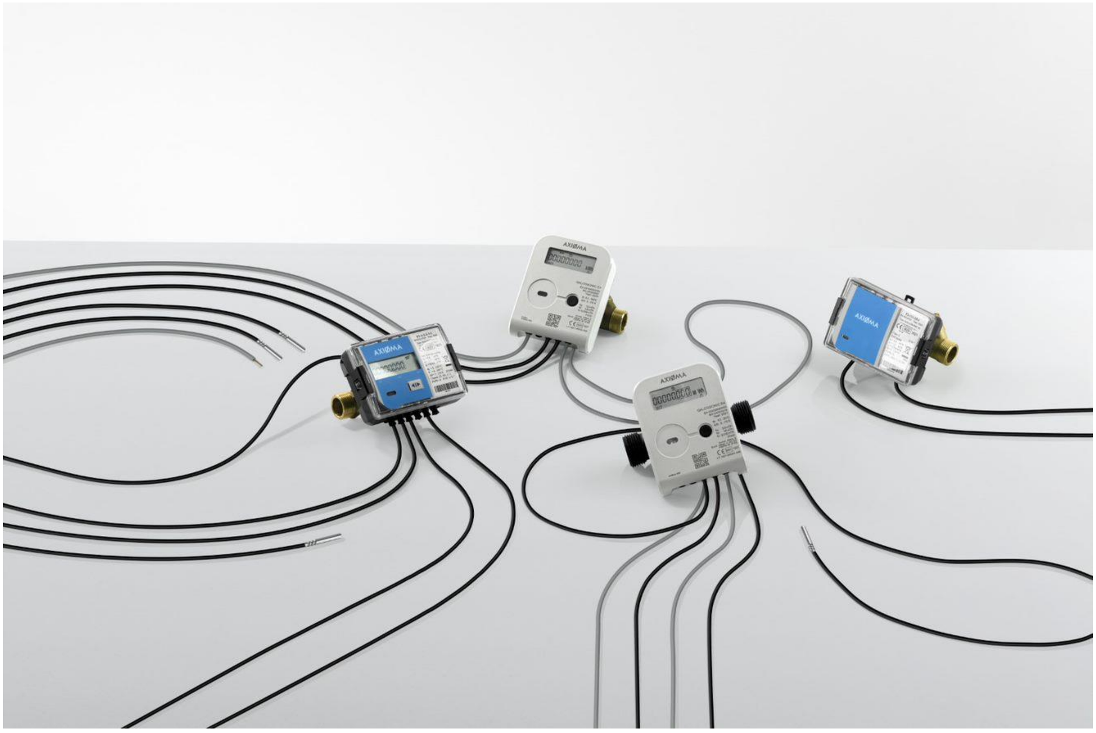
AXIOMA METERING UAB

ULTRASONIC HEATING/COOLING METERS

QALCOSONIC E3/E4



LoRa functional description
V01_20221108

Table of Content

1. Scope of this document

This document describes Lora WAN communication used in devices Qalcosonic E3/E4.

1.1 LoRa WAN communication

The LoRa® technology is an Internet of Things solution for connecting many devices to some wide-area networks.

LoRa WAN is a low-power, wide area networking protocol built on top of the LoRa radio modulation technique. It wirelessly connects devices to the internet and manages communication between end-node devices and network gateways.

End devices communicate with nearby gateways and each gateway is connected to the network server. Lora WAN networks use an ALOHA based protocol, so end devices don't need to peer with specific gateways. Messages sent from end devices travel through all gateways within range. These messages are received by the Network Server. On the Network Server, the data is processed and transmitted to the application server, where the data is displayed to the user.

