and negative. It cannot be reset by the user.

7.2 TOTAL AH/m/s Counter

This counter is incremented from cycle to cycle. It can be reset using a special command from remote, or through entry "**3- RESET TOT COUNT"** in the "**AH menu**" of the operating parameters menu.

Its maximum value is 100.000.000. In case of overflow this counter is reset but no warning message is generated.

The value of this counter is displayed on the third line of the display when the rectifier is in standby mode.

7.3 TOTAL PUMP AH/m /s Counter

Like the previous counter, this one is incremented from cycle to cycle. It maximum value is 100.000.000. In case of overflow this counter is reset but no warning message is generated. It can be manually reset using the **“AH MENU”** entry **"7- RESET PUMP COUNT?"**.

The characteristic of this counter is that it can be programmed to activate a digital output for a certain interval, when its value overcome a programmed threshold. The digital output is often used to turn ON a pump that can add some chemicals into the bath, hence the name of the counter. This counter is automatically reset when the pump is activated.

To activate the external pump the user has to follow these steps:

1) Set the “**11-DIG OUT FUNC”** as EXTERNAL PUMP in the RECT OPER CONF menu.
2) Program a threshold in the **"5- TOTAL PUMP LIMIT"** parameter in the AH MENU of the Operating parameters menu.
3) Program the **"6- PUMP ON"** parameter with the number of seconds the digital output will be activated in the AH MENU of the Operating parameters menu.

7.4 PARTIAL AH/m/s Counter

The partial counter is reset every time a new cycle is started. This counter is used to measure the current supplied to a load during a cycle and it is reset every time the rectifier is switched from Standby to Run.

This counter is also used to automatically turn the rectifier OFF when a certain threshold is overcome. The thresholds can be programmed when the rectifier is operating in local mode. See the parameter AH/m LIMITS in DC MODE and WAVEFORM MODE of the OPERATING MODE menu in the Operating parameters menu.

8 The messages reported by the rectifier: info, warning and error

The rectifier reports various messages regarding its operating status.

The messages are divided into three groups of categories:

- **Information messages**: these messages inform the user about the status of the rectifier
- **Warning messages**: these messages warn the user about abnormal conditions
- **Error messages**: these messages report errors that can compromise the rectifier operations

All the messages are showed in the display of the rectifier.

The messages with fault code: **Ixx, Wxx, Exx are stored in the LOG memory and sent to the SCADA.**

If the SD memory card option is added in the rectifier: all the messages with fault code can be stored in the SD card or can be seen in real time in a PC. In order to see the LOG in real time, a PC has to be connected to the Rj45 port, available in SD card, with a special cable provided by ACRS. In the PC is necessary to install the M090 software manager.

The list in the table 8.1 reports: all the messages , the category of the message and it indicates which messages are stored in the LOG & sent to the SCADA (and saved in the SD memory card).

Concerning the priority of the message showed in the display: the info has less priority than the warning and the warning has less priority than the error. This means that if an error message is enabled, the warning and the information messages won't be displayed.

For the messages sent to the SCADA or read in the display of the rectifier, the message code with the highest number has the highest priority.

This means for example: if **E37** and **E81** are contemporary enabled only the E81 will be sent to the SCADA.

However both of them will be stored in the Log memory.

In order to read from the SCADA all **information**, **warnings** and **errors** active in the rectifier it is necessary to map the ADD-ON data of the STANDARD MEMORY MAP (see chapter 12 for details).

NOTE: some errors/warnings can force the output current to 0 to prevent the damaging of the rectifier.

8.1 The list of the messages

8.1.1 Info messages without fault code:

Displayed message	Message category	Message information
Q-SERIES AIR	INFO	The rectifier is Q-SERIES, air cooled type and it is correctly operating
Q-SERIES WATER	INFO	The rectifier is Q-SERIES, water cooled type and it is correctly operating
VEGA AIR	INFO	The rectifier is VEGA, air cooled type and it is correctly operating
VEGA WATER	INFO	The rectifier is VEGA, water cooled type and it is correctly operating
Rect MISMATCH	INFO	This info is displayed in case a CPU090, set as Vega rectifier, is assembled in a Q-Series rectifier (or vice-versa). The rectifier cannot operate.
REM connected	INFO	The rectifier is controlled by a REM-8 or REM-8E
Support mode	INFO	The rectifier is in support mode. This message shall never be displayed unless the service personnel is operating the rectifier
Parameter locked	INFO	The parameter can be changed only by service personnel. Please call the technical support for more information.
Waveform enabled	INFO	A waveform has been programmed. If the user presses the RUN button in local mode the waveform will be executed.
Ethernet IP installed	INFO	EthernetIP board installed and correctly initialized
Profibus installed	INFO	Profibus board installed and correctly initialized
Profinet installed	INFO	Profinet board installed and correctly initialized
Devicenet installed	INFO	Devicenet board installed and correctly initialized
Modbus TCP installed	INFO	ModbusTCP board installed and correctly initialized
Analog card installed	INFO	The Analog card is correctly installed
Com board HW test	INFO	This message is shown only at startup when the communication board is initialized
Slave tower add: **n**	INFO	In a multi tower system, on each slave tower it is displayed the address of the tower in the multi tower chain.
RECTIFIER PAUSED	INFO	The rectifier is in pause mode.
RS485 port already used	INFO	This message is displayed when the same port is selected to connect contemporary the REM and the SCADA via Modbus protocol
No pulse rectifier	INFO	The user is trying to program a pulsed waveform in a rectifier that cannot make pulsed waveform
No sin rectifier	INFO	The user is trying to program a sine waveform in a rectifier that cannot make sine waveform
Press run to resume	INFO	In case of an emergency stop is released it is asked to the user to press the button ON to continue the process

8.1.2 Messagges with fault code:

Fault code	Displayed message	Message category	Message information	Output power set to zero	Led signal in the keypad	Led status in the keypad	Fault bit
I1	Power On/reset	INFO	This info is Log every time the rectifier is switch on from the main. This message is not sent to Scada.	-	Line	fixed	**1**
E2	ANL no comm	ERROR	There is a communication issue between the Rectifier and the Analog Card. The rectifier is turned in Standby after the Comm Timeout is elapsed. This message is not sent to Scada.	-	Check	fixed	**2**
E5	NIC not init	ERROR	The Network Interface Card installed in the rectifier cannot be initialized, for examble the 9 pins cable that connect to the CPU is cut or the card is failed. This message is not sent to Scada.	-	Check	fixed	**5**
E6	NIC no comm	ERROR	There is a problem in the Network interface Card, for example after the initialization of the network card the communication with the CPU was cut. This message is not sent to Scada.	-	Check	fixed	**6**
E7	NIC wrong comm	ERROR	The Network interface Card is detecting an error in the communication Network, for example: in an Ethernet Network the same network address is used in multiple machines or the PLC is not set correctly. This message is not sent to Scada.	-	Check	fixed	**7**
E8	NTW no comm	ERROR	The Scada is shutted down or the communication bus is disconnected or has a problem**.** **The rectifier is turned in Standby after the Comm Timeout is elapsed.** This message is not sent to Scada.	-	Check	fixed	**8**
W10	REM no comm	WARNING	The rectifier is connected to the SCADA and the REM is connected to the rectifier as a remote display. This warning message is displayed in the rectifier, in the REM and sent to SCADA, when the communication between the rectifier and the REM is lost.	-	Check	blinks 1 time /3s pause	**10**
E11	REM no comm	ERROR	The Rectifier is driven by the REM. This error is displayed in the rectifier , in the REM and sent to SCADA (in case it is connected as monitoring), when the communication between the rectifier and the REM is lost. **The rectifier is turned in Standby after the Comm Timeout is elapsed.**	-	Check	fixed	**11**

I12	STANDBY/RUN req	INFO	The rectifier is controlled in remote by SCADA. The message appears after an Emergency Input command. The user is asked to send by SCADA the command to put the rectifier in standby and then to send the specific command to run current.	-	Line	fixed	**12**
I13	Release start	INFO	In case an external start-stop switch or push button is used, at the end of a waveform execution, or after an Emergency Input command , the user is asked to release the start switch, before a new cycle is executed	-	Line	fixed	**13**
I14	Start to resume	INFO	This message appears when an Emergency Stop or an external start-stop / push button has turned OFF. The user is asked to turn in Start to run the current.	-	Line	fixed	**14**
I15	Wait Modules Ctl	INFO	In local or remote a run command was given before CPU finished the routine for check the number of the half modules. After the check time is elapsed the rectifier turns in run mode.	-	Line	fixed	**15**
I16	Log RAM Full	INFO	70 Error logs are recorded in the CPU RAM and it is required to go in standby to store them in the CPU no volatile support (EEPROM and SD card).	-	Line	fixed	**16**
I18	Run	INFO	This info is stored in the LOG every time the rectifier goes in Run mode. The info is not showed in the display.	-	Line	fixed	**18**
I19	Stby	INFO	This info is stored in the LOG every time the rectifier goes in Stby mode. The info is not showed in the display.	-	Line	fixed	**19**
I20	Yxxx Log susp	INFO	An error occurred 10 times in the same hour.	-	Line	fixed	**20**
E22	Battery low Sxx	ERROR	The battery of the RTC clock is failed or low level in the machine/ Slave xx and has to be replaced. To clean the error is necessary to reset the CPU	-	Check	fixed	**22**
E23	SD card fail	ERROR	An error occurred during the access to the SD Card. Verify the right insertion of the SD card or try to extract and insert it again to solve the problem.	-	Check	blink 4 time /4s pause	**23**
E24	EE	ERROR	The non volatile memory is corrupted. It will be erased and initialized again. All configuration data will be lost.	-	Check	fixed	**24**
W25	SD card full	WARNING	The SD card is full. Extract the card and transfer the data to a PC .	-	Check	blink 1 time /1s pause	**25**

