

Key Features:

- Provides UPS functionality for Raspberry Pi Zero and other Pi models.
- Use Li-Ion or Li-Polymer batteries. **Batteries not included.**
- 5V, 2A UPS out.
- Batteries attach via terminal block.
- No reboot when power fails. UPS takes over.
- Ideal diode power OR between UPS and USB power. No heat.
- Monitor Input, Output, Battery Voltage and temperature via ADC. Up to three I²C addresses.
- Add power on/off switch. All power to the Pi is off when off.
- No GPIO's used.

PiZ-UpTime 2.0



UPS 5V, 2A using Li-Ion or Li-Polymer battery

PiZ-UpTime 2.0 provides Uninterruptable Power Supply (UPS) for a Raspberry Pi Zero, other Pi models and other USB Single Board Computers (SBC) such as Odroid, Asus etc. Power is provided via the USB-out port or the 40-pin Raspberry Pi compatible header. The board has the same dimensions as a Pi

Zero and can be mounted securely on a Raspberry Pi Zero using spacers for a compact, mechanically stable connection. When used with a Pi Zero 40-pin header (e.g. Pi Zero W H), UPS power is provided via the header pins. UPS power can also be provided via the micro USB Out port. A micro-USB to micro-USB cable is needed (not supplied).

An on-board 12-bit ADC monitors Vin, Vout, battery Voltage and operating Temperature (in °C and °F) providing accurate operating conditions. Temperature sensor (via an on board NTC) below the battery area provides approximate battery temperature or the operating temperature of PiZ-UpTime 2.0. Battery charging is usually safe between 0°C and 50°C. Recommend getting the operating temperature range of the battery from the manufacturer.

No GPIO connections or GPIO monitoring is needed. The on-board ADC provides information via the I²C. Up to three different I²C addresses can be selected via jumper J11-J12 to avoid conflict with other I²C devices.

External connections are available for Vin, Battery and Vout via jumper studs, terminal blocks or JST connectors. The external connection points can be used for an external battery¹, external Vin of 5V and 5V Vout.

Max UPS and operating current for the system is 2A. External battery can be Li-Polymer or Li-Ion connected via a terminal block. Please make sure to connect the battery with the proper polarity. Incorrectly inserting the battery will burn out the electronics.



¹ Only one battery can be used at any time.

PiZ-UpTime has been sold and used world-wide. This version is an improvement to the older version. A comparison table is provided below for users familiar with PiZ-UpTime.

Maximum current is limited to 2A via a current limit resistor. Since the USB connector provides power for charging the battery and providing power to devices connected via Pi-UpTime-UPS 2.0, a 3.5A power supply is strongly recommended. A good quality USB cable will minimize power loss.

Key Features

- Provides UPS using one rechargeable Lithium-Ion or Lithium Polymer battery connected via terminal blocks. Batteries are not included.
 - Space on board for specific Li-Polymer batteries, indicated on the board.
 - Can be glued on to the surface with dual sided heat conductive, electrically insulated tape.
- Choice of Li-Ion or Li-Polymer batteries.
- Stable 5V output, eliminates pesky “bolt” on Raspbian. Max 2A out, enough for most uses.
- Connection for on/off switch. Use a 2.54mm header cable (e.g. Amazon Product ID B07FXXDN2M) to connect a switch inline. Please ensure the on-off switch can support 2A or more.
- Includes Battery management system (BMS). Charges the battery when power is available.
 - Ensures battery remains charged over time.
 - Ensures fully discharged batteries are handled properly.
 - CCCV battery charging.
 - LED indicates when battery is charging. When Battery is fully charged, battery is off.
- On board ADC allows Battery V monitoring via I²C. Sample Python code is provided and can be downloaded for use. The sample code can be modified to adapt to the battery V level for your needs. Input V level monitoring also provides accurate V monitoring for Input Voltage, brown outs and power failure. Output Voltage and temperature can also be monitored via the ADC.
- System shuts down when batteries fall below 3.1V (reconfigurable in software), protecting the batteries.
- Power reset is done by pulling out the Power on/off shunt on Jumper J3 and inserting it back in again. An on-off switch can be used instead of the shunt via a 2.54mm cable header as described earlier.
- Using M2.5 x 11mm spacers, PiZ-UpTime 2.0 can mount securely on a Raspberry Pi Zero. Spacers are not included.
- Maximum battery charge current is limited to 0.5A, a safe charging limit for Li-Polymer batteries. Battery charge time will vary based on battery capacity and battery charge level.
- Several safety features are built in.
 - Includes Battery Management System (BMS) which uses CCCV charging and maintains the charge level for Li-Polymer or Li-Ion batteries.
 - An initial slow charge for depleted batteries is provided to allow batteries heavily drained to recover gracefully.
- Power to the Pi is provided via the 2x4 pin header, pins 2,4.
- LEDs indicators:
 - **Yellow** – LED on indicates battery is charging and Power is On. LED Off when battery is fully charged.
- UPS out – regulated 5 V, 2 Amps for overall UPS system. Please make sure the battery can sustain at least 2.1 Amps or more as its output or discharge current.
- Sample Python code to monitor system is available. Download from www.alchemypower.com/downloads.

