

P1110-EVAL-01



Lifetime Power® Energy Harvesting Development Kit for Battery Recharging User Manual

Overview

The Lifetime Power® Energy Harvesting Development Kit for Battery Recharging is a complete demonstration and development platform for recharging batteries wirelessly from RF energy (radio waves). It is designed to be used with an App and is configured for out-of-the-box operation.

The battery recharging boards utilize the P1110B Powerharvester Receiver, which converts RF energy into DC power. Either the PowerSpot® transmitter or TX91501-3W transmitter is the source of RF energy, with both operating at 915MHz. Other RF energy sources operating from 850-950 MHz can also be used as power sources (UHF RFID readers for example). The battery recharging boards receive the RF energy, convert it to DC, and charge the onboard batteries.

The kit also includes two BLE radio boards that can be attached to the battery recharging boards. When used in conjunction with the watch or credit card battery recharging boards, the measured charge current and battery voltage are transmitted via Bluetooth to a mobile device and displayed in the included App. This enables the user to test both configurations on battery recharging boards simultaneously.

The P1110-EVB is included in the kit as well. The P1110-EVB contains an evaluation board and antennas to test and develop with the P1110B Powerharvester Receiver. Like the Battery Recharge Boards, it converts RF energy into DC power which can be stored in a battery or capacitor, or used to directly power a circuit. It includes two different antenna configurations.

Contents

The contents of the kit are shown in the image and table on the next page. The kit includes a PowerSpot RF transmitter (with plastic mounting clips), a TX91501 transmitter, an RF energy harvesting evaluation board (P1110-EVB) with two antennas, a smartwatch shaped battery recharging board, a credit card shaped battery recharging board, two coin cell (CR2032) sized radio boards and the necessary power adaptors.



Qty	Item	Description
1	PowerSpot Transmitter (TX-91502-ASSEMBLY)	3-watt, 915 MHz transmitter for power and data with integrated 8dBi antenna and power jack.
1	Power and Data Transmitter (TX91501-3W-ID)	3-watt, 915 MHz transmitter for power and data with integrated 8dBi antenna and two power jacks. Sends a pre-programmed transmitter ID that is received by the P1110B Powerharvester component and can be decoded by an external MCU.
1	P1110 Evaluation Board (P1110-EVB)	Evaluation board (Rev. B) for P1110B Powerharvester Receiver. This board has an SMA connector to attach the antennas and a 10-pin connector for plug in test board WSN-EVAL-01 (not included).
1	Patch antenna (PA-915-01)	915MHz directional antenna with 120-degree reception pattern (included with the P1110-EVB evaluation board).
1	Dipole antenna (DA-915-01)	915MHz omni-directional antenna with 360-degree reception (included with the P1110-EVB evaluation board).
1	Watch Shaped Battery Recharging Board (EVAL-FLEX1-PCB)	Flexible watch-shaped board that contains Powercast energy harvesting technology to recharge the connected 100mAh lithium ion battery. Status LED will turn on when the battery is fully charged.
1	Credit Card Shaped Battery Recharging Board (EVAL-CC1-PCB)	Rigid credit-card sized board that contains Powercast energy harvesting technology to recharge the connected 13mAh lithium ion battery. Status LED will turn on when the battery is fully charged. Some units are equipped with a switch to disconnect the battery. It must be turned on when to charge the device.
2	Radio Boards (EVAL-RB1-PCB)	Radio board that receives the current charge and voltage data from the connected battery recharge board and transmits that data via BLE to the App. Each radio board has its own unique ID and is powered from an included CR2032 coin cell battery.

Set-up and Operation

Installation Overview

The following basic steps are required to operate the kit and are provided as an overview. Detailed installation instructions are provided immediately after this summary.

Battery Recharging

1. Install the App on your Android or iOS device.
2. Pull the tab from the battery housing on the radio board. Connect the radio board to the desired Battery Recharging Board.

