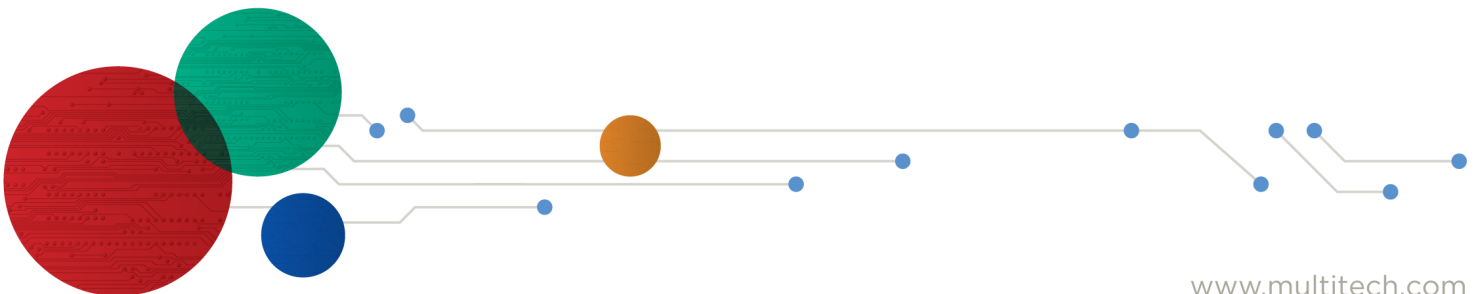




# Radio Bridge LoRaWAN<sup>®</sup> Wireless Sensor

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Air Temperature Humidity Sensor User Guide



### LoRaWAN Wireless Air Temperature Humidity Sensor

Model: RBS3010NA0EBNO, RBS3010EU0EBNO

Part Number: RB0027 Rev. 1.1

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# Chapter 1 – Overview

The LoRaWAN wireless air temperature humidity sensor uses air flow to measure temperature and humidity levels. If the temperature and/or humidity rises above or falls below the configured thresholds, an alert is sent over the wireless network.

## Part Numbers

| Part Number     | Rating | Wireless | Region        |
|-----------------|--------|----------|---------------|
| RBS3010NA0EBN00 | Indoor | LoRaWAN  | North America |
| RBS3010EU0EBN00 | Indoor | LoRaWAN  | Europe        |

## Documentation

The following documentation is available at <https://www.multitech.com/products/sensors>.

| Document         | Description                                                                                                                              | Part Number |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| User Guide       | This document provides overview, safety and regulatory information, design considerations, schematics, and general hardware information. | RB00027     |
| Connection Guide | This document provides instructions and information on how to connect LoRaWAN sensors on gateways and networks.                          | RB00001     |

## Chapter 2 – Quick Start

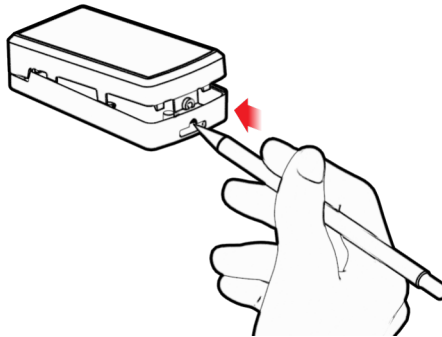
### Preparing an RBS301 Sensor

Sensors ship with batteries installed. There is a plastic tab over the battery, which needs to be removed.

- Pull the tab out of the sensor to connect the battery. If the tab does not pull out easily, you may need to open the case to remove it.

To open the case:

1. Use a pen or similar object to press the button on the opposite side of the case.



2. Remove the battery tab. You may need to remove the battery to remove the tab.
3. Re-insert the battery and close the case.

### Quick Start

Use your sensor through either the console or a third-party network. To use the console, use the following steps. To use a third-party network, refer to the *Connecting LoRaWAN Sensors on Gateways and Networks* (RB00001) , which is available through the sensor page at <https://www.multitech.com/products/sensors>

1. Create a console account at: <https://console.radiobridge.com/>
2. Click on **Devices** on the left.
3. Click **Add Device**.
4. Select the network you want to use.
5. Make sure Console Only Device is NOT selected.
6. Specify if you want to **Register Through Radio Bridge** or use an existing account with the network.
7. Enter the **Device Name**, **Device ID**, and **Device Key**.

**Note:** For easy Device ID and Key entry, scan the QR code on the yellow key card included with your device. Then copy and paste data into the console. With the QR code, the first line is the Device ID and the rest is the key.

8. Select the model from the **Device Type** drop down. Model is on the device label.
9. Set the **Join EUI** to **7894E80000000000** and click **Continue**.
10. Review the summary and click **Confirmation**.

The console shows complete when the device is successfully added.

## Mounting the Sensor

Do not mount higher than 2 meters from floor surface.

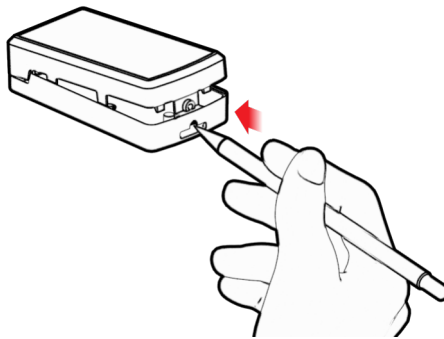
To mount the sensor:

- Use the large adhesive pad included with a sensor to secure the case in position.

