elvaco

CMa11L
User's Manual
English
V 1.1

Contents

1 Document notes

All information in this manual, including product data, diagrams, charts, etc. represents information on products at the time of publication, and is subject to change without prior notice due to product improvements or other reasons. It is recommended that customers contact Elvaco AB for the latest product information before purchasing a CMa Series product.

The documentation and product are provided on an "as is" basis only and may contain deficiencies or inadequacies. Elvaco AB takes no responsibility for damages, liabilities, or other losses by using this product.

1.1 Copyright and trademark

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CMa11L is a trademark of Elvaco AB, Sweden.

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2 Important usage and safety information

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any CMa11L product. Users of the product are advised to convey the information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Elvaco AB assumes no liability for customer's failure to comply with these precautions.

All instructions must be carefully read before CMa11L is installed and used. They contain important information about how the product is used properly.

The installation of CMa11L should not be started before the technical specifications are fully understood. The work must be performed in the order listed in this manual, and only by qualified personnel. The work must also be done in accordance with national electrical specifications and applicable local regulations.

In order to avoid the product being damaged by static electricity, an ESD wristband should be worn when handling the product.

The labelling of the product must not be changed, removed or made unrecognizable.

3   Using this manual

3.1   Purpose and audience

This manual provides all information needed to mount, deploy, configure and use the CMa11L indoor temperature and humidity sensor for LoRaWAN and mainly targets installers and system integrators.

3.2   Online resources

To download the latest version of this user's manual, or to find information in other languages, please visit http://www.elvaco.com/.

3.3   Symbols

The following symbols are used throughout the manual to emphasize important information and useful tips:

The Note symbol is used to mark information that is important to take into consideration for safety reasons or to assure correct operation of sensor.

The Tip symbol is used to mark information intended to help you get the most out of your product. It might for example be used to highlight a possible customization option related to the current section.

4   Introduction

4.1   Purpose

This chapter provides a general description of CMa11L. In the next-coming sections you will learn more about possible applications for the product and how CMa11L can be combined with other products to build versatile solutions.

4.2   Application description

Long range and extensive battery-life with LoRaWAN

CMa11L is a temperature and humidity sensor for high-accuracy measuring in indoor environments. The sensor uses LoRaWAN, a low-power wide-area network (LPWAN) communication technique, to offer a combination of long range and high energy-efficiency; by using EcoMode, the sensor has an anticipated battery-life of at least 12 years.

All data that is delivered from end-point to receiving application is encrypted with double layers of 128-bit encryption keys to maximize security.

A completely digitalized metering chain

CMa11L supports Elvaco One-Touch Commissioning for secure and flexible deployment, configuration and key transferring.

In the Elvaco OTC App, configuration profiles are easily created and shared with other users to make the configuration of the sensors smooth and secure.
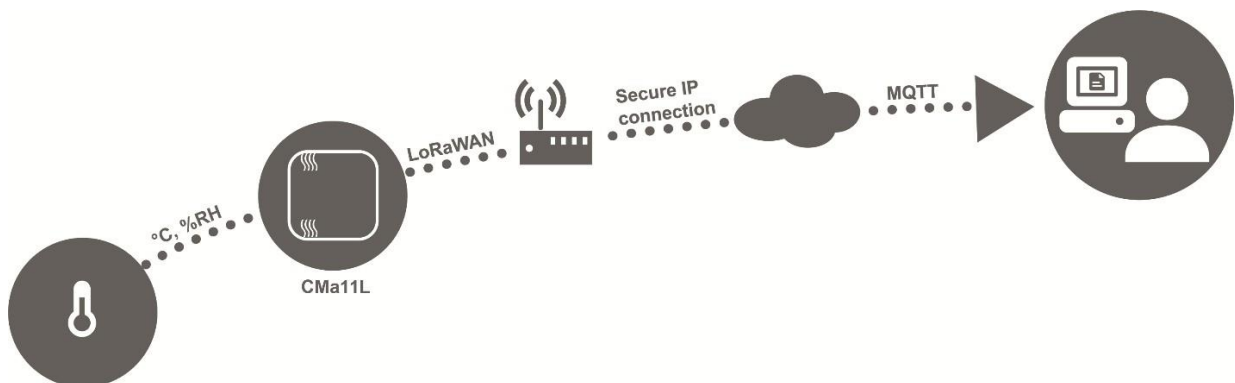
5   Getting started

5.1   Purpose

This chapter provides instructions on how to get started with CMa11L. After reading and carefully following each step of this chapter, your meter sensor will be mounted and connected to the LoRaWAN network.

