



# TEKTELIC Communications Inc.

## Smart Room Sensor Gen4

### User Guide

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**Document Type:** User Guide

**Document Number:** T0007525\_UG

**Document Issue:** 1.0

**Document Status:** Released

**Product Name:** Smart Room Sensor Gen4

**Product Code & Revision:** T0007496 (CO2 Module)  
T0007497 (PIR Module)  
T0007498 (CO2 & PIR Module)

**Issue Date:** August 17, 2021

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## Revision History

Version	Date	Editor	Comments
1.0	August 17, 2021	T. Danshin, S. Stewart	Released

# Table of Contents

Revision History .....	2
List of Tables .....	4
List of Figures .....	5
1 Product Description .....	6
1.1 Overview .....	6
1.2 Specifications.....	7
1.2.1 Transducer Details .....	8
1.2.2 Temperature/Humidity Sensor.....	8
1.2.3 Ambient Light Sensor .....	9
1.2.4 Barometer .....	10
1.2.5 CO <sub>2</sub> Concentration Sensor .....	10
1.2.6 PIR Sensor .....	10
2 Installation .....	11
2.1 Included Product and Installation Material .....	11
2.2 Safety Precautions.....	11
2.3 Unpacking and Inspection .....	11
2.4 Required Equipment for Installation.....	11
2.5 Smart Room Sensor Mounting.....	11
3 Power UP and Commissioning, and Monitoring .....	13
3.1 Required Equipment .....	13
3.2 Power Up/Down Procedure .....	13
4 Operation, Alarms, and Management.....	14
4.1 Configuration.....	14
4.2 Default Configuration.....	14
4.3 LED Behaviour .....	14
4.4 Reset Button Function.....	15
5 Compliance Statements.....	16
References .....	18

List of Tables

Table 1-1: Smart Room Sensor Models..... 6

Table 1-2: Smart Room Sensor Functional Variants ..... 6

Table 1-3: Smart Room Sensor Specifications ..... 7

## List of Figures

Figure 1-1: The Smart Room Sensor models.....	6
Figure 1-2: The typical and maximal tolerance for %RH at 25°C .....	9
Figure 1-3: The typical and maximal tolerance for the temperature sensor in °C. ....	9

# 1 Product Description

## 1.1 Overview

The Smart Room Sensor is a multi-purpose LoRaWAN IoT sensor packed into a very small form factor. The Smart Room Sensor is ideal for monitoring and reporting temperature, humidity, light, barometric pressure, motion, and CO<sub>2</sub> levels in an indoor environment. Table 1-1 presents the available Smart Room Sensor models and corresponding LoRa channel plan [1]. Table 1-2 presents the features available in the three functional variants (CO<sub>2</sub>, PIR, and CO<sub>2</sub> & PIR).

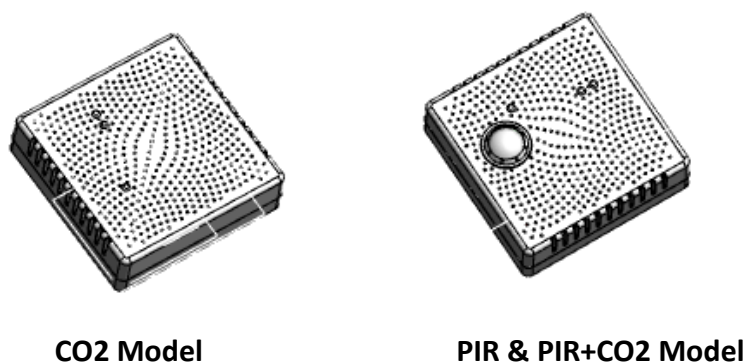
**Table 1-1: Smart Room Sensor Models**

Family	Module T-Code	LoRaWAN RF Region	Tx (Uplink) Band	Rx (Downlink) Band
Smart Room CO <sub>2</sub>	T0007496	US915	902-915 MHz (ISM)	923-928 MHz (ISM)
Smart Room PIR	T0007497	US915	902-915 MHz (ISM)	923-928 MHz (ISM)
Smart Room CO <sub>2</sub> & PIR	T0007498	US915	902-915 MHz (ISM)	923-928 MHz (ISM)

**Table 1-2: Smart Room Sensor Functional Variants**

Sensing Function	Room Sensor Model		
	CO <sub>2</sub>	PIR	CO <sub>2</sub> & PIR
Temperature	X	X	X
Relative Humidity	X	X	X
Light	X	X	X
Barometer	X		X
CO <sub>2</sub>	X		X
PIR		X	X

Figure 1-1 illustrates the Smart Room Sensor functional variants. All variants share the same external dimensions.