NOTE: The Lithium-Ion batteries on the EVAL-FLEX1-PCB and the EVAL-CC1-PCB need to be recharged every 3 months to prevent damage to the battery. If the device is equipped with a switch, it should be turned off during storage

NOTE: Orientation is critical. DO NOT ATTEMPT TO PLUG IN THE RADIO BOARD BACKWARDS.

3. Plug in the transmitter and point towards the Battery Recharging Board.
4. Observe app data, status and discharge LEDs.

P1110-EVB

1. Connect desired antenna P1110-EVB evaluation board.
2. Set switches/jumpers on P1110-EVB evaluation board.
3. Attach test equipment to desired test points on P1110-EVB evaluation board.
4. Enable a transmitting source.
5. Measure data.

Note: For more detail on the P1110-EVB evaluation board setup see

<http://www.powercastco.com/wp-content/uploads/2016/11/p1110-evb.pdf>

Step-by-Step Installation

Battery Recharging Board

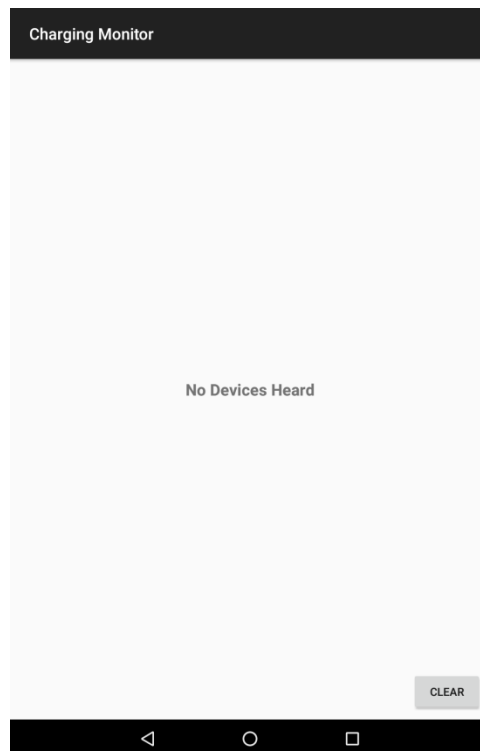
1. Install the App on your Android or iOS device.

On the Apple or Google Play app store, search for Powercast. Find and install the App called Charging Monitor.



Charging Monitor
Powercast

Make sure Bluetooth is enabled on your device. Launch the App. Your screen should look like the image below.



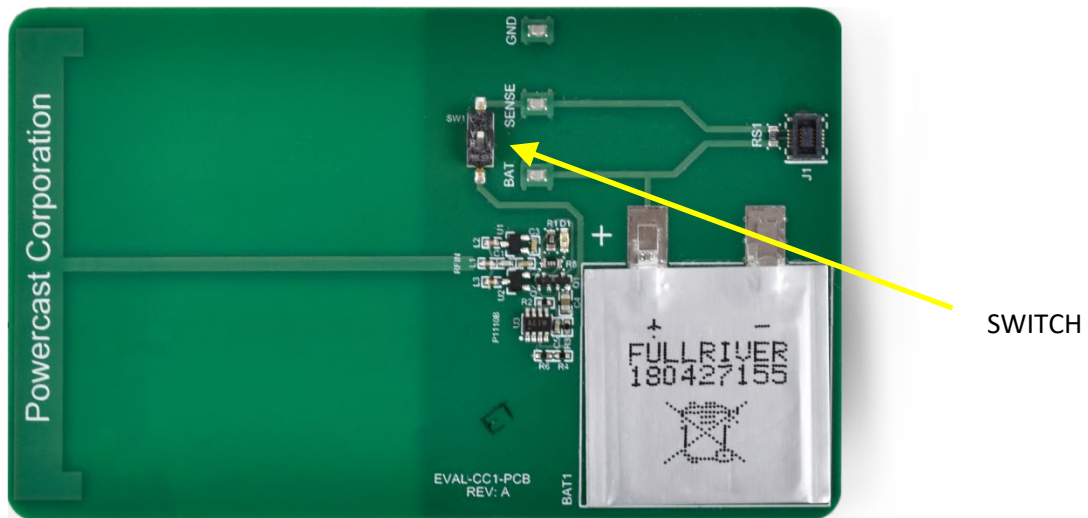
2. Connect the radio board to the desired Battery Recharging Board.

