



# **EM511**

Energy analyzer for single-phase systems

**USER MANUAL**

04/03/2024

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# This manual

## Information property

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## Safety messages

The following section describes the warnings related to user and device safety included in this document:

**NOTICE:** indicates obligations that if not observed may lead to damage to the device.



**CAUTION!** Indicates a risky situation which, if not avoided, may cause data loss.



**IMPORTANT:** provides essential information on completing the task that should not be neglected.

## General warnings



This manual is an integral part of the product and accompanies it for its entire working life. It should be consulted for all situations tied to configuration, use and maintenance. For this reason, it should always be accessible to operators.



**NOTICE:** no one is authorized to open the analyzer. This operation is reserved exclusively for CARLO GAVAZZI technical service personnel.  
Protection may be impaired if the instrument is used in a manner not specified by the manufacturer.

## Service and warranty

In the event of malfunction, fault, requests for information or to purchase accessory modules, contact the CARLO GAVAZZI branch or distributor in your country.

Installation and use of analyzers other than those indicated in the provided instructions and removal of the MABC module void the warranty.

# EM511

## Introduction

EM511 is an energy analyzer for direct connection up to 45 A, for single-phase systems up to 240 V L-N. In addition to a digital input, the unit is can be equipped, according to the model, with a static output (pulse or alarm), a Modbus RTU communication port or an M-Bus communication port.

## Description

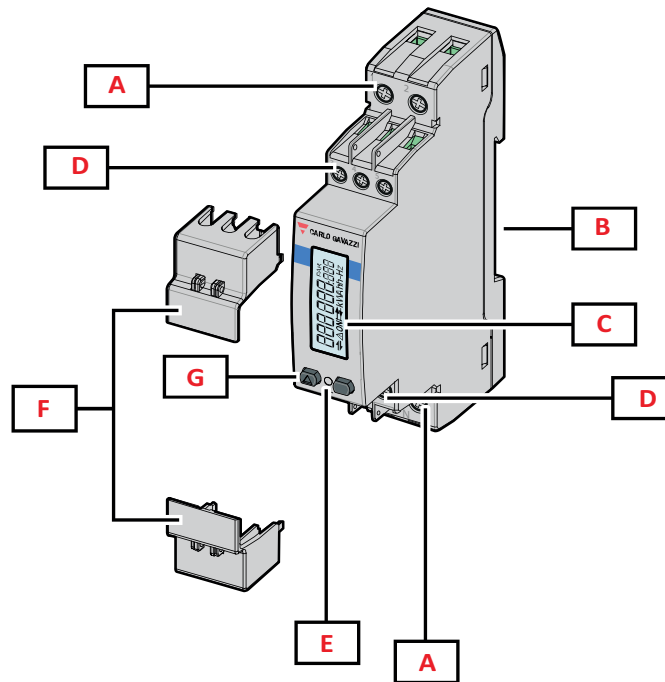


Figure 1 EM511

Area	Description
A	Voltage inputs / Current inputs
B	DIN rail mounting bracket
C	Display
D	Digital input, digital output and communication connections
E	LED
F	Sealable covers
G	Browsing and configuration buttons

## Available versions

Part number	Connection	Output	MID approval	Swiss MID approval	cULus approval
<b>EM511DINAV81XO1X</b>	Direct connection up to 45 A	Digital output			x
<b>EM511DINAV81XS1X</b>	Direct connection up to 45 A	RS485 Modbus RTU			x
<b>EM511DINAV81XM1X</b>	Direct connection up to 45 A	M-Bus			x
<b>EM511DINAV81XO1PFA</b> <b>EM511DINAV81XO1PFB</b>	Direct connection up to 45 A	Digital output	x		
<b>EM511DINAV81XS1PFA</b> <b>EM511DINAV81XS1PFB</b>	Direct connection up to 45 A	RS485 Modbus RTU	x		
<b>EM511DINAV81XM1PFA</b> <b>EM511DINAV81XM1PFB</b>	Direct connection up to 45 A	M-Bus	x		
<b>EM511DINAV81XS1PFA70</b> <b>EM511DINAV81XS1PFB70</b>	Direct connection up to 45 A	RS485 Modbus RTU	x		
<b>EM511DINAV81XO1SFA</b>	Direct connection up to 45 A	Digital output		x	
<b>EM511DINAV81XS1SFA</b>	Direct connection up to 45 A	RS485 Modbus RTU		x	
<b>EM511DINAV81XM1SFA</b>	Direct connection up to 45 A	M-Bus		x	

### PFA models and SFA models

Easy connection function: irrespective of the current direction, the power always has a plus sign and contributes to increase the positive energy meter. The negative energy meter is not available.

### PFB models

Bidirectional. Both kWh+ (imported energy) and kWh- (exported energy) are MID certified.

## UCS (Universal Configuration Software)

UCS is available in desktop and mobile versions.

It may connect to EM511 via RS485 (RTU protocol, desktop version only).

UCS allows to:

- set up the unit (online or offline);
- display the system state for diagnostic and setup verification purposes

### Overview of the UCS functions:

- Setting up the system with energy meter connected (online setup)
- Defining the setup with energy non connected, then applying it later (offline setup)
- Displaying the main measurements
- Displaying the state of inputs and outputs
- Displaying the state of the alarms
- Recording the measurements of selected variables

# Use

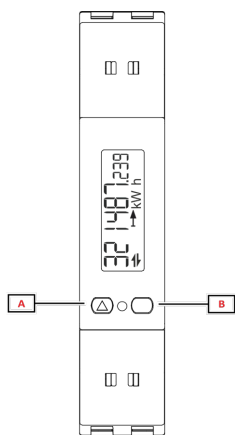
## Interface

### Introduction

EM511 is organized into two menus:

