

# Circuitor

Multifunctional Energy Meter

**CEM-C12c**  
**CEM-C12c-MID**



## INSTRUCTION MANUAL

(M362B01-03-22A)





## SAFETY PRECAUTIONS

Follow the warnings described in this manual with the symbols shown below.



### DANGER

Warns of a risk, which could result in personal injury or material damage.



### ATTENTION

Indicates that special attention should be paid to a specific point.

If you must handle the unit for its installation, start-up or maintenance, the following should be taken into consideration:



Incorrect handling or installation of the device may result in injury to personnel as well as damage to the device. In particular, handling with voltages applied may result in electric shock, which may cause death or serious injury to personnel. Defective installation or maintenance may also lead to the risk of fire.

Read the manual carefully prior to connecting the device. Follow all installation and maintenance instructions throughout the device's working life. Pay special attention to the installation standards of the National Electrical Code.



### Refer to the instruction manual before using the device

In this manual, if the instructions marked with this symbol are not respected or carried out correctly, it can result in injury or damage to the device and /or installations.

CIRCUTOR S.A.U. reserves the right to modify features or the product manual without prior notification.

## DISCLAIMER

CIRCUTOR S.A.U. reserves the right to make modifications to the device or the unit specifications set out in this instruction manual without prior notice.

CIRCUTOR S.A.U. on its web site, supplies its customers with the latest versions of the device specifications and the most updated manuals.

[www.circutor.com](http://www.circutor.com)



CIRCUTOR S.A.U. recommends using the original cables and accessories that are supplied with the device.

## CONTENTS

SAFETY PRECAUTIONS .....	3
DISCLAIMER .....	3
CONTENTS.....	4
REVISION LOG .....	5
SYMBOLS.....	5
1.- VERIFICATION UPON RECEPTION .....	6
2.- PRODUCT DESCRIPTION .....	6
3.- DEVICE INSTALLATION .....	7
3.1.- PRELIMINARY RECOMMENDATIONS .....	7
3.2.- INSTALLATION .....	8
3.3.- DEVICE TERMINALS.....	9
3.4.- CONNECTION DIAGRAM.....	9
4.- OPERATION .....	10
4.1.- KEYBOARD FUNCTIONS .....	12
4.2.- DISPLAY .....	12
4.3.- LED INDICATORS.....	12
5.- DISPLAY .....	13
6.- CONFIGURING RS-485 COMMUNICATIONS .....	14
6.1.- PERIPHERAL NUMBER.....	15
6.2.- MODBUS BAUD RATE .....	15
6.3.- DATA BITS.....	16
6.4.- PARITY.....	16
6.5.-STOP BITS .....	16
6.6.- EXIT FROM MENU.....	17
7.- RS-485 COMMUNICATIONS.....	18
7.1.- MODBUS PROTOCOL.....	18
7.1.1. READING EXAMPLE: Function 0x03.....	18
7.1.2. WRITING EXAMPLE: Function 0x10.....	18
7.2.- MODBUS COMMANDS .....	19
8.- TECHNICAL FEATURES.....	21
9.- MAINTENANCE AND TECHNICAL SERVICE .....	23
10.- GUARANTEE .....	23
11.- CE CERTIFICATE .....	24

**Note:** The images of the devices are solely for the purpose of illustration and may differ from the original device.

## REVISION LOG

Table 1: Revision log.

Date	Revision	Description
06/22	M362B01-03-22A	Initial Version

## SYMBOLS

Table 2: Symbols.

Symbol	Description
CE	In compliance with the relevant European directive.
	Device covered by European directive 2012/19/EC. At the end of its useful life, do not leave the unit in a household waste container. Follow local regulations on electronic equipment recycling.
~	AC current

## 1.- VERIFICATION UPON RECEPTION

Check the following points upon receiving the device:

- a) The device meets the specifications described in your order.
- b) The device has not suffered any damage during transport.
- c) Perform an external visual inspection of the device prior to switching it on.
- d) Check that it has been delivered with the following:
  - An installation guide,



If any problem is noticed upon reception, immediately contact the transport company and/or **CIRCUITOR's** after-sales service.

## 2.- PRODUCT DESCRIPTION

The **CEM-C12c** static single-phase energy meter measures class 1 (IEC 62053-21) / class B (EN50470), with multifunction, RS-485 communications and DIN rail standard installations. It is the ideal solution for residential and commercial installations.



The device features:

- Only 18 mm wide, can up to 100A.
- **RS-485 communication**, protocol Modbus-RTU.
- Device has 3.6V Lithium battery. The precision of RTC is better than 0.5s/day.
- Blue LCD backlight allows the device to be read in low light conditions.
- **1 key**, to move between the different display screens and be able to configure the communications.

