

## Status-DP/AF

# Differential Pressure / Airflow Sensor User Guide

## LoRaWAN Wireless Differential Pressure / Airflow Sensor

**RF-LW-DP1**

**RF-LW-AV-100**

**RF-LW-AV-200**

**RF-LW-AV-300**

**RF-LW-AV-400**

**RF-LW-AV-500**

**RF-LW-AV-600** ∂ LoRaWAN long-range wireless.

∂ Battery powered.

∂ High accuracy across a wide range of pressures.

∂ Status-DP supplied with Duct Fixing Kit to monitor differential pressure.

∂ Status-AF supplied with Multi-Point Air Velocity Probes measure average velocity pressure across air ducts. Probe lengths of 100mm to 600mm are available.



Status-DP measures differential pressure in the range of 25Pa to 5000Pa with industry leading accuracy of 0.1% of selected range. Easily detect blocked filters in building ventilation systems to reduce the risk of spreading disease. Differential Pressure data is transmitted to the cloud using long range LoRa wireless where the device data can be displayed and analysed to reveal operational performance and generate alerts.

Status-AF measures air velocity in the range of 0 to 40m/s with industry leading accuracy of 0.1%. This sensor can be used to ensure that recommended air flow rates for public buildings and industrial plant are achieved. Air velocity data is transmitted using long range LoRa wireless for integration with cloud services or onsite systems via Modbus IP to reveal operational performance and generate alerts.

The units are battery powered with long life of 3+ years<sup>#</sup>. A built in USB port allows all parameters including pressure ranges, sampling interval, wireless signal strength and wireless network

∂ Differential pressure and Airflow monitoring\*

∂ LoRa long range wireless

∂ Frequency Range 863-870MHz\*

∂ Frequency Range 902-928MHz\*

∂ Up to +16dBm Tx Power

∂ Built in USB port for power and configuration

∂ Battery powered

∂ CE / FCC compliant

∂ RoHS compliant

∂ Made in the UK

\*Option / Model dependent

<sup>#</sup> Dependent on settings and environment

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## 1. Introduction

LoRaWAN devices are configured using OTAA (Over-the-Air-Activation).

OTAA is the most secure way to connect a device to the LoRaWAN network. In OTAA, the device performs a Join procedure with the network, during which a dynamic DevAddr (device address) is assigned and security keys are negotiated with the device.

The OTAA configuration requires the following parameters to be correctly set:

∂ DevEUI: End-device Identifier. It is unique for every device and is set at device manufacture.

∂ AppEUI: Application Identifier. Used to identify the end application.

∂ AppKey: Application key. Used to create the session keys.

\*Note: In LoRaWAN 1.1, AppEUI was renamed to JoinEUI.

Providing the LoRa gateway has the matching values, the join process will happen automatically once the Status unit is in wireless range and switched on.

The DevEUI is always set at device manufacture and is unique. The device AppEUI and AppKey can easily be set via the USB connection if required and the process is detailed later in this document.

## 2. Powering the unit

To power the device ON, remove the cover of the Status by unscrewing the two screws on the cover. Locate the power switch, shown below and using a small screwdriver gently slide the power switch towards the Off position.

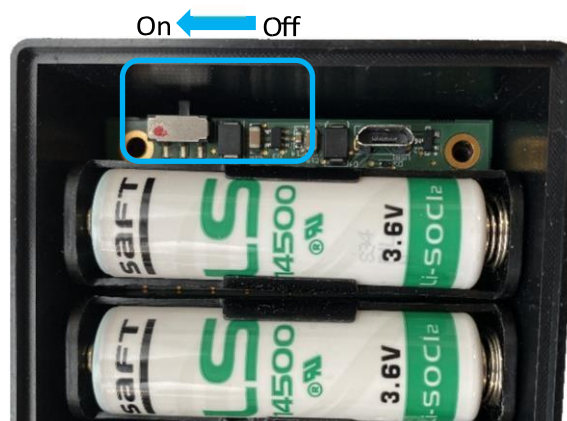
Insert the 2 x AA sized Lithium 3.6V batteries taking great care to insert them the correct way around. Locate the plus (+) and minus (-) signs on the battery and use the plus (+) and minus (-) guides on AA battery holders to insert the batteries in the proper direction. Both batteries face in the same direction.