E26	M3	ERROR	Microprocessor memory access failure level 3.	-	Check	fixed	**26**
E27	M2	ERROR	Microprocessor memory access failure level 2.	-	Check	fixed	**27**
E28	M1	ERROR	Microprocessor memory access failure level 1.	-	Check	fixed	**28**
E30	Cpu reset	ERROR	The CPU has been re-set by the Watch Dog (400ms). To clean the error is necessary to restart the rectifier.	-	Check	fixed	**30**
E31	Can busy	ERROR	The CAN bus is always locked and never released.	-	Check	fixed	**31**
E32	Can error	ERROR	There is an error in the CAN bus.	-	Check	fixed	**32**
I40	Ah uom changed	INFO	The unit of the Ah counter has been changed by the user or the Total counter is reset by the Keypad or by the PLC. The value of the Total counter reached is saved in the LOG and restart from 0 with new unit (visible only by download the LOG with M90 Manager).	-	Line	fixed	**40**
E42	Master no comm	ERROR	The message is displayed in the Slave Tower at start up for the following cases: 1 - The Master tower is OFF, 2 - The comm bus is disconnected, 3 - The term is not set on the Slave at the end of the circuit. Problem must be resolved to run the system.	-	Check	blink 3 times / 3s pause	**42**
E43	Slave no comm	ERROR	The message is displayed in the Master Tower at start-up for the following cases: 1 - One Slave xx is OFF. 2 - One Slave xx has the Comm Bus disconnected, 3 - The TERM is not set on the Slave at the end of the circuit. Problem must be resolved to run the system.	-	Check	blink 3 times / 3s pause	**43**
E44	Wrong slave num	ERROR	The message is displayed in the Master at start up, when it doesn't recognize the correct number of slaves connected. The problem must be resolved to run the system	-	Check	blink 3 times / 3s pause	**44**
E45	No MTW Sync	ERROR	The message is displayed in the Master at the start up, when the Master or the Slaves are not able to drive the 3 Digital signals: MRG, INV, ZERO. The error must be resolved to run the system.	-	Check	blink 3 times / 3s pause	**45**
E46	Rect mismatch	ERROR	This info is displayed in case a CPU090, set as Vega rectifier, is assembled in a Q-Series rectifier (or vice-versa).	-	Check	blink 1 times / 1s pause	**46**
I47	Max volt reached	INFO	The rectifier turns to Standby when the programmed threshold of Voltage is reached. The error is cleaned when a new run cycle is start.	-	Line	fixed	**47**
I48	Max amp reached	INFO	The rectifier turns to Standby when the programmed threshold of Current is reached. The error is cleaned when a new run cycle is start.	-	Line	fixed	**48**

I50	Max TAh Reached	INFO	The Max value of the Total Ah counter has been reached. The value of Tot Ah is saved in the LOG. (visible only by downlod the LOG with M90 Manager).	-	Line	fixed	**50**
I51	Open circuit Sxx	INFO	The machine / Slave xx has the outputs not connected to the load. The message is displayed when Vout>5% Vout max of the rectifier and Iout< 1% Iout Nominal of the rectifier.	-	Line	fixed	**51**
I52	Output in short Sxx	INFO	The machine /Slave xx has the outputs in short circuit. The message is displayed when Vout<1% Vout max of the rectifier and Iout> 10% Iout Nominal of the rectifier.	-	Line	fixed	**52**
E53	Set point err	WARNING	The rectifier cannot reach the desired set point. Usually this happens because the rectifier has reached one of its operating limits (the Limit voltage, if the rectifier is operating in current mode, or the Limit current, if the rectifier is operating in voltage mode).	-	Check	fixed	**53**
E54	EValve err Sxx	ERROR	In a water cooled rectifier /Slave xx ,equipped with an internal water valve, this alarm means an overcurrent on the valve. Change the valve.	YES	Therm	fixed	**54**
W60	Low BAR/PSI Sxx	WARNING	The water pressure in the machine/ Slave xx is low but not dangerous.	-	Therm	blink 1 time /3s pause	**60**
W61	Temp high [low] Sxx	WARNING	The water temperature in the machine / Slave xx has reached the lower thereshold (see Low Temp THR in menu Sensors) or the upper thereshold (37 C)	-	Therm	blink 1 time /3s pause	**61**
W62	Flow high [low] Sxx	WARNING	The water flow has reached the lower threshold (programmable) or the upper threshold (2 *nominal) in the machine / Slave xx.	-	Therm	blink 1 time /3s pause	**62**
I64	Lim amp<max Sxx	INFO	The Current Limit in the machine/Slave xx is under the current data label, after a module was disconnected. To clean the error is necessary to restore the max ampere capacity of the rectifier.	-	Line	fixed	**64**
E65	MOD yy VS zz Sxx	ERROR	The machine / Slave xx has one or more half module not connected. It is only detected when the machine goes to Standby. The error is suppressed by adjusting the number of half modules. To clean the error is necessary to switch off and on the rectifier.	-	Check	fixed	**65**
W67	Over V>115% Sxx	WARNING	The machine / Slave xx is detecting an over voltage issue > 115 % (toll: -5%).	-	Check	blink 1 time /3s pause	**67**
W68	Under V<80% Sxx	WARNING	The machine / Slave xx is detecting	-	Check	blink 1	**68**

			an under voltage issue < 80 % (toll : +5%).			time /3s pause	
E70	High BAR/PSI Sxx	ERROR	The water pressure in the machine / Slave xx reached the maximum limit value - output currnet is set to 0 while error is active.	Y	Therm	fixed	**70**
E71	High wat tem Sxx	ERROR	The temperature of the water in the machine / Slave xx has reached the maximum limit (40 C) - the output power is set to 0 while the error is active.	Y	Therm	fixed	**71**
E72	Low wat flow Sxx	ERROR	The min programmed water flow has been detected in the machine / Slave xx –the output power is set to 0 while error is active. The same fault code is activeted in case the WFS is installed in Q-Series.	Y	Therm	fixed	**72**
E80	No rev mod	ERROR	In case of reverse machine, this error indicates that the reverse module was not found by the CPU. With this error is not possible to run power.	-	Check	fixed	**80**
E81	Module issue Sxx	ERROR	The machine / Slave xx has one or more modules broken or not providing the correct output current.	-	Check	fixed	**81**
E83	Mod therm Sxx	ERROR	The machine / Slave xx has one or more power modules in thermal issue. The output power of the side of the module in therm is set to 0.	-	Therm	fixed	**83**
E84	Rev therm Sxx	ERROR	The machine / Slave xx has one or more reverse modules in thermal issue. The output current is set to 0 while the error is active. Resumes automatically once the therm alarm is removed.	Y	Therm	fixed	**84**
E85	MTW BUS Err	ERROR	In operation mode the slaves has no comm from Master due to the following causes: 1 - The Comm Bus was disconnected, 2 - The Master was swiched OFF. The Slave tower with this error turns in stand-by. The error is displayed in the Master if the all the Slaves don't communicate.	-	Check	blink 3 times / 3s pause	**85**
E86	Slave Disc Sxx	ERROR	The message is displayed in the Master tower, during the operation, when one or more slaves Sxx are suddenly not communicating any more. The slaves disconnected turns in stand-by.	-	Check	blink 3 times / 3s pause	**86**
E87	Amp not zero	ERROR	The message appears in the Master, during the operation of the machine, when the output current doesn't go to 0 in a tower. The output power of the rectifier is set to 0.	Y	Check	blink 3 times / 3s pause	**87**
E88	Not rev Sxx	ERROR	This message appears during the operation when the output current in the machine / Slave xx is not reversed. It appears in the Master and in the slave has not reversed the current. The output power of the rectifier is set to 0.	Y	Check	blink 3 times / 3s pause	**88**
E89	Phase miss Sxx	ERROR	The machine / Slave xx has one of	Y	Check	fixed	**89**

			the 3 main input phases missing or one of the input fuses of the CPU is blown. The output power of the rectifier is set to 0. To clean the error it is necessary to power OFF /ON the rectifier.				
E90	Over V>120% Sxx	ERROR	The machine / Slave xx is detecting an over voltage issue > 120 % (toll: -5%). The output current is set to 0 while the error is detected.	Y	Check	fixed	**90**
E91	Under V<75% Sxx	ERROR	The machine / Slave xx is detecting an under voltage issue < 75 % (toll: +5%). The output current is set to 0 while the error is detected.	Y	Check	fixed	**91**
E93	Safety stop Sxx	ERROR	The Emergency Input, is triggered and the machine goes in Standby	Y	All except line	Blink	**93**

In case of a multi-tower configuration, if an error message is shown on a slave tower, the same message is displayed on the master tower. On the master tower the error message is followed by the number of the tower (Sxx) that reported the failure.

9 Rectifier output waves

The rectifier can generate three types of output waves: DC, PULSE and SINE.