## 3.- DEVICE INSTALLATION

### 3.1.- PRELIMINARY RECOMMENDATIONS



In order to use the device safely, it is critical that individuals who handle it follow the safety measures set out in the standards of the country where it is being used, use the necessary personal protective equipment, and pay attention to the various warnings indicated in this instruction manual.

The **CEM-C12c** device must be installed by authorised and qualified staff.

The measuring systems switched off before handling, altering the connections or replacing the device. It is dangerous to handle the unit while it is powered.

Also, it is critical to keep the cables in perfect condition in order to avoid accidents, personal injury and damage to installations.

The manufacturer of the device is not responsible for any damage resulting from failure by the user or installer to observe the warnings and/or recommendations set out in this manual, nor for damage resulting from the use of non-original products or accessories or those made by other manufacturers.

If an anomaly or malfunction is detected in the device, do not use the device to take any measurements.

Inspect the work area before taking any measurements. Do not take measurements in dangerous areas or where there is a risk of explosion.



Disconnect the device from the power supply before maintaining, repairing or handling the device's connections.  
Please contact the after-sales service if you suspect that there is an operational fault in the device.

## 3.2.- INSTALLATION



Terminals, opening covers or removing elements can expose parts that are hazardous to the touch while the device is powered. Do not use the device until it is fully installed.

**Installation instruction:**

- 1.- Choose 35mm standard DIN rail (the length is confirmed by yourself), fixed them in the location which are waiting for installation.
- 2.- Push down the clip under the bottom of the meter for a gear, see **Figure 1**.

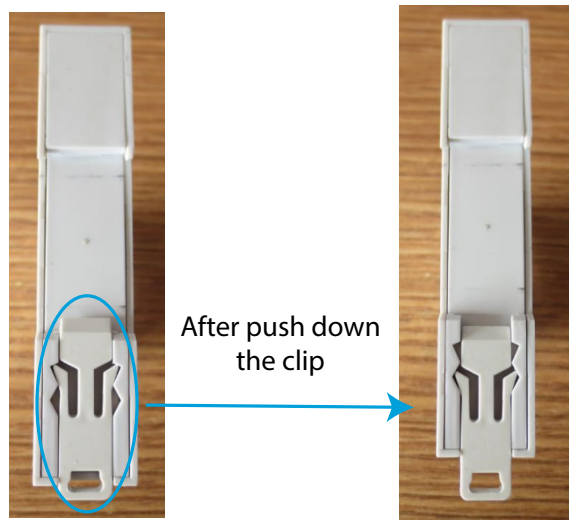


Figure 1: Push down the clip.

- 3.- Put the meter into the DIN rail as per **Figure 2**, then push up the clip for a gear, install meter to the DIN rail, see **Figure 3**.

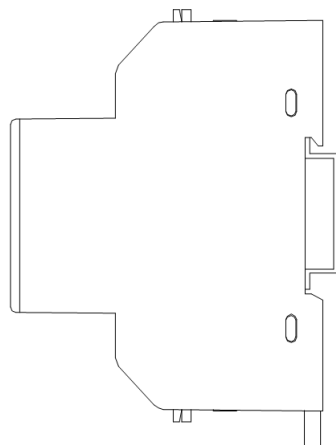


Figure 2: Put the meter into the DIN rail.

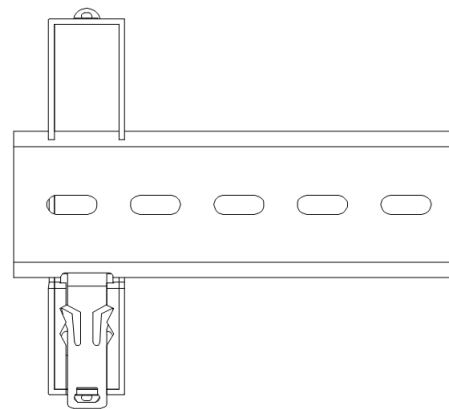


Figure 3: Install meter to the DIN rail.

- 4.- Making the connection according to the wiring diagram.
- 5.- After connection, use lead sealing to seal terminal cover.



## 3.3.- DEVICE TERMINALS

Table 3:List of CEM-C12c terminals.

Device terminals	
1 : L, Input, connected to the mains phase	B-: B-, RS-485 connection
3: LOAD, Output	S: S, RS-485 connection
N: N, Input, connected to neutral	A+: A+, RS-485 connection

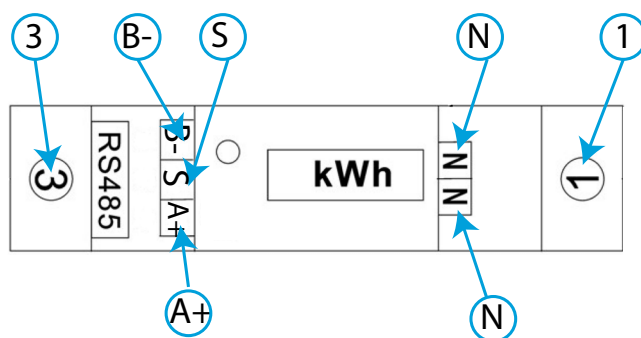


Figure 4:Terminals of the CEM-C12c.