The radio board is equipped with a 10 pin connector, as is each of the Battery Recharging boards. Pull the one time use tab from the radio board to power it on. Connect the radio board to the desired Battery Recharging Board as shown below. **Orientation is critical. DO NOT ATTEMPT TO PLUG IN THE RADIO BOARD BACKWARDS.** The radio boards are powered separately so that they do not draw power from the battery that is being recharged.



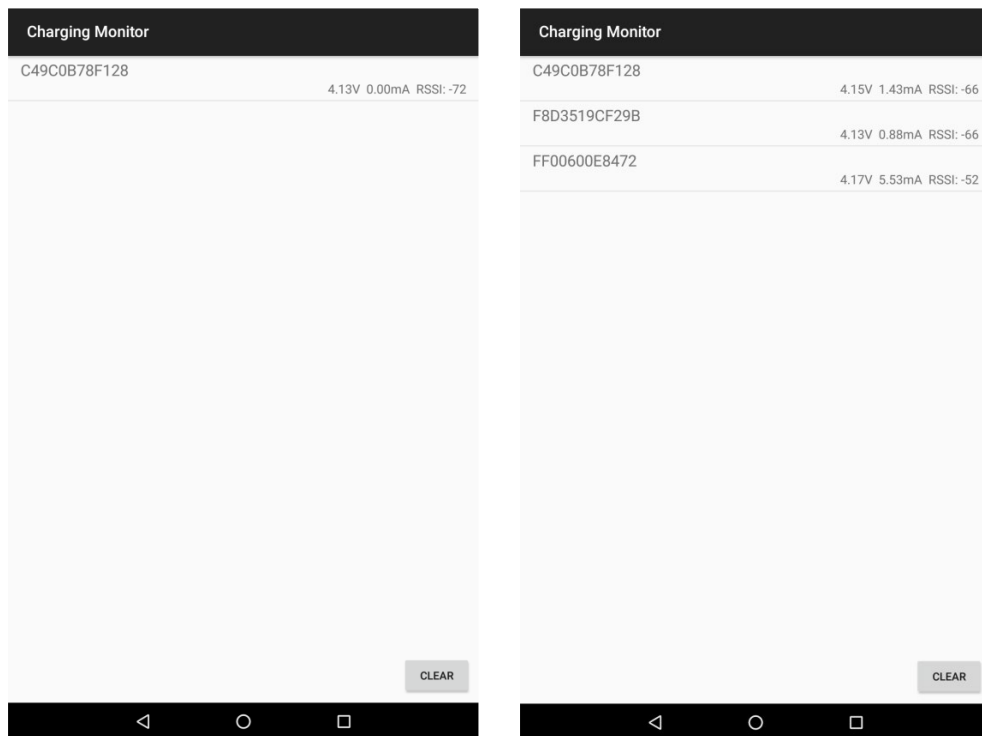
The Radio Boards correctly connected to the Battery Recharging Boards

If the credit card board is equipped with a switch, it must be turned on to charge battery. The switch is shown below.



Press the wakeup button on the radio board momentarily (1 second) by gently squeezing the radio board and battery recharging board together (opposite end as the connector). This will begin

transmitting the charging data to the app. The app will automatically receive the data. No pairing is required. Your screen should now look like the image on the left below.



The charging data will be sent to the app for a period of 10 minutes before going to sleep. Press the wakeup button again to begin another 10 minute period of data transmission. If you wish to end the data transmission earlier than 10 minutes simply press the button on the radio board again. The radio board will go to sleep.

