CMi6140
User's Manual
English
V1.4

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 CMi 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

1.2 Contacts

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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 CMi Series 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.

CMi6140 receives and transmits radio frequency energy while switched on. Remember that interference can occur if the product is used close to TV sets, radios, computers or inadequately shielded equipment. Follow any special regulations and always switch off the product wherever forbidden, or when you suspect that it may cause interference or danger.

The device or antenna of the product must not be mounted closer than 0.5 m from areas where people are staying permanently in order not to risk exposing people to RF fields.

To use the product's NFC functionality, follow the instructions issued by the manufacturer of the NFC reader for safe and efficient operation.

Ensure yourself that power supply and/or battery-unit connected to CMi6140 fulfil EN 62368-1 or equivalent safety standard.

For expected lifetime of a battery-operated device, configuration and settings must be approved by Elvaco and not changed during the lifetime of the device.

3 Using this manual

3.1 Purpose and audience

This manual provides all information needed to mount, deploy and configure CMi6140 and targets installers and system integrators.

This manual will provide device-specific information for CMi6140, such as status/configuration parameters and message formats, needed to integrate the module with a DM system and a receiving MDM server.

This manual is meant to be used along with the common "Elvaco NB-IoT Module Integrator's Manual", which provides information about the bootstrapping process, device management, data transport and encryption.

3.2 Online resources

To download the latest version of this user's manual, or to find information in other languages, please visit https://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 the meter connectivity module.

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

The following symbols are used to provide information on how the product should be used:

Symbol	Description
	Waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Contact your Local Authority for recycling advise.
	Electrostatic-sensitive device. Please observe the necessary ESD protective measures when installing the MCM.

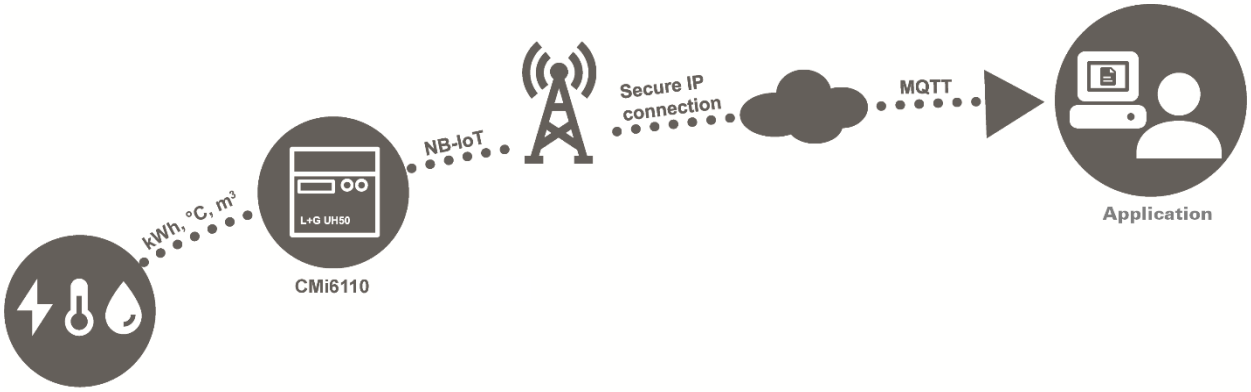
4 Introduction

4.1 Purpose

This chapter provides a general description of CMi6140. In the next-coming sections you will learn more about possible applications for the product and how CMi6140 can be combined with other products to build versatile solutions.

4.2 Application description

CMi6140 is a cost-effective NB-IoT meter connectivity module, which is mounted inside a Kamstrup MC403, MC603, MC803 heat/cold meter and calculator. As soon as the device has been mounted and commmisioned, it will start to deliver meter data to a receiving system via the NB-IoT (LPWAN) network. The product is ideal for applications where long range and high energy-efficiency are required and a lower bandwidth is not a concern.



4.3 Product features

Key features of CMi6140 include:

- **IoT-ready**
  As soon as the meter connectivity module has been mounted and started up, it will automatically initiate transmission of meter data without any manual steps needed. The CMi6140 is prepared for seamless integration with all leading IoT platforms.

- **Battery or mains supply operated**
  CMi6140 has several options for power supply. It can be battery operated for up to 10 years with daily transmission of meter data.

- **One-Touch Commissioning**
  The product uses the Elvaco One-Touch Commissioning (OTC) to configure and deploy products quickly and securely. Using the Elvaco OTC App, simply enter your desired settings and place your mobile phone on the Kamstrup MC403, MC603, MC803 meter. New settings will be applied instantaneously via NFC.

- **Flexible message scheme**
  CMi6140 has different message formats to choose from, which makes it easy to setup the device for your specific project.

4.4 Compatibility

CMi6140 is compatible with Kamstrup MC403, MC603, MC803. The power supply must be one of Kamstrup high power (230VAC or 24VAC/DC) or Kamstrup IoT-battery (D-, or C-cell).

5 Getting started

5.1 Purpose

This chapter provides instructions on how to get started with the CMi6140. After reading and carefully following each step of this chapter, the MCM will be mounted and deployed.

5.2 Product overview CMi6140

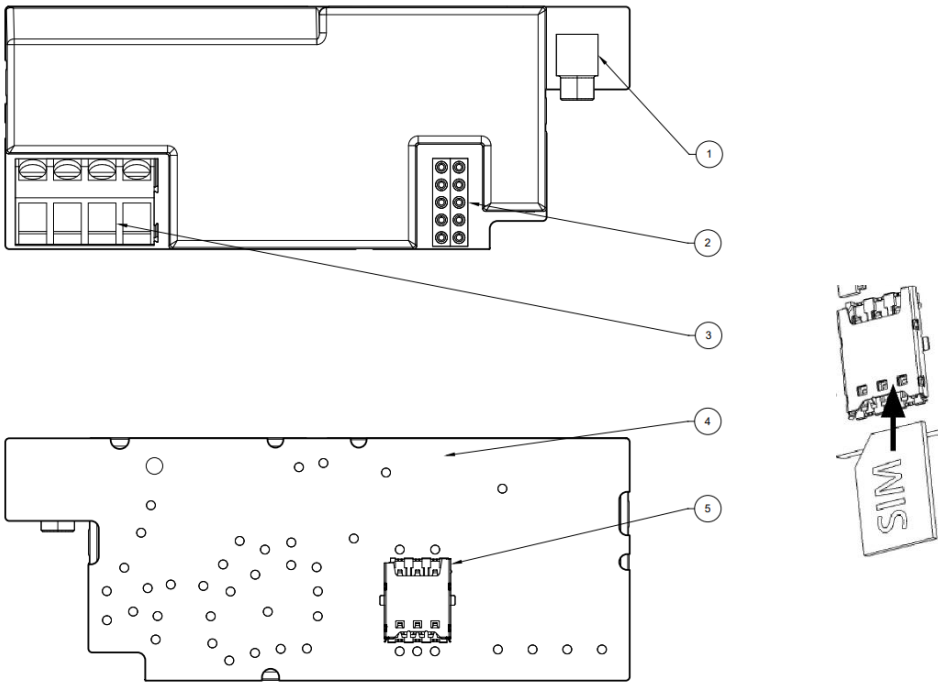


Figure 1. Product overview

1. Antenna Connector (MCX female)
2. Meter interface
3. Pules inputs
4. NFC Antenna
5. SIM (Nano)

5.3 Mount and start-up the device

To use CMi6140, a SIM card (size: Nano) needs to be mounted in the SIM card holder (5), see Figure 1. The module is thereafter mounted in module slot 1 or 2 of a Kamstrup MC403, MC603, or MC803, see Figure 2. Grab the module by the outer edges and gently press it into position. Make sure to connect external antenna to the module MCX antenna connector.

Figure 2. Mounting options

5.3.1 Start-up and LED indications

Module activation
Upon delivery, CMi6140 will be set to passive mode, which means that no messages will be transmitted from the module. Please make sure a SIM card (size: Nano) has been mounted before activating the module. There are two ways to activate the module:

1. **By using the meter front buttons.**
On MULTICAL® 403: press and hold both buttons on the front of the meter until "CALL" is displayed.

On MULTICAL® 603 and MULTICAL® 803: Press down the two arrow buttons on the front of the meter until "CALL" is displayed.

2. **By using the Elvaco OTC App**.

Open the Elvaco OTC app available in Google Play or App Store and scan the module (make sure NFC is activated on the phone). The NFC antenna of CMi6140 is best reached from backside of meter. This can result that the operator needs to dismantle the meter housing from the pie/wall mount to access the NFC antenna of CMi6140

Go to **Apply mode**, set the Power mode to "active" and click **Apply settings.** Place the phone next to the module. New settings are applied via NFC.