**Note:** The Neutral wire can be connected to one of N ports or both.

**Note:** If RS-485 installation does not have S port, it is not necessary to connect it.

## 3.4.- CONNECTION DIAGRAM

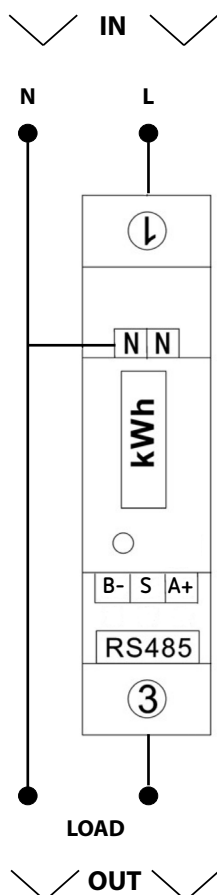


Figure 5: Connection diagram, CEM-C12c.

4.- OPERATION

The CEM-C12c measures in the 4 quadrants (consumption and generation).

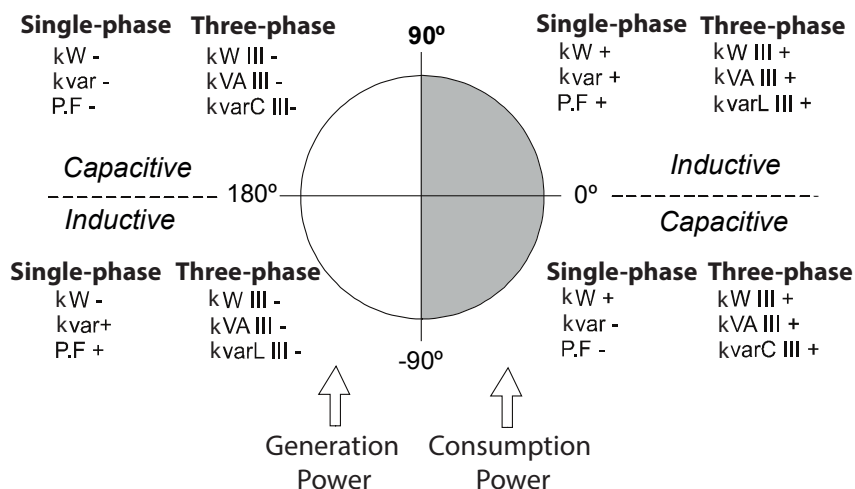


Figure 6: Sign convention.

Table 4: CEM-C12c Measurement parameters.

Parameter	Display	RS-485		
		Instantaneous	Maximum	Minimum
Voltage	✓	✓	✓	✓
Current	✓	✓	✓	✓
Frequency	✓	✓	-	-
Active Power	✓	✓	✓	✓
Reactive Power	✓	✓	✓	✓
Inductive Reactive Power	-	✓	✓	✓
Capacitive Reactive Power	-	✓	✓	✓
Apparent Power	✓	✓	✓	✓
Power Factor	✓	✓	✓	✓
Maximum Active Power Demand	-	✓	✓	-
Active Energy Consumed	-	✓	-	-
Active Energy Generated	-	✓	-	-
Total Active Energy	✓	✓	-	-
Inductive Reactive Energy Consumed	✓	✓	-	-
Inductive Reactive Energy Generated	-	✓	-	-
Capacitive Reactive Energy Consumed	-	✓	-	-
Capacitive Reactive Energy Generated	-	✓	-	-
Reactive Energy Consumed	-	✓	-	-
Reactive Energy Generated	-	✓	-	-
Total Reactive Energy	-	✓	-	-

✓ Maximum demand

The maximum demand is the average instantaneous power over a specific time interval, usually 15 minutes. There are several ways to calculate this parameter:

## Fixed Window (by block)

This is the calculation of maximum demand in a specific interval (usually every 15 minutes). Once the number is calculated, the value is saved and a new calculation for the next 15 minutes begins. The result would be 4 values per hour.

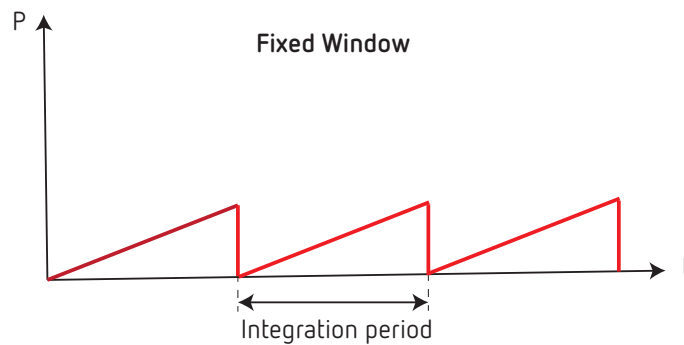


Figure 7:Fixed Window.

