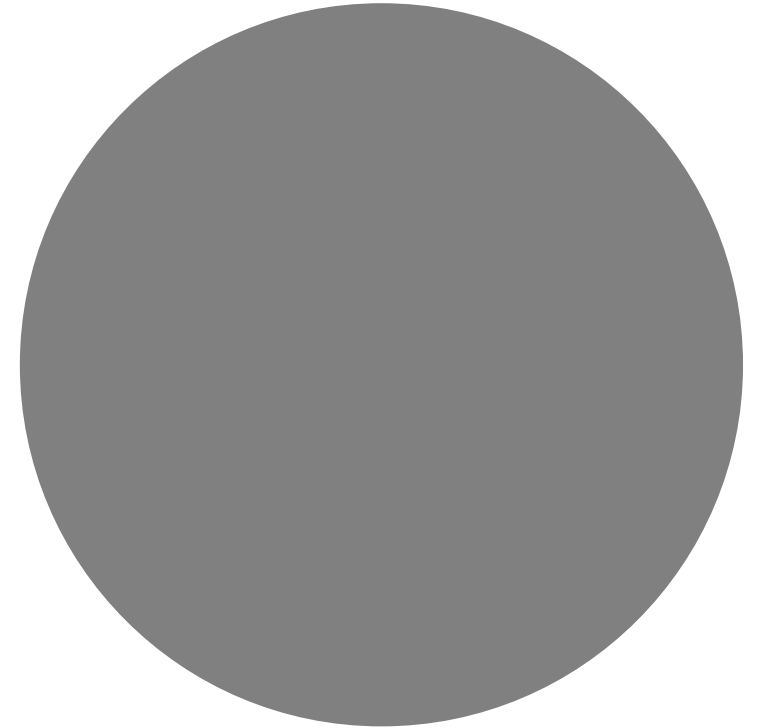


Using Raspberry Pi with Solar Panel

Remote Raspberry Pi



Goal, Materials

Goal –
Operate a
Raspberry
Pi-3 using a
solar panel

- Power obtained from a Solar Panel (15 W or more, $V < 24V$)
- Operate Pi without shutdown at night time
- Charge UPS and operate Pi in day when solar power is available

Materials

- Raspberry Pi-3
- Solar Panel
 - 7V to 24 V
 - Min of 15W – ideally 20 to 25 W
 - Mounting for solar panel
- UPS to provide power and proper shutdown
 - 5V charging
 - External reset switch

Materials - continued

Materials

- Pi-BB-RPS unit
 - Create a RPS between solar panel and USB Power
 - Charge Battery bank when there is power from the Sun
- Pi-UpTime UPS
 - UPS for 8 hours or more
 - External reset switch
 - Proper shutdown when batteries run low
- Two 18650 3000 mAh Li-Ion batteries
- USB cables as needed
- Mounts for Pi, NEMA enclosure, etc.