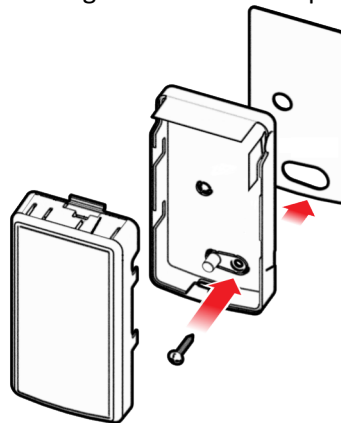
### Mounting the Sensor with the Tamper Screw

For increased security, open the case, and fasten it to the wall using the included tamper screw as shown. Then reassemble the case. The tab will break away and send a tamper alert if the case is forcibly removed.

1. Open the case. To do this, use a pen or similar object to press the button on the opposite side of the case.



2. Stick the adhesive pad where you want to install the sensor.
3. Attach the case over the adhesive using the included tamper screw as shown.



4. Reassemble the case.

The tab will break away if the case is forcibly removed. If you enabled the sensor's tamper option, the sensor sends a tamper alert. (Note: Tamper switches are disabled by default.)

## Chapter 3 – Hardware Specifications and Information

### Absolute Maximum Ratings

| Parameter                                       | Rating         |
|-------------------------------------------------|----------------|
| Operating ambient temperature (indoor version)  | -30°C to +70°C |
| Operating ambient temperature (outdoor version) | -40°C to +70°C |
| Storage ambient temperature                     | -40°C to +90°C |

### Battery Life

The sensor uses a lithium non-rechargeable battery, capable of an estimated 200,000+ messages.

**Note:** Refer to the Sensor Battery Estimator.xlsx spreadsheet on the on the sensor's product page for specific battery life estimates:

<https://radiobridge.com/documents/Sensor%20Battery%20Estimator.xlsx>

Battery life depends on the number of transmissions per day. Power required for a message transmission is greater than the “sleep current” for high power radio technologies (e.g, LoRaWAN).

Different battery chemical types deplete over time with different voltage profiles; a lithium battery maintains high voltage for the life of the battery with a rapid drop near the end of life, and an alkaline battery has gradual reduction in voltage over time. Sensors ship with a lithium battery, which is the recommended replacement type.

Recommended battery: Panasonic CR123A

Battery life estimates in the online spreadsheet assume room temperature, meaning temperatures near the maximum and minimum ratings negatively impact battery life. Battery voltage lowers in cold temperatures, and internal circuitry needs a minimum voltage to operate properly.

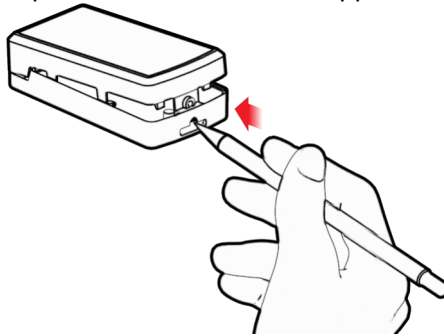
**Note:** Battery life will be reduced in cold environments leading to possible device shut down.

The battery voltage and a low battery indicator are reported by supervisory messages. Refer to the section on Message Protocol for details.

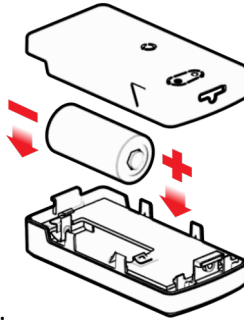
## Replacing the Battery

Replacement battery type is listed in the Battery Life topic. To replace the battery:

1. Use a pen or similar object to press the button on the opposite side of the case.



2. Remove the battery.



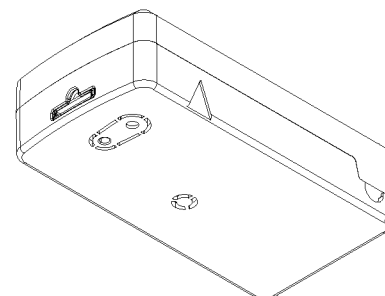
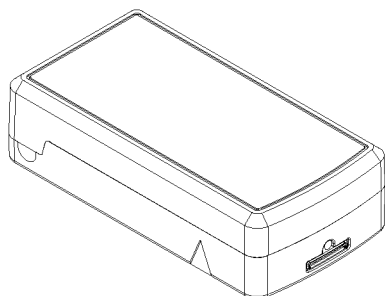
3. Insert the new battery as shown.
4. Close the case.