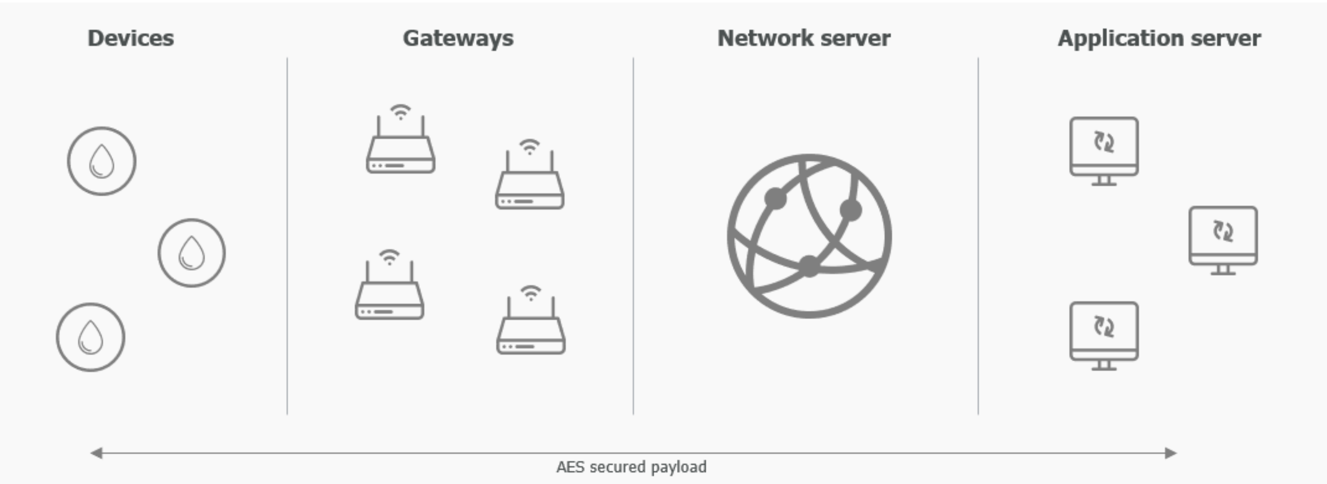


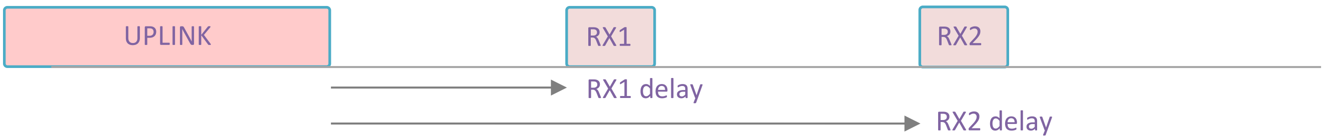
Figure 1

LoRa WAN uses lower radio frequencies with a longer range. The fact that frequencies have a longer range also comes with more restrictions that are often country specific. Lora WAN tries to be as uniform as possible in all different regions of the world. As a result, Lora WAN is specified for a number of bands for these regions.

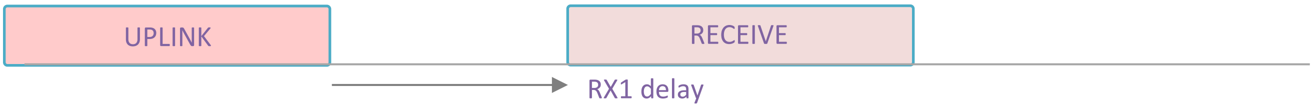
The Lora WAN specification defines three device types: **Class A**, **Class B**, and **Class C**. All Lora WAN devices must implement Class A, whereas Class B and Class C are extensions to the specification of Class A devices. All device classes support bi-directional communication between a device and a gateway (uplink and downlink commands).

- **Uplink messages** - Uplink messages are sent by end devices to the Network Server relayed by one or many gateways. If the uplink message belongs to the Application Server or the Join Server, the Network server forwards it to the correct receiver.
- **Downlink messages** - Each downlink message is sent by the Network Server to only one end device and is relayed by a single gateway. This includes some messages initiated by the Application Server and the Join Server too.

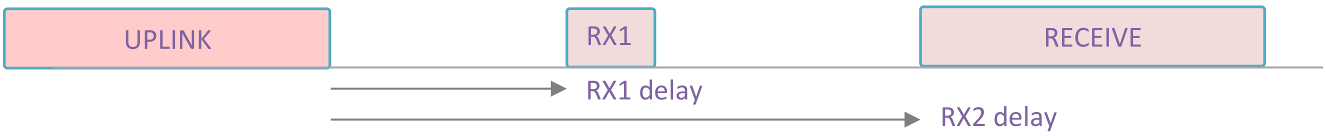
Class A. Communication is always initiated by the end-device. A device can send an uplink message at any time. Once the uplink transmission is completed the device opens two short receive (downlink) windows. There is a delay between the end of the uplink transmission and the start of the receive windows (RX1 and RX2 respectively). If the network server does not respond during these two receive windows, the next downlink will be after the next uplink transmission.



- In this case nothing is received. The end device opens both receive windows, but it doesn't receive a downlink message during either receive window.



- Packet received in Rx1 window. The end device receives a downlink during the first receive window and therefore it does not open the second receive window



- Packet received in Rx2 window. The end device opens the first **receive window**, but it does not receive a downlink. Therefore, it opens the second receive window and it receives a downlink during the second receive window.