Be sure to insert the minus (-) end first and remove the plus (+) end first when replacing the batteries.



Lithium batteries have very high energy capacity and a great degree of care should be exercised to ensure that all batteries are new, from the same manufacturer, installed the correct way around and are not in any way damaged. Refer to Section 11 for more details.

Check that the batteries are correctly inserted and then slide the power switch to On.



### Switch to the ON position

Once powered ON, the device will send a Join request message to the LoRaWAN network server. The Status LED will blink RED as shown below whilst the Join process is taking place. Depending on factors such as signal strength, RF interference etc. the join process may take several seconds to complete.



### Blinking Red LED – Attempting to Join

When the device has successfully joined the network the Mode LED will blink GREEN five times to show that the join has been completed. The LED's will then switch off to conserve the batteries.



*Blinking Green LED – Device Successfully Joined*

### 3. Setting / changing the LoRaWAN keys and device parameters

The unique **DevEUI** is printed on all devices and is also present in the QR code. The **DevEUI** can be used to identify the device once joined to the network.

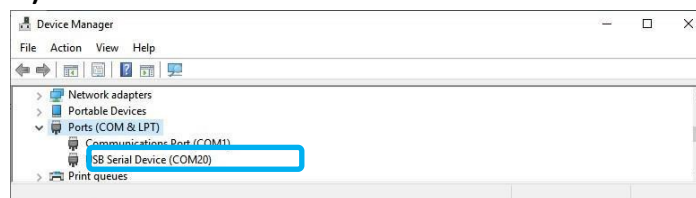
If the LoRa gateway has matching keys the join process will happen automatically once the unit is in wireless range and switched on.

The DevEUI is always set at device manufacture and is unique. The device **AppEUI** and **AppKey** can easily be set via the USB connection as detailed below.

Connect a micro USB cable to the enLink unit. The device will attach to a COM port on your PC.

Using a terminal program (e.g. Tera Term <https://tssh2.osdn.jp/>) connect to the COM port used by the device.

To verify which COM port is being used, check the Windows™ Device Manager (In Windows - Click the **Start** button, type **device manager** into the search box and tap **Device Manager** on the menu.) Expand the **Ports (Com & LPT)** menu as shown below.



In your terminal program press the **Enter** key. An summary screen will appear as shown below. The default password is the last four digits of the displayed **DevEUI**, in the screen below this is 2fa5.

```

COM5 - Tera Term VT
File Edit Setup Control Window Help
-----
Synetica - enLink :: Wireless Sensor Networks
-----
Region:      European band on 868MHz
Firmware Code: FW-ST5-DP/AF
Firmware Ver: 5.12
Description: enLink Status - Differential Pressure / Air Flow
DevEui:      00-04-a3-0b-00-08-2f-a5
-----
Password: █
  
```

logon

### screen

The screen below will show with the **Main Menu** options. Enter **Q** to enter the **Quick Start Menu**.

```

COM5 - Tera Term VT
File Edit Setup Control Window Help
-----
enlink Main Menu:
-----
Q - Quick Start Menu
L - LoRa Radio Settings
C - Configure Device
P - Password and Security
T - Test Mode
R - Reboot
F - Factory Reset
X - Log off
-----
Select an option: █
  
```

### Main Menu

The **Quick Start Menu** contains only the parameters that normally need to be configured to setup the device and join the LoRa network.

