User's Manual for WS and WM Series DataSling™ LoRaWAN® Wireless Sensors

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1. Product Description / Overview

Product Overview

This section introduces the sensor, highlighting its key functions and applications. The sensor is part of a wireless end-to-end solution designed for monitoring environmental parameters such as temperature, humidity, differential pressure and more. Its low power consumption and long-range communication capabilities make it ideal for many applications, including pharmaceuticals, HVAC, industrial settings, greenhouses, cleanrooms and others.

Key Features

Wireless Connectivity: Powered by two CR123A lithium batteries, Sensocon® DataSling™ Wireless Sensors leverage LoRaWAN® (Long Range Wide Area Network) technology for long-range, low-power communication with typical battery life 5+ years, dependent upon settings.

Single or Multi-Parameter Monitoring: Offered as a single variable or multi-variable unit capable of measuring multiple environmental factors such as temperature, humidity, differential pressure, current/voltage input and more in one package.

Easy Integration: Ideal for use with the Sensocon Sensograf™ cloud-based platform, DataSling WS & WM Series Sensors are also compatible with existing 3rd party LoRaWAN gateways and network servers, offering seamless integration into various monitoring systems.

Scalable Design: Suitable for small to large-scale deployments, with flexible configuration options to suit different operational needs.

Data Accuracy and Reliability: High-precision sensors ensure accurate data collection for reliable monitoring and control of environments.

Applications

Pharmaceuticals: Ensure compliance with stringent environmental standards by monitoring and recording environmental parameters in production and storage areas.

HVAC Systems: Optimize energy usage by providing real-time data on system performance.

Industrial Monitoring: Track critical conditions in equipment, manufacturing, and storage, reducing downtime through predictive maintenance alerts.

Cleanrooms: Maintain controlled environments by monitoring and recording temperature, humidity, and many other variables to prevent contamination.

Greenhouses: Provide precise monitoring to optimize growing conditions, enhancing crop quality and yield while reducing water and energy consumption. User alerts ensure rapid response to environmental changes.

Benefits

Enhanced Operational Efficiency: Helps reduce energy consumption and optimize environmental conditions.

Regulatory Compliance: Supports compliance with industry standards by providing accurate, real-time environmental data.

Reduced Initial Costs: Affordable as single devices, multi-variable units reduce the already low acquisition cost. Little to no wiring is required and transmission automatic starts upon applying power, reducing installation time.

Ongoing Cost Savings: Minimizes maintenance costs and reduces downtime with predictive alerts and remote monitoring capabilities.

Scalable Solutions: Suitable for diverse applications, from small-scale setups to complex, multi-site deployments.

2. Specifications

Detailed Technical Specifications

Weight	7 oz
Enclosure Rating	IP 65
Operating Temperature	-40° to 149°F (-40 to 65°C) -4° to 149°F (-20 to 65°C) differential pressure models
Antenna	External Pulse Larsen W1902 (short) Optional External Pulse Larsen W1063 (long)
Battery Life	5+ Years
Minimum Interval	10 minutes
Wireless Technology	LoRaWAN® Class A
Wireless Range	Up to 10 miles (clear line-of-sight)
Wireless Security	AES-128
Max Receive Sensitivity	-130dBm
Max Transmit Power	19dBm
Frequency Bands	US915
Battery Type	CR123A (x2) Lithium Manganese Dioxide (Li-MnO2)

Figure 1: General Specifications

Unit-level specifications can be found on their respective datasheets at www.sensocon.com

