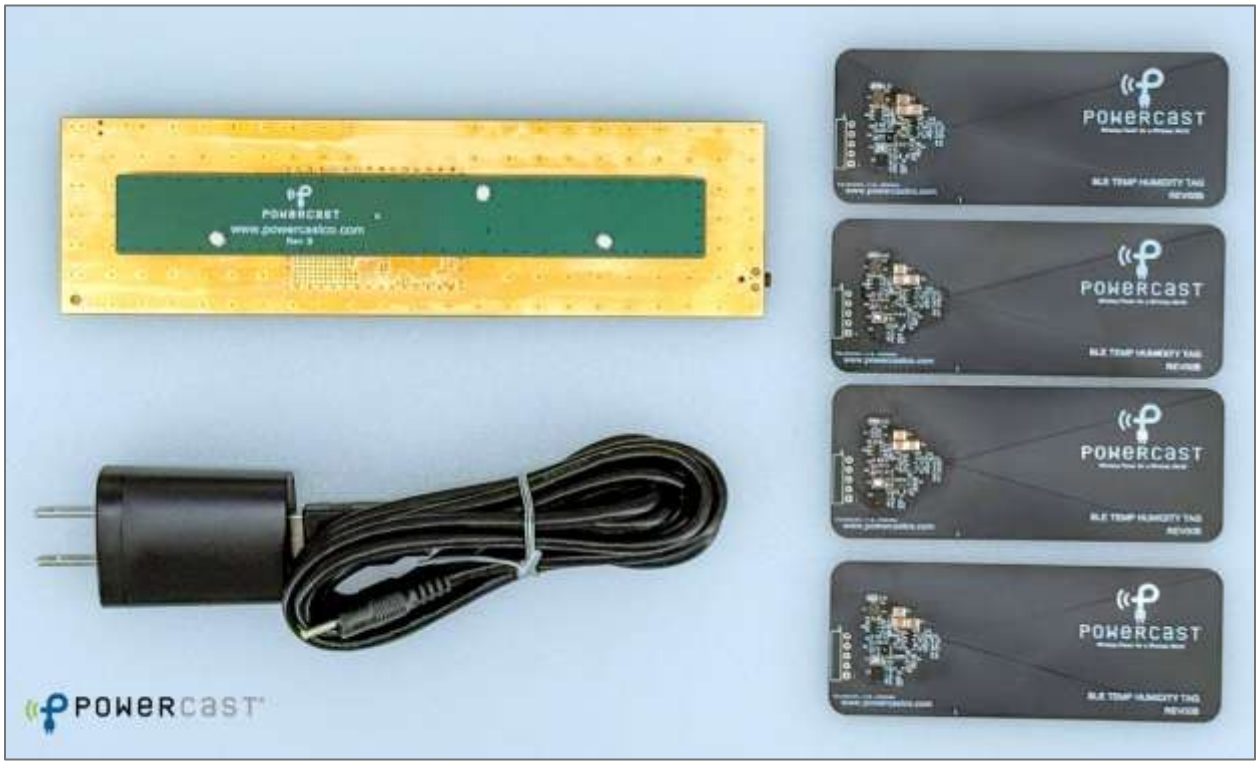
P2110-EVAL-BLE

Powercast BLE Sensor Kit



KIT CONTENTS

The contents of the kit are shown in the table and the above image. The Powercast BLE Sensor Kit (P2110-EVAL-BLE) consists of 1 PowerSpot transmitter subassembly (TX91502 – Always on), 4 battery-free BLE sensors (Temp & Humidity).

Qty	Item	Description
1	Power and Data Transmitter Subassembly (PowerSpot Transmitter -TX91502)	3-watt, 915 MHz transmitter for power and data with a receiver that can hear when a harvesting device is in range
4	BLE Temperature and Humidity Tags	low profile, versatile asset-tracking device that operates wirelessly, powered by any UHF source.

P2110-EVAL-BLE

Powercast BLE Sensor Kit

BLE TAG

DESCRIPTION

The Powercast BLE Temperature and Humidity Tag is a low profile, versatile asset-tracking device that operates wirelessly, powered by any UHF source, including the TX91502. In addition to monitoring temperature and humidity, it transmits a unique ID via Bluetooth Low Energy (BLE), enabling seamless data collection and asset tracking while remaining battery free.