9.1. DC output

If the rectifier is a DC or DCR machine only the DC operating mode is available. In the DC mode the rectifier output can be adjusted to a desired current or voltage set point. The set point can be dynamically changed and a ramp can be programmed to be executed between two set points.

The minimum duration of a ramp in a DC phase is 1 second. A waveform can be drawn adding a step after another.

To produce a negative output current or voltage set point the rectifier has to be programmed as a reverse machine. The parameter: **5-REVERSE MACHINE** in RECT HW CONF menu has to be set to Yes

Below there is an example of a DC waveform:

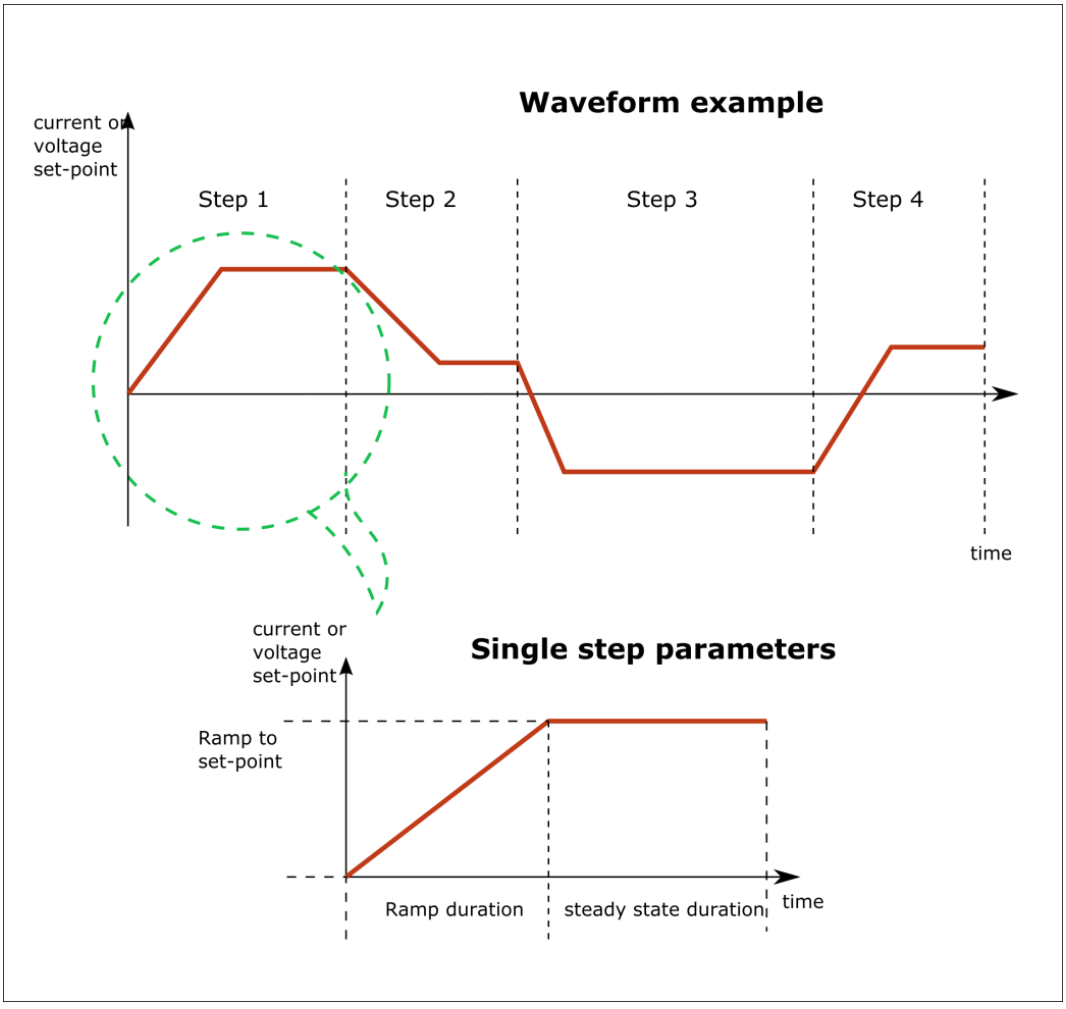


Figure 7: DC operating mode

9.2. PULSE output

If the rectifier is a pulsed machine, pulses can be generated. In this case parameter: **8-P TYPE MACHINE** shall be set to Yes.

Every pulse has a fixed ramp time of 1ms. **In case the current needs to be inverted, the required ramp time is 2ms, 1ms to go to 0 current and to apply the inversion, 1ms to set the new output current.**

When a pulsed waveform is designed, the ramp time should be taken into account. In the picture below it is shown a pulsed waveform made of 5 phases. In yellow it is shown the desired output, in red the real output with the ramps. The duration of every phase is comparable to the ramp time, with the scope to show the effect of the ramps. The waveform will be repeated again and again, until the rectifier is turned off.

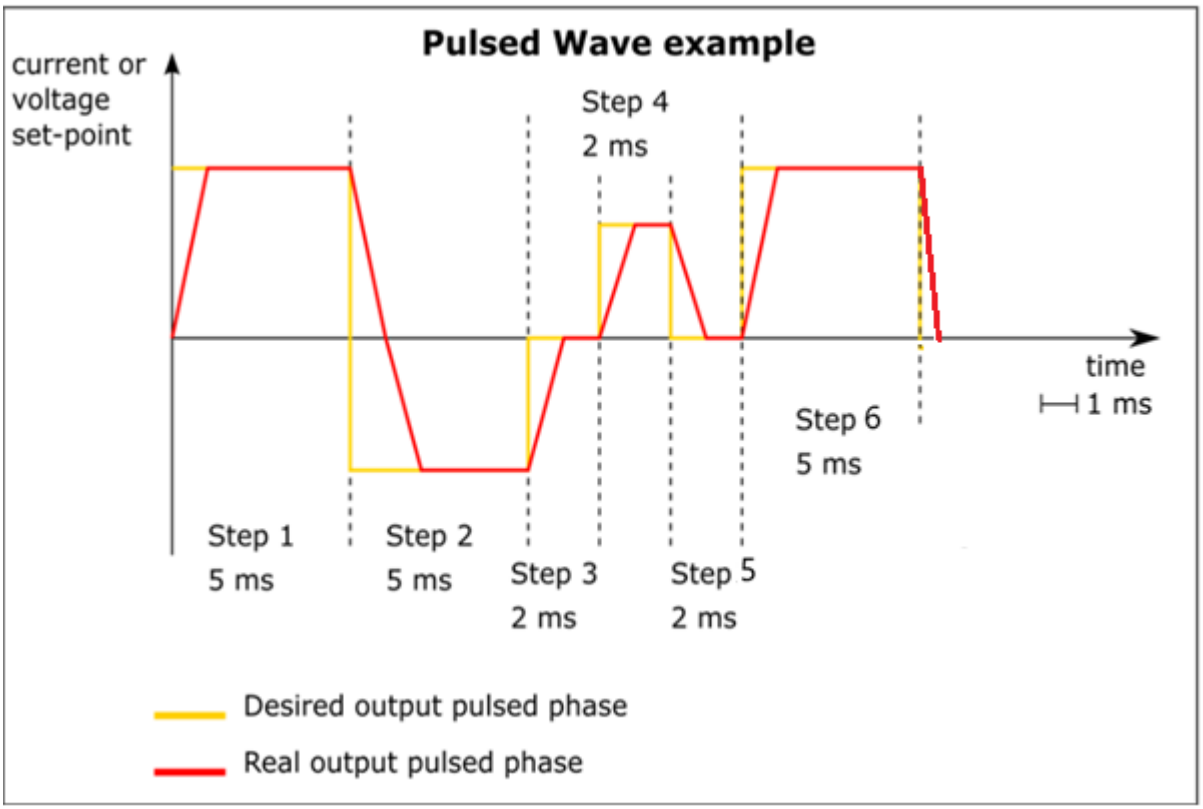


Figure 8: a pulsed waveform

9.3. SINE waves

If the rectifier is a sine wave machine, sine waves can be generated. In this case parameter: **9-S TYPE MACHINE** shall be set to Yes.

Sine waveforms are sinusoids made of a positive phase and of a negative phase. The terms “positive” and “negative” only refers to the first half and to the second half of the sinusoid, not to the sign of the set point.

The duration of the positive and of the negative half can be different. The minimum duration is 5ms, the maximum duration is 25ms.

The other parameter needed is the RMS set point of the positive phase and the RMS set point of the negative phase.

It is also possible to apply an offset to have a sinusoid that lies entirely in the positive plane or entirely in the negative plane. If an offset is applied both the positive and the negative peak values of the sinusoid must stay in the same plane. The values of the positive and of the negative phases are still expressed as a positive and a negative value, but they are referred to the offset instead of the 0.

The picture below shows a sample of a sine wave.