Class B. In addition to the class A initiated receive windows, Class B devices open scheduled receive windows for receiving downlink messages from the network server. Using time - synchronized beacons transmitted by the gateway, the devices periodically open receive windows. The device opens downlink 'ping slots' at scheduled times for receiving downlink messages from the network server. Class B devices also open receive windows after sending an uplink.

Class C. Class C devices extend Class A by keeping the receive windows open unless they are transmitting. This allows for low-latency communication but is many times more energy consuming than Class A devices.

The advantages of class A:

- The lowest energy consumption.
- Spends most of its time in sleep mode.
- Usually maintains long intervals between uplinks.
- High redirect delay (the terminal must send an uplink to receive a redirect).

Lora WAN integration in Qalcosonic E3/E4:

- **Lora WAN specification device type: Class – A.**
- **Qalcosonic E3/E4 supported Lora WAN Stack version: regional parameters V 1.0.2 rev B.**
- **Max output power: 14 dBm for EU region.**

Note: For more information about Lora WAN communication read RP002-1.0.2 Lora WAN® Regional Parameters document.

1.2 General description

Qalcosonic E3/E4 meters have embedded Lora WAN communication. Meters use Lora WAN communication to transmit information to the user by sending payload telegrams. LoRa payload is an encoded data archive in HEX format. Depending on payload type, it provides different information for the user. Payload goal is to transmit archival values over a specified period at a specified interval. Payload includes current date and time, status code, volume, energy for heating/cooling, temperature and power (depending on payload type). General LoRa payload information is written below:

- Frequency band EU 863 – 870 MHz
- Spreading factor SF7 – SF12
- Data rate – 250bps - 50kbps
- Data size (bytes) –30/ 45/ 48
- Number of channels – 1

1.3 LoRa acknowledgement adaptive requirement (ACKAdrReq) management*

LoRa ACKAdrReq function goal is to ensure reliable connection between a server and a water meter. To guarantee the connection with the server ACKAdrReq2 bit is set every 10th telegram, and if there is no confirmation server asks for ACK 4 more times. When device does not get acknowledgment after 4 telegrams, it reduces spreading factor by one, going from SF7 to SF8 and so on. When device reaches SF12 it still asks for ACK every time, but now it counts how many times it did not get acknowledgment. After 16 telegrams without the ACK, it goes into join state and tries to join the server again. It is possible to change after how many telegrams ACKAdrReq bit is selected using downlink command (described in chapter 5).

1.4 Communication credits

Communication credit system is implemented to control long-time average energy consumption of the device. It assures that the battery is not depleted too soon. The credit system consists of three types of credits:

Communication credits

Communication credits are used when data telegrams are sent. To distribute communication evenly, credits are increased once a minute with a constant value. At different spread factors, the device consumes different number of credits (see table below). Data telegrams are not sent when there are fewer credits on the device than are required sending a telegram. When credits are restored to the sufficient amount - the telegrams are being sent again.

Communication	LoRa SF12	LoRa SF11	LoRa SF10	LoRa SF9	LoRa SF8	LoRa SF7
Number of credits for one byte	704	400	180	100	56	32

1.5 Regional parameters

Parameter	EU 868 MHz
Default frequency band	863-870 Mhz
Payload types	Basic, Nordic, LT
DIF/VIF telegram	Optional
OTAA/ABP	Optional
Downlink	Optional
Devtimereq	-
Spreading factor / Data rate	SF7 – SF12 DR0 – DR5
Number of channel group	1
LoRa join procedure	Join request at SF12
ADR ACK limit	By default – 8
ADR ACK delay	By default – ON Delay – 4
LoRa ports	Set by default*

Table 1. Regional parameters

2.2 Device activation process

Radio activation

When device is new and its total volume value is zero, it is in transportation mode by default. In transportation mode radio is disabled. It is enabled automatically when meter reaches consumption of 10 liters.

The smart meter sends telegrams at predefined transmission interval. The more frequent the sending period, the faster the device will discharge; therefore, battery protection system will be activated if the period is too short.

LoRa authentication methods

Device authentication on the network is done using LoRa keys.

- DevEUI, AppKey and JoinEUI (AppEUI) keys are used for OTAA authentication.
- DevEUI, NwkSKey, AppSKey and DevAddr keys are used for ABP authentication.

It is possible to use only one - ABP (Activation by personalization) or OTAA (Over the-air activation), authentication method for one device at a time.