## Sliding window

This is the calculation of maximum demand in a specific interval (usually every 15 minutes). Once the number is calculated, it is refreshed every minute with the values from the last 15 minutes. In other words, every minute (this time can be variable) we will have a maximum demand number for the last 15 minutes. The result would be 60 values per hour.

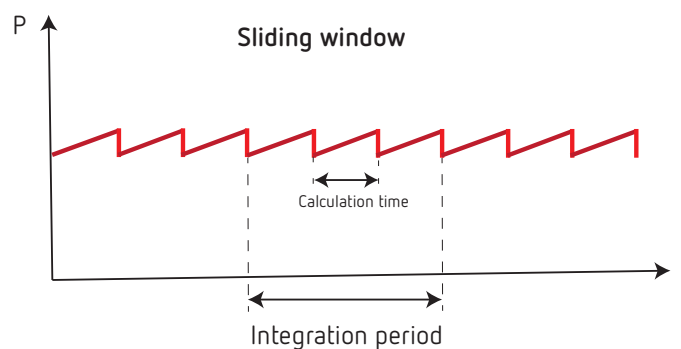


Figure 8:Sliding Window.

The **CEM-C12c** calculates the Maximum demand with a fixed window and a 15-minute integration period

#### 4.1.- KEYBOARD FUNCTIONS

The CEM-C12c has one key to move around the different screens and configure the communications (Figure 9).

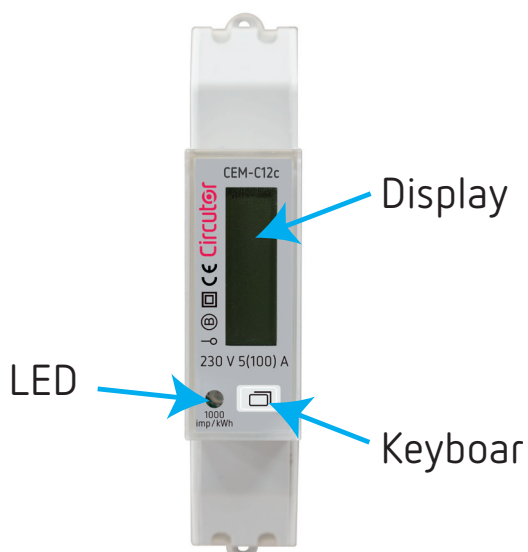


Figure 9: CEM-C12c, description.

#### 4.2.- DISPLAY

The device has an LCD where all parameters are displayed (Figure 9).












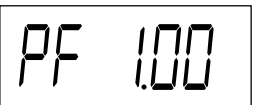

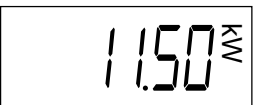



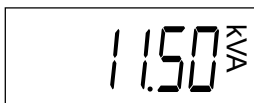
#### 4.3.- LED INDICATORS

The device has one verification LED, to verify the **active energy**. The weight of the LED is 1000 imp/kWh (Figure 9).


## 5.- DISPLAY

The data can be displayed through 2 methods:

- ✓ Automatically, the device automatically switches screens every 5 seconds.
- ✓ Pressing the key.

		Total Active Energy (consumed + generated) (kWh)
		Inductive Reactive Energy consumed (kVArh)
		Voltage (V)
		Current (A)
		Frequency (Hz)
		Power factor ( $\cos \phi$ )
		Active power (kW)
		Reactive power (kVAr)
		Apparent power (kVA)

6.- CONFIGURING RS-485 COMMUNICATIONS

To go into the communications configuration menu, press  > 5 seconds while in any display screen.

