

# WIRELESS LORAWAN® PRESSURE TRANSDUCER USER MANUAL

Doc# 20027955-11

Revision 2.0



## REVISIONS

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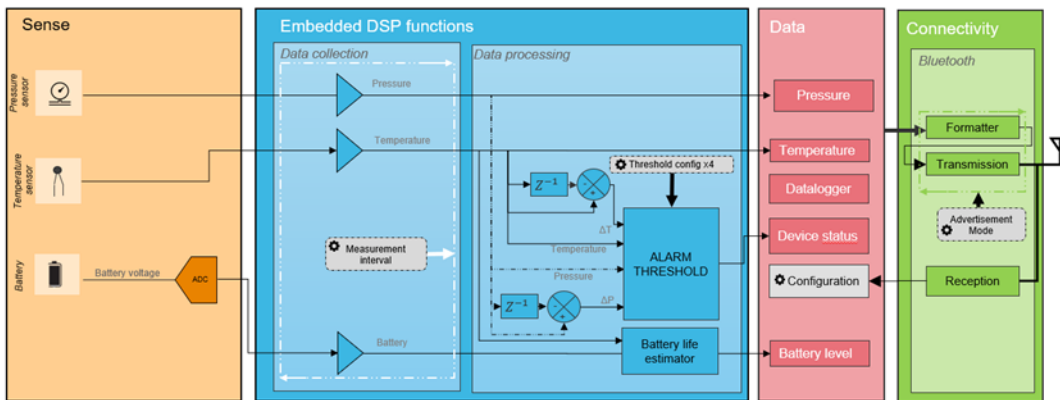
# 1 GLOBAL OVERVIEW

The pressure sensor operates as a smart device. It offers sensor acquisition, data processing, analysis, and wireless communication capabilities.

The sensor computes pressure data in a smart way:

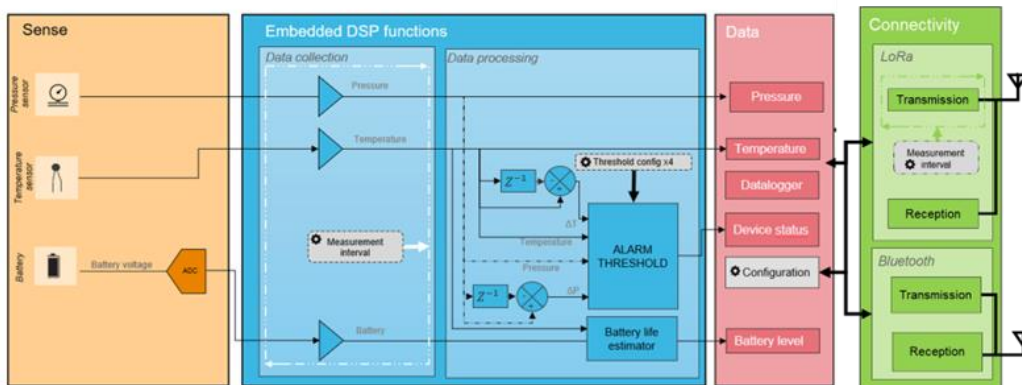
- Delta detection
- raw data

The threshold can be configured. The user may choose between data options to feed threshold.



BLE can be used for local configuration for 1 hour after activation.

LoRaWAN® connectivity will be used to send sensor data periodically. Once configured and connected to a LoRaWAN® network, the downlink frame can then be used to configure the sensor.



This sensor has two Bluetooth® modes:

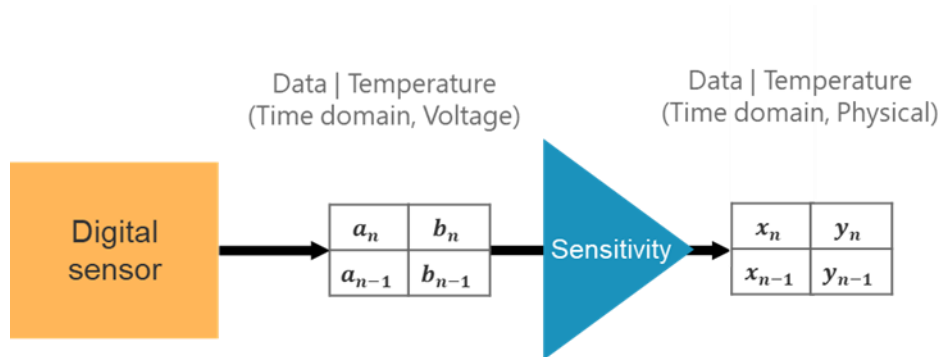
- Advertisement Mode: provides data periodically and provides access to Connected Mode.
- Connected Mode: mode for configuration and advanced features.

**!The temperature provided is used for internal processing and should not be used as accurate temperature data!**

## 2 MEASUREMENT PROCESS

The platform acquires digital data from the sensor:

- The system acquires and stores data.
- The system applies sensitivity to the raw value.



Data collection diagram

At every measurement interval, the platform powers up the sensor and requests a new acquisition, then the sensor provides pressure and temperature data.

Both data types are stored. When the measurement interval is changed, a new measurement is performed, and the new value is received by the system.

### 3 DATA PROCESS

#### 3.1 Data processing

Time domain data is used to calculate a variation between two data types.

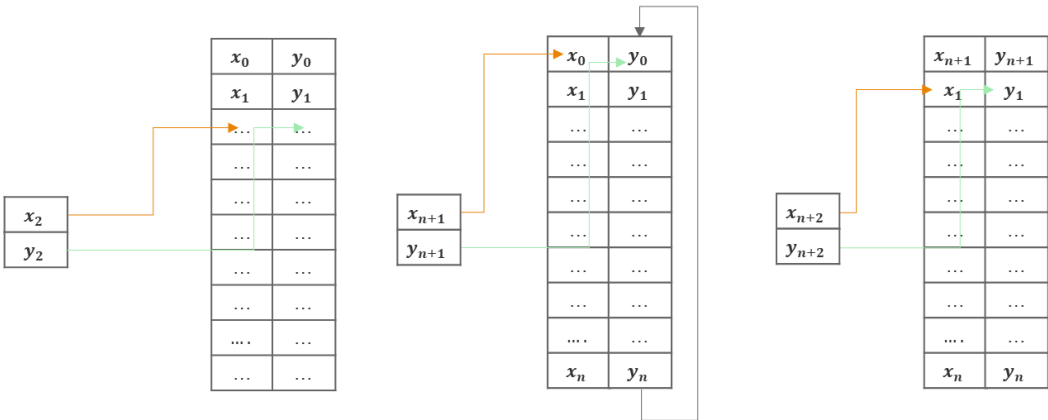
$$\Delta(n) = x_n - x_{n-1}$$

#### 3.2 Trig measurement command

When BLE connected mode is activated, the user can request a new measurement without waiting for the measurement interval. After a trigger measurement command, measurement will occur after the next interval.

#### 3.3 Datalog data

The system stores in 4096 data points in memory. When the memory is full FIFO is used to manage data storage.



Data stored in memory is available in BLE connected mode.

The last data stored in memory will have index 0.

System can provide information about data acquired: min, max, mean, standard deviation.

#### 3.4 Live mode

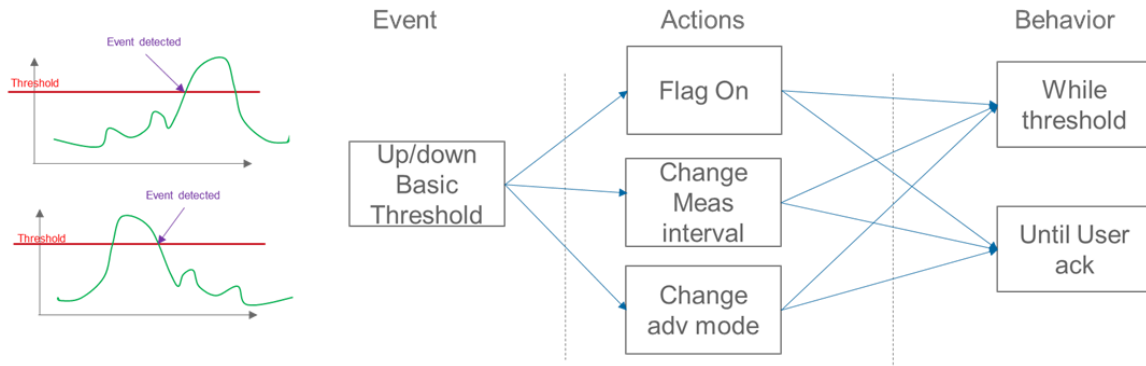
When connected mode is activated, the user can get access to live mode. It will acquire data at a new measurement interval fixed at 100ms and provide all data in “real time”.

When the user ends the BLE connection, the system returns to its current configuration and applies the defined measurement interval.

Note: If a threshold is reached during live mode the system will use the threshold measurement interval. Otherwise, it will use a standard measurement interval.

### 3.5 Threshold event manager

Threshold event manager allows users to have a defined configuration when a value reaches a specified level (main sensor and/or secondary sensor).



- Greater\_Than/Less\_Than threshold: Every new acquired value is compared to a threshold.

$$Threshold_{greater} = x_n > Thr$$

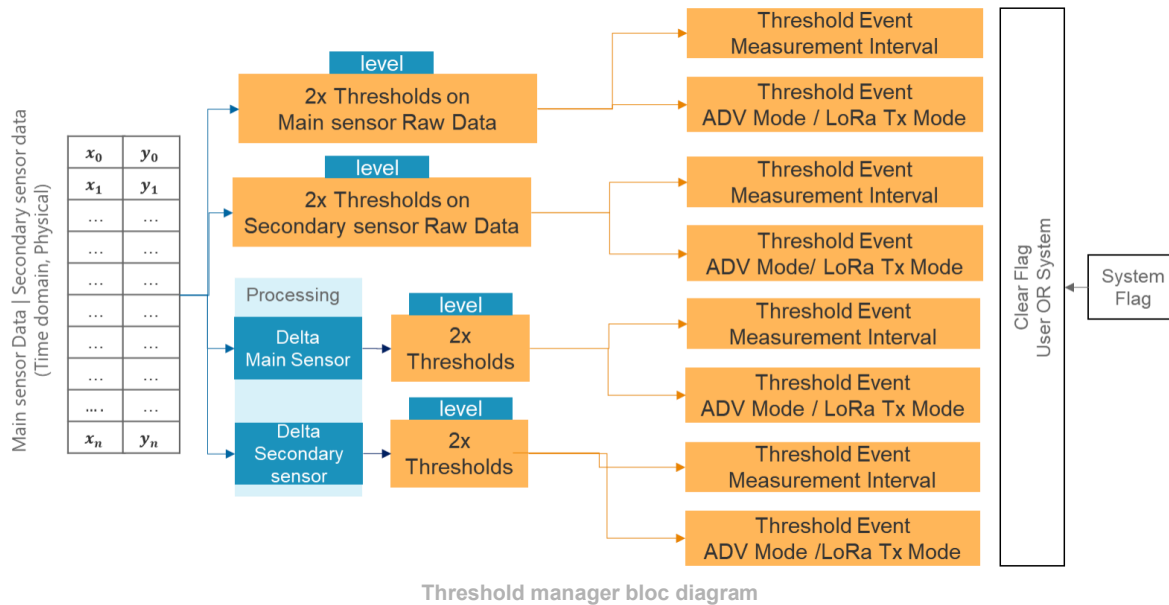
**Threshold high formula**

$$Threshold_{less} = x_n < Thr$$

**Threshold low formula**

The user can configure 2 thresholds for the same input acquired value. If two thresholds are selected, different configurations can be set:

- Range threshold:  $Thrmin < x_n < Thrmax$  If a value is outside of a range defined by  $Thrmin$  and  $Thrmax$ , the system will change its actions and behavior. The system will automatically define  $Thrmin$  and  $Thrmax$  upon a value defined by user.
- Successive threshold:  $x_n > Thr1 \& x_n > Thr2$  or  $x_n < Thr1 \& x_n < Thr2$ . The user can have two levels of action and behavior when  $Thr1$  and  $Thr2$  is reached.
- Actions: When a threshold is reached, the system will set a flag. This flag is available on advertisement frame. Upon user configuration the system can change the advertisement mode and measurement interval. This configuration can be done on BLE connected mode.
- Behavior: This new configuration can last while the threshold is reached or until user clears the threshold flag. Configurations can be performed in BLE connected mode.



At configuration, the user needs to define:

- Data to consider: main sensor and/or secondary sensor
- Data to use: raw data and/or Delta
- Threshold level and type: “greater than” or “less than”
- Event after threshold: flag, measurement interval, Advertisement mode

Every newly acquired value is compared to a defined threshold. The sensor will then complete a specific action and behavior that is defined by the user:

- Set up flags to inform the user that a threshold is reached
- Change BLE Advertisement mode (only on event mode activated) or change LoRaWAN® TX mode (only if LoRaWAN® connectivity is available and event mode is activated)
- Change measurement interval (only on event mode activation)

If there are conflicts when several thresholds are reached:

- System will use the lowest measurement interval and at each new threshold reached or released, a new configuration analysis will be performed.
- System will give priority to: LoRaWAN® On Measurement mode

## 4 COMMUNICATION

LoRaWAN® communication can:

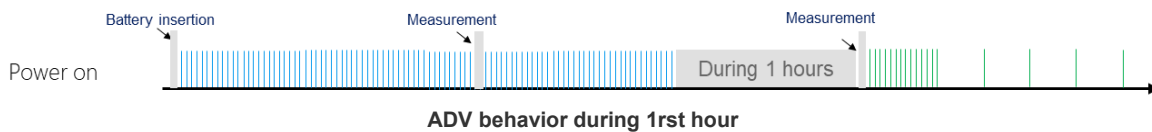
- Receive configuration for central system.
- Send requested configuration parameters.
- Send data.
- Send Keep Alive.

The device includes a LoRaWAN® MAC 1.0.3 rev A compliant interface (see LoRaWAN®1.0.3 Specification). It operates as a Class A end-device.

### 4.1 PRELIMINARY PHASE: for 1 hour after power on

#### 4.1.1 Bluetooth® Behavior

When the device is powered on, a yellow LED blinks to confirm the proper battery insertion. From the sensor startup and for 1 hour, the device advertises every 1 second. This allows the user to configure the product by switching to connected mode.



#### 4.1.2 LoRaWAN® & BLE Behavior

When initiating a measurement and a LoRaWAN® communication, BLE is disabled. Between BLE advertisement OFF and LoRaWAN® communication ON takes 4000ms.