APPLICATIONS

- Asset Tracking
  - Retail
  - Logistics
  - Medical
- Data Collection
- Inventory management
- Perishable Goods Monitoring
- Data Logging

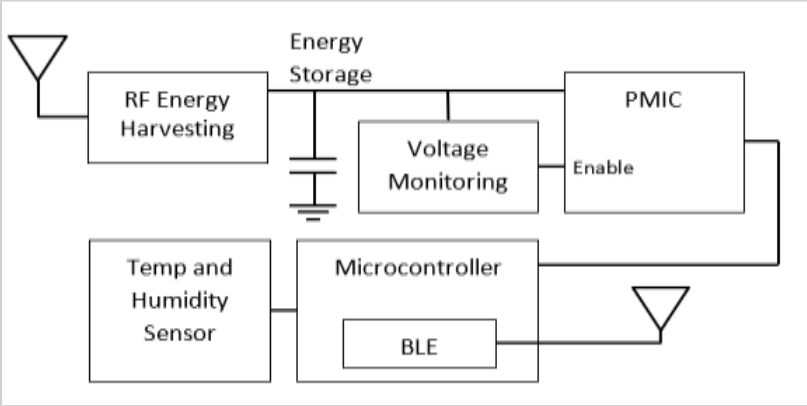
FEATURES

- Battery Free
- Powered from 902-928MHz RF
- Sensitivity <-20 dBm*
- Greater than 85 feet operating distance (open range tested)
- Powered from the TX91502, or any UHF RFID reader
- Data over BLE at 2.4 GHz
- Functional on many common materials
- Commercial temperature range: -20°C to +70°C
- Temperature: ±0.1°C (typ.)
- Humidity ±1.5% (typ.)
- Low profile package, 100mm x 40mm x 2.8mm

**Includes antenna gain of 2.15dBi (typical)*

+1 (412) 455-5800
www.powercastco.com / contact@powercastco.com

REPRESENTATIVE SCHEMATIC



ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Parameter	Rating	Unit
RF Input Power	23	dBm
Operating Temperature Range (Temperature)	-20 to +70	°C
Operating Temperature Range (Humidity)	-20 to +70	°C
Storage Temperature Range	-50 to +145	°C
Operating Relative Humidity Range	0 to 100	%

Exceeding the absolute maximum ratings may cause permanent damage to the device.

ESD CAUTION

This is an ESD (electrostatic discharge) sensitive device. Proper ESD precautions should be taken to avoid degradation or damage to the component.

SPECIFICATIONS

T_A = 25°C, unless otherwise noted

Parameter		Symbol	Note	Min	Typ	Max	Unit
Harvesting	Input Power(1)	RF_{IN}		-20	--	20	dBm
	Frequency	f_P		902	--	928	MHz
Data	Frequency	f_D	BLE	2.4000	--	2.4835	GHz
	Output Power	P_D		--	0	--	dBm
	Beacon Rate	--		--	1	--	s
Sensor	Temperature Range	--		-20	--	70	°C
	Temperature Accuracy	--		--	±0.1	±0.4	°C
	Humidity Range	--		0	--	100	%
	Humidity Accuracy	--		--	±1.5	±3.5	%
Antenna	Radiation Pattern	--	Dipole Antenna	--	Omni	--	dBi
	Gain	--		--	2.15	--	
	Polarization	--		--	Linear	--	

(1)Includes antenna gain of 2.15dBi (typical)

FUNCTIONAL DESCRIPTION

NORMAL OPERATION

The tag is designed to be placed in an RF field and harvest the RF energy. The tag will periodically read ambient temperature and humidity data and send out that information via a BLE advertising beacon.

POWER HARVESTING

The BLE Tag is battery free and is powered by harvesting energy from available RF sources. The integrated antenna receives RF power at 915MHz and the Powercast PCC110 ICs convert the RF energy to DC to power the tag. The BLE Tag can harvest energy from any available 915MHz RF source, including the Powercast TX91502 or any UHF RFID reader.