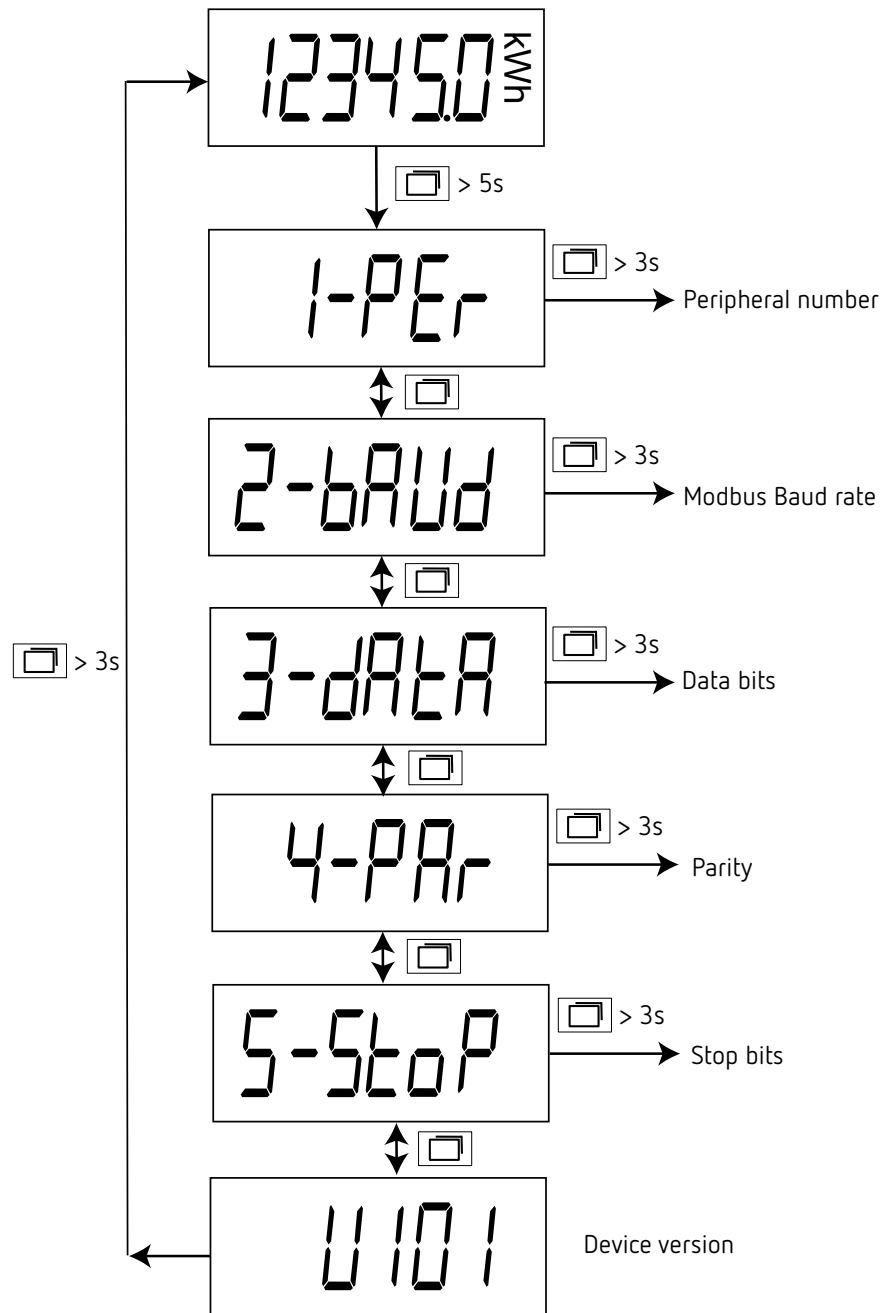

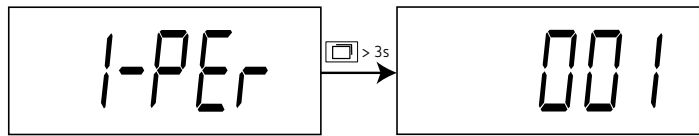


Figure 10: Communications menu.


If the key is not pressed for 1 minute, the device skips to the display screens.

## 6.1.- PERIPHERAL NUMBER

This screen enables peripheral number configuration. To go into the configuration screen, press  > 3 seconds.



Press  to change the digit value.

Press  > 3 seconds to change digits.


If the last digit is pressed for  > 3 seconds, the change is saved. The screen shown in Figure 11 indicates that the changes have been saved correctly.



Figure 11: Done screen.

### ✓ Configuration values

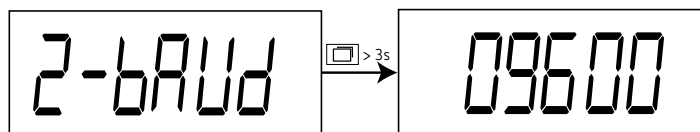
Table 5: Configuration values: Peripheral n°.

	Peripheral N°
Minimum value	1
Maximum value	247


Press  to skip to the next programming step.

## 6.2.- MODBUS BAUD RATE

This screen is used to configure the Baud Rate. Press  > 3 seconds to open the configuration screen.




Press  to change options.

Press  > 3 seconds to save the change. The screen shown in Figure 11 indicates that the changes have been saved correctly.

### ✓ Configuration values

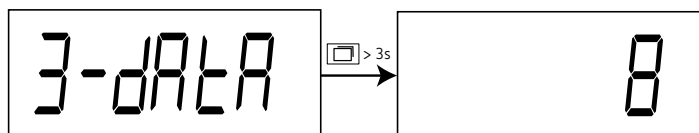
Table 6: Configuration values: Baud rate.

	Baud Rate	
Possible values	9600	9600 bps
	19200	19200 bps
	38400	38400 bps
	115200	115200 bps

Press  to skip to the next programming step.