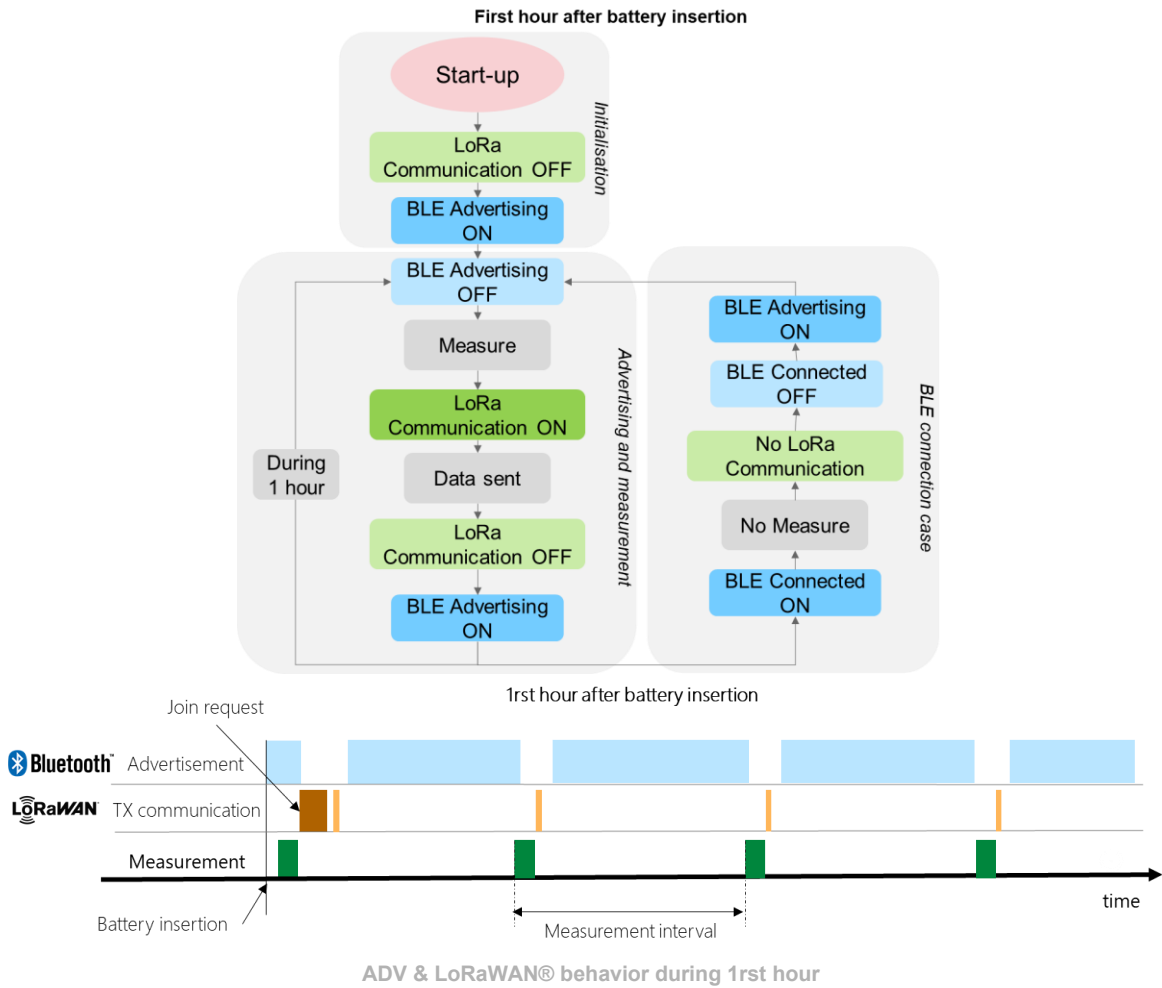
The device performs an initial set of acquisitions on the factory default settings.

The Join Request process allows customer identification and connection to the LoRaWAN® network. The procedure is performed as follows:

- At startup, a request to join the LoRaWAN® network (called “Join Request”) is sent from the unit.
- If the Join Request is accepted, a connection is made, and the sensor can begin sending data via upstream links to the LoRaWAN® network.
- If the Join Request fails, the unit tries again every (see [Unjoined paragraph](#)) seconds until the request is accepted. The Join Request signal from the LoRaWAN® radio transmitter is never transmitted simultaneously with an advertising or connection signal from Bluetooth® radio transmitter.

Once LoRaWAN® communication is ended, the system will reactivate BLE. It takes 950ms between LoRaWAN® communication OFF and BLE communication ON.

During this phase the user can configure the system by using BLE connected mode. This phase can be activated locally with magnet.



### 4.2 NOMINAL MODE PHASE: 1 hour after power on

#### 4.2.1 Keep Alive

A Keep Alive is a simple message that confirms to the user that the device is operating and communicating. A Keep Alive message will be sent at least once a day. Keep Alive intervals can be changed by the user with defined values of 2 hours, 4 hours, 12 hours, and 24 hours (default value). This configuration can be made over BLE and LoRaWAN®.

The Keep Alive frame is different than the Periodic frame ([see Keep Alive paragraph](#)).

#### 4.2.2 Bluetooth®

- LoRaWAN® is disabled
- The device acquires data from the sensor. Then it processes the measurements depending on the default parameters.
- Data is sent over BLE depending on BLE\_ADV\_MODE
- Once BLE advertisement is ended, the system enters an idle state.

There are three BLE advertising modes:

- **1) ADV Burst + Periodic mode: (Default ADV mode)**

After each measurement, the system will send an advertisement at a 1s interval for 15 seconds. This will provide multiple chances for the gateway to connect to the device. After 15 seconds, the device will advertise at 10s intervals until the next measurement. During this phase, the connection between the system and an external device could be more difficult. Between two measurements, the data in the advertisement frames are the same. The payload is only updated after every measurement interval.

- **2) ADV On Measure Mode:**

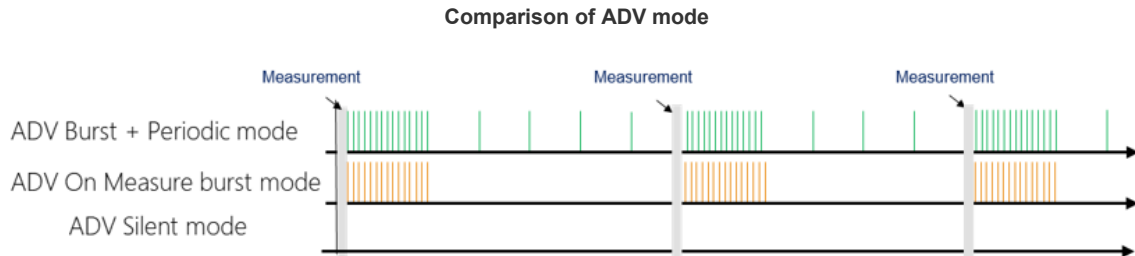
After each measurement, the sensor will send an advertisement at a 1s interval for 15 seconds. This will provide multiple chances for the gateway to connect to the device. After 15 seconds, the device will stop advertising.

This ADV Mode can be selected by using BLE services **ADV\_CFG** for current state and **THS\_ADV\_MODE** if a threshold is activated.

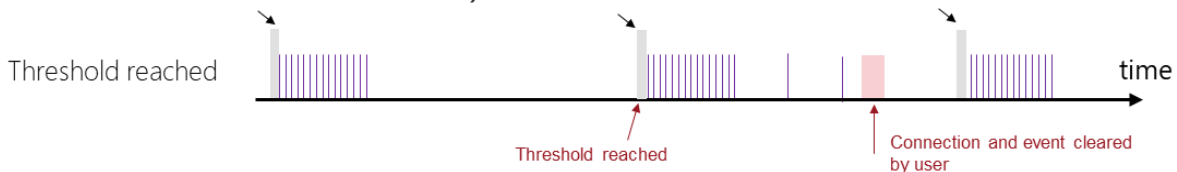
### 3) ADV Silent Mode:

The sensor will not send an advertisement after each measurement. This ADV Mode can be selected by using BLE services **ADV\_CFG**.

This mode is not recommended if threshold is not activated and **THS\_ADV\_MODE** is not configured. The only way to change configuration over BLE is to use the magnet and activate advertisement (see 4.2.4 Magnet Event).



If the threshold is reached after a measurement, the system will use threshold configuration (ADV mode and measurement interval).



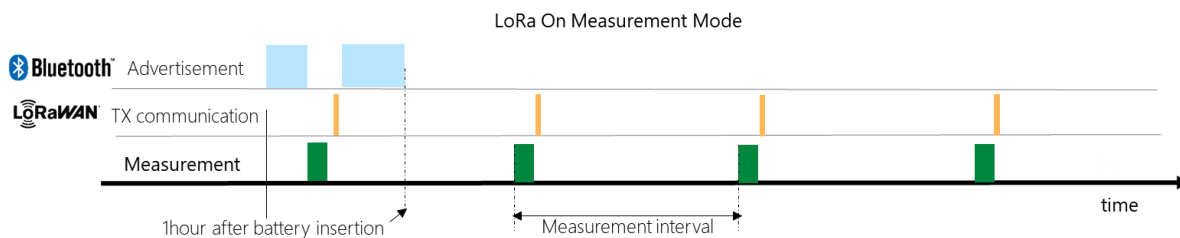
Example of ADV On Measure Mode and ADV Periodic mode after a threshold

### 4.2.3 LoRaWAN®

- BLE is disabled.
- The device acquires data from the sensor. Then, depending on the default parameters, it will process the measurements.
- If this LoRaWAN® join procedure is successful, the data is transmitted. This is dependent on the LoRaWAN® measurement mode.
- Once LoRaWAN® communications are ended, the system enters an idle state.

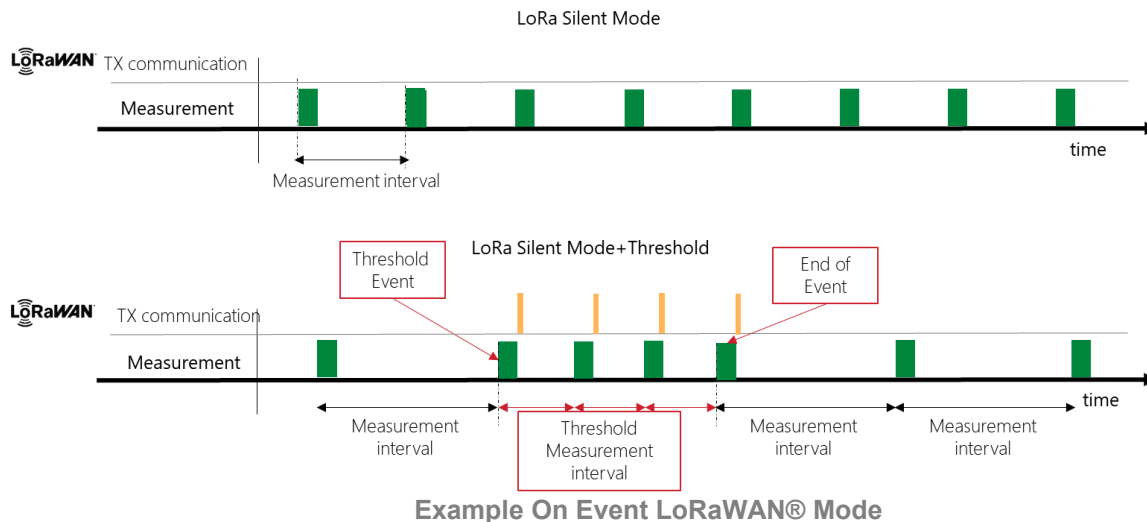
There are two LoRaWAN® communication modes:

- **1) LoRaWAN® On Measurement mode:** data is sent at every measurement interval.



Example On Measure LoRaWAN® Mode

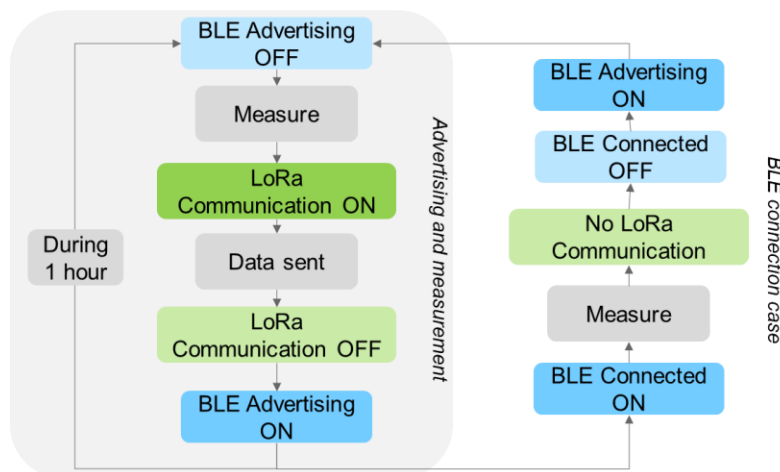
- **2) LoRaWAN® Silent mode:** The system doesn't send data periodically. It measures and stores the data. It will send data only if a threshold is reached.

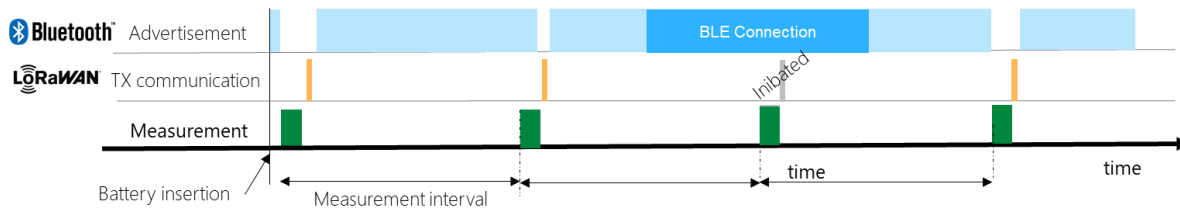


**Note:** If silent mode is selected and no event is detected, configuration over LoRaWAN® can be done only when a Keep Alive message is sent. TE IoT platform is a LoRaWAN® Class A and will listen only when it sends uplink data to the gateway.

#### 4.2.4 Bluetooth® Connected mode

If the sensor is advertising, the user can initiate a connection and the sensor will switch into BLE Connected mode. While a communication is established between the sensor and the master, measurements and LoRaWAN® transmissions are frozen. This mode is used to configure the device parameters.



