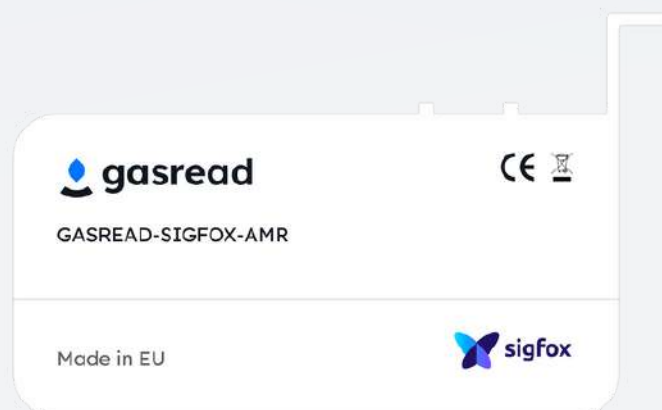# User manual

Gasread Sigfox

gasread

GASREAD-SIGFOX-AMR

CE

Made in EU

sigfox

Document designation: 100048
Date of last change: 21.7.2023
Revision: 13

Table of contents

1. DOCUMENT HISTORY (TODO)

This document is the user manual for the Gasread Sigfox automatic meter reader device.

REVISION	FIRMWARE VERSION	DESCRIPTION
13	01-02-00	Updated activation routine Updated communication protocol: • Downlink message is not expected for alarm messages • The time of the next downlink message is not delayed because of the downlink error • The downlink error flag is added in the status byte The device version with wire input is introduced The device version with ATEX certification is introduced The device versions for RC2 and RC4 zones are introduced Updated order number Adapter type E01 is no longer available and it is substituted with E02. Updated technical specification (for RC2 / RC4 versions)
12	01-00-00	• Updated technical specification (device dimensions and weight)
11	01-00-00	• Updated technical specification (battery duration) • Updated activation routine
10	01-00-00	• Initial release

2. GASREAD SIGFOX

2.1. General description

Gasread is a remote gas meter reader device that is intended for mounting on the gas meters. The device will count the pulses generated by the gas meter and it will periodically report the state of the counter over the Sigfox network.

Additionally, the device will monitor for alarm events and if they occur, it will report them immediately.

Figure 1: Gasread installed on the meter

2.2. Supported Gas Meters

Several types of gas meters are supported via adapters. Those types of gas meters with appropriate adapters are shown below.

GAS METER	TYPE	ADAPTER TYPE
ELSTER	BK 1.6 – BK G6	 E02
METRIX	UG1.6, UG2.5, 6G4, 6G5, 2G10, 2G16, 2G25, 2G40, 2G65, 2G40, 2G65, UG4, UGT4	 M01
ITRON ACTARIS SCHLUMBERGER	RF1, ACD	 I01

ELSTER

METRIX

ITRON

2.3. Device Features

The reader is delivered in shipping mode. While in shipping mode the reader does nothing and waits for the activation routine. Once the reader is activated it enters normal operation mode. Immediately after activation, it will send an activation message to signal that the device is alive and wait for the first configuration packet. During normal operation mode, the reader sends regular reports and waits for configuration messages. The configuration is achieved through downlink messages as described in chapter 4.3.

2.3.1. Pulse Counting

The reader supports pulse counting from two sources depending on the model. One source goes through magnetic sensors and the other one goes through a wire i.e. interface cable. The reader will increase the internal counter on each magnet pass or a rising edge in the case of the interface cable. The counter value is stored redundantly inside the reader's memory.

2.3.2. Reporting

While in normal operation mode, the reader sends daily counter reports at the scheduled time. In addition to the state of the counter, the report also contains the temperature and alarm status.

2.3.3. Alarms

The device will monitor for three different types of alarm events:
1. Magnetic tamper detection – magnetic interference (not available in the device version with wire input)
2. Mechanical tamper detection – unauthorized removal of the device
3. Gas overconsumption detection – possible gas leakage

If one of these alarm events is triggered, the appropriate alarm flag in the uplink message will be set (see chapter 4.2.1) and an alarm message will be sent.