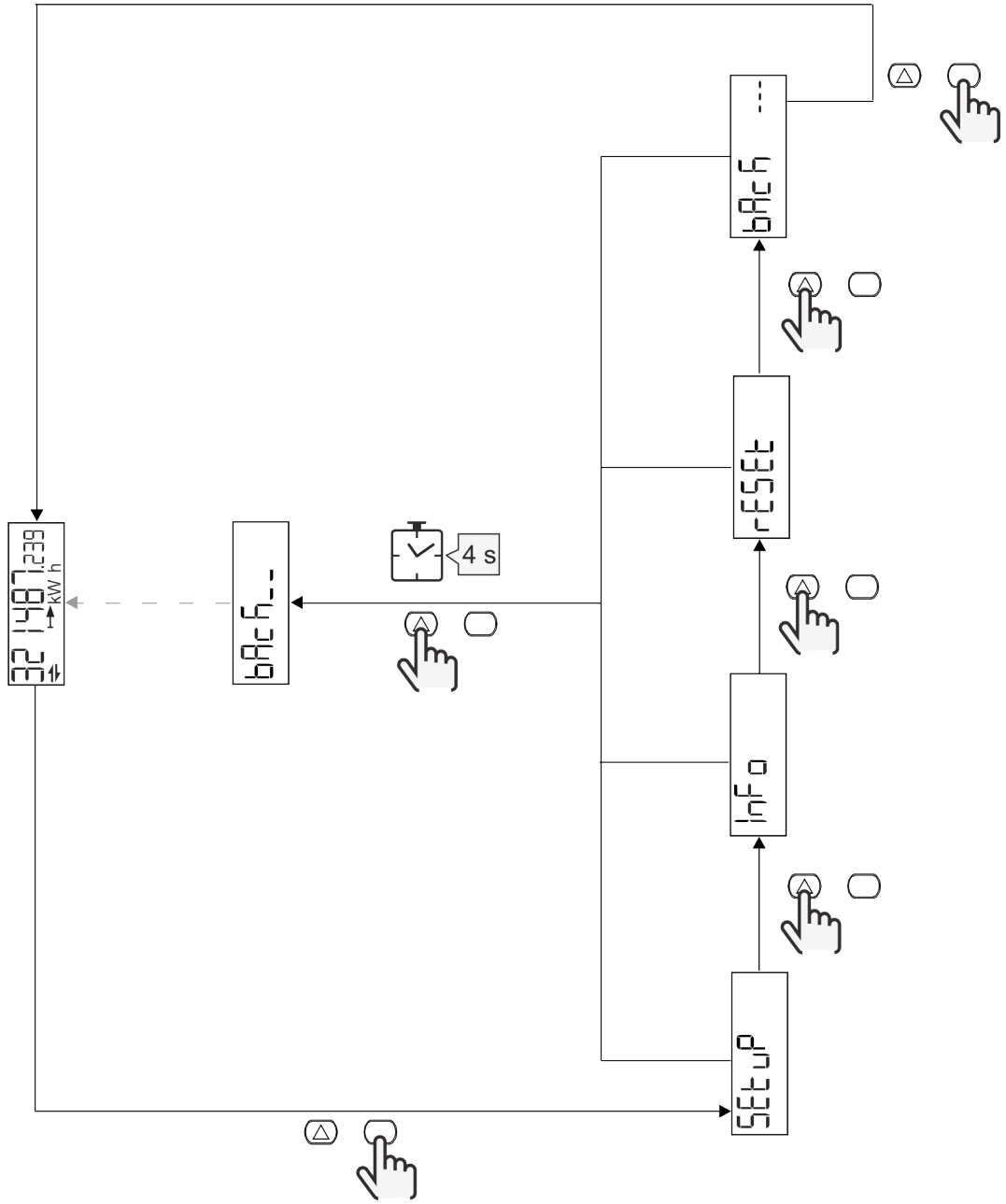
- Measurement pages: pages allowing to display the energy meters and the other electrical variables
- Main menu, divided into three sub-menus:
  - » SETUP: pages allowing to set the parameters
  - » INFO: pages displaying general information and the set parameters
  - » RESET: pages allowing to reset the partial counters and the dmd calculation, or to restore the factory settings

### Push buttons

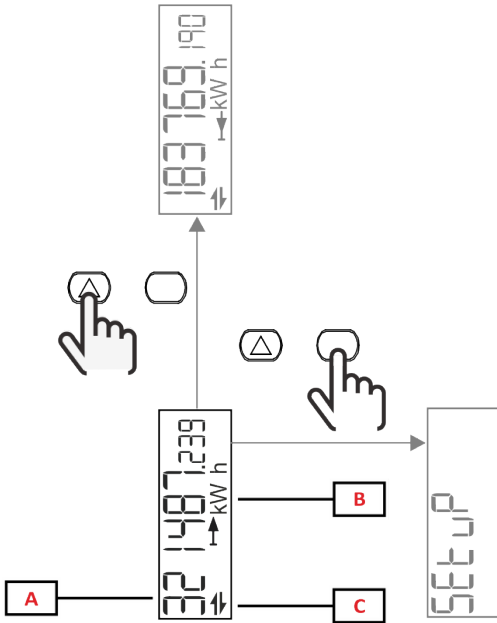


Button	Action
<b>A</b>	<ul style="list-style-type: none"><li>• Next page</li><li>• Increase value</li><li>• Home/previous menu (long press &gt;3 s)</li></ul>
<b>B</b>	<ul style="list-style-type: none"><li>• Enter menu</li><li>• Confirm</li></ul>

# Menu Overview



## Measurement page



Part	Description
A	Measured values/data
B	Unit of measurement
C	Information and diagnostics

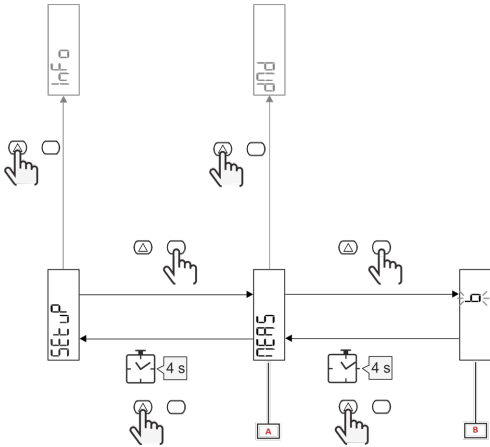
Button	Action
	Next page
	Enter the main menu

## Information and warnings

Symbol	Description
	ALARM (blinking icon): the value of the variable has exceeded the threshold set.
	COMMUNICATION: reading or writing command is addressed to EM511 serial communication state (reception / transmission)
ON	Total ON time
PAR	Partial meters
	Exported energy (kWh-)
	Imported energy (kWh+)
kWhh-Hz	Unit of measurement



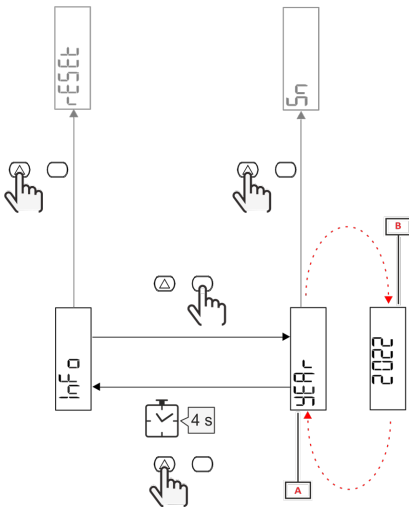
## SETUP menu



Part	Description
A	Parameter
B	Value

Button	Action
	Next option / increase value
	Confirm

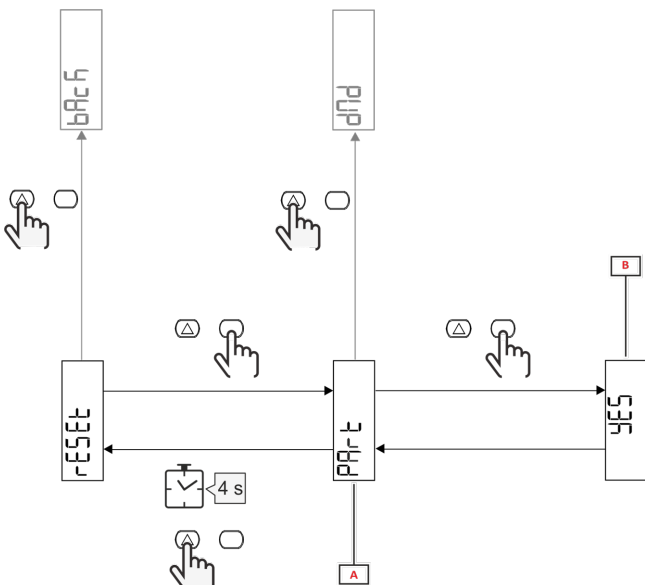
## INFO menu



Part	Description
A	Parameter
B	Value

Button	Action
	Next parameter
	Enter / exit

## RESET menu



Part	Description
A	Sub-menu title, see "RESET menu"
B	Selection (YES/NO)

Button	Action
	Next option
	Confirm

# Commissioning

## Commissioning

### Introduction

At power on, the device displays a configuration wizard, the QUICK SETUP, for a fast setup of the main parameters.