Physical Dimensions and Diagrams

Internal Components
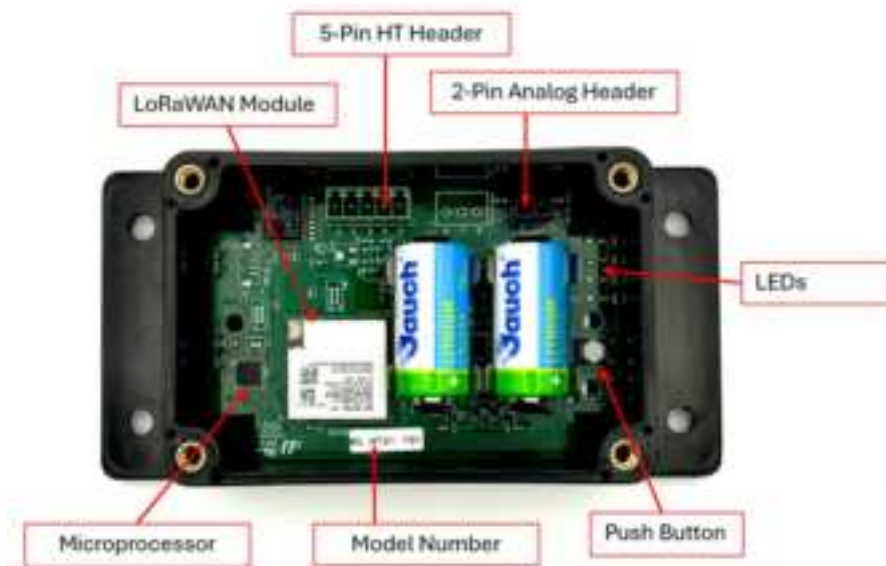
Picture 1: Internal Components

Dimensional Drawings

Drawing 1: Housing with Barbed Fittings

Drawing 2: Housing with Attached RH/Temp Probe

Drawing 3: Housing with Cable Gland

Drawing 4: Multivariable Housing with (2) Barbed Fittings, (1) RH/Temp Attached Probe, & (2) Cable Glands

3. Installation Roadmap

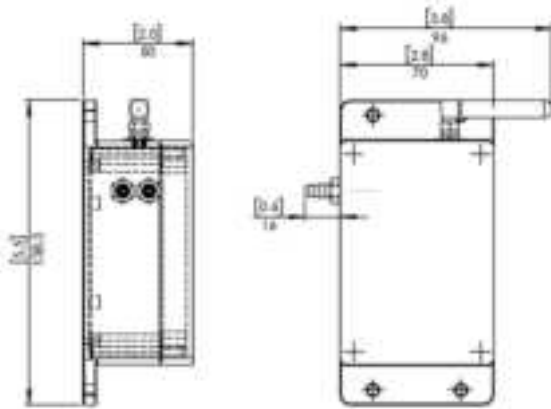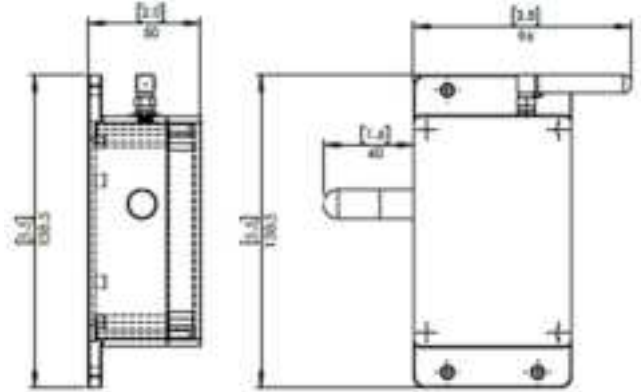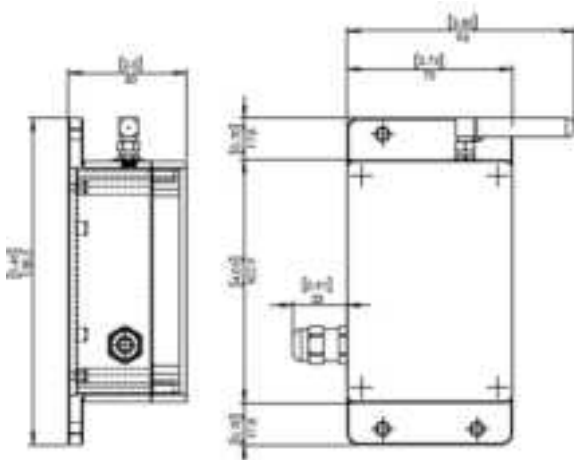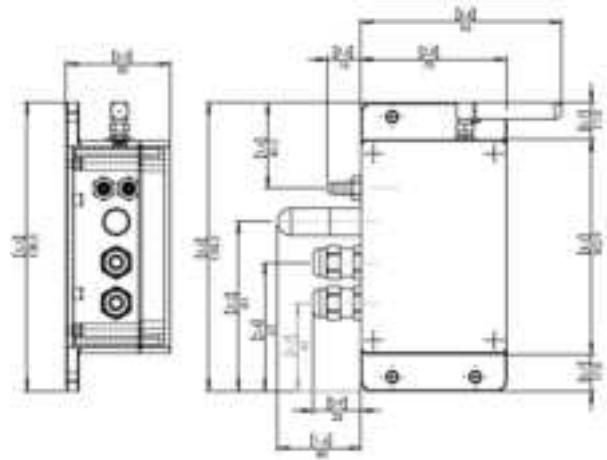There are three common use cases that determine how best to install a private LoRaWAN network, depending upon where the hardware is purchased from and what platform is being used for device/data management.