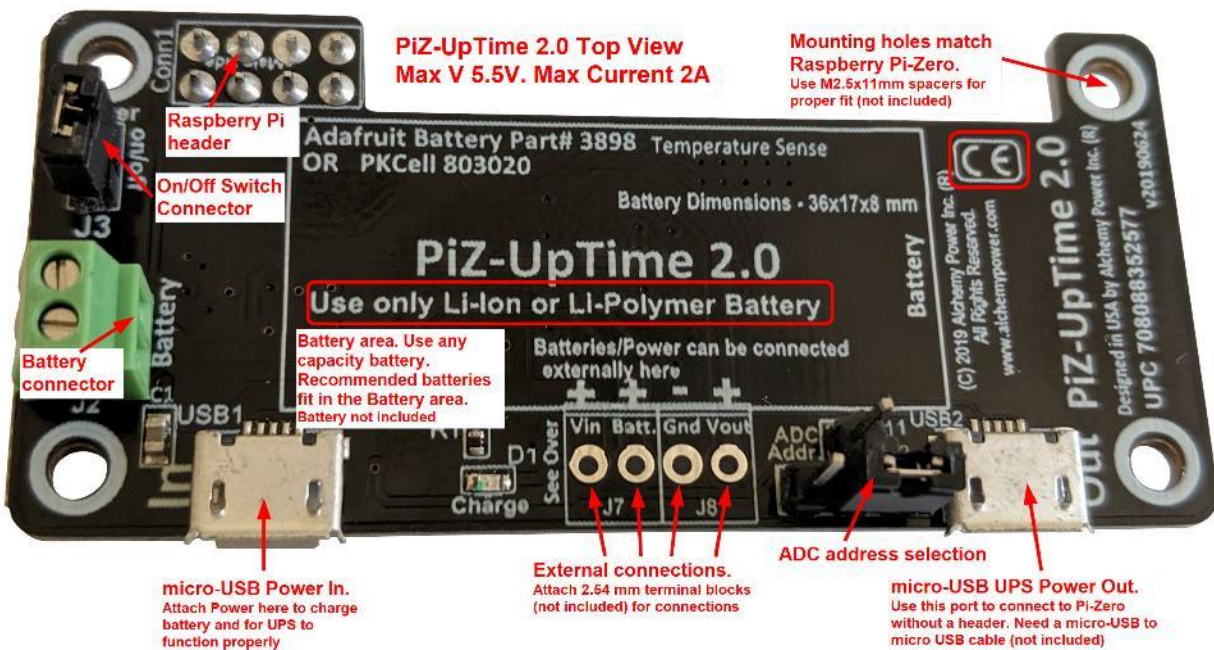
- Output Voltage – UPS generates regulated 5V ($\pm 2\%$ across full load range). When the USB Power is on, the power is passed through a very low loss ideal diode. The output Voltage is the almost the same as that provided by the USB power supply.