5.2   Product specification

(1) NFC Antenna

(2) Green LED

(3) Red LED

(4) Product Label
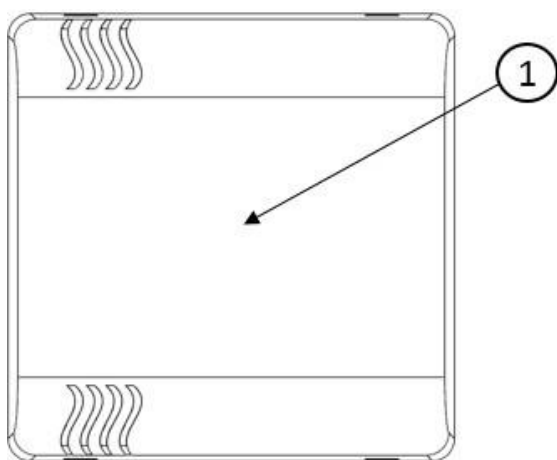
(5) Push Button

Figure 1. CMa11L Product specification, Front
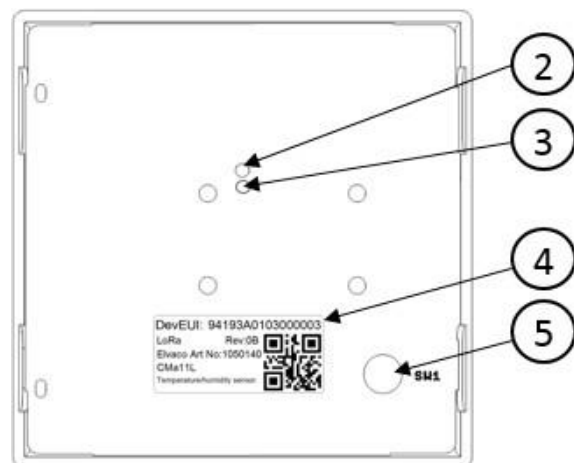
Figure 2. CMa11L Product specification, Back

5.3 Mount the device

CMa11L is mounted on a wall by using the holes on its back cover.

⚠️ Avoid mounting the sensor near supplementary heat sources, such as kitchen stoves or in direct sunlight.

⚠️ Make sure to mount the product at least 1.5 meters above the floor and at least 1 meter from nearest radiator.

⚠️ Do not mount the product on an external wall or near a door. If mounted over a conduit pipe, make sure that the pipe is filled to prevent air flow.

5.4 Demount the device

To demount the CMa11L, carefully insert the end of a screwdriver in the upper part of one of the enclosure bottom holes, as illustrated by Figure 3.
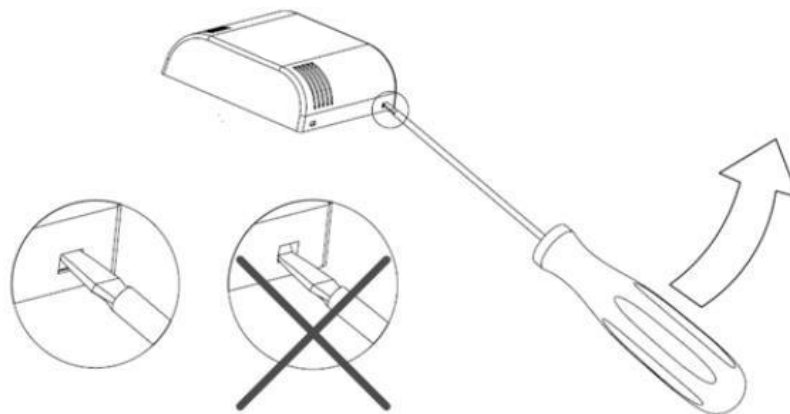
Figure 3. Demount CMa11L