Each alarm can be sent only once in one reporting period (the time period from sending one report to the time of sending the next) to avoid network overload. Alarms are initially disabled and can be enabled with a configuration message (see chapter 4.3.6).

2.3.4. Temperature

The device measures the temperature using an internal temperature sensor and sends it in every uplink message (see chapter 4.2).

2.3.5. Low Battery Detection

If a low battery status is detected, the low battery flag in the uplink message is set (see chapter 4.2.1). Sometimes, depending on the environmental and operating conditions, it may toggle battery status several times. In this case, assume that the battery is empty if the low battery flag is set in several messages in a row.

2.3.6. Factory Reset

The device can only be restored to the factory defaults settings via a special configuration message (see chapter 4.3.1).

2.3.7. Device Forensics

The device redundantly stores the last 400 daily pulse counter readings and settings which can be read by an authorized person when device forensics is needed.

2.3.8. Device Configuration

The following can be configured with downlink messages:
- Internal clock time
- Number and time of daily reports
- Number and time of downlink configurations

- Gas meter type
- Overconsumption alarm
- Mechanical tamper alarm
- Magnetic tamper alarm
- Factory reset

More about incoming configurations in chapter 4.3.

2.4. Default Behaviour

2.4.1. Default Configuration

Default values of configuration parameters are set after device activation and are shown below:

SETTINGS	VALUE
Internal clock time	00:00 h (UTC)
Report time	06:00 h (UTC) / once per day
Configuration time	Once per week
Overconsumption limit	0 (disabled)
Mechanical tamper detection	Disabled
Magnetic tamper detection	Disabled
Gas meter type	None

2.4.2. Example of Device Behavior

The illustration below shows an example of communication between a Gasread device and a server. It is assumed that the reader is activated at noon and that the Time Sync configuration has been prepared in advance. It is visible that the device sends a report every day at 06:00 h. This is the default time to send a report, and since it has received a sync configuration, the reader's internal clock is synchronized with the server time.

After exactly one week (more precisely, after 7 uplink messages) the reader waits for a new configuration. In this view below, it is assumed that a configuration message has been prepared, which enables mechanical tamper option. According to the illustration, the reader was moved on Wednesday at 14:30 and that is why the reader sent an alarm message.

In the third week (according to the illustration) the report time was changed.
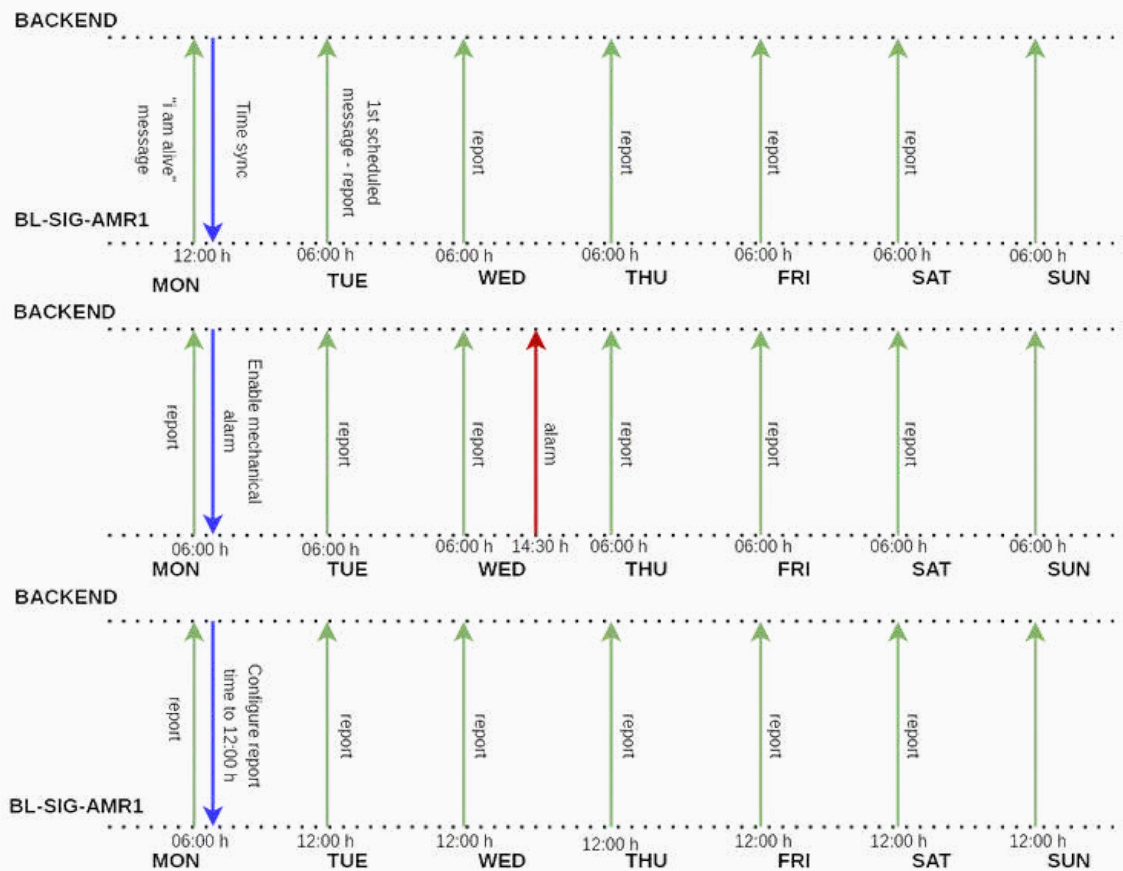
Figure 2: Example of device behaviour