From the **Quick Start Menu** you can change the **AppEUI** and **AppKey**.

```

COM5 - Tera Term VT
File Edit Setup Control Window Help
-----
enlink Quick Start Menu:
-----
Status          Joining...
Join Check in   0s
-----
DevEui          00-04-a3-0b-00-08-2f-a5
E - AppEui      53-79-6e-00-00-00-00-00
K - AppKey      08-34-5e-d2-a4-a1-5a-1e-00-cd-16-2a-1b-b9-91-f7
T - Transmit Interval 30 mins
X - Exit Menu
-----
Select an option: █
  
```

### Quick Start Settings Menu

From the **Quick Start Settings Menu**, access the **AppEUI** setting by entering **e**. Enter the 16 character **AppEUI** using numbers and letters a to f. Do not include spaces or any other characters. Pressing **S** will enter the default **AppEUI** which you can then edit. **R** will set a random AppEUI. Press **Enter** when the key is correctly entered to return to the **Quick Start Settings Menu**.

```

E - AppEui          53-79-6e-00-00-00-00
K - AppKey         e6-ba-6c-c9-61-87-47-75-9d-13-e4-e0-9a-5f-40-0d
T - Transmit Interval 15 mins
X - Exit Menu

Select an option: e

Enter a new 16 character AppEUI using only numbers and the letters A to F (no separators)
Hit <S> to enter the default value or <R> for a random value

Current Setting: AppEUI = 53-79-6e-00-00-00-00

-----
New AppEUI: 53796e0000000000
  
```

### AppEUI setting

From the **Quick Start Settings Menu** access the **AppKey** setting by entering **k**. Enter the 32 character **Appkey** using numbers and letters a to f. Do not include spaces or any other characters. Pressing **S** will enter the default **AppKey** which you can then edit. **R** will set a random AppKey. Press **Enter** when the key is correctly entered to return to the **Quick Start Settings Menu**.

```

E - AppEui          53-79-6e-00-00-00-00
K - AppKey         e6-ba-6c-c9-61-87-47-75-9d-13-e4-e0-9a-5f-40-0d
T - Transmit Interval 15 mins
X - Exit Menu

Select an option: k

Enter a new 32 character AppKey using only numbers and the letters A to F (no separators)
Hit <S> to enter the default value or <R> for a random value

Current Setting: AppKey = e6-ba-6c-c9-61-87-47-75-9d-13-e4-e0-9a-5f-40-0d

-----
New AppKey:
  
```

### AppKey setting

Press **X** from the **Quick Start Settings Menu** to return to the Main menu.

The header will show **\*\* Reboot Required \*\*** as shown below. The new key settings will not take effect until the device is restarted. Enter **R** to reboot followed by **OK**. The device will restart with the entered **AppEUI** and **AppKey** and attempt to join the LoRa network.

```

Unlink Quick Start Menu: ** Reboot Required **
-----
Status          Joining..
Join Check in   0s

DevEui          00-04-a3-0b-00-08-2f-a5
E - AppEui      53-79-6e-00-00-00-00-01
K - AppKey      08-34-5e-d2-a4-a1-5a-1e-00-cd-16-2a-1b-b9-91-f7
T - Transmit Interval 30 mins
X - Exit Menu

Select an option:
  
```

*Reboot Required notification*

Check your LoRaWAN network server to verify that the device has joined successfully.

## 4. Setting / changing the transmit interval

Access the **Transmit Interval** setting by entering **t** from the quick start menu.

```

Transmit Interval:  ** Reboot Required **
=====
1 - 30 s
2 - 1 min <==
3 - 2 mins
4 - 5 mins
5 - 10 mins
6 - 15 mins
7 - 20 mins
8 - 30 mins
9 - 60 mins
10 - 2 hours
11 - 3 hours
Enter Selection: █
  
```

### Transmit Interval settings

Select a fixed transmit interval from the menu options. 15 minutes or longer is recommended to extend battery life.

Press **Enter** when the key is correctly entered to return to the **Quick Start Settings Menu**.

## 5. Setting / changing the pressure sensor parameters

The pressure sensor parameters can be offset to compensate for pipe lengths, environmental conditions and sensor drift. Where possible, the zeroing adjustment should be carried out when the sensor is in its measurement position and environment.