TAG POWERING SCHEME

The tag functions on a power scheme known as charge and fire. In this design, the DC energy from the PCC110s is stored on onboard capacitors. Once it is determined that enough energy is stored to complete a sensor reading and send a beacon, the PMIC is enabled, powering the microcontroller, which remains powered just long enough for the sensor reads and beacon to take place. This scheme allows the tag to be powered intermittently when there is not instantaneous power to power the tag directly, which enables the powering of the tag at much farther distances. Therefore, the beacon rate of the tags are proportional to the received power and distance from the transmitter. The closer to the transmitter, the faster the beacon rate.

PLACEMENT CONSIDERATIONS

The tag is designed with a wide bandwidth to accommodate being placed on different surfaces. The tag should function on most common surfaces, such as cardboard, wood, drywall, etc. The tag is not designed for operation on metal surfaces.

BLE BEACON FORMAT

The BLE tags will send all relevant information in a BLE advertising beacon. The format is:

Byte	Value	Endian	Notes
0	0x05		Length of Local Name Data
1	0x09		Type
2	0x42		BLET in hex to represent the BLE Tag
3	0x4C		
4	0x45		
5	0x54		
6	0x09		Length of Manufacturer Specific Data
7	0xFF		Type
8	0xD3		Powercast Bluetooth SIG ID
9	0x02		
10	0x	Little	Temp Data MSB
11	0x	Little	Temp Data LSB
12	0x	Little	Temp Data CRC
13	0x	Little	Hum Data MSB
14	0x	Little	Hum Data LSB
15	0x	Little	Hum Data CRC

CRC

The CRC is CRC-8/NRSC-5

Property	Value
Name	CRC-8/NRSC-5
Width	8 bits
Polynomial	0x31
Init	0xFF
Ref In	False
Ref Out	False
Final Xor	0x00
Example	0xABCD = 0x6F

DATA CONVERSION

Humidity (0 to 100%)

$$RH(\%) = (20 * RH_{RAW}/13107)$$

Temperature (-20°C to 70°C)

$$T(°C) == -45 + (35 * T_{RAW}/13107)$$

$$\mathrm{T(°F)} = -49 + \ (21 * T_{RAW}/4369)$$

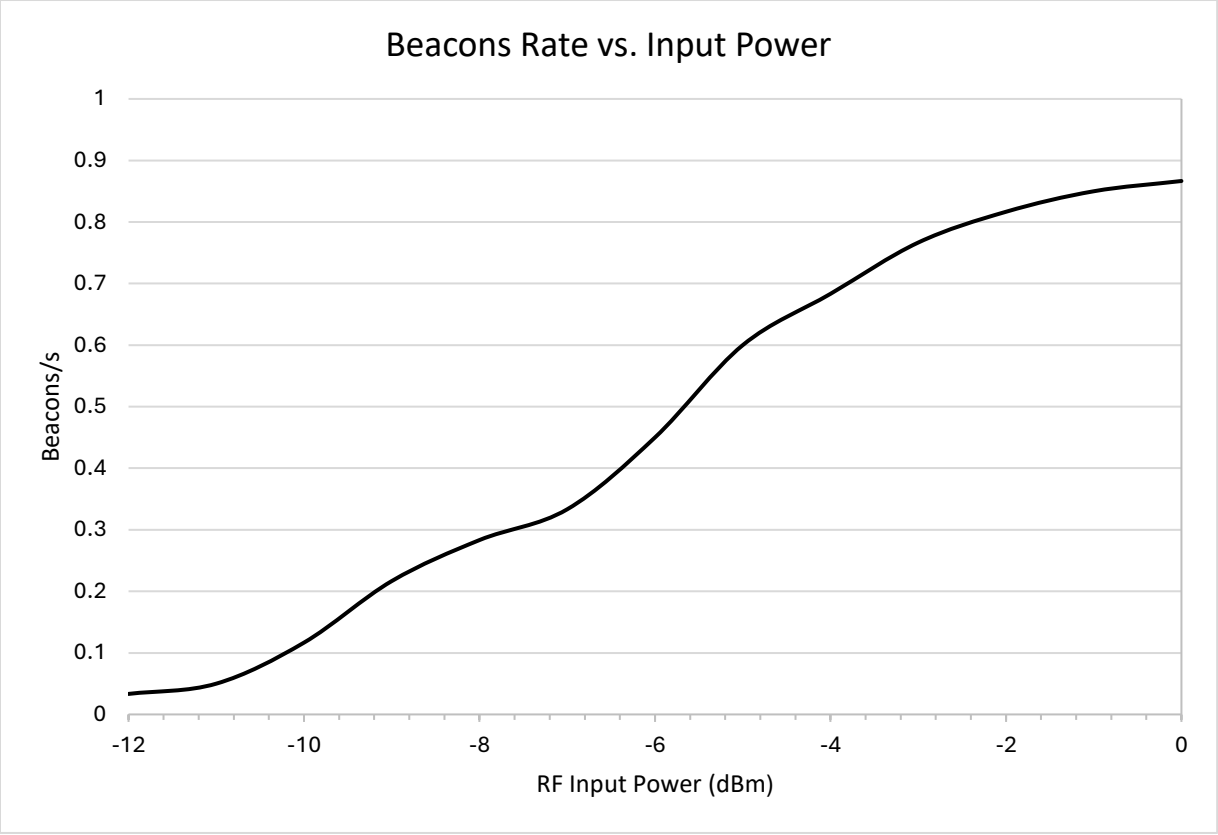
Where, RH_{RAW} is the Humidity data taken from the BLE beacon (Hum Data) and T_{RAW} is the temperature data taken from the BLE beacon (Temp Data).