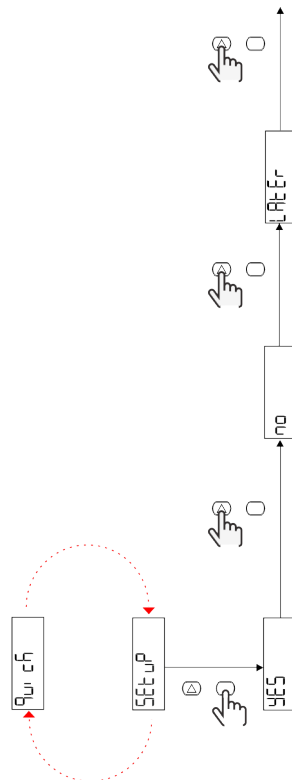
### QUICK SETUP menu

This procedure is available when the instrument is switched on for the first time.

In the "QUICK SETUP?" starting page

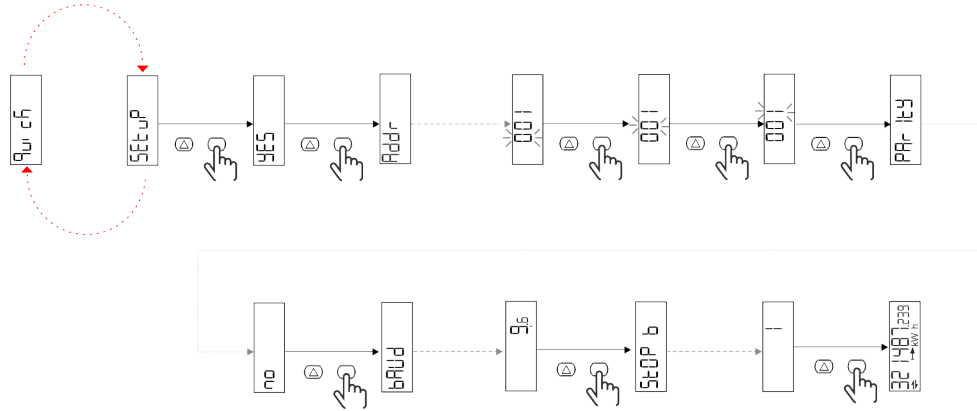
Select...	To...
Go	run the QUICK SETUP procedure
no	skip the procedure and no longer display the QUICK SETUP menu
LAtEr	skip the procedure and display the QUICK SETUP menu at the next switch-on