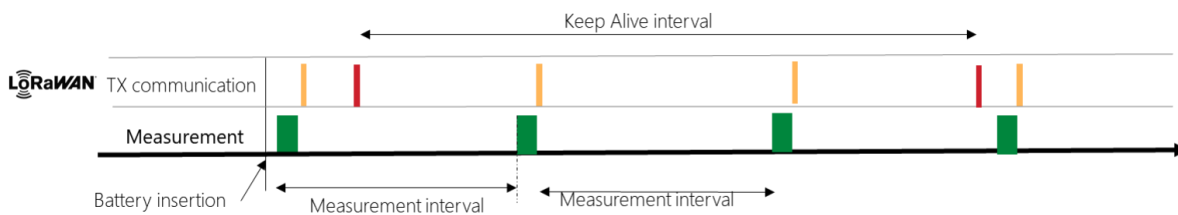


#### 4.2.5 LoRaWAN® Keep Alive

There are 2 different modes for LoRa Keep Alive:

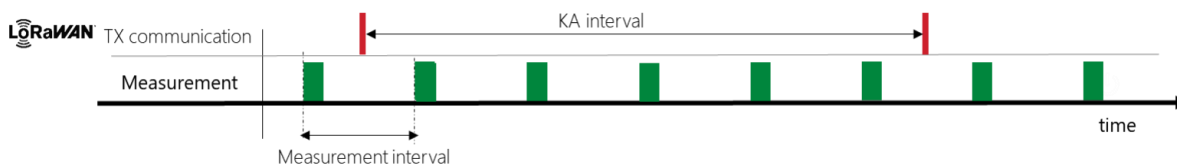
##### -1) Always Keep Alive

Keep Alive is always sent, even if the sensor sent data during Keep Alive interval.

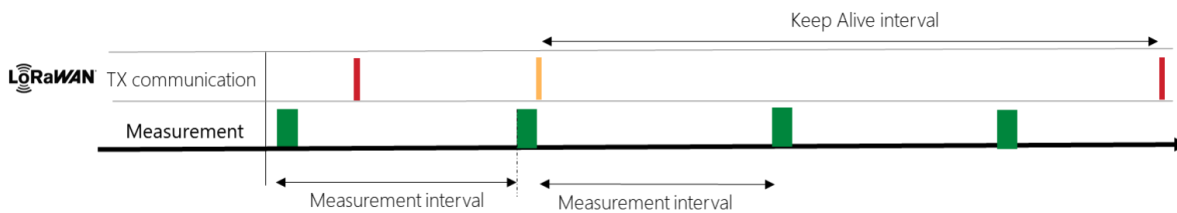


##### - 2) Power efficiency Keep Alive:

If a LoRaWAN® frame is sent, Keep Alive interval is reset.



##### Example Power efficiency Keep Alive with no communication

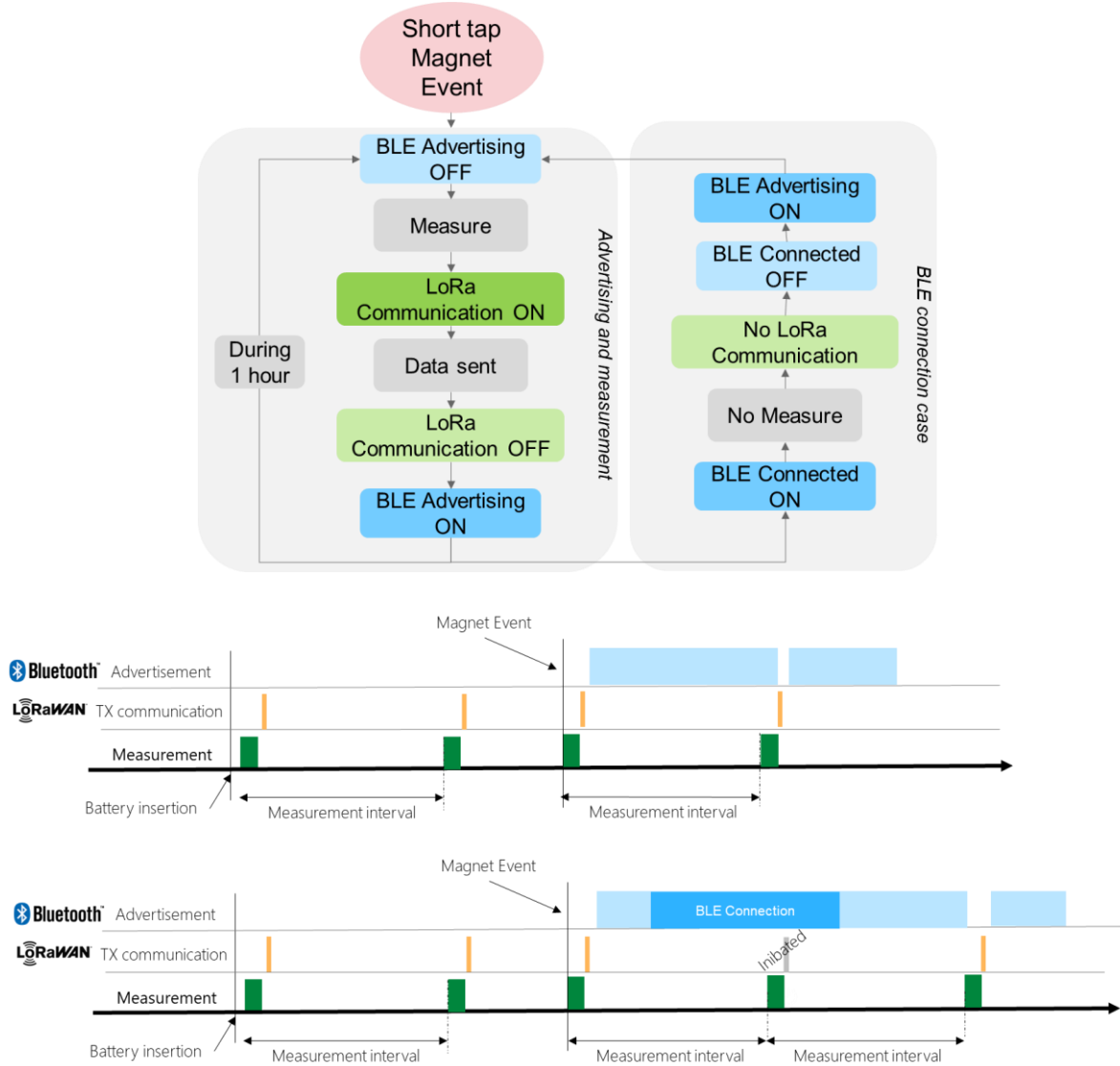


##### Example Power efficiency Keep Alive with a communication

#### 4.2.6 Special event: Magnet

If the user wants to make an asynchronous data acquisition, or access BLE connected mode, a magnet can be used. The magnet event will trigger a measurement to enter the preliminary phase.

If the system is in connected mode, a magnet event will stop connected mode and set the sensor back to the nominal phase.



## 4.3 Bluetooth® Communication

### 4.3.1 Bluetooth® Connected Mode

Users can connect to the system with a Bluetooth® device such as a computer, smartphone, or tablet. BLE connected mode enables configuration, access to special functions and firmware updates.

The product is embedded with 2 different BLE connected modes, which are listed below:

| Operating mode | Description                                                                                          | Condition  |
|----------------|------------------------------------------------------------------------------------------------------|------------|
| Standard       | User mode to configure the sensor and activate some specific functions only available when connected | None       |
| DFU            | Mode used during firmware updates.                                                                   | OTA update |

**Note:** If the device is in BLE connected mode and a power off (remove the battery) occurs without being disconnected from the central device, configuration will be lost.

### 4.3.2 Access to Connected mode

To access connected mode, the user should use a BLE enabled device. When an advertisement is sent by the system, the BLE device will be able to make the connection.

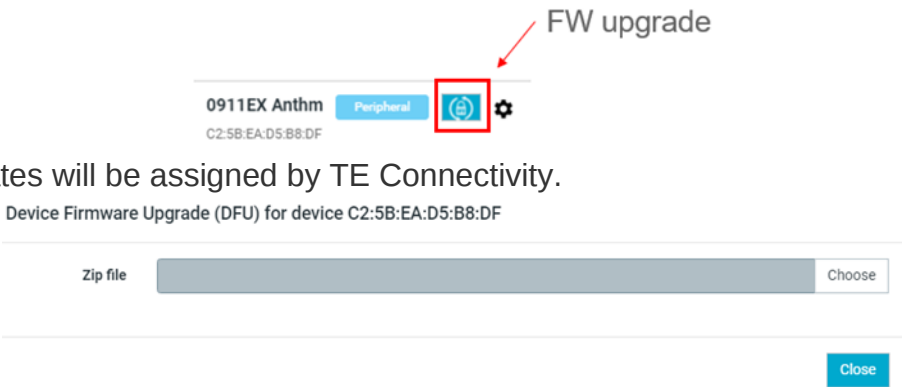
### 4.3.3 Exiting from Connected mode

When in connected mode, there are two ways to disconnect:

- Use the disconnect software function on the BLE central device
- Use the magnet to disconnect

4.3.4 Device Firmware Update (DFU Mode):

DFU mode should be used to upgrade the sensor firmware. It is accessible from the standard operating mode.



Firmware updates will be assigned by TE Connectivity.

The DFU works with a single bank only. This means that if the firmware update is interrupted (power cut off or BLE disconnection), the application firmware will be corrupted, and the sensor will stay in DFU mode. The user will have to retry the upgrading process. Note that the DFU MAC address is the sensor MAC address +1.

4.3.5 List of services available

Users on the BLE connected mode can access a list of services. Each service includes characteristics which allow the user to configure the sensor. Every service and characteristic share a common UUID. Only bytes #3 and #4 (XXXX) differ from the identifier.

|                  |                                      |
|------------------|--------------------------------------|
| BLE UUID         | B614XXXX-B14A-40A6-B63F-0166F7868E13 |
| UUID Service key | XXXX                                 |

4.4 LORAWAN® COMMUNICATION

4.4.1 Frequency plans

The LoRaWAN® communication protocol operates in an unlicensed radio spectrum. The part number must be selected to match with the region of operation and be in line with local regulations.

| Region            | Frequency | Channel Plan | Common name |
|-------------------|-----------|--------------|-------------|
| Europe (EU)       | 868 MHz   | EU862-870    | EU868       |
| United State (US) | 915 MHz   | US902-928    | US915       |

#### 4.4.2 Data rates

Following the LoRaWAN® specification, each data rate is a combination of one spreading factor and one bandwidth.

##### 4.4.2.1 EU868

For European regions, the product supports data rates from 0 up to 7 in both uplink and downlink directions.

| Data Rate (DR) | Spreading Factor (SF) | Bandwidth (BW) | Bitrate (bit/s) |
|----------------|-----------------------|----------------|-----------------|
| 0              | SF12                  | 125 kHz        | 250             |
| 1              | SF11                  | 125 kHz        | 440             |
| 2              | SF10                  | 125 kHz        | 980             |
| 3              | SF9                   | 125 kHz        | 1,760           |
| 4              | SF8                   | 125 kHz        | 3,125           |
| 5              | SF7                   | 125 kHz        | 5,470           |
| 6              | SF7                   | 250 kHz        | 11,000          |

##### 4.4.2.2 US915

For the US915, the data rates supported by the product are:

| Direction | Data Rate (DR) | Spreading Factor (SF) | Bandwidth (BW) | Bitrate (bit/s) |
|-----------|----------------|-----------------------|----------------|-----------------|
| Uplink    | 0              | 10                    | 125            | 980             |
|           | 1              | 9                     | 125            | 1,760           |
|           | 2              | 8                     | 125            | 3,125           |
|           | 3              | 7                     | 125            | 5,470           |
|           | 4              | 8                     | 500            | 12,500          |
| Downlink  | 8              | 12                    | 500            | 980             |
|           | 9              | 11                    | 500            | 1,760           |
|           | 10             | 10                    | 500            | 3,900           |
|           | 11             | 9                     | 500            | 7,000           |
|           | 12             | 8                     | 500            | 12,500          |
|           | 13             | 7                     | 500            | 21,900          |

#### 4.4.3 TX power

RF transmitting systems must adhere to certain rules set by the regulatory bodies such as FCC (*Federal Communications Commission*) or ETSI (The European Telecommunications Standards Institute). Radio devices must not exceed certain ERP or EIRP values set by these regulatory bodies.

Depending on the regional parameters, the product supports the following power:

##### 4.4.3.1 EU868

| TX Power | Power (dBm) | Power (mW) |
|----------|-------------|------------|
| 0-1      | +14 dBm     | 25         |
| 2        | +12 dBm     | 16         |
| 3        | +10 dBm     | 10         |
| 4        | +8 dBm      | 6.3        |
| 5        | +6 dBm      | 4          |
| 6        | +4 dBm      | 2.5        |
| 7        | +2 dBm      | 1.6        |

##### 4.4.3.2 US915

| TX Power | Power (dBm) | Power (mW) |
|----------|-------------|------------|
| 0-8      | +14 dBm     | 25         |
| 9        | +12 dBm     | 16         |
| 10       | +10 dBm     | 10         |

#### 4.4.4 Time on air limitation

##### 4.4.4.1 Duty cycle (EU868 only)

The European Telecommunications Standards Institute (ETSI) sets the maximum duty cycle for the EU868 at 1%, which is the maximum amount of time a device may spend communicating. This means that in 24h a device should not transmit more than 864 seconds.

Example: On measurement mode

The table below shows the effect of the data rate on the maximum number of uplink message which could be transmitted in a day. Assuming the payload size of the uplink message to be 11 bytes, it gives the following results:

| Duty cycle limitation effect (EU868) |        |        |      |      |      |       |       |
|--------------------------------------|--------|--------|------|------|------|-------|-------|
| DR                                   | 0      | 1      | 2    | 3    | 4    | 5     | 6     |
| Number max of uplink per day         | 582    | 1165   | 2330 | 4662 | 8396 | 15265 | 30530 |
| Minimum uplink interval              | 2min30 | 1min15 | 37s* | 19s* | 11s* | 6s*   | 3s*   |

\*Minimum configurable uplink interval is 1 min.

#### 4.4.4.2 Dwell time (US913 only)

There are no duty cycle limitations under Federal Communications Commission (FCC), but the device must respect a certain limit of transmission duration. This parameter is called “dwell time” and should not exceed 400ms per channel. Dwell time is the amount of time needed for a transmission.

This parameter is always respected by the product due to its compressed payload.