TYPICAL PERFORMANCE GRAPHS

T_A = 25°C, unless otherwise noted

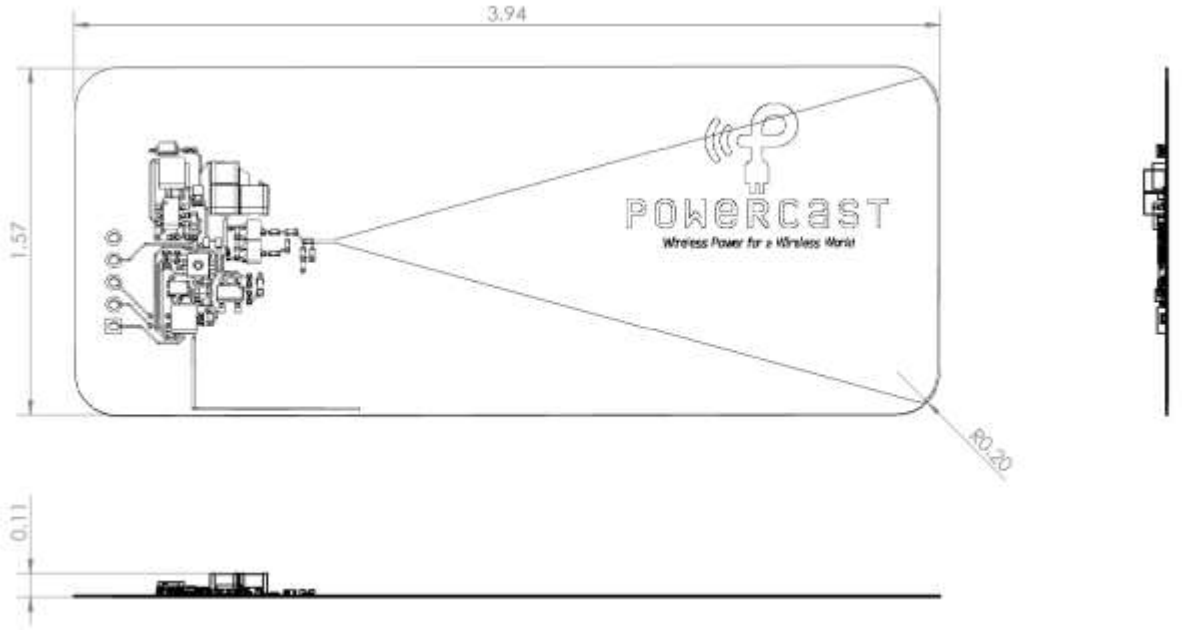
Tag Beacon Rate at Different RF Input Powers in Open Air

Note: This does not include the antenna gain. This is the RF input power after the antenna.