## Mechanical Drawings

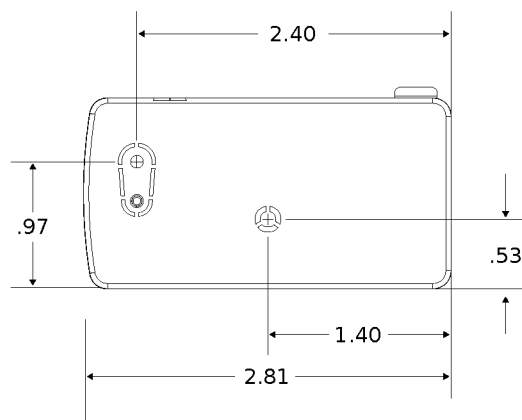
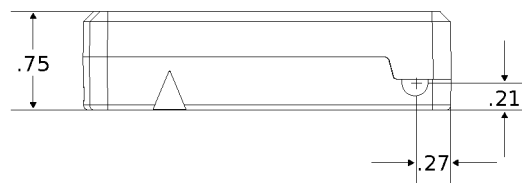
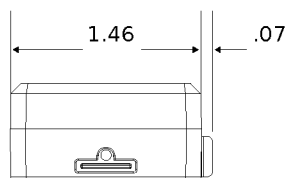
The mechanical drawings provided in this section are for the main body of the sensor. All dimensions use inches unless specified.

### Indoor RBSx01 Sensors

ISOMETRIC  
TOP VIEW



ISOMETRIC  
BOTTOM VIEW



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## Chapter 4 – Safety

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### Lithium Battery Safety

**CAUTION:** The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C (212°F) or dispose of in fire. Replace battery with Panasonic CR123A. Use of another battery may present a risk of fire or explosion. Dispose of batteries according instructions.

**Attention:** La batterie utilisée dans cet appareil peut présenter un risque d'incendie ou de brûlure chimique si elle est maltraitée. Remplacez la batterie par une Panasonic CR123A. Ne pas démonter, incinérer ou exposer à des températures supérieures à 100°C. Jeter les piles utilisé conformément aux instructions.

Lithium cells and batteries are subject to the Provisions for International Transportation. Multi-Tech Systems, Inc. confirms that the Lithium batteries used in the MultiTech product(s) referenced in this manual comply with Special Provision 188 of the UN Model Regulations, Special Provision A45 of the ICAO-TI/IATA[1]DGR (Air), Special Provision 310 of the IMDG Code, and Special Provision 188 of the ADR and RID (Road and Rail Europe).

### User Responsibility

Keep the wireless sensor away from children.

Respect all local regulations for operating your wireless device. Use the security features to block unauthorized use and theft.

End user must operate product per country laws and rules

## Chapter 5 – Common Messages

### Common Messages

This chapter defines the protocol and message definitions common to all MultiTech wireless sensors. Common messages include basic error messages, tamper, supervisory, link quality, and downlink acknowledgments. Sensor specific messages are in the *Sensor Specific Messages* chapter.

### Message Protocol

This section defines the protocol and message definitions for the device.

**Note:** MultiTech provides a web-based console at [console.radiobridge.com](https://console.radiobridge.com) for configuring and monitoring devices. We recommend using this console rather than the protocols defined in this section.

If not using the console, use this topic to configure the device through downlink messages and decode the device data.

### Uplink Messages

The uplink messages (sensor to web application) have the following structure.

| Item             | Size              | Description                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Protocol Version | 4 bits            | A constant 1, provides extensibility to the specific format of a message type.                                                                                                                                                                                                                                                                                                                                         |
| Packet Count     | 4 bits            | A sequential number starting at 0 for the first message sent from the sensor to the cloud. It increments by one for each subsequent message. When it reaches 0xF (15 decimal), it wraps back to 0. Packet count helps identify when a message is lost. For example, if the packet count goes 2,4 instead of 2,3,4, it indicates a message has been lost. It can also help identify out-of-order or duplicate messages. |
| Message Type     | 1 byte            | Byte format is 8 bits. Refer to next table.                                                                                                                                                                                                                                                                                                                                                                            |
| Message Payload  | 0-7 bytes         | Each message type has between 0 and 8 bytes of payload data specific to the sensor. Refer to the following table for payload information.                                                                                                                                                                                                                                                                              |
| 0x00             | 5-byte reset code | Device has reset. The reset cause is represented in the 5-byte reset code payload.                                                                                                                                                                                                                                                                                                                                     |
| 0x01             | >9 bytes          | Daily supervisory message (1-2 per day). The 9-byte payload contains current sensor status. Refer to <a href="#">Supervisory Message (0x01)</a> for payload details.                                                                                                                                                                                                                                                   |

| Message Type | Payload      | Description                                                                              |
|--------------|--------------|------------------------------------------------------------------------------------------|
| 0x02         | 1-byte event | A tamper event has occurred. Refer to <a href="#">Tamper Message (0x02)</a> for details. |
| --           | Sensor event | Sensor events are defined in the <i>Sensor Specific Messages</i> chapter.                |

| Message Type | Payload       | Description                                                                                                                                                                               |
|--------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0xfb         | Link quality  | Sent after each downlink configuration (refer to <a href="#">Link Quality Message</a> ) or to periodically ping the network server (refer to <a href="#">Link Quality Check Period</a> ). |
| 0xfe         | --            | Reserved.                                                                                                                                                                                 |
| 0xff         | 1-byte status | Downlink message ACK. Refer to <a href="#">Downlink ACK</a> for more detail.                                                                                                              |

## Reset Message (0x00)

Every time a sensor powers up it sends a reset message to the cloud.