5.5 Connect device to LoRaWAN network

5.5.1 Network preparation

For the sensor to connect to the LoRaWAN network, it needs to be registered in the network server. The following information needs to be added in the network server, depending on activation type:

- **Over-the-air activation (OTAA)**: Device EUI, Application key, Join EUI
- **Activation by personality (ABP):** Application Session key, Network Session key, Device address

> Elvaco strongly recommends using **Over-the-air activation (OTAA)** to facilitate deployment and minimize the risk of duplicated keys.

5.5.2 Activation and LED indications

When the product has been registered in the network server and the sensor has been activated, it will automatically connect to the LoRaWAN network. There are two ways to activate the sensor:

1. Press and hold the Push button (5) on the back of the product for at least 5 seconds until the green LED lights up.

2. Start the Elvaco OTC app and scan the sensor by placing the back of your phone next to the front of the sensor. Navigate to the **Apply** tab and set Power mode to "Active". Click **Apply** and place the device on top of the sensor in the same way as when the device was scanned.

Device activation

By default, CMa11L is to passive mode, which means no messages will be transmitted from the sensor until it is activated. The sensor can be activated in one of the following ways:

1. By using the **Elvaco OTC App:** Open the Elvaco OTC app, which is available in Google Play.

   a) Scan the sensor, make sure NFC is activated on the phone.
   b) In Elvaco OTC App, go to the "APPLY" tab,
   c) Set "Power mode" to "Active"
   d) Click "APPLY" in the bottom of the screen
   e) Scan the sensor to apply new settings.

   To verify that the sensor has been activated, go to the "INSPECT" tab, scan the sensor, and make sure that "Power mode" is set to "Active".

> Make sure to locate the NFC antenna on your phone before scanning the sensor. It should be placed as close as possible to the sensor's NFC antenna to facilitate scanning of the device.

> Note that it is possible to create a configuration profile to apply a preconfigured setting to multiple devices, for further information please refer to the OTC app documentation, available on the Elvaco website.

2. By using the **sensor push button:** Press down the push button of the sensor for at least five seconds until the green LED lights up.

Network join

When activated, the sensor will attempt to join the LoRaWAN network. Activation is indicated by a short flash of the green and the red LED. When CMa11L succeeds in joining the LoRaWAN network, the green LED will light up for 8 seconds, as indicated by Figure 2.

The time for CMa11L to join the LoRaWAN network join may differ depending on network conditions.

If the sensor fails to join the LoRaWAN network, it will retry until it succeeds. The time between each attempt will increase successively, to a minimum of once every day. A new join attempt cycle can be manually started at any time by rebooting the sensor (see section 5.5.3) or by deactivating and activating the sensor using the Elvaco OTC App.

Once the sensor has joined the LoRaWAN network, meter data will initially be transmitted from the sensor every minute (regardless of transmit interval settings) to set the right data rate. After eight minutes of calibration, the sensor will start to deliver meter data using its configured settings.
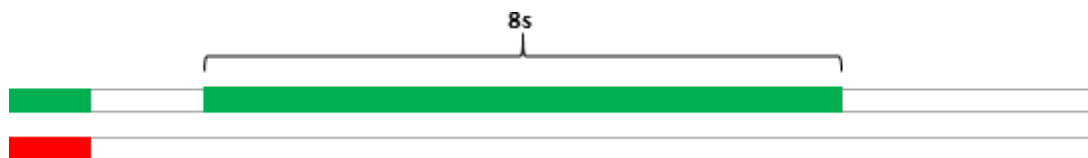
Figure 4: LED indication, network join

5.5.3 Reboot/Switch off sensor

Reboot
Press and hold the sensor's push button for 5-15 seconds. Release the push button when the green LED is lit.