The tag can operate below -12dBm and above 0dBm. This is to show a typical use case.

MECHANICAL DIMENSIONS



Please Note: All dimensions in the figure above are presented in inches (in)

PC BLE APP

STEPS BY STEP INSTALLATION for PC BLE APP

1. **Install the PC BLE App**
   i) The PC BLE Tag app can be found in the Apple App Store and Google Play by searching “PC BLE Tag” or through the Powercast developer page. *(Refer fig 1 below)*

Fig 1: PC BLE Tag App Page and Powercast Developer page in Apple Store

   ii) To scan for tags in the app, press the start button in the bottom right. The button will then turn green and read stop, which can be pressed to stop reading tags. Pressing stop will prevent new tags from being read and already read tags from reporting new data. *(Refer fig 2 below)*
   iii) To clear tags from the page, press the clear button. This will remove all the previously read tags from the page and tags will only be displayed if they are read again after the clear button is pressed. *(Refer fig 2 below)*

iv) The PC BLE Tag app has two tag scanning modes, which can be toggled between on the main app page. By default, the app only shows Powercast BLE Tags. By pressing the toggle switch to enable “Show All Tags” the app with display any BLE tag that is actively advertising within range. Instead of displaying temperature and humidity, non-Powercast tags display “NOT PC TAG” to easily differentiate when in the mode. *(Refer fig 2 below)*

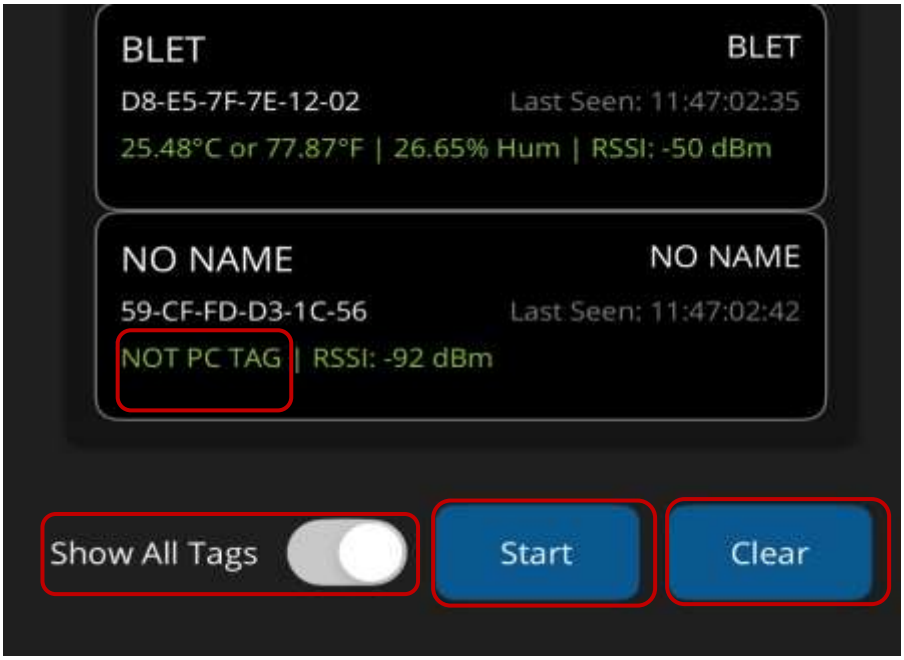


Fig 2: Powercast and a non-Powercast tag shown in ‘Show All Tags’ mode

v) Each tag displays multiple data points when scanned by the app: *(Refer fig 3 below)*

- Name
- Type
- Bluetooth Device Address
- Temperature (°C and °F)
- Relative Humidity (%)
- Relative Signal Strength Indicator (RSSI) shows the strength of the BLE beacon
- Last Seen shows the last time the BLE tag was read