3. ACTIVATION

Activation procedure depends on the model of the device and is explained in the following chapters. Once the device is activated, it can only be deactivated over the network.

3.1. Activation with an Activator

This applies to all devices without a wire input option (see chapter 7 Order number). To activate the device use the following procedure:

1. Put the activator (magnet) on the top of the device (Figure 3) and keep it there while   the LED is on.
2. When the LED is turned off (after 10 seconds), move the activator away immediately (you have 4 seconds to remove it).

Figure 3: Activation position

If the procedure is done correctly, the device will reboot and resume with default configurations. If there was an error in the procedure, the device would stay in deactivated mode and the activation procedure ccould be repeated at any time.

Light Indications

ACTION	DESCRIPTION	LIGHT INDICATION				
Unsuccessful activation	Fast blinking	150 ms	150 ms	...	150 ms	150 ms	150 ms
Successful activation	Slow blinking and a long blink	1500 ms	1500 ms	...	1500 ms	5000 ms	

Example of successful activation:

ACTION	TIMELINE
Activator is on	
Light indication	

3.2. Activation over Wire Input

This applies to all devices with a wire input option (see chapter 7 Order number).
To activate the device use the following procedure:
  1. Short the wires from the device and keep them like that while the LED is on.
  2. When the LED is turned off (after 10 seconds), separate them immediately (you have 4 seconds to do it).

If the procedure is done correctly, the appropriate light indication will be seen. After that, the device will reboot and resume with default configurations. If there was an error in the procedure, the device would stay in deactivated mode and the activation procedure could be repeated at any time.

Light Indications:

ACTION	DESCRIPTION	LIGHT INDICATION				
Unsuccessful activation	Fast blinking	150 ms	150 ms	...	150 ms	150 / 150 ms
Successful activation	Slow blinking and a long blink	1500 ms	1500 ms	...	1500 ms	5000 ms

Example of successful activation:

ACTION	LIGHT INDICATION
Wires are shorted	
Light indication	

4. COMMUNICATION PROTOCOL

4.1. Sigfox Network

The Sigfox network provides a simple and reliable way of communication between the reader and the backend. However, several limitations exist. One limitation is the maximum number of daily uplink and downlink messages which depend on the subscription option. Another is that the downlink message can be sent only if the device is expecting it. This is done by signaling in the uplink messages. These and other limitations were taken into account when the communication protocol was designed.

Figure 4: Sigfox logo

4.2. Uplink Messages

There are three types of uplink messages:
- Report message – the message that is sent according to the schedule
- Alarm message – the unscheduled message that is sent when a specific alarm is detected. This message type can be sent only once in the reporting period to avoid network overload.
- Activation message – the message that is sent after activation only

The format of uplink messages is shown below.