Please visit www.alchemypower.com/products for additional information and sample python code.

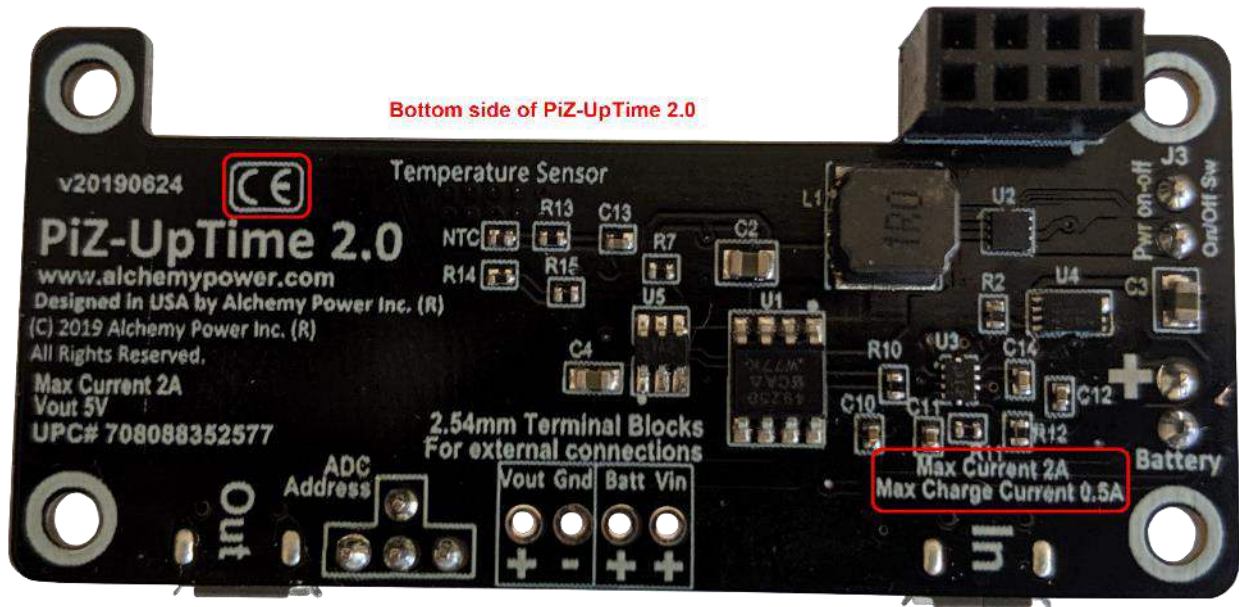
Recommended installation steps

1. Remove Jumper J3 to turn off all power to the Pi and external power sources (USB-out, 3.3V).
 - a. Insert an on/off switch if desired at Jumper J3. Ensure the switch is in the off position.
2. Connect the battery to the terminal block (J2) labelled Battery. Make sure you follow the proper polarity. Improper battery insertion can damage the electronics.
3. Mount the PiZ-UpTime 2.0 board on the Pi. Recommend using 11mm spacers to mechanically secure the unit.
4. Plug in the USB power to USB-In port on Pi-UpTime UPS 2.0. The yellow/amber LED may come on, indicating the power is on and the battery is charging.
5. Finally, when ready, insert the shunt on Jumper J3. Alternately, turn the on/off switch to on. The Pi should be booting up once power is applied.