**Note:** the available parameters depend on the model.

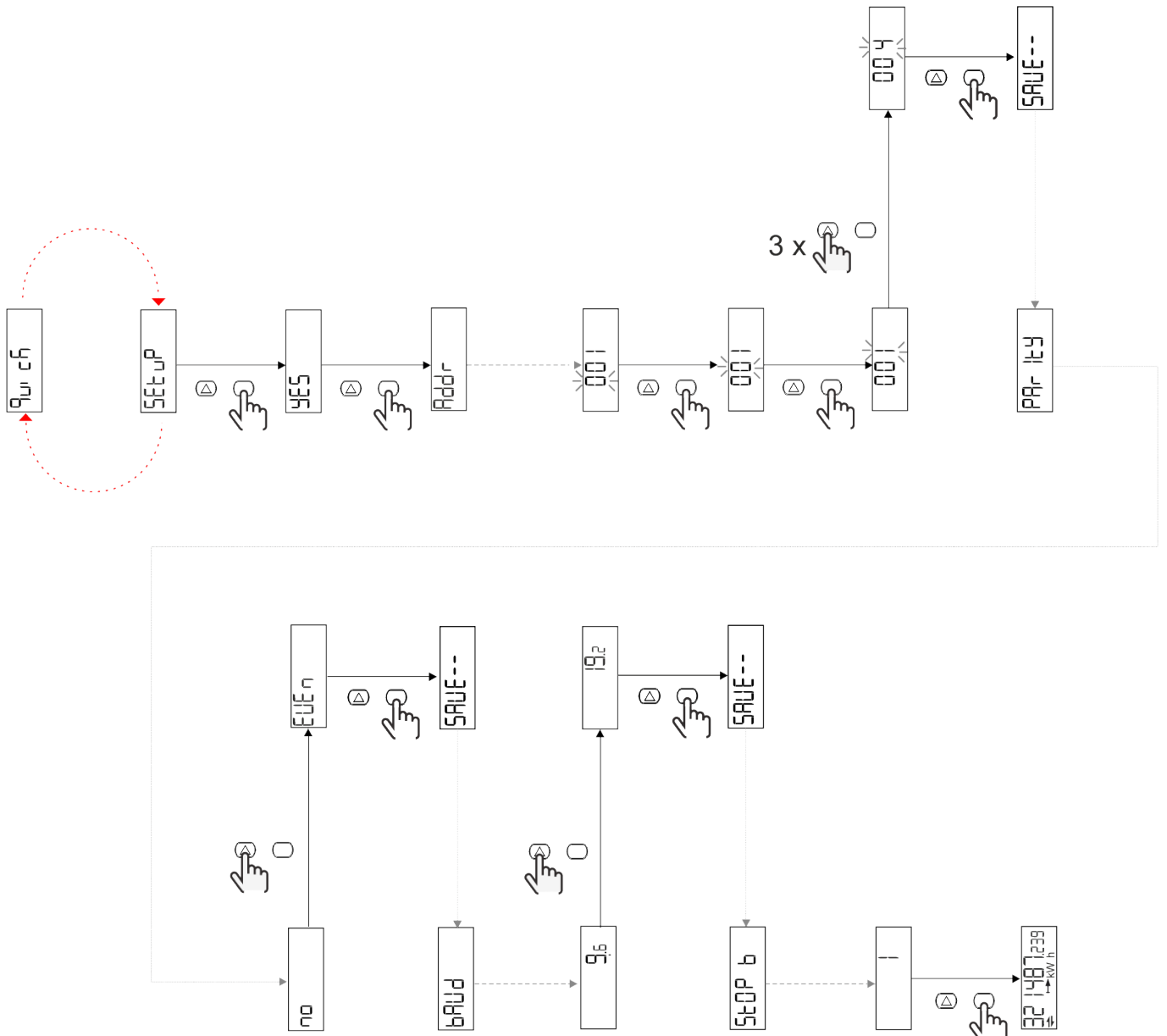


**S1 models**

**Example 1: confirmation**

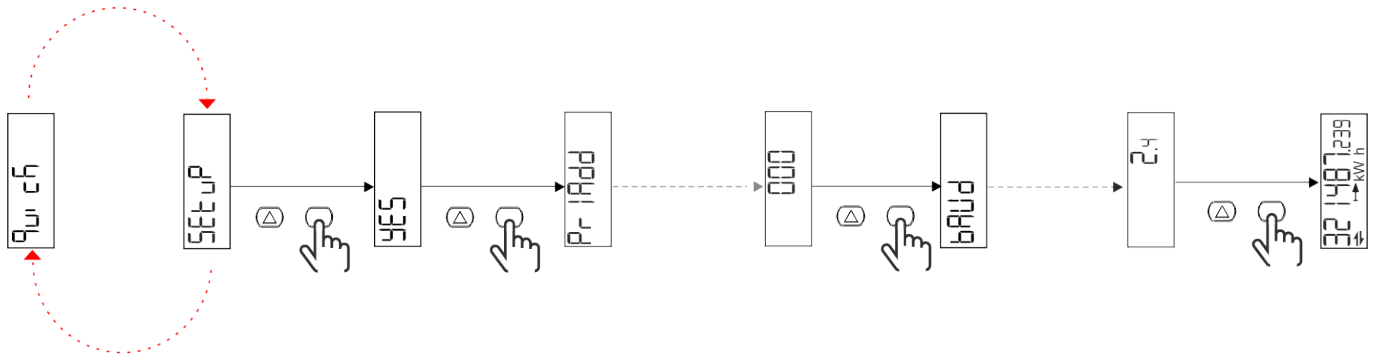


**Example 2: modification (address 4, parity EVEN, baudrate 19.2 kbps)**

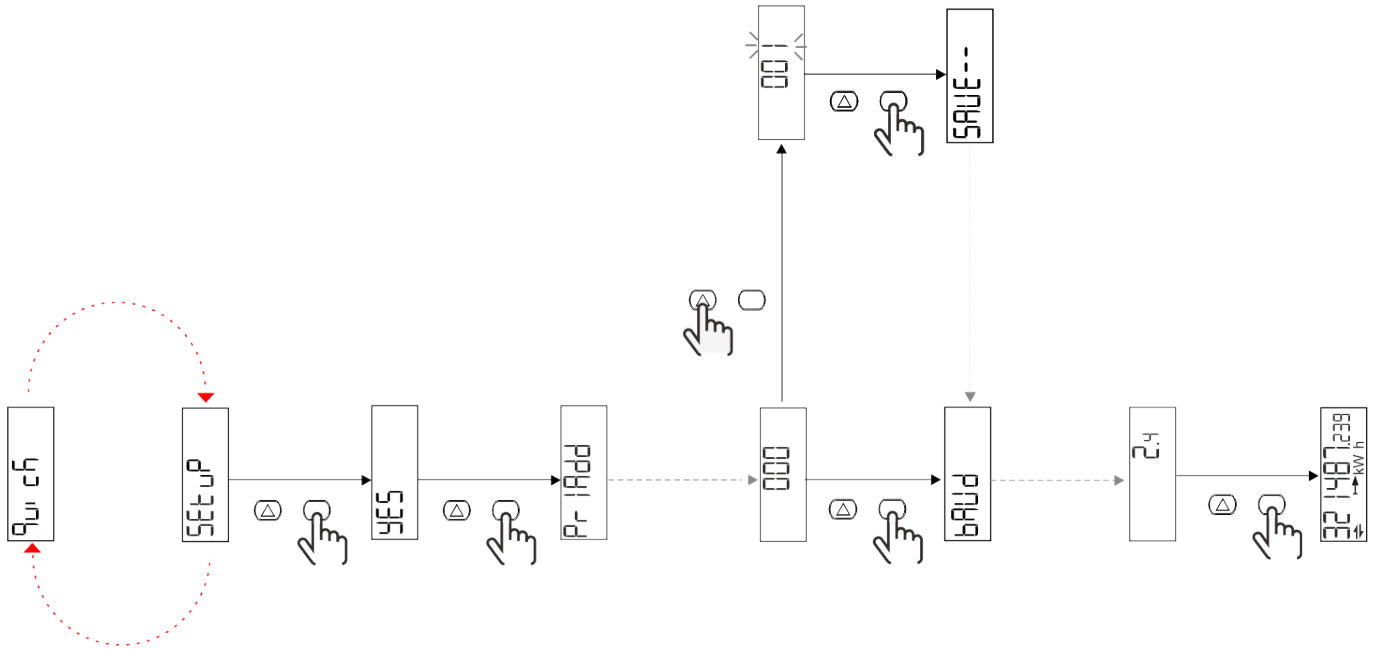


### M1 models

Example 1: confirmation

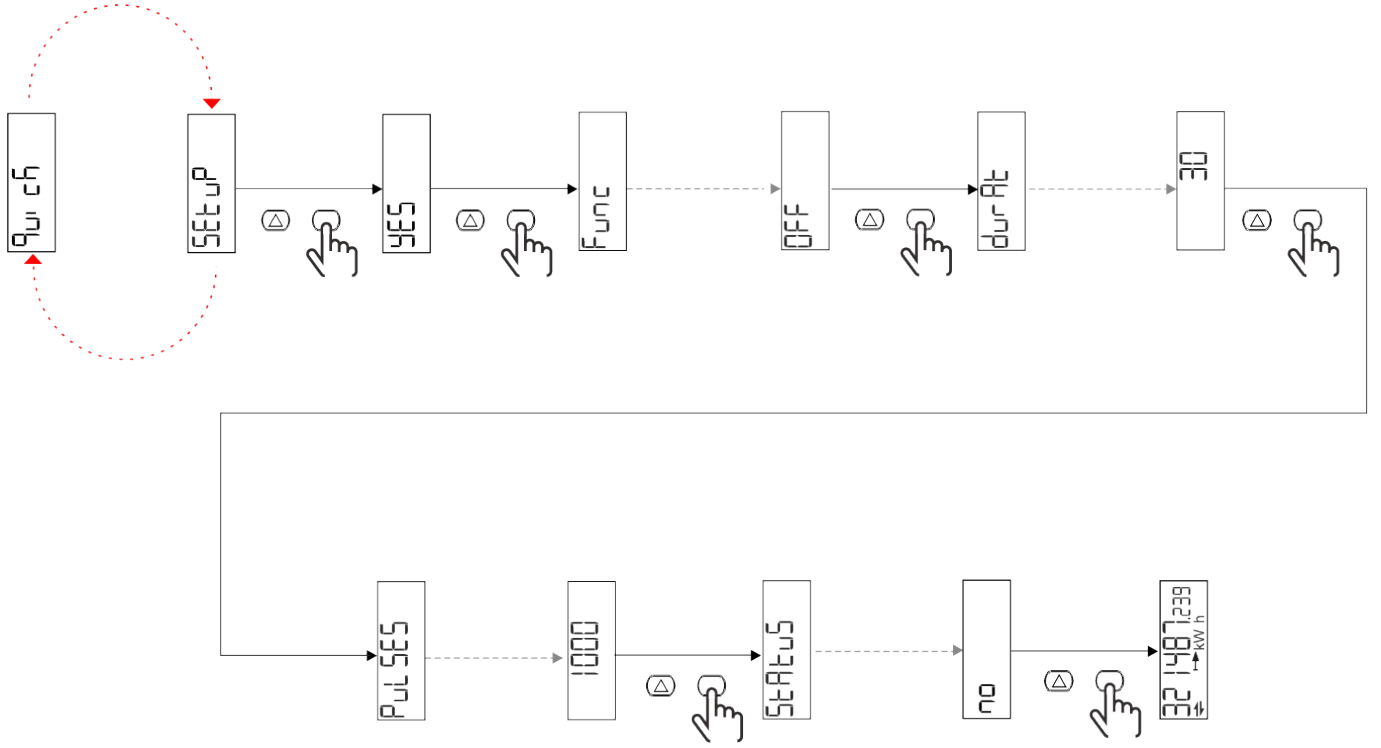


Example 2: modification (primary address 1)