The device ID is shown as well as the charge information; the battery voltage level, the charging current, and the received signal strength indicator (strength of the Bluetooth signal). If more than one radio board is used, the app will populate the next line with the other radio boards ID and charging information, as shown in the right image above.

For DISCHARGING the onboard Lithium cell, see step 4.

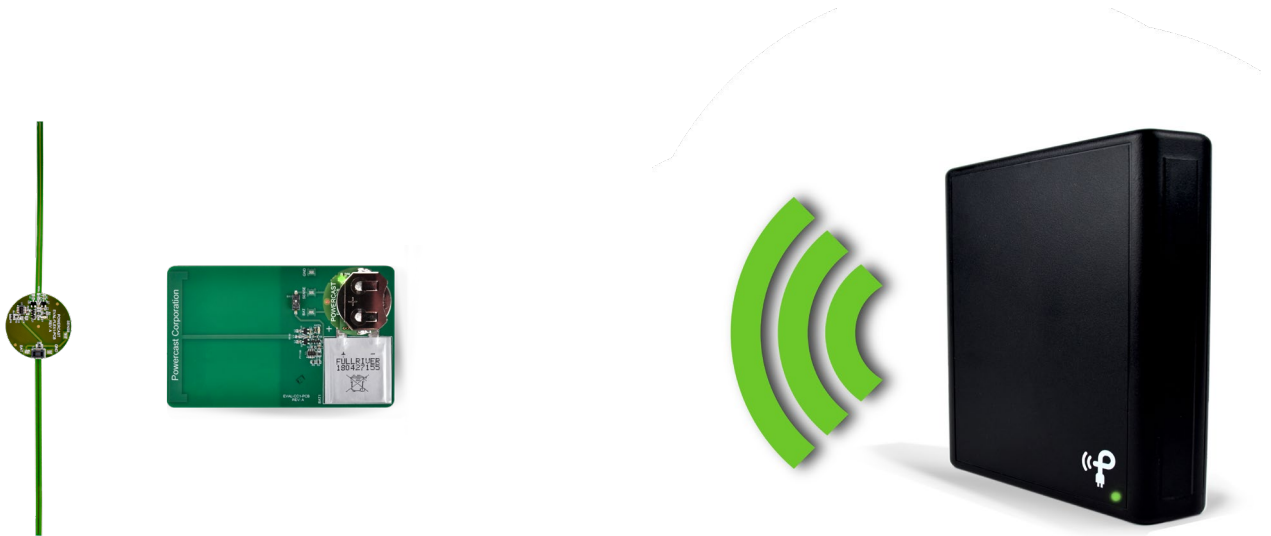
When disconnecting the radio board from the Watch Battery Recharging board, do not pull on the antenna as this could damage the board.

NOTE: The Lithium-Ion batteries on the EVAL-FLEX1-PCB and the EVAL-CC1-PCB need to be recharged every 3 months to prevent damage to the battery. If the device is equipped with a switch, it should be turned off during storage

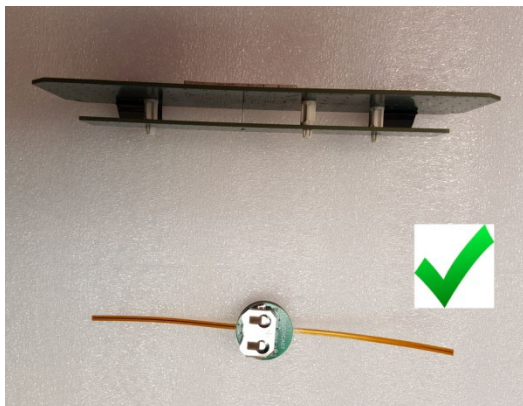
Note: The Battery Recharging boards will still function without the radio board connected, however charge data will not be transmitted.

3. Turn on the transmitter and point towards the Battery Recharging Board.

Plug in the TX91501 Powercaster Transmitter or the PowerSpot Transmitter and point it toward the Battery Recharging boards. Place the Battery Recharging boards at an initial distance of 1 to 2 feet from the transmitter. The app will automatically update with the new charging values.