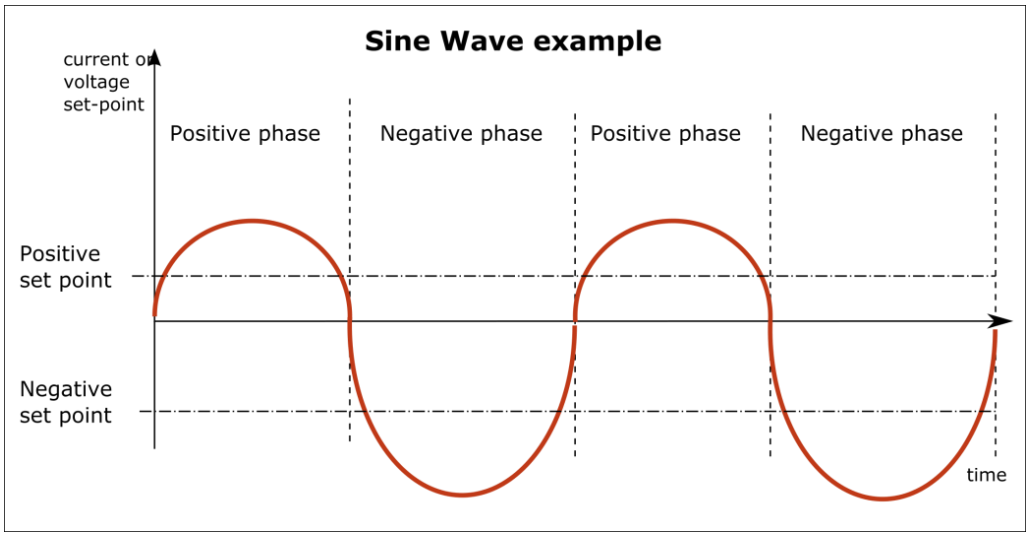


Figure 9: a sine wave

The picture below shows the same sine wave pictured in the previous example, only a positive set point has been added. Please note that the positive and the negative set points are still expressed as if the sine wave had a 0 offset.

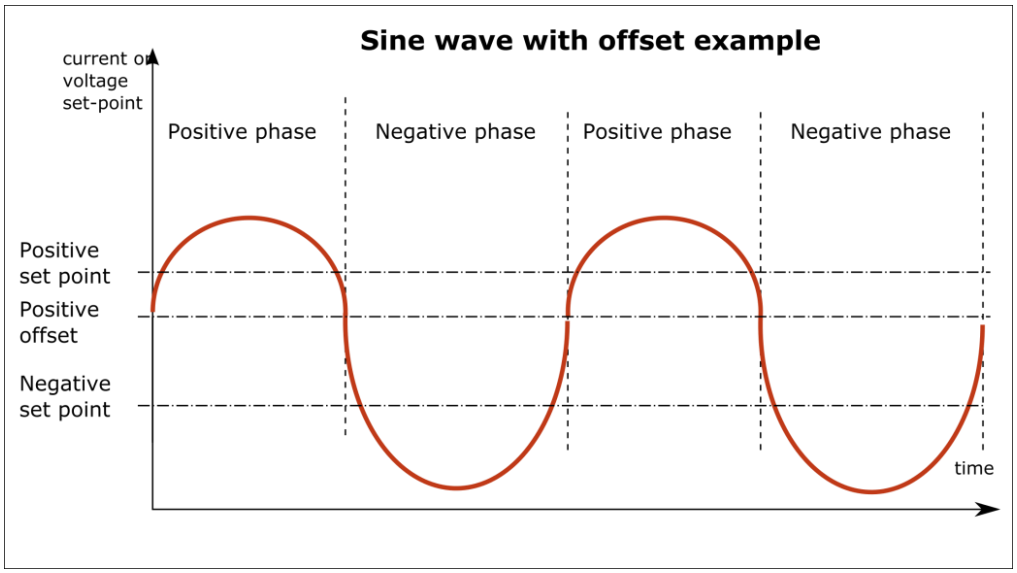


Figure 10: a sine wave with a positive offset

The Sine wave with the offset=0 has to be complaint to the followings rules:

$$\text{MAX RMS VALUE} = \frac{Limit\ Current\ or\ Volt}{\sqrt{2}}$$

In case of an offset is added the following rules have to be applied:

- positive rms value = negative rms value.

- positive duration = negative duration.

-OFFSET ≤ Limit Current or Volt – rms value * $\sqrt{2}$

10 Rectifier operating modes

10.1 Local mode and Remote mode

- When the rectifier is working in **local** mode, the Led integrated in the local button is turned ON. In Local mode the rectifier can be controlled only using the keypad.

  In local mode the rectifier is like a stand alone. The control from the SCADA is not allowed; The SCADA can only monitoring the rectifier data map.

- When the rectifier is working in **remote** , the Led integrated in the remote button is turned ON . In this case the rectifier must be connected to a remote SCADA.

  In remote the status, the operating mode and the set point of the rectifier are controlled from the SCADA. However it is possible to use the button local in the keypad to switch from remote to local mode in the followings cases:

  - Local/Remote KBD ONLY set to Yes.

  - Local/Remote KBD ONLY set to No and a Communication error with SCADA.

    Once the communication error occurs, if the user doesn't turn from remote to local, the rectifier will turn automatically in STANDBY, after the COMM TIME OUT is expired

    If the communication returns active, after the rectifier was switched in local , it is possible to return in remote in the following ways:

    - If the Local/Remote KBD ONLY is set to Yes : only by pressing the Remote button in the keypad.

    - If the SCADA REMOTE ENA is set to YES and Local/Remote KBD ONLY is set to No: by a command in the SCADA.

Note: When the main voltage switch OFF and ON the rectifier will return in the mode, local or remote, set before the main power supply was switched OFF.

10.2 Rectifier operating in local mode

When the rectifier is operating in local mode, it is controlled by the front panel keypad or by a remote REM.

The rectifier can be operated as a local controlled machine, or it can be programmed to execute some waveforms.

10.2.1 Rectifier operated as Local controlled machine

If parameter "1- OPERATING MODE" in "LOCAL OPERATING MODE" menu is set to "DC MODE" the keypad buttons are used to select the operating mode (pressing the "VOLT" or "AMPERE" button) and the "UP" and "DOWN" arrow keys can be used to adjust the set point. In this mode it is possible to set some limits based on the execution time and the AH/m partial counter (please check parameters "1- DC TIMER LIMIT" and "2- DC AH/m LIMITS").

10.2.2 Rectifier programmed to execute waveforms

The rectifier can be programmed to execute some waveforms. Waveforms are a sequence of steps that can be programmed when the rectifier is in standby mode to be automatically executed once it is turned on. The Local waveform can be selected programming parameter "1- OPERATING MODE" in "LOCAL OPERATING MODE" menu. The available options are: a DC waveform, a PULSE current waveform, a PULSE voltage waveform, a SIN current waveform and a SIN voltage waveform.

10.3 Rectifier operating in remote mode

When the rectifier is operating in remote mode, all command must come from a remote SCADA. It is still possible to use the rectifier to generate DC or PULSED or SIN waves, but their parameters must be programmed from remote. Please check the data map of the rectifiers for a detailed analysis of the information needed to program a working mode from remote.

10.4 Rectifier in Emergency mode

The rectifier can be programmed to use one of the 2 digital inputs as an emergency input.

The digital inputs pins are available in the port CN5 of the rectifier, see the paragraph: Communication ports at the beginning of the manual.

Connecting a push button, normally closed, between one of the digital input pin and the digital input common GND, is possible to turn OFF the rectifier in standby, when the push button is opened.

To configure one of the digital inputs as an emergency input the parameter "9-DIG 1 FUNC" or "10-DIG 2 FUNC" in the RECT OPER CONF menu must be set to "EXT EMERGENCY". When the corresponding digital input is opened, the rectifier is immediately switched to standby mode and message "EMERGENCY INPUT OPEN" is shown on the display. The rectifier cannot be operated if the emergency input is open (active). When the emergency input is active it is possible to enter in the configuration Menu only by entering in Support Mode.

10.5 Rectifier in Pause mode

If the rectifier is operating in local mode, one of the available digital inputs can be programmed to pause the rectifier. If the parameter "9-DIG 1 FUNC" or "10-DIG 2 FUNC" is set to "EXT PAUSE" and an external contact, normally open, is connected between one of the digital input pin and the common input GND, the rectifier can be turned to pause mode, when the contact is closed.

In pause mode the rectifier output current goes to 0, and message "RECTIFIER PAUSED" is shown on display. When the external contact is opened again, the rectifier execution is restored from the last point it was before the pause mode was activated.

If the rectifier is operating from remote, it is still possible to pause it using a special command bit.

10.6 Rectifier operating in Short circuit mode

When the rectifier is operating in short circuit mode, the output bars are connected together. In this condition a small output voltage is measured even if the rectifier is feeding a current to the load. When this condition is detected it is possible to limit the max output current adjusting parameter "SHORT CIRC LIMIT". This parameter is expressed as a percentage of the Nominal current of the rectifier.

Programming this parameter to 100% it means the maximum short circuit current will be equal to the LIMIT current of the rectifier.

The rectifier can operate in short circuit mode without being damaged. The max output current can be limited only to protect the load connected to the rectifier.

10.7 Rectifier operating in Open circuit mode

The rectifier can operate in voltage control and in open circuit mode, providing a stable output voltage, only if it is connected to a load or if an enhanced pre-load resistor is installed inside the rectifier.

Note: The pre-load resistor is not installed in every rectifiers, please consult ACRS for the types of rectifiers that mount the pre-load resistor.

10.8 Rectifier status line in standby mode

When the rectifier is in standby mode, in the 4th line of the display of the rectifier could be showed cyclically, for few seconds, some characters to identify some status information as depicted below:

																		T	➔

Description:

➔: Fixed = SD card inserted and working, Blinking = SD card fail

T : Fixed = Termination active. This identify the first slave in the multi-tower system.

If the rectifier is single unit and without SD card the status line will not be displayed.