Pi-UpTime UPS with Pi-BB-RPS – a HA* solution

*High Availability

Raspberry Pi-3

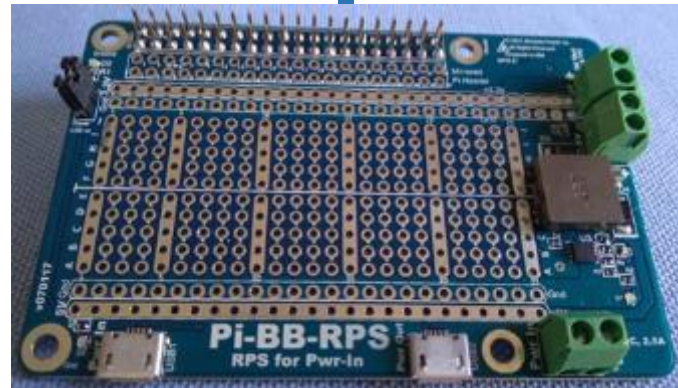


Solar Panel – Powers the Raspberry Pi and charges battery bank



Provides Power when needed

Charges from Solar Panel

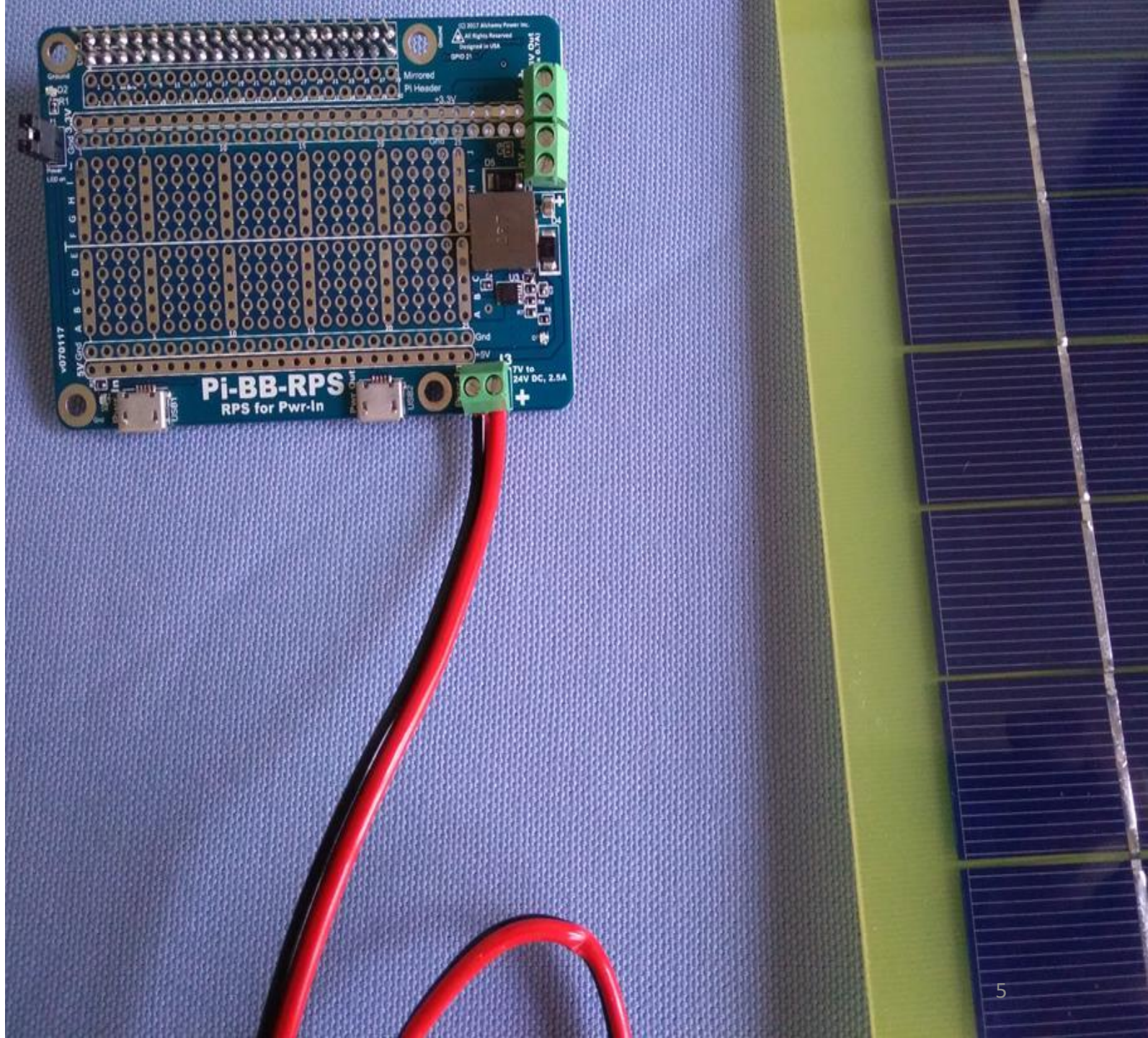


Micro-USB to Micro-USB cable

Second power source (if available)