- Over-The-Air-Activation (OTAA) - the most secure activation method for end devices. OTAA end devices are provisioned with initial keys. In OTAA activation, an end device performs a joining procedure with a Lora WAN network, during which a dynamic DevAddr is assigned to an end device, and root keys are utilized to derive session keys. Hence, DevAddr and session keys **change as each new session is established**.
- Activation By Personalization (ABP) – end devices skip the join procedure. In ABP activation, a fixed DevAddr and session keys for a pre-selected network are hardcoded in the end device, and they **remain the same throughout the lifetime** of an ABP device.

Required authentication method is pre-configured at the time of manufacturing and may be changed later.

LoRa join request

LoRa communication is started when device activation keys and keys stored on the server are matching, and radio is active. The first LoRa join request telegram is then sent. If no acknowledgement is received for the first time, the next join request will be sent only after the specified sending period. LoRa join requests are sent with the same time period as data telegrams.

2. Ports used for communication

Qalcosonic E3/E4 meters communicate on different ports, depending on telegram type. Port numbers are configurable.

Port 100	Used for sending regular data telegrams
Port 101	Used for transmitting configuration telegrams (VIF/DIF telegrams)
Port 102	Used for downlink commands

Table 2. Ports used for communication

3. Available payloads

3.1 General information

Qalcosonic E3/E4 meters may have the following payload types:

Differences between payload versions are presented in the following table:

Version / Parameter	Basic LT	Basic with cooling energy	Basic with heating energy	Nordic	Nordic with cooling energy
Number of historical values	1	3	4	2	1
Telegram length in bytes	35	45	41	48	30
Payload structure	Date and time, status code, historical values of heating and cooling energy volume, power, flow, temperature 1 and temperature 2; working time without error, period between past values	Data and time; status byte; current cooling and heating energy, current volume; historical values of cooling and heating energy and volume; period between past values	Data and time; status byte; current heating energy, current volume; historical values of heating energy and volume; period between past values	Current date and time, status code, historical values of heating energy volume, power, flow, temperature 1 and temperature 2	Current date and time, status code, historical values of heating energy, cooling energy, volume, power, flow, temperature 1 and temperature 2
Configuration telegrams (VIF/DIF) (enabled by default)	+	+	+	+	+
Default store period	1h	4800s	1h	24h	24h
Default send period	4h	4h	4h	6h	6h

Payload includes volume values of the same day	+	+	+	+	+
Possibility to configure settings through downlink commands	+	+	+	+	+
Possibility to change number of historical records	-	+	+	+	-
Possibility to change logging period	+	+	+	+	+
Possibility to encrypt telegrams	+	+	+	+	+

Table 3. Differences between payload versions

3.2 Decoding the payload

- All VIF data are sending through Port 100.
- By default, information of the metering device will always be shown in the order indicated in the tables 4, 6, 8, 10, 12.
- When the device sends a new telegram, all payload historical values are updated. The last historical value disappears, and the new value fills the blank place. This way telegram sends hourly statistics of volume values.
- Bytes in the payload are swapped (***the sequence is little-endian***) – least significant byte is on the left of the byte sequence.
- Data and time are indicated in UNIX hexadecimal timestamp.
- List of possible status of the metering device indicated in table 27.
- Energy for heating and cooling is indicated in kWh.
- Volume is multiplied by 0.001 m^3.
- Power is multiplied by 0.1 kW in **BCD digits**.
- Flow is multiplied by 0.001 m^3/h in **BCD digits**.
- Temperature 1 and 2 are multiplied by 0.01 °C.
- Working time without error is transferred in seconds.
- Period between past values indicates time offset between present values and values given in past periods. By default, this period is provided in seconds.

3.2.1 Decoding the payload – Basic LT

Structure of Basic LT payload

Order	Number of bytes	Description
1	4	Date and time
2	1	Status code
3	4	Energy for heating of the past period
4	4	Energy for cooling of the past period
5	4	Volume of the past period
6	3	Power of the past period
7	3	Flow of the past period
8	2	Temperature 1 of the past period
9	2	Temperature 2 of the past period
10	4	Working time without error
11	4	Period between past values (store period)

Table 4. Basic LT payload structure

3.2.2 Example of decoding basic LT payload

Decoding Basic with heating energy structure packet with 1 historical value.