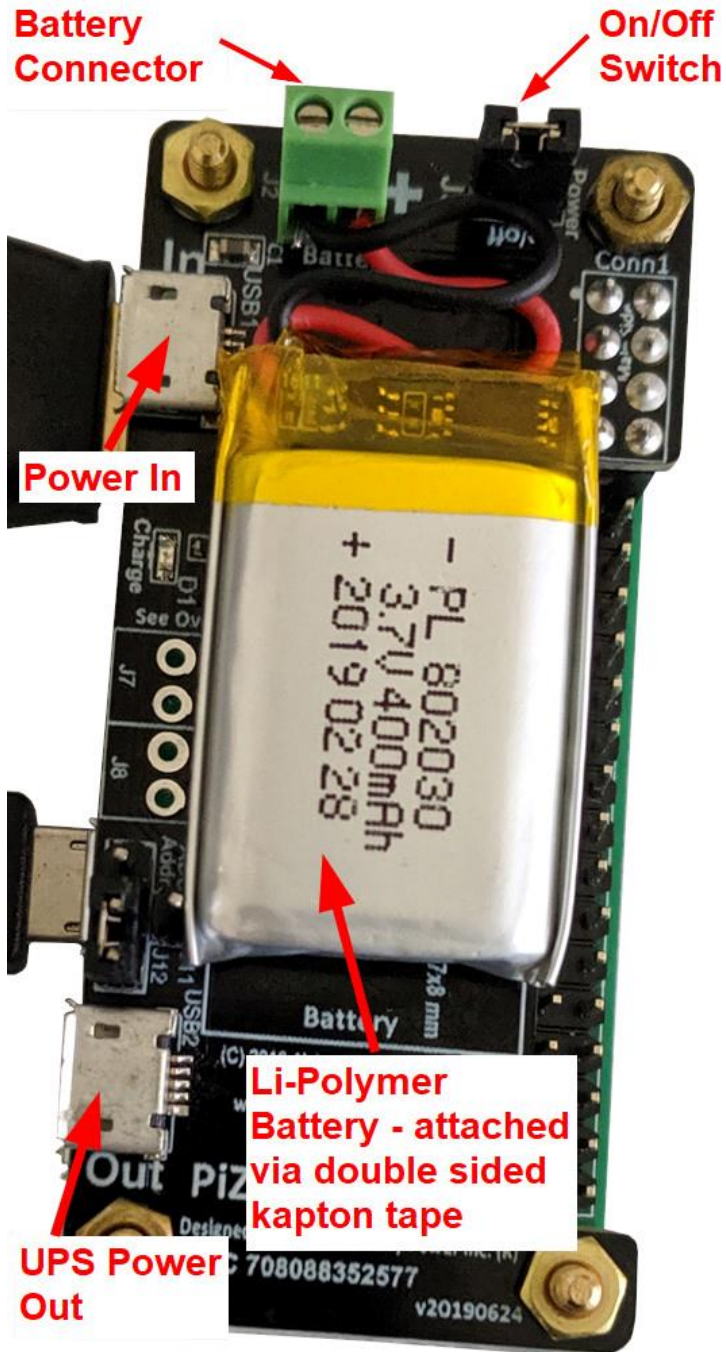
Picture Gallery



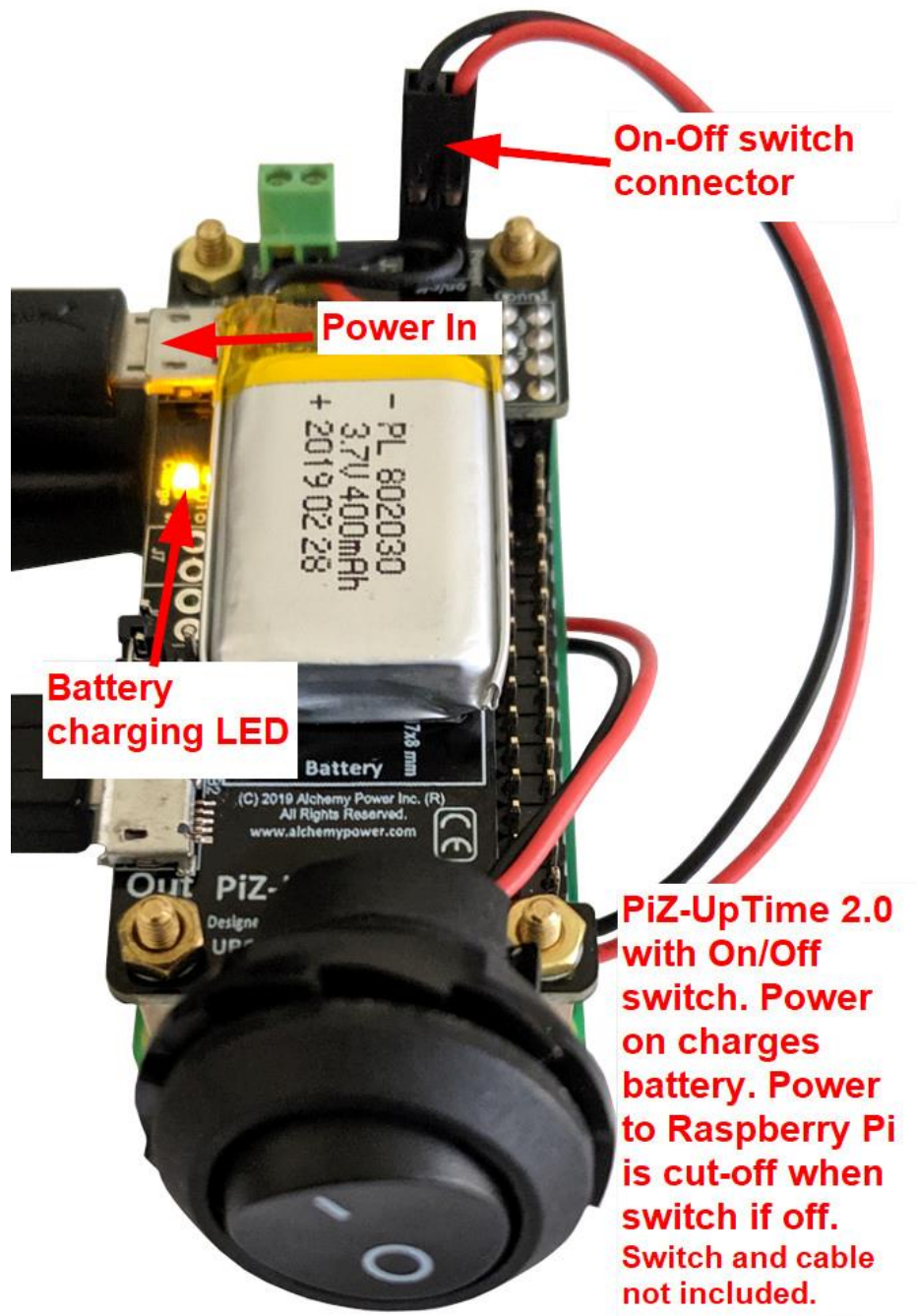
Top side. Capabilities and connections shown.