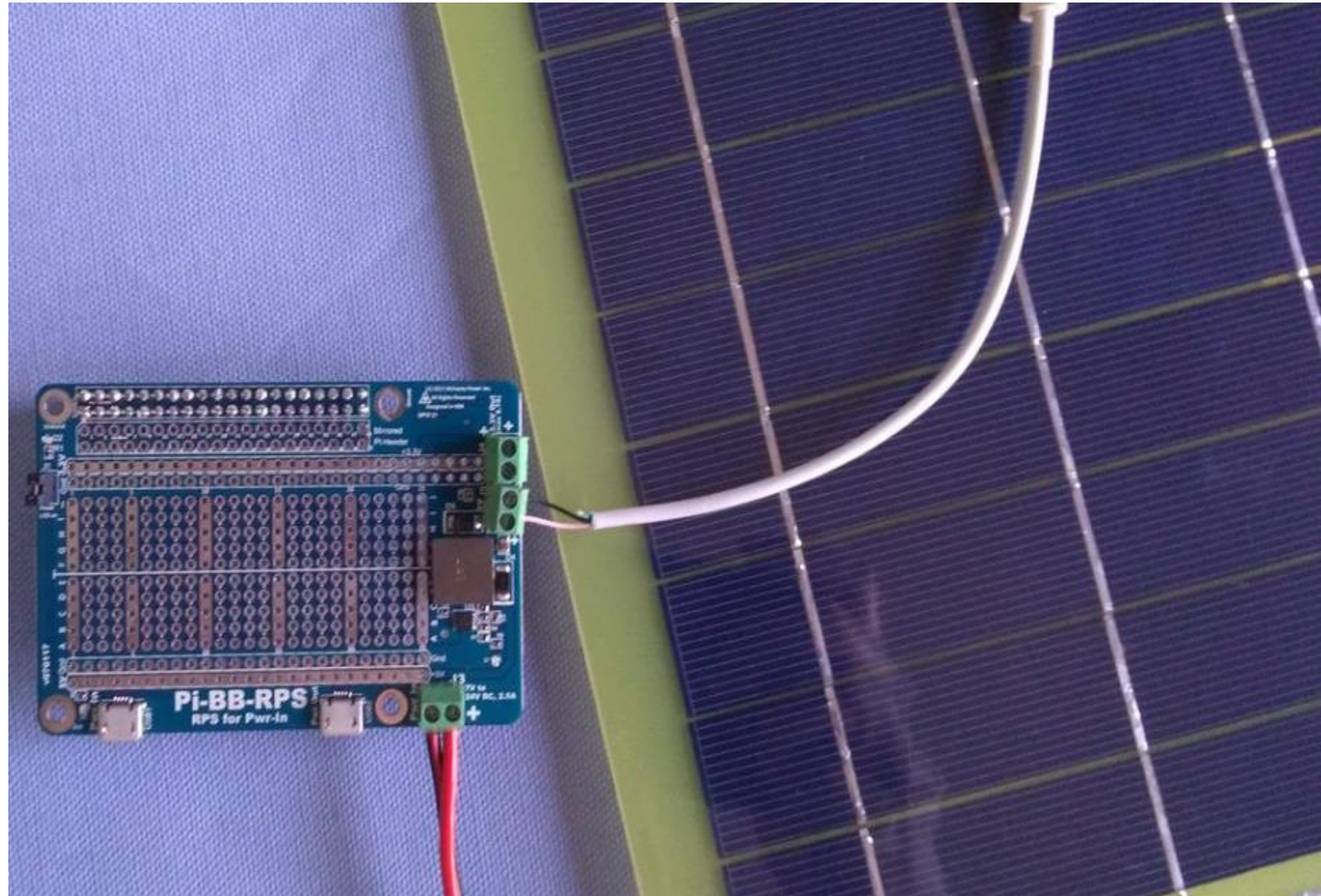
Step 1 – Connect Solar Panel to 7-24V terminal block

- Connect Solar Panel + to + on Pi-BB-RPS as shown
- Make sure wires are tightened properly in Terminal Block
- Operational Voltage – from 7V to 24V DC
- 5V output from this is available on J5, as shown on next slide