### 6.3.- DATA BITS

This screen shows the number of data bits. Press  > 3 seconds to open the configuration screen.

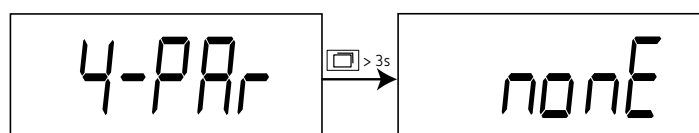


**Note:** This parameter cannot be modified.


Press  to skip to the next programming step.

### 6.4.- PARITY

This screen is used to configure the parity. Press  > 3 seconds to open the configuration screen.



Press  to change options.

Press  > 3 seconds to save the change. The screen shown in **Figure 11** indicates that the changes have been saved correctly.


#### ✓ Configuration values

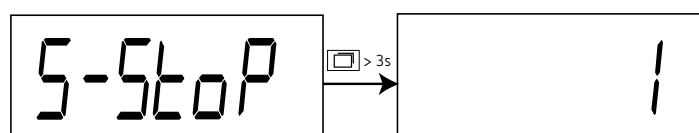
Table 7: Configuration values: Parity.

	Parity	
Possible values	none	No parity
	odd	Odd parity
	even	Even parity


Press  to skip to the next programming step.


### 6.5.-STOP BITS

This screen is used to configure the number of stop bits. Press  > 3 seconds to open the configuration screen.





Press  to change options.

Press  > 3 seconds to save the change. The screen shown in **Figure 11** indicates that the changes have been saved correctly.


### ✓ Configuration values

Table 8: Configuration values: Stop bits.

	Stop bits	
Possible values	1	1 stop bit
	2	2 stop bit

Press ● to skip to the next programming step.

## 6.6.- EXIT FROM MENU

This screen displays the software version of the device and pressing it for  > 3 seconds exits the configuration menu.



## 7.- RS-485 COMMUNICATIONS

The **CEM-C12c** has one RS-485 communications port to view the measurement data and configure the devices. The visualization and configuration can also be done through the **CIRCUTOR PowerStudio** software.

**Note:** Default values of RS-485 communication: **No. of peripheral 1, 9600 bps, No parity, 8 data bits and 1 stop bit.**

### 7.1.- MODBUS PROTOCOL

In the Modbus protocol, the **CEM-C12c** device uses the RTU (Remote Terminal Unit) mode. The Modbus functions implemented in the device are as follows:

**Function 0x03:** Reading integer registers

**Function 0x10:** Writing multiple registers

#### 7.1.1. READING EXAMPLE: Function 0x03.

**Question:** Voltage value

Address	Function	Initial register	No. of registers	CRC
01	03	0000	0002	C40B

**Address: 01,** Peripheral number: 1 in decimals.

**Function: 03,** Read function.

**Initial Register: 0000,** register on which the reading will start. (Modbus address).

**No of registers: 0002,** number of registers read.

**CRC: C40B,** CRC Character.

**Response:**

Address	Function	No of Bytes	Register no 1	Register no 2	CRC
01	03	02	0000	091F	359A

**Address: 01,** Responding peripheral number: 1 in decimals.

**Function: 03,** Read function.

**No. of bytes: 02,** No. of bytes received.

**Register: 091F,** value of the voltage :0000091F : 2335 → 233.5V

**CRC: 359A,** CRC Character.

#### 7.1.2. WRITING EXAMPLE: Function 0x10.

**Question:** Modify the Modbus baud rate to 9600 bps

Address	Function	Initial Register	No of Registers	No of Bytes	Value	CRC
01	10	0064	0001	02	0001	xxxx

**Address: 01**, Peripheral number: 1 in decimals.

**Function: 10**, Writing function.

**Initial Register: 0064**, Address of the Baud rate parameter.

**No of registers: 0001**, number of registers write.

**No of bytes: 02**, number of bytes write.

**Value: 0001**, 0001 → 9600 bps.

**CRC: xxxx**, CRC Character.

## 7.2. - MODBUS COMMANDS

**Note:** The waiting time of a Modbus query can exceed 200 ms, depending on the number of registers requested.

All the addresses of Modbus memory are in Hexadecimal.

Table 9: Modbus memory map (Table 1).

Parameter	Function	Modbus address			Units
		Instantaneous	Maximum	Minimum	
Voltage	03	00 - 01	32 - 33	44 - 45	V x 10
Current	03	02 - 03	34 - 35	46 - 47	A x 100
Active Power	03	04 - 05	36 - 37	48 - 49	kW x 100
Reactive Power	03	06 - 07	38 - 39	4A - 4B	kvar x 100
Inductive Reactive Power	03	08 - 09	3A - 3B	4C - 4D	kvarL x 100
Capacitive Reactive Power	03	0A - 0B	3C - 3D	4E - 4F	kvarC x 100
Apparent Power	03	0C - 0D	3E - 3F	50 - 51	kVA x 100
Power Factor	03	0E - 0F	40 - 41	52 - 53	x 100
Maximum demand of the Active Power	03	10 - 11	42 - 43	-	kW x 100

Table 10: Modbus memory map (Table 2).