Switch Off
Press and hold the sensor's push button for 15-20 seconds. Make sure to release the button when the red LED is lit. If releasing the push button after more than 20 seconds, the sensor will not switch off.
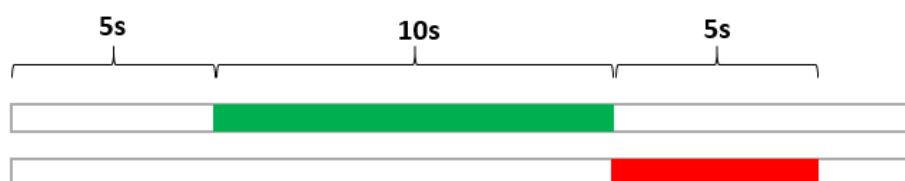
Figure 5: Reboot/switch off sensor

6 Administration reference

6.1 Purpose

This chapter contains detailed information about configuring options and the different message formats of CMa11L.

6.2 Security and access control

CMa11L has a "configuration lock" feature, which prevents unauthorized access to the sensor. When "configuration lock" has been enabled, a Product Access Key will be needed to configure the device. For more information about security and access control, please refer to the One-touch commissioning (OTC) documentation, available on the Elvaco website.

6.3 Configuration options

CMa11L can be configured in one of the following ways:

- By using the Elvaco OTC app, downloadable in Google Play store (compatible with Android 5.0 or later). For more information about the Elvaco OTC App, please refer to the separate Elvaco OTC App User's manual available at Elvaco's website.

- Via Downlink (see section 0 for more information about downlink).

⚠️ Please note that the Elvaco OTC App is compatible with Android phones with Android 5.0 or later.

Table 1 provides a summary of all CMa11L parameters and settings.

Field name (Abbr.)	Default value	Elvaco OTC App Locked device & correct Product Access Key *or* Open device	Elvaco OTC App No Product Access Key	Downlink
DevEUI	Device-unique 64-bit number	Readable	Readable	N/A
Firmware version	N/A	Readable	Readable	N/A
Current data rate	N/A	Readable	Readable	N/A
RSSI (Signal strength)	N/A	Readable	Readable	N/A
Current temperature	N/A	Readable	Readable	N/A
Current humidity	N/A	Readable	Readable	N/A

Network Joined	N/A	Readable	Readable	N/A
Configuration lock	Open	Readable / Writeable	Readable	Writeable
Power mode	Off	Readable / Writeable	Readable	N/A
MaxDTx (Maximum Daily Transmissions)	Off	Readable / Writeable	Readable	Writeable
EcoMode	On	Readable / Writeable	Readable	Writeable
Transmit interval (EcoMode off)	N/A	Readable / Writeable	Readable	Writeable
Message format	Standard (0x00)	Readable / Writeable	Readable	Writeable
SDC mode	N/A	Readable / Writeable	Readable	Writeable
SDC data	N/A	Readable / Writeable	Readable / Writeable	N/A
Factory reset	N/A	Writeable	N/A	N/A
Activation type	OTAA	Readable / Writeable	Readable	N/A
Join EUI	94193A0306000001	Readable / Writeable	Readable	N/A
Device address	N/A	Readable / Writeable	Readable	Writeable

Table 1. Configuration options

6.3.1 Downlink

CMa11L supports configuration via downlink, i.e. sending commands to an end-device via the LoRaWAN network. **Note that this feature should only be used sparingly due to bandwidth consideration.** Communication via downlink can only be made in a short window after an uplink transmission from sensor to server. Therefore, time-critical communication should not be performed over downlink.

Downlink are sent on **port 2,** structured according to the following format: *"0x00" "TLV" "Number of bytes in configuration" "Configuration".* For a complete description of all available downlink commands, see Table 2.

