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CMa20w Users Manual English

1050023-CMa20w Wireless M-Bus
Temp.sensor

The CMa20w is a wireless M-Bus communicating temperature and humidity sensor for outdoor use. CMa20w is the ideal product for temperature and humidity report of outdoor climate.

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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 therefore recommended that customers contact Elvaco AB for the latest product information before purchasing a CMa20w 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.

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2 Using this manual

2.1 Purpose and Audience

This manual covers the information needed to mount, configure and use the CMA20w, wireless M-Bus outdoor temperature and humidity sensor. It is intended for field engineers and developers.

2.2 Models

CMA20w

2.3 Additional and updated information

Latest documentation version is available on Elvaco web site at <http://www.elvaco.com>.

3 Introduction

3.1 Product configuration

Use the table below to find out the capabilities of your product.

Product name	Comments
CMA20w	Outdoor wireless M-Bus temperature and humidity sensor

Table 1 Product configuration

3.2 Capabilities

The CMA20w is a wireless M-Bus communicating temperature and humidity sensor for outdoor use. CMA20w is the ideal product for temperature and humidity report of outdoor climate. The high accuracy sensor and user friendly handling makes the CMA20w the perfect choice for outdoor climate logging.

3.3 Applications

The CMA20w should be used in the following scenarios:

- Outdoor measuring of temperature and/or humidity
- Attic monitoring of temperature and/or humidity
- Cellar monitoring of temperature and/or humidity
- Other harsh environment conditions

If measurement of temperature and humidity is needed for indoor use, please see Elvaco AB product CMA10 Indoor M-Bus temperature and humidity sensor.

4 Getting started

This chapter covers the steps required for getting the CMA20w installed and operational. No pre-configuration is needed before using the CMA20w.

The ID number (serial number) label is placed in the upper left corner of the PCB.

4.1 Overview

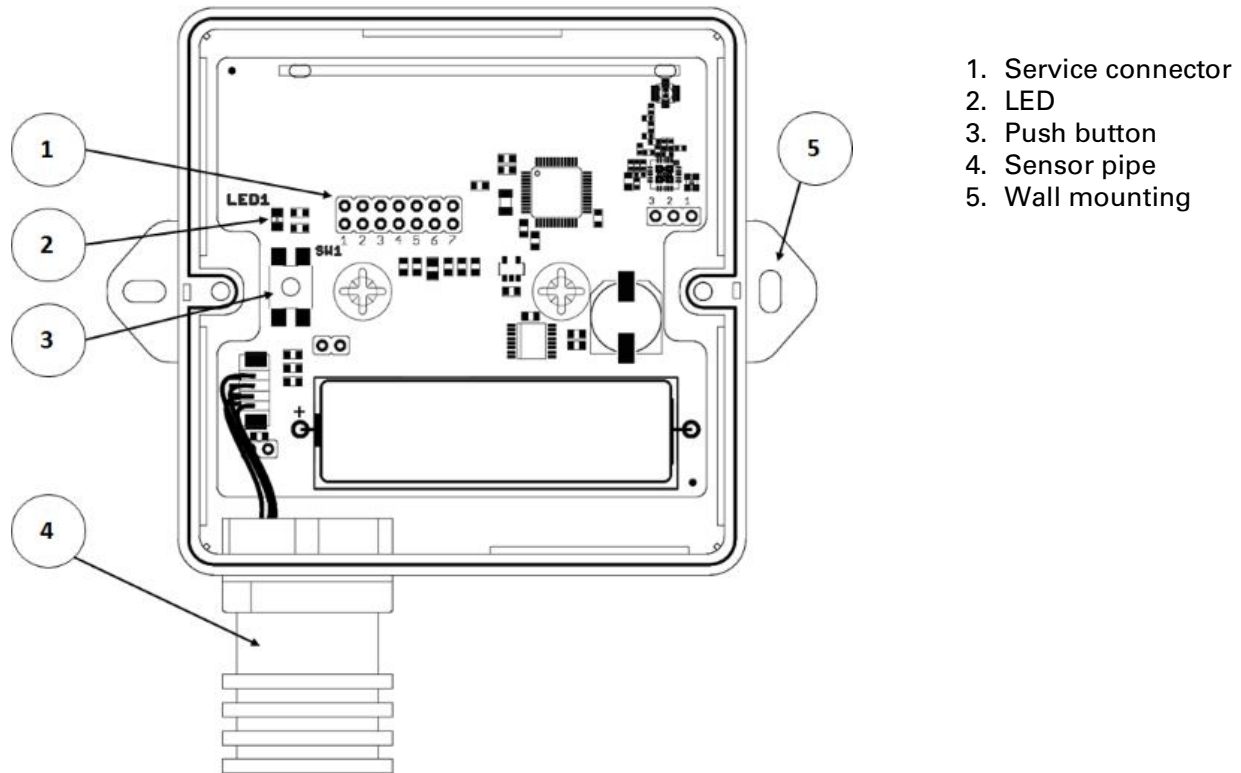
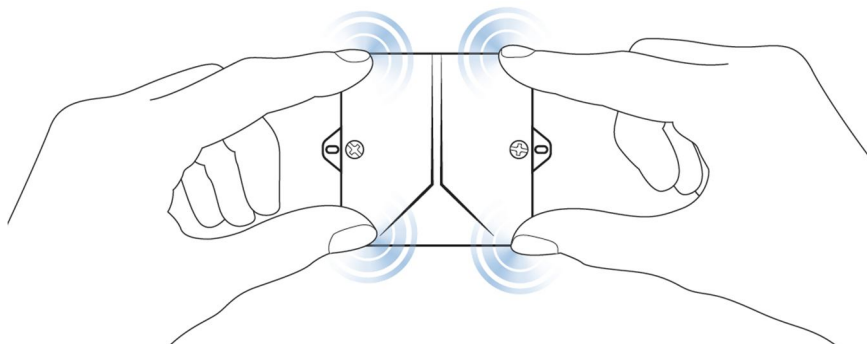