You can make sure that the module has joined the NB-IoT network correctly by checking the "connection" field in the Inspect tab of the OTC App. The mobile phone should vibrate three times. This indicates that settings have successfully been applied.

Read module status via meter display
In addition to the Elvaco OTC App, the status of the module can be read via the meter display.

To retrieve the status of the module via the meter display, enter the tech loop of the meter display and request the status information of the module. For detailed information, please refer to the Kamstrup MULTICAL Technical description. See Table 1 through Table 7 for information accessible in tech menu of the meter and how to interpret the status.

Main-menu	Sub-menu	View ID	Name	Purpose
1	0	31	Module type	Show module type and config
1	1	70	Network status	Show the status of the network connection
1	2	71	Bootstrap status	Show the status of the LwM2M Bootstrap connection
1	3	72	DM status	Show the status of the LwM2M DM connection
1	4	73	MDM status	Show the status of the MDM connection
1	5	74	Network condition - RSRP	Show RSRP value for last transmission
1	6	75	Network condition - RSRQ	Show RSRQ value for last transmission
1	7	76	Network condition - ECL	Show ECL value for last transmission

Table 1 Supported menus

Digit	Meaning	Comment
0-2	Datagram description	Hardcoded to 100
3-4	System configuration	Hardcoded to 00
5 - 6	Module type	Hardcoded to the value 57
7	Not used, left blank	

Table 2 Module type

Number	Meaning
0	Device is inactive, network is not used
1	Cannot read SIM
2	Attempting to register on the network
11111111	Successfully registered to the network

Table 3 Network status

Number	Meaning
0	Bootstrap not started
1	Bootstrapping
2	Bootstrap Failed
11111111	Device has bootstrapped

Table 4 Boostrap status

Number	Meaning
0	Device is inactive, network is not used
1	Device is configured to not use DM
11111111	Successfully registered to the DM server

Table 5 DM Status

Number	Meaning
0	Device is inactive, network is not used
1	Device is configured to not use separate MDM connection
2	Attempting to register to MDM server
3	Failed to register due to issues with encryption or communication timeout
4	Registration denied
5	Setting up DTLS
6	Connecting to MDM Server, such as MQTT-SN Gateway
11111111	Last meter data transport successful

Table 6 MDM Status

RSPR Menu
The RSRP is shown as a signed floating point value.

Example: -112.7 → -112.7 dBm

RSRQ Menu
The RSRQ is shown as a signed floating point value.

Example: -10.0 → -10.0 dB

Number	Meaning
0	ECL 0
1	ECL 1
2	ECL 2

Table 7 ECL Menu

5.3.2 Switch off/reboot module

To reboot the module, use the OTC app and follow the procedure of activation, but instead use the reboot switch and apply changes. This function is restricted to registered owner of the product in Elvaco OTC app and will not be visible/available for other users.

6 Integration guide

6.1 Purpose

This chapter provides the technical details needed to integrate an Elvaco NB-IoT module with a MDM (Meter Data Management) and/or DM (Device Management) server.

Note that this section will provide device-specific information and is meant to be used with the common "Elvaco NB-IoT MCM Integrator's guide".

6.2 Introduction

For device management, the module will act as a LwM2M device connecting to a LwM2M server. The Device Management system enables configuration and monitoring of a CMi6140 module remotely. This includes setting configuration parameters, update the firmware and trigger momentaneous/historical readouts of the module. For meter data transport, the module uses the MQTT-SN protocol.

Upon activation, the device will attempt to connect to its configured bootstrap server via the mobile (NB-IoT) network. When successful, the module will receive connection credentials, i.e. IP addresses to the DM server and the meter data server.

The module will thereafter connect to the DM server and perform a DTLS handshake to generate the session key used to encrypt the data that is transmitted between DM server and module if configured to do so.

The module will thereafter connect to the MQTT-SN gateway and perform a DTLS handshake to generate the sessions keys used to encrypt the session key used to encrypt the meter data transport if configured to do so.

Each module has a security chip where a device-unique set of keys are stored. These are provisioned to the module during production. The UDP transport of both DM and MDM can be secured using DTLS 1.2. Either the pre-provisioned keys can be used, or new keys can be provisioned during the bootstrap phase.

6.3 Status and configuration parameters

Table 8 below provides a list of all standard LwM2M status and configuration parameters available for CMi6140. Elvaco product specific LwM2M objects are listed in Table 9.

Standard LwM2M status and configuration parameters:

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
R	LwM2M Security	LWM2M Server URI	0/0/0	String		Bootstrap URI
R	LwM2M Security	Bootstrap server	0/0/1	Bool		TRUE
R	LwM2M Security	Security Mode	0/0/2	Integer	0..4	BS Security mode 0 = PSK mode 3 = No security
R	LwM2M Security	PSK Identity	0/0/3	Opaque		DevEUI
-	LwM2M Security	Secret Key	0/0/4	Opaque		Bootstrap PSK
R	LwM2M Security	Short Server ID	0/0/10	Integer	1..65534	
R	LwM2M Server	Short Server ID	1/0/0	Integer	1..65534	
R	LwM2M Server	Lifetime	1/0/1	Integer		
E	LwM2M Server	Bootstrap-Request Trigger	1/0/9			

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
R(W)	LwM2M Security	LWM2M Server URI	0/1/0	String		DM ServerURI Writable by Bootstrap server
R	LwM2M Security	Bootstrap server	0/1/1	Bool		FALSE
R(W)	LwM2M Security	Security Mode	0/1/2	Int	0..4	DM Security mode Writable by Bootstrap server
R	LwM2M Security	PSK Identity	0/1/3	Opaque		DM PSK identity (DevEUI)
(W)	LwM2M Security	Secret Key	0/1/4	Opaque		DM PSK Writable by Bootstrap server
R	LwM2M Security	Short Server ID	0/1/10	Integer	1..65534	
R	LwM2M Server	Short Server ID	1/1/0	Integer	1..65534	
R	LwM2M Server	Lifetime	1/1/1	Integer		DM lifetime
E	LwM2M Server	Registration Update Trigger	1/1/8			
R	Device	Manufacturer	3/0/0	String		Manufacturer ("Elvaco")
R	Device	Model Number	3/0/1	String		Product model ("CMi6140")
R	Device	Serial Number	3/0/2	String		DevEUI
R	Device	Firmware Version	3/0/3	String		Firmware version
E	Device	Reboot	3/0/4			Reboot
R	Device	Available Power Sources	3/0/6/0	Integer	0..7	Power source 1: Internal battery 2: External battery 6: AC (Mains) power
R	Device	Power Source Voltage	3/0/7/0	Integer		Power source voltage (Millivolt)
R	Device	Battery level	3/0/9		0..100	Battery level (in %)
R	Device	Error Code	3/0/11/0	0..8		Error codes, according to LwM2M 1
RW	Device	Current Time	3/0/13	Time		Current time
RW	Device	UTC Offset	3/0/14	String		UTC Offset UTC+X (ISO 8601)
R	Device	Hardware version	3/0/18	String		Hardware version
R	Connectivity Monitoring	Network Bearer	4/0/0	Integer	0..50	7 = NB-IoT
R	Connectivity Monitoring	Available Network Bearer	4/0/1/0	Integer	0..50	7 = NB-IoT
R	Connectivity Monitoring	Radio Signal Strength	4/0/2	Integer		RSRP (NRSRP)
R	Connectivity Monitoring	APN	4/0/7/0	String		APN
R	Connectivity Monitoring	Cell ID	4/0/8	Integer		Cell ID

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
R	Connectivity Monitoring	SMNC	4/0/9	Integer	0..999	MNC PLMN = SMNC + SMCC
R	Connectivity Monitoring	SMCC	4/0/10	Integer	0..999	MCC PLMN = SMNC + SMCC
W	Firmware Update	Package URI	5/0/1			Firmware Update URI
E	Firmware Update	Update	5/0/2			Firmware Update Trigger
R	Firmware Update	State	5/0/3	Integer	0..3	Firmware Update Status 0: Idle 1: Downloading 2: Downloaded 3: Updating
R	Firmware Update	Update result	5/0/5	Integer		Firmware Update Result
R	Firmware Update	Firmware Update Protocol Support	5/0/8/0	Integer	0..5	0 = CoAP
R	Firmware Update	Firmware Update Delivery Method	5/0/9	Integer	0..2	0 = Pull only
'R	LwM2M Cellular Connectivity	PSM Timer	10/0/4	Integer		NB-IoT T3412. .
R	LwM2M Cellular Connectivity	Active Timer	10/0/5	Integer		NB-IoT T3324.
R	LwM2M Cellular Connectivity	eDRX parameters for NB-S1 mode	10/0/9	Opaque	8 bit	NB-IoT eDRX.
R	LwM2M Cellular Connectivity	Activated Profile names	10/0/11	ObjLink		Link to APN Connection Profile object
RW	LwM2M APN Connection Profile	Profile name	11/[0,1]/0	String		
RW	LwM2M APN Connection Profile	APN	11/[0,1]/1	String		Manual APN Writable in object resource 1.
RW	LwM2M APN Connection Profile	Auto select APN by device	11/[0,1]/2	Boolean		Auto APN Mode Writable in object resource 1.
RW	LwM2M APN Connection Profile	Authentication Type	11/[0,1]/4	Integer	0..3	3 = None, Writing currently not supported