10.9 Turn Off the rectifier for current or voltage threshold reached

The user can program these thresholds to turn the rectifier in standby if a specific output current limit or output voltage limit is reached. In this case a blinking message is also displayed on the front panel of the rectifier. The displayed message could be:

TURN OFF FOR CURRENT or TURN OFF FOR VOLTAGE.

To program these limits see the parameters 14-TURN OFF CURRENT or 15-TURN OFF VOLTAGE in the RECT OPER CONF.

To reset this condition is only necessary restart the rectifier pressing the RUN button on the keypad, if the rectifier is operating in local mode, or send a switch off / switch on command if the rectifier is operating in remote mode via SCADA. In case of an external switch or push button is used to start the rectifier, a turn off / turn on is required to reset the condition.

This feature is available in local mode, remote mode, using a remote control (REM) and also in multi-tower system.

The feature is disabled if the parameter value is programmed to 0.

11 Detection of the number of the half modules

The CPU090 board implements a circuit to detect the total number of half power modules connected to the CPU.

This circuit is able to detect a failure in the rectifier in the following cases:

-The analog control bus (flat cable) that connect the CPU to the modules is cut or failed.

- The CTRL card of the module disconnect from the current sense circuit.

The procedure to check the modules connected to the CPU is made every time the rectifier turns from run to standby. To do this operation the CPU takes 15 seconds and during this time the rectifier cannot run current.

However if the rectifier receives the RUN command during the check procedure, in local or either in remote, the message (I15): "Wait modules ctl" is displayed in the rectifier; after the control time is elapsed, if there is a Set Point command, the rectifier starts automatically to run current.

When the CPU detects a problem the error message: "**MOD yy VS zz**" is showed in the display and sent to the SCADA.

Where yy is the number of half modules detected and **zz** is the total number of half modules of the rectifier.

For example in a rectifier composed by 4 modules, 8 half modules, if one half module has an issue the error displayed is: "MOD 7 Vs 8".

When the error is detected it is no possible to run current, until the issue is fixed.

At this point if it is not possible to stop the process it is possible to continue to work modifying the total number of the half modules.

Taking the above example: with one half module missing is necessary to modify the parameter **16- HALF MODULES NUM** from 8 to 7.

In case the error displayed is 6 vs 8 then the "16-Half modules Num" has to be modified from 8 to 6.

Every time the "Half modules number" is modified, the parameter Limit current is automatically changed by the software, according the new value set in the parameter 16.

For example if the current of the machine is 2400 A and it is made by 4 modules of 600 A- 8 half modules of 300 A; then, in case the number of half modules is modified from 8 to 6, the new limit current of the rectifier will be 1800 A. In this case the message: "Amp Lim chg" is displayed in the rectifier to inform the Limit current of the rectifier has been modified.

After the issue in the module is fixed then it is necessary to restore the original numbers of half modules. Following the above example the "16-Half modules Num" has to be modified from 6 to 8. The limit current of the rectifier will be automatically increased from 1800 A to 2400 A.

Pay attention: in case the parameter 16- HALF MODULES NUM has been disabled, to perform some test or Service, before to restore the correct number of half modules, it is necessary to check the parameters: I Nominal and I limit stored in the "Rec HW Conf menu", they have to correspond the original factory parameters. In case of doubt ask to ACRS Service.

12 Controlling the rectifier from remote: the data map

When the rectifier is controlled from remote using a SCADA, a data map must be defined to exchange the data between the rectifier and the remote Scada. The data map used is always the same, regardless the protocol used.

The rectifier can operate with different data maps, to be compatible with Q-Series machines equipped with Q63 software that used different data maps for different operating modes.

The rectifier uses two area maps:

- ✓ the **DATA** area map contains the operating data that is transmitted to the SCADA

(DATA AREA MAP) : **RECT => PLC/SCADA**

- ✓ the **COMMAND** area map contains the operating data programmed by the SCADA

(COMMAND AREA MAP) : **PLC/SCADA => RECR**

12.1 The DATA area map (data read from the rectifier)

The rectifier data area map is described in the below table:

Offset	Type	Variable name	Description
0	UDWORD	MAX Ampere	The maximum current that can be delivered by the rectifier. This value is expressed in Ampere.
4	UWORD	MAX Volts	The maximum voltage the rectifier can operate. This value is expressed in Volts.
6	UWORD	Rectifier status	The rectifier status register. This is a bit mapped register, see below for more details.
8	UWORD	- Rectifier fault code - Fault tower number	This field is made of two bytes: **Most significant byte:** The "Rectifier fault code" contains the error code of the rectifier. Please see the below table for the errors 8.1 **Less significant byte:** The "Fault tower number". In a multi-tower system this byte contains the address of the tower that reported the error. In a single tower system this byte is always set to 1. If 2 or more errors are active in the same time, the error with the higher severity (high number) is published in the field.
10	SDWORD	Average measured current	The average output current. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
14	SDWORD	Average measured voltage	The average output voltage Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
18	UDWORD	Partial counter	The AH/m/s partial counter
22	UDWORD	Total counter	The AH/m/s total counter
26	UWORD	Elapsed seconds	The seconds elapsed since the rectifier was turned in run mode.

28	UWORD	Work mode	The rectifier working mode. This is a code that identify the rectifier operating mode: ✓ 0: rectifier operating in DC current mode ✓ 1: rectifier operating in DC voltage mode ✓ 2: rectifier generating a sinusoidal wave in current mode ✓ 3: rectifier generating a sinusoidal wave, in voltage mode ✓ 4: rectifier generating pulses, in current mode ✓ 5: rectifier generating pulses, in voltage mode
PLEASE NOTE: the following bytes have a different meaning according to the work mode used. See the tables below for details			

Where: SBYTE = 8 bits signed, UBYTE = 8bit unsigned, SWORD = 16 bits signed, UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits.

The "rectifier status" bits are mapped according to the below table:

Bit	Description	Mask
0	**0** = Stopped(Standby) **1** = Started	**0001**
1	**0** = Local mode **1** = Remote mode	**0002**
2	**0** = Current mode **1** = Voltage mode	**0004**
3	**0** = Dosing pump OFF **1** = Dosing pump ON	**0008**
4	**0** = No data error **1** = Data error. This bit is raised if the SCADA is setting a negative set point in a machine without the inversion module.	**0010**
5	Heart beat signal	**0020**
6	**NOT USED**	
7	**0** = Water temperature in Centigrade **1** = Water temperature in Fahrenheit	**0080**

8	**0** = DC machine (without reverse module)	**0100**
	1 = DCR machine (with reverse module)	
9 -10	Ampere Hour/Min/Sec:	**0200**
	B10 – B09= 00 AH, 01= Am , 10= As	**0400**
11	**0** = No Water valve	**0800**
	1 = Water valve	
12	**0** = Rectifier type Q-Series	**1000**
	1 = Rectifier type Vega	
13	**0** = AIR	**2000**
	1 = WATER	
14	**0** = Analog uses 0..10V IN	**4000**
	1 = Analog uses 4..20mA IN	
15	**0** = Analog doesn‘t use DUAL SET POINT	**8000**
	1 = Analog uses DUAL SET POINT	

12.1.1 The operating mode data

If the rectifier is operating in Pulsed mode or in Sine wave mode, some additional information can be retrieved by the SCADA reading some registers located at the end of the standard data area map;

PULSED MODE

In pulsed mode the below data can be retrieved from the rectifier:

Offset	Type	Variable Name	Description
30	SDWORD	Average measured current of the first phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
34	SDWORD	Average measured voltage of the first phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
38	SDWORD	Average measured current of the second phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
42	SDWORD	Average measured voltage of the second phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
46	SDWORD	Average measured current of the third phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
50	SDWORD	Average measured voltage of the third phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.

54	SDWORD	Average measured current of the fourth phase	The average measured current of this phase Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
58	SDWORD	Average measured voltage of the fourth phase	The average measured voltage of this phase Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
62	SDWORD	Average measured current of the fifth phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
66	SDWORD	Average measured voltage of the fifth phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
70	SDWORD	Average measured current of the sixth phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
74	SDWORD	Average measured voltage of the sixth phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
78	SDWORD	Average measured current of the seventh phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
82	SDWORD	Average measured voltage of the seventh phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
86	SDWORD	Average measured current of the eight phase	The average measured current of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.

90	SDWORD	Average measured voltage of the eight phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
94	SDWORD	Average measured current of the ninth step	The average measured current of this step. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
98	SDWORD	Average measured voltage of the ninth phase	The average measured voltage of this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.

SINE WAVE MODE

In sine wave mode the below data can be retrieved from the rectifier:

Offset	Type	Variable Name	Description
30	SDWORD	RMS measured current	The RMS measured current for the sine wave. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
34	SDWORD	RMS measured voltage	The RMS measured voltage for the sine wave. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
38	SDWORD	RMS measured current of the positive phase	The RMS measured current of the positive phase of the sine wave. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
42	SDWORD	RMS measured voltage of the positive phase	The RMS measured voltage of the positive phase of the sine wave. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.

46	SDWORD	RMS measured current of the negative phase	The RMS measured current of the negative phase of the sine wave. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.
50	SDWORD	RMS measured voltage of the negative phase	The RMS measured voltage of the negative phase of the sine wave. Please note: all analog measures are multiplied by 100. If 50.8 is the measured value, the output value will be 5080.