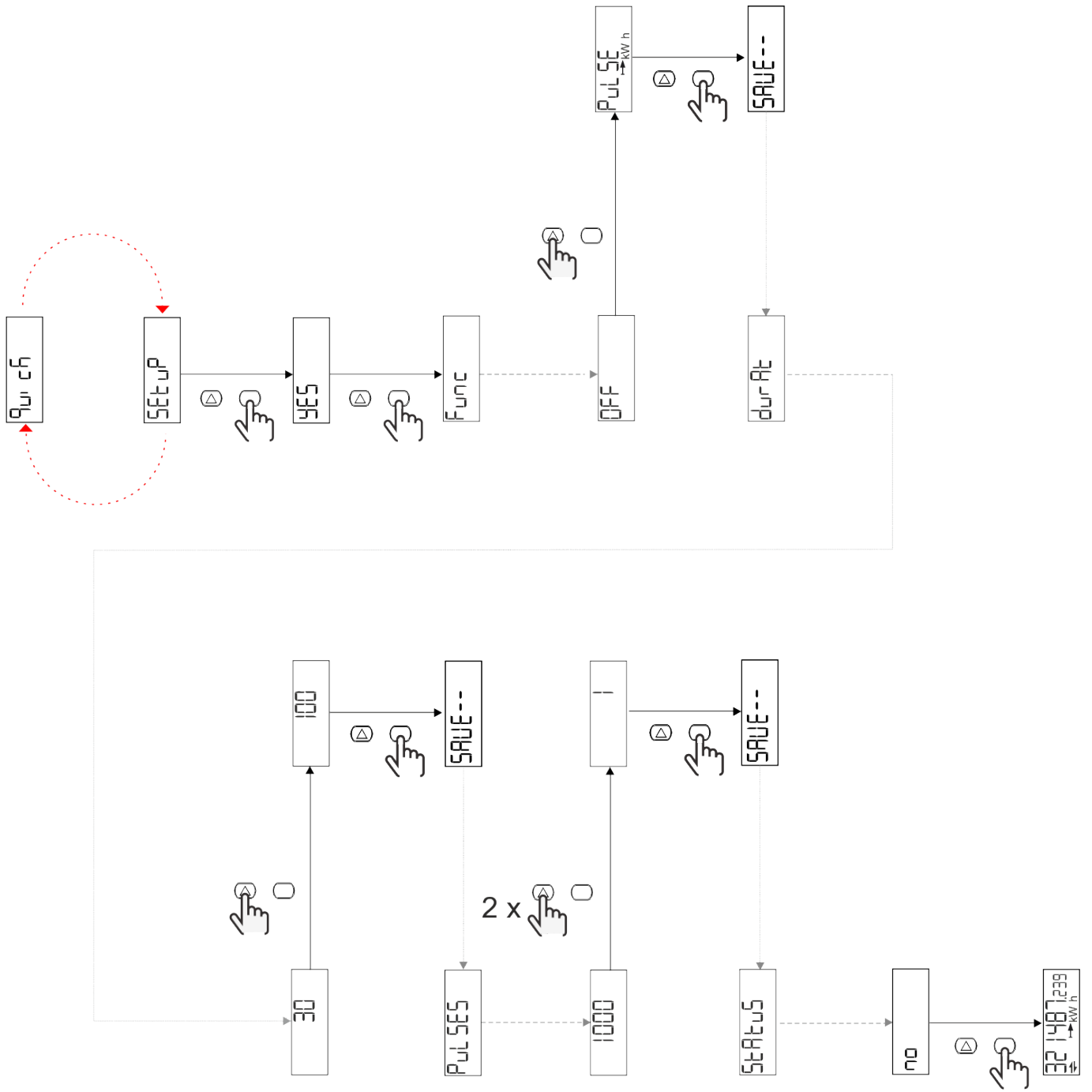


**O1 models**

Example 1: confirmation



Example 2: modification (pulse kWh+, duration 100 ms, 10 pulses/kWh)



# Menu description

## Measurement pages

Page	Displayed measurements	Description	Note
1	kWh+ TOT	Imported active energy (TOTAL)	
2	kWh- TOT	Exported active energy (TOTAL)	Not available in PFA and SFA models
3	kW	Active power	
4	V L-N	Voltage	
5	A	Current	
6	PF	Power factor	
7	Hz	Frequency	
8	THD V	Voltage THD	
9	THD A	Current THD	
10	kvarh+ TOT	Imported reactive energy (TOTAL)	Not available in SFA models
11	kvarh- TOT	Exported reactive energy (TOTAL)	Not available in SFA models
12	kvar	Reactive power	Not available in SFA models
13	kVAh	Apparent energy (TOTAL)	Not available in SFA models
14	kVA	Apparent power	Not available in SFA models
15	kW dmd	Demand active power	
16	kW peak dmd	Peak demand active power	
17	kWh T1	Imported active energy, tariff 1	Not available in SFA models
18	kWh T2	Imported active energy, tariff 2	Not available in SFA models
19	h (kWh+) TOT	Run hour meter (imported energy)	
20	h (kWh-) TOT	Run hour meter (exported energy)	Not available in PFA and SFA models
21	h (ON time) TOT	Run hour meter (ON time) TOT	
22	kWh+ PAR	Imported active energy (PARTIAL)	Not available in SFA models
23	h (kWh+) PAR	Run hour meter (imported energy, PARTIAL) PARTIAL	Not available in SFA models
24	kWh- PAR	Exported active energy (PARTIAL)	Not available in PFA and SFA models
25	h (kWh-) PAR	Run hour meter (exported energy, PARTIAL)	Not available in PFA and SFA models

## SETTINGS menu

This menu allows to set the parameters.