Field name	TLV	Number of bytes in configuration	Configuration	Example
Configuration lock	0x05	0x01	0x00 = Locked 0x01 = Open	0x00050101 (Enables configuration lock)
Transmit interval (only applies when EcoMode is inactive)	0x06	0x02	0xNumber of minutes between transmission (lsByte -> msByte)	0x0006021E00 (Sets the Tx interval to 30 minutes)
Message format	0x07	0x01	0x00 = Standard 0x01 = Compact 0x02 = JSON	0x00070101 (Sets the message format to compact)
SDC mode	0x08	0x01	0x00 = Disable SDC mode 0x01 = Enable SDC mode	0x00080100 (Disables SDC mode)
EcoMode	0x0F	0x01	0x00 = Disable EcoMode 0x01 = Enable EcoMode, 10 years 0x02 = Enable EcoMode, 6 years	0x000F0100 (Disables EcoMode)
MaxDTx	0x21	0x01	Maximum number of transmissions per day	0x00210118 (Limits the number of daily transmissions to 24)

Table 2: Downlink commands

6.4 Adaptive data rate (ADR)

CMa11L uses Adaptive Data Rate (ADR), part of the LoRaWAN standard, where the network server determines the optimal rate of communication for the sensor based on current signal conditions. In best case, the sensor will use its highest data rate (DR5) in order to be as energy efficient as possible. When signal conditions are poor, the network server will incrementally lower the data rate until it is able to receive the message. When the data rate is low, the energy consumption per telegram will increase.

6.5 Transmit interval

The transmit interval of CMa11L is set automatically via EcoMode or manually. You can also set an upper limit for the number of messages transmitted from the sensor each day by using the MaxDTx parameter.

6.5.1 EcoMode

When EcoMode is active, the sensor has an anticipated battery lifetime of 12 years.

When radio conditions are poor (and data rate is low), the sensor will send data less frequently to conserve battery-life. When signal conditions are good, the sensor will send data more frequently. When EcoMode is enabled, the sensor will continuously check if the set transmit interval is "allowed" by the EcoMode table. If a lower transmit interval is needed for the specific data rate to achieve 12 years of battery life, the sensor will adjust the parameter accordingly. See Table 3 the transmit interval allowed in each data rate.

Data rate	Transmit interval
DR0	120 minutes
DR1	60 minutes
DR2	30 minutes
DR3	20 minutes
DR4	15 minutes
DR5	10 minutes

Table 3. CMa11L Transmit Intervals in EcoMode

The anticipated 12-year battery-lifetime is calculated from the first activation of the sensor and applies to message format standard and compact. If EcoMode is disabled at any time, the anticipated 12-year battery life can no longer be assured.

6.5.2 MaxDTx

In some cases, it might be necessary to limit the number of daily transmissions that the sensor is allowed to send. This can be done by using the MaxDTx parameter. For example, by setting MaxDTx to "24", no more than 24 telegrams will be transmitted every day. These will be evenly distributed, so in this case the sensor will deliver hourly values. Table 4 provides a few examples.

MaxDTx configuration	Maximum number of transmissions
0	No limit
1	One per day
24	One per hour
48	One per 30 minutes
96	One per 15 minutes

Table 4. MaxDTx examples

6.6 SDC Data

The SDC data field can be used to write 4 ASCII characters to the sensor by the end-users. When SDC mode is enabled, a telegram will be sent to the receiving application each time a new value is written to the SDC data field. The SDC telegram is sent by confirmed uplink to enable the sensor to perform retries if data is not received. Up to three retries will be performed. When a value has been written to the SDC field, you can get information about the SDC telegram status via the "SDC status" field in the Elvaco OTC App. Table 5 provides a description of the possible states of the parameter.

State	Description
OK	The SDC telegram has been successfully received by the network server.
Failed	All four attempts to deliver the SDC telegram to the network server have failed.
Sending	The SDC telegram is currently being sent to the network server.

Table 5. SDC status parameter

6.7 Message formats

CMa11L has three different message formats: Standard, Compact and JSON. Each one will be described in detail in this section.

6.7.1 Message structure

Message formats *Standard and Compact* are encoded in M-Bus format (M-Bus standard EN 13757-3:2013). Message format JSON is encoded in JSON format.