**Figure 1-1: The Smart Room Sensor models.**

## 1.2 Specifications

The Smart Room Sensor specifications are listed in Table 1-3.

**Table 1-3: Smart Room Sensor Specifications**

Parameter	Requirement
Use environment	Indoor commercial/residential only
Operating temperature	0°C–60°C
Storage temperature	-40°C–60°C
RH	5%–95%, non-condensing
Size	71 mm x 71 mm x 23 mm (enclosure) 71 mm x 71 mm x 26 mm (with bracket assembly)
Weight	91 g (with battery)
Power source	Battery operated, with FET based reverse polarity protection.
Network technology/Frequency band	LoRaWAN with different regional variants (see <b>Error! Reference source not found.</b> )
Air interface	LoRa
Lifetime	CO <sub>2</sub> model with baseline use case <sup>1</sup> transmitting 4 packets per hour. <ul style="list-style-type: none"><li>• &gt; 5.7 years with 2xAA LTC batteries</li></ul> PIR model with baseline use case transmitting 4 packets per hour. <ul style="list-style-type: none"><li>• &gt; 5.9 years with 2xAA LTC batteries</li></ul> CO <sub>2</sub> & PIR model with baseline use case transmitting 4 packets per hour. <ul style="list-style-type: none"><li>• &gt; 5.5 years with 2xAA LTC batteries</li></ul>
Maximum transmit power	15 dBm
Number of indicator LEDs	2 (red and green)
Measurement sensing functions	Temperature, humidity, light, pressure, CO <sub>2</sub> concentration
Detection sensing functions	Human movement
Temperature measurement accuracy	< ±0.3°C between 0°C and 5°C ±0.2°C between 5°C and 60°C
Humidity measurement accuracy	< ±4% between 0% and 100% ±2% between 20% and 80%

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<sup>1</sup> Baseline use case:

Temperature:	22°C
Tx power:	14 dBm
LoRa SF:	10
LoRa BW:	125 kHz

Light sensitivity	Detection of weak light to typical work light conditions (5 lux to 1000 lux) <sup>2</sup> Peak sensitivity at 550 nm
Pressure measurement accuracy	< $\pm 1$ hPa between 300 hPa and 1200 hPa
CO <sub>2</sub> concentration measurement accuracy	$\pm 30$ ppm +3% of reading between 400 ppm and 5000 ppm Extended range $\pm 10\%$ of reading for an extended range of up to 10000 ppm <sup>3</sup>
Motion detection	Pyroelectric infrared sensor Ceiling mount: <ul style="list-style-type: none"> <li>• X-angle: 104° (no mask)</li> <li>• Y-angle: 104° (no mask)</li> </ul> Height: 3 m (no mask)

### 1.2.1 Transducer Details

### 1.2.2 Temperature/Humidity Sensor

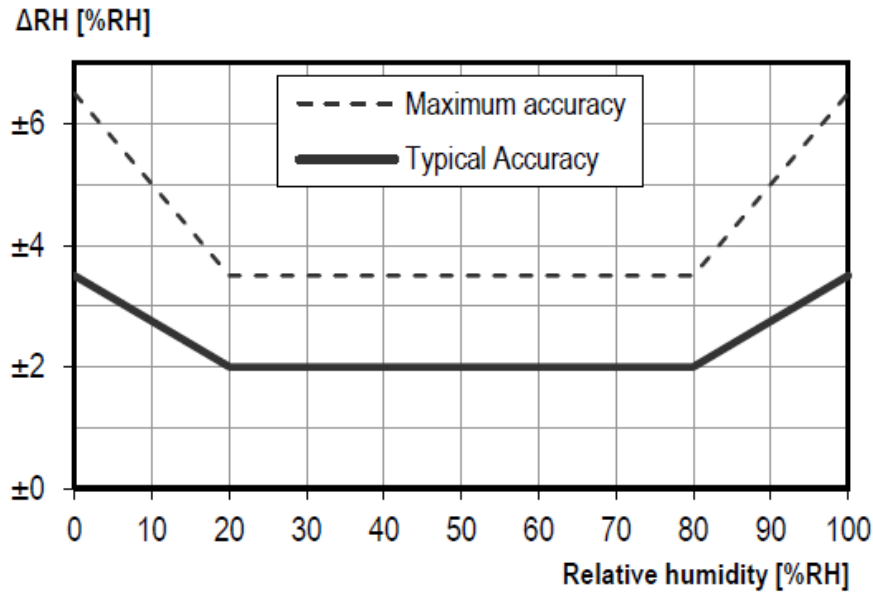
The Room Sensor includes a combination temperature/humidity transducer from Sensirion (SHTC3). It is a small footprint, very low power device. It features operation over I<sup>2</sup>C protocol and operates from 0% to 100% RH and -40°C to 125°C with a typical accuracy of  $\pm 2\%$  RH and  $\pm 0.2^\circ\text{C}$ . The typical and maximum accuracies specified across the operating relative humidity and temperature range of the sensor are shown in Figure 1-2 and Figure 1-3, respectively.