1) Sensors and gateway hardware purchased from Sensocon, with a Sensograf subscription.
   a. Gateway and platform are pre-provisioned. No further programming or settings changes should be needed. Simply power gateway, then sensors, and check platform for successful JOIN.
2) Sensors and gateway purchased from Sensograf, with a 3rd party platform subscription
   a. The gateway will be provisioned to recognize the sensors. Platform provider will need to supply APPKEY and APP/JOIN EUI information. Payload information is listed on page 11 and 12 of this manual to assist with ensuring that the 3rd party platform recognizes the transmitted data.
3) Sensors and gateway purchased from 3rd party, with Sensograf 3rd party subscription
   a. Hardware provider will need to provide the DEV EUI from the hardware, as well as Gateway EUI information so that the platform can be set up.

End-to End Installation – Sensocon Sensograf Platform Subscriber

The sequence shown below is the standard sequence of full end-to-end installation of the sensor. Additional steps within each sequence are provided in the next sections. **NOTE:** registering the device, whether sensor or gateway, on Sensograf is NOT needed if purchased from Sensocon.
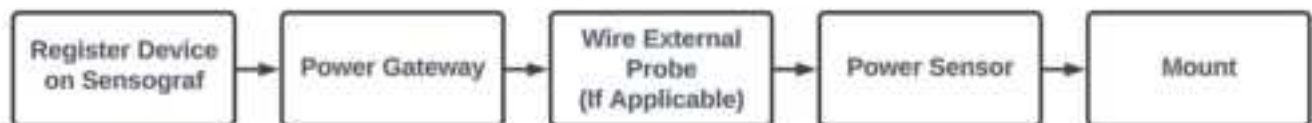
Figure 2: End-to-End Installation of Sensocon-Supplied Sensor, Gateway, & Sensograf Platform

End-to End Installation – 3rd Party Platform Subscriber

To use a 3rd party platform with Sensocon wireless sensors, you will need the App EUI and App Key from the platform provider, in addition to gateway-specific settings. Please refer to gateway and platform manuals for detailed instructions.
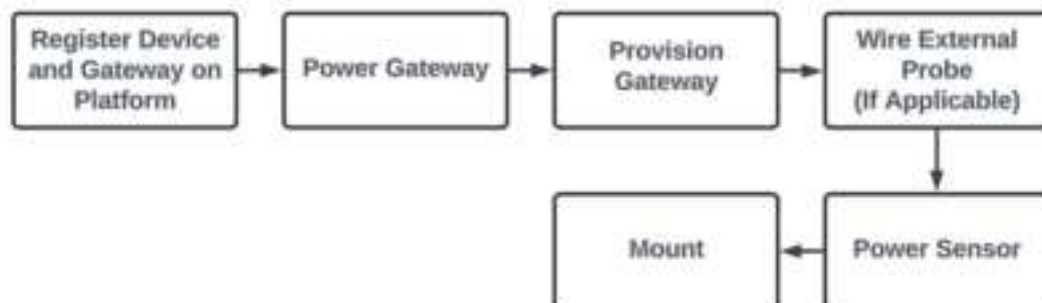
Figure 3: End-to-End Installation of Sensocon Sensor with 3rd Party Gateway & Platform

4. Installation

Unpacking and Inspection

Before installing the sensor, carefully unpack and inspect the device and all included components. Ensure that no parts were damaged during shipping.