The reset message payload is defined in the following table.

| Bytes | Description                                                                                                                                                         |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0     | Sensor type code, a product identifier sent as part of the reset message. (The following code is specific to your device).<br><br>Air Temperature and Humidity 0x0e |
| 1     | Hardware version.                                                                                                                                                   |
| 2-3   | Firmware version.                                                                                                                                                   |
| 4-5   | Reset code. Used for factory diagnostics.                                                                                                                           |

## Firmware Version

The 16-bit firmware version is constructed from reset payload Bytes 2-3, where Byte 2 is the most significant byte. Beginning with version 2.0, the format is as shown in the following table.

The original format is compatible by redefining the reserved most significant bit (Bit 15).

| Byte  | Description           |
|-------|-----------------------|
| 15    | Format (bit == 0)     |
| 14:8  | Major number (7 bits) |
| 7:0   | Minor number (8 bits) |
| 15    | Format (bit == 1)     |
| 14:10 | Major number (5 bits) |
| 9:5   | Minor number (5 bits) |
| 4:0   | Build number (5 bits) |

### 16-Bit Firmware Version Examples

- 0x0103 is decoded as Firmware Version 1.3
- 0x8823 is decoded as Firmware Version 2.1.3

## Supervisory Message (0x01)

Wireless sensors periodically (19 hours by default) send a supervisory message so the backend system can verify the device is still alive and report error conditions. The supervisory message payload include current sensor status.

You can also trigger a supervisory message. To do this:

- Place a magnet near the triangular notch on the side of the sensor.

The following table shows the supervisory message payload:

| Bytes | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|-----|-----------|---|-----------------------------------|---|-----------------------|---|---------------------------|---|---------------------------|---|-----------------------------------------------------------------------------------------------------|
| 0     | Supervisory error codes as follows: <table> <tr> <th>Bits</th><th>Description</th></tr> <tr> <td>7:5</td><td>Not used.</td></tr> <tr> <td>4</td><td>Tamper detected since last reset.</td></tr> <tr> <td>3</td><td>Current tamper state.</td></tr> <tr> <td>2</td><td>Error with last downlink.</td></tr> <tr> <td>1</td><td>Battery low (under 2.8v).</td></tr> <tr> <td>0</td><td>Radio communication error, communication with the integrated radio failed and the device was reset.</td></tr> </table> | Bits | Description | 7:5 | Not used. | 4 | Tamper detected since last reset. | 3 | Current tamper state. | 2 | Error with last downlink. | 1 | Battery low (under 2.8v). | 0 | Radio communication error, communication with the integrated radio failed and the device was reset. |
| Bits  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 7:5   | Not used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 4     | Tamper detected since last reset.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 3     | Current tamper state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 2     | Error with last downlink.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 1     | Battery low (under 2.8v).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 0     | Radio communication error, communication with the integrated radio failed and the device was reset.                                                                                                                                                                                                                                                                                                                                                                                                        |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 1     | Current sensor state, 1-byte. This is device specific, refer Sensor Specific Messages chapter for details. For other devices, use the periodic reporting feature.                                                                                                                                                                                                                                                                                                                                          |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 2     | Battery level is a two-digit battery voltage. For example, if the battery voltage is 2.9V, byte 2 would be 0x29.                                                                                                                                                                                                                                                                                                                                                                                           |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 3-6   | Extended sensor state, 4-bytes. Allows sensors with higher precision or multiple values to report during a supervisory event. For other devices, use the periodic reporting feature.<br><b>Note:</b> For applications requiring periodic readings, using the periodic reporting feature is recommended. Refer to <i>Periodic Reports</i> . in Sensor Specific Downlink Messages.                                                                                                                           |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |
| 7-8   | Event accumulation count is the number of sensor events since the last supervisory message. To improve battery life, can be used with the <b>Disable all sensor events</b> setting so only an event total is reported during a supervisory message, individual events are not reported as they occur. This feature is available in firmware v2.0 and beyond.                                                                                                                                               |      |             |     |           |   |                                   |   |                       |   |                           |   |                           |   |                                                                                                     |

## Tamper Message (0x02)

A sensor sends a message when the tamper switch has been opened or closed through either an enclosure tamper or a wall mount tamper. The tamper message contains a 1-byte payload as shown in the following table.

| Payload | Description           |
|---------|-----------------------|
| 0x00    | Tamper switch opened. |
| 0x01    | Tamper switch closed. |

## Downlink ACK (0xFF)

The cloud app uses this downlink ACK message to verify the that sensor received the downlink message received and it was considered valid.