Payload:		
61a0426204240e00006e050000d8c503001700009906004e09d30834120000100e0000		
Payload length:		35 (bytes)
Data:		**Description:**
(6242a061) (First 4 bytes of payload)	2022-03-29	Date
	06:00:01	Time (UTC)
Power low	04 (payload)	Status code
(00000e24) 3,620 MWh; 06:00:00		Energy for heating of the past period
(0000056e) 1,390 MWh; 06:00:00		Energy for cooling of the past period*
(0003c5d8) 247,256 m^3; 06:00:00		Volume of the past period
(000017) 1,7kW; 06:00:00		Power of the past period
(000699) 0,699 m^3/h; 06:00:00		Flow of the past period
(094e) 23,82 °C; 06:00:00		Temperature 1 of the past period
(08d3) 22,59 °C; 06:00:00		Temperature 2 of the past period

(00001234) 4660 s	Working time without error
(00000e10) 3600 s	Period between past values

Table 5. Example of decoding basic LT payload

3.2.3 Decoding the payload – Basic with heating energy

Structure of Basic with heating energy payload.

Order	Number of bytes	Description
1	4	Current date and time
2	1	Status code
3	4	Energy for heating
4	4	Volume
5	4	Energy for heating of the past period 1
6	4	Volume of the past period 1
7	4	Energy for heating of the past period 2
8	4	Volume of the past period 2
9	4	Energy for heating of the past period 3
10	4	Volume of the past period 3
11	4	Period between past values

Table 6. Basic with heating payload structure

3.2.4 Example of decoding Basic with heating energy payload

Decoding Basic with heating energy structure packet with 4 historical values.

Payload:		
61a04262006e050000d8c503006d0500005ac503006d050000dcc403006c0500005dc40300100e0000		
Payload length:		41 (bytes)
Data:		**Description:**
(6242a061) (first 4 bytes of payload)	2022-03-29	Date
	06:00:01	Time (UTC)
NO ERROR	00 (payload)	Status code
(0000056e) 1,390 MWh; 06:00:00		Energy (current)
(0003c5d8) 247,256 m3; 06:00:00		Volume (current)
(0000056d) 1,389 MWh; 05:00:00		Energy of the past period 1
(0003c55a) 247,130 m3; 05:00:00		Volume of the past period 1

(0000056d) 1,389 MWh; 04:00:00	Energy of the past period 2
(0003c4dc) 247,004 m3; 04:00:00	Volume of the past period 2
(0000056c) 1,388 MWh; 03:00:00	Energy of the past period 3
(0003c45d) 246,877 m3; 03:00:00	Volume of the past period 3
(00000e10) 3600 s	Period between past values

Table 7. Example of decoding basic with heating payload

3.2.5 Decoding the payload – Basic with cooling energy

Structure of Basic with cooling energy payload.

Order	Number of bytes	Description
1	4	Date and time
2	1	Status code
3	4	Energy for heating
4	4	Energy for cooling
5	4	Volume
6	4	Energy for heating of the past period 1
7	4	Energy for cooling of the past period 1
8	4	Volume of the past period 1
9	4	Energy for heating of the past period 2
10	4	Energy for cooling of the past period 2
11	4	Volume of the past period 2
12	4	Energy for heating of the past period 3
13	4	Energy for cooling of the past period 3
14	4	Volume of the past period 3
15	4	Period between past values

Table 8. Basic with cooling payload structure

3.2.6 Example of decoding Basic with cooling energy payload

Decoding Basic with cooling energy structure packet with 3 historical values. (Port 100)

Payload:	
C46f0363008d020000000000003ba701008b020000000000006da601008902000000000000009fa50100c0120000	
Payload length:	45 (bytes)
Data:	**Description:**

(63036fc4) (first 4 bytes of payload)	2022-08-22	Date
	12:00:04	Time (UTC)
NO ERROR	00 (payload)	Status code
(0000028d) 0,653 MWh; 12:00:00		Current energy (heat)
(00000000) 0,000MWh; 12:00:00		Current energy (cooling)
(0001a73b) 108,347m3; 12:00:00		Current volume
(0000028b) 0,651MWh; 10:40:00		Energy (heat) of the past period 1
(00000000) 0,000MWh; 10:40:00		Energy (cooling) of the past period 1
(0001a66d) 108,141m3; 10:40:00		Volume of the past period 1
(00000289) 0,649 MWh; 09:20:00		Energy (heat) of the past period 2
(00000000) 0,000 MWh; 09:20:00		Energy (cooling) of the past period 2
(0001a59f) 107,935 m3; 09:20:00		Volume of the past period 2
(000012c0) 4800 s		Period between past values

Table 9. Example of decoding Basic with cooling payload

3.2.7 Decoding the payload – Nordic

Structure of Nordic payload. Nordic payload is static.