Included Components:

- LoRaWAN Sensor
- 2x CR123A Battery (pre-installed with insulated pull tabs)
- Quick Start Guide
- Enclosure Mounting Screws (#8 x 1" self-tapping)

Registering Device, Connecting to Gateway & Sensograf Platform

The addition of a Sensocon DataSling WS or WM sensor to the Sensograf device management platform is designed to be simple and fast. Sensocon-supplied gateways are pre-provisioned to begin communication to the platform with little to no further intervention. This should enable instant communication upon sensor power-up. However, it may be necessary at times to ensure that the following fields under "Add Device" on the Sensograf platform are populated correctly:

- DEV EUI: A 16-digit identifier that serves as the address of the device. Pre-populated on platform and located on device product label.

- APP EUI: A 16-digit identifier that tells the network where to route data. Pre-populated on platform and printed on individual label inside sensor box.

- APP KEY: A 32-digit security key for encryption and authentication. Pre-populated on platform and printed on individual label inside sensor box.

If any of these items are inaccessible, please call or email Sensocon customer support via email at info@sensocon.com or telephone at (863)248-2800.

Step-By-Step Process for Registering & Confirming Device on Sensograf Platform

For devices not pre-provisioned by Sensocon.

1

Register Sensor & Confirm Gateway Registration
   a. Navigate to Sensograf.com, Log In, Select "Admin" and "Add Device" to Register Sensor.
   b. Return to Admin Screen, Select "Gateways" and Confirm Gateway is Shown (Status = 🔴)

2

Power Gateway
   a. Power the Gateway and Confirm Connection to Sensograf ("Status" Indicator = ✅)

3

Power Sensor
   a. Power the Sensor by Removing Insulated Battery Tabs.
   b. Confirm Connection to Sensograf by Returning to "Admin" Screen, Selecting "Devices" and Confirming "Last Checkin"

Figure 4: Step-by-Step Process to Install and Register Sensocon-Supplied Sensor, Gateway, and Platform

Registering Device, Connecting to Gateway & 3rd Party Platforms

This section is provided as a general guide. Please refer to the gateway user's manual and platform provider guide for detailed instructions. Both the gateway and device will need to be registered on the 3rd party platform with the proper information for routing traffic from the sensor to the application.

Step-By-Step Process for Registering & Confirming Device on 3rd Party Platform

Register Sensor & Gateway on Platform
Typically Requires:
   Sensor DEV EUI (included on sensor label)
   Gateway DEV EUI (provided w/gateway)
   App/Join EUI (from platform provider)
   AppKey (from platform provider)

Provision Gateway
If not pre-provisioned, requires:
   Server Certificate
   Client Certificate
   Key File
   Server Address
Other settings may apply.

Power Sensor
a. Remove insulated battery tabs
b. Confirm connection (flashing green and then solid green for 3 seconds

Figure 5: Step-by-Step Process to Install and Register Sensocon-Supplied Sensor with 3rd Party Gateway, & Platform

Payload Decoder

Sensocon DataSling Sensors are designed to work well with third-party platforms that have custom payload decoders. Information about how the sensor data is formatted, including encoding details, is included below to streamline setup. This will ensure the platform can interpret the data correctly.

This JavaScript decoder is designed to interpret uplink messages from your LoRaWAN device. It extracts sensor measurements and returns a structured JSON object.

Decoder Specification

- **Input**: A byte array containing encoded sensor data.
- **Output**: A JSON object with human-readable key-value pairs.