Table 8: Standard LwM2M objects

Elvaco product specific LwM2M objects:

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
RW	Elvaco MCM Config	Meter Readout Interval	33906/./0	Integer		Interval in minutes
RW	Elvaco MCM Config	Report data encoding	33906/./1	Integer		0 = SenML/CBOR 1 = JSON 2 = MBus

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
RW	Elvaco MCM Config	Report frame type	33906/./2	Integer		66:Standard 67:Extended 68:Combined 69:Pulse
RW	Elvaco MCM Config	Eco mode enabled	33906/./3	Boolean		
RW	Elvaco MCM Config	NFC Enabled	33906/./4	Boolean		
R	Elvaco MCM Config	NFC Config-locked	33906/./5	Boolean		
W	Elvaco MCM Config	Adjust time	33906/./6	Integer		Adjustment in seconds
E	Elvaco MCM Config	Instantaneous readout trigger	33906/./10			Trigger a meter readout.
E	Elvaco MCM Config	Historic resend trigger	33906/./13			Trigger upload of all historic data
R	Elvaco MCM Config	Historic resend status	33906/./14	Integer		Number of messages in uplink queue
E	Elvaco MCM Config	Apply APN staging profile	33906/./15			Apply APN staging profile.
R	Elvaco MCM Config	Config write status	33906/./16	Boolean		Result of last config write to flash
RW	Elvaco MCM Config	Meter Report Interval	33906/./17	Integer		Interval in minutes
RW	Elvaco MCM Config	Meter Transmit Interval	33906/./18	Integer		Interval in minutes
RW	Elvaco MCM Config	Meter Transmit Offset	33906/./19	Integer		Offset in minutes
RW	Elvaco MCM Config	Meter Transmit Delay	33906/./20	Integer		Delay in minutes
RW	Elvaco MCM Config	Meter Uploads Per Tx	33906/./21	Integer		Max number of messages per tx interval
RW	Elvaco MCM Config	DTLS Min Timeout	33906/./22	Integer		Timeout in seconds
RW	Elvaco MCM Config	DTLS Max Timeout	33906/./23	Integer		Timeout in seconds
RW	Elvaco MCM Config	MQTT-SN Communication Timeout	33906/./24	Integer		Timeout in seconds
RW	Elvaco MCM Config	MQTT-SN Communication Attempts	33906/./25	Integer		Total number of attempts
RW	Elvaco MCM Config	MQTT-SN Register Timeout	33906/./26	Integer		OBSOLETE! Timeout in seconds
RW	Elvaco MCM Config	MQTT-SN Register Attempts	33906/./27	Integer		OBSOLETE! Total number of attempts
RW	Elvaco MCM Config	MQTT-SN Publish Timeout	33906/./28	Integer		OBSOLETE! Timeout in seconds
RW	Elvaco MCM Config	MQTT-SN Publish Attempts	33906/./29	Integer		OBSOLETE! Total number of attempts
RW	Elvaco MCM Config	CoAP ACK Timeout	33906/./30	Integer		Timeout in seconds
RW	Elvaco MCM Config	CoAP Max Retransmit	33906/./31	Integer		Number of retransmissions

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
RW	Elvaco MCM Config	IOWA DTLS Min Timeout	33906/./32	Integer		Timeout in seconds
RW	Elvaco MCM Config	IOWA DTLS Max Timeout	33906/./33	Integer		Timeout in seconds
RW	Elvaco MCM Config	IOWA Communication Retry Count	33906/./34	Integer		Number of retries
RW	Elvaco MCM Config	IOWA Communication Retry Delay	33906/./35	Integer		Delay in seconds
RW	Elvaco MCM Config	IOWA Communication Sequence Retry Count	33906/./36	Integer		Number of retries
RW	Elvaco MCM Config	IOWA Communication Sequence Retry Delay	33906/./37	Integer		Delay in seconds
RW	Elvaco MCM Config	Network Connection Maximum Hold-off	33906/./38	Integer		Delay in seconds
RW	Elvaco MCM Config	Network Search Period	33906/./39	Integer		Period in seconds
RW	Elvaco MCM Config	Modem Restart Back-off Intervals	33906/./40	String		min0-max0,min1-max1,... in minutes
RW	Elvaco MCM Config	MDM Re-connect Back-off Intervals	33906/./41	String		min0-max0,min1-max1,... in minutes
RW	Elvaco MCM Config	LwM2M Resume Back-off Intervals	33906/./42	String		min0-max0,min1-max1,... in minutes
RW	Elvaco MCM Config	Meter Max Retry Count	33906/./43	Integer		Max number of retries when meter communication fails
RW	Elvaco MCM Config	Auto Upload Age Limit	33906/./44	Integer		Max age in minutes of unsent measurements to upload
RW	Elvaco MCM Config	Auto Upload Order	33906/./45	Integer		In what order should unsent measurements be uploaded. 0 = FIFO, 1 = LIFO.
RW	Elvaco MCM Config	Time Sync Source	33906/./46	Integer		Which source to use for time synchronization. 0 = Manual, 1 = Network.
RW	Elvaco MCM Config	MDM Communication Failures	33906/./47	Integer		Maximum number of failures before connection is considered broken.

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
RW	Elvaco MCM Config	Upload Protocol	33906/./48	Integer	0..1	Protocol to use for meter data upload 0 = MQTT-SN 1 = LwM2M
RW	Elvaco MCM Config	Use PSM	33906/./49	Integer	0..3	Power saving mode: 0 = Disabled, 1 = eDRX, 2 = PSM, 3 = PSM + eDRX
RW	Elvaco MCM Config	eDRX Mode	33906/./50	Integer	0..1	eDRX mode: 0 = Automatic, 1 = Manual
RW	Elvaco MCM Config	Enable RAI	33906/./51	Integer	0..1	Enable RAI: 0 = RAI Disabled, 1 = RAI=2 for MQTT-SN QoS=1
RW	Elvaco MCM Config	Power Source	33906/./52	Integer	0..1	Configuration value for power source. Used when hardware unit cannot determine source. 0 = Battery, 1 = PSU
RW	Elvaco MCM Config	NB-IoT Radio Bands	33906/./53	String		NB-IoT Radio Bands to use: band0,band1,...
RW	Elvaco MDM Server	URI	33905/./0	String		URI to the meter data server
RW	Elvaco MDM Server	Protocol	33905/./1	Integer	0..	0 = MQTT-SN
RW	Elvaco MDM Server	Transport Security Mode	33905/./2	Integer	0..4	0 = PSK mode 3 = No security
W	Elvaco MDM Server	Transport Secret Key	33905/./5	Opaque		Key to use with the selected security mode
RW	Elvaco MDM Server	Connection config	33905/./10	Integer	0..1	0 = Optimized 1 = Compliant
RW	Elvaco MDM Server	Topic	33905/./11	String		MQTT-SN topic
R	Elvaco Meter Data	Message Type	33911/./0	Integer		
R	Elvaco Meter Data	Message Encoding	33911/./1	Integer		
R	Elvaco Meter Data	Message Data	33911/./2	Opaque		
R	Elvaco Meter Info	Meter Model	33908/./0	String		User-friendly string
R	Elvaco Meter Info	Meter ID	33908/./1	Integer		
R	Elvaco Meter Info	Communication status	33908/./2	Integer	0..2	0 = OK 1 = No meter detected 2 = Error
R	Elvaco Meter Info	Error flags	33908/./3	Opaque		