From the **Main Menu** access the configuration menu by entering **C**. This screen will display the current device temperature, humidity, pressure sensor values and also provide access to live readings.

```

-----
Temperature                25.3°C
Humidity                    38 %rH
-- Differential Pressure / Air Flow Sensor
Temperature                21.9°C
Raw Read                    5.913 Pa
Delta                      -5.000 Pa
Pressure                    0.913 Pa
Air Flow                    1.233 m/s

Device Options:
-----
D - Live readings display
P - Differential Pressure / Air Flow
X - Exit Menu
Select an option: █
  
```

### Configuration menu

Enter **P** to view the Differential Pressure / Air Flow menu

```

Select an option: p

DP/AF options:
=====
T - Radio Transmit Options      Both Pressure and Air flow
Z - Zero reading (auto delta)
D - Set Delta Offset            -23.322 Pa
X - Exit Menu
Select an option: █
  
```

Enter **Z** to enter the **Zero reading (auto delta)** menu. The required offset value will be shown. Enter **Z** to zero the measurement.

```

DP/AF options:
=====
T - Radio Transmit Options          Both Pressure and Air flow
Z - Zero reading (auto delta)
D - Set Delta Offset                -23.329 Pa
X - Exit Menu

Select an option: z

Hit <Z> to offset the value by the last raw reading of '23.329 Pa': z

Delta Offset set to: -23.329 Pa

Press a key to continue:
  
```

To manually enter an offset, press **D** to enter the **Set Delta Offset** menu. The offset value is used to adjust the measurement. Negative or positive values can be entered to adjust the reading.

Enter **X** to return to the **options** menu.

The unit can be configured to transmit Air Flow, Differential Pressure, or both readings.

Enter **T** to access the **Radio Transmit Options** menu and select the transmission of Pressure data only, Airflow data only or both.

```

Select an option: t

DP/AF -> Radio Transmit Options:
=====
0 - Pressure Only
1 - Air flow Only
2 - Both Pressure and Air flow      <==
X - Exit Menu

Select an option:
  
```

*Radio Transmit Options*

## 6. Zeroing differential pressure readings

On Status-DP/AF units with Firmware release v5.14 and later, the differential pressure reading can also be set to Zero by pressing the Config button on the front of the unit.

To automatically zero the differential pressure reading, press and hold the Config button for more than two seconds. The Red and Green LED's will flash rapidly as the unit measures the differential pressure. Once the differential pressure offset has been applied the Green Mode LED will blink several times to confirm that the operation is complete.

The differential pressure reading may also be automatically Zeroed with a LoRaWAN Downlink message.

The downlink message to send is: A5 01 40

## 7. Live Display

From the **Main Menu** access the configuration menu by entering **C**. This screen will display the current device temperature, humidity, pressure sensor values and also provide access to live readings.

```

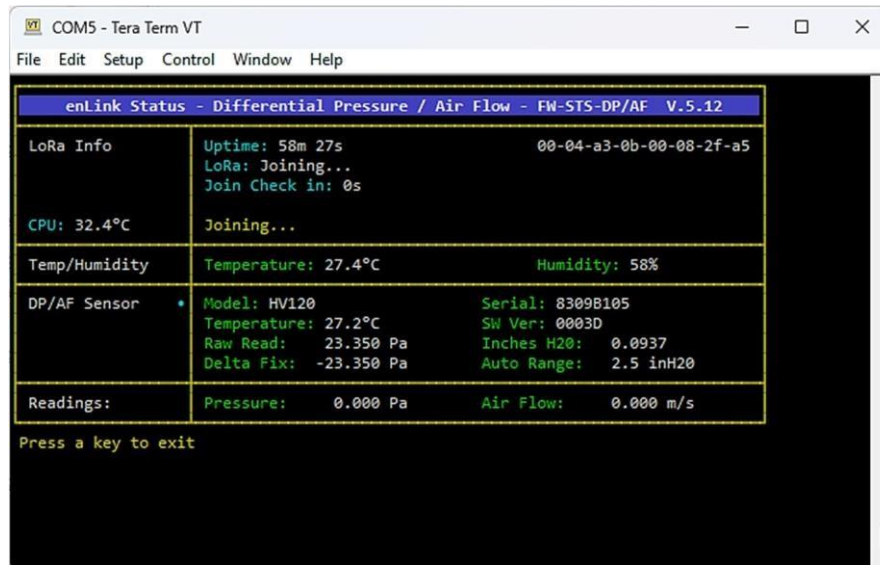
Sensor Readings:
-----
Temperature/Humidity      27.3°C / 58%
-- Differential Pressure / Air Flow Sensor
Temperature               27.3°C
Raw Read                  23.329 Pa
Delta Offset Zero Fix     -23.329 Pa
Pressure                  0.000 Pa
Air Flow                  0.000 m/s

Device Options:
-----
D - Live readings display
P - Differential Pressure / Air Flow
X - Exit Menu

Select an option: [ ]
  
```

## Configuration menu

The **D** option displays live readings, which can be used to verify the readings before deployment.