Note: Orientation of the Battery Recharging Boards in relation to the transmitting source matters. Properly aligning the transmitting and receiving antennas will give the best performance. The correct alignment is shown below:



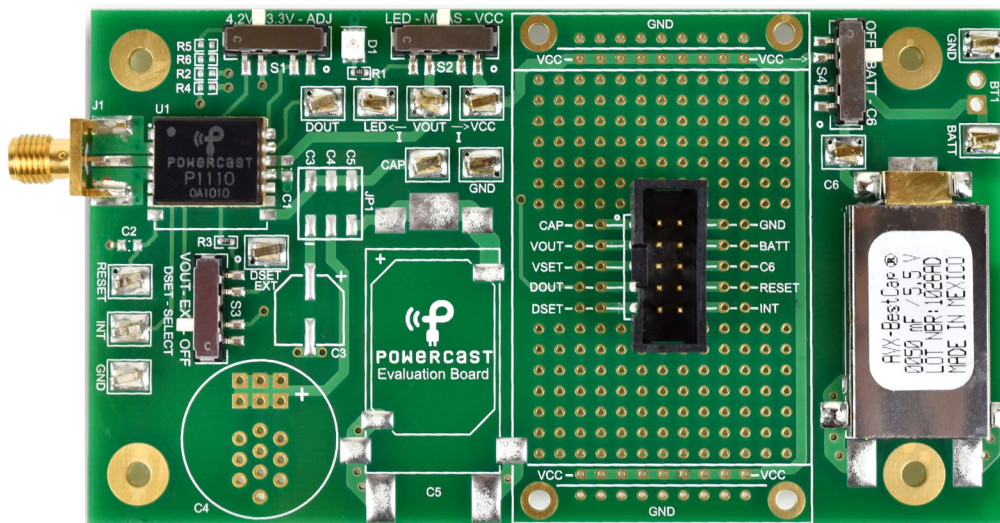
Note: For the P1110-EVB: As a precaution, do not operate the transmitter within 12 inches of the evaluation board when the patch antennas are attached. Please see the transmitter user’s manual for operating details.

4. Status LED’s and Battery Discharge

Both the Watch Battery Charging Board and the Credit Card Charging Board have a status LED. The LED will turn on when the attached battery is fully charged. At this point, it is necessary to discharge to battery.

To DISCHARGE the rechargeable Lithium cell, press and hold the wakeup button by gently squeezing the radio and recharging boards together for approximately 4 seconds. A green LED on the **radio board** will illuminate. This LED acts as a load to discharge the lithium cell. BLE data is still transmitted until the cell is discharged to the minimum level or terminated by the user. To terminate the discharge, momentarily press the wakeup button again. The device will no longer be discharging and it will be in sleep mode. To see recharge data again, press the wakeup button and it will begin transmitting data for another 10 minute period

P1110-EVB



1. Connect an antenna to the P1110-EVB evaluation board.

Attach an antenna to the P1110-EVB evaluation board using SMA connector J1.

2. Configure the P1110-EVB evaluation board

Set switches S1, S2, S3 and S4 as desired.

3. Attach test equipment to the test points of interest.

4. Enable a transmitting source.

Plug in the TX91501 Powercaster Transmitter or the PowerSpot Transmitter and point it toward the P1110-EVB evaluation board. The line-of-sight range when using the included patch antennas is around 40-45 feet, and less for the dipole antenna.

Note: For the P1110-EVB: As a precaution, do not operate the transmitter within 12 inches of the evaluation board when the patch antennas are attached. Please see the transmitter user's manual for operating details.

5. Measure data.

Note: Operating the evaluation board on a ground plane such as an anti-static protection mat on a lab bench may cause significant signal attenuation.