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
R	Elvaco NB-IoT info	IMSI	33909/./0	Integer		International mobile subscriber identity
R	Elvaco NB-IoT info	ICCID	33909/./1	String		Integrated circuit card identifier
R	Elvaco NB-IoT info	Registrations	33909/./2	Integer		Number of network registrations done
R	Elvaco NB-IoT info	Last registration duration	33909/./3	Integer		Duration in seconds
R	Elvaco NB-IoT info	Modem model	33909/./4	String		
R	Elvaco NB-IoT info	Modem firmware	33909/./5	String		
R	Elvaco NB-IoT info	Registration uptime	33909/./6	Integer		Last network registration uptime in seconds
R	Elvaco NB-IoT status	Uptime	33907/./0	Integer		Uptime in seconds
R	Elvaco NB-IoT status	Average current consumption	33907/./1	Integer		Consumption in uA (micro-amps)
R	Elvaco NB-IoT status	Network classification	33907/./2	Integer		0 = Excellent 1 = Good 2 = Fair 3 = Poor
R	Elvaco NB-IoT status	ECL	33907/./3	Integer	0..2	
R	Elvaco NB-IoT status	RSSI	33907/./4	Integer		In tenths of dBm
R	Elvaco NB-IoT status	SNR	33907/./5	Integer		In tenths of dB
R	Elvaco NB-IoT status	MDM connection status	33907/./10	Integer	0..5	0 = OK 1 = Connecting 2 = No credentials 3 = DTLS failed 4 = Communication failed 6 = Socket failed 7 = Idle
R	Elvaco NB-IoT status	Current radio band	33907/./11	Integer	0..85	Current radio band id
E	Elvaco Transaction statistics	Reset statistics	33910/./0			Resets statistics for what this object instance is tracking.
R	Elvaco Transaction statistics	Transactions	33910/./1	Integer		Number of transactions.
R	Elvaco Transaction statistics	Retransmissions	33910/./2	Integer		Number of retransmissions.
R	Elvaco Transaction statistics	Lost transactions	33910/./3	Integer		Number of lost transactions.
R	Elvaco Transaction statistics	Average response time	33910/./4	Integer		
R	Elvaco Transaction statistics	Minimum response time	33910/./5	Integer		

Op.	LwM2M object	LwM2M resource	ID	Type	Range or Enumeration	Comment
R	Elvaco Transaction statistics	Maximum response time	33910/./6	Integer		

Table 9: Elvaco and product specific LwM2M objects

6.3.1 Kamstrup MC403, MC603, MC803 error codes

Table 10 lists error codes, or info codes, for Kamstrup MC403/603/803. It is a verbatim copy from Kamstrup document "Kamstrup Meter Protocol" version AB1, section 6.4. The same information is publicly available on Kamstrup's website.

Bit	Display	Description	403	603	803
0	10000000	Power off	✓	✓	✓
1	20000000	Low battery	✓	✓	✓
2	90000000	External alarm (i.e. via KMP)	✓	✓	✓
3	01000000	t1 above range or disconnected	✓	✓	✓
4	00100000	t2 above range or disconnected	✓	✓	✓
5	02000000	t1 below range or short circuited	✓	✓	✓
6	00200000	t2 below range or short circuited	✓	✓	✓
7	09900000	Wrong dt (t1-t2)	✓	✓	✓
8	00003000	V1 air	✓	✓	✓
9	00004000	V1 reverse	✓	✓	✓
10	00005000	V1 low signal	✓	✓	✓
11	00006000	V1 > qs for more than 1 hour	✓	✓	✓
12	00000080	InA water system leak	✓	✓	✓
13	00000008	InB water system leak	✓	✓	✓
14	00000090	InA external alarm	✓	✓	✓
15	00000009	InB external alarm	✓	✓	✓
16	00001000	V1 com. error	✗	✓	✓
17	00002000	V1 pulse error	✗	✓	✓
18	00000070	InA2 water system leak	✗	✓	✓
19	00000007	InB2 water system leak	✗	✓	✓
20	00010000	t3 or t4 above range or disconnected	✗	✓	✓
21	00020000	t3 or t4 below range or short circuit	✗	✓	✓
22	00000100	V2 com. error	✗	✓	✓
23	00000200	V2 pulse error	✗	✓	✓
24	00000300	V2 air	✗	✓	✓
25	00000400	V2 reverse	✗	✓	✓
26	00000500	V2 low signal	✗	✓	✓
27	00000600	V2 > qs for more than 1 hour	✗	✓	✓
28	00007000	V1V2 Burst Out	✗	✓	✓
29	00000700	V1V2 Burst In	✗	✓	✓
30	00008000	V1V2 Leak Out	✗	✓	✓
31	00000800	V1V2 Leak In	✗	✓	✓
>=32	????????	Reserved	✗	✗	✗

Table 10: Kamstrup error codes (info codes)

6.4 Changing APN via the DM system

Since changing APN is a potentially hazardous operation that may render the device disconnected from the mobile network, there is a rollback functionality in place when changing the APN.
To change APN, write the APN to the resource /10/1/1 and set APN mode to manual in /10/1/2. Once done, stage the changes by executing /33906/0/15. When executed, the device will reset and try to use the new APN. If the device manages a successful bootstrapping, the new APN will be saved as the default. If a successful bootstrapping has not happened for some time, the device will roll back to the old APN and reset again.

7 Administration reference

7.1 Purpose

This chapter contains detailed information about configuring options for CMi6140.

7.2 Security and access control

CMi6140 has a configuration lock feature, which prevents unauthorized access to the module. When configuration lock has been enabled, a Product Access Key (PAK) will be needed to access the device via NFC. The Product Access Key is claimed by the end-user to his One-Touch Commissioning (OTC) account via the Elvaco OTC App or the OTC web interface.

Note that the default setting of the CMi6140 is **Open**, meaning the user must set it to **Lock** to activate the configuration lock. In section 7.5, all default configurations are listed.

7.3 Scheduling readouts / transmissions

A Readout refers to a readout of meter data and storing the information locally in the device memory.

A Transmission refers to a sending a set of readouts from the device over NB-IoT network to a LWM2M or MQTT-SN server.

A combination of above is set to achieve the functionality specified by the project/customer.

7.3.1 Time handling

The module relies on the meter's clock for keeping time. Time in the meter is assumed to be in standard local time (no DST). When synchronizing time in the meter using the OTC App or network time. Local standard time is always used, even if DST is in effect. The timestamped meter data sent from the module can be adjusted to be sent in UTC by specifying the "UTC offset" configuration parameter. The UTC offset will be subtracted from the timestamp prior to transmission. If the meter is in Sweden, which uses CET (Central European Time), it should have UTC offset set to +60 (+1h). In this case at time 12.00 a telegram is sent with timestamp 11.00 as this is the corresponding UTC time. A meter in New York (USA) should have a UTC offset of -300 (-5h) etc. A UTC offset of 0 means the meter time is used as-is.

7.3.2 Synchronization

All schedules are based on a synchronization with a clock. That means that if a readout schedule of 60 minutes is used, it is synchronized on top of the hour, so 11:00, 12:00, 13:00 etc. 120 minutes will give 12:00, 14:00, 16:00 etc.

When time in the module (or meter) is synchronized a rescheduling takes place such that the next meter readout is made according to an updated time.

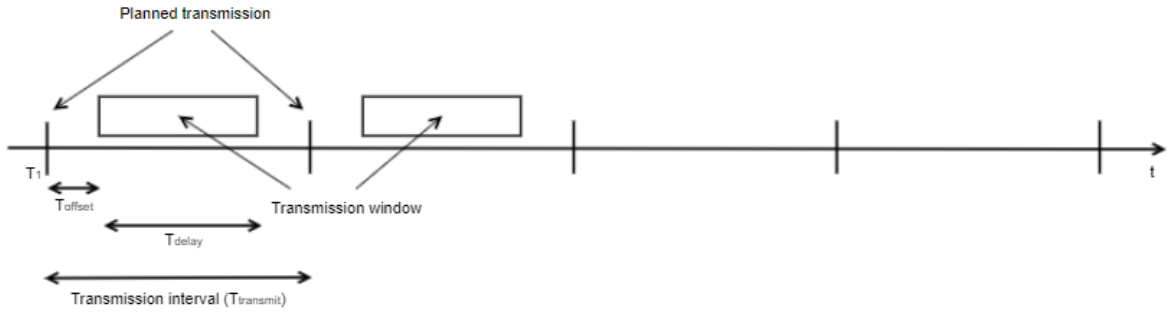
To handle the case where time synchronization "moves time" past a previously planned readout (like 23.58 → 00.02) the module will always make a readout and transmission of a new value when time is synchronized. The device will therefore send an additional readout which can be masked on the server-side.