Figure 1 CMA20w Overview

4.2 Mounting

Mount the product in a weatherproof location to avoid that direct sunlight or rain affects the sensors. The product should be mounted straight vertically and horizontally with the sensor pipe (4) downwards. Use the holes (5) when mounting on wall.

IMPORTANT! To assure correct sealing when assembling the lid, **first fixate the lid by pressing on all 4 corners firmly** (see image below). The two screws are used to secure the lid once pressed into place, **don't use screws to put lid into place!**



4.2.1 Wireless M-Bus

The product is delivered with the radio turned off. The radio must be manually switched on during the installation procedure. The product will not be activated until the installation procedure is started.

5 Application description

This chapter covers general application description of the product.

5.1.1 Purpose

The product has two main purposes:

- Measure outdoor temperature at high precision via wireless M-Bus
- Measure outdoor humidity at high precision via wireless M-Bus

5.2 Operation

The product will automatically, after the installation procedure, send C1 messages every 3rd minute containing sensor data, such as instantaneous temperature and humidity. The telegrams are transmitted with M-Bus mode C1b (mode C1 with frame type B). The product will also send product status information, containing age indication of the battery and other relevant information.

The product has two operation modes:

1. Normal operation – unencrypted mode
2. Normal operation – encrypted mode

5.2.1 Normal operation – unencrypted mode

In normal operation unencrypted mode, the product will send unencrypted messages every 3rd minute. This mode is normally used when the master or AMR/AMM system does not handle AES encryption or if the AES key is unknown to the system.

The link layer address is composed of the manufacturer code "ELV", the 8-digit unique ID (serial number), a version number and a device type code "Room sensor" (0x1B). The telegram has a "short application header" (CI code = 0x7A) consisting of an ACC byte, a STATUS byte and a CONFIG word. No encryption key is needed to receive the unencrypted telegrams.

5.2.2 Normal operation – encrypted mode

Encrypted mode is similar to unencrypted mode, see 5.2.1 above, but adds an encryption on the application layer using encryption mode 5 (AES128 CBC mode with dynamic initialization vector according to the standard EN13757-4:2013).