All M-Bus encoded messages begin with one byte specifying the message format used. Then follows a sequence of data information blocks (DIBs), each one containing a data information field (DIF), a value information field (VIF) and a data field (DATA). The structure of the telegram is illustrated in Figure 6.

For message format *JSON*, the data is presented as plain text.
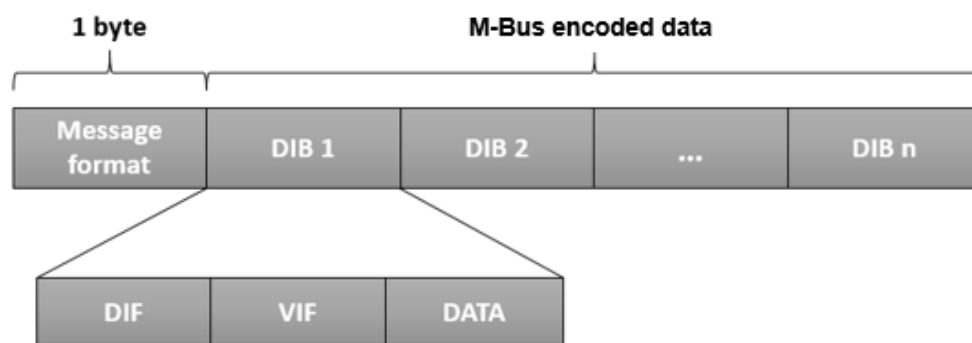
Figure 6: CMa11L M-Bus message structure

Field	Size	Description
Message format	1 byte	0x00 = Standard 0x01 = Compact 0x02 = JSON

Table 6: CMa11L Message formats

6.7.2 Structure and payload

In this section, a detailed description of each message format payload is provided. All numbers in the payload are given in hexadecimal unless otherwise stated.

6.7.2.1 Standard

Table 7 provides a detailed description of the payload of message format *Standard*.

Byte index	Data	Description
0	0x00	Message format standard
1	0x02	Instantaneous temperature DIF
2	0x65	Instantaneous temperature VIF, external temperature
3-4	0xnn nn	Instantaneous temperature x 100 °C In case of error the temperature will be set to -300.
5	0x01	Instantaneous relative humidity DIF
6	0xFB	Instantaneous relative humidity VIF, extension table FB
7	0x1B	Instantaneous relative humidity VIFE
8	0xnn	Instantaneous relative humidity %RH In case of error the relative humidity will be set to 200.
9	0x0F	End of standard M-Bus. Indicated that the rest of the telegram is manufacturer specific. **This byte is only included in the SDC telegram, i.e. in the first telegram sent when the SDC data field has been updated**.
10-13	0xnn nn nn nn	SDC data. **These bytes are only included in the SDC telegram, i.e. in the first telegram sent when the SDC data field has been updated**.

Table 7: Payload, message format Standard

6.7.2.2 Compact

Table 8 provides a detailed description of message format *Compact*.

Byte index	Data	Description
0	0x01	Message format standard
1-2	0xnnnn	Temperature x 100 °C, 2 decimals (lsByte -> msByte) In case of error the temperature will be set to -300.
3	0xnn	Relative humidity %RH In case of error the relative humidity will be set to 200.
(4-7)	0x nn nn nn nn	SDC data. **These bytes are only included in the SDC telegram, i.e. in the first telegram sent when the SDC data field has been updated**.

Table 8. Payload, message format Compact

6.7.2.3 JSON

In message format *JSON*, data is presented on a plain text format. Table 9 provides a description of message format JSON.

Field	Description	Data (examples)
Message ID	Message format JSON	0x02
Temperature	Temperature (°C)	"T":-10.20
Humidity	Relative Humidity	"H":100
SDC Data	When SDC data is available it is included in the telegram, otherwise not.	"S":1282364001

Table 9: Message format JSON

Examples of message format JSON payload:

Payload with SDC data:
027b2254223a32352e34312c2248223a34322c2253223a32303737313137355363135387d
gives the following JSON string: {"T":25.41,"H":42,"S":2071756158}

Payload without SDC data: 027b2254223a32352e35302c2248223a34327d
gives the following JSON string: {"T":25.50,"H":42}.