12.1.2 The DATA area map ADD-ON

Using the **STANDARD MEMORY MAP**, there is the possibility to add some additional data to be read by PLC/SCADA. These data are called ADD-ON and are added in the memory map to the last address of the map of the working mode used. For example if the rectifier is working in **DC mode**, these data will be available after the offset 28 (Work mode) and precisely they will start at the offset 30 because the work mode occupies 2 bytes. For **pulsed mode** they will start at offset 98 (because Average measured voltage of the sixth phase is 4 bytes long) and for **Sin wave mode** they will start at offset 54 (because RMS measured voltage of the negative phase is 4 bytes long).

The ADD-ONs are identified by number **1**, **2** etc and can be selected in the parameter **DATA MAP ADD-ON,** in the section where are defined all others protocol parameters. If the user doesn't need these data, the DATA MAP ADD-ON parameter must be configured to **NONE** and only the STANDARD MEMORY MAP data are exchanged.

ADD-ON 1 (16 bytes of data)

With this Add-on 1 the SCADA can read all the messages in the table of 8.1 that are active in the same time.

Offset	Type	Variable Name	Description
(30 or 98 or 54) +0	UDWORD	Rectifier log bits 0..31	Messages of the table in chapter 8.1 (one bit for each): The log bits Bit0 ... Bit31
+4	UDWORD	Rectifier log bits 32..63	Messages of the table in chapter 8.1 (one bit for each): The log bits Bit32 ... Bit63
+8	UDWORD	Rectifier log bits 64..95	Messages of the table in chapter 8.1 (one bit for each): The log bits Bit64 ... Bit9
+12	UDWORD	Tower Fault bits 0..31	Here is reported the status of each tower in a multitowers system. These data are valid only in the Master tower *(to continue in the next page)*

			Tower fault bits Bit0..Bit31. Bit0: Master Tower Bit1 … Bit25 : Towers

Rectifier log bit = 1 => log Active, bit= 0 => normal state
Tower fault bit = 1 => Fault Active, bit=0 => normal state

ADD-ON 2 (22 bytes of data)

With this Add-On 2 the SCADA can read: all the messages in the table of 8.1 that are active in the same time, the temperature of the water, the water flow and the water pressure.

Offset	Type	Variable Name	Description
(30 or 98 or 54) +0	UDWORD	Rectifier log bits 0..31	Messages of the table in chapter 8.1 (one bit for each): The log bits Bit0 ... Bit31
+4	UDWORD	Rectifier log bits 32..63	Messages of the table in chapter 8.1 (one bit for each): The log bits Bit32 ... Bit63
+8	UDWORD	Rectifier log bits 64..95	Messages of the table in chapter 8.1 (one bit for each): The log bits Bit64 ... Bit95
+12	UDWORD	Tower fault bits 0..31	Here is reported the status of each tower in a multitowers system. These data are valid only in the Master tower. Tower fault bits Bit0..Bit31. Bit0: Master Tower Bit1 … Bit25 : Towers
+16	UWORD	Water Temperature	Water temperature in Celsius or Fahrenheit multiplied by 10 to have 1 decimal digit.
+18	UWORD	Water Flow	Water Flow in Liter/minute multiplied by 10 to have 1 decimal digit.
+20	UWORD	Water Pressure	Water Pressure in PA multiplied by 10 to have 1 decimal digit.

Rectifier log bit = 1 => log Active, bit= 0 => normal state
Tower fault bit = 1 => Fault Active, bit=0 => normal state

Log and Tower fault bits details:

Log Bits 31-0

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
E31	E30	- -	E28	E27	E26	W25	E24	E23	E22	- -	I20	I19	I18	- -	I16	I15	I14	I13	I12	E11	W10	- -	E8	E7	E6	E5	- -	- -	E2	I1	- -

Log Bits 63-32

63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
- - -	W62	W61	W60	- - -	- - -	- - -	- - -	- - -	E54	E53	I52	I51	I50	- - -	I48	I47	- - -	E45	E44	E43	E42	- - -	I40	- - -	- - -	- - -	- - -	- - -	- - -	- - -	E32

Log Bits 95-64

95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64
- - -	- -	E93	- -	E91	E90	E89	E88	E87	E86	E85	E84	E83	- -	E81	E80	- - -	- - -	- - -	- - -	- - -	- - -	- -	E72	E71	E70	- -	W68	W67	- -	E65	I64

Tower Fault Bits 31-0

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
- - -	- -	-	- -	- -	- -	T25	T24	T23	T22	T21	T20	T19	T18	T17	T16	T15	T14	T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1	M

M= Master tower or single tower.

Rectifier log bit = 1 => log Active, bit= 0 => normal state
Tower fault bit = 1 => Fault Active, bit=0 => normal state

12.1.3 The DATA area size

Some protocols (like Modbus) don't require setting the size of the DATA area size both on the rectifier and on the SCADA. The SCADA can connect to the rectifier and it can read all registers or only a part of them without informing the rectifier of it.

Other protocols (like Profinet or Ethernet IP or Profibus) require the DATA area size to be the same size both on the rectifier and on the SCADA.

In the rectifier the default DATA area size is 64 bytes. But this value can be raised or lowered according to the rectifier data map used mode. This is done setting parameter "DATA AREA SIZE", in the specific menu of the communication protocol.

For example if the rectifier uses a Q63 Profinet/EthernetIP data map, this parameter should be lowered to 20. If the new data map is used, this value should be set to 64 (default).

12.2 The COMMAND area map (command sent to the rectifier)

The rectifier input area map is mapped according to the below table:

Offset	Type	Variable Name	Description
0	UWORD	Rectifier status command	The rectifier status command register. This is a bit mapped register, see below for more details.
2	UWORD	Work mode	The rectifier working mode. This field tells the rectifier which mode it should operate according to the below codes: ✓ 0: rectifier operating in DC current mode ✓ 1: rectifier operating in DC voltage mode ✓ 2: rectifier generating a sinusoidal wave in current mode ✓ 3: rectifier generating a sinusoidal wave, in voltage mode ✓ 4: rectifier generating pulses, in current mode ✓ 5: rectifier generating pulses, in voltage mode
PLEASE NOTE: the following bytes have a different meaning according to the work mode used. See the tables below for details			

Where: SWORD = 16 bits signed, UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

The "rectifier status command register" bits are mapped according to the below table:

Bit	Description	Mask
0	**0** = Turn the rectifier to standby mode **1** = Turn the rectifier in run mode	**0001**
1	**0** = Turn the rectifier to local mode **1** = Turn the rectifier to remote mode	**0002**
2	**0** = Leave the pause mode **1** = Put the rectifier in pause mode	**0004**
3	**0** = Water temperature in Centigrade **1** = Water temperature in Fahrenheit	**0008**

4÷7	**Reserved** (Analog Card Software revision bits)	**0010, 0020, 0040, 0080**
8	**0** = Digital output on the CPU is not turned ON	**0100**
	1 = Digital output on the CPU is turned ON. Please note: to enable this feature the digital output on the CPU must be programmed to be controlled from remote.	
9	**0** = Turn the cooling OFF.	**0200**
	1 = Turn the cooling ON. Please note: this command is used to test if the cooling system is operating when the rectifier is in standby mode. Regardless the status of this bit, the cooling will be turned ON when the rectifier is enabled. Moreover even in standby mode, the cooling will be turned ON for 5 minutes after the bit status is changed from 0 to 1, and then automatically turned OFF again. To turn it on again, this bit must be reset to 0 and then set again to 1.	
10	**0** = No any command.	**0400**
	1 = Reset the total AH counter. If this bit is set to 1, the total AH counter is reset to 0.	
11	**0** = In multi-tower systems, all towers deliver a current proportional to their output power	**0800**
	1 = in multi-tower systems, enable the **current division mode**. The required current is provided using a subset of all available towers. See the paragraph on this topic for more details.	
12÷13	**Reserved** (Analog Card Software version bits)	**1000 2000**
14-15	**NOT USED**	

12.2.1 The work mode data

The work mode data must be programmed from the SCADA. These parameters are different according to the selected operating mode, as it can be seen in the below sections.

DC CURRENT MODE

If the rectifier is operating in DC current mode, these are the parameters that must be programmed:

Offset	Type	Variable Name	Description
4	UWORD	Ramp time	The ramp time, in seconds. The max duration of the ramp is 7200s (2 hours)
6	SDWORD	Current set point	The current set point. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
10	SDWORD	Voltage limit	The maximum voltage allowed during this phase. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.

Where: SWORD = 16 bits signed , UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

DC VOLTAGE MODE

If the rectifier is operating in DC voltage mode, these are the parameters that must be programmed:

Offset	Type	Variable Name	Description
4	UWORD	Ramp time	The ramp time, in seconds. The max duration of the ramp is 7200s (2 hours)
6	SDWORD	Current limit	The maximum output current the rectifier can provide to the load Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
10	SDWORD	Voltage set point	The voltage set point Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.