Unencrypted and encrypted modes both use exactly the same link layer address and short application header except that the header CONFIG word is different due to the encryption. The product's unique 128-bit encryption key must be known to decrypt the encrypted telegrams.

5.3 Installation

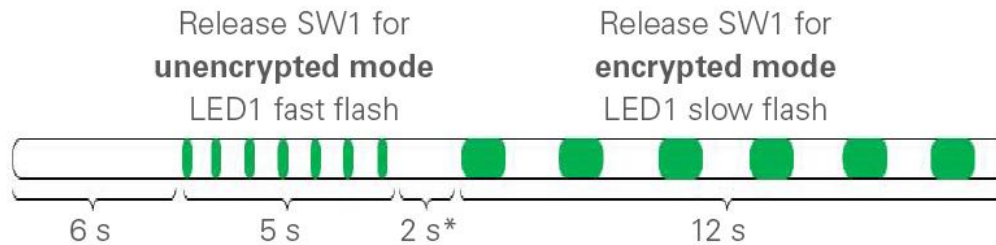
Selection of unencrypted or encrypted mode is made when the product is activated during installation. Please advise your project manager which operation mode is used in your project.

Product activation in unencrypted mode: Meter data is sent unencrypted and no encryption key is needed to decrypt the data.

1. Press and hold button (3) for 5-10 seconds until LED1 (2) flashes quickly.
2. Release button (3), the product is now activated and starts sending unencrypted telegrams.

Product activation in encrypted mode: Meter data is sent in encrypted mode and the encryption key is needed to decrypt the data.

1. Press and hold button (3) for 10-22 seconds, until LED1 (2) flashes slowly.
2. Release button (3), the product is now activated and starts sending encrypted telegrams.



* If the button is released in this mode, the CMA20w will return to inactive mode. This also applies if the button is pressed down for longer than 25 seconds.

⚠ IMPORTANT 1

Make sure that the product is activated by pressing the button (3) during normal operation. If the product is activated in unencrypted mode, LED will flash quickly 5 times. If the product is activated in encrypted mode, LED will be illuminated for 1 second.

⚠ IMPORTANT 2

During the first 24 hours after activation it is possible to change encryption mode between encrypted and unencrypted. See section "5.3 Installation" above.

5.4 LED-indications

When the CMA20w is activated (normal mode) and you push the switch, the LED will tell you which mode it is in.

For unencrypted mode, the LED will flash for 3 seconds.

For encrypted mode the LED will be illuminated (constant on) for 3 seconds.

6 Administration of the product

This chapter covers the configuration and wireless M-Bus implementation of the product. The wireless M-Bus slave implementation is according to the wireless M-Bus standard EN 13757-4:2013.

6.1 M-Bus product identification

The product can be identified by the following information:

- Manufacturer string = 0x1596 = "ELV"
- Version field = 2
- Device type field = 0x1B = "Room Sensor"

The version field of the link layer address reflects the telegram version and will be changed only if the contents of the wireless M-Bus telegram is changed in some way due to a new product/software release.

The actual software version number can be found in a dedicated record of the M-Bus telegram.

Wireless M-Bus mode

The product is using wireless M-Bus mode C1b, (i.e. mode C1 with frame type B), which means that the product sends spontaneous data in one direction, from product to collector.

6.2 Operation mode

The product can operate in encrypted or unencrypted mode. In encrypted mode, a 128 bit AES key is used for all telegrams.

6.3 Spontaneous transmission

After activation, the product will send spontaneous unidirectional SND-NR telegrams every 3rd minute (C-field = 0x44 = SND-NR = Send, No Reply").