7.3.3 Randomized transmissions

In order to prevent a large population of devices from transmitting data at exactly the same time the devices should have a random delay before transmitting data. The delay should be configurable via NFC/DM.
Readouts from the meter are always performed on top of the hour, 11.00, 13.00 etc. Transmissions can be carried out at other times but are *planned* at full hours given a set *transmission interval* ($T_{transmit}$). The figure below illustrates this. The transmissions are planned at time T_1. The actual $T_{transmit}$ is a random time

between (T_1 + T_{offset}) and (T_1 + T_{offset} + T_{delay}).
$T_{transmit}$, T_{offset} and T_{delay} are parameters in the product.
Conditions

- T_{offset} + T_{delay} <= $T_{transmit}$
    - This should be checked by the device and the OTC App.
- If $T_{transmit}$ is reduced below T_{offset} + T_{delay}, then T_{offset} is set to 0 and T_{delay}.= $T_{transmit}$.



7.3.4 Data retransmission

If data cannot be sent, due for instance to network issues, there will be a number of retries after which the device will give up and leave the readout as "unsent" in its storage. Next time a transmission is attempted unsent data will be resent (if possible). Retransmission can be done by FIFO or LIFO.

Rules for retransmissions include maximum age of data, order of data, number of retransmitted data / transmission interval,

Example 1

A device is configured the following way:

- Message encoding: M-Bus
- Auto upload order: FIFO
- Measurement interval: 60 minutes
- Transmit interval: 60 minutes
- Transmit offset: 15 minutes
- Transmit delay: 30 minutes
- Maximum uploads per transmission: 4
- Upload maximum age 72h

A network issue caused the module to be offline for 5 days, while still reading and storing measurement data. When the device manages to go online the following scenario takes place.

- The device will start by transmitting measurement data that is 3 days old (FIFO order)
- The device will send 4 measurement telegrams per hour, at a randomly chosen time between minute 15 and 45
- Each telegram contains a single readout, totaling 4 readouts per transmission
- The device will take approximately 1 day to "catch up" and start sending one measurement per hour

Example 2

A device is configured the following way:

- Message encoding: SenML/CBOR/M-Bus
- Auto upload order: FIFO
- Measurement interval: 60 minutes
- Transmit interval: 60 minutes
- Transmit offset: 15 minutes
- Transmit delay: 30 minutes
- Maximum uploads per transmission: 4
- Upload maximum age 72h

A network issue caused the module to be offline for 5 days, while still reading and storing measurement data. When the device manages to go online the following scenario takes place.

- The device will start by transmitting measurement data that is 3 days old (FIFO order)
- The device will send 4 measurement telegrams per hour, at a randomly chosen time between minute 15 and 45
- Each telegram contains 12 meter readouts, totaling 4 x 12 = 48 readouts per transmission
- The device will take approximately 2 hours to "catch up" and start sending one measurement per hour

7.4 Meter data transmissions

CMi6140 sends meter data messages according to its transmit interval settings. Meter read out is always related to meter's clock at time 00:00:00. Transmission time is randomized between read outs.

The user can customize the data sent from the module by configuring **message format** and **encoding** of the telegram.

7.4.1 Message formats

CMi6140 has four different message formats, Standard, Extended, Combined and Pulse. By selecting message format, the user can decide which meter registers to include in the telegram.

In message format Standard, all meter registers in Table 11 is included in the telegram. For message format Extended, all meter registers of Table 11 and Table 12 will be included in the message. Message format Combined, is covered in Table 13, and Pulse in Table 14.Below each message format table, the same message format but in JSON encoding is displayed.

Standard: Message format ID 66

Field		Description		
Date and Time (see Note 1)		6	INT32	Date and Time (Type F), Example: 046Dxxxxxxxx M-Bus Format F for Date & Time
Meter ID (see Note 1) (see Note 2)		6	BCD8	According to M-Bus EN13757-3 identification field e.g. 0C78xxxxxxxx
Energy		6-7	INT32	Example: 0406xxxxxxxx, 040Fxxxxxxxx
Volume		6	INT32	Example: 0413xxxxxxxx

Field		Description		
Power		4	INT16	Example: 022Bxxxx
Flow		4	INT16	Example: 023Bxxxx
Fw temp		4	INT16	Example: 025Axxxx
Rt temp		4	INT16	Example: 025Exxxx
Info codes		7	INT32	Error and warning flags Example: 04FD17xxxx Note that this field is always 32 bits, even when using MultiCal 403 which only reports 16 bits.

Table 11: Meter registers, standard message

JSON

{"TS":"2022-07-01T13:40:10Z","ID":72591526,"E":0,"U":"kWh","V":0,"VU":"l","P":0,"PU":"W","F":0,"FU":"l/h",
"FT":26.11,"TU":"C","RT":26.43,"RU":"C","EF":"0x00000100"}

Extended: Message format ID: 67

Field		Description		
Date and Time (see Note 1)		6	INT32	Date and Time (Type F), e.g. 046Dxxxxxxxx M-Bus Format F for Date & Time
Meter ID (see Note 1) (see Note 2)		6	BCD8	According to M-Bus EN13757-3 identification field e.g. 0C78xxxxxxxx
Energy		6-7	INT32	Example: 0406xxxxxxxx, 040Fxxxxxxxx
Volume		6	INT32	Example: 0413xxxxxxxx
Tariff 2 Energy		8	INT32	Example: 842003xxxxxxxx
Tariff 3 Energy		8	INT32	Example: 843003xxxxxxxx
Power		4	INT16	Example: 022Bxxxx
Flow		4	INT16	Example: 023Bxxxx
Fw temp		4	INT16	Example: 025Axxxx
Rt temp		4	INT16	Example: 025Exxxx
Info codes		7	INT32	Error and warning flags Example: 04FD17xxxx Note that this field is always 32 bits, even when using MultiCal 403 which only reports 16 bits.

Table 12: Meter registers, extended message

JSON

{"TS":"2022-07-01T14:17:36Z","ID":72591526,"E":0,"U":"kWh","V":0,"VU":"l",
"T2":0,"U2":"kWh","T3":0,"U3":"kWh","P":0,"PU":"W","F":0,"FU":"l/h",
"FT":26.25,"TU":"C","RT":26.50,"RU":"C","EF":"0x00000100"}

Pulse: Message format ID 68

Field		Description		
Date and Time (see Note 1)		6	INT32	Date and Time (Type F), e.g. 046Dxxxxxxxx M-Bus Format F for Date & Time
Meter ID (see Note 1) (see Note 2)		6	BCD8	According to M-Bus EN13757-3 identification field e.g. 0C78xxxxxxxx
Energy E1		6-7	INT32	Heat energy Example: 0406xxxxxxxx, 040Fxxxxxxxx
Energy E3		6-7	INT32	Cooling energy Example: 0483FF02xxxxxxxx = xxxxxxxx Wh
Energy E8		7	INT32	Energy (m3 * °C) Example: 04FF07xxxxxxxx = xxxxxxxx m3 * °C
Energy E9		7	INT32	Energy (m3 * °C) Example: 04FF08xxxxxxxx = xxxxxxxx m3 * °C
Volume		6	INT32	Example: 0413xxxxxxxx
Info codes		7	INT32	Error and warning flags Example: 04FD17xxxx Note that this field is always 32 bits, even when using MultiCal 403 which only reports 16 bits. Kamstrup MCxx3 Heat Meters Info Codes
Date and Time (see Note 1)		6	INT32	Date and Time (Type F), e.g. 046Dxxxxxxxx M-Bus Format F for Date & Time
Meter ID (see Note 1) (see Note 2)		6	BCD8	According to M-Bus EN13757-3 identification field e.g. 0C78xxxxxxxx
Energy E1		6-7	INT32	Heat energy Example: 0406xxxxxxxx, 040Fxxxxxxxx

Table 13: Meter register, combined message

Pulse: Message format ID 69

Field		Description		
Date and Time (see Note 1)		6	INT32	Date and Time (Type F), e.g. 046Dxxxxxxxx M-Bus Format F for Date & Time
Meter ID (see Note 1) (see Note 2)		6	BCD8	According to M-Bus EN13757-3 identification field e.g. 0C78xxxxxxxx
Energy		6-7	INT32	Example: 0406xxxxxxxx, 040Fxxxxxxxx
Volume		6	INT32	Example: 0413xxxxxxxx
Pulse In A	84 or 224	7	INT32	Reads the registers corresponding to the In A connector on the module. Sub-unit 1 is used in DIFE for In A Examples:

Field		Description		
				Volume: 844014B1EB0100 = 1258.73 m³ Energy: 84400725120000 = 46450 kWh
Pulse In B	85 or 225	8	INT32	Reads the registers corresponding to the In B connector on the module. Sub-unit 2 is used in DIFE for In B Example: Volume: 848040144E1E0100 = 732.94 m³ Energy: 8480400601230000 = 8961 kWh
Power		4	INT16	Example: 022Bxxxx
Flow		4	INT16	Example: 023Bxxxx
Fw temp		4	INT16	Example: 025Axxxx
Rt temp		4	INT16	Example: 025Exxxx
Info codes		7	INT32	Error and warning flags Example: 04FD17xxxx Note that this field is always 32 bits, even when using MultiCal 403 which only reports 16 bits.