JavaScript Decoder (for Network Servers)

```javascript
// LoRaWAN Uplink Decoder for Sensocon Series WS and WM
function decodeUplink(input) {
    let bytes = input.bytes;
    let port = input.fPort; // Typically used to differentiate payload types
    let index = 0;

    // Initialize data object
    let data = {};
    data.rawHex = Buffer.from(bytes).toString('hex'); // Store raw payload
    data.header = getHead(bytes); // Extract header

    // Remove header byte before parsing measurements
    bytes = bytes.slice(1);

    // Parse up to 10 measurements (adjust if needed)
    for (let i = 0; i < 10; i++) {
        if (bytes.length < 5) break; // Avoid processing incomplete data

        let measurementChunk = bytes.slice(0, 5);
        bytes = bytes.slice(5);

        let measurement = getMeasurement(measurementChunk);
        if (measurement.key !== "EMPTY") {
            data[measurement.key] = measurement.parsed;
        }
    }
    return { data };
}
// Extract header byte (usually a device identifier or status flag)
function getHead(d) {
    return d.length > 0 ? d[0] : null;
}
// Convert measurement type byte into human-readable format
function getType(typeByte) {
    const typeMap = {
        0: "pressure",
        1: "humidity_temp",
        2: "humidity",
        3: "batt_voltage",
        4: "contact",
```

```
        5: "velocity", // aka flow
        6: "voltage",
        7: "current",
        8: "temperature",
        9: "altitude",
        10: "latitude",
        11: "light",
        12: "longitude",
        13: "resistance",
        14: "vibration",
        15: "x_position",
        16: "y_position",
        17: "z_position"
        18:
        19: "gauge_diff_pressure"
    };
    return typeMap[typeByte] || "EMPTY";
}
// Parse a single measurement (5-byte chunk: 1-byte type + 4-byte float value)
function getMeasurement(d) {
    if (d.length !== 5) return { key: "EMPTY", parsed: null };

    let typeKey = getType(d[0]); // Extract type byte
    let valueBytes = d.slice(1, 5); // Extract 4-byte float value

    // Convert bytes to float32
    let parsedValue = new Float32Array(new Uint8Array(valueBytes).buffer)[0];

    return { key: typeKey, parsed: parsedValue };
}
// Export decoder for network server integration
export { decodeUplink };
```

How to Use This Decoder

    For ChirpStack (LoRaWAN Network Server)
1. Go to **Device Profiles → Payload Codec**
2. Select **"Custom JavaScript functions"**
3. Copy and paste the above code into the **"Decoder"** field.

    For The Things Stack (TTS)
1. Navigate to **Applications → Payload Formatters**
2. Select **"Custom JavaScript formatter"**
3. Paste the code into the **Decoder** function.

For Helium Console
1. Under **Integrations → Custom Functions**
2. Add a new decoder function and insert the code.

For AWS IoT Core for LoRaWAN
1. **Go to AWS IoT Core Console → LoRaWAN → Devices**.
2. Select your device and navigate to **Payload Decoders**.
3. Choose **Custom Decoder**.
4. Paste the **JavaScript Decoder** code from above.
5. Save the changes and verify the decoded output in the **AWS IoT MQTT Test Client**.

For AWS Lambda (Custom Payload Decoder)
If it is preferred to handle decoding using an AWS Lambda function:
1. Create a new AWS Lambda function with a **Node.js runtime**.
2. Copy and paste the decoder code into the function.
3. Modify the function handler to process LoRaWAN uplink payloads from **AWS IoT Rules**.
4. Integrate the function with **AWS IoT Rule Engine** to automatically decode payloads before forwarding them to an IoT topic, DynamoDB, or another AWS service.

Example Input & Output

Raw Payload (Hex)
```
aa 00 a3cc3c40 02 a0c16d42 01 9a439f42 07 00008040
```

Decoded JSON Output
```
{
  "rawHex": "aa00a3cc3c4002a0c16d42019a439f420700008040",
  "pressure": 2.56,
  "humidity": 59.23,
  "humidity_temp": 79.12,
  "current": 4.00
}
```

LoRaWAN Downlink Command Format

To configure the end device settings, the following commands can be sent to the device.