6.3.1 Send data (SND_NR)

6.3.1.1 Unencrypted telegram

Unencrypted telegram as transmitted on-air:

Byte index	Data	Description
	0x55	preamble
	0x55	preamble
	0x55	preamble
	0x55	preamble
	0x54	sync word byte 0
	0x3D	sync word byte 1
	0x54	sync word byte 2
	0x3D	sync word byte 3
0	0x62	L-field = Number of bytes that follows, including CRC bytes

1	0x44	C-field = 0x44 = SND-NR
2	0x96	Byte 0 of manufacturer field, lsByte (0x1596 = "ELV")
3	0x15	Byte 1 of manufacturer field, msByte
4	0xnn	Byte 0 of ID field, packed BCD, the two lsDigits
5	0xnn	Byte 1 of ID field, packed BCD
6	0xnn	Byte 2 of ID field, packed BCD
7	0xnn	Byte 3 of ID field, packed BCD, the two msDigits
8	0xnn	Version field
9	0x1B	Device type field, 0x1B = Room sensor
10	0x7A	CI-field, 0x7A = short application layer header follows
11	0xnn	ACC, 0..255, incremented by 1 after each transmission
12	0xnn	STATUS, normally 0x00 (see note 1)
13	0x00	Byte 0 of CONFIG word, lsByte
14	0x20	Byte 1 of CONFIG word, msByte (see note 2)
15	0x2F	Decryption verification byte 1
16	0x2F	Decryption verification byte 2
17	0x02 (0x32)	DIF = 16-bit integer, instantaneous value, storage number 0 (see note 3)
18	0x65	VIF = "External temperature, unit is 0.01 centigrade"
19	0xnn	Byte 0 of current temperature, lsByte
20	0xnn	Byte 1 of instantaneous value, msByte
21	0x42 (0x72)	DIF = 16-bit integer, instantaneous value, storage number 1 (see note 3)
22	0x65	VIF = "External temperature, unit is 0.01 centigrade"
23	0xnn	Byte 0 of 1-hour average temperature, lsByte
24	0xnn	Byte 1 of 1-hour average temperature, msByte
25	0x82 (0xB2)	DIF = 16-bit integer, instantaneous value, storage number 2 (see note 3)
26	0x01	DIFE needed for storage number > 1
27	0x65	VIF = "External temperature, units is 0.01 centigrade"
28	0xnn	Byte 0 of 24-hour average temperature, lsByte
29	0xnn	Byte 1 of 24-hour average temperature, msByte
30	0x22 (0x32)	DIF = 16-bit integer, minimum value, storage number 0 (see note 3)
31	0x65	VIF = "External temperature, unit is 0.01 centigrade"
32	0xnn	Byte 0 of 1-hour minimum temperature, lsByte
33	0xnn	Byte 1 of 1-hour minimum temperature, msByte
34	0x12 (0x32)	DIF = 16-bit integer, maximum value, storage number 0 (see note 3)
35	0x65	VIF = "External temperature, unit is 0.01 centigrade"
36	0xnn	Byte 0 of 1-hour maximum temperature, lsByte
37	0xnn	Byte 1 of 1-hour maximum temperature, msByte
38	0x62 (0x72)	DIF = 16-bit integer, minimum value, storage number 1 (see note 3)
39	0x65	VIF = "External temperature, unit is 0.01 centigrade"
40	0xnn	Byte 0 of 24-hour minimum temperature, lsByte
41	0xnn	Byte 1 of 24-hour minimum temperature, msByte
42	0x52 (0x72)	DIF = 16-bit integer, maximum value, storage number 1 (see note 3)
43	0x65	VIF = "External temperature, unit is 0.01 centigrade"
44	0xnn	Byte 0 of 24-hour maximum temperature, lsByte