Page title	Sub-menu	Description	Values	Default values	Note
Meas	-	Measurement mode	A (easy connection) B (bidirectional)	A	Non MID only
DMD	-	DMD interval	1 min 5 min 10 min 15 min 20 min 30 min 60 min	15 min	
inPut	-	Digital input	Tariff (tariff management) Status (remote status) P st (Start/stop partial meters) P res (partial meter reset)	Status	
RS485	Addr	Address	1 to 247	1	
	PArity	Parity	NO/EVEN	no	
	bAud	Baudrate	9.6 kbps 19.2 kbps 38.4 kbps 57.6 kbps 115.2 kbps	9.6 kbps	
	StoP bit	Stop bit	1 or 2	1	
M bus	Pri Add	Primary address	0 to 250	0	
	bAud	Baudrate	0.3 kbps 2.4 kbps 9.6 kbps	2.4 kbps	
Output	Fun	Function	Off PuLSE (kWh+): pulse output linked to kWh+ PuLSE (kWh-): pulse output linked to kWh- ALArM: linked to alarm status	PuLSE (kWh+)	
	durAt	Pulse duration	30 ms 100 m	30 ms	
	PuLSES	Pulse weight (pulses/kWh)	0.1/1/10/100/500/1000	1000	
	StAtuS	Output status	No (normally open) Nc (normally closed)	No	
ALARM	EnAbLE	Enable	ON/OFF	OFF	
	VAriAb	Monitored variable	kW kVA Kvar PF A V	kW	
	SEt 1	Set point 1 (activation)	-1000.00 to 1000.00	0	
	SEt 2	Set point 2 (deactivation)	-1000.00 to 1000.00	0	
	dELAY	Activation delay	0 to 1000 s	0	



Page title	Sub-menu	Description	Values	Default values	Note
dISPL	LiGht	backlight	ON (always on) 1 min 2 min 5 min 10 min 15 min 30 min 60 min oFF: always off	ON	
	SC SAV	Screensaver	oFF home: homepage SLidE: slideshow	home	
	HOME	homepage	1 to 25	1	Only 1 in PFA or SFA models Only 1 or 2 in PFB models
	PAGES	Page filter	ALL FILtEr	ALL	
	PASS	Password enabling for the SETTINGS and RESET menu	0 (not protected) to 9999	0 (not protected)	
bAck ---	-	Exit	-	-	

## INFO menu

This menu allows to display the set parameters.

Page title	Description	Notes
YEAr	Production year	
Sn	Serial number	Sliding digits
FW rEV	FW revision	
MEAs	Measurement type	
dMd	Demand calculation interval	
Input	Digital input function	
Addr	Address	
bAud	Baudrate (kbps)	
PArity	Parity	
StoP b	Stop bit	
PriAdd	M-Bus primary address	
bAud	M-Bus baudrate	
SECAdd	M-Bus secondary address	
output	Digital output function	
StAtuS	Current output status	
durat	Pulse output duration	
PuLSE	Output pulse weight	
ALARm	Alarm enabling	
VAr	Linked variable	
SEt 1	Alarm activation set point	
SEt 2	Alarm deactivation set point	
dELAY	Alarm activation delay	
LiGht	Backlight timer	
tEMP	Internal microcontroller temperature	Available only in PFA70 and PFB70 models. For further information refer to the communication protocol
CHECKSuM	Firmware checksum	

## RESET menu

This menu allows to reset the following settings:

Page	Page title	Description
1	PARTIAL	It resets the partial meters
2	DMD	It resets the dmd calculation
3	tARiFF	It restores the factory settings
4	total	It resets the total meters (only non MID)
5	FACtor	It resets the device to factory settings
6	Back---	Back to main menu

## Communication Interface

Available setting parameters:

Parameter name	Description	Available on UI			Available on RS485	Available on Mbus
		S1 Model	M1 Model	O1 Model	only S1 Model	only M1 model
Password	Password for accessing parameters via UI	X	X	X	X	
DMD time	Time for DMD calculation (average on measures)	X	X	X	X	
Alarm enable	Enable or disable the virtual alarms	X	X	X	X	
Alarm link	Variable linked to the alarm	X	X	X	X	
Alarm SET1	Alarm setpoint 1	X	X	X	X	
Alarm SET2	Alarm setpoint 2	X	X	X	X	
Alarm Delay	Alarm delay	X	X	X	X	
Measure mode	Type of measurement	X*	X*	X*	X*	
Digital input selection	Function of the digital input	X	X	X	X	
Page Filter	Filter on real-time pages	X*	X*	X*	X*	
Screen saver	Indicates what happens after 300s of inactivity	X*	X*	X*	X*	
Home page	Page on startup or when the UP button is pressed for 2s	X**	X**	X**	X**	
Backlight	Backlight time	X	X	X	X	
Screen saver time	Page rotation time when using screensaver				X***	
Tariff management	Configuration to enable the tariff management via serial				X	
Quick setup	Restores the initial quick setup menu				X	
Startup current	Set the start-up current only for hour counters				X	
Current direction	Direction of the input current				X***	
Tariff selection	Tariff selection				X	X
Pages cfg	Dedicated register for each Real time page to configure the visibility				X*	

Parameter name	Description	Available on UI			Available on RS485	Available on Mbus
		S1 Model	M1 Model	O1 Model	only S1 Model	only M1 model
Device name	Registers to set a device name				X	
RS485 Address	RS485 address	X			X	
RS485 Baud	RS485 baudrate	X			X	
RS485 Parity	RS485 parity	X			X	
RS485 Stop	RS485 Stop bits	X			X	
Delay on reply	Minimum time before answering				X	
MBUS Address	MBUS primary address		X			X
MBUS Baud	MBUS baudrate		X			X
OUT Config.	Output configuration			X		
OUT Type	Output NO or NC			X		
Pulse duration	Pulse duration			X		
Pulse weight	Pulse weight			X		

\* = Read-Only on MID models

\*\* = Home page can be set only to 1 in PFA and SFA and between 1 and 2 on PFB

\*\*\* = Not available on MID models

# Input, output and communication

## Digital input

The digital input can perform four functions:

Function	Description	Parameters
Tariff management	Digital input used to manage the tariff	
	<b>Digital input status</b>	<b>Tariff</b>
	Open	Tariff 1
	Closed	Tariff 2
Remote status	Digital input is used to check the status via Modbus or M-Bus.	
	<b>Digital input status</b>	<b>Register 300h</b>
	Open	0
	Closed	1
Partial meters start/stop	Digital input is used to enable/disable the increasing of partial meters	
	<b>Digital input status</b>	<b>Partial meter</b>
	Open	Disabled (in pause)
	Closed	Enabled
Partial meter reset	Digital input is used to enable/disable the reset of partial meters	
	<b>Digital input status</b>	<b>Action</b>
	Open	No action
	Closed	After 3 seconds, reset partial meters

## Digital output (version O1)

The digital output can perform two functions:

Function	Description	Parameters
Alarm	Output associated with the alarm	Output state when no alarm is active
Pulse output	Pulse transmission output for imported active energy consumptions.	<ul style="list-style-type: none"><li>• Linked energy (kWh+, kWh-)</li><li>• Pulse weight</li><li>• Pulse duration</li></ul>

## Modbus RTU port (version S1)

Modbus RTU communication port is used to transmit data to a Modbus master.

For further information about Modbus RTU communication refer to the communication protocol.

## M-Bus port (version M1)

M-Bus communication port is used to transmit data to a M-Bus master (Carlo Gavazzi SIU-MBM or any third party M-Bus master).

For further information about M-Bus communication refer to the communication protocol.