The sensor replies to the downlink data with a 0xFF message (downlink ACK) with the payload shown in the following table.

| Command | Payload                          |
|---------|----------------------------------|
| 0x00    | Not used                         |
| 0x01    | Message was invalid or undefined |
| 0x02    | Message was valid                |

## Link Quality Message (0xFB)

The link quality message provides a signal strength and a signal to noise measurement at the device itself. The link quality message payload is shown in the following table.

| Bytes | Description                                                                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0     | Current Sub-Band, sub-band currently joined and used for communication to the gateway and network server. Value ranges from 1-8 for US915. For other regions, value depends on available channels. |
| 1     | RSSI of last DOWNLINK received, signed integer format values in bytes 1 and 2 in two's complement format.                                                                                          |
| 2     | SNR of last DOWNLINK received, signed integer format values in bytes 1 and 2 in two's complement format.                                                                                           |

## Downlink Messages

Downlink messages are from the cloud to the sensor and are used to configure the sensor. The sensor initiates receiving downlink messages upon transmitting, since the sensor is typically sleeping with the radio turned off.

All downlink messages must contain 8 bytes, padded with zeroes.

A downlink will be received after any uplink within the receive window.

The following command messages can be sent back to the sensor as downlink.

| Command | Payload   | Description                                                                |
|---------|-----------|----------------------------------------------------------------------------|
| 0x00    | Not used  | Not used                                                                   |
| 0x01    | 4 bytes   | General configuration                                                      |
| --      | 0-7 bytes | Sensor configuration, refer to the <i>Sensor Specific Messages</i> chapter |
| 0xED    | 1 byte    | Device Info Request ( <i>Firmware version 3.0 or newer</i> )               |
| 0xEE    | 1 byte    | Link quality configuration ( <i>Firmware version 3.0 or newer</i> )        |
| 0xEF    | 4 bytes   | ADR Advanced configuration ( <i>Firmware version 3.0 or newer</i> )        |
| 0xFC    | 3 bytes   | Advanced configuration                                                     |

## General Configuration

Use the general configuration command to configure parameters that apply to all sensor types.

| Byte | Description                           |
|------|---------------------------------------|
| 0x00 | Disable sensor events                 |
| 0x01 | Radio config                          |
| 0x02 | Supervisory period. Default 19 hours. |
| 0x03 | Sampling rate                         |

## Disable Sensor Events

The following table shows the disable sensor event bit definitions.

| Bit | Description               |
|-----|---------------------------|
| 7:1 | Not used                  |
| 0   | Disable all sensor events |

## Radio Config

The following table shows the radio config byte definition.

**Note:** Available in firmware version 1.4 or newer.

| Bits | Description                                                                                                                                                                                                                                                                                                                                              |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | Not used (reserved)                                                                                                                                                                                                                                                                                                                                      |
| 6    | Enable duty cycle requirement. <i>EU868 only</i> . To enforce the EU868 band duty cycle requirements, enable before production deployment. Cannot be disabled. Available in firmware 2.2.1 or later.                                                                                                                                                     |
| 5:2  | Uplink retries. . The range for uplink retries is 1-8 for confirmed messages (ACK required) and does not apply to unconfirmed messages. Default 0 (leave unchanged). Available in firmware v1.4 and above.                                                                                                                                               |
| 1    | Use unconfirmed messages. If set to use the unconfirmed messages bit, the sensor does not look for an ACK from the network server. Default is 1 (unconfirmed messages, no ACK required). EU sensors can't use confirmed messages, setting this bit to 0 on an EU device causes an invalid downlink error (0xFF01). Available in firmware v1.4 and above. |
| 0    | Disable Adaptive Data Rate (ADR). To enable ADR, set to 0. To disable ADR, set to 1. Default is 0 (enabled). Available in firmware v1.3 and above.                                                                                                                                                                                                       |

**Important:** The duty cycle bit is always set for production deployments in the EU868 band. It cannot be changed.

## Supervisory Period

The general configuration command's supervisory period controls the time between supervisory messages as defined in the following table.

| Bit 7 | Bits 6:0                                                                        |
|-------|---------------------------------------------------------------------------------|
| 0     | Period defined in hours (1-127 hours). Available in firmware v1.3 and above.    |
| 1     | Period defined in minutes (1-127 minutes) Available in firmware v1.3 and above. |

For example, to receive a report every 4 hours, set Byte 1 to 0x04. To receive a periodic report every 15 minutes, set Byte 1 to 0x8f.

## Sampling Rate

Sampling rate controls the frequency at which devices wake from low power sleep mode to check the sensor state. Some sensors require very little power to check the state and need to react quickly. Other sensors can be sampled at a lower rate, such 30-second or 30-minute intervals. Increasing the time between samples increases battery life.

Refer to the Battery Estimator for battery life estimates relative to sampling rate:

<https://radiobridge.com/documents/Sensor%20Battery%20Estimator.xlsx>

A value of 0 in this field leaves the sampling rate at the current value. Use the following table to determine the sampling rate if the value is not zero.

**Note:** Sampling period only applies to sensors that take measurements like temperature and tilt, it does not apply to sensors with binary inputs such as door/window sensors or push buttons.