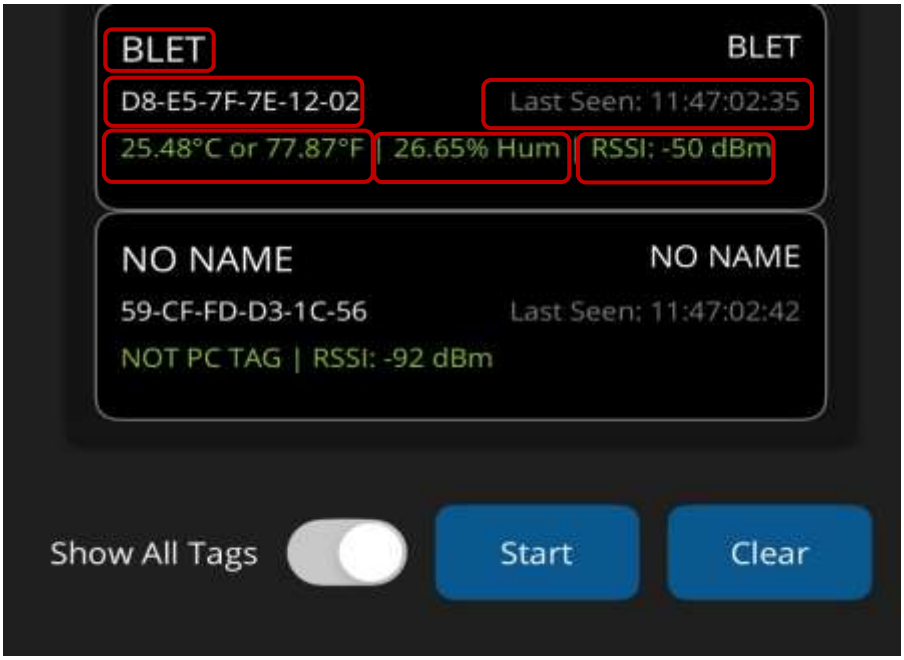


Fig 3: Multiple BLE Tag data points

vi) By default, all BLE Temperature and Humidity Tags are named "BLET." To differentiate between multiple read tags, the Bluetooth Device Address can be used. This 6-byte Hexadecimal number is unique for each tag, does not change and is found directly below the tag name. *(Refer fig 4 below)*

Fig 4: Two BLE Tags with the same name but different Bluetooth Device Address

vii) The PC BLE Tag app supports assigning custom names to BLE Tags. To rename a tag, click on the tag's name in the app, type the desired name, and press OK. The tag will now be displayed under the new tag name. *(Refer fig 5.1 below)*

viii) Tags can be renamed multiple times, and the same custom name can be assigned to multiple tags. The device type, shown in the top right of each tag remains the same even when the tag name is changed. This can be used to quickly identify what devices are Powercast BLE Temperature and Humidity tags, even if they have been renamed, as they will all still have the device type "BLET." *(Refer fig 5.2 below)*

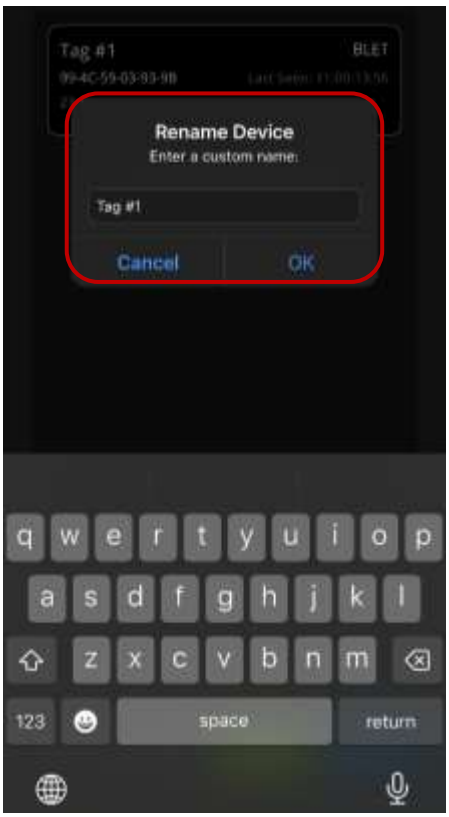


Fig 5.1: A BLE Tag being renamed

Fig 5.2: Renamed tags with device type

DOWNLOAD THE PC BLE APP

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Google Play Store

Download on the App Store

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Powercast Corporation
620 Alpha Drive, Suite 1
Pittsburgh, PA, USA 15238
www.powercastco.com
contact@powercastco.com
+1 (412)-455-5800