**Note** that in case of  $F_{OptsLen} > 3$ , the payload may be fragmented for DR0.

#### 4.4.5 Modes of operation

##### **Enrollment**

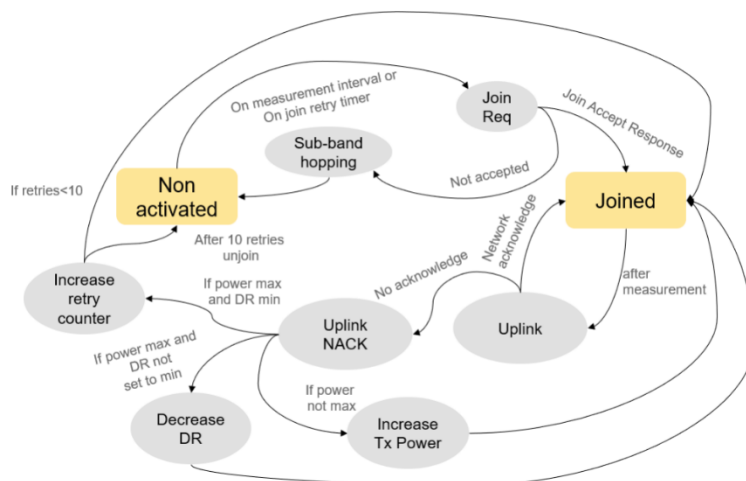
To be recognized by the LoRaWAN® server, the product must be enrolled on the final application server.

Use the LoRaWAN® keys provided by TE Connectivity with the device.

|                |                                                                   |
|----------------|-------------------------------------------------------------------|
| <b>Dev EUI</b> | 64-bit unique identifier of the end-device. Pre-provisioned by TE |
| <b>App EUI</b> | 64-bit extended unique identifier. Provided by TE                 |
| <b>App KEY</b> | 128-bit Pre-provisioned by TE Connectivity                        |

##### **Join and activation**

After power on, the sensor performs a self-diagnostic then it initiates a join-request to the



LoRaWAN®™ network using Over-The-Air-Activation (OTAA).

4.4.5.1 Join accept

In case of a sufficient LoRaWAN® coverage, and if the device was already enrolled in the server database, the network server responds to the join-request with a join-accept message.

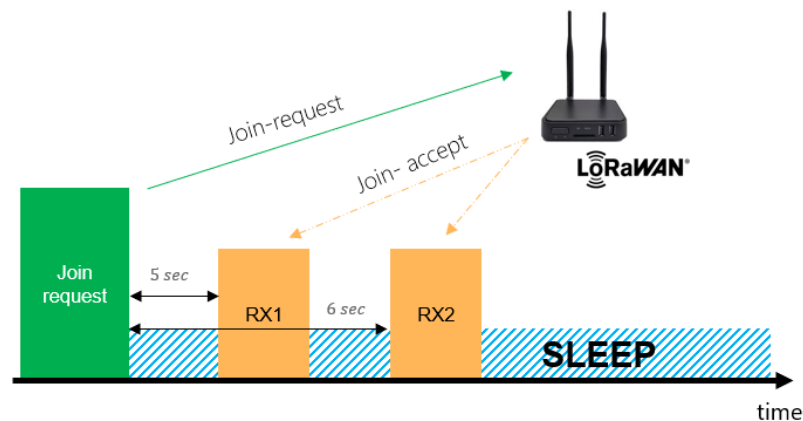


Figure 1:join accept

The possible reception windows delays are:

| Window | Parameters         | Delay |
|--------|--------------------|-------|
| RX1    | JOIN_ACCEPT_DELAY1 | 5s    |
| RX2    | JOIN_ACCEPT_DELAY2 | 6s    |

During that operation, the end-device shares the sessions keys with the server.

#### 4.4.5.2 Unjoined

If the LoRaWAN® gateway is out of the product range, or if the end-device is not enrolled on the network, the product will not receive any join accept response and will be in an unjoined state.

In that state, system tries to rejoin the network every 10 seconds and increases the join timer in case of failure by 20%, up to 30 minutes maximum.

However, the rejoin timer may conflict with the measurement interval. If the rejoin happens at the same time as a measurement, the measurement will synchronize with rejoin.

The value of the retry timer can be found below:

| Try index | Calculation         | Next retry in second |
|-----------|---------------------|----------------------|
| 1         | N/A                 | 8                    |
| 2         | $8 \times 1.25$     | 10                   |
| 3         | $10 \times 1.25$    | 12.5                 |
| 4         | $12.5 \times 1.25$  | 15.625               |
| N         | $(N-1) \times 1.25$ | Limit to 30min       |

Note that for EU868 regions, the join-request may be sent only every 8 hours due to duty-cycle restriction.

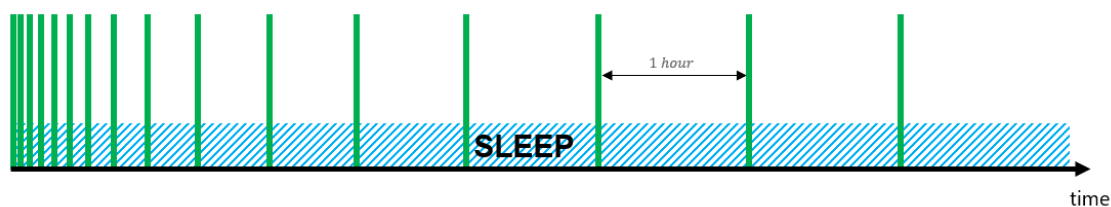


Figure 2: Rejoin procedure in case of failure

#### Normal mode

Once the product has joined the LoRaWAN® network, it operates in normal mode.

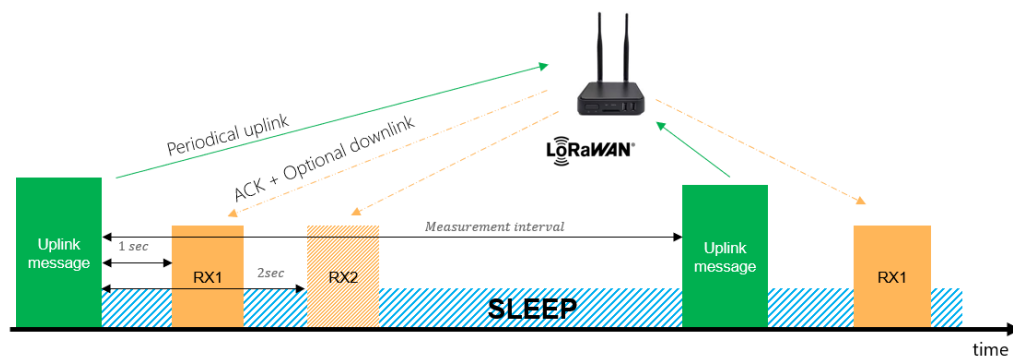


Figure 3 Normal mode of operation

### Uplink message

Every measurement determined by the measurement interval or new threshold event will trigger an uplink message.

If the server does not send back the LoRaWAN® ACK flag, the product implements an error counter. After 10 consecutive fails, it will try to rejoin the network.

To ensure that the sensor is still alive a Keep Alive frame is sent. The interval between the Keep Alive frame can be changed by the user. This frame is a dedicated frame.

#### 4.4.5.3 Downlink message

Following each uplink transmission, the end-device (LoRaWAN® Class A) opens one or two receive windows for potential downlink messages. If no packet is destined for the product in RX1, the device opens the second receive window (RX2).

The possible reception windows delays are:

| Window | Parameters     | Delay |
|--------|----------------|-------|
| RX1    | RECEIVE_DELAY1 | 1s    |
| RX2    | RECEIVE_DELAY2 | 2s    |

If the sensor is configured with LoRaWAN® Event Mode, the system will receive a configuration only when Keep Alive is sent.

This frame is a dedicated frame.

Keep alive interval can be configured by the user.

#### 4.4.5.4 Message Priority

The system cannot perform a measurement phase and communication phase at the same time. The communication phase can be nominal uplink, keep alive or downlink.

In case of downlink response or a Keep Alive not sent due to duty cycle, the frame will be postponed by 2 minutes and 30 seconds upon priority.

For system stability system set priority upon phase:

##### **Priority 1: Downlink**

While downlinks are received or communication is on LoRaWAN® RX with no downlink, no measurements and communication (nominal uplink and Keep Alive) are performed.

After each downlink response, if no other downlink is received downlink phase is ended.

Measurement, nominal uplink and keep alive will be restarted at same interval as before.

**Priority 2:** Measurement and nominal uplink

If a downlink phase is not in progress, the system measures and sends an uplink. When a Keep Alive should occur in a timeslot of 30s before a measurement, the measurement will be performed. Keep Alive is not performed and never sent.

**Priority 3:** Keep Alive: If no measurement is scheduled and the system isn't in a downlink phase, system will send a Keep Alive signal.

## 4.4.6 Specific Led Behavior for LoRaWAN®

**LoRaWAN® Specific Led Behavior**

| Category  | Mode                  | Description            | Pattern            |
|-----------|-----------------------|------------------------|--------------------|
| Operation | LoRaWAN® join request | Join request message   | 3 very fast blinks |
|           | Uplink                | Sending uplink message | Very fast blink    |
| Status    | Success               | Operation successful   | Very fast blink    |
|           | Fail                  | Operation failed       | 1 second long on   |

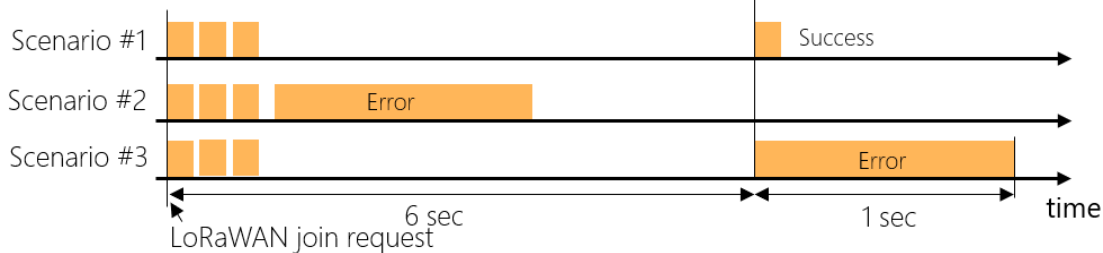
**LoRaWAN® join request example**

A normal join request gives 3 shorts blinks (few milliseconds on), a 6 second delay, then another short blink. In case of an error, the LED is turned on for about 1 second.

Scenario #1: A LoRaWAN® join request is shown with 3 short blinks (few milliseconds on) and about a 6 seconds later, another short blink (join accept from the gateway).

Scenario #2: For EU-868 region, if an error pattern (1 second on) is shown just after the 3 blinks, it means the device hasn't sent the message due to duty cycle restrictions.

Scenario #3: In case of no response from the gateway, and after about 6 seconds after the 3 short blinks, the LED is turned on for about 1 second.

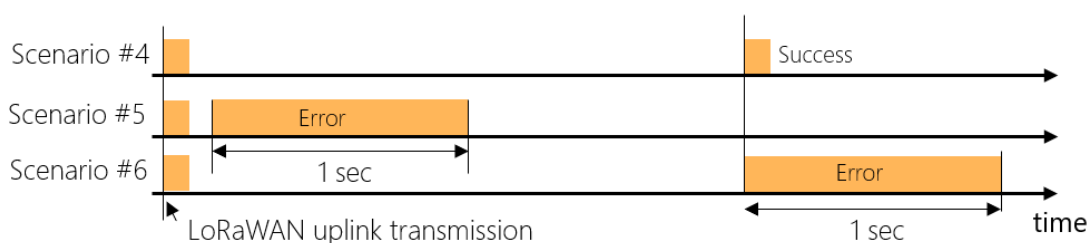


#### 4.4.7 LoRaWAN® uplink transmission example

Scenario #4: A normal uplink transmission gives 1 short blink (few milliseconds on) and few seconds later, another short blink (ACK from the gateway).

Scenario #5: For EU-868 region, if an error pattern (1 second on) is shown just after a short blink, it means the device hasn't sent the message due to duty cycle restrictions.

Scenario #6: In case of no response from the gateway (the confirmed message needs a downlink with an acknowledge), delay is about 8 seconds after the short blink, the LED is turned on for about 1 second (NACK).



## 4.5 PAYLOAD description

### 4.5.1 Keep Alive

| ADVERTISEMENT GENERIC |    |   |         |   |                         |   |   |   |     |   |          |
|-----------------------|----|---|---------|---|-------------------------|---|---|---|-----|---|----------|
| byte                  | 0  | 1 | 2       | 3 | 4                       | 5 | 6 | 7 | 8   | 9 | 10       |
| field                 | CI |   | DEVTYPE |   | CUSTOM ADVERTISING DATA |   |   |   | CNT |   | DEV STAT |

- CI: Company identifier, 0xDE08
- DEVTYPE: Information about the product
- CUSTOM ADV DATA: 4-byte array
- CNT: measurement counter
- DEVSTAT: System global status
- BATT: Battery level

## 4.5.2 BLE Generic Advertising message format

Advertising is sent during phase 1.

| ADVERTISEMENT GENERIC |    |         |   |                               |   |   |   |     |             |   |      |      |          |    |    |    |    |    |
|-----------------------|----|---------|---|-------------------------------|---|---|---|-----|-------------|---|------|------|----------|----|----|----|----|----|
| byte                  | 0  | 1       | 2 | 3                             | 4 | 5 | 6 | 7   | 8           | 9 | 10   | 11   | 12       | 13 | 14 | 15 | 16 | 17 |
| field                 | CI | DEVTYPE |   | CUSTOM<br>ADVERTISING<br>DATA |   |   |   | CNT | DEV<br>STAT |   | BATT | TEMP | SENSOR32 |    |    |    |    |    |

- CI: Company identifier, 0x08DE
- DEVTYPE: Information about the product
- CUSTOM ADV DATA: 4-byte array
- CNT: measurement counter
- DEVSTAT: System global status
- BATT: Battery level
- TEMP: Secondary data from sensor 2-Byte.
- SENSOR32: Main data from the sensor 4-Byte  
SENSOR32 data type is defined by DEVTYPE output field.

## 4.5.3 Uplink message (Platform -> Gateway)

### 4.5.3.1 Keep Alive

| LoRaWAN® Keep Alive (fport30 + confirmed flag) |         |   |     |   |             |      |
|------------------------------------------------|---------|---|-----|---|-------------|------|
| byte                                           | 0       | 1 | 2   | 3 | 4           | 5    |
| field                                          | DEVTYPE |   | CNT |   | DEV<br>STAT | BATT |

- DEVTYPE: Information about the product
- CNT: measurement counter
- DEVSTAT: System global status
- BATT: Battery level

#### 4.5.3.2 Nominal Data uplink

The uplink “sensor data” message follows the standard format.

| LoRaWAN® Nominal Uplink format (fport:10 + confirmed flag depending on % of acknowledge) |         |   |     |   |             |      |        |   |          |   |    |    |
|------------------------------------------------------------------------------------------|---------|---|-----|---|-------------|------|--------|---|----------|---|----|----|
| byte                                                                                     | 0       | 1 | 2   | 3 | 4           | 5    | 6      | 7 | 8        | 9 | 10 | 11 |
| field                                                                                    | DEVTYPE |   | CNT |   | DEV<br>STAT | BATT | TEMP16 |   | SENSOR32 |   |    |    |

- DEVTYPE: Information about the product
- CNT: measurement counter
- DEVSTAT: System global status
- BATT: Battery level
- TEMP: Secondary data from sensor 2-Byte.
- SENSOR32: Main data from the sensor 4-Byte (Pressure)  
SENSOR32 data type is defined by DEVTYPE output field.