Order	Number of bytes	Description
1	4	Current date and time
2	4	Date and time of past period 1
3	4	Energy of the past period 1
4	4	Volume of the past period 1
5	3	Power of the past period 1
6	3	Flow of the past period 1
7	2	Temperature 1 of the past period 1
8	2	Temperature 2 of the past period 1
9	4	Date and time of past period 2
10	4	Energy of the past period 2
11	4	Volume of the past period 2
12	3	Power of the past period 2
13	3	Flow of the past period 2
14	2	Temperature 1 of the past period 2
15	2	Temperature 2 of the past period 2

Table 10. Nordic payload structure

3.2.8 Example of decoding Nordic payload

Decoding Nordic payload structure packet with 2 historical values.

Payload:		
a9ac0463801804630d070000ead10300100000260100df0b280900c70263f306000013c60300090000260100f50b450a		
Payload length:		48 (bytes)
Data:		**Description:**
(6304aca9) (first 4 bytes of payload)	2022-08-23	Current date
	10:32:09	Time (UTC)
(63041880)	2022-08-23 00:00:00	Date and Time of past period 1
(0000070d) 1,805MWh;	2022-08-23 00:00:00	Energy of the past period 1
(0003d1ea) 250,346m^3	2022-08-23 00:00:00	Volume of the past period 1
(000010) 1,0kW	2022-08-23 00:00:00	Power of the past period 1
(000126) 0,126 m^3/h	2022-08-23 00:00:00	Flow of the past period 1
(0bdf) 30,39 °C	2022-08-23 00:00:00	Temperature 1 of the past period 1
(0928) 23,44 °C	2022-08-23 00:00:00	Temperature 2 of the past period 1
(6302c700)	2022-08-22 00:00:00	Date and Time of past period 2
(000006f3) 1,779MWh	2022-08-22 00:00:00	Energy of the past period 2
(0003c613) 247,315 m^3	2022-08-22 00:00:00	Volume of the past period 2
(000009) 0,900 kW	2022-08-22 00:00:00	Power of the past period 2
(000126) 0,126 m^3/h	2022-08-22 00:00:00	Flow of the past period 2
(0bf5) 30,61 °C	2022-08-22 00:00:00	Temperature 1 of the past period 2
(0a45) 26,29 °C	2022-08-22 00:00:00	Temperature 2 of the past period 2

Table 11. Example of decoding Nordic payload

3.2.9 Decoding the payload – Nordic with cooling energy

Structure of Nordic with cooling energy payload.

Order	Number of bytes	Description
1	4	Current date and time
2	4	Date and time of past period

3	4	Energy for heating of the past period
4	4	Energy for cooling of the past period
5	4	Volume of the past period
6	3	Power of the past period
7	3	Flow of the past period
8	2	Temperature 1 of the past period
9	2	Temperature 2 of the past period

Table 12. Nordic with cooling payload structure

3.2.10 Example of decoding Nordic with cooling payload

Payload:		
a9ac0463801804630d0700000d040000ead10300100000140100da0a2809		
Payload length:		30 (bytes)
Data:		**Description:**
(6304aca9)	2022-08-23	Current date
(first 4 bytes of payload)	10:32:09	Time (UTC)
(63041880)	2022-08-23 00:00:00	Date and Time of past period 1
(0000070d) 1,805MWh	2022-08-23 00:00:00	Energy (heat) of the past period 1
(0000040d) 1,037MWh	2022-08-23 00:00:00	Energy (cooling) of the past period 1
(0003d1ea) 250,346m^3	2022-08-23 00:00:00	Volume of the past period 1
(000010) 1,0kW	2022-08-23 00:00:00	Power of the past period 1
(000114) 0,114 m^3/h	2022-08-23 00:00:00	Flow of the past period 1
(0ada) 27,78 ^{o}C	2022-08-23 00:00:00	Temperature 1 of the past period 1
(0928) 23,44 ^{o}C	2022-08-23 00:00:00	Temperature 2 of the past period 1

Table 13. Example of decoding Nordic with cooling payload

3.3 AES 128 encryption (optional)

The purpose of encryption (AES 128) is to encrypt a date telegram to prevent information from being accessed by keyless users. An encryption key is assigned to each counter that is used to decrypt the counter date telegrams. The devices encrypted in the company comply with the AES 128 Open metering system (OMS) encryption standard. The encryption key according to this standard is 16 bytes long.

AES mode 5 encryption, which is supported by all payload types can be enabled (enhanced payload do not support this function). CBC (cipher block chaining) is used for decrypting payload.