Command Structure

- **Format**: CMD (1 Byte) + Data (2 Bytes) (e.g., 010001)
- **Data Encoding**:
    o The unit of data is **1/1000** of the base unit for the measured value.

Command List

Command Name	Command Code
SET_INTERVAL_CMD	00
SET_PRESSURE_OFFSET_CMD	02
SET_TEMP_OFFSET_CMD	04
SET_HUMIDITY_OFFSET_CMD	06
SET_VOLTAGE_OFFSET_CMD	08
SET_CURRENT_OFFSET_CMD	0A
SET_HUMIDITY_TEMP_OFFSET_CMD	0C
SET_GAUGE_DIFF_PRESSURE_OFFSET_CMD	10

Notes

- The **header byte** is used for **version control**.
- The decoder **processes up to 10 measurements**; you can modify this limit.
- It gracefully **ignores unknown sensor types**.
- The output uses **floating-point values** where applicable.
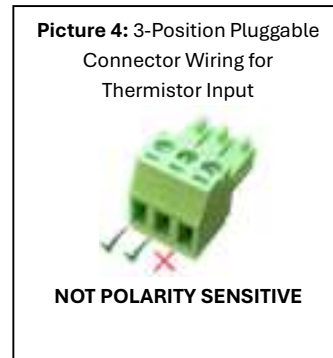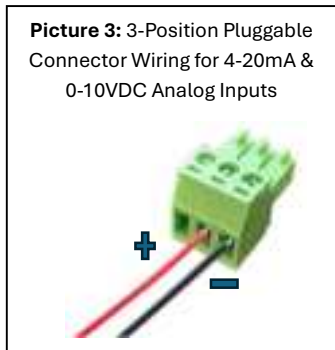
Troubleshooting

If the sensor does not respond to configuration changes, ensure it is properly connected. Review the configuration settings for accuracy and consult the troubleshooting guide for further assistance.

Wiring External Inputs

Connect external probes to the pluggable connector provided on the PCB board. The connector needs to be removed from the board for wiring and re-installed when wiring is complete.

- **Thermistor and Contact inputs (Sensocon supplied):** wiring is not polarity sensitive, see below, right
- **Industrial Input Sensors (e.g. 4-20mA, 0-10V):** see below, left

Picture 3: 3-Position Pluggable Connector Wiring for 4-20mA & 0-10VDC Analog Inputs

Picture 4: 3-Position Pluggable Connector Wiring for Thermistor Input

NOT POLARITY SENSITIVE

Sensor Power-up Procedure, LED Indicators & Button

To activate the sensor, remove the battery insulation tabs (shown below). The sensor will power up automatically once the batteries are in contact with the battery holder.

Once powered and initialization is complete, the JOIN procedure will commence. The internal LEDs will indicate progress towards joining LoRaWAN Server Network (LNS) via the gateway.

Picture 3: Battery Insulating Pull Tabs. Remove to Apply Power.

LED FUNCTIONS

FUNCTION	LED	DESCRIPTION
Initializing	●	Solid Yellow LED
Network JOIN	☀	Flashing Green LED
JOIN Success	●	Solid Green LED (3 Seconds)
Unsuccessful JOIN	●	Solid Red LED (3 Seconds)
Transmitting Data	☀	Flashing Green LED

Figure 6: LED Functions

If JOIN is unsuccessful, ensure gateway is powered, within range, with the correct credentials. The sensor will continue JOIN attempts until successful. See the troubleshooting guide on page 18 in this manual for help.

BUTTON FUNCTIONS

BUTTON FUNCTION	DESCRIPTION
Manual Transmit	Short Press
Test/Manufacture Mode	Short Press During Initialization

Figure 7: Button Functions

Mounting and Physical Setup

Location

Select an appropriate location for installation, considering the following:

- **Height and Position**: Install the sensor at a height of at least 1.5 meters above ground level. Transmission will often improve by increasing elevation where possible.

- **Obstacles**: Minimize obstacles such as walls, metal objects, and concrete that could impede wireless communication. Position the sensor near an opening (e.g., window) when possible to enhance signal strength.