Table 14: Meter register, Pulse message

JSON
Example when In-A measure volume ("VA" and "UA"), and In-B measure Energy ("EB" and "UB").

{"TS":"2021-12-02T13:14:15Z","ID":12345678,"E":1,"U":"Wh","V":5,"VU":"l","VA":3,"UA":"l",
"EB":2,"UB":"Wh","P":6,"PU":"W","F":7,"FU":"l/h","FT":8.1,"TU":"C","RT":-9.2,"RU":"C","EF":"0x12345678"}

7.4.2 Message encoding

7.4.2.1 M-Bus

In message format M-Bus, data will be M-Bus encoded. Data will be divided into Data Information Blocks (DIB) that include Data information field (DIF code), Value information field (VIF code) and a data field (DATA) where the actual payload is stored (illustrated in Figure 3)

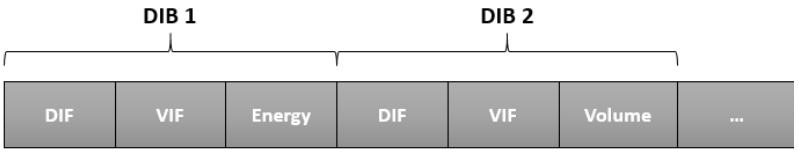


Figure 3: DIB structure

7.4.2.2 JSON

The payload of message format JSON consists of one object with a list of key – value pairs. The names of each value type and unit is presented in Table 15. The values are encoded as numbers or strings and the units are encoded as strings.

Field	JSON key
Meter ID	ID
Meter date / time	TS
Energy	E
Energy unit	U
Volume	V
Volume unit	VU
Power	P
Power unit	PU
Flow	F
Flow unit	FU
Forward temperature	FT
Forward temperature unit	TU
Return temperature	RT
Return temperature unit	RU
Error flags	EF
Tariff 1 Energy*	T1
Tariff 1 Energy unit*	U1
Tariff 2 Energy*	T2
Tariff 2 Energy unit*	U2
Tariff 3 Energy*	T3
Tariff 3 Energy unit*	U2
Missing time*	MT
Missing time unit*	MU

Table 15: Payload, JSON encoded message

***Only included in the extended message.**

Example payload, JSON:


```
{
  "TS":"2019-11-28T20:39Z",
"ID":87654321,
  "E":12345.678,
  "U":"MWh",
  "V":3456.7,
  "VU":"m3",
  "P":5012,
  "PU":"W",
  "F":212,
  "FU":"l/h",
  "FT":80.3,
  "TU":"°C",
  "RT":53.8,
  "RU":"C",
  "EF":"0x4012"
}
```


7.4.2.3 SenML/CBOR encoded telegram

For battery-powered devices it might be necessary to send several measurements in the same UDP frame to save energy. In order to achieve this SenML RFC 8428 - Sensor Measurement Lists (SenML) + CBOR RFC 8949: Concise Binary Object Representation (CBOR) is used to define a measurement list.

The idea is to send a list of measurements, where the first entry contains the base time for all the readouts (which only need to specify an offset) and the meter id shared by all readouts. The other records in the list may contain fewer readout fields to save space. The format allows sending all the data for every readout, in which case the save (in terms of bytes) is smaller and lies in that fewer telegrams are sent, some data needs not be transferred for every reading (like meter-id) and timestamps can be handled more efficiently. SenML/CBOR also provides one way to structure lists of readings in an efficient manner.

The first implementation will use M-Bus for encoding the data transferred, but other formats could be implemented in the future.

Note that SenML, CBOR and M-Bus are separate standards, this page describes how products can use these three in conjunction for representing multiple measurement values in a compact format suitable for radio transmission over for instance NB-IoT. Also, other means of encoding the data than M-Bus can be used in the future.

Elvaco uses SenML/CBOR/M-Bus data representation for transferring meter data in a compact and self-describing manner. The data being transferred is referred to as a pack, containing one record per readout.

Structure of SenML pack

Meter readout data is sent as SenML, i.e., a list (aka array) of readout values (records), encoded using CBOR. Each record is a map of key/value pairs using SenML.

Each product that uses the SenML/CBOR format shall follow the requirements below. In addition, it shall specify the exact contents of the data values included, meter id format etc. This specification alone is not sufficient for building a parser for a specific product.

Base Time

- *Base time* is used to set a reference time.
    - Timestamps are always encoded according to SenML (i.e., UNIX time). SenML label -1 "Base time", SenML definition of Time field
    - This value MUST be included in the first record of the pack
    - All other values have a *time* value that is added to the *base time* to define the exact time of the readout

Base Name

- *Base name* is used to represent the MeterID (Meter identification in M-Bus)
    - This value MUST be included in the first record of the pack
    - This is represented as a string array (CBOR Major Type 3 - SenML label -2 "Base name")
        - The product shall specify the exact format for this field, as it may vary depending on what type of "meter" is used. For an M-Bus format it is typically the M-Bus data without DIF/VIF.
    - No *name* is set for remaining meter readout values, only values belonging to a single meter can be represented in one pack.

Data values

- The actual values from the meter can be encoded using multiple methods, such as M-Bus.
- The first record can also contain a data value field containing more information than the remaining records in the pack. This is to include more information for the first reading and then only a subset of values for the remaining records to save space. (SenML label 8 - "Data value")

Other values

- *(Base) Unit* is not used, since the unit is specified by the M-Bus data
- An "Encoder Version field" is used in a separate record to define the type and version of the encoded payload data.

Additional Records

All records in the SenML pack are expected to contain measurement values. If there is a need for transmitting additional information in the same pack additional records can be added. For such records the name field shall be used by defining a name of at least a single character. In SenML the *base name* and the *name* fields are appended to result in the final record name.

The *name* shall contain at least one character outside [A-Fa-f0-9] which signifies non-hexadecimal representation, since meter-id is typically decimal/hexadecimal, and this makes it easier to check the record name for validity.

If a parser finds a record with a *name* field like described above that it does not recognize it shall ignore the record.

The following additional records are currently used

Record	Name field	Comment
Encoder Type & Version	"V"	This field allows defining versions for the contents of the measurement field.

Encoder Type & Versioning

The following table defines allowed encoder types and versions. The information is sent in a special record "Encoder Version field".

- This field encapsulates both the encoding of the data and versioning
- It contains no timestamp
- It is encoded as a SenML Value
- It has a *Name* field with the single letter "V"
- If, when parsing, an invalid version is encountered the parsing shall stop with an error
- The value shall be interpreted as an UINT16
    - The first byte is the *encoder* type and the second is the encoder *version*, both interpreted as UINT8.
    - **Example:** value 0x0102 means Encoder type 0x01 and Encoder version 0x02.
    - Defined valid encoder types and versions are found in a table below on this page
    - Size of whole record is maximum 7 bytes
    - If we ever need to extend this beyond 256 encoder types or versions, we could use an UINT32 and let the least significant byte overlap with the definition above and thus simply extend encoder type and version to use UINT16 instead of UINT8
- If record is excluded, *encoder* type is 0 and *encoder* version is 0

Record	Name field	Data	Comment
0 (M-Bus)	0	0x0000	M-Bus encoding of payload data. Each data record contains all DIF/VIF/Values according to M-Bus. Note that M-Bus uses LSB first byte order for the data and it shall be preserved here as well.