Where: SWORD = 16 bits signed , UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

SINE WAWE CURRENT MODE

If the rectifier is generating a sinusoidal, current based, waveform, these are the required parameters:

Offset	Type	Variable Name	Description
4	UWORD	Ramp time	The ramp time, in seconds. The max duration of the ramp is 7200s (2 hours)
6	UDWORD	Duration of the positive phase in ms	The duration of the positive phase of the sine wave in ms. Min value is 5ms, max value is 25ms. Step is 1ms.
10	SDWORD	RMS sine positive phase current	The RMS current of the positive phase. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
14	UDWORD	Duration of the negative phase in ms	The duration of the negative phase of the sine wave in ms. Min value is 5ms, max value is 25ms. Step is 1ms.
18	SDWORD	RMS sine negative phase current	The RMS current of the negative phase. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
22	SDWORD	Current offset	The current offset that will be applied to the sine wave. If the offset is above 0, the sine wave must lie in the same plane. Positive if the offset is above 0, negative otherwise.
26	SDWORD	Voltage limit	The maximum output voltage during the sine wave generation Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.

Where: SWORD = 16 bits signed, UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

SINE WAVE VOLTAGE MODE

If the rectifier is generating a sinusoidal, voltage based, waveform, these are the required parameters:

Offset	Type	Variable Name	Description
4	UWORD	Ramp time	The ramp time, in seconds. The max duration of the ramp is 7200s (2 hours)
6	UDWORD	Duration of the positive phase in ms	The duration of the positive phase of the sine wave in ms. Min value is 5ms, max value is 25ms. Step is 1ms.
10	SDWORD	RMS sine positive phase voltage	The RMS voltage of the positive phase. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
14	UDWORD	Duration of the negative phase in ms	The duration of the negative phase of the sine wave in ms. Min value is 5ms, max value is 25ms. Step is 1ms.
18	SDWORD	RMS sine negative phase voltage	The RMS voltage of the negative phase. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
22	SDWORD	Voltage offset	The voltage offset that will be applied to the sine wave. If the offset is different from 0, the sine wave must lie in the same plane. Positive if the offset is above 0, negative otherwise.
26	SDWORD	Current limit	The maximum output current during the sine wave generation Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.

Where: SWORD = 16 bits signed, UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

PULSED CURRENT MODE

If the rectifier is generating a pulsed, current based, waveform, these are the required parameters:

Offset	Type	Variable Name	Description
4	UWORD	Ramp time	The ramp time, in seconds. The max duration of the ramp is 7200s (2 hours)
6	SDWORD	Voltage limit	The maximum output voltage during the wave generation Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
10	SDWORD	1st phase current set point	The set point of the first phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
14	UDWORD	1st phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
18	SDWORD	2nd phase current set point	The set point of the second phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
22	UDWORD	2nd phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following step will be ignored.
24	SDWORD	3rd phase current set point	The set point of the third phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
28	UDWORD	3rd phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this phase and all following steps will be ignored.
32	SDWORD	4th phase current set point	The set point of the fourth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed

36	UDWORD	4th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
40	SDWORD	5th phase current set point	The set point of the fifth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
44	UDWORD	5th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
48	SDWORD	6th phase current set point	The set point of the sixth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
52	UDWORD	6th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
56	SDWORD	7th phase current set point	The set point of the seventh phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
60	UDWORD	7th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
64	SDWORD	8th phase current set point	The set point of the eight phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
68	UDWORD	8th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.

72	SDWORD	9th phase current set point	The set point of the ninth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
76	UDWORD	9th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.

Where: SWORD = 16 bits signed, UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

PULSED VOLTAGE MODE

If the rectifier is generating a pulsed, voltage based, waveform, these are the required parameters:

Offset	Type	Variable Name	Description
4	UWORD	Ramp time	The ramp time, in seconds. The max duration of the ramp is 7200s (2 hours)
6	SDWORD	Current limit	The maximum output current during the wave generation Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed.
10	SDWORD	1st phase voltage set point	The set point of the first phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
14	UDWORD	1st phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
18	SDWORD	2nd phase voltage set point	The set point of the second phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
22	UDWORD	2nd phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
26	SDWORD	3rd phase voltage	The set point of the third phase of the pulsed waveform. Please note: all analog measures are multiplied by 100.

		set point	If 50.8 is the desired set point, value 5080 must be programmed
30	UDWORD	3rd phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
34	SDWORD	4th phase voltage set point	The set point of the fourth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
36	UDWORD	4th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
40	SDWORD	5th phase voltage set point	The set point of the fifth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
44	UDWORD	5th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
48	SDWORD	6th phase voltage set point	The set point of the sixth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
52	UDWORD	6th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
56	SDWORD	7th phase voltage set point	The set point of the seventh phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
60	UDWORD	7th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
64	SDWORD	8th phase voltage	The set point of the eight phase of the pulsed waveform.

		set point	Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
68	UDWORD	8th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.
72	SDWORD	9th phase voltage set point	The set point of the ninth phase of the pulsed waveform. Please note: all analog measures are multiplied by 100. If 50.8 is the desired set point, value 5080 must be programmed
76	UDWORD	9th phase duration	The min duration is 30 (3ms) in step of 1 (0,1 ms). The max value for this entry is 50000 (= 5000 ms = 5 secs). If this entry is left to 0, this step and all following steps will be ignored.

Where: SWORD = 16 bits signed, UWORD = 16 bits unsigned, UDWORD=unsigned 32 bits, SDWORD=signed 32 bits

12.2.2 The COMMAND area map ADD-ON

Using the **STANDARD MEMORY MAP**, there is the possibility to add some additional data to be written by PLC/SCADA. These data are called ADD-ON and are appended in the memory map to the last address of the map of the working mode used. For example if the rectifier is working in **DC mode**, these commands will be available after the offset 10 (Voltage set point or Voltage limit) and precisely they will start at the offset 14 because the Voltage set point occupies 4 bytes. For **pulsed mode** they will start at offset 80 (because 9th step duration is 4 bytes long) and for **Sin wave mode** they will start at offset 30 (because Voltage limit or Current limit is 4 bytes long).

The ADD-ONs are identified by number **1**, **2** etc and can be selected in the rectifier's parameter **DATA MAP ADD-ON** in the section where are defined all others protocol parameters. If the user doesn't need these data, the DATA MAP ADD-ON parameter must be configured to **NONE** and only the STANDARD MEMORY MAP data are exchanged.

ADD-ON 1 (4 bytes of command)

Offset	Type	Variable Name	Description
(14 or 80 or 30) +0	UWORD	Cmd1	Future Use
+2	UWORD	Cmd2	Future Use

ADD-ON 2 (4 bytes of command)

Offset	Type	Variable Name	Description
(14 or 80 or 30) +0	UWORD	Cmd1	Future Use
+2	UWORD	Cmd2	Future Use

Note: With the MODBUS protocol, selecting STANDARD MEMORY MAP, also the highest ADD-ON number is always accessible.

12.3 The COMMAND area size

Some protocols (like Modbus) don't require setting the size of the COMMAND area size both on the rectifier and on the SCADA. The SCADA can connect to the rectifier and it can update all registers or only a part of them without informing the rectifier of it.

Other protocols (like Profinet or Ethernet IP or Profibus) require the COMMAND area size to be the same size both on the rectifier and on the SCADA.

In the rectifier the default COMMAND area size is 64 bytes. But this value can be raised or lowered according to the data map used. This is done setting parameter "CMD AREA SIZE", in the menu of the communication protocol.

For example if the rectifier uses an old Profinet/EthernetIP data map, this parameter should be lowered to 16. If the new data map is used, this value should be set to 64.

13 The available communication protocols

The rectifier can be connected to a remote SCADA to be operated from remote. The rectifier support many protocols that can be used for this purpose. For some of them an additional communication board is required.

13.1 The ASCII protocol

This protocol is available only to support legacy devices. This protocol was used in the past. It is natively supported by the CPU and it uses the RS485 bus as physical bus. For details regarding this protocol, please ask the technical support.

13.2 The Modbus protocol

The Modbus protocol is natively supported by the CPU, no additional communication module is required. It uses the RS485 bus as physical medium.

The below table shows the Modbus commands supported by the CPU.

Function	Description	Query	Response
1	Read Coil Status	Not supported	Not supported
2	Read Input Status	Not supported	Not supported
3	Read Holding Registers	SUPPORTED	SUPPORTED
4	Read Input Registers	SUPPORTED	SUPPORTED
5	Force Single Coil	Not supported	Not supported
6	Preset Single Register	Not supported	Not supported
7	Read Exception Status	Not supported	Not supported
8	Diagnostics	Not supported	Not supported
9	Program 484	Not supported	Not supported
10	Poll 484	Not supported	Not supported
11	Fetch Comm. Event Ctr.	Not supported	Not supported
12	Fetch Comm. Event Log	Not supported	Not supported
13	Program Controller	Not supported	Not supported
14	Poll Controller	Not supported	Not supported
15	Force Multiple Coils	Not supported	Not supported
16	Preset Multiple Registers	SUPPORTED	SUPPORTED
17	Report Slave ID	Not supported	Not supported
18	Program 884/M84	Not supported	Not supported
19	Reset Comm. Link	Not supported	Not supported
20	Read General Reference	Not supported	Not supported
21	Write General Reference	Not supported	Not supported

The refresh rate of the registers should never be below 200ms.

PLEASE NOTE: Modbus registers are 16 bits wide. The table with the data map provides an offset in terms of bytes (8 bits wide). The equivalent Modbus register can be found dividing the provided offset by 2. **For example** if the offset of a register is 10 bytes, it is possible to access this register writing / reading the Modbus register at address 05.

13.3 The Profibus protocol

The Profibus protocol is supported only using a special communication adapter. The adapter is connected to the CPU using the DB9 port.