This feature is available in firmware v2.0 and above.

| Bit 7:6 | Bits 5:0                                                          |
|---------|-------------------------------------------------------------------|
| 00      | Sampling period defined in increments of 250ms (0.25-15 seconds). |
| 01      | Sampling period defined in increments of seconds (1-63 seconds).  |
| 10      | Sampling period defined in increments of minutes (1-63 minutes).  |
| 11      | Sampling period defined in increments of hours (1-63 hours).      |

## Device Info Request

The Device Info Request command is a downlink to inform the gateway to report its downlink configuration information.

| Bit  | Description                                                                                                                                                                      |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x00 | Downlink configuration type to request.<br><br>0-254: Request device info for specific downlink type to report.<br><br>255: Request device info for all downlink configurations. |

## Link Quality Configuration (0xEE)

The Link Quality configuration command configures the number of failed confirmed message attempts before re-entering the LoRaWAN join state.

| Byte | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x00 | Number of failed confirmed message transmits before the device re-enters a LoRaWAN join state. The default value is 12.<br><br>When the device transmits a confirmed message and exhausts uplink retries without receiving an acknowledgment, the device increments an internal failed counter by 1. This counter not increment if the message being transmitted is not a confirmed message.<br><br>If this counter does not exceed the threshold specified in this byte, the device attempts a retransmit.<br><br>The default value is 12. |

## ADR Advanced Configuration

The ADR configuration message overrides the LoRaWAN ADR\_ACK\_LIMIT and ADR\_ACK\_DELAY parameters.

| Byte | Description                                                                    |
|------|--------------------------------------------------------------------------------|
| 0x00 | ADR_ACK_LIMIT value when running in Unconfirmed Mode. The default value is 64. |
| 0x01 | ADR_ACK_DELAY value when running in Unconfirmed Mode. The default value is 32. |
| 0x02 | ADR_ACK_LIMIT value when running in Confirmed Mode. The default value is 2.    |
| 0x03 | ADR_ACK_DELAY value when running in “Confirmed Mode”. The default value is 1.  |

For additional details with usage to ADR\_ACK\_LIMIT and ADR\_ACK\_DELAY, refer to *LoRaWAN Link Layer Specification v1.0.4 - Section 4.3.1.1: Adaptive data-rate control in frame header*.

## Factory Reset (0xEC)

Restores all setting to factory defaults. Does not preserve any custom configuration.

- In US915, the device returned the device information message.
- In EU868, the device returns that downlink confirmation.

## Advanced Configuration (0xFC)

Use this command for advanced configuration parameters that apply to all sensor types. The advanced configuration command is defined in the following table.

| Byte | Description               |
|------|---------------------------|
| 0x01 | Port number               |
| 0x02 | Link quality check period |

### Port Number

Byte 0x01 of the advanced configuration command changes the uplink port per the LoRaWAN protocol. The default port is 2, and a value of 0 in this field means to leave it at the default.

This feature is available in firmware v1.4 and above.

### Link Quality Check Period

Setting this register causes the device to ping the network server periodically with a requested ack. Typically used with unconfirmed messages, this feature creates a periodic confirmed message and looks for the ack to ensure the device is still connected.

The following table shows this byte’s encoded bit definitions.

Available in firmware v2.0 and above.

| Bit 7 | Bits 6:0                                  |
|-------|-------------------------------------------|
| 0     | Period defined in hours (1-127 hours).    |
| 1     | Period defined in minutes (1-127 minutes) |

## Chapter 6 – Sensor-Specific Messages

### Uplink Messages

The uplink message (sensor to web application) specific to the sensor is defined in following table. The common uplink messages are not included in this section (see Common Messages).

#### Temperature and Humidity Event (0x0D)

| Byte | Description                                                                             |
|------|-----------------------------------------------------------------------------------------|
| 0    | Temperature/Humidity Event Payload (see Temperature/Humidity Event Payload Definitions) |
| 1    | Current temperature in degrees Celsius with sign bit                                    |
| 2    | First decimal of current temperature (0-9) in the most significant 4-bits.              |
| 3    | Humidity in % relative humidity (0-100%)                                                |
| 4    | First decimal of relative humidity (0-9) in the most significant 4-bits.                |

The temperature and humidity values in the above table are broken out as whole units and the first decimal point. For example, if the current temperature is 26.5 degrees C, byte 1 would be 0x1A and byte 2 would be 0x50. If the humidity is 22.4%, byte 3 would be 0x16 and byte 4 would be 0x40.

The most significant bit in the temperature field (byte 1) is the sign bit where a '1' represents a negative temperature and a '0' represents a positive temperature. Thus, if the reported temperature is -26.5 degrees C, byte 1 would be 0x9A (0x1A with the MSB set) and byte 2 would be 0x50. Note that this is not two's complement notation, it is a sign bit followed by an unsigned 7-bit value.

The temperature/humidity event is defined in the following table.

| Event payload | Description                                  |
|---------------|----------------------------------------------|
| 0x00          | Periodic report                              |
| 0x01          | Temperature has risen above upper threshold  |
| 0x02          | Temperature has fallen below lower threshold |
| 0x03          | Temperature report on change increase        |
| 0x04          | Temperature report on change decrease        |
| 0x05          | Humidity has risen above upper threshold     |
| 0x06          | Humidity has fallen below lower threshold    |
| 0x07          | Humidity report on change increase           |
| 0x08          | Humidity report on change decrease           |

The current temperature field in the uplink message is the current temperature in degrees Celsius. Values of 0x7f (high side) and 0x80 (low side) are considered out of range.

The humidity field in the uplink message is the air humidity percentage which can range from 0-100%.