# Essential information

## Alarms

### Introduction

EM511 manages a measured variable alarm. To set the alarm, define:

- the variable to be monitored (**VARIABLE**)
- alarm activation threshold value (**SET POINT 1**)
- alarm deactivation threshold value (**SET POINT 2**)
- alarm activation delay (**ACTIVATION DELAY**)

### Variables

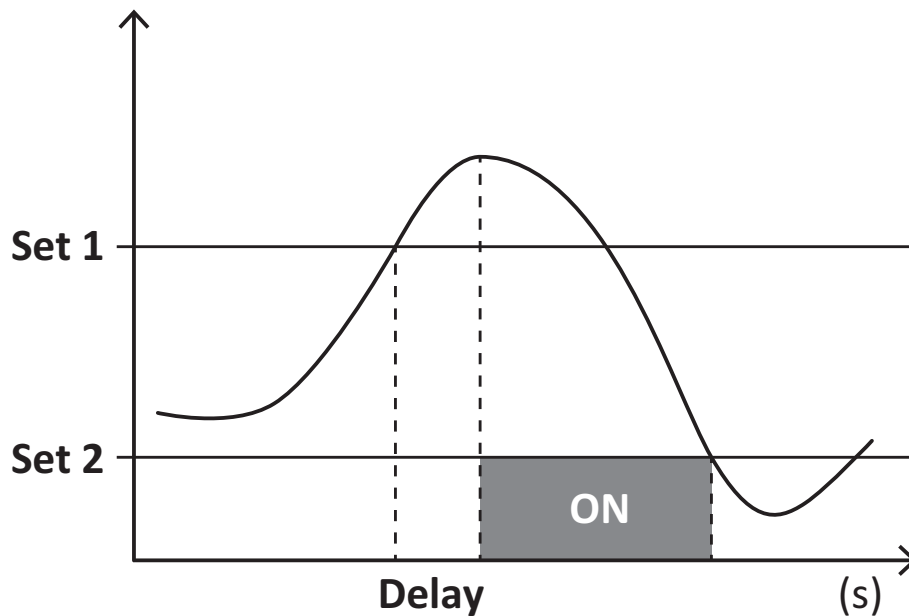
The unit can monitor one of the following variables:

- active power
- apparent power
- reactive power
- power factor
- voltage
- current

### Alarm types

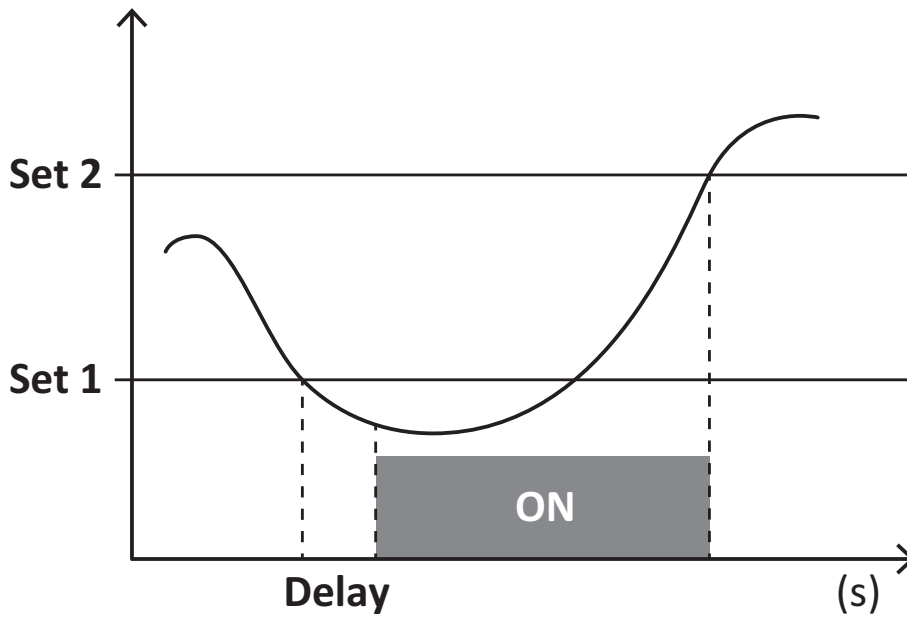
#### Up alarm (Set point 1 $\geq$ Set point 2)

The alarm activates when the monitored variable exceeds the Set 1 value for a time equal to the activation delay (Delay) and deactivates when the values drops below Set 2.



### Down alarm (Set point 1 < Set point 2)

The alarm activates when the monitored variable drops below the Set 1 value for a time equal to the activation delay (Delay) and deactivates when it exceeds Set 2.



## DMD values

### Average value calculation (dmd)

EM511 calculates the average values of the electrical variables within a set integration interval (15 min by default).

### Integration interval

The integration interval starts at switch-on or when the reset command is issued. The first value is displayed at the end of the first integration interval.

### Example

The following is a sample integration:

- reset at 10:13:07
- set integration time: 15 min.

The first value displayed at 10:28:07 refers to the interval from 10:13:07 to 10:28:07.

## LCD display

### Home page

The unit may display the default measurement pages after no operation has been performed for five minutes, if the screensaver is enabled and the screensaver type is as “Home page” (default value).

**Notes:** if you select a page that is not available in the set system, the unit displays as its home page the first available page. In MID models the home page cannot be changed and displays the active energy meter.

### Backlight


EM511 is equipped with a backlight system. You can set whether the backlight shall always be ON or whether it should automatically switch off after a given interval has elapsed since a button was pressed (1 to 60 minutes).

## Screensaver

After 5 minutes have elapsed since a button was pressed the unit will display the home page if the screensaver type is “Home page” (default setting), or it shall activate the slideshow function (if enabled), which displays the selected pages on a rotating basis. The pages shown can be selected in UCS (S1 version). By default the pages are: 1 (kWh+ TOT, kW), 3 (KW), 4 (V L-N), 5 (A).

**Notes:** In MID models the screensaver setting is “Homepage” and cannot be changed.

## Page filter

The page filter makes it easier to use and browse the measurement pages. When you use the  button, the unit shall only display the pages you are most interested in, which can be selected through the UCS software (S1 version) or is pre-defined (O1 and M1 version)

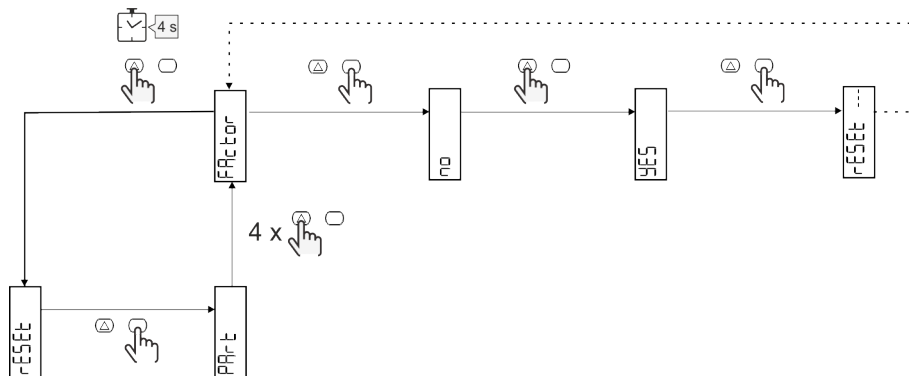
**Note:** to display all the pages without using the UCS software, you can disable the page filter from the SETTINGS MENU (DISPLAY → PAGES → ALL). By default, the pages included in the filter are: 1 (kWh+ TOT, kW), 2 (kWh- TOT, kW), 3 (KW), 4 (V L-N), 5 (A), 7 (Hz), 10 (kvarh+ TOT), 11 (kvarh- TOT), 12 (kvar), see “Measurement pages” on page 15.