Decryption can be done using free online AES128 decoder. For testing purpose free online decoder may be used –http://aes.online-domain-tools.com/

1. Encrypted telegram is entered in the online AES128 decoder.
2. To decrypt data telegram is required to know the AES key configured to the meter in HEX format.
3. Select CBC (cipher block chaining) mode to decrypt telegrams.
4. Initialization vector must be set to zeroes.
5. Decrypted telegram is received.

Encrypted data telegram	6100a03e4dd8476bc2809e7edb8d0ea5045e08ad9f1bbe51a64a8c182bd34 53dc4facdaa0958a4b53ae47d198f995c10
AES 128 key (16 bytes)	FBC0F0EF25FB22548D20A0FBD2EAA9DE
Mode	**CBC** (cipher block chaining)
Initialization vector (16 bytes)	00000000000000000000000000000000
Decrypted data telegram	a9ac0463801804630d070000ead10300100000260100df0b280900c70263f 306000013c6030009000026010 0f50b4e09

Table 14. Encrypted payload example

<u>Decrypted telegram example:</u>

Payload:	
a9ac0463801804630d070000ead10300100000260100df0b280900c70263f306000013c6030009000026010 0f50b4e09	
Payload length:	48
Real	Description
2022-08-23 10:32:09	Current Date and Time
2022-08-23 00:00:00	Date and Time of past period 1
1,805 MWh	Energy
250,346 m^3	Volume
1,600 kW	Power
0,294 m^3/h	Flow
30,39 °C	Temperature 1
23,44 °C	Temperature 2
2022-08-22 00:00:00	Date and Time of past period 2
1,779 MWh	Energy
247,315 m^3	Volume
0,900 kW	Power
0,294 m^3/h	Flow
30,61 °C	Temperature 1
23,82 °C	Temperature 2

*<u>Note.:</u> * This parameter is optional.*

4. Configuration parameters (Port 101)

Configuration parameters are transmitted through Port number 101. Configuration is transmitted every time after ten data telegrams or immediately after any change in device configuration. These telegrams are extended by DIF values and every DIF value is inserted before every VIF value.
Currently, device configuration can only be changed by sending downlink commands.

By default, port 101 is enabled in all payload types. To disable transmission of DIF/VIF telegram transmission, disable the App VIF Uplink Port parameter.

1. DIF values mean length of data (code of data format) transmitted in the payload.
   a. 32 bits integer, i.e. 0x04,
   b. 16 bits integer, i.e. 0x02,
   c. 8 bits / 1 byte, i.e. 0x01
1. VIF values mean type of data (code of data units) in the payload. Date and time, Unix time, i.e. 0xFF8913
   a. Date and time, Type F, i.e. 0x6D,
   b. Status code, i.e. 0xFD17
   c. Volume, liters or 0.001 m³, i.e. 0x13
   d. Energy for heating, kWh, i.e. 0x863B,
   e. Period between past values, sec., i.e. 0xFD2C.

Example of payload through port number 101 is explained in the following table.

Order	Number of bytes	Description	Example
1	1	DIF – 32 bits integer	0x04
2	3	VIF – Current date and time, Unix time	0xFF8913
3	1	DIF – 32 bits integer	0x04
4	1	VIF – Date and time of the past period, Type F	0x6D
5	1	DIF – 8 bits / 1 byte	0x01
6	2	VIF – Status code	0xFD17
7	1	DIF – 32 bits integer	0x04
8	2	VIF – Energy for heating, kWh	0x863B
9	1	DIF – 32 bits integer	0x04
10	2	VIF – Energy for cooling, kWh	0x863C
11	1	DIF – 32 bits integer	0x04

12	1	VIF – Volume, 1l	0x13
13	1	DIF – 6 digit BCD	0x1B
14	1	VIF – Power, 0.1kW	0x2D
15	1	DIF – 6 digit BCD	0x1B
16	1	VIF – Flow, 0.001m^3/h	0x3B
17	1	DIF – 16 bits integer	0x02
18	1	VIF – Temperature 1, 0.01°C	0x59
19	1	DIF – 16 bits integer	0x02
20	1	VIF – Temperature 2, 0.01°C	0x5D
21	1	DIF – 32 bits integer	0x04
22	1	VIF – Working time without error, sec.	0x24
23	1	DIF – 32 bits integer	0x04
24	2	VIF – Period between past values, sec.	0xFD2C

Table 15. Example of payload through port number 101

Example of VIF / DIF telegram:

Telegram	04ff891331fd17041344ff891344134d931e206204						
DIF/VIF	04ff8913	31fd17	0413	44ff891344134d931e	20	62	04
Meaning	Current date and time	Status code	Current volume	Historical data of volume	Length byte	Spacing unit	Spacing