To test the proper function of the P1110-EVB Evaluation Board use the following settings or see the instructions for the P1110-EVB at:

<http://www.powercastco.com/wp-content/uploads/2016/11/p1110-evb-1.pdf>

J1: Antenna connected

JP1: C3 connected

S2: LED

The LED will blink when sufficient power is available. The blinking rate is faster when closer to the transmitter and slower when further from the transmitter.

Documentation

Powercast

All documentation and software can be obtained through the following page:

<http://www.powercastco.com/documentation/>

Warranty

Seller warrants that the Products, when delivered by Seller or Seller's authorized distributor and for twelve (12) months with the exception of development kits which are (90) days, following the delivery date (the "Warranty Period"), will be free from defects in material and workmanship and will substantially conform to Seller's publicly available specifications for such Products in effect at the time of delivery. In all cases, Seller has sole responsibility and discretion for determining the cause and nature of a Product defect, and Seller's determination with regard thereto shall be final. Buyer's exclusive remedy and Seller's sole

liability for a breach of warranty reported to Seller during the Warranty Period shall be, at Seller's option, to replace or repair the affected Product, or to refund to Buyer the price of the affected Product. This limited warranty excludes: (i) engineering samples (which are provided "AS-IS" without warranty); (ii) circuit board assembly (iii) development products (such as but not limited to boards and cables); (iv) design defects or errors known as "errata"; (v) electronic components procured through unauthorized third parties; and (vi) electronic components that have been subject to misuse, mishandling, accident, alteration, neglect, unauthorized repair or installation. Furthermore, this limited warranty shall not apply to the use of covered products in an application or environment that is not within Powercast specifications or in the event of any act, error, neglect or default of Customer. The availability of replacement products is subject to product discontinuance policies at Powercast. Customer may not return products without first obtaining a customer return material authorization (RMA) number from Powercast. Seller does not warrant that Products will be free from design defects or errors. This warranty does not extend to any implementation by Buyer in an application or environment that is not contained within Seller's specifications, and does not extend for use of the Products as the principal mechanism in life-support applications or other applications that invoke potential risks of death, bodily injury or severe property or environmental damage ("Critical Applications"). THE WARRANTIES SET FORTH HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, REMEDIES AND CONDITIONS, WHETHER ORAL OR WRITTEN, EXPRESS OR IMPLIED. POWERCAST DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS, IMPLIED OR STATUTORY, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT, AND ANY WARRANTY THAT MAY ARISE FROM COURSE OF DEALING, COURSE OF PERFORMANCE, OR USAGE OF TRADE. IF POWERCAST CANNOT LAWFULLY DISCLAIM IMPLIED WARRANTIES UNDER THIS LIMITED PRODUCT WARRANTY, ALL SUCH IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE WARRANTY PERIOD (AS DEFINED ABOVE). YOUR SOLE REMEDY WITH RESPECT TO ANY BREACH OF THE LIMITED PRODUCT WARRANTY SHALL BE THE REPAIR OR REPLACEMENT OF THE DEVICE AS SPECIFIED IN THE LIMITED PRODUCT WARRANTY. POWERCAST IS NOT RESPONSIBLE FOR DIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY BREACH OF WARRANTY OR UNDER ANY OTHER LEGAL THEORY INCLUDING, BUT NOT LIMITED TO, LOST PROFITS, DOWNTIME, GOODWILL, DAMAGE TO OR REPLACEMENT OF EQUIPMENT AND PROPERTY, AND ANY COSTS OF RECOVERING, REPROGRAMMING, OR REPRODUCING ANY PROGRAM OR DATA STORED IN OR USED WITH A SYSTEM CONTAINING POWERCAST PRODUCTS. Some states do not allow the exclusion or limitation of incidental or consequential damages or exclusions or limitations on the duration of implied warranties or conditions, so the above limitations or exclusions may not apply to you. This limited product warranty gives you specific legal rights, and you may also have other legal rights which vary from state to state. No agent, employee, sales representative or distributor of Seller has any authority to bind Seller to any affirmation, representation or warranty except as stated in this Section 8.