TOTAL COUNTER	STATUS BYTE	TEMP (°C)	PERIOD 1/6 (%)	PERIOD 2/6 (%)	PERIOD 3/6 (%)	PERIOD 4/6 (%)	PERIOD 5/6 (%)	PERIOD 6/6 (%)
BYTE[11:8]	BYTE[7]	BYTE[6]	BYTE[5]	BYTE[4]	BYTE[3]	BYTE[2]	BYTE[1]	BYTE[0]

- BYTE[11:8]: Total counter – the number of pulses since the activation of the device
- BYTE[7]: Status byte – More in chapter 4.2.1
- BYTE[6]: Temperature byte – Value (signed char - int8_t) of internal temperature
- sensor
- BYTE[5:0]: Interval counters [%] - Percentage of pulses detected in the Nth sixth of reporting time.

Note: Uplink messages are in the little-endian format.

4.2.1. Status Byte

Low battery	Reporting message	Alarm 1	Alarm 2	Alarm 3	Counter error	Unexpected reset	Downlink error
BIT [7]	BIT [6]	BIT [5]	BIT [4]	BIT [3]	BIT [2]	BIT [1]	BIT [0]

BIT [7]: LOW BATTERY

- 0 – battery isn't low
- 1 – low battery

BIT [6]: REPORTING MESSAGE

- 0 – this is not reporting message
- 1 – this is reporting message

BIT [5]: ALARM_1 – Magnetic tamper (not available in the device version with wire input)

- 0 – no alarm
- 1 – alarm is activated

BIT [4] : ALARM_2 – Mechanical tamper

- 0 – no alarm
- 1 – alarm is activated

BIT [3] : ALARM_3 – Gas overconsumption

- 0 – no alarm
- 1 – alarm is activated

BIT [2]: COUNTER ERROR

- 0 – no error
- 1 – possible error in total counter monitoring

BIT [1] : UNEXPECTED RESET

- 0 – no error
- 1 – there was an unexpected reset

BIT [0] : DOWNLINK ERROR

- 0 – no error
- 1 – the device was expecting to receive a downlink message after the previous uplink message, but it didn't

4.3. Downlink Messages

In normal operation mode the reader will wait for a configuration message in (pre)configured intervals. Additionally in case of an unsuccessful reception the reader will wait for the downlink message after the next two uplink messages.

There are six different types of configuration messages:
1. Factory reset
2. Time synchronization
3. Reporting time
4. Gas overconsumption
5. Time of the next configuration

With each configuration message alarms can be enabled/disabled.

4.3.1. Factory Reset

When the message ID is 0x00 and the payload matches the one below the factory reset is executed. The configuration will reset to default values.

ID=0x0	PAYLOAD = 0X11223344556677
BYTE [7]	BYTE [6:0]

4.3.2. Time Synchronization and Fast Configuration

To set internal device time and to avoid device time drifting, it should be periodically synchronized with the server time. It can be done with the configuration that has ID 0x01.
This message can be used to tell the device to receive multiple additional configurations.

ID= 0x01	Alarms	Time sync	Number of additional configurations	X
BYTE [7]	BYTE [6]	BYTE [5:2]	BYTE [1]	BYTE [0]

- **Alarms:** See chapter 4.3.6
- **Time sync:** Unix time format
- **Number of additional configurations:** [0 - 5] – The number of downlink messages that the device is waiting for immediately after receiving this configuration. If the number of those repetitions is greater than 5, the device ignores this parameter.

Note: This is a very helpful configuration when a user wants to send multiple configurations in a short time period. Note that the device references to the UTC time.

4.3.3. Reporting Time

There are two ways to configure the number and time of sending a report.

1) Fixed times for sending reports

When the message ID is 0x02, the device is receiving alarms configuration and up to 3 "fix" reporting times. With this configuration, it is also possible to disperse device report times to avoid network overload. Note that the device references to the UTC time.