- **Distance from Interference Sources**: Keep the sensor a minimum of 1-2 feet away from other electronic devices that might cause interference.

Mounting

Depending on the sensor model, different mounting options are available:

- **Wall Mounting**

    o Use the provided screws or ones more appropriate for your installation to secure the sensor onto a flat surface, ensuring the sensor is firmly attached.

- **Pipe or Mast Mounting**:

    o Use clamp fasteners (not included) to secure the sensor to a pipe or mast. Ensure the sensor is oriented correctly and securely attached to prevent movement.

Testing and Verification

- After installation, confirm that the sensor is communicating correctly with the network. Use the device's status indicators or the network platform to verify.

Safety and Maintenance

- Regularly check the sensor for signs of wear or damage, especially if installed in harsh environments.
- Replace batteries as needed as indicated in Sensograf (or 3rd party platform), or according to a planned maintenance schedule that incorporates battery life expectations based on interval selection.
- Clean the sensor gently with a dry cloth. Avoid using water or cleaning agents that could damage the device.

Note: Refer to the troubleshooting section on page 18 if any issues arise during installation or operation.

5. Configuration

Initial Setup and Configuration

Configuring your LoRaWAN sensor correctly is essential for ensuring optimal performance and reliable data transmission. The sensor uses Over-the-Air (OTA) methodology. OTA configuration allows the sensor settings to be adjusted remotely via the Device Management Platform. Configuration of the sensor requires that it be registered on the platform and communicating properly.

- **Configuration Commands**: Access the platform and navigate to the sensor's settings. Use the available configuration commands to adjust parameters such as data reporting interval, alert settings, and sensor scaling.

- **Monitor and Confirm**: After sending the configuration commands, monitor and/or test the changed parameters to ensure that the sensor begins operating with the new settings.

Configuration Options

Below are key configuration parameters that can be adjusted from the device platform during setup:

- **Reporting Interval**: Defines how often the sensor transmits data. This can be set to intervals ranging from minutes to hours, depending on the application.

- **Alert Thresholds**: Set alerts as upper and/or lower limits for parameters like temperature, humidity, or pressure to trigger alerts via email and/or text when these limits are breached.

- **Battery Status Monitoring**: Enable battery status monitoring to receive alerts when the battery voltage drops below a specified level.

- **Lost Communications:** Configure the system to alert designated users when a defined number of check-ins are missed.

6. Battery Information

Battery Specifications

Specification	Details
Type	Lithium Manganese Dioxide (Li-MnO2)
Nominal Voltage	3.0 V
Cutoff Voltage	2.0V
Capacity	1600 mAh each
Max Continuous Discharge	1500 mA
Operating Temperature	-40°C to 70°C (-40°F to 158°F)
Shelf Life	Up to 10 years
Dimensions	Diameter: 17 mm (0.67 in), Height: 34.5 mm (1.36 in)
Weight	Approx. 16.5g
Self-Discharge Rate	Less than 1% per year
Chemistry	Non-rechargeable Lithium
Protection	No built-in protection circuit

Figure 10: Battery Specifications

Key Battery Features

- **High Energy Density**: Provides a longer run time compared to other batteries of similar size.

- **Wide Operating Temperature Range**: Suitable for use in extreme temperatures, making it ideal for industrial and outdoor applications.

- **Low Self-Discharge Rate**: Maintains charge during long-term storage, making it reliable for devices that are used infrequently.

- **Long Shelf Life**: Up to 10 years, ensuring reliable performance when stored.

These specifications are typical of CR123A lithium batteries, though exact values may vary slightly depending on the manufacturer.