## Downlink Messages

The downlink message (web application to sensor) specific to the sensor configuration is defined in following table. The common downlink messages are not included in this section (see common messages document).

| Byte | Description                                            |
|------|--------------------------------------------------------|
| 0    | Mode: 0x00 for Threshold, or 0x01 for Report on Change |
| 1-6  | Defined by Mode (See Mode sections)                    |

The mode byte selects one of two modes: threshold based alerts or report-on-change alerts. The remainder of the payload (bytes 1-6) are determined by the mode selected and defined in the next two sections.

For example, to receive a periodic report every 4 hours, byte 1 would be set to 0x04. To receive a periodic report every 15 minutes, byte 1 would be set to 0x8f.

### Threshold Mode

Threshold mode is set when byte 0 of the payload is set to 0x00. The remainder of the payload is defined in the following table.

| Byte | Description                                                                                                                 |
|------|-----------------------------------------------------------------------------------------------------------------------------|
| 0    | 0x00 (Threshold mode)                                                                                                       |
| 1    | Periodic reporting in 1 minute or 1 hour intervals. Default is 0 (disabled)                                                 |
| 2    | Restoral margin (bits 7:4 for humidity, bits 3:0 for temperature). Default 5 degrees C for temperature and 5% for humidity. |
| 3    | Lower temperature threshold. Default 10 degrees C.                                                                          |
| 4    | Upper temperature threshold. Default 40 degrees C.                                                                          |
| 5    | Lower humidity threshold. Default 40% relative humidity.                                                                    |
| 6    | Upper humidity threshold. Default 60% relative humidity.                                                                    |

The upper and lower temperature thresholds are signed values with units of one degree Celsius (range is -40 to 100 degrees C). Note that if the configuration settings exceed the maximum ratings on the sensor, the sensor may not report an event.

The Restoral Margin is used for the upper and lower thresholds and requires the temperature or humidity values to cross back over the threshold a certain amount before a new event is reported. This prevents excessive event messages if the measurement is at or near the threshold.

For example, consider an upper temp threshold set at 30 degrees Celsius and the restoral margin set at 5 degrees. If the temperature initially exceeds 30 degrees then an event is generated and a message is sent to the network. The temperature must now drop to 25 degrees and then exceed 30 degrees before another event is reported.

The restoral margins are unsigned values with units of 1 degree Celsius (range is 1-15 degrees C) and 1% relative humidity (range is 1%-15%). If a restoral margin is set to 0, it is disabled.

Periodic reporting is described in the section Periodic Reports.

## Report on Change Mode

Report on Change mode is set when byte 0 of the payload is set to 0x01. The remainder of the payload is defined in the following table.

| Byte | Description                                                                 |
|------|-----------------------------------------------------------------------------|
| 0    | 0x01 (Report on Change mode)                                                |
| 1    | Periodic reporting in 1 minute or 1 hour intervals. Default is 0 (disabled) |
| 2    | Not used.                                                                   |
| 3    | Temperature increase                                                        |
| 4    | Temperature decrease                                                        |
| 5    | Humidity increase                                                           |
| 6    | Humidity decrease                                                           |

The temperature/humidity changes are unsigned values and have units of degrees C and % relative humidity.

If the report-on-change feature is used, the sensor will send an alert any time the temperature/humidity changes by the specified amount. For example, if the temperature increase and decrease are set to 5 degrees, then an alert is sent every time the temperature changes 5 degrees from the last report. There is no time limit as to when the change must take place.

If the temperature/humidity increase is set to zero then the feature is disabled.

Periodic reporting is described in the section Periodic Reports.

## Periodic Reports

The temperature/humidity sensor can also send periodic updates of the temperature and humidity, and this is defined in byte 1 of both modes. A setting of 0 will disable periodic reporting. The period is defined in 1 hour increments when the most significant bit is 0, and it is defined in 1 minute increments when the most significant bit is 1 as shown in the following table.

| Bit 7 | Bits 6:0                                  |
|-------|-------------------------------------------|
| 0     | Period defined in hours (1-127 hours)     |
| 1     | Period defined in minutes (1-127 minutes) |

For example, to receive a report every 4 hours, byte 1 would be set to 0x04. To receive a periodic report every 15 minutes, byte 1 would be set to 0x8f.

Note that prior to firmware version 1.3, only hourly reporting is available. The firmware version can be found in the reset message and is logged on the Radio Bridge console.

**Note:** Periodic reporting is not recommended as it will increase data service fees and significantly reduce battery life. Wherever possible, use thresholds or report-on-change only.

## Periodic Reports

The weather station bridge sends all data on a periodic basis. This period is defined in byte 1 of the downlink message. The period is expressed in 1 hour increments when the most significant bit is 0, and in 1 minute increments when the most significant bit is 1 as shown in the following table.

### Period Byte from Downlink Configuration Message

| Bit 7 | Bits 6:0                                  |
|-------|-------------------------------------------|
| 0     | Period defined in hours (1-127 hours)     |
| 1     | Period defined in minutes (1-127 minutes) |

For example, to receive a report every 4 hours, byte 1 would be set to 0x04. To receive a periodic report every 15 minutes, byte 1 would be set to 0x8f.