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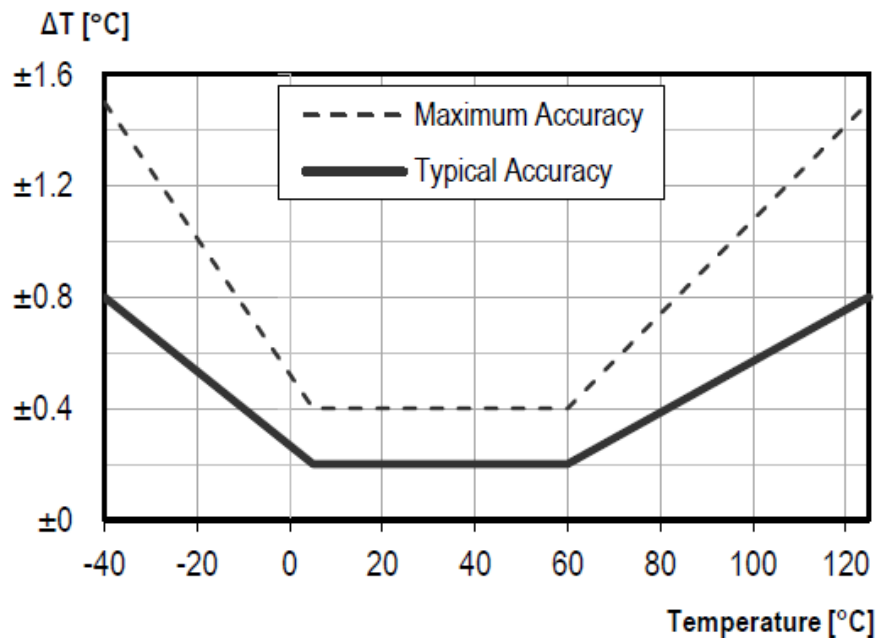
<sup>2</sup> The sensor provides light intensity measurements, but they are not calibrated in lux. See the Technical Reference Manual **Invalid source specified.** for more details.

<sup>3</sup> No data available from manufacturer on performance outside the range of 15°C to 35°C and 0% to 80% RH.





**Figure 1-2: The typical and maximal tolerance for %RH at 25°C**



**Figure 1-3: The typical and maximal tolerance for the temperature sensor in °C.**

### 1.2.3 Ambient Light Sensor

A phototransistor and bias resistor form a light detection transducer on the Room Sensor. The light sensor provides a sufficient window of detection to allow detection of desired light levels. This window will be tuned as necessary by changing the resistor to give a detection window

corresponding to the light levels to be detected. The output of the light transducer is an analog voltage that is read by the MCU ADC.

Vishay's TEMT6200FX1 is a phototransistor specifically designed for ambient light sensing as it includes a filter to give a response similar to the human eye, thus being capable of detecting weak light to typical work light conditions.

#### **1.2.4 Barometer**

A barometer is included in the Room Sensor in order to measure the barometric air pressure. Infineon's DPS310 is designed for low power applications while provided highly accurate measurements. The sensor can operate over a range of 300 hPa to 1200 hPa, and can communicate over I<sup>2</sup>C or SPI protocols. The pressure accuracy of the sensor is  $\pm 1$  hPa between 300 hPa and 1200 hPa while operating between 0°C and 65°C.

#### **1.2.5 CO<sub>2</sub> Concentration Sensor**

The Room Sensor includes the Senseair Sunrise to measure the CO<sub>2</sub> concentration using non-dispersive infrared (NDIR). It operates over an I<sup>2</sup>C interface and can measure in the range of 400 ppm to 5000 ppm with an accuracy of up to  $\pm 30$  ppm +3% of the reading. This sensor also features an extended range of up to 10000 ppm with a projected accuracy of extended range  $\pm 10\%$  of the reading.

#### **1.2.6 PIR Sensor**

A motion detection feature on the Room Sensor is implemented with a PIR sensor. Panasonic's EKM1291111 is specifically designed to be sensitive enough to detect small movements with a wide field of view of 104° x 104°.

