PCT100

Powercast® High-Function RFID Sensor Tag

DESCRIPTION

The PCT100 RFID Sensor Tag is a high-function RFID tag capable of measuring temperature, humidity, and light level with high accuracy. The tag harnesses the capability of the Powercast Powerharvester® Chipset to enable long range, high-function RFID all without the need for an on-board battery. The tags are designed to maximize the RF to DC conversion efficiency of the energy provided by an RFID reader. Using this energy, sensor measurements can be taken and then read back out of the tag's memory using any standard UHF RFID reader. Powercast's technology enables a completely maintenance-free and battery-free sensing and tracking solution for UHF RFID applications.

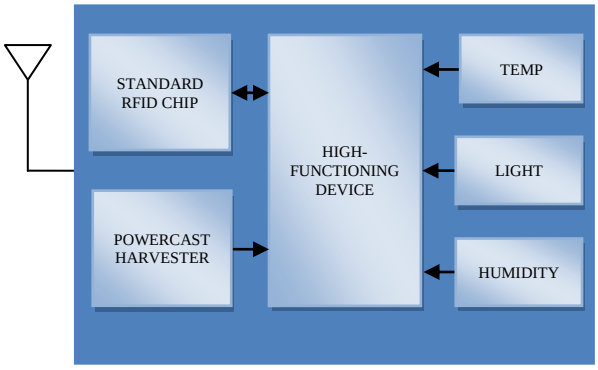
FEATURES

- EPC Class 1 Gen 2 compliant
- ISO/IEC 18000-6C compliant
- 10 meter read range
- High sensor accuracy
- "Find Tag" feature – locate one specific tag by illuminating an on-board LED
- Wide RF range: -17dBm to +20dBm
- Frequency range: 860MHz to 960MHz
- Compact hard case packaging
- RoHS compliant
- High RF to DC conversion efficiency - up to 75%
- -40 to +85C operational temperature range
- Completely battery-free
- Data accessible in user memory
- Fast read rate

APPLICATIONS

- Medical Asset Tracking and Monitoring
- Smart Grid
- Building Automation
- Logistics
- Asset Monitoring
- Supply Chain Management
- Materials Management
- Industrial Monitoring

FUNCTIONAL BLOCK DIAGRAM



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

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Parameter	Value	Unit
RF Input Power	23	dBm
Operating Temperature Range	-40* to 85	°C
Storage Temperature Range	-40 to 85	°C

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

*Humidity Sensor operates from -20°C to 85°C

SPECIFICATIONS

T_A = 25°C, RF_{IN} = 915MHz unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
RF Characteristics[1]						
Input Power			-17		20	dBm
Frequency			860	915	960	MHz
Read Distance			0	5	10	m
Read Time			4	5	15	s
Temperature						
Range			-40	-	85	°C
Accuracy			-	±2%	-	°C
Light						
Range			0	-	1000	Lux
Accuracy			-	±10%	-	Lux
Humidity						
Operating Temperature			-20	-	85	°C
Range			-		-	%RH
Accuracy				±4%		%RH
11% to 89%				±8%		%RH
0 to 10% or 90% to 100%						

FUNCTIONAL DESCRIPTION

POWER

The PCT100 tag is passive and completely battery free. It utilizes Powercast's harvesting technology to harvest the RF energy produced by an RFID reader and converts it into usable DC Power. Because of this harvesting technology, the tag is able to power multiple sensors at one time. The tag stores the DC power until it is significant enough to take a sensor reading and write the values to the RFID chip. This can cause the time between sensor reads to vary with distance. The minimum read time will be around 5s when close to the reader, and increase as you move away from the reader.

FLAGS

The PCT100 is equipped with a flag byte to switch between locate and run modes.

SENSOR READS

The PCT100 has the option to sense temperature, light, humidity or any combination of the three. There is also a locate tag only version. Every time the tag takes a sensor read, it writes the values to the same memory locations on the RFID chip. Therefore, only the most recent sensor values will be stored and read. The memory location for the sensor reads are listed in **Table 1**.

LOCATE TAG

The PCT100 is equipped with a locate tag feature. This helps to find a tag in the field when there are multiple tags. It causes the LED on the tag to blink. The closer you are to the reader, the faster the LED will blink. To set the tag into locate mode, you must set the appropriate flag high. To go back to normal operation, you must clear this flag.

DESCRIPTION OF MEMORY

MEMORY MAP

The tags are compatible with EPC Gen2 commands. Data should be read in 16 bit words. The user data is stored in the user memory locations (memory bank 3) starting at byte 00h.

Table 1: Memory Map

Word	Memory Address	Content	Data Source
0	00h	Product ID	PCT100
1	02h	Product Configuration	PCT100
2	04h	Flags	PC
3	06h	RESERVED	-
4	08h	Temperature	PCT100
5	0Ah	Light	PCT100
6	0Ch	Humidity	PCT100

PRODUCT ID AND CONFIGURATION

The product ID code for the PCT100 is 100 (64h). For the PCT200 tag, it will be 200 (C8h). The product configuration is dependent upon which sensors are populated. It is a binary code where 1 represents the sensor being populated and 0 represents the sensor being absent.