## Chapter 7 – Regulatory Information

### 47 CFR Part 15 Regulation Class B Devices

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 cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

**Warning:** Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### Federal Communications Commission (FCC)

Per FCC 15.19(a)(3) and (a)(4) 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 undesired operation.

Per FCC 15.21, Changes or modifications not expressly approved by MultiTech could void authority to operate the devices.

LoRaWAN RBS301 Wireless Sensor:

- FCC ID: AU792U22A05869
- IC: 125A-0066

## Industry Canada Class B Notice

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement Canadien sur le matériel brouilleur.

This device complies with Industry Canada license-exempt RSS standard(s). The operation is permitted for the following two conditions:

1. the 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'Industrie 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.

## EMC, Safety, and R&TTE Directive (RED) Compliance



The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

Council Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment;

and

Council Directive 2014/53/EU on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

and

Council Directive 2014/35/EU on the harmonization of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits.

MultiTech declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be downloaded at <https://www.multitech.com/red>

## Standards

| Directive                         | Description         | Applicable Standards       |
|-----------------------------------|---------------------|----------------------------|
| 2014/35/EU Art. 3,1<br>2011/65/EU | LVD                 | EN 62368-1:2014 + A11:2017 |
| 2014/53/EU                        | MPE /RF<br>Exposure | EN 62311:2008              |
|                                   | ROHS                | EN IEC 63000:2018          |

| Directive  | Description | Applicable Standards                                                                                  |                                                         |
|------------|-------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| 2014/53/EU | RED         | Art 3.1b<br>EN 301 489-1 V2.1.1 (General)<br>EN 301 489-3 V2.1.2 (SRD devices)<br>EN61326 (Lab Equip) | Art. 3.2<br>EN 300 220-2 V3.1.1 and v3.2.1(SRD devices) |

## Harmonized Commodity Description (HS Code)

The Harmonized Commodity Description and Coding System generally referred to as “Harmonized System” or simply “HS” is a multipurpose international product nomenclature developed by the World Customs Organization (WCO).

HS Code: 8531.90.9001

## Export Control Classification Number (ECCN)

ECCNs are five character alpha-numeric designations used on the Commerce Control List (CCL) to identify dual-use items for export control purposes. An ECCN categorizes items based on the nature of the product, i.e. type of commodity, software, or technology and its respective technical parameters.

ECCN: 5a992.c

## Chapter 8 – Environmental

### REACH-SVHC Statement

#### Registration of Substances

**Multi-Tech Systems, Inc.** confirms that none of its products or packaging contain any of the Substances of Very High Concern (SVHC) on the REACH Candidate List, in a concentration above the 0.1% by weight allowable limit.

For the current REACH-SVHC statement, refer to additional regulatory documents at:

<https://www.multitech.com/support/support>

### Waste Electrical and Electronic Equipment Statement

**Note:** This statement may be used in documentation for your final product applications.

#### WEEE Directive

The WEEE Directive places an obligation on EU-based manufacturers, distributors, retailers, and importers to take-back electronics products at the end of their useful life. A sister directive, ROHS (Restriction of Hazardous Substances) complements the WEEE Directive by banning the presence of specific hazardous substances in the products at the design phase. The WEEE Directive covers all MultiTech products imported into the EU as of August 13, 2005. EU-based manufacturers, distributors, retailers and importers are obliged to finance the costs of recovery from municipal collection points, reuse, and recycling of specified percentages per the WEEE requirements.

#### Instructions for Disposal of WEEE by Users in the European Union

The symbol shown below is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, contact your local city office, your household waste disposal service or where you purchased the product.

July, 2005



## Restriction of the Use of Hazardous Substances (RoHS)

**Multi-Tech Systems, Inc.**

### **Certificate of Compliance**

#### **2015/863**

Multi-Tech Systems, Inc. confirms that its embedded products comply with the chemical concentration limitations set forth in the directive 2015/863 of the European Parliament (Restriction of the use of certain Hazardous Substances in electrical and electronic equipment - RoHS 3).

These MultiTech products do not contain the following banned chemicals<sup>1</sup>:

- Lead, [Pb] < 1000 PPM
- Mercury, [Hg] < 100 PPM
- Cadmium, [Cd] < 100 PPM
- Hexavalent Chromium, [Cr+6] < 1000 PPM
- Polybrominated Biphenyl, [PBB] < 1000 PPM
- Polybrominated Diphenyl Ethers, [PBDE] < 1000 PPM
- Bis(2-Ethylhexyl) phthalate (DEHP): < 1000 ppm
- Benzyl butyl phthalate (BBP): < 1000 ppm
- Dibutyl phthalate (DBP): < 1000 ppm
- Diisobutyl phthalate (DIBP): < 1000 ppm

Environmental considerations:

- Moisture Sensitivity Level (MSL) =1
- Maximum Soldering temperature = 260C (in SMT reflow oven)

<sup>1</sup>Lead usage in some components is exempted by the following RoHS annex, therefore higher lead concentration would be found in some modules (>1000 PPM);

- Resistors containing lead in a glass or ceramic matrix compound.