45	0xnn	Byte 1 of 24-hour maximum temperature, msByte
46	0x02 (0x32)	DIF = 16-bit integer, instantaneous value, storage number 0 (see note 3)
47	0xFB	VIF = use VIF extension table 0xFB
48	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
49	0xnn	Byte 0 of current relative humidity, lsByte
50	0xnn	Byte 1 of current relative humidity, msByte
51	0x42 (0x72)	DIF = 16-bit integer, instantaneous value, storage number 1 (see note 3)
52	0xFB	VIF = use VIF extension table 0xFB
53	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
54	0xnn	Byte 0 of 1-hour average relative humidity, lsByte
55	0xnn	Byte 1 of 1-hour average relative humidity, msByte
56	0x82 (0xB2)	DIF = 16-bit integer, instantaneous value, storage number 2 (see note 3)
57	0x01	DIFE needed for storage number > 1
58	0xFB	VIF = use VIF extension table 0xFB
59	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
60	0xnn	Byte 0 of 24-hour average relative humidity, lsByte
61	0xnn	Byte 1 of 24-hour average relative humidity, msByte
62	0x22 (0x32)	DIF = 16-bit integer, minimum value, storage number 0 (see note 3)
63	0xFB	VIF = use VIF extension table 0xFB
64	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
65	0xnn	Byte 0 of 1-hour minimum relative humidity, lsByte
66	0xnn	Byte 1 of 1-hour minimum relative humidity, msByte
67	0x12 (0x32)	DIF = 16-bit integer, maximum value, storage number 0 (see note 3)
68	0xFB	VIF = use VIF extension table 0xFB
69	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
70	0xnn	Byte 0 of 1-hour maximum relative humidity, lsByte
71	0xnn	Byte 1 of 1-hour maximum relative humidity, msByte
72	0x62 (0x72)	DIF = 16-bit integer, minimum value, storage number 1 (see note 3)
73	0xFB	VIF = use VIF extension table 0xFB
74	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
75	0xnn	Byte 0 of 24-hour minimum relative humidity, lsByte
76	0xnn	Byte 1 of 24-hour minimum relative humidity, msByte
77	0x52 (0x72)	DIF = 16-bit integer, maximum value, storage number 1 (see note 3)
78	0xFB	VIF = use VIF extension table 0xFB
79	0x1A	VIFE = "Relative humidity, unit is 0.1 percent"
80	0xnn	Byte 0 of 24-hour maximum relative humidity, lsByte
81	0xnn	Byte 1 of 24-hour maximum relative humidity, msByte
82	0x02	DIF = 16-bit integer, instantaneous value, storage number 0
83	0xFD	VIF = use VIF extension table 0xFD
84	0x1B	VIFE = "Digital inputs"
85	0xnn	Byte 0 of product status flags, lsByte (see note 4)
86	0xnn	Byte 1 of product status flags, msByte (see note 4)
87	0x0D	DIF = Variable length, instantaneous value, storage number 0
88	0xFD	VIF = use VIF extension table 0xFD

89	0x0F	VIFE = "Other software version"
90	0x05	LVAR = 5, length of ASCII string that follows
91	0x30	'0' "1.0.0" backwards according to M-Bus standard (!) Index 91 to 95 is an example of how it will look. The revision might be other than what is written here.
92	0x2E	','
93	0x30	'0'
94	0x2E	','
95	0x31	'1'
96	0x0F	End-of-telegram marker
97	0xnn	Byte 1 of CRC of frame type B, msByte
98	0xnn	Byte 0 of CRC of frame type B, lsByte

Note 1:

STATUS, which is normally 0x00, has two error flags in bits 2 and 3:
 Bit 2 = 1 (0x04) if the measured battery voltage drops under the low limit during transmission.
 Bit 3 = 1 (0x08) if there is an error in the temperature/humidity sensor (see also notes 3 and 4).

Note 2:

CONFIG word = 0x2000 if unencrypted.
 CONFIG word = 0x2560 if encrypted (application layer encryption mode 5, six encrypted 16-byte blocks).
 CONFIG bit 13 (SYNC) is always 1 to indicate that the product transmits synchronous telegrams according to the standard EN13757-4:2013.

Note 3:

In case of temperature/humidity sensor error, bits 4 and 5 of these DIFs are set to 1 to indicate "Value during error state". Bit 3 of STATUS will also be set to 1 and all temperature and humidity values will be cleared to zero (also see notes 1 and 4).