Example and Data Size

Below is a break-down of the number of bytes used for the different parts described above.

```
1                                                                  : size (bytes)
2 98 18                       # 24 item array                      : 2 (fixed)
3   A3                        # Map with length 3                  : 1 (fixed)
4     21                      # Key 1 = -2 = Base name             : 1 (fixed)
5     68                      # Value 1 = String array, length 8   : 1 (fixed)
6        3132333435363738     # meter specific encoding            : 8 (fixed, depends on meter)
7     22                      # Key 2 = -3 = Base time             : 1 (fixed)
8     1A 5DE02740             # Value 2 = 1574971200 =             : 5 (fixed)
9                             #   Time "2019-11-28T20:00Z"
10     08                     # Key 3 = 8 = Data value             : 1 (fixed)
11     58 21                  # Value 3 = Byte array, length 33    : 2 (payload1 < 256 bytes)
12                            #                                          or
13                            #                                      3 (payload1 > 255)
14        04064E61BC000415
15        07870000022B9413
16        023BD400025A2303
17        025E1A0202FD1712
18        40                                                       : variable
19                                                              Sum : 22 + (1) + payload1 bytes
20
21                 ** Record for defining encoder and version **
22
23   A2                       # Map with length 2                 : 1 (fixed)
24     00                     # Key 1 = "0" name                   : 1 (fixed)
25       61 56                # Value 1 = string => "V" = version  : 2 (fixed)
26     02                     # Key 2 =  integer value             : 1 (fixed)
27       00                   # Value 2 UINT16
28                            # 0x0000 => enc=0, ver=0             : 3 (max)
29                                                              Sum : 8 bytes (max)
30                 ** Follows X items of same size **
31
32   A2                       # Map with length 2                 : 1 (fixed)
33     06                     # Key 1 = 6 = Time                   : 1 (fixed)
34     39 0E0F                # Value 1 = -3600 =                  : 3 (fixed)
35                            #   Time "2019-11-28T19:00Z"
36     08                     # Key 2 = 8 = Data value             : 1 (fixed)
37     46                     # Value 2 = Byte array, length 6     : 1 (payload < 24)
38        0406F24FBC00        #   M-bus record with one DIB:       : variable
39                            #     Energy = 12341,234 MWh
40                                                      Sum : X * (7 + (1) + payload2 size)
41
42                 Total: 22 + (1) + payload 1 + 8 + X * (7 + (1) + payload2 size)
```

Given the fixed sizes above using M-Bus and assuming payload is < 256 bytes for the first record and < 24 for the subsequent records, the total size is:

29 + payload1 + 6 + X * (7 + payload2)

Some example sizes:

payload1	payload2	Total #records	Total size
33	6	24	367
33	33	12	508
36	32	24	968

Validators

http://cbor.me/ - Validator for CBOR, does not understand SenML or M-Bus

Noted a small bug in the hex interpretation of negative numbers, the diagnostic window seems correct though.

Configuration

SenML/CBOR is to be considered a *message encoding*. It defines how the messages are encoded, but not the actual contents of the messages (which fields from the meter are included). SenML/CBOR/M-Bus is one such encoding, but there could be several based on this SenML/CBOR specification and the *encoder version field* above defines exactly which type and version is used.

The contents of the message are defined by the *message* format. The message format sets which fields are to be included in both the first and the subsequent records of the SenML pack.

The number of records included in a pack is set by the readout and transmit intervals. See Scheduling Readouts for more details. If the readout interval is 120 minutes and the transmit interval is 1440 minutes 12 readouts in total will be included.

Message Size Restrictions

Each product may have different maximum payload sizes in a single telegram. Also depending on configuration (DTLS or not for instance) the net payload size may vary. Therefore, the device shall "fill up" as many telegrams as required to send the data. It is for the user to define a configuration that gives a reasonable tradeoff between power consumption (send fewer telegrams) and functional requirements (much data is sent).

If a device is configured using a *Message Format* and many readouts the data may not fit in a single telegram. In such cases multiple telegrams shall be sent and each telegram shall be fully self-described, i.e., contain Meter ID, timestamps etc.

Examples

Example 1:

Parameter	Value
Readout interval	60
Transmit interval	1440 (daily)
Message encoding	SenML/CBOR/M-Bus version 0
Message format	Standard
Max transmissions per day	3

This example results in the transmission of one message per day, containing 24 readings, all with the contents defined in the Standard message format. Data is encoded using SenML/CBOR/M-Bus. Maximum 3 unsent such messages are sent each time (if for some reason the messages were not sent "last time"). So maximum transmitted messages per day is 3 (containing 3x24=72 readings, covering 3 days)

Example 2:

Parameter	Value
Readout interval	120
Transmit interval	720
Message encoding	SenML/CBOR/M-Bus version 0
Message format	Tariff
Max transmissions per day	2

This example results in the transmission of one message every 12h, containing 6 readings, all with the content defined in the Tariff message format. Data is encoded using SenML/CBOR/M-Bus. Maximum 2

unsent such messages are sent each time (if for some reason the messages were not sent "last time"), so maximum transmitted messages per day is 4 (containing 4x6=24 readings, covering 2 days).

7.5 Configuration options

CMi6140 is configured via preconfigure service at delivery, via LwM2M device management or via the Elvaco OTC App, using NFC to transfer settings to the module. The Elvaco OTC App is downloaded via Google Play or at App Store for iOS. When the application has been installed, you can log in by using the user symbol in the top right corner. This will give you access to all your configuration profiles and enable you to configure any locked devices that have been claimed to your account.

Table 16 through Table 20 provides a summary of all readable/writeable settings in CMi6140. Please note that the default configuration is tailored for optimizing the performance of battery powered units. If changing these settings, the stipulated battery lifetime cannot be guaranteed.

Device related configurations available in CMi6140:

Parameter	**Description**	**Configurable values**	**Default value (battery)**	**Device access –** Locked device & correct PAK **or** open device	**Device access –** No PAK
Meter ID	Meter identification (secondary ID) for Kamstrup MC403, MC603, or MC803	N/A	N/A	Readable	Readable
Power mode	Activation status of the module.	Passive, Active	Passive	Readable/ Writeable	Readable
Configuration Lock	Locks the module to prevent unauthorized access.	Open, Locked	Open	Readable/ Writeable	Readable
Synchronize meter time	Used in OTC via NFC to use time of mobile phone to synchronize meter clock	Used via App	N/A	Writeable	Readable
UTC offset	UTC offset of the meter (in minutes).	-720 - 720	0	Readable/ Writeable	Readable
Max meter retries	Maximum amount of quick retries when failing communicating with a meter	0-255	255	Readable/ Writeable	Readable
Factory reset	Resets the CMi6140 to factory settings (default setting for power mode is Active)	N/A	N/A	Writeable	N/A

Table 16: Device Related Configurations

LwM2M-related configurations available in CMi6140:

Parameter	**Description**	**Configurable values**	**Default value (battery)**	**Device access –** Locked device & correct PAK **or** open device	**Device access –** No PAK
Bootstrap IP	IP address of the bootstrap server the module will connect to upon activation.	N/A	84.19.147.226 (Elvaco Bootstrap server)	Readable/ Writeable	Readable

Parameter	**Description**	**Configurable values**	**Default value (battery)**	**Device access –** Locked device & correct PAK **or** open device	**Device access –** No PAK
Bootstrap port	Port of the bootstrap server the module will connect to upon activation.	N/A	5694	Readable/ Writeable	Readable
Bootstrap security	Sets the way data sent from the module is encrypted.	DTLS / no security	DTLS	Readable/ Writeable	Readable
CoAP ack timeout	LWM2M CoAP timeout value.	See LWM2M specification for more info	60	Readable/ Writeable	Readable
CoAP max retransmit	LWM2M max retransmit value.	See LWM2M specification for more info	1	Readable/ Writeable	Readable
DTLS min timeout	The first timeout in seconds used when transmitting packets via DTLS for LWM2M		60	Readable/ Writeable	Readable
DTLS max timeout	The last timeout in seconds used when transmitting packets via DTLS for LWM2M		90	Readable/ Writeable	Readable
Communication retry count	Number of connection attempts to a LWM2M server before marking a connection failed	0..	1	Readable/ Writeable	Readable
Communication retry delay	Delay in seconds between connection attempts to LWM2M servers	1..	3600	Readable/ Writeable	Readable
Sequence retry count	Number of connection sequence attempts to LWM2M servers.	1..	2	Readable/ Writeable	Readable
Sequence retry delay	Delay in seconds between connection sequence attempts to LWM2M servers.	1..	86400	Readable/ Writeable	Readable
Sequence backoff	Delay ranges in minutes to wait between full LWM2M sequence connection attempts. I.e. If both bootstrapping and connection to device management fails consecutively, delay progressively until connectivity can be restored	N/A	0-5,60-120,1300-1600,1300-1600,1300-1600,1300-1600	Readable/ Writeable	Readable

Table 17: LwM2M-related configurations.

NB-IoT-related configurations available in CMi6140.

