

# Documentation



LD-System 

**Communication Protocol**

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## Explanation of Terms

### **DevEUI / AppEUI / AppKey**

The device identification number (DevEUI) and the application identification number (AppEUI) are unique identification numbers of the measuring device. The application key (AppKey) is an AES-128 key of the device from which the session parameters are derived when joining a network.

### **Uplink und Downlink**

Communication from the measuring device to the network server is referred to as Uplink. The communication from the network server to the measuring device is called Downlink.

### **Not / to be confirmed Uplink**

The transmission can take place via Uplinks that are not to be confirmed or via Uplinks that are to be confirmed. With an Uplink to be confirmed, in contrast to an Uplink not to be confirmed, a response from the network server is expected. This ensures the transmission of the measurement data. The content of the message is not affected.

## Deadband

The deadband is the range around the threshold value that must also be exceeded or undercut in order to trigger or delete a threshold value alarm. It is also the difference between two consecutive measured values above which an edge alarm is sent.

## Measuring Interval

Time between two measurements.

## Transmit Interval

The number of measurements until the next data transmission to the gateway.

## Data rate and spreading factor

The spreading factor indicates how much the bandwidth of the transmitted signal is spread. The spreading factors SF7 to SF12 are defined, whereby the higher the spreading factor, the more the bandwidth is stretched. With a low spreading factor, the number of user data increases so that the data rate increases. The data rates 0 to 5 are defined accordingly for the spreading factors SF12 to SF7.

## 1. General information

The measuring devices type LD/LP/LT transmit data with a radio module with LoRaWAN® version 1.0.2 via the LoRa® 868 MHz EU frequency band in LoRaWAN® class A. The measuring devices are configured for "over-the-air" activation (OTAA) and are supplied with a device passport containing the following data:

- a device identification (DevEUI)
- an application identification (AppEUI)
- an application key (AppKey)

This data must be provided to the network server in order to establish a connection to the measuring device.

The measuring devices send the measured value to the network server at regular, individually adjustable intervals as an uplink that does not need to be confirmed. The measured value can assume values from 1000 to 11000, where 1000 = 0 % and 11000 = 100 % of the measuring range. With a measuring range of 0 - 6 bar, a value of 1000 therefore corresponds to a pressure of 0 bar and 11000 to a pressure of 6 bar.

The measuring devices can also send an alarm as an uplink to be confirmed if certain events occur. These events include exceeding or falling below a threshold value or a significant change in the current measured value compared to the previous one. If, for example, an alarm is to be sent when a threshold value is exceeded, an uplink is sent as soon as the measured value is higher than the threshold value including the deadband. As soon as the measured value is then below the threshold value including the deadband, an uplink to be confirmed is sent to indicate that the alarm has been canceled. If an alarm is to be sent in the event of a significant change in a measured value compared to the previous measurement, an uplink is sent as soon as the difference between two measured values is greater than the deadband. These alarms are sent in addition to the normal transmission interval.

The following parameters of the measuring device can be set by the user via the downlink:

- the measuring interval
- the transmission interval
- the data rate (the device can also adapt the data rate automatically)
- the port used
- the alarm

## 2. Uplink Format

Both the measurement data and additional information for the reason for the Uplink are transmitted via the Uplink.

| Byte | Bit | Description       | Memo   |
|------|-----|-------------------|--|
| 1    | -   | Type of Message   | 1: Transmission interval<br>2: Additional Uplink |
| 2-3  | -   | Measuring Data    | Measured values from 1000 - 11.000               |
| 4    | -   | Operating Voltage | 0-100 in 1% (equals 0 to 3,6 V)                  |
| 5    | 8   | Alarm Status      | 1: Alarm triggered<br>0: Alarm erased            |
|      | 1   | Measurement Curve | 1: increasing<br>0: dropping                     |

Possible triggers for an alarm as an additional Uplink are:

- Falling below a threshold value
- Exceeding a threshold value
- Significant change to the last measured value

### 3. Downlink Format

The following device settings can be configured via Downlink. After an Uplink, only one Downlink with the command type and the associated parameters is expected. The same port that was used for the Uplink must be used for the Downlink.