When data cannot be read from the sensor, the value null is used. Like {"T":null,"H":null}. Note that SDC data can still be transmitted in this case.

7 Troubleshooting

No telegrams are received from the sensor

Please verify that:

- The Application key, the Join EUI and the Device EUI of the sensor has been correctly registered in the network server.
- The sensor has been activated.
- The sensor is within range of the LoRaWAN gateway.
- The sensor is not mounted inside a metallic cabinet.
- The sensor is not disturbed by other radio equipment.

Temperature value is inaccurate

Although the temperature sensor is very accurate in normal cases, an incorrect positioning of the product can sometimes result in unintended temperature variations. When mounting the sensor, please verify that:

- The product is not mounted near any heat sources.
- The product is not mounted in direct sunlight.
- The product is not mounted in a spotlight beam.

8   Technical specifications

Type	Value	Unit	Comments
Mechanics			
Casing material	ABS UL94-V0	-	White
Protection class	IP30		
Dimensions (w x h x d)	80 x 80 x 25	mm	
Weight	75	g	
Mounting	Wall-mount	-	
Electrical connections			
Supply voltage	Battery (3.6 V)	-	Life span 12 years (when using EcoMode)
Environmental specifications			
Operating temperature	-20 to +55	ºC	
Operating humidity	0 to 100	% RH	No condensation
Operating altitude (max)	2000	m	
Usage environment	Indoors	-	
Storage temperature	-40 to +85	ºC	
Measurement range, temperature	-20 to +60	ºC	
Measurement range, humidity	0-100	% RH	
Radio characteristics			
Frequency	868	MHz	
Output power	14	dBm	
Receiver sensitivity	-135	dBm	
LoRaWAN characteristics			
Device class	Class A	-	Bi-directional
LoRa version	1.0.2 Rev B	-	
Activation	OTAA or ABP	-	
Data rate	DR0 - DR5	-	250 – 5470 bit/s
Temperature sensor, margin of error			
Temperature: +10 to +30 °C	+/- 0.2	°C	
Temperature: 0 to +10 °C	+/- 0.4	°C	
Temperature: -10 to +0 °C	+/- 0.5	°C	
Temperature: below -10 °C or above +30 °C	+/- 1.5	°C	

Humidity sensor, margin of error			
Repeatability RH	+/- 0.1	%RH	
Humidity: 10 to 90 %RH	+/- 2	%RH	
Humidity: below 10 %RH or above 90 %RH	+/- 4	%RH	
User Interface			
Green LED	Activation		
Red LED	Super-cap indicator		
Push button	Start-up/ reboot/ deactivate device		
Configuration	NFC via Elvaco OTC App or downlink		

9   Type approvals

CMa11L is designed to comply with the directives and standards listed below.

Approval	Description
EMC	EN 61000-6-2, EN 61000-6-3
LoRa Alliance®	LoRaWAN® Certified

10 Document history

10.1 Versions

Version	Date	Description	Author
V1.0	2019-04	First version	Anton Larsson
V1.1	2020-11	V1.1, Updated for FW 1.0.2	David Svensson

11 References

11.1 Terms and abbreviations

Abbreviation	Description
ABP	Activation by personalization
DIB	Data Information Block
DIF	Data Information Field
OTAA	Over-the-air activation
OTC	One-Touch Commissioning
PAK	Product Access Key
VIF	Value Information Field

11.2 Number representation

- Decimal numbers are represented as normal number, i.e. 10 (ten).
- Hexadecimal numbers are represented with prefix 0x, i.e. 0x0A (ten)
- Binary numbers are represented with prefix 0b, i.e. 0b00001010 (ten)
- Payload data follows the M-Bus Standard with the least significant byte (LSB) first

11.3 European Standards

[1] M-Bus standard EN 13757-3:2013 Communication systems for and remote reading of meters – Part 3: Dedicated application layer