*Live readings display*

## 8. Sensor Installation

Depending on the probes used, the Status unit can be used as either a differential pressure monitor or as an airflow monitor.

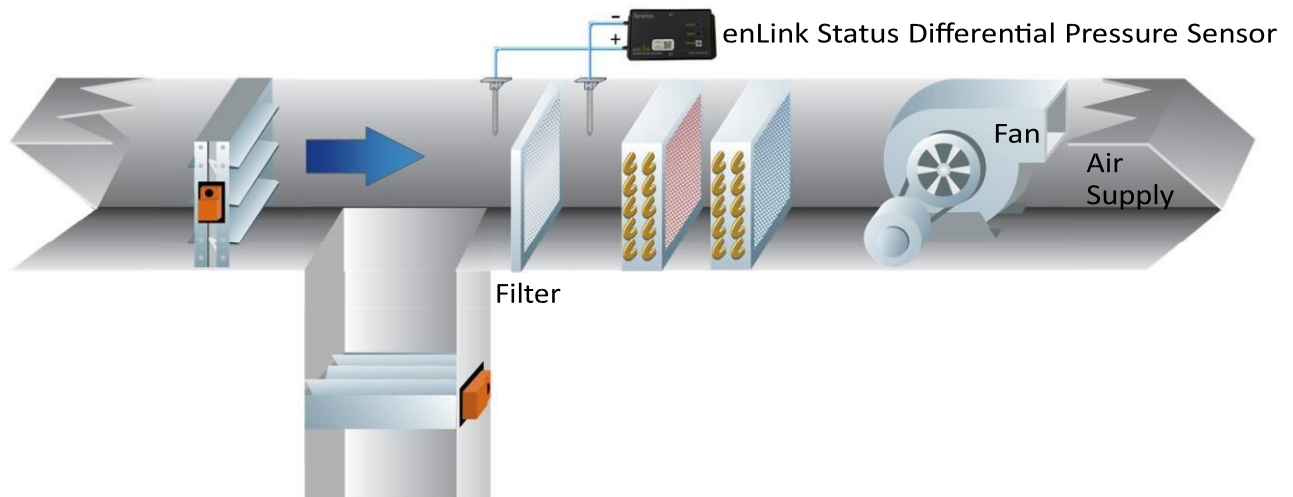
## 9. Differential Pressure / Air Filter Monitoring

When a filter starts to clog, its resistance to airflow increases. In systems where the airflow is kept at a constant level, this leads to a rise in the differential pressure across the filter.

Air filters can only perform well when the pores remain unclogged. Filters should be replaced when they begin to clog to ensure economical, safe and efficient operation. Clogged filters can lead to an undersupply of ventilation, an increase in energy consumption, and noisy fan operation. Filters which are dirty and humid can provide a breeding ground for mould and bacteria, damaged filters can be hazardous.

To monitor the filter condition, attach one of the supplied pitot probes to either side of the filter as shown below. Ensure that the port on the Status unit shown as + goes on the airflow input to the filter and the port shown as – on the downstream side of the filter.

With the fan in the off state, the differential pressure should be close to zero. If necessary, offset the pressure reading to as close to zero as possible using the instructions in section 5 / 6.