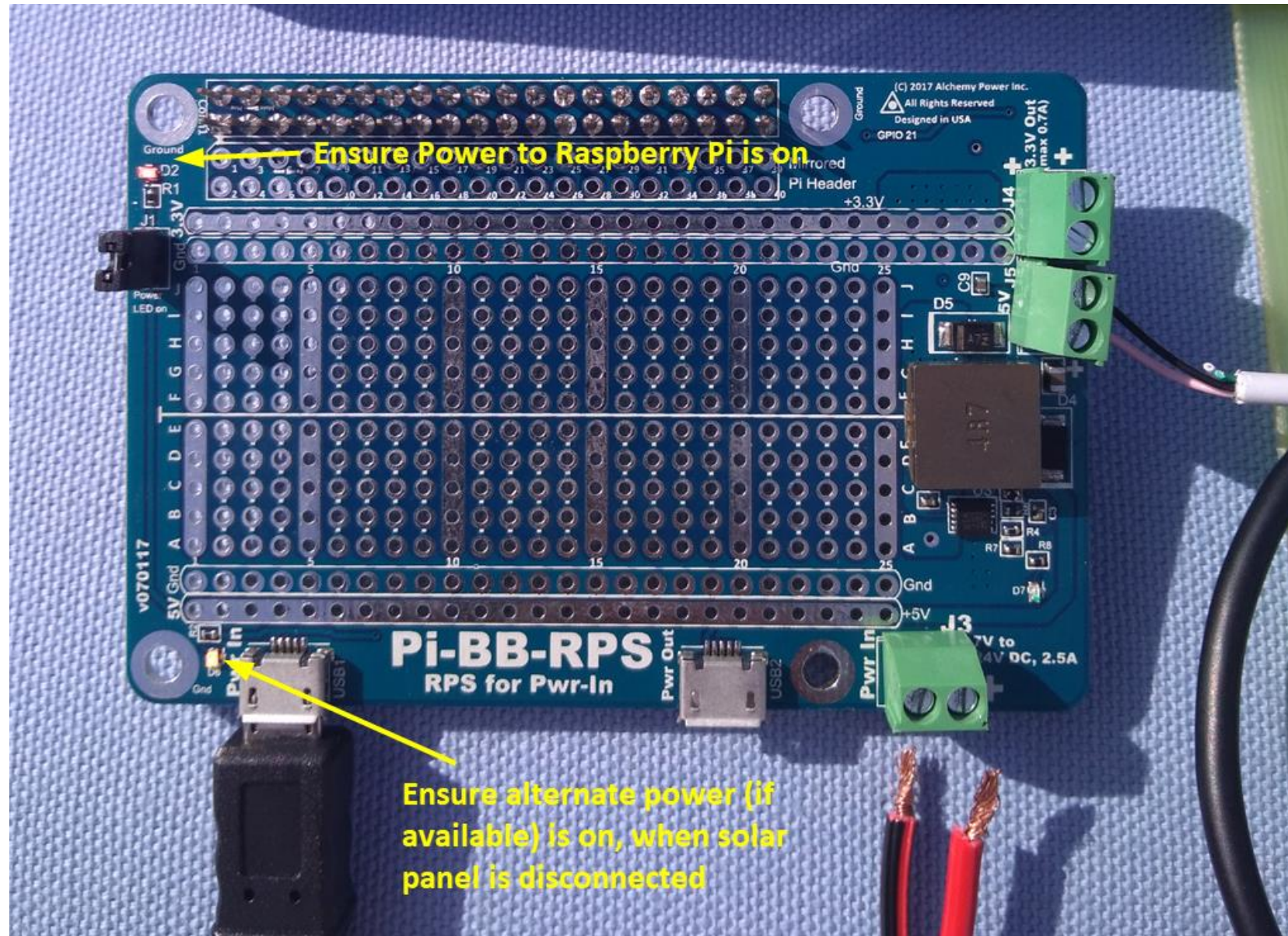
Step 2 – Connect a USB cable to charge Pi-UpTime UPS

- Splice a USB cable. Black end is ground. Red or Red-White is Positive. Best to check with multimeter.
- Connect USB cable to charge battery bank from DC-DC output on connector shown
 - Connector marked J5, “5V”
- This connector provides 5V power from 7V to 24V input (Solar panel)



Step 3 – Test Power sources

- Disconnect solar panel
- Ensure power to the Raspberry Pi is still on (Red LED)
- Ensure 5V power from alternate source (if available) is on, when solar panel is disconnected.
- Reconnect solar panel and second power source after this test is complete
- The Redundant Power Supply (RPS) capability of Pi-BB-RPS allows optimal use of solar panel and second power source.