ID= 0x02	Alarms	FIX_TIME_1	FIX_TIME_2	FIX_TIME_3
BYTE [7]	BYTE [6]	BYTE [5:4]	BYTE [3:2]	BYTE [1:0]

- Alarms: See chapter 4.3.6
- FIX_TIME_1: [0 – 1439] – Number of minutes after 00:00 h (0 – the fix time is ignored)
- FIX_TIME_2: [0 – 1439] – Number of minutes after 00:00 h (0 – the fix time is ignored)
- FIX_TIME_3: [0 – 1439] – Number of minutes after 00:00 h (0 – the fix time is ignored)

Payload example: 02 00 012C 0384 0000
  - $(02)_{16} = 2_{10}$ – ID
  - $(00)_{16} = 00000000_2$ – Alarms: not set
  - $(012C)_{16} = 300_{10}$ – FIX_TIME_1: 300 minutes since midnight (05:00 h)
  - $(0384)_{16} = 900_{10}$ – FIX_TIME_2: 900 minutes since midnight (15:30 h)
  - $(0000)_{16} = 0_{10}$ – FIX_TIME_3: Unused

If the device receives this configuration, it will send two reports a day (at 05:00 h and 15:30 h).

2) Periodic sending of reports

When the message ID is 0x03, the device receives alarms configuration and periodic reporting configuration. In this reporting mode, it is possible to set referent time and period duration. After the period has elapsed, the device is sending a report. (e.g. for the referent time at 12:00 h and duration of 2 h, the device is sending reports at 10:00, 12:00, 14:00…).

With this configuration, it is also possible to dissipate device report times (by changing referent time) to avoid network overload. Note that the device references to the UTC time.

ID= 0x03	Alarms	REFERENT TIME	DURATION	X
BYTE [7]	BYTE [6]	BYTE [5:4]	BYTE [3]	BYTE [2:0]

- **Alarms:** See chapter 4.3.6
- **REFERENT TIME:** [0 – 1439] – Number of minutes since midnight (0 is 00:00 h)
- **DURATION:** [1 – 24] – Period duration (how often the device is sending reports)

Payload example: 03 00 004B 06 000000
- $(03)_{16} = 3_{10}$ – ID
- $(00)_{16} = 00000000_2$ – Alarms: not set
- $(004B)_{16} = 75_{10}$ – REFERENT TIME: 75 minutes since midnight (01:15 h)
- $(06)_{16} = 6_{10}$ – PERIOD: 6 hours
- $(000000)_{16} = 0_{10}$ – X: Dummy bytes

If the device receives this configuration it will report every six hours (01:15 h, 07:15 h, 13:15 h, 19:15 h)

4.3.4. Gas Overconsumption

With the configuration that has ID 0x04 gas overconsumption limit can be set. Besides the limit, the overconsumption alarm bit in the alarm byte must be set to enable the mentioned alarm detection.

ID= 0x04	Alarms	Overconsumption limit	X
BYTE [7]	BYTE [6]	BYTE [5:4]	BYTE [3:0]

- Alarms: See chapter 4.3.6
- Overconsumption limit [1, 65534] – The number of pulses that the device needs to count in one reporting period (the time period from sending one report to the time of sending the next) in order to signal the overconsumption alarm.

Payload example: 04 88 2710 00000000
   - $(04)_{16} = 4_{10}$ – ID
   - $(88)_{16} = 10001000_2$ – Alarms: alarm mask that enables overconsumption alarm detection
   - $(2710)_{16} = 10000_{10}$ – Overconsumption limit: 10 000 pulses
   - $(00000000)_{16} = 0_{10}$ – X: Dummy bytes

If the device receives this configuration it will enable gas overconsumption detection for a given limit.

4.3.5. Time of Next Configuration

With this configuration message the reader is receiving alarms configuration and the number of uplink messages after which the device will wait for downlink message (configuration).

ID= 0x05	Alarms	Number of TX till RX	X
BYTE [7]	BYTE [6]	BYTE [5]	BYTE [4:0]

- **Alarms:** See chapter 4.3.6
- **Number of TX till RX- [1 – 255] –** The number of report messages after which the device will wait for the downlink message. The unscheduled messages, as alarm messages, are not taken into account.

The device will, besides this configuration, wait up to a maximum of 10 days for a downlink message.

Payload example: 05 00 0A 0000000000
- $(05)_{16} = 5_{10}$ – ID
- $(00)_{16} = 00000000_2$ – Alarms: not set
- $(0A)_{16} = 10_{10}$ – Number of TX till RX: after sending 10 report uplinks, the device will wait for downlink message
- $(0000000000)_{16} = 0_{10}$ – X: Dummy bytes

When the device receives this configuration it will wait for a downlink message after sending ten report messages. If the device is configured to send two reports a day, it will happen every five days.