| Byte | Description | Memo              |
|------|-------------|-------------------|
| 1    | Command     | -                 |
| 2-N  | Parameter   | Command-dependent |

Das Gerät kann folgende Befehle interpretieren:

| hexadecimal value | Command             |
|-------------------|---------------------|
| 01                | Configuration       |
| 02                | Alarm configuration |
| 80                | Reset               |

#### 3.1. Konfiguration

| Byte | Description        | Memo                              |
|------|--------------------|-----------------------------------|
| 1    | 0x01               | -                                 |
| 2-3  | Measuring interval | 1 – 32.767 in 1 Minutes           |
| 4-5  | Transmit interval  | 1 – 32.767 in Measuring Intervals |

#### 3.2. Alarm Configuration

| Byte | Bit | Description     | Memo   |
|------|-----|-----------------|--|
| 1    | -   | 0x02            | -  |
| 2-3  | -   | Threshold value | 0 – 10.000 in 0,01 %   |
| 4-5  | -   | Deadband        | 0 – 5.000 in 0,01 %  |
| 6    | 8   | Alarm activated | 1: Alarm is Active<br>0: Alarm ist Deactivated   |
|      | 2   | Schwellenwert   | 1: Alarm if threshold value is exceeded or not reached<br>0: Alarm if the measured value changes significantly |
|      | 1   | Typ             | 1: Alarm when the threshold value is exceeded<br>0: Alarm when the value falls below the threshold             |

#### 3.3. Reset to default settings

| Byte | Description |
|------|-------------|
| 1    | 0x80        |

For standard settings, see page 7.

## 4. Examples of Application Uplink

### 4.1 Transferring a measurement

| Transferred Data: 0x 01 07D0 5F 01 |  |
|------------------------------------|--|
| Hexadecimal Value                  | Command  |
| 01                                 | Measurement data is transferred                          |
| 07D0                               | Measured value is 10 % of the measuring range            |
| 5F                                 | Battery voltage is 95 % of 3.6 V (corresponds to 3.42 V) |
| 01                                 | will be ignored  |

### 4.2. Ausgelöster Alarm

| Transferred Data: 0x 02 2328 5F 81 |  |
|------------------------------------|--|
| Hexadecimal Value                  | Command  |
| 02                                 | Measurement data is transmitted because an alarm has been triggered or deleted |
| 2328                               | Measured value is 80 % of the measuring range                                  |
| 5F                                 | Battery voltage is 95% of 3.6 V  |
| 81                                 | Alarm was triggered because the threshold value was exceeded                   |

## 5. Application Examples Downlink

### 5.1. Configuration

| Transferred data: 0x 01 000A 0006 |  |
|-----------------------------------|--|
| Hexadecimal value                 | Command  |
| 01                                | Configuration data is sent                                   |
| 000A                              | The measuring interval is set to 10 minutes                  |
| 0006                              | The measurement data of every 6th measurement should be sent |

### 5.2. Configuring Threshold Value

| Transferred Data: 0x 02 1388 00C8 82 |  |
|--------------------------------------|--|
| Hexadecimal Value                    | Command  |
| 02                                   | The alarm is configured  |
| 1388                                 | The threshold value is set to 50 % of the measuring range  |
| 00C8                                 | The dead band is set to 2 % of the measuring range   |
| 82                                   | The alarm function is activated and the alarm is sent as soon as the value falls below the threshold value |

### 5.3. Alarm in the event of abrupt

| Transferred Data: 0x 02 1388 01F4 81 |   |
|--------------------------------------|---|
| Hexadecimal Value                    | Command   |
| 02                                   | The alarm is configured   |
| 1388                                 | Threshold value has no influence on this alarm  |
| 01F4                                 | The dead band is set to 5 % of the measuring range  |
| 81                                   | The alarm function is activated and the alarm is sent as soon as a measured value deviates from the previous measured value by more than 5 % of the measuring range |

## 6. Standard configuration

| Parameter             | Value         |
|-----------------------|---------------|
| Measurement Interval  | 15 min        |
| Transmission Interval | 1 Measurement |
| Alarm                 | Deactivated   |



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