The address of the Profibus board can be set through parameter **"1- PROFIBUS ADDRESS"** in the Profibus configuration menu.

On the Profibus adapter two LED are available. The first one is identified with the MS (module status) label, and it gives a visual feedback of the status of the interface board. The second one is identified with the NS (network status) label and it provides a visual feedback of the status of the network.

The information provided by these LED can be found in the below tables:

Module status LED	Indication
Off	Module not initialized or not powered
Green	Module initialized and operating
Green blinking	Online clear command
Red	Module hardware error
Red blinking	Module configuration error

Network status LED	Indication
Off	Network not initialized
Green	Network initialized
Green blinking	Network diagnostic event
Red	Network error
Red blinking	Network error

On the remote SCADA the Profibus interface must be manually configured using the below parameters:

Slot 1

Type: Input

Size: 64 bytes

Slot 2

Type: Output

Size: 64 bytes

Please note: 64 is the default size of the input and output regions. Their values can be changed adjusting parameters “DATA AREA SIZE” and “CMD AREA SIZE”. In case of doubts please check the values of these parameters.

13.4 The Devicenet protocol

The Devicenet protocol is supported only using a special communication adapter. The adapter is connected to the CPU using the DB9 port.

The address of the Devicenet board can be set through parameter **"1- DEVICENET ADDRESS"** in the Devicenet configuration menu.

On the Devicenet adapter two led are available. The first one is identified with the MS (module status) label, and it gives a visual feedback of the status of the module. The second one is identified with the NS (network status) label and it provides a visual feedback of the status of the network.

The information provided by these led can be found in the below tables:

Module status led	Indication
Off	Module not initialized or not powered
Green	Module initialized and operating
Green blinking	Missing, incorrect or incomplete configuration. Device needs commissioning.
Red	Module hardware error
Red blinking	Module configuration error

Network status led	Indication
Off	Network not initialized
Green	On line, one or more connections are established
Green blinking	On line, no connection established
Red	Critical link failure
Red blinking	One or more connection timed out

On the remote SCADA the Devicenet interface must be manually configured using the below parameters:

Slot 1

Type: Input

Size: 64 bytes

Slot 2

Type: Output

Size: 64 bytes

Please note: 64 is the default size of the input and output regions. Their values can be changed adjusting parameters “DATA AREA SIZE” and “CMD AREA SIZE”. In case of doubts please check the values of these parameters.

The connector on the Devicenet adapter is a 5-pole, male, pluggable screw connector (pitch 5.08mm). The female connector is shown in the below picture. The sample below is from Phoenix Contact.

Note: for this protocol the LITTLE ENDIAN parameter, in the Devicenet Oper. Conf. menu, has to set=YES.

Figure 11: the TFKC 2,5/5-STF-5,08 AU connector from Phoenix Contact

DeviceNet Connector (5.08mm Pluggable Screw)	
Pin	Signal
1	V-
2	CAN_L
3	SHIELD
4	CAN_H
5	V+

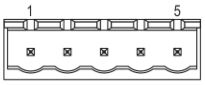


Figure 12: Devicenet pinout on the communication adapter

13.5 The Profinet protocol

The Profinet protocol is supported only using a special communication adapter. The adapter is connected to the CPU using the DB9 port.

The address of the Profinet adapter, its subnet mask, and the address of the gateway, they can all be programmed in the PROFINET menu. In this menu it is also possible to enable the optional features of this module like:

- ✓ The support of the DHCP protocol
- ✓ The support of the FTP protocol
- ✓ The possibility to enable the internal web server

Through this menu it is also possible to check the MAC address of the Profinet board.

On the Profinet board two led are available. The first one is identified with the MS (module status) label, and it gives a visual feedback of the status of the module. The second one is identified with the NS (network status) label and it provides a visual feedback of the status of the network.

The information provided by these led can be found in the below tables:

Module status led	Indication
Off	Module not initialized or not powered
Green	Module initialized and operating
Green blinking	Diagnostic event(s) present
Red	Module hardware error
Red blinking	Module configuration error

Network status led	Indication
Off	No power No connection with IO Controller
Green	Connection with IO Controller established IO Controller in RUN state
Green 1 blink	Connection with IO Controller established IO Controller in STOP state or IO data bad IRTsynchronization not finished
Green blinking	Used by engineering tools to identify the node on the network
Red	Major internal error
Red, 1 blink	Station Name not set
Red, 2 blinks	IP address not set
Red, 3 blinks	Expected Identification differs from Real Identification

On the remote SCADA the Profinet interface must be manually configured using the below parameters:

Slot 1

Type: Input

Size: 64 bytes

Slot 2

Type: Output

Size: 64 bytes

Please note: 64 is the default size of the input and output regions. Their values can be changed adjusting parameters “DATA AREA SIZE” and “CMD AREA SIZE”. In case of doubts please check the values of these parameters.

PLEASE NOTE:

Set the polling rate of the Profinet network at least to 50ms. Some PLC vendors set this value by default to a very small polling rate, like 2ms. Values below 50ms could lead to communication problems.

Our data fields are all multiples of 16bit. For this reason it is common practice to set the data type to INT and to declare a size of 32 for the input and output region.

13.6 The EthernetIP protocol

The EthernetIP protocol is supported only using a special communication adapter. The adapter is connected to the CPU using the DB9 port.

The address of the EthernetIP board, its subnet mask, and the address of the gateway, they can all be programmed in the ETHERNETIP menu. In this menu it is also possible to enable the optional features of this module like:

- ✓ The support of the DHCP protocol
- ✓ The support of the FTP protocol
- ✓ The possibility to enable the internal web server

Through this menu it is also possible to check the MAC address of the board.

On the Ethernet adapter two led are available. The first one is identified with the MS (module status) label, and it gives a visual feedback of the status of the module. The second one is identified with the NS (network status) label and it provides a visual feedback of the status of the network.

The information provided by these led can be found in the below tables:

Module status led	Indication
Off	Module not initialized or not powered
Green	Controlled by a Scanner in Run state
Green blinking	Not configured, or Scanner in Idle state
Red	Module hardware error
Red blinking	Recoverable fault(s). Module is configured, but stored parameters differ from currently used parameters.

Network status led	Indication
Off	No power or no IP address
Green	Online, one or more connections established (CIP Class 1 or 3)
Green blinking	Online, no connections established
Red	Duplicate IP address, FATAL error
Red blinking	One or more connections timed out (CIP Class 1 or 3)

On the remote SCADA the interface must be manually configured using the below parameters:

Type: Outputs

Instance: 150

Size: 64

32 bit header: Yes

Refresh: 100ms

Type: Input

Instance: 100

Size: 64

32 bit header: No

Refresh: 100ms

PLEASE NOTE:

Set the polling rate of the network at least to 50ms. Some PLC vendors set this value by default to a very small polling rate, like 2ms. Values below 50ms could lead to communication problems.

Our data fields are all multiples of 16bit. For this reason it is common practice to set the data type to INT and to declare a size of 32 for the input and output region.

Note: for this protocol the LITTLE ENDIAN parameter, in the EthernetIP Oper Conf menu, has to set=YES.

13.7 The Modbus TCP protocol

The Modbus TCP protocol is supported only using a special communication adapter. The adapter is connected to the CPU using the DB9 port.

The address of the EthernetIP board, its subnet mask, and the address of the gateway, they can all be programmed in the ETHERNETIP menu. In this menu it is also possible to enable the optional features of this module like:

- ✓ The support of the DHCP protocol
- ✓ The support of the FTP protocol
- ✓ The possibility to enable the internal web server

Through this menu it is also possible to check the MAC address of the board.

On the Modbus TCP adapter two led are available. The first one is identified with the MS (module status) label, and it gives a visual feedback of the status of the module. The second one is identified with the NS (network status) label and it provides a visual feedback of the status of the network.

The information provided by these led can be found in the below tables:

Module status led	Indication
Off	Module not initialized or not powered
Green	Controlled by a Scanner in Run state
Green blinking	Not configured, or Scanner in Idle state
Red	Module hardware error
Red blinking	Recoverable fault(s). Module is configured, but stored parameters differ from currently used parameters.

Network status led	Indication
Off	No power or no IP address
Green	Online, one or more connections established (CIP Class 1 or 3)
Green blinking	Online, no connections established
Red	Duplicate IP address, FATAL error
Red blinking	One or more connections timed out (CIP Class 1 or 3)

On the remote SCADA the interface must be manually configured using the below parameters:

Type: Outputs

Instance: 150

Size: 64

32 bit header: Yes

Refresh: 100ms

Type: Input

Instance: 100

Size: 64

32 bit header: No

Refresh: 100ms

PLEASE NOTE:

Set the polling rate of the network at least to 50ms. Some PLC vendors set this value by default to a very small polling rate, like 2ms. Values below 50ms could lead to communication problems.

Our data fields are all multiples of 16bit. For this reason it is common practice to set the data type to INT and to declare a size of 32 for the input and output region.

14 Revisions

Manual Version	FW version	Author	Changes
20200707	QV90_01.001	Marco B	First release of this manual
20201201	QV90_01.004	Marco B	-Correct some mistake in the text. -Updated Menu Sensors. -Changed default value short circ. limit from 100% to 25%.
20201204	QV90_01.003	Marco B	-Updated error messages and fault codes -Add ON added in the Memory Map
20210419	QV90_01.003	Marco B	-Made some correction in the text. -Add messages: I18, I19.