The motion detection system uses a ceiling mount type lens that has an expected coverage area of 7.7 m x 7.7 m when ceiling mounted at a height of 3 m. Note that this is the theoretical maximum sense range claimed by the transducer manufacturer. The sense range is determined as the projection of the transducer FoV on the ground, and therefore, should not be interpreted as the coverage area where the sensor can detect moving people. In general, due to the conical nature of the transducer FoV, people need to be closer to the sensor to be detected. The amount of IR radiation from a moving person, which is also impacted by the person's clothing or type of skin cover, also plays an important role at determining the detection range.

## 2 Installation

### 2.1 Included Product and Installation Material

The following items are included with each sensor:

- Smart Room Sensor
- Mounting Bracket
- User Guide

### 2.2 Safety Precautions

The following safety precautions should be observed:

- The Smart Room Sensor is intended for indoor use only.
- The Smart Room Sensor contains lithium batteries.
- NEVER allow small children near batteries: if a battery is swallowed, immediately seek medical attention.
- To reduce risk of fire, explosion or chemical burns: replace only with approved 2xAA LTC batteries; DO NOT recharge, disassemble, heat above 100°C (212°F) or incinerate battery.

### 2.3 Unpacking and Inspection

The following should be considered during the unpacking of a new Smart Room Sensor:

1. Inspect the shipping carton and report any significant damage to TEKTELIC.
2. Unpacking should be conducted in a clean and dry location.
3. Do not discard the shipping box or inserts as they will be required if a unit is returned for repair or re-configuration.

### 2.4 Required Equipment for Installation

There are no tools required for Smart Room Sensor installation.

### 2.5 Smart Room Sensor Mounting

Smart Room Sensor is designed to be mounted using the supplied mounting bracket. The bracket can be attached using screws or double-sided tape (not included).

When mounting on a vertical surface, ensure that the Room Sensor will not be orientated with the case retaining screws towards the ceiling. This could cause the Room Sensor to accidentally

slip off the mount and fall. There are no orientation concerns when the Room Sensor is mounted to a horizontal surface.

## **3 Power UP and Commissioning, and Monitoring**

### **3.1 Required Equipment**

No special equipment is required to power on the Smart Room Sensor.

### **3.2 Power Up/Down Procedure**

Once the sensor information has been added to the Network Server, pull out the battery tabs to engage the battery. To turn off the device the batteries must be removed, but to simply reset the device, the external reset button can be pushed; see Section 4.4 for description of the reset function.

## 4 Operation, Alarms, and Management

### 4.1 Configuration

The Smart Room Sensor supports a full range of Over-the-Air (OTA) configuration options. Specific technical details are available in the Room Sensor Technical Reference Manual [2]. All configuration commands need to be sent OTA during a sensor's downlink windows.

### 4.2 Default Configuration

The default configuration on the Smart Room Sensor is:

- Report Temperature and Humidity every one (1) hour.
- CO2 model only:
  - Report the carbon dioxide (CO<sub>2</sub>) concentration every 15 (fifteen) minutes.
- PIR model only:
  - Report motion after 1 (one) PIR event.
  - Clear motion after 5 (five) minutes of no motion.
- CO2 & PIR model only:
  - Report the carbon dioxide (CO<sub>2</sub>) concentration every 15 (fifteen) minutes.
  - Report motion after 1 (one) PIR event.
  - Clear motion after 5 (five) minutes of no motion.

### 4.3 LED Behaviour

During the join procedure:

- After the Sensor has gone through the initial boot procedure, the join procedure will begin. During that time, the red LED will blink continuously until the sensor has joined a network.

During normal operation:

- The green LED will blink when the Sensor transmits a packet.
- The red LED will blink when the Sensor receives a packet.

## 4.4 Reset Button Function

There is a reset button on the device, that can be pushed by a pin, such as a paper clip. The button should not be pushed hard. The reset is instant, i.e. the button does not need to be kept pushed. The reset restarts the microprocessor. All the FW load and configuration parameters in the Flash are remembered during the reset.

## 5 Compliance Statements

### **Federal Communications Commission**

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.

To comply with FCC exposure limits for general population / uncontrolled exposure, this device should be installed at a distance of 20 cm from all persons and must not be co-located or operating in conjunction with any other transmitter.

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

### ***Innovation, Science and Economic Development Canada***

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

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



This device should be installed and operated with minimum distance 0.2 m from human body.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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.
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Cet appareil doit être installé et utilisé à une distance minimale de 0.2 m du corps humain.

## References

- [1] LoRa Alliance, "LoRaWAN 1.1 Regional Parameters," ver. 1.1, rev. B, Jan 2018.
- [2] TEKTELIC Communications Inc., "LoRa IoT Smart Room Sensor (Gen4) Technical Reference Manual," ver 0.1.