Parameter	Function	Modbus address	Units
Consumed Active Energy Total	03	12 - 13	kWh x 100
Consumed Inductive Reactive Energy Total	03	14 - 15	kvarh x 100
Consumed Capacitive Reactive Energy Total	03	16 - 17	kvarh x 100
Consumed Reactive Energy Total	03	18 - 19	kvarh x 100
Consumed Active Energy Partial	03	1A - 1B	kWh x 100
Consumed Inductive Reactive Energy Partial	03	1C - 1D	kvarh x 100
Consumed Capacitive Reactive Energy Partial	03	1E - 1F	kvarh x 100
Consumed Reactive Energy Partial	03	20 - 21	kvarh x 100
Generated Active Energy Total	03	22 - 23	kWh x 100
Generated Inductive Reactive Energy Total	03	24 - 25	kvarh x 100
Generated Capacitive Reactive Energy Total	03	26 - 27	kvarh x 100
Generated Reactive Energy Total	03	28 - 29	kvarh x 100
Generated Active Energy Partial	03	2A - 2B	kWh x 100
Generated Inductive Reactive Energy Partial	03	2C - 2D	kvarh x 100
Generated Capacitive Reactive Energy Partial	03	2E - 2F	kvarh x 100
Generated Reactive Energy Partial	03	30 - 31	kvarh x 100
Frequency	03	5A	Hz x 100

Tabla 10(Continuación) : Mapa de memoria Modbus (Tabla 2)

Parameter	Function	Modbus address	Units
Total active Energy (Consumed + Generated)	03	5B - 5C	kWh x 100
Total reactive energy (Consumed + Generated)	03	5D - 5E	kvarh x 100

Table 11: Modbus memory map (Table 3).

Parameter	Function	Modbus address
Reset of maximum values	05	5F
Reset of minimum values	05	60
Maximum Demand Reset	05	61
Reset of Partial Energies	05	62
Total reset (Maximum and minimum values, Maximum demand and Partial Energies)	05	63

Table 12: Modbus memory map (Table 4).

Parameter	Modbus address	Function	Data format
Date and time	56 ... 59	04 / 10	YY YY MM DD WW hh mm ss <sup>(1)</sup>
Serial number	69 ... 6C	04	-

<sup>(1)</sup>Data format :

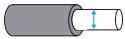


Table 13: Data format.

Parameter	Data format	Description
Date and time	YY YY (decimal value)	Year
	MM (decimal value)	Month
	DD (decimal value)	Day
	WW (decimal value)	Weekday number
	hh (decimal value)	Hour
	mm (decimal value)	Minutes
	ss (decimal value)	Seconds

Table 14: Modbus memory map (Table 5).

Parameter	Modbus address	Function	Default values	Data format
Baud Rate	64	04 / 10	01	01: 9600 bps 02: 19200 bps, 03: 38400 bps 04: 115200 bps
ID (peripheral number)	65	04 / 10	1	1 - 247
Parity	66	04 / 10	0	0: none, 1: odd, 2: even
Data bits	67	04	0	0: 8 bits
Stop bits	68	04 / 10	0	0: 1 stop bit, 1: 2 stop bit

## 8.- TECHNICAL FEATURES

Power supply			
Mode	Self-powered		
Voltage Measurement			
Connection	Single-phase		
Reference voltages	230 V ~		
Frequency	CEM-C12c	50 / 60 Hz	
	CEM-C12c-MID	50 Hz	
Power consumption	≤ 12 VA, ≤ 1 W		
Current measurement			
Rated Current (I <sub>n</sub> )	CEM-C12c	5 A	
	CEM-C12c-MID	0.25 ... 5 A	
Maximum current (I <sub>max</sub> )	100 A		
Starting current	0.004 I <sub>b</sub>		
Accuracy			
Accuracy	CEM-C12c	Class 1 (IEC 62053-21)	
	CEM-C12c-MID	Class B (EN50470)	
RS-485 Communications			
Bus	RS-485		
Protocol	Modbus RTU		
Baud rate	9600 - 19200 - 38400 - 115200 bps		
User interface			
Display	LCD		
Maximum counter value	99999.99 kWh		
Keys	1 key		
LED (kWh)	1000 imp/kWh ( width: 90 ms)		
Environmental features			
Operating temperature	-25°C... +70°C		
Storage temperature	-30°C... +70°C		
Relative humidity (maximum value)	95%		
Average humidity value of year	75%		
Mechanical features			
Dimensions ( Figure 12)	90 x 18 x 72 mm		
Weight	0.10 kg		
Enclosure	PTB + 15% GF		
Protection degree IP	IP51		
Use	Indoor		
Connections			
RS-485 (B-, S, A+)	≤ 1.5 mm <sup>2</sup>	0.4 Nm	Flat, PH2
Neutral (N)	≤ 1.5 mm <sup>2</sup>	0.4 Nm	Flat, PH2
Measure (L, LOAD)	≤ 22 mm <sup>2</sup>	≤ 3 Nm	Flat, PZ2