#### 4.5.3.3 Uplink Information Response frame

| LoRaWAN® Information Response Uplink format (fport:20) |                       |   |      |   |         |  |  |  |  |  |   |
|--------------------------------------------------------|-----------------------|---|------|---|---------|--|--|--|--|--|---|
| byte                                                   | 0                     | 1 | 2    | 3 | ...     |  |  |  |  |  | n |
| field                                                  | OPERATION<br>RESPONSE |   | UUID |   | PAYLOAD |  |  |  |  |  |   |

- RESPONSE: Context about response from the system.

**Note:** (Only for software version 3.3.X and above) After a Read (0x00) or Write+Read(0x02) request, the sensor automatically sends a Response (fPort 20) as soon as possible (directly in US915 or when the Duty Cycle limitation elapses in EU868).

Also, the sensor sends a response (fPort 20) if an error is detected when a Write (0x01) is performed. This should not impact the periodic uplink messages.

| OPERATION RESPONSE |          |               |           |         |             |   |           |
|--------------------|----------|---------------|-----------|---------|-------------|---|-----------|
| byte               | 0        |               |           |         |             |   |           |
| bit                | 7        | 6             | 5         | 4       | 3           | 2 | 1 0       |
| field              | UUID_UNK | OPERATION_ERR | READ_ONLY | NET_ERR | PERIOD_SKIP |   | OPERATION |

- UUID\_UNK: set if characteristic does not exist
- OPERATION\_ERR: set if invalid payload or configuration
- READ\_ONLY: set if not able to write because the field is read only
- NET\_ERR: set if partial response sent (check DR vs payload max)
- PERIOD\_SKIP: If there is a conflict with the periodic message, the system informs the network that it is giving priority to the operation frame. The measurement is stored but not sent.
- OPERATION

| Read/Write                                                                                           | Value |
|------------------------------------------------------------------------------------------------------|-------|
| Read                                                                                                 | 0     |
| Write + Read of last data written<br>Note: Read the value from the register even if the write fails. | 2     |

- UUID: Service ID to identify the service answer.  
Note1: UUID for LoRaWAN® operation requests and responses are UUID characteristics.
- PAYLOAD: Information from the service

#### 4.5.3.4 Downlink message (Gateway -> Platform)

The downlink frame formats are defined as below.

*Information and configuration request downlink*

| LoRaWAN® Write or Write/Read Request Downlink format (fport:20) |                   |      |   |         |     |  |  |  |  |  |   |
|-----------------------------------------------------------------|-------------------|------|---|---------|-----|--|--|--|--|--|---|
| byte                                                            | 0                 | 1    | 2 | 3       | ... |  |  |  |  |  | n |
| field                                                           | OPERATION REQUEST | UUID |   | PAYLOAD |     |  |  |  |  |  |   |

*Frame format for Write or Write/Read request*

| LoRaWAN® Read Request Downlink format (fport:20) |  |                   |      |
|--------------------------------------------------|--|-------------------|------|
| byte                                             |  | 0                 | 1 2  |
| field                                            |  | OPERATION REQUEST | UUID |

*Frame format for write request*

- OPERATION REQUEST: Define if the user wants to read, write, or write with system acknowledgement of the data

| OPERATION REQUEST |   |   |   |   |                    |   |           |
|-------------------|---|---|---|---|--------------------|---|-----------|
| byte              | 0 |   |   |   |                    |   |           |
| bit               | 7 | 6 | 5 | 4 | 3                  | 2 | 1 0       |
| field             |   |   |   |   | FRAGMENTED<br>DATA |   | OPERATION |

| OPERATION                         | Value | Comment                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Read                              | 0     | Read a configuration/data over LoRaWAN®<br><i>Note: Read function is not available for threshold and datalog. To read threshold or datalog the user should use the Write/Read operation frame with threshold or the datalog read function.</i>                                                                                                         |
| Write                             | 1     | Write a configuration/data over LoRaWAN®.<br><i>Note1: If the configuration is Read Only, the system will send back an operation error</i><br><i>Note2: The read function is not available for threshold and datalog. To read threshold or datalog the user should use the Write/Read operation frame with threshold or the datalog read function.</i> |
| Write + Read of last data written | 2     | Write configuration/data over LoRaWAN® and then the system will read and send the value stored into configuration.<br><i>Note1: If a write error occurs value read will be the same as before.</i>                                                                                                                                                     |

- **UUID:** Service ID to identify the service answer.  
**Note1:** UUID for LoRaWAN® operation request and response are UUID characteristic.
- **PAYLOAD:** Information from the service. Payload is empty if a read request is asked.

## 4.5.4 Global overview of payload available depending on communication

| Function              | Service Address | Information                                | Characteristic Address<br>UUID to use for<br>LoRaWAN®<br>communication | Payload size<br>(Bytes) | BLE                              | LoRaWAN®                                                    |
|-----------------------|-----------------|--------------------------------------------|------------------------------------------------------------------------|-------------------------|----------------------------------|-------------------------------------------------------------|
| Generic access        | 1800            | Device Name                                | 2A00                                                                   | 25                      | Connected: R                     | /                                                           |
|                       |                 | Appearance                                 | 2A01                                                                   | 2                       | Connected: R                     | /                                                           |
|                       |                 | Peripheral Preferred Connection Parameters | 2A04                                                                   | 8                       | Connected: R                     | /                                                           |
|                       |                 | Central Address Resolution                 | 2AA6                                                                   | 1                       | Connected: R                     | /                                                           |
| Generic Attribute     | 1801            | Service Change                             | 2A05                                                                   | 0                       | Connected: R                     | /                                                           |
| Device information    | 180A            | Model Number                               | 2A24                                                                   | 6                       | Connected: R                     | Operation Msg: R                                            |
|                       |                 | Serial Number                              | 2A25                                                                   | 13                      | Connected: R                     | Operation Msg: R                                            |
|                       |                 | Firmware revision                          | 2A26                                                                   | 23                      | Connected: R                     | Operation Msg: R                                            |
|                       |                 | Hardware revision                          | 2A27                                                                   | 7                       | Connected: R                     | Operation Msg: R                                            |
|                       |                 | Manufacturer                               | 2A29                                                                   | 9                       | Connected: R                     | Operation Msg: R                                            |
| Device                | FC00            | Device status                              | FC01                                                                   | 1                       | Connected: R/N<br>Advertising: R | Periodic Uplink<br>Keep Alive Msg                           |
| Battery               | 180F            | Battery level                              | 2A19                                                                   | 1                       | Connected: R/W<br>Advertising: R | Periodic Uplink<br>Keep Alive Msg<br>Operation Msg: R/W/W+R |
| Bluetooth®            | CD00            | Customer Specific Data                     | CD01                                                                   | 4                       | Connected: R/W<br>Advertising: R | /                                                           |
|                       |                 | BLE Adv Mode Configuration                 | CD02                                                                   | 1                       | Connected: R/W                   | Operation Msg: R/W/W+R                                      |
|                       |                 | Change Device Name                         | CD03                                                                   | 25                      | Connected: R/W<br>ScanResp: R    | /                                                           |
| Environmental sensing | 181A            | Internal platform temperature              | 2A6E                                                                   | 2                       | Connected: R/N                   | Operation Msg: R                                            |

| Function              | Service Address | Information                    | Characteristic Address<br>UUID to use for LoRaWAN® communication | Payload size (Bytes) | BLE                                | LoRaWAN®                                              |
|-----------------------|-----------------|--------------------------------|------------------------------------------------------------------|----------------------|------------------------------------|-------------------------------------------------------|
| Keep Alive            | CE00            | Keep Alive configuration       | CE01                                                             | 1                    | Connected: R/W                     | Operation Msg: R/W/W+R                                |
| Data collection       | B300            | Measurement Counter            | B301                                                             | 2                    | Connected: R/W/N<br>Advertising: R | Periodic Uplink<br>Keep Alive Msg<br>Operation Msg: R |
|                       |                 | Measurement interval           | B302                                                             | 3                    | Connected: R/W                     | Operation Msg: R/W/W+R                                |
|                       |                 | Trig measurement               | B303                                                             | 1                    | Connected: W                       | Operation Msg: W/W+R                                  |
| Last data from sensor | DA00            | Last data acquired             | DA01                                                             | 6                    | Connected: R/N<br>Advertising: R   | Periodic Uplink<br>Operation Msg: R                   |
| Live Mode             | B400            | Live Measurement interval      | B401                                                             | 1                    | Connected: R                       | /                                                     |
|                       |                 | Live mode configuration        | B402                                                             | 1                    | Connected: R/W                     | /                                                     |
| Threshold             | B200            | Threshold                      | B201                                                             | 5                    | Connected: R/W/N                   | Operation Msg: W/W+R                                  |
| Datalog Raw value     | DB00            | Datalog data                   | DB01                                                             | /                    | Connected: R/W/N                   | Operation Msg: W/W+R                                  |
| LoRaWAN®              | F800            | LoRaWAN® Mode Configuration    | F810                                                             | 1                    | Connected: R/W                     | Operation Msg: R/W/W+R                                |
|                       |                 | DevEUI                         | F801                                                             | 8                    | Connected: R                       | Operation Msg: R                                      |
|                       |                 | AppEUI                         | F802                                                             | 8                    | Connected: R                       | Operation Msg: R                                      |
|                       |                 | Region                         | F803                                                             | 1                    | Connected: R                       | Operation Msg: R                                      |
|                       |                 | NetID                          | F804                                                             | 4                    | Connected: R                       | Operation Msg: R                                      |
|                       |                 | Status (Reserved)              | F805                                                             |                      | Connected: R                       | Operation Msg: R                                      |
|                       |                 | Percentage of confirmed uplink | F806                                                             | 1                    | Connected: R/W                     | Operation Msg: R/W/W+R                                |
| DFU                   | FE59            | OTA process                    | -                                                                | /                    |                                    |                                                       |
| Engineering           | DD00            | Reserved                       | DD01                                                             | /                    | Connected: R/W                     | /                                                     |

**Note1:** Two BLE generic services are embedded into the sensor:

- GENERIC ATTRIBUTE
- GENERIC ACCESS

These are mandatory for BLE use.

**Note2:** UUID for LoRaWAN® operation request and response are UUID characteristics.

**Note3:** All bytes in a frame are coded in BigEndian when used with a TE custom service  
 All bytes in a frame are coded in LittleEndian when linked with BLE standard  
 When specific code is implemented, a note is added into description.

**Note4:** All array of byte is coded in BigEndian

**Note5:** Serial Number is the BLE MAC Address

**Note6:** When a byte is composed of bit fields, unused bits must remain set to “0”.  
 Setting an empty or unused bit might create unexpected behavior of the sensor when writing into a bit field register.

#### 4.5.5 Device status

| DEVICE STATUS |                  |                  |               |           |                 |   |   |                   |
|---------------|------------------|------------------|---------------|-----------|-----------------|---|---|-------------------|
| byte          | 0                |                  |               |           |                 |   |   |                   |
| bit           | 7                | 6                | 5             | 4         | 3               | 2 | 1 | 0                 |
| field         | SENSOR_<br>Error | CONFIG_<br>Error | COM_<br>Error | CONDITION | SYSTEM<br>PHASE |   |   | Battery_<br>Error |

- **SENSOR\_Error:** Sensor error (more details on sensor diagnosis)
- **CFG\_Error:** Configuration Error (Reserved for future use)
- **COM\_Error:** Communication error  
(more details on communication diagnosis)
- **CONDITION:** Threshold related
- **SYSTEM PHASE:**

| System Phase                                   | Value |
|------------------------------------------------|-------|
| Preliminary (LoRaWAN® and BLE (ex:1rst hours)) | 1     |
| Nominal (LoRaWAN® or BLE only MODE)            | 0     |

- **BATT\_Error:** Battery error (more details on Battery diagnosis)

#### 4.5.6 Device Type

DEVTYPE: Information about the product

| DT VALUE |             |             |    |    |        |             |   |   |          |                   |   |   |                         |         |   |   |
|----------|-------------|-------------|----|----|--------|-------------|---|---|----------|-------------------|---|---|-------------------------|---------|---|---|
| Bit      | 15          | 14          | 13 | 12 | 11     | 10          | 9 | 8 | 7        | 6                 | 5 | 4 | 3                       | 2       | 1 | 0 |
|          | SW Platform |             |    |    | Sensor |             |   |   | Wireless |                   |   |   | Output Type<br>SENSOR32 |         |   |   |
|          | 0           | Error       |    |    | 0      | Error       |   |   | 0        | Error             |   |   | 0                       | Error   |   |   |
|          | 1           | Platform_21 |    |    | 1      | Vibration   |   |   | 1        | BLE               |   |   | 1                       | Float   |   |   |
|          |             |             |    |    | 2      | Temperature |   |   | 2        | BLE /<br>LoRaWAN® |   |   | 2                       | Integer |   |   |
|          |             |             |    |    | 3      | Pressure    |   |   |          |                   |   |   |                         |         |   |   |
|          |             |             |    |    | 4      | Humidity    |   |   |          |                   |   |   |                         |         |   |   |

Example for a pressure BLE only product the DT value will be:

| DT Value | Description                                 |
|----------|---------------------------------------------|
| 0x1311   | Pressure Generic BLE with a float data type |

#### 4.5.7 Diagnosis

##### 4.5.7.1 Sensor diagnosis

| Sensor diagnosis |                    |                    |                    |                    |                      |                      |                      |                      |
|------------------|--------------------|--------------------|--------------------|--------------------|----------------------|----------------------|----------------------|----------------------|
| bit              | 7                  | 6                  | 5                  | 4                  | 3                    | 2                    | 1                    | 0                    |
| field            | TEMP16_OoR_<br>ERR | TEMP16_CRC_<br>ERR | TEMP16_CAL_<br>ERR | TEMP16_CIR_<br>ERR | SENSOR32_OoR_<br>ERR | SENSOR32_CRC_<br>ERR | SENSOR32_CAL_<br>ERR | SENSOR32_CIR_<br>ERR |