Note 4:

Product status flags:
 Bit 15: Toggles every hour (when the 24h min/max/average values have been updated)
 Bit 14: Toggles every 10 minutes (when the 1h min/max/average values have been updated)
 Bits 13..10: Unused, always 0
 Bits 9..8: Operating time since activation:

Bit 9	Bit 8	
1	1	Less than 10 years
1	0	10 to 11 years
0	1	11 to 12 years
0	0	More than 12 years

Bits 7..4: Telegram transmission interval in minutes, binary value 011 = 3 minutes.
 Bits 3..2: Unused, always 0
 Bit 0: 1 if sensor error (same as STATUS bit 3, see also notes 1 and 3)

6.3.1.2 Encrypted telegram

When encryption is enabled, a 9-byte extended link layer block is inserted at byte index 10..19. The application layer payload, from CI-field to the 0x0F end-of-telegram marker is encrypted. The CRC at the end of the telegram belongs to the link layer and is calculated after encryption.

Encrypted telegram as transmitted on-air:

Byte index	Data	Description
	0x55	preamble
	0x55	preamble
	0x55	preamble
	0x55	preamble
	0x54	sync word byte 0
	0x3D	sync word byte 1
	0x54	sync word byte 2
	0x3D	sync word byte 3
0	0x70	L-field = Number of bytes that follows, including CRC bytes
1	0x44	C-field = 0x44 = SND-NR
2	0x96	Byte 0 of manufacturer field, lsByte (0x1596 = "ELV")
3	0x15	Byte 1 of manufacturer field, msByte
4	0xnn	Byte 0 of ID field, packed BCD, the two lsDigits
5	0xnn	Byte 1 of ID field, packed BCD
6	0xnn	Byte 2 of ID field, packed BCD
7	0xnn	Byte 3 of ID field, packed BCD, the two msDigits
8	0xnn	Version field
9	0x1B	Device type field, 0x1B = Room sensor
10	0x7A	CI-field, 0x7A = short application layer header follows
11	0xnn	ACC, 0..255, incremented by 1 after each transmission
12	0xnn	STATUS, normally 0x00 (see note 1)
13	0x60	Byte 0 of CONFIG word, lsByte
14	0x25	Byte 1 of CONFIG word, msByte (see note 2)
15..110		Encrypted payload (same data as unencrypted byte index)
111	0xnn	Byte 1 of CRC of frame type B, msByte
112	0xnn	Byte 0 of CRC of frame type B, lsByte

7 Troubleshooting

7.1 The master does not receive any telegram from the product

Troubleshooting:

- Check that CMA20w has been activated (by pushing the button, see section 5.4 and 5.3).
- The master is out of range of the radio signal.
- The master's antenna is not optimally placed.
- The product is mounted in a metal cabinet or disturbed by other radio equipment.

7.2 Temperature value is inaccurate

The temperature sensor is very accurate, but incorrect positioning of the product may result in unintended temperature variation. Please take the following in consideration when mounting the product:

- Do not mount the product close to heat sources (front and rear).
- Do not mount the product in direct sunlight.

8 Technical specifications

8.1 Characteristics

Type	Value	Unit	Comments
Mechanics			
Casing material	Polystyrol	-	Light Grey
Protection class	IP65	-	
Dimensions	110x100x52	mm	
Weight	140	g	
Antenna wireless M-Bus	Internal	-	
Mounting	Wall mounted		
Electrical			
Power supply	Internal battery		
Power consumption	12	Years	
Environmental			
Operating temperature range	-20 to +45	°C	
Storage temperature range	-40 to +30	°C	
Operating humidity	0 to 95	%RH	No condensation
Temperature sensor			
Temperature range	-40 to +55	°C	
Temperature 0 to +55 °C	+/- 0.2	°C	
Temperature -20 to +0 °C	+/- 0.4	°C	
Humidity sensor			
Range	0 to 100	%RH	
Repeatability RH	+/- 0.1	%RH	
Humidity 10 to 90 %RH	+/- 2	%	
Humidity 0 to 100 %RH	+/- 4	%	
M-Bus			
M-Bus standard	EN 13757-4	-	Mode C1b
M-Bus commands	SND_NR	-	
Momentary values	Temperature , humidity, status	-	
Historic values	Average values for last hour and last day for temperature and humidity	-	

Transmit power	10	mW	
Frequency	868.95	MHz	Band

Table 2 Technical specifications

8.2 Factory defaults

Name	Value	Unit	Comments
Mode	Sleep		At delivery, the CMA20w is in sleep mode, where it does not consume any power, and does not transmit any data. It needs to be activated by pressing the button. After that it cannot go back to sleep mode again.