Bottom Side.



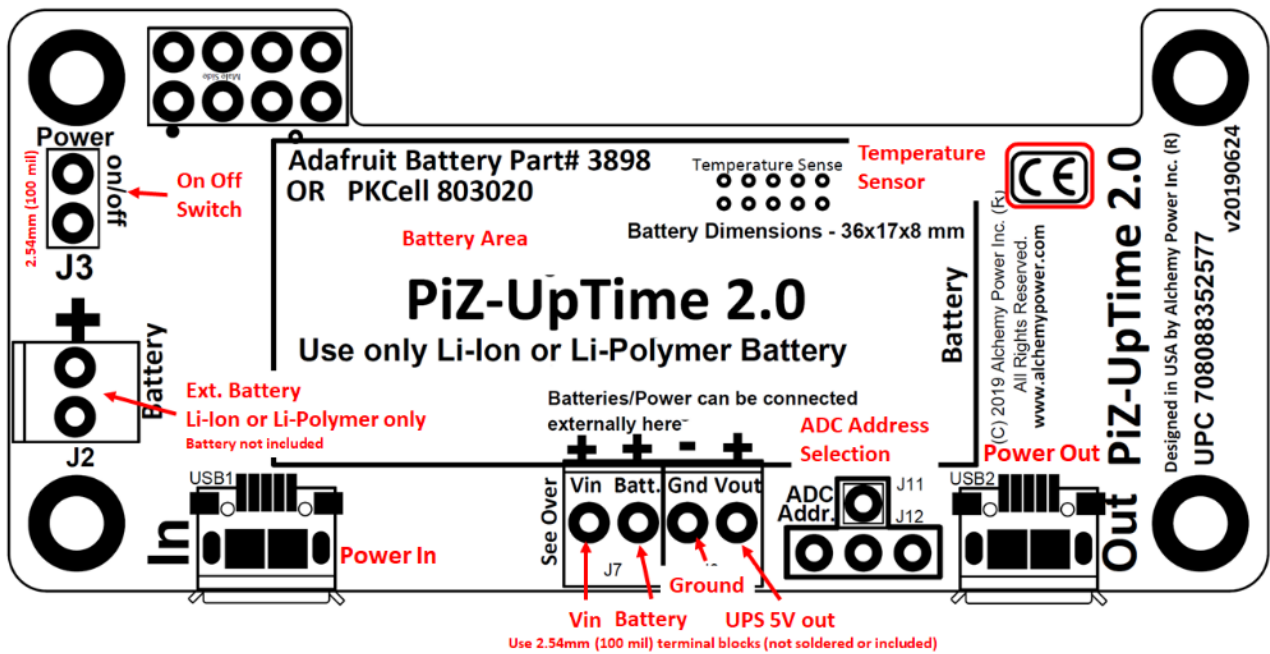
Mounted on Pi-Zero with 11mm spacers and Li-Polymer battery.