Table 2: Product Configuration

Bit 2	Bit 1	Bit 0
Temperature	Light	Humidity

For Example, if temperature and humidity are populated and light is not, the product ID would be 101b or 5h.

FLAGS

The flags are what control the function of the tag. Currently, the two options are run and locate. To set the tag in locate mode, 0001h must be written to the flag word. To set it back into run mode, 0000h must be written to the tag.

SENSOR READS

The sensor read results are integers between 0 and 1023 and can be converted using the equations below. If a sensor is not populated, the ADC value will be read as FFFFh.

CONVERSION FORMULAS

The values for each sensor read will be between 0 and 1024 in decimal and stored on the RFID chip as hexadecimal values. The following are the formulas to convert these values into their respective sensor values.

TEMPERATURE

For temperature, the formula will convert the values read into a resistance.

$$R(k\Omega) = \frac{10 * X}{1024 - X}$$

Where X is the decimal value read from the tag. The resistance must then converted into temperature using the look up table in **Table 1**. If the resistance falls between two values, a linear approximation is made.

Table 1: Resistance to Temperature

Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)
195.652	-40	4.917	45
148.171	-35	4.161	50
113.347	-30	5.535	55
87.559	-25	3.014	60
68.237	-20	2.586	65
53.65	-15	2.228	70
42.506	-10	1.925	75
33.892	-5	1.669	80
27.219	0	1.452	85
22.021	5	1.268	90
17.926	10	1.11	95
14.674	15	0.974	100
12.081	20	0.858	105
10	25	0.758	110
8.315	30	0.672	115
6.948	35	0.596	120
5.834	40	0.531	125

LIGHT

$$Ill.(Lux) = -1.3913 * X + 1345.4$$

Where X is the decimal value read from the Tag.

Note: The light equations used for the PCT100 and PCT200 are different.

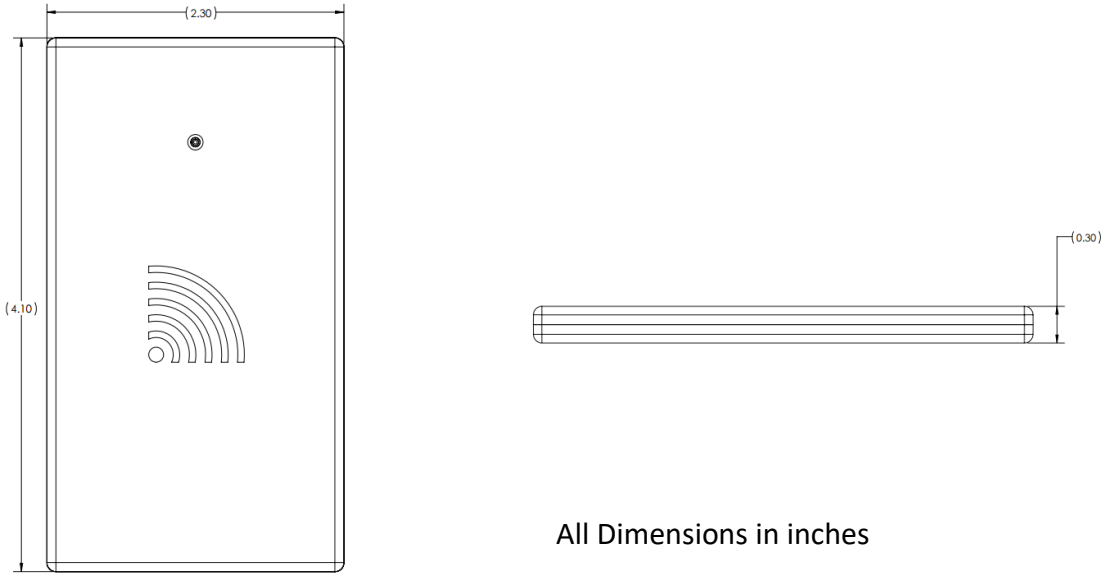
HUMIDITY

$$\%RH = \frac{1}{.00636}\left(\frac{X}{1024} - 0.1515\right)$$

Where X is the decimal value read from the tag.

Please see the *PCT Conversions Document.xlsx*

MECHANICAL SPECIFICATIONS



All Dimensions in inches

P2110 MODULE SERIES

PCT 1 00 - XYZ

PCT Tag series	Version **100** = Battery Free **200** = Datalogging	XYZ (Sensors Desired) **T**= Temperature **H**=Humidity **L** = Light **F** = Find Tag Only

PCT100-T	Temperature
PCT100-L	Light
PCT100-H	Humidity
PCT100-TL	Temperature and Light
PCT100-TH	Temperature and Humidity
PCT100-LH	Light and Humidity
PCT100-TLH	Temperature, Light and Humidity
PCT200-T	Temperature
PCT200-L	Light
PCT200-H	Humidity
PCT200-TL	Temperature and Light
PCT200-TH	Temperature and Humidity
PCT200-LH	Light and Humidity
PCT200-TLH	Temperature, Light and Humidity

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