Standards	
Electrical energy metering equipment (AC). Particular requirements. Part 21: Static active energy meters (classes 1 and 2)	IEC 62053-21
Electricity metering equipment (AC) - General requirements, tests and test conditions -- Part 11: Metering equipment	IEC 62052-11
Electricity metering equipment (a.c.) -- Part 1: General requirements, tests and test conditions - Metering equipment (class indexes A, B and C)	EN 50470-1
Electricity metering equipment (a.c.) -- Part 3: Particular requirements - Static meters for active energy (class indexes A, B and C)	EN 50470-3
CEM-C12c-MID	
MID (Measuring Instruments Directive): EU Directive 2014/32/EU on Measuring Instruments Annex II, Module B	

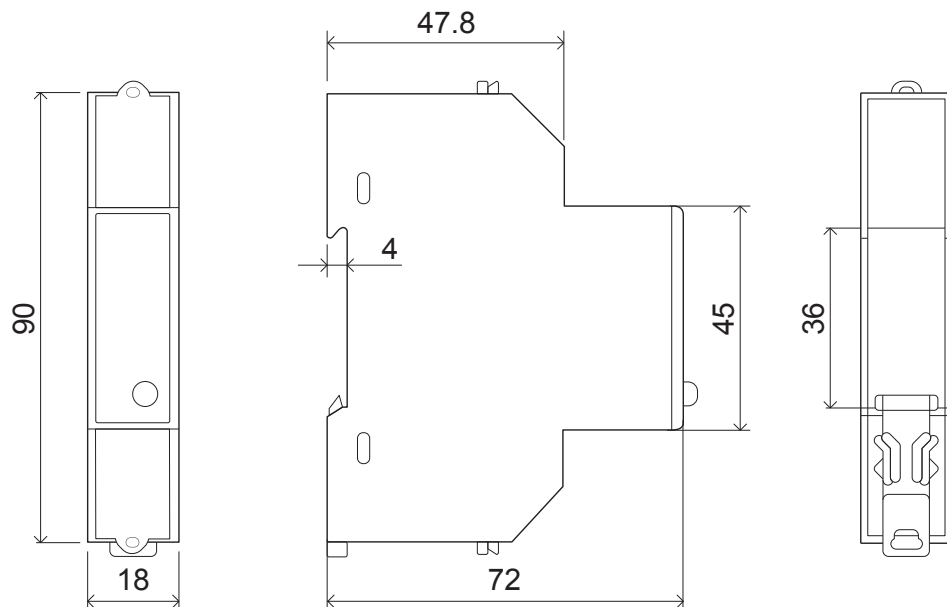


Figure 12: Dimensions of the CEM-C12c.

## 9.- MAINTENANCE AND TECHNICAL SERVICE

In the case of any query in relation to device operation or malfunction, please contact the **CIRCUTOR S.A.U.** Technical Support Service.

### Technical Assistance Service

Vial Sant Jordi, s/n, 08232 - Viladecavalls (Barcelona)

Tel: 902 449 459 (Spain) / +34 937 452 919 (outside of Spain)

email: sat@circutor.com

## 10.- GUARANTEE

**CIRCUTOR** guarantees its products against any manufacturing defect for two years after the delivery of the units.

**CIRCUTOR** will repair or replace any defective factory product returned during the guarantee period.



- No returns will be accepted and no unit will be repaired or replaced if it is not accompanied by a report indicating the defect detected or the reason for the return.
- The guarantee will be void if the units has been improperly used or the storage, installation and maintenance instructions listed in this manual have not been followed. "Improper usage" is defined as any operating or storage condition contrary to the national electrical code or that surpasses the limits indicated in the technical and environmental features of this manual.
- **CIRCUTOR** accepts no liability due to the possible damage to the unit or other parts of the installation, nor will it cover any possible sanctions derived from a possible failure, improper installation or "improper usage" of the unit. Consequently, this guarantee does not apply to failures occurring in the following cases:
  - Overvoltages and/or electrical disturbances in the supply;
  - Water, if the product does not have the appropriate IP classification;
  - Poor ventilation and/or excessive temperatures;
  - Improper installation and/or lack of maintenance;
  - Buyer repairs or modifications without the manufacturer's authorisation.

11.- CE CERTIFICATE









**CIRCUTOR S.A.U.**

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