With On-Off switch connected. Note battery charges even when the switch is off.



With an 18650 Li-Ion battery for additional UPS run time capability



Board Layout (CAD Image)

Table 1: PiZ-UpTime vs PiZ-UpTime 2.0

This table compares the older version of PiZ-UpTime with the current version of PiZ-UpTime 2.0

	PiZ-UpTime	PiZ-UpTime 2.0
Charge Current	Max 1.0 A	Max 0.5A
Battery Chemistry (battery not supplied)	14500 Li-Ion only	Li-Ion or Li-Polymer – attached via terminal block
Battery Holder	On top, 14500 size	None, attach via Terminal Block(s)
Access to Vin, Vout, Battery	No	Yes, via terminal blocks, and in software
Input V	Max 5.5V, via micro USB only	Max 5.5V, via micro-USB (in) OR via terminal blocks (not included)
Output V	4.6V to 5.1V	Regulated 5V out ($\pm 2\%$), irrespective of input V. No irritating “bolts” on Raspbian
Max Current	1A	2A
On/Off Switch	None. Only power reset switch is provided	Can attach an external on/off switch for manual on/off. Power reset by pulling shunt out/in
UPS USB Out	Yes, via micro-USB	Yes, via micro-USB OR via terminal blocks
GPIO used	Yes	None – internal ADC is used
Vin, Vout, Battery and temperature info	None	Available via on-board 4 channel 12-bit ADC, accurate to 3mV (Temp $\pm 2^{\circ}\text{C}$)
Python code for shutdown	Yes, depends on GPIO indicators	Yes. Python code provides Vin, Vout, board temperature and Battery level. Can be modified for different use cases
External Battery	No, only via the AA battery holder on board	Only external battery can be attached. Space on board for Li-Polymer batteries
Battery size	Usually 400-600 mAh (14500 battery capacity)	Can be any capacity. Higher capacity takes longer to charge & provides longer run time on UPS

	PiZ-UpTime	PiZ-UpTime 2.0
LED's	Many	One – when battery is being charged. LED is off when battery is fully charged
Power in	Via micro-USB	Via micro-USB
UPS Power out	Via micro USB	Via micro USB, Terminal Blocks
Other	Many units in use worldwide. Uses built in ideal diode, limits max current to 1.2A.	Uses Ideal diode OR – very little heat or power loss – efficient operation and seamless transition to battery backup for UPS
Shutdown Trigger point	Hardware – cannot be modified	Can be modified in software. Battery V level when shutdown is triggered can be changed
Battery management / charging	Built on board, uses CCCV charging	Built on board, uses CCCV charging
Board Color	Green with white text	Black with white text
UPC code	691852747184	708088352577
Planned use / future	Legacy. Not recommended for new designs	Recommended for new designs
Models supported	Pi-Zero family	Pi-Zero family, Model 3B and below. Models 3B+ and Model 4 may stress the unit. Models 3B+ and Model 4 will also require a higher mAh battery to sustain the current needed during shutdown / reboot.