## Restoring the factory settings

### Restoring the settings using the RESET menu

From the RESET menu you can restore all the factory settings. At start-up the QUICK SET-UP menu shall be available again.

**Notes:** meters are not reset.



## Offset function

### Setting some target values using the total reset function

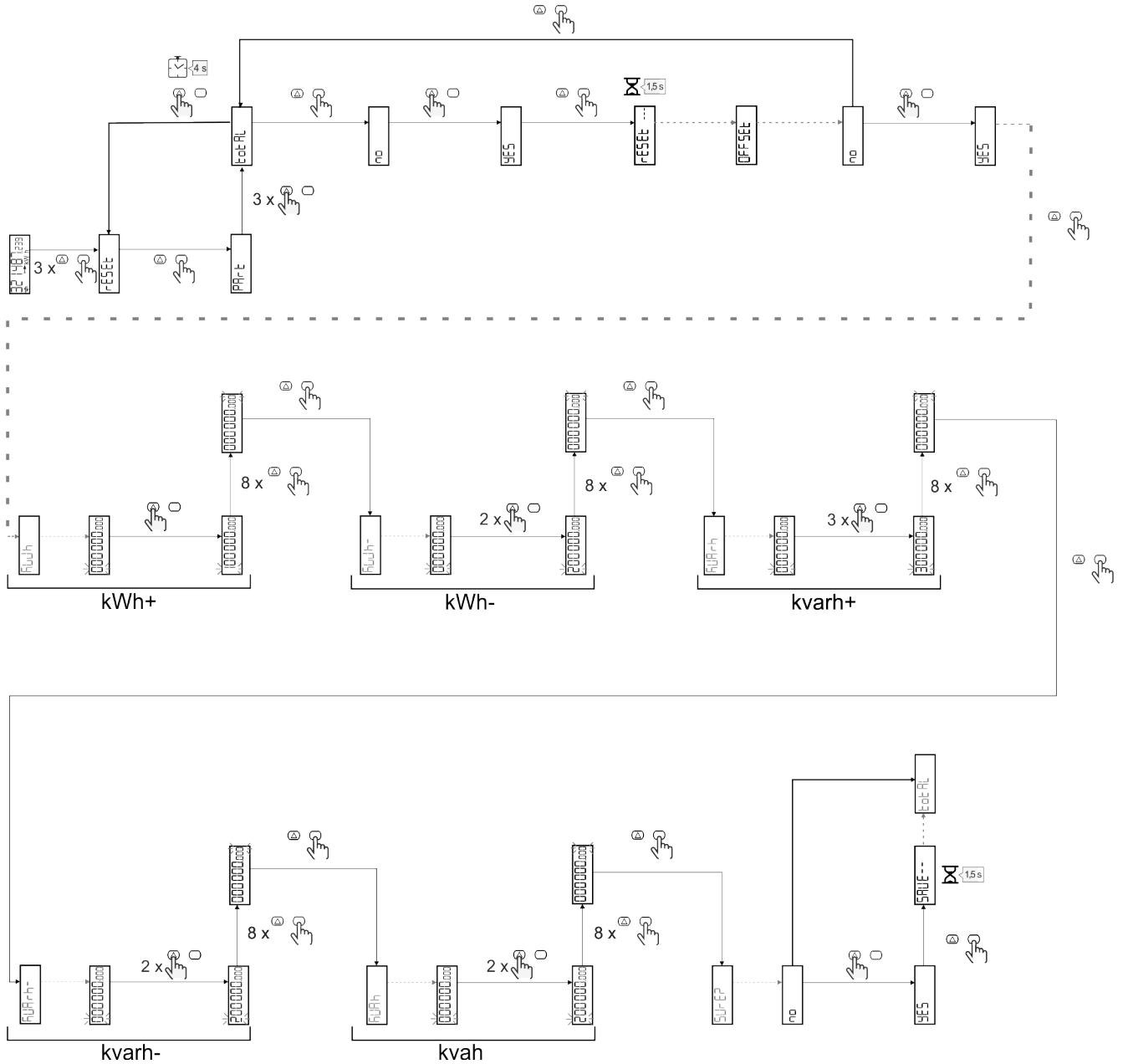
Using this function you can set a target value, it allows you to satisfy your needs:

- to substitute an existent analyzer and maintain the acquired data;
- to let the device work in parallel with your analyzer.

**Notes:** this function is available only for non-MID models.

Example: follow the diagram below if you want to set the target values that you find in the table:

Energy meters	Values
kWh+	100 000.00
kWh-	200 000.00
kvarh	300 000.00
kvarh-	200 000.00
kvah	200 000.00





## Tariff management

### Tariff management via digital input

To manage tariffs using the digital input set the function of the digital input as tariff (via keypad or UCS software). The current tariff depends on the status of the input

Digital input status	Tariff
Open	Tariff 1
Closed	Tariff 2

### Tariff management via Modbus RTU

To manage tariffs using the Modbus RTU command enable tariff management via Modbus command from UCS software

Modbus value	Tariff
0	No tariff
1	Tariff 1
2	Tariff 2

### Tariff management via M-Bus

To manage tariffs via M-Bus, a specific frame can be sent by the M-Bus Master

M-Bus value	Tariff
1	Tariff 1
2	Tariff 2

# Maintenance and disposal

## Troubleshooting

**Note:** in case of other malfunctions or of any failure, please contact the CARLO GAVAZZI branch or the distributor for your country

Problem	Cause	Possible solution
The 'EEEE' indication is displayed instead of a measurement	The analyser is not used within the prescribed measuring range; as a consequence, the measurement exceeds the maximum permitted value or is the result of a calculation with at least one measurement in error.	Uninstall the analyser
	The analyser has just been switched on and the interval defined for the calculation of the average power values (default: 15 min) has not expired yet.	Wait. If you wish to change the interval, access the Dmd page of the Settings menu
The displayed values are not the expected ones	Electrical connections are incorrect	Verify the connections
Exported energy meters (kWh-) don't increase	Measurement mode is set to A (default setting)	Set Measurement mode from A to B via keypad or UCS

## Alarms

Problem	Cause	Possible solution
An alarm is triggered, but the measurement has not exceeded the threshold value	The value with which the alarm variable is calculated is in error	Check the connections
The alarm is not activated and deactivated as expected	The alarm settings are incorrect	Check the set parameters

## Communication problems

Problem	Cause	Possible solution
No communication can be established with the analyser	Communication settings are incorrect	Check the set parameters
	Communication connections are incorrect	Verify the connections
	The settings of the communication device (third-party PLC or software) are incorrect	Check the communication with the UCS software

## Display problem

Problem	Cause	Possible solution
You cannot display all measurement pages	The page filter is enabled	Disable the filter, see "Page filter" on page 23

## Download

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## Cleaning

To keep the display clean, use a slightly wet cloth. Never use abrasives or solvents.

## Responsibility for disposal



Dispose of the unit by separately collecting its materials and bringing them to the facilities specified by government authorities or by local public bodies. Proper disposal and recycling will help preventing potentially harmful consequences for the environment and for people.



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