*Differential Pressure Sensor to monitor filter condition.*

## 10. Airflow Monitoring

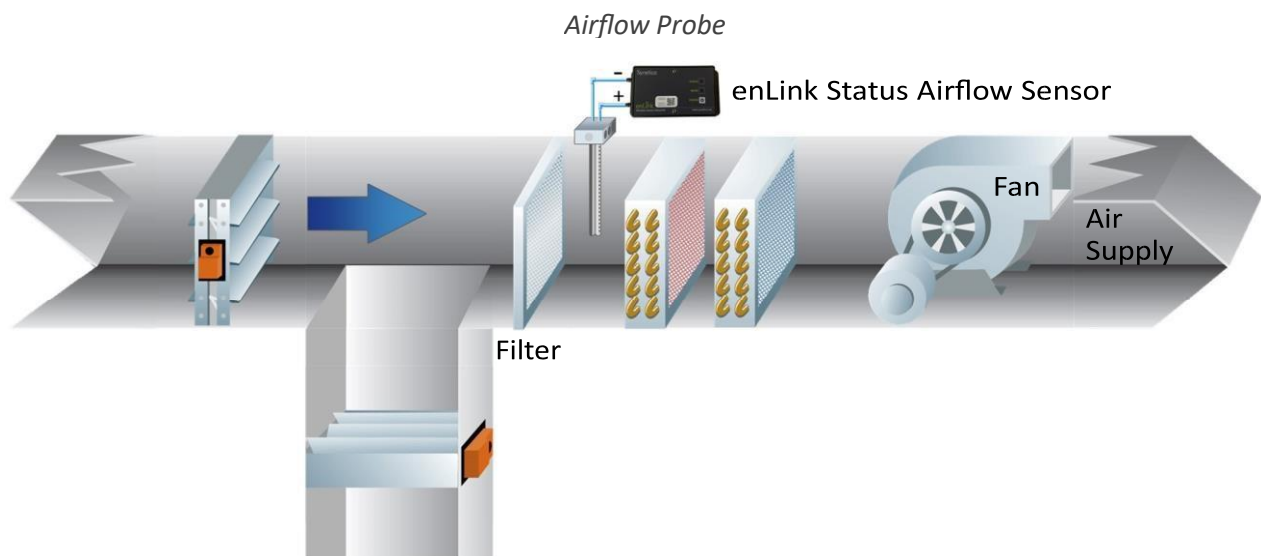
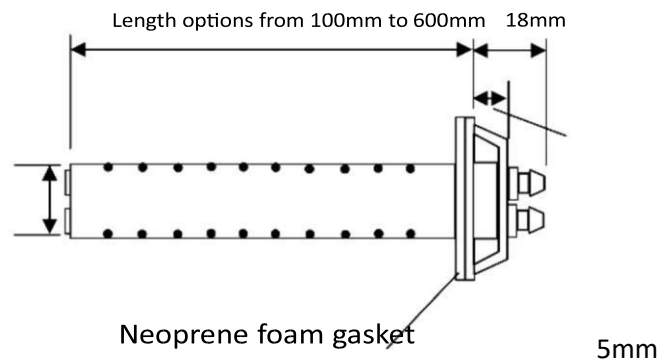
Measuring the airflow in ducts is an important maintenance aspect of an HVAC system. Each system is designed to work under a given load. Lower loads can lead to an underperforming system and higher loads can result in reduced efficiency and increased running costs.

To monitor the airflow, insert the airflow probe into the duct as shown below.

The airflow probe should be mounted in the duct where it can measure the unrestricted airflow and at least 2 metres downstream from dampers, duct bends, fans, filters, humidifiers, heating or cooling coils.

- ∂ Avoid installation into systems with turbulent airflow.
- ∂ Ensure that the two end probe caps are fitted and not loose.
- ∂ Ensure that the probe is mounted with all the holes inside the ductwork and that the mounting flange is providing a good airtight seal.
- ∂ Ensure that the probe is mounted with the arrow pointing in the direction of the airflow.
- ∂ Ensure that the tube connections for the Hi and Lo ports are matched on the Status Unit.
- ∂ Secure the pipes to the probe with cable ties if necessary.

With the fan in the off state the airflow should be close to zero. If necessary, offset the sensor pressure reading to as close to zero as possible using the instructions in section 5 / 6.