- **TEMP16\_OoR:** Secondary sensor data out of range.  
Pressure: -40°C +85°C or data is unreliable (Pressure sensor operation T° range -30°C to +75°C)
- **TEMP16\_CRC\_ERR:** Secondary sensor data read error (CRC error)
- **TEMP16\_CAL\_ERR:** Secondary sensor calibration error (not possible to read from

EEPROM or not calibrated in ROM)

- **TEMP16\_CIR\_ERR**: Secondary sensor circuitry error (no answer from sensor). It concerns the acquisition of the sensor and the sensor calibration reading.
- **SENSOR32\_OoR**: Main sensor data out of range or unreliable.  
Embedded into Register address (0x40)
- **SENSOR32\_CRC\_ERR**: Main sensor data read error (CRC data error)
- **SENSOR32\_CAL\_ERR**: Main sensor calibration error  
(not possible to read from EEPROM or not calibrated in ROM)
- **SENSOR32\_CIR\_ERR**: Main sensor circuitry error  
(No answer from sensor)

#### 4.5.7.2 Communication diagnosis

| COMMUNICATION Diagnosis |   |   |   |   |   |                               |                      |                             |
|-------------------------|---|---|---|---|---|-------------------------------|----------------------|-----------------------------|
| bit                     | 7 | 6 | 5 | 4 | 3 | 2                             | 1                    | 0                           |
| field                   |   |   |   |   |   | LORA_REGIONAL_<br>RESTRICTION | LORA_POWER_<br>ERROR | LORA_NETWORK_<br>JOIN_ERROR |

- **LoRa\_Network\_Join\_Error:**

| State                                    | Value |
|------------------------------------------|-------|
| System connected to network              | 0     |
| System has not joined a LoRaWAN® network | 1     |

- **LoRa\_Power\_Error:**

| State              | Value |
|--------------------|-------|
| No power issues    | 0     |
| Power issue occurs | 1     |

- **LoRa\_Regional\_Restriction:**

| State                                                              | Value |
|--------------------------------------------------------------------|-------|
| No restriction                                                     | 0     |
| LoRaWAN® communication is restricted by region policy (Duty cycle) | 1     |

## 4.5.7.3 Battery diagnosis

| Sensor diagnosis |   |   |   |   |   |                     |                 |                    |
|------------------|---|---|---|---|---|---------------------|-----------------|--------------------|
| bit              | 7 | 6 | 5 | 4 | 3 | 2                   | 1               | 0                  |
| field            |   |   |   |   |   | BATTERY_<br>WARNING | BATTERY_<br>LOW | BATTERY_<br>CHANGE |

**BATTERY\_Warning:**

Voltage drop occurs during Measurement, Communication, or Sleep mode:

- Measurement continues (in case of voltage drop during measure data into frame is replace by NaN or 7FFFFFFF).
- Communication continues

| State                  | Value |
|------------------------|-------|
| No battery warning     | 0     |
| Battery warning occurs | 1     |

**BATTERY\_Low:** Battery capacity is below 15%

User should plan a battery change:

- Measurement continues
- Communication continues

| State             | Value |
|-------------------|-------|
| No battery issues | 0     |
| Battery low       | 1     |

**BATTERY\_Change:** Several voltage issues occur during sleep or communication.

User should change the battery:

- Measurement is stopped
- Communication is only Keep Alive

| State                       | Value |
|-----------------------------|-------|
| No battery change requested | 0     |
| Battery change requested    | 1     |

#### 4.5.8 Battery

| BATTERY |          |   |   |   |   |   |   |   |
|---------|----------|---|---|---|---|---|---|---|
| bit     | 7        | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field   | BATTERY8 |   |   |   |   |   |   |   |

**BATTERY8:** percentage of remaining battery. Writing 0xFF in this register will reset the battery algorithm to 100%.

Other values written here will be ignored.

#### 4.5.9 Bluetooth®

##### 4.5.9.1 Customer specific data

| CAD |   |   |   |
|-----|---|---|---|
| 3   | 2 | 1 | 0 |
| CAD |   |   |   |

- **CAD:** Custom Advertisement Data: 4Bytes

##### 4.5.9.2 BLE Adv Mode Configuration

| ADV_CFG |          |   |   |   |   |   |          |   |
|---------|----------|---|---|---|---|---|----------|---|
| bit     | 7        | 6 | 5 | 4 | 3 | 2 | 1        | 0 |
| field   | ADV_MUTE |   |   |   |   |   | ADV_MODE |   |

**ADV\_MUTE:** when the external device is connected, the system stops advertising until the next event or measurement if this flag is set. Flag is reset on next event.

**ADV\_MODE:**

| Mode                      | Value | Description                                                                 |
|---------------------------|-------|-----------------------------------------------------------------------------|
| ADV Burst + Periodic Mode | 0     | Advertisement 15 times every second after measurement then every 10 seconds |
| ADV On Measure Burst Mode | 1     | Advertisement 15 times every second only after a measurement.               |
| ADV Silent Mode           | 2     | No advertisement included even after measurement.                           |
| ADV Periodic Mode         | 3     | Advertise periodically                                                      |

## 4.5.9.3 Advertisement interval for ADV Periodic Mode

**Note:** On LoRaWAN® devices this service will be hidden during BLE discovery mode.  
Interval between two advertisements **when ADV Periodic mode is selected.**

| ADV_Interval |   |   |   |   |   |                                                      |     |
|--------------|---|---|---|---|---|------------------------------------------------------|-----|
| bit          | 7 | 6 | 5 | 4 | 3 | 2                                                    | 1 0 |
| field        |   |   |   |   |   | ADV_INTERVAL_PERIODIC_ONLY<br>ADV periodic mode only |     |

## ADV\_INTERVAL\_PERIODIC\_ONLY: (ADV periodic mode only)

| Value | Description               |
|-------|---------------------------|
| 0     | Advertisement every 500ms |
| 1     | Advertisement every 1s.   |
| 2     | Advertisement every 1,5s. |
| 3     | Advertisement every 2s.   |
| 4     | Advertisement every 3s.   |
| 5     | Advertisement every 4s.   |
| 6     | Advertisement every 5s.   |
| 7     | Advertisement every 10s.  |

**Note1:** Default value is 10s. Minimum value is 500ms.

**Note2:** This value can be only use for ADV Periodic.

## 4.5.9.4 Change Device Name

Change device name characteristic allows customer to change device name.

| Device Name |   |   |   |   |   |   |   |
|-------------|---|---|---|---|---|---|---|
| 24          | - | 5 | 4 | 3 | 2 | 1 | 0 |
| DEVICE NAME |   |   |   |   |   |   |   |

- **DEVICE NAME:** Device name when BLE scan: 25 Bytes

**Note1:** Only ASCII characters are permitted.

**Note2:** Any (0x00) \0 is recognized as an end of string.

**Note3:** Value returned is a string (without \0 at the end)

## 4.5.10 Internal platform temperature

| INTERNAL_TEMPERATURE16 |                        |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|------------------------|------------------------|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| Bit                    | 15                     | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field                  | INTERNAL_TEMPERATURE16 |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |

**INTERNAL\_TEMPERATURE16** (signed): Internal temperature of the platform

$$TEMP_{\circ C} = INTERNAL\_TEMPERATURE16 * 0.01$$

## 4.5.11 Keep Alive

Configure Keep Alive over LoRaWAN®.

| Keep Alive Configuration |   |   |   |                 |   |   |                     |   |
|--------------------------|---|---|---|-----------------|---|---|---------------------|---|
| bit                      | 7 | 6 | 5 | 4               | 3 | 2 | 1                   | 0 |
| field                    |   |   |   | Keep_Alive_Mode |   |   | Keep_Alive Interval |   |

## Keep Alive Interval

| State                | Value |
|----------------------|-------|
| Keep Alive every 24h | 0     |
| Keep Alive every 12h | 1     |
| Keep Alive every 8h  | 2     |
| Keep Alive every 4h  | 3     |
| Keep Alive every 2h  | 4     |

**Note:** Default value is 24 hours.

**Keep\_Alive\_Mode:**

| State                                                                                                                         | Value |
|-------------------------------------------------------------------------------------------------------------------------------|-------|
| Keep Alive Active and send every time                                                                                         | 0     |
| Keep Alive Active and not emitted if a data is sent between two Keep Alive. Keep Alive interval is reset when a frame is sent | 1     |
| Keep Alive Disabled                                                                                                           | 2     |

**Note:** Default value is 0.

## 4.5.12 Data Collection

## 4.5.12.1 Measurement Counter

| MEASUREMENT COUNTER (R/W) |       |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |
|---------------------------|-------|----|----|----|----|----|---|---|---|---|---|---|---|---|---|---|
| Bit                       | 15    | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field                     | CNT16 |    |    |    |    |    |   |   |   |   |   |   |   |   |   |   |

- **CNT16:** Number of measurements done. When it reaches 0xFFFF it will reset to 0x0000. Writing 0x0000 will reset the counter to 0x0000. Other values won't affect current counter.

## 4.5.12.2 Measurement interval

Interval between two measurements.

| MEAS_INTERVAL |        |         |         |
|---------------|--------|---------|---------|
| Byte          | 0      | 1       | 2       |
| field         | HOURL8 | MINUTE8 | SECOND8 |

- **HOURL8:** Number of hours [0-255]
- **MINUTE8:** Number of minutes [0-255]
- **SECOND8:** Number of seconds [0-255]
- **MEAS\_INTERVAL** = "HOURL8" & "MINUTE8" & "SECOND8"

**Note1:** Default value is 10min. Minimum value is 1second. Value 0x000 (0h0min0s) is not considered.

**Note2:** It is possible to write the value only in minutes (e.g.:120min).

The system will automatically transform values into standard time representation (e.g.:120min = 2hours).

**Note3:** When a measurement interval is modified by the user, the next new measurement will be completed after the new measurement interval the system won't wait until the end of the current measurement interval.

**Note4:** Maximum value is HOUR8: 0xFF MINUTE8: 0x3B SECOND8: 0x3B. (255h 59min 59s) If a written value exceeds this value, it won't be considered.

#### 4.5.12.3 Trigger Measurement

When using a TRIG, the system will send the data first over BLE and then LoRaWAN®

| TRIG MODE |        |   |   |   |   |   |   |      |
|-----------|--------|---|---|---|---|---|---|------|
| bit       | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0    |
| field     | DISCON |   |   |   |   |   |   | TRIG |

**TRIG:** trigger a new measurement flow (read raw values, temperature, battery and process the data)

| Trig                      | Value |
|---------------------------|-------|
| Disabled                  | 0     |
| Request a new measurement | 1     |

**DISCON:** force BLE disconnection before measurement trigger.

| Trig                             | Value |
|----------------------------------|-------|
| Disabled                         | 0     |
| BLE connected mode disconnection | 1     |

**Note:** Only 0x81 and 0x01 are allowed.

#### 4.5.12.4 Last data from sensor

Last data acquired from the sensor:

| Last data |        |   |          |   |   |   |
|-----------|--------|---|----------|---|---|---|
| Byte      | 0      | 1 | 2        | 3 | 4 | 5 |
| field     | TEMP16 |   | SENSOR32 |   |   |   |

**TEMP16:** Temperature of the sensor

| Sensor Type | TEMP16 | Format/Unit                                 |
|-------------|--------|---------------------------------------------|
| Pressure    | T°C    | Big Endian<br>Signed 16bit<br>1LSB = 0.01°C |

**SENSOR32** (signed): Data from the sensor

| Sensor Type | SENSOR32     | Format/Unit               |
|-------------|--------------|---------------------------|
| Pressure    | Pressure Bar | Big Endian<br>Float 32bit |

| Pressure Full Scale (FS) (bar) | Resolution (bar) |
|--------------------------------|------------------|
| 2                              | 0.000001         |
| 7                              | 0.0000035        |
| 20                             | 0.00001          |
| 35                             | 0.0000175        |
| 200                            | 0.0001           |
| 350                            | 0.000175         |

#### 4.5.13 Live mode

##### 4.5.13.1 Measurement interval

This mode is only available over BLE connection.

| LIVE_MODE_MEAS_INTERVAL |                          |   |   |   |   |   |   |   |
|-------------------------|--------------------------|---|---|---|---|---|---|---|
| bit                     | 7                        | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field                   | LIVE_MODE_MEAS_INTERVAL8 |   |   |   |   |   |   |   |

**MEAS\_LIVE\_INTERVAL8**: Read Only value in milliseconds.

##### 4.5.13.2 Live mode configuration

| LIVE_MODE_CFG |   |   |   |   |   |   |   |        |
|---------------|---|---|---|---|---|---|---|--------|
| bit           | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0      |
| field         |   |   |   |   |   |   |   | ENABLE |

**ENABLE**: enable or disable Live mode.

| Enable   | Value |
|----------|-------|
| Disabled | 0     |
| Enabled  | 1     |

**NOTE:** Two ways are available to stop “Live mode”:

- BLE disconnection from the central device or with the magnet
- Send Live Mode disable to LIVE\_MODE\_CFG

## 4.5.14 Threshold

To request threshold parameters, use the following frame:

| Request Threshold information |         |           |
|-------------------------------|---------|-----------|
| byte                          | 0       | 1         |
| field                         | ID DATA | PARAM SEL |

The sensor will respond with the following frame:

| Answer after a Read request |         |           |        |   |   |   |
|-----------------------------|---------|-----------|--------|---|---|---|
| byte                        | 0       | 1         | 2      | 3 | 4 | 5 |
| field                       | ID DATA | PARAM SEL | DATA32 |   |   |   |

To write threshold parameters:

| Write Threshold Configuration |         |           |        |   |   |   |
|-------------------------------|---------|-----------|--------|---|---|---|
| byte                          | 0       | 1         | 2      | 3 | 4 | 5 |
| field                         | ID DATA | PARAM SEL | DATA32 |   |   |   |

**ID\_DATA:** defines the source for threshold value

| Source                                |                                                      | Value |
|---------------------------------------|------------------------------------------------------|-------|
| Main sensor raw data threshold 1      | <i>pressure sensor (P)</i>                           | 0x0   |
| Main sensor Delta threshold 1         |                                                      | 0x1   |
| Secondary sensor raw data threshold 1 | <i>Temperature into sensor (P)</i>                   | 0x2   |
| Secondary Sensor Delta Threshold 1    |                                                      | 0x3   |
| Main sensor raw data threshold 2      | <i>pressure sensor (P)</i>                           | 0x4   |
| Main Sensor Delta threshold 2         |                                                      | 0x5   |
| Secondary sensor Raw data threshold 2 | <i>Temperature into sensor (P)</i>                   | 0x6   |
| Secondary sensor Delta threshold 2    |                                                      | 0x7   |
| Error                                 | ID_DATA not defined or threshold configuration error | 0xF   |

**!The temperature provided is used for internal processing and should not be used as accurate temperature data!**

**PARAM SEL:** Select parameters to be changed (more details below)

| Value              |     |
|--------------------|-----|
| THS_CONFIG         | 0x0 |
| THS_LEVEL          | 0x1 |
| MEAS_INTERVAL      | 0x2 |
| Communication_MODE | 0x3 |

- **PARAM SEL=0x0** (Threshold configuration)

This command can be used with multiple parameters.