Step 4 – Run the monitoring scripts

- Download the software and software installation guides from <http://alchemy-power.com/downloads/>
 - Make sure to use Python 2 instead of Python 3
- Update the crontab file to monitor battery power and shutdown Pi as needed
 - Make sure the proper path names are provided to execute the scrips
- Test the script – make sure they run properly i.e. shut down the Pi when battery runs low

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Downloads

Pi-16ADC

- [Pi-16ADC.zip](#) – ZIP file containing the Pi-16ADC User Guide, Datasheet, sample code, Python HOW-TO
- [Pi-16ADC-User-Guide](#) – Documentation for Pi-16ADC
- [Pi-16ADC Datasheet](#) – Datasheet for Pi-16ADC
- [Pi-16ADC.py](#) – sample python code, stored in ZIP format
- [Pi-16ADC CE Certificate](#) – CE compliance Certification
- [Pi-16ADC STEP](#) – STEP design file
- [Pi-16ADC How to Use Python](#) – PDF document HOW-TO

Pi-EzConnect

- [Pi-EzConnect STEP](#) – STEP design file

Pi-UpTimeUPS

- [GPIO_shutdown.py](#) – sample python code, stored in ZIP format
- [GPIO-crontab.py](#) – sample python code, stored in ZIP format
- [Pi-UpTimeUPS How to Use Python](#) – PDF document HOW-TO

Step 5 – Mount Pi-BB-RPS and Pi-UpTime UPS

- Mount Pi-BB-RPS and the Pi-UpTime UPS boards on the Pi
- Recommend Pi-UpTime UPS on the top – easy access to batteries and internal reset switch
- Mount unit in NEMA enclosure. Run all wires from Solar panel. Run all cables for internal boards. Make sure all wires run properly without any obstruction or stress
- Connect the Raspberry Pi and Pi-BB-RPS to all power sources as shown earlier.

Pi-BB-RPS + Pi-UpTime UPS – a HA* solution

*High Availability

- Reliable configuration
 - N+1 redundancy
 - RPS + UPS capability
- Nice compact package – all boards can be mounted easily in one tall stack.
- Expect 10+ hours run time from two 18650 batteries
 - Recommend 3000 to 3200 mAh batteries
 - Run time depends on what is connected
 - Max current supported ~1.1A
 - Re-charge time will vary depending on use
- Keep the Pi-UpTime UPS board on top of the stack created

Advantages of HA* Configuration

*High Availability

- Highly Available (HA) configuration provides RPS and UPS capability
 - N+2 power failure redundancy (possible two failures are tolerated when an additional source of power is available)
- If all external electric grid power fails, OR solar panel is non operations (e.g. night time) UPS is used till battery runs out
 - Used good quality, high capacity (max 3200 mAh) Li-Ion batteries

Building a HA* solution

*High Availability

Raspberry Pi-3

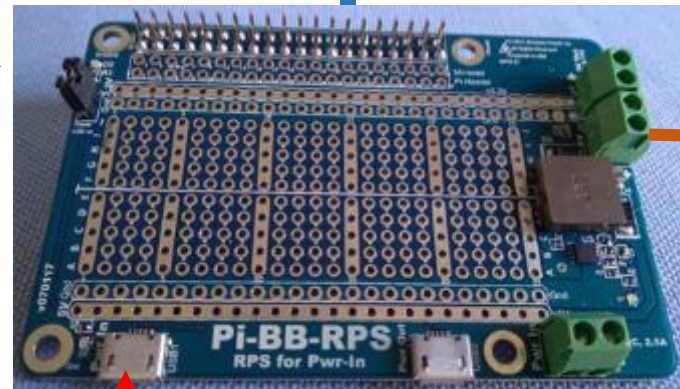


Solar Panel – Powers the Raspberry Pi and charges battery bank



Provides Power when needed

Charges from Solar Panel



Second power source

USB cable with Micro-USB - spliced and connected to 5V out header

Other recommendations / considerations

Attach a Real Time Clock module to the Pi-BB-RPS to provide accurate time when off network is not available

Attach a cellular modem or other communications device on Pi-BB-RPS to upload information or connect remotely