*Airflow Sensor to monitor ventilation rate.*

## 11. Battery Installation / Replacement

Devices use SAFT LS14500 or EVE ER14505 AA size 3.6 Volt Lithium Thionyl Chloride (Li-SOCl<sub>2</sub>) batteries (non-rechargeable) or direct equivalent.

No other batteries are approved for use in the device.

Lithium Thionyl Chloride batteries have very high energy capacity and must be used and handled with care observing the guidance below.



### WARNING

Risk of death or serious injury from explosion or fire.

- ∂ Keep out of sight and reach of children.
- ∂ Fire, explosion and burn hazard - do not recharge, short circuit, crush, disassemble, or incinerate.
- ∂ Due to the high terminal voltage (3.6V), they are not suitable as direct replacements for other battery technologies in the same can sizes.

- ∂ When not in use the Batteries must be stored in a non-Hazardous Area.
- ∂ Do not change batteries in an explosive gas atmosphere.
- ∂ When installing batteries, do not snag the battery terminal on the clip or the battery may be damaged. Do not apply excessive force.
- ∂ Do not drop. Dropping the battery may cause damage. If a battery is dropped, do not install the dropped battery into the unit. Dispose of dropped batteries promptly per local regulations or per the battery manufacturer's recommendations.

### Guidance

- ∂ Always install the batteries correctly as per instructions taking great care to observe the battery polarity.
- ∂ Ensure that the contact points are clean and conductive.
- ∂ All batteries must be the same model from the same manufacturer.
- ∂ Do not mix old and new batteries or batteries from different manufacturers.
- ∂ Do not heat or attempt to recharge the battery.
- ∂ Do not dispose of in a fire.
- ∂ Only install approved batteries: SAFT LS14500 or EVE ER14505 Lithium Thionyl Chloride AA Battery 3.6 Volt, or direct equivalent.

### Safe disposal



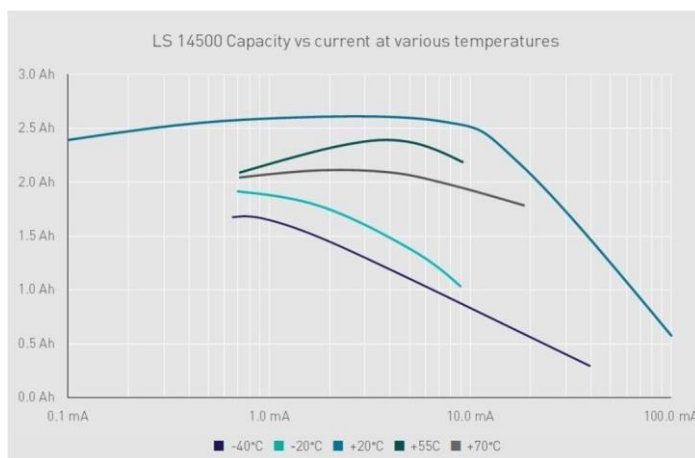
- ∂ Please recycle responsibly, a wide range of schemes are available.
- ∂ Do not dispose of in normal waste or in a fire.

## 12. Power Considerations

The device is powered with 2 x 3.6V Lithium-Thionyl chloride (Li-SOCl<sub>2</sub>) AA sized batteries.

The pressure sensor consumes additional power while actively sensing and therefore, to prolong battery life, the sampling interval should be set to the longest period practical for the application. Sampling / transmission intervals of less than 15 minutes place strain on the batteries, limiting their capacity and should be avoided if possible.

Battery capacity is dependent on ambient temperatures and this should be considered when estimating battery life. Low temperatures slow down electrochemical reactions significantly and increase the internal resistance of the batteries. High temperatures increase the battery selfdischarge. The chart below illustrates the effect of temperature on the available battery capacity.



*Battery capacity vs current at various temperatures for SAFT LS14500 batteries.* Battery life is also highly dependent on the LoRa spreading factor used. Higher spreading factors result in longer active times for the radio transceivers and shorter battery life. Positioning devices in closer proximity to a gateway will generally result in lower spreading factors, shorter time on air and much

lower transmit power.

**WEEE Directive:**



At the end of the products useful life please  
dispose as per the local regulations.  
Do not dispose of with normal household waste.  
Do not burn.