4.3.6. Alarm byte

In every configuration message, the sixth byte is an alarm byte. With this byte, various alarms can be enabled.

Update	X	X	Mechanical tamper	Overconsumption detection	X	Meter type 1	Meter type 2
BIT [7]	BIT [6]	BIT [5]	BIT [4]	BIT [3]	BIT [2]	BIT [1]	BIT [0]

BIT [7]: Update – To ignore or not to ignore alarm byte.
- 0 – there are no changes in alarm configurations (ignore it)
- 1 – there are new setups in alarm byte (take it)

BIT [6] : X – dummy

BIT [5] : X – dummy

BIT [4] : Enable mechanical tamper detection (available in GASREAD-SIG-AMR-T-RCXY version)
- 0 – disable
- 1 – enable

BIT [3] : Enable overconsumption detection – Gas overconsumption limit must be set also
- 0 – disable
- 1 – enable

BIT [2] : X – dummy

BIT [1] : Meter type 1 (Elster / Itron / Actaris / Schlumberger) – This enables magnetic tamper detection (not available in the wire input version)
- 0 – no
- 1 – yes

BIT [0] : Meter type 2 (Metrix) – This enables magnetic tamper detection (not available in the wire input version)
- 0 – no
- 1 – yes

Note: Meter type 1 and 2 cannot be set at the same time.

Payload example: 01 91 60422948 0000

- $(01)_{16} = 1_{10}$ – ID of time sync configuration message
- $(91)_{16} = 1001000_2$ – Alarm mask: update = 1, enable mechanical tamper detection = 1, enable overconsumption detection = 0, meter type 1 = 0, meter type 2 = 1 (enable magnet tamper detection)
- $(60422948)_{16} = 1614948680$ – UNIX time: Fri Mar 05 2021 12:51:20 (GMT+0000)
- $(00)_{10} = 0_{10}$ – The number of additional configurations
- $(00)_{10} = 0_{10}$ – X: Dummy bytes

If the device receives this configuration it will synchronize internal clock time with given
time and it will enable mechanical and magnet tamper detection.

5. SIGFOX CREDENTIALS

A Sigfox ID can be found on the device label (QR code). It is used to access the Sigfox network.

6. TECHNICAL SPECIFICATION

Power supply	Description
Battery type and capacity	Li-SOCl2; 1200 mAh
Nominal voltage	3.6 V
Estimated battery life	≈ 15 years (*)
Replaceable battery	Yes
Sigfox	
Radio configuration	RC1 / RC2 / RC4
Operating frequency	868 MHz (RC1), 902 MHz (RC2), 920 MHz (RC4)
Antenna	Integrated
Transmit power	14 dBm (RC1), 24 dBm (RC2 / RC4)
Certification	RC1: Sigfox Ready (P_0161_233D_01) RC2 / RC4: In progress
Mechanical	
Dimensions (hwd / mm)	65 x 86.5 x 25 without adapter
Mass	~ 70 g
Working conditions	
Operating temperature	-20°C to 60°C
Storage temperature range	5°C to 45°C
Ingress protection rating	IP67

(*) Room temperature (25°C), one uplink message a day, one downlink message a week, 100 pulses a day.

7. ORDER NUMBER

7.1. Device and adapter

Order number for the device or adapter and device combination:

GASREAD-SIG-TWA-RCX-Y

- **T** – Tilt sensor included (mechanical tamper detection)
- **W** – Wire input version, otherwise magnet sensor version
- **A** – ATEX certified version
- **X** – Sigfox radio zone number (1, 2 or 4)
- **Y** – Adapter type (see chapter 2.2, e.g. M01)

Example: GASREAD-SIG-TA-RC1-E02

(Tilt, magnet sensor, ATEX certfication, radio configuration 1, Elster adapter)

7.1. Device and adapter

Order number for adapter only:

GASREAD-SIG-ADAPT-AMR1-Y

- **Y** - Adapter type (see chapter, e.g. M01)

Gasread Sigfox

contact@gasread.com