Data32 format:

| THS_CONFIG |          |           |           |          |              |                  |              |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------|----------|-----------|-----------|----------|--------------|------------------|--------------|-----------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte       | 3        |           |           |          |              |                  |              |           | 2 |   |   |   |   |   |   |   | 1 |   |   |   |   |   |   |   | 0 |   |   |   |   |   |   |   |
| bit        | 7        | 6         | 5         | 4        | 3            | 2                | 1            | 0         | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field      | EVT_FLAG | THRESHOLD | CONDITION | AUTO_CLR | ACTION: MEAS | ACTION: ADV MODE | ACTION: COMM | MODE LoRa |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|            |          |           |           |          |              |                  |              |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|            |          |           |           |          |              |                  |              |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|            |          |           |           |          |              |                  |              |           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

**EVT\_FLAG:** Forcing this bit to 0 clears the event flag until the next trigger.

| State                    | Value |
|--------------------------|-------|
| No event detected        | 0     |
| Threshold event detected | 1     |

### THRESHOLD ENABLE

| State               | Value |
|---------------------|-------|
| Deactivated         | 0     |
| Threshold activated | 1     |

**CONDITION:** Define the threshold condition

| Condition                | Value |
|--------------------------|-------|
| Data32 < Threshold Level | 0     |
| Data32 > Threshold Level | 1     |

**AUTO\_CLR:** Auto clear once event condition

| State                                    | Value |
|------------------------------------------|-------|
| Keep flag even if the threshold is ended | 0     |
| Auto clear Flag after threshold end      | 1     |

**ACTION: MEAS\_INTERVAL:** Change Measurement Interval after the threshold level reached

| State                                       | Value |
|---------------------------------------------|-------|
| Disabled                                    | 0     |
| Change measurement interval after threshold | 1     |

**ACTION: ADV MODE BLE:** Change Advertisement mode after the threshold level reached

| State                               | Value |
|-------------------------------------|-------|
| Disable                             | 0     |
| Change ADV Mode BLE after threshold | 1     |

**ACTION: COMM MODE LoRaWAN®:** Change LoRaWAN® Communication mode after the threshold level reached

| State                                              | Value |
|----------------------------------------------------|-------|
| Disable                                            | 0     |
| Change LoRaWAN® communication mode after threshold | 1     |

**PARAM SEL=0x1** Data32 format: Threshold level

| THS_LEVEL |                 |   |       |   |
|-----------|-----------------|---|-------|---|
| Byte      | 3               | 2 | 1     | 0 |
| field     | INT32 / FLOAT32 |   |       |   |
|           | N/A             |   | INT16 |   |

Same data format as SENSOR32 /TEMP16

Default value: 0x0

**PARAM SEL=0x2** Data32 format: Measurement interval after a threshold reached

| MEAS_INTERVAL |        |         |          |             |
|---------------|--------|---------|----------|-------------|
| Byte          | 3      | 2       | 1        | 0           |
| field         | HOURL8 | MINUTE8 | SECONDE8 | 0 (Not Use) |

**Note1:** Default value is 1min. Minimum value is 1s.**Note2:** Value 0x000 (0h0min0s) is not consider.

**Note3:** Maximum value is HOUR8: 0xFF MINUTE8: 0x3B SECOND8: 0x3B.

(255h 59min 59s) If a written value exceeds this value, it will not be considered.

**PARAM SEL=0x3** Data32 format: Communication mode after a threshold reached.

| THS_COMM_MODE |   |   |   |   |   |   |              |   |   |   |   |   |   |   |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|--------------|---|---|---|---|---|---|---|-----------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Byte          | 3 |   |   |   |   |   |              |   | 2 |   |   |   |   |   |                       |   | 1 |   |   |   |   |   |   |   | 0 |   |   |   |   |   |   |   |
| bit           | 7 | 6 | 5 | 4 | 3 | 2 | 1            | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1                     | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field         |   |   |   |   |   |   | BLE_ADV_MODE |   |   |   |   |   |   |   | LoRaWAN® COMM<br>MODE |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|               |   |   |   |   |   |   |              |   |   |   |   |   |   |   |                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

#### BLE\_ADV\_MODE:

| Mode            | Value | Description                                                    |
|-----------------|-------|----------------------------------------------------------------|
| Periodic mode   | 0     | Advertisement 15 times after measurement then every 10 seconds |
| On Measure mode | 1     | Advertisement only after a measurement (15 consecutive ADV)    |
| ADV Silent mode | 2     | No advertisement included even after measurement               |
| Periodic mode   | 3     | Periodic advertisement                                         |

#### LoRaWAN®\_COMM\_MODE:

| Mode                         | Value | Description                    |
|------------------------------|-------|--------------------------------|
| LoRaWAN® On Measurement Mode | 0     | Send a frame every measurement |

### 4.5.15 Datalog

#### 4.5.15.1 Datalog array access request

| ARRAY ACCESS REQUEST |       |         |   |         |
|----------------------|-------|---------|---|---------|
| byte                 | 0     | 1       | 2 | 3       |
| field                | TYPE8 | INDEX16 |   | LENGTH8 |

- **TYPE8:** Data (0 = TEMPERATURE16, 1 = SENSOR32, 2 = TEMPERATURE16 + SENSOR32).
- **INDEX16:** start index from 0 up to 4095 for raw data (MSB first)  
0=latest data acquired, 4095= oldest data acquired

- **LENGTH8**: number of values to be read. Admissible range depends on TYPE8:
  - 1-120 for TYPE8=TEMPERATURE16
  - 1-60 for TYPE8=SENSOR32
  - 1-40 for TYPE8= TEMPERATURE16 + SENSOR32

If the required length is larger than network capabilities, the frame will be filled with the maximum possible data. No data will be truncated.

Over LoRaWAN®, if the network does not allow the sensor to provide the amount of data, a Network\_Error flag will be set in the Operation Response field.

#### 4.5.15.2 Datalog array access response with notification

| ARRAY ACCESS RESPONSE |       |         |   |         |         |  |   |         |   |
|-----------------------|-------|---------|---|---------|---------|--|---|---------|---|
| byte                  | 0     | 1       | 2 | 3       |         |  | - | m-1     | m |
| field                 | TYPE8 | INDEX16 |   | LENGTH8 | VALUE_0 |  |   | VALUE_n |   |

- **TYPE8**: Data (0 = TEMPERATURE16, 1 = SENSOR32, 2 = TEMP16 + SENSOR32).
- **INDEX16**: start index of the value
- **LENGTH8**: number of values sent
- **VALUE\_n**: SENSOR32 or TEMP16 or SENSOR32 + TEMP16. For TEMP16 the 1st Byte is a 0 value

**Note:** In case of error, ARRAY ACCESS RESPONSE will be 0xFFFFFFFF.

#### 4.5.15.3 Datalog analysis request

| DATALOG STATISTIC REQUEST |       |          |   |
|---------------------------|-------|----------|---|
| byte                      | 0     | 1        | 2 |
| field                     | TYPE8 | LENGTH16 |   |

- **TYPE8**: Value = 2  
Analysis of TEMPERATURE16 and SENSOR32  
Data format depends on sensor type. Please refer to DEVTYPE.
- **LENGTH16**: number of values to be analyzed.  
If the length required exceeds the amount of data currently stored, system will use only available data.  
The first data to be use will be last acquired data.

## 4.5.15.4 Datalog statistics response with notification

| DATALOG STATISTIC RESPONSE |               |        |   |            |   |       |   |       |   |       |    |            |       |       |       |
|----------------------------|---------------|--------|---|------------|---|-------|---|-------|---|-------|----|------------|-------|-------|-------|
| byte                       | 0             | 1      | 2 | 3          | 4 | 5     | 6 | 7     | 8 | 9     | 10 | 11-14      | 15-18 | 19-22 | 23-26 |
| field                      | TY<br>PE<br>8 | SIZE16 |   | MEAN_<br>T |   | MIN_T |   | MAX_T |   | STD_T |    | MEAN_<br>S | MIN_S | MAX_S | STD_S |

- **TYPE8:** Value= 2 (TEMPERATURE16 + SENSOR32).
- **SIZE16:** nb value used for computation
- **MEAN\_T** Mean value of batch data analyzed for temperature
- **MIN\_T** Minimum value of batch data analyzed for temperature
- **MAX\_T** Maximum value of batch data analyzed for temperature
- **STD\_T** Standard deviation value of batch data analyzed for temperature
- **MEAN\_S** Mean value of batch data analyzed for Pressure
- **MIN\_S** Min value of batch data analyzed for Pressure
- **MAX\_S** Max value of batch data analyzed for Pressure
- **STD\_S** Standard deviation value of batch data analyzed for Pressure

**Note:** In case of error, ARRAY ACCESS RESPONSE will be 0xFFFFFFFF.

**Note:** Format depends on data type. Please refer to DEVTYPE.

## 4.5.16 LoRaWAN® Platform

## 4.5.17.1 LoRaWAN® Mode configuration

| LoRaWAN® TX Mode Config |   |   |   |   |   |   |                        |   |
|-------------------------|---|---|---|---|---|---|------------------------|---|
| bit                     | 7 | 6 | 5 | 4 | 3 | 2 | 1                      | 0 |
| field                   |   |   |   |   |   |   | LORAWAN®_COMM_<br>MODE |   |

**LoRaWAN® Communication Mode:**

| Mode             | Value       | Description                                   |
|------------------|-------------|-----------------------------------------------|
| Measurement Mode | 0 (Default) | LoRaWAN® Communication at every measurement   |
| Silent Mode      | 1           | No LoRaWAN® communication at each measurement |

#### 4.5.17.2 DevEUI

This number is the 64-bit Device Extended Unique Identifier of the sensor. It is generated by TE and is derived from the TE Organizationally Unique Identifier (OUI) assigned by the IEEE Registration Authority.

#### 4.5.17.3 AppEUI

This number is the 64-bit application Extended Unique Identifier of the sensor.

#### 4.5.17.4 NET ID

Contains the operator network identifier coded on the 4-byte value (LSB first). The list of all possible operator is listed below.

[NetID and DevAddr Prefix Assignments | The Things Network](#)

For example, 0x00000013 identifies “The Things Network”.

#### 4.5.17.5 Region

LoRaWAN® configured region for either US or EU.

#### 4.5.17.6 Status Reserved

#### 4.5.17.7 LoRaWAN® percentage of confirmed uplink messages

It is possible to reduce the number of acknowledgements between the LoRaWAN® gateway and the device.

| LORA_ACK_PER |                  |   |   |   |   |   |   |   |
|--------------|------------------|---|---|---|---|---|---|---|
| byte         | 0                |   |   |   |   |   |   |   |
| bit          | 7                | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| field        | PERCENTAGE = 100 |   |   |   |   |   |   |   |

**PERCENTAGE:** Percentage of LoRaWAN® uplink confirmed messages. From 0% up to 100%. Default is 100%.

**Note:** Value 0% should not be used

**Note1:** LoRaWAN® percentage of confirmed uplink is only applied on Nominal(Keep Alive frame is confirmed) data uplink.

## 5 BATTERY

### 5.1 Saft LS17330

The system should be exclusively powered with an LS17330 battery.

| Parameters                  | Typical value                                            |
|-----------------------------|----------------------------------------------------------|
| Manufacturer                | SAFT                                                     |
| Reference                   | LS 17330                                                 |
| Technology                  | Primary lithium-thionyl chloride (Li-SOCl <sub>2</sub> ) |
| Nominal voltage             | 3.6 V                                                    |
| Capacity at 20°C            | 2100 mA                                                  |
| Operating temperature range | - 60°C /+ 85°C                                           |

### 5.2 Battery life

Depending on customer settings the battery life could extend to 10 years (dependent on measurement interval and RF communication).

The number of measurements per day will affect the battery life. More measurements will reduce the battery life.

Temperature and battery depletion can have an effect on the behavior of the system. When the temperature is higher than +60°C or lower than -30°C the electrical current availability may be reduced. A related voltage drop can affect system stability.

We have implemented some firmware mechanisms to detect this critical voltage drop. Dedicated mechanisms are implemented into:

- Sleep phase
- Measurement phase
- Communication phase

Mechanisms are based on:

- Integrated MCU voltage monitoring (POFWARN= Power Failure Warning). It will trigger a flag when voltage drops below a defined level.
- MCU internal temperature monitoring (Environmental Sensing Service)

**Sleep phase:** POFWARN is set at 2.8V.

During sleep phase, if the system had several voltages drops detected (11 consecutive times) and the temperature is between  $[-30^{\circ}\text{C} +60^{\circ}\text{C}]$ , this means that the battery may have an issue. If this issue happens several times (11 consecutive times), the system sets a battery change flag.

If the temperature is below  $-30^{\circ}\text{C}$  and higher than  $+60^{\circ}\text{C}$  and voltage drops are detected (10 consecutive times), the system sets a battery warning flag and will wait to be in nominal range  $[-30^{\circ}\text{C} +60^{\circ}\text{C}]$  to define if a battery change should be declared.

**Measurement phase:** POFWARN is set at 2.8V

During a measurement process POFWARN is activated to define if measurements acquired by the system are reliable.

If a voltage drop is detected during measurement, a specific measurement health process is activated to define if voltage drop happens at each measurement. If yes, the measurement value is set to  $0x7FFFFFFF/\text{NaN}/7FFF$ . Sensor\_Error, TEMP16\_OOR\_ERR, SENSOR32\_OOR\_ERR and Battery\_Warning is set to 1.

**Communication phase:** POFWARN is set at 2.0V

Communication phase has a memory effect about voltage drop. If a POFWARN happens it will be sent on next communication. Note if a POFWARN happens, communication frame can be sent properly.

If POFWARN happens during communication, to prevent wrong payload the system will send only Keep Alive frame with warning.

Com\_Error, Com\_Diag\_LoRa power Error and Battery\_Warning is set to 1.

If system remains in this communication phase for 10 consecutive intervals, BATTERY\_Diag Change will be set to 1.

### 6.2 BATTERY REPLACEMENT

The 69XXN's battery must be replaced if depleted.