Table 3 Factory defaults

9 Type approvals

CMA20w is designed to comply with the directives and standards listed below.

Approval	Description
EMC	EN 61000-6-2, EN 61000-6-3

Table 4 Type approvals

10 Safety and environment

10.1 Safety precautions

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any CMA20w product. Users of the product are advised to convey the following safety 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 CMA20w is installed and used. They contain important information about how the product is used properly.

The installation of CMA20w 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 may not be changed, removed or made unrecognizable.

11 Document History

Version	Date	Description	Author
1.0	2015-08-13	First release	Nicklas Alnström
1.1	2016-02-11	Minor changes	Nicklas Alnström

11.1 Document software and hardware appliance

Type	Version	Date	Comments
Hardware	R1A	2015-08-13	
Software	1.0.0	2015-08-13	

12 References

12.1 References

- [1] EN-13757-1, EN-13757-2, EN-13757-3, EN-13757-4
Communication System for meters and remote reading of meters, Part1, Part2, Part3 and Part4
- [2] Open Metering System Specification – Volume 2 – Primary Communication, Issue 3.0.1/2011-01-29

12.2 Terms and Abbreviations

Abbreviation	Description
Product	In this document, CMA20w
DIF	Data Information Field (M-Bus data clock information)
VIF	Value Information Field (M-Bus value block information)
M-Bus slave	General in this document CMA20w

12.2.1 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)

13 Appendix A – Example

13.1 Denomination of values in reports

Denomination	Description
serial-number	M-Bus master id
device-identification	M-Bus slave id
created	Time stamp
value-data-count	Index at multiple telegram. Usually 0.
manufacturer	Manufacturer
version	Hardware version
device-type	M-Bus slave device type
access-number	Number of times the meter has been read
status	Status
signature	Reserved for future use
digital-input,,inst-value,0,0,0	
%rh ,,inst-value,0,0,0	Humidity, momentary value
%rh ,,min-value,0,0,0	Humidity, lowest value since reset
%rh ,,max-value,0,0,0	Humidity, highest value since reset
ext-temp,°c,inst-value,0,0,0	Temperature, momentary value
ext-temp,°c,min-value,0,0,0	Temperature, lowest value since reset
ext-temp,°c,max-value,0,0,0	Temperature, highest value since reset
avg-duration,hour(s),inst-value,0,0,0	Number of hours that average values have been collected
ext-temp,°c,inst-value,0,0,1	Temperature, 1-hour rolling average
ext-temp,°c,inst-value,0,0,2	Temperature, 24-hour rolling average
fabrication-no,,inst-value,0,0,0	Fabrication number
other-sw-version,,inst-value,0,0,0	Software version
manufacturer-specific,,inst-value,0,0,0	

13.2 Denomination of values for use in filters

Denomination	Description
mbus.dib.%rh.0.0.0.0	Humidity, momentary value
mbus.dib.%rh.0.0.0.2	Humidity, lowest value since reset
mbus.dib.%rh.0.0.0.1	Humidity, highest value since reset
mbus.dib.ext-temp.0.0.0.0	Temperature, momentary value
mbus.dib.ext-temp.0.0.0.2	Temperature, lowest value since reset
mbus.dib.ext-temp.0.0.0.1	Temperature, highest value since reset
Mbus.dib.avg-duration.0.0.0.0	Number of hours that average values have been collected
mbus.dib.ext-temp.0.1.0.0	Temperature, 1-hour rolling average
mbus.dib.ext-temp.0.2.0.0	Temperature, 24-hour rolling average
Mbus.dib.fabrication-no.0.0.0.0	Fabrication number