Parameter	**Description**	**Configurable values**	**Default value (battery)**	**Device access –** Locked device & correct PAK **or** open device	**Device access –** No PAK
APN mode	Sets how APN settings is implemented in the module.	Auto, Manual	Auto	Readable/ Writeable	Readable
APN	APN to use if APN mode is manual	Name of APN	N/A	Readable/ Writeable	Readable
Radio frequency band	Which NB-IoT frequency band to use. Setting this will make the modem skip scanning all bands and just use the supplied one if possible. If this fails, the modem will scan all bands. 0 means all bands	0,3,8,20	0	Readable/ Writeable	Readable
Power saving mode	Setting for power save mode.	Disabled, eDRX, PSM, eDRX+PSM	eDRX+PSM	Readable/ Writeable	Readable
T3324 timer	LTE Active Timer. This setting controls how long (in seconds) the modem will wait for network activity before entering power saving mode.	0-…	120	Readable/ Writeable	Readable
T3412 timer	LTE Extended TAU timer. This setting controls how long (in seconds) the modem will be in power saving mode before waking up.	0-…	252000	Readable/ Writeable	Readable
eDRX mode		Automatic / Manual	Manual	Readable/ Writeable	Readable
eDRX value	eDRX controls how often the device can be contacted when not in power saving mode	0-…	19	Readable/ Writeable	Readable
Time sync source	Source for setting meter clock	Network/Manual	Network	Readable/ Writeable	Readable
Brown out delay	The maximum delay in seconds before reconnecting after a power outage	0-…	21600	Readable/ Writeable	Readable

Parameter	Description	Configurable values	Default value (battery)	Device access – Locked device & correct PAK **or** open device	Device access – No PAK
Search period	Maximum network search period in seconds. After this period, the device will enter deep sleep until next connection attempt-	0…	21600	Readable/ Writeable	Readable

Table 18: NB-IoT-related configurations.

Payload setup configurations available in CMi6140:

Parameter	Description	Configurable values	Default value (battery)	Device access – Locked device & correct PAK **or** open device	Device access – No PAK
Message format	Sets the payload of the data message from the module.	Standard, Extended, Combined, Pulse.	Standard	Readable / Writeable	Readable
Message encoding	Sets the encoding of the payload.	M-Bus, JSON, SenML/CBOR	SenML/CBOR	Readable/ Writeable	Readable
Readout interval	Number of minutes between each meter data readout	5-1440	60	Readable/ Writeable	Readable
Report interval	Number of minutes between each meter data readout	5-1440	60	Readable/ Writeable	Readable
Transmit interval	Number of minutes between each data transmission.	5-1440	1440	Readable/ Writeable	Readable
Transmit offset	Time before transmit window starts from transmit interval (in seconds)	1..	30	Readable/ Writeable	Readable
Transmit delay	Time period were the transmission while be randomized (in minutes)	1..	240	Readable/ Writeable	Readable
Max uploads per transmission	The number of max packages / transmissions. This will effect the time to recover when communication link has been down.	1..	4	Readable/ Writeable	Readable
MQTT/SN Connection	Connection type used when publishing messages to the MQTT-SN broker.	Optimized / Compliant	Optimized	Readable/ Writeable	Readable
MQTT/SN Topic	Topic used when publishing messages to the MQTT-SN broker.	N/A		Readable/ Writeable	Readable

Parameter	Description	Configurable values	Default value (battery)	Device access – Locked device & correct PAK **or** open device	Device access – No PAK
Auto-upload max. age	Maximum age of the resent data (in minutes)	1..	10080	Readable/ Writeable	Readable
Auto-upload order	Start with oldest or newest data when resending data	Oldest first/ Latest first (FiFo/LiFo)	Latest first (LiFo)	Readable/ Writeable	Readable
Restart backoff	Delay range in minutes between restarting the modem on failures	N/A	0-5,5-15,15-60,60-360,360-1440,1300-1600	Readable/ Writeable	Readable

Table 19: Payload setup configurations.

MDM (MQTT-SN)-related configurations available in CMi6140.

Parameter	Description	Configurable values	Default value (battery)	Device access – Locked device & correct PAK **or** open device	Device access – No PAK
Communication timeout	MQTT-SN timeout when communication actions. E. g. timeout when publishing without DTLS.	1..	92	Readable/ Writeable	Readable
Communication attempts	MQTT-SN max number of retries before considering operation failed.	1..	2	Readable/ Writeable	Readable
DTLS min timeout	The first timeout in seconds used when transmitting packets via DTLS for MDM packages	1..	60	Readable/ Writeable	Readable
DTLS max timeout	The last timeout in seconds used when transmitting packets via DTLS for MDM packages	1..	90	Readable / Writeable	Readable
Reconnect backoff	Delay range in minutes between restarting the modem on failures	N/A	0-5,5-15,15-60,60-360,360-1440,1300-1600	Readable / Writeable	Readable

Table 20: MDM (MQTT-SN)-related configurations.

8 Technical specifications

Type	Value	Unit	Comments
Mechanics			
Dimensions (w x h x d)	90 x 35 x 12	mm	
Weight	20	g	
Mounting	In module slot of Kamstrup Multical® 403/603/803	-	
External antenna connector	MCX female	-	
SIM card	Slide, size Nano	-	
Power requirements			
Power supply	HC99303 230 VAC high power supply HC99305 D-cell battery IoT HC99306 C-cell battery IoT	-	
Electrical characteristics			
Nominal voltage	3.5	VDC	
Power consumption (max)	300	mA	
Power consumption (sleep mode)	8	µA	
Environmental specifications			
Operating temperature	+5 to +55	ºC	
Operating humidity	0 - 93	% RH	No condensation
Operating altitude	2000	m	
Pollution degree	Degree 1	-	
Usage environment	Indoors	-	
Storage temperature	-20 to +60	ºC	Storage temperature for battery pack is separated. See info on specific battery pack. This is for module only.
Mobile network			
Transmit power	23.0	dBm	
Receiver sensitivity	-129	dBm	
Certified for Bands	20,8,3	-	Hardware support for: B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/ B19/20/B25/B26/B28/B66/B71/B85
3GPP	Release 14 (NB2)	-	
User interface			
Push button of meter	Activation, Deactivation	-	
Configuration	• NFC via Elvaco OTC App	-	

	• via LwM2M (Elvaco Evo DM-system, or third-party DM-system) • Preconfig on delivery		
General			
Supported Protocols	LwM2M, MQTT-SN	-	both over UDP
Security	DTLS 1.2	-	
Data storage (examples)			
Meter data storage	4445 meter read out	-	Stores all supported meter data

9 Approvals

CMi6140 is designed to comply with the followed directives and standard listed below.

Directive	Corresponding Standards
2014/53/EU (RED) 2014/30/EU (EMC) 2014/35/EU (LVD) 2011/65/EU + 2015/863 (RoHS)	EN 301 489-1: V2.2.1 (EMC) EN 301 489-52: V1.1.2 (EMC) EN 55032:2015 (EMC) EN IEC 61000-3-2:2019 (EMC) EN 61000-3-3:2013 + A1 (EMC) EN IEC 61000-3-11:2019 (EMC) EN 61000-3-12:2011 (EMC) EN 61000-4-2:2009 (EMC) EN IEC 61000-4-3:2020 (EMC) EN 61000-4-4:2012 (EMC) EN 61000-4-5:2014 + A1 (EMC) EN 61000-4-6:2014 (EMC) EN IEC 61000-4-11:2020 (EMC) EN 61000-4-34:2007 + A1 (EMC) EN 301 908-1: V13.1.1 (RED) EN 301 908-13: V13.1.1 (RED) EN 62368-1:2014+A11:2017 (LVD)

10 Document history

10.1 Versions

Version	Date	Description
V0.1	2021-02	Evaluation samples
V0.2	2021-06	LVD Basis
V1.0	2022-03	Updated release document
V1.1	2022-06	Updated release document
V1.2	2022-10	Updated release document
V1.3	2022-10	Updated release document
V1.4	2022-12	Updated release document

11 References

11.1 Terms and abbreviations

Abbreviation	Description
CBOR	Concise Binary Object Representation
COSE	CBOR Object Signing and Encryption
DevEUI	Device Extended Unique Identifier
DM	Device Management
DNS	Domain Name Server
DTLS	Datagram Transport Layer Security
IP	Internet Protocol
LPWAN	Low Power Wide Area Network
LWM2M	Lightweight Machine to Machine
MCM	Meter Connectivity Module
MD	Meter Data
MQTT	MQ Telemetry Transport
MQTT-SN	MQTT for Sensor Networks
NB-IoT	Narrowband Internet of Things
OSCORE	Object Security Constrained RESTful Environments
OTC	One-Touch Commissioning
PAK	Product Access Key
PSK	Pre-Shared Key
PSM	Power Save Mode
PSU	Power Supply Unit
SenML	Sensor Measurement List
TLS	Transport Layer Security
UDP	User Datagram Protocol
URI	Universal Resource Identifier
MDM	Meter Data Management
RSRP	Integer type. Reference signal received power (see 3GPP 36.133)
RSRQ	Reference signal received quality (see 3GPP 36.133)

ECL	Extended Coverage Level

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)