7. Troubleshooting Guide

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Sensor not connecting to network	Incorrect network settings	Verify the gateway network configuration settings.
	Weak signal	Ensure the sensor is within range of the gateway by testing closer to gateway. Verify connection at close range, then move to final installation location.
		Check for any obstacles blocking the signal and reposition the sensor if necessary and possible.
		Check for any obstacles blocking the signal and reposition the sensor if necessary and possible.
Data not updating on platform	Configuration issues or communication errors	Check the sensor's reporting interval settings.
		Restart the sensor by disconnecting batteries for 10 seconds to clear any misconfigurations.
Short battery life	High frequency of data transmission	Reduce the reporting frequency or adjust alert/notification thresholds to balance transmission frequency with battery life.
	Extreme environmental conditions	Extreme cold or heat can significantly impact battery performance, move to cooler/warmer location if practical.
Incorrect temperature or humidity readings	Environmental interference	Make sure the sensor is installed in a location free from direct sunlight, drafts, or moisture that could affect readings.
	Condensation on humidity sensor	Remove from condensing environment and allow sensor to dry.
Sensor not responding to commands	Power problems	Check the power source and replace the batteries if necessary.
Missed check-ins	Signal interference caused by obstacles such as metal objects or thick walls	Relocate the sensor to an area with fewer obstructions. Elevate the sensor to improve line-of-sight with the gateway.
LED indicators do not turn on	Power supply issues or incorrect installation	Check the battery connections and ensure the sensor is properly installed. Replace batteries if necessary.

Figure 11: Troubleshooting Chart

8. Customer Support

Contact Information for Technical Support

At Sensocon, Inc., we are committed to providing exceptional support to ensure that your LoRaWAN sensor operates efficiently and meets your needs. If you encounter any issues or require assistance with your sensor, please do not hesitate to reach out to our customer support team.

Contact Information:

Address:

Sensocon, Inc.
3602 DMG Dr
Lakeland, FL 33811 USA

Phone: 1-863-248-2800

Email: support@sensocon.com

Support Hours:
Our customer support team is available Monday through Friday, 8:00 AM to 5:00 PM EST.

9. Compliance and Safety Precautions

Compliance Statement

This device complies with all applicable national and international standards, including:

Federal Communications Commission (FCC): This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement: This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada Compliance: This device complies with Industry Canada's license-exempt RSS standards. Operation is subject to the following conditions:

- This device may not cause interference.
- This device must accept any interference, including interference that may cause undesired operation of the device.

IC Radiation Exposure Statement: This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment and should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

RoHS Compliance: The product complies with the Restriction of Hazardous Substances Directive, ensuring it contains no more than the allowable levels of lead, mercury, cadmium, hexavalent chromium, and other hazardous materials.

Safety Precautions

Installation and Use
Install the device with a minimum distance of 20 cm from all persons. For best results, ensure the device is not co-located with any other transmitter.

Battery Safety
The device contains lithium batteries. Do not recharge, disassemble, heat above 100°C (212°F), or incinerate. Replace only with approved battery types as specified in this manual. Ensure proper handling and disposal in accordance with local regulations.

Handling and Maintenance:
Avoid exposure to extreme temperatures, water, or moisture beyond the rated enclosure protection level (IP65). Handle the device with care to avoid damage. Improper handling may void warranty and compliance status.

Regulatory Warnings:
Changes or modifications not expressly approved by the responsible party for compliance could void the user's authority to operate the equipment. Ensure that all local and national regulations are adhered to when deploying and operating this device.

10. Legal Notices

Disclaimers

The information in this manual is provided "as is" without any warranties of any kind, either express or implied, including but not limited to the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. While every effort has been made to ensure the accuracy of the information provided in this manual, Sensocon, Inc. assumes no responsibility for errors, omissions, or inaccuracies and shall not be liable for any damages arising from the use of the information contained herein.

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End-of-Life and Disposal: This product contains materials that may be hazardous to the environment. Proper disposal in accordance with local regulations is required. Do not dispose of this product in household or general waste facilities.

Firmware and Software Updates: Sensocon, Inc. reserves the right to make changes to the product, firmware, or software without prior notice. Regular updates may be required to ensure optimal performance and security of the device. Sensocon, Inc. does not guarantee backward compatibility with all previous versions of firmware or software.

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12. Revision History

Document Version History

Version	Date	Change(s)
1.0	9/23/24	Initial Version

Figure 12: Revision History Chart