Table 16. Example of DIF/VIF telegram

5. Configurable settings through downlink commands (Port 102)

There is possible to modify sending and logging periods and some other parameters by sending a downlink command to Port 102. List of configurable settings through downlink commands is presented in the following list:

Payload type / Configurable settings	Basic LT	Basic with cooling energy	Basic with heating energy	Nordic	Nordic with cooling energy
To set/reset send period (Table 18, 19, 20)	+	+	+	+	+
To set/reset read period (Table 21, 22)	+	+	+	+	+
Change number of historical data (Table 23)	-	+	+	+	-
Make the reinitialization (Reinit) (Table 26)	+	+	+	+	+
LoRa ACK limit change / reset to default (Table 27, 28)	+	+	+	+	+

Table 17. Configurable settings through downlink

The command to set sending period when data should be transmitted from the meter is described below:

Order	Number of bytes	Description and meaning	Example
1	1	DIF value – 32-bit signed integer	0x04
2	4	VIF value – exact command	0xFF898500
3	4	Data send period (LSB), i.e. 3600 sec.	0x100e0000

Table 18. Downlink command to set send period

Full downlink command example:

Sending period in seconds, DEC	3600s (1 hour)	28800s (8 hours)	86400s (24 hours)
Sending period in seconds, HEX	E10	7080	15180
Exact command	04FF898500100E0000	04FF89850080700000	04FF89850080510100

Table 19. Downlink command example

The reset command of the sending period to default is explained below:

Order	Number of bytes	Description	Example
1	1	DIF value – no data to send	0x00
2	4	VIF value – exact command	0xFF898507

Table 20. Downlink command to reset send period to default

The command to set logging period when data should be collected from the meter is presented below:

Order	Number of bytes	Description	Example
1	1	DIF value – 32-bit signed integer	0x04
2	4	VIF value – exact command	0xFF898C00
3	4	Data read period (LSB), i.e. 3600 sec.	0x100e0000

Table 21. Downlink command to set logging period

The reset command of the logging period to default is presented in the table below:

Order	Number of bytes	Description	Example
1	1	DIF value – no data to send	0x00
2	4	VIF value – exact command	0xFF898C07

Table 22. Downlink command to reset logging period to default

Additional commands can be applied to the device through port 102

Number of historical data can be changed according to the command below:

Order	Number of bytes	Description	Example
1	1	DIF value – 8-bit unsigned integer	0x01
2	4	VIF value – exact command	0xFF899200
3	1	Number of historical data, i.e. 16. (Different in different payload)	0x10

Table 23. Downlink command to change number of historical data

It is possible to reinitialize the LoRa stack after the selected time. The following command should be applied:

Order	Number of bytes	Description	Example
1	1	DIF value – 32-bit unsigned integer	0x04
2	4	VIF value – exact command	0xFF899A00
3	4	Reinit LoRa after, i.e. 10s.	0x0A000000

Table 24. Downlink command to make the reinitialization

LoRa ACK limit, when the ADRAckReq bit is selected can be changed according to the command below:

Order	Number of bytes	Description	Example
1	1	DIF value – 8-bit unsigned integer	0x01
2	4	VIF value – exact command	0xFF899C00
3	1	ADRAckReq bit set period, i.e. 8 telegrams.	0x08

Table 25. Downlink command to change LoRa ACK limit

The reset command of the LoRa ACK limit to default is presented in the table below:

Order	Number of bytes	Description	Example
1	1	DIF value – no data to send	0x00
2	4	VIF value – exact command	0xFF899C07

Table 26. Downlink command to reset LoRa ACK limit to default

6. Device status

Device transmits its status through payload. Status byte is indicated in every basic payload type regular data telegram.

Status byte - a byte that indicates what error has occurred on the device.

Error code - Full error code for Qalcosonic E3/E4 meters.

Status of the metering device is indicated in the following table.

ERROR COMBINATION:	STATUS:
POWER LOW	04
PERMANENT ERROR	08
EMPTY SPOOL + TEMPORARY ERROR	10
POWER LOW + TEMPORARY ERROR + EMPTY SPOOL	14
EMPTY SPOOL + TEMPORARY ERROR + PERMANENT ERROR	18
POWER LOW + PERMANENT ERROR + EMPTY SPOOL + TEMPORARY ERROR	1C
NO ERROR	00

Table 27. Possible status of metering device

If you do not find the answer to your problem or have more questions, please contact our technical support team at support@axioma.eu