- Remove the plastic cover following the opening directions
- Use the orange ribbon to pull out the battery
- Put the orange ribbon back to the cavity before installing the new battery.  
Note: the battery MUST be replaced by the same battery reference, SAFT LS17330.
- Put the spacer on the negative terminal and install the battery positive upward
- Pull the spacer out and then install the plastic cover and tighten it following the locking direction. Refer to the Installation Manual or the Quick Start Guide for details of battery installation and replacement.

N.B.: Only replace the battery in non-hazardous areas.

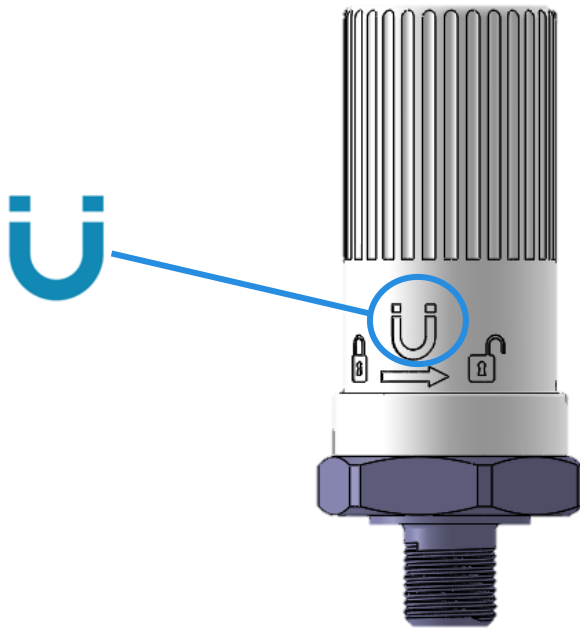
Once the battery installation is complete, the battery life meter in the firmware must be reset to a "full" battery status.

**!This action is mandatory otherwise battery level will stay at 0%!**

## 6 MAGNETIC SWITCH

To make an asynchronous data acquisition, or access BLE connected mode, use a magnet. The magnet event will trigger a measurement, then the sensor will be in Preliminary Phase.

The magnetic switch location is indicated by the magnet drawing on the plastic cover.



The magnet must be of sufficient strength and proximity to create a magnetic field of 25 mT at the switch location.

Two different functions are available depending on the user action:

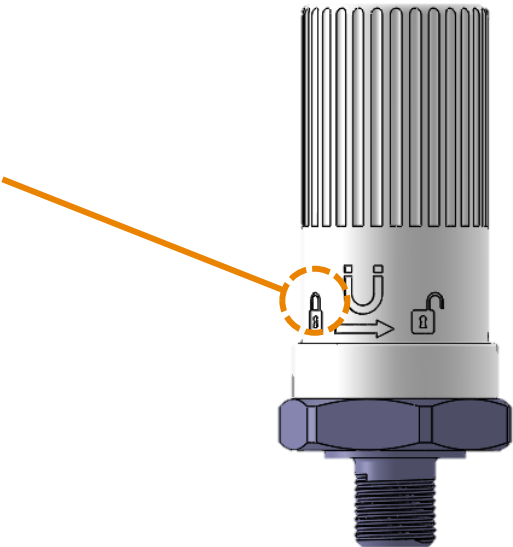
| Function                                                                                                                                                                           | User action                     | LED                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Activates BLE for another one hour<br>Trigs a new measurement and a LoRaWAN <sup>®</sup> ™ transmission (uplink if joined, else join request<br>Disconnect from BLE connected mode | Short tap                       | One fast blink. If user holds the magnet close to the switch for a longer duration, the LED will blink faster. Remove the magnet to only initiate a transmission, or else a sensor reset will be initiated |
| System Restart                                                                                                                                                                     | Hold the magnet for 10 seconds. | Wait for at least 10 seconds, to see the very fast blink. Release the magnet once a very long orange led appears                                                                                           |

7 LED

A yellow LED is used to indicate user some specific event:

|                    |          | LED Behavior  |
|--------------------|----------|---------------|
| Battery insertion  |          | ON for 2s     |
| Magnet event       |          | ON for 200ms  |
| Maintaining Magnet | <3s      | Slow blinking |
|                    | [3s-10s] | Fast blinking |
|                    | >10s     | OFF -> reboot |

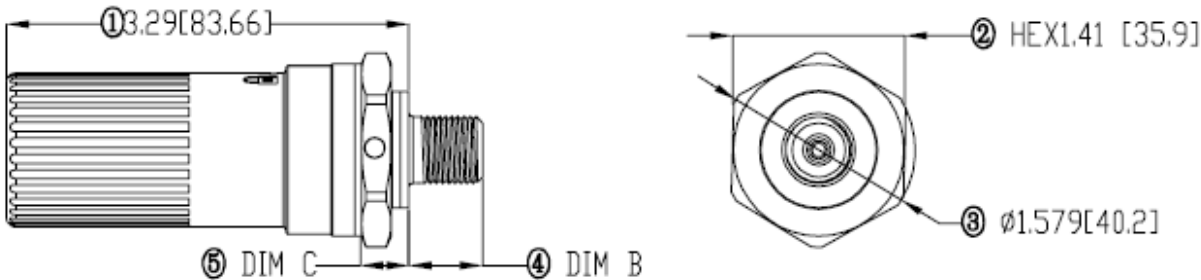
LED Location  
(Inside translucent cover)



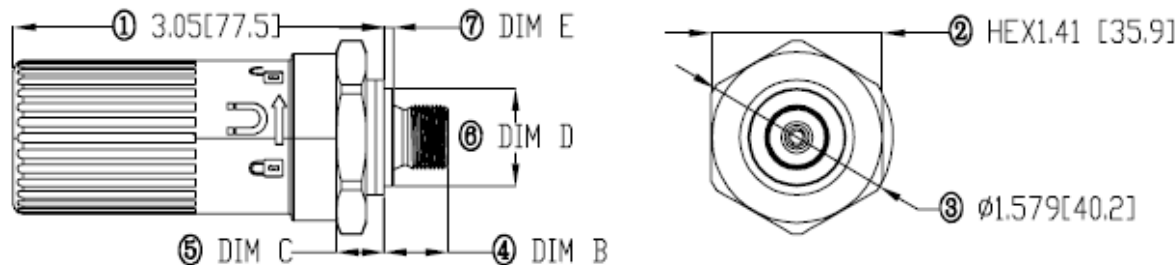
## 8 DIMENSIONS

Dimensions units: Inches [Millimeter]

### COMPOUND TYPE CRITICAL DIMENSIONS



### ABSOLUTE TYPE CRITICAL DIMENSIONS



| PORT TYPE   | PRESSURE RANGE | DIM B TYP.       | DIM D TYP.      | DIM E TYP.       |
|-------------|----------------|------------------|-----------------|------------------|
| 1/4-18 NPT  | 2 BAR          | 0.60<br>[15.24]  | NA              | NA               |
|             | 7 BAR          |                  |                 |                  |
|             | 20 BAR         |                  |                 |                  |
|             | 35 BAR         |                  |                 |                  |
|             | 200 BAR        |                  |                 |                  |
|             | 350 BAR        |                  |                 |                  |
| 1/4-19 BSPP | 2 BAR          | 0.526<br>[13.36] | 0.80<br>[20.32] | 0.075<br>[1.905] |
|             | 7 BAR          |                  |                 |                  |
|             | 20 BAR         |                  |                 |                  |
|             | 35 BAR         |                  |                 |                  |
|             | 200 BAR        |                  |                 |                  |
|             | 350 BAR        |                  |                 |                  |

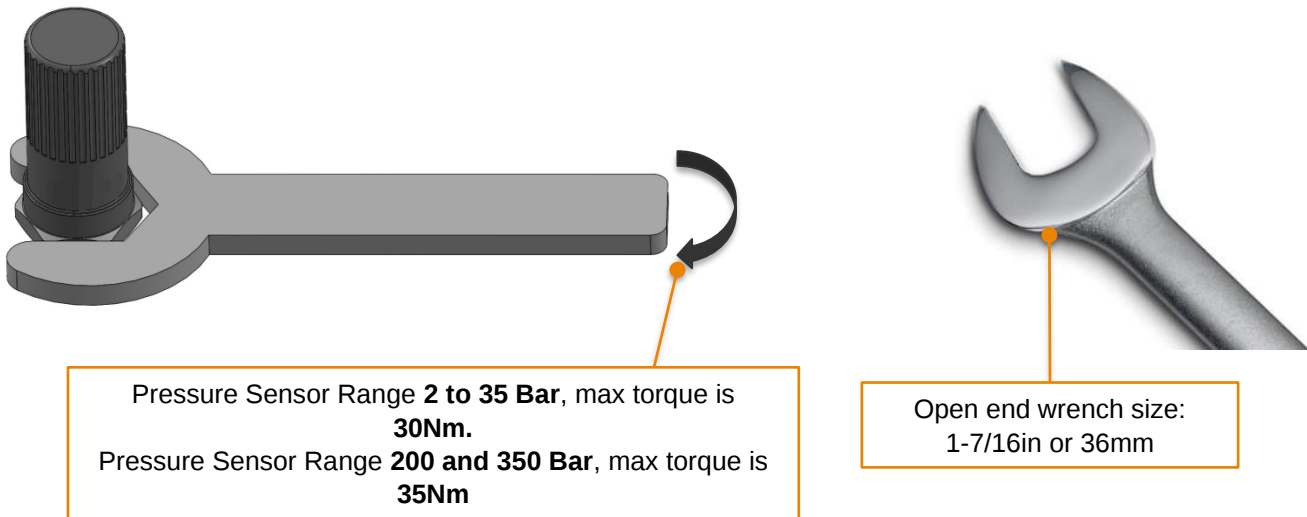
| Pressure Range   | PRESSURE REF         | DIM C TYP.   |
|------------------|----------------------|--------------|
| 2, 7, 20, 35 BAR | ABSOLUTE             | 0.397[10.08] |
|                  | COMPOUND             | 0.391[9.92]  |
| 200, 350 BAR     | ABSOLUTE<br>COMPOUND | 0.397[10.08] |

## 9 MOUNTING CONSIDERATIONS

The pressure sensor should be installed on a clean and compatible thread, the use of an open-end wrench is recommended.

For the ¼ NPT thread the use of pipe thread sealant or Teflon tape is recommended. The NPT threaded part should be tightened 2~3 turns from finger tight (TFFT).

For ¼ BSPP threads, mounting torque for the sensor of pressure ranges 2 to 35 bar should not exceed 30Nm, and for sensors with ranges over 200 bar the mounting torque should not exceed 35 Nm.



Assembly torque depends on many factors, particularly the lubrication, the coating, and the surface finish.

**!The user should qualify the tighten torque in their application!**

**WARNING** – Do NOT tighten the sensor by twisting on the housing. Damage to the sensor WILL occur. Tighten to the correct torque using a wrench on the hex base.

**WARNING** – Install in a process connection with enough room to allow the use of spanner/wrench.

**WARNING** – To reduce the risk of burns or frost bite, wear protective personal equipment when installing or removing from high or below-freezing temperature environments.

**WARNING** – After installation carefully check for leaks.

## 10 CERTIFICATIONS & COMPLIANCES

This Equipment is certified for Intrinsic Safety when model code “EX” is selected during the ordering process. Please see ordering information in section 13 for details:

Intrinsic Safety approval is as follows:

IS Class I, Div1, Groups A, B, C, and D;

Class I Zone 0, AEx ia IIC T4 Ga;

Ex ia IIC T4 Ga;

 II 1 G Ex ia IIC T4 Ga

## 11 REGULATORY STATEMENTS

FCC and IC

This Radio Equipment is Certified for FCC (US) and ISED (Canada).

This equipment does not support simultaneous transmissions.

Changes or modifications not expressly approved or authorized by TE Connectivity for compliance could void the user's authority to operate the equipment.

### FCC Warning:

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRE OPERATION.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does not cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver▪ Connect the equipment to an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### Industry Canada (IC) Warning:

This device complies with ISED Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'ISED Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

### IMPORTANT NOTE:

**Radiation Exposure Statement:** This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance.

To maintain compliance with IC RF exposure compliance requirement, please follow operation instruction as documented in this manual.

### Déclaration d'exposition aux radiations

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.

A distance of 20cm shall be maintained between the antenna and users, and the transmitter may not be co-located with any other transmitter or antenna.

## 12 EU CONFORMITY

The products below were tested by approved agencies and found compliant with EU regulatory standards.

**Model Families:** 69XXN

**Product Description:** Wireless Pressure Sensor

**Manufacture/Brand:** TE Connectivity Ltd

**Manufacturer:**

Measurement Specialties (China) LTD

No 26 LangShan Road

518057 Shenzhen-Nanshan District, China

**European Contact:**

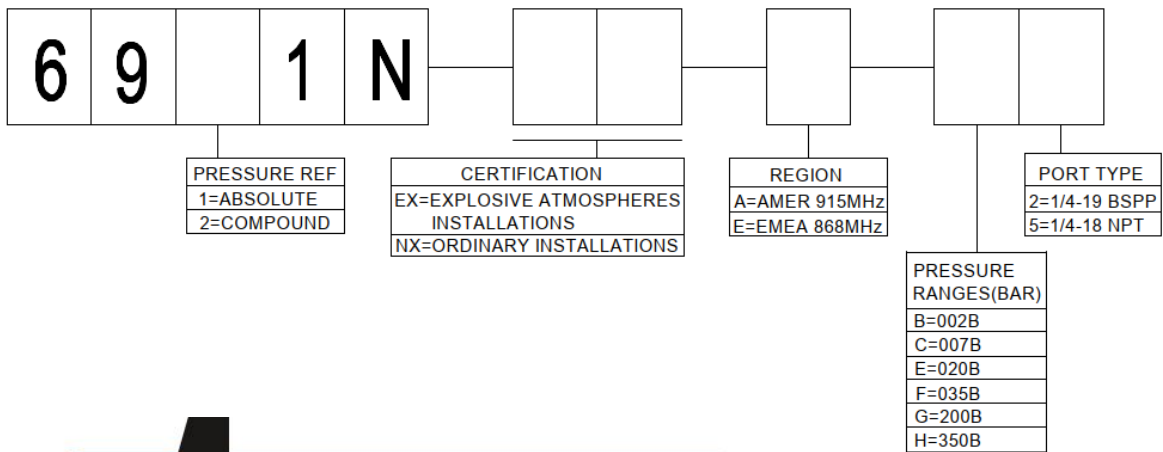
TE Connectivity Sensors France

4 Rue Gaye Marie

31027 Toulouse – France

# 13 ORDERING INFORMATION

## LoRa + BLE Sensor Model Number



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