Table 2: Comparing UpTime family

	Tiny-UPS	PiZ-UpTime 2.0	Pi-UpTime UPS 2.0
Functionality	“In-Line” UPS for USB Power, inline to USB Power	UPS for a Pi-Zero or Pi-A, typically mounted on a Pi-Zero or Pi-A	UPS for a Pi-3. Typically mounted on a Pi-3
Battery Chemistry	Li-Ion or Li-Polymer	Li-Ion or Li-Polymer	Li-Ion, Li-Polymer or Li-Phosphate , jumper selectable.
Battery connection	External via Terminal Block	External via Terminal Block	Onboard two 18650 battery or External battery via Terminal Block
Max Current	2A	2A	2.5A
Output V	5V±2% regulated	5V±2% regulated	5V±2% regulated or Vin from Power supply
Indicator / measurement	Battery low via GPIO. Power off via GPIO	Vin, Vout, Battery V and temperature monitored via on board 12-bit ADC	Vin, Vout, Battery V and temperature monitored via on board 12-bit ADC
Shutdown routine	Sample Python code provided	Sample Python code provided	Sample Python code provided
Adjust battery level to trigger shutdown	No	Yes, controlled in software	Yes, controlled in software
LEDs	Charging, charge complete	Charging	Charging Charge complete UPS on Input V < 4.8V (brown-out)
Charge current	1A	0.5A	1.5A
Models supported	Any, up to 2A current	Pi-Zero and others	All, including Pi-4
Max battery capacity	No upper limit – takes longer to charge	No upper limit – takes longer to charge	No upper limit – takes longer to charge
Vin Power supply	Via micro USB only	Via micro USB or terminal block	Via USB-C, micro USB or terminal block
UPS Vout	5V, via micro USB or terminal block (not provided)	5V via micro USB or terminal block	5V via micro USB or terminal block. 3.3V, 0.7A via terminal block
I ² C bus access for external sensors	None	None	I ² C connection to the Pi is accessible via terminal block for external sensors etc.
GPIO	External. Jump wires needed to connect to Pi or another device.	No GPIO used	No GPIO used

	Tiny-UPS	PiZ-UpTime 2.0	Pi-UpTime UPS 2.0
Temperature	Not applicable as battery is external	Board temperature is provided. When it is too hot or too cold, the Pi can be shutdown. Sample routine will need modification	Board temperature is monitored and BMS disables charging when it is too hot or too cold
Shutdown Trigger	External when battery is low	Software driven, with check for battery low and Power off	Software driven, with check for battery low and Power off
Battery Management	CC-CV charging. Battery charge level maintained over time	CC-CV charging. Battery charge level maintained over time	CC-CV charging. Battery charge level maintained over time
Additional Battery Safety	Max charge current monitoring	Provides board temperature. Software can decide what to do next. Max charge current monitoring	Active temperature monitoring. Battery charging is disabled when it's too hot or too cold. PTC fuse protection between batteries to prevent current loops. Max charge and use current monitoring & current limits
Current limit	Only for charge current	Only for charge current	Charge current and max current monitoring
Board Color	Green	Black	Black
Board dimensions	35mm x 28mm x 12mm 4 mounting holes. Can be mounted on a Pi-Zero.	65mm x 30mm x 12mm Bottom connector 11mm. Ideal for mounting on a Pi-Zero. Can be mounted on Pi-A or Pi-3 family	85mm x 56 mm x 22mm (with 18650 battery holder). Bottom connector 13.5mm
Mounting	4 mounting points. Long edge aligns with Raspberry Pi-Zero short edge for mounting	Mounts to Raspberry Pi Zero. Long edge aligns with Raspberry Pi-3 or Pi-A dimensions	Designed to mount on Raspberry Pi-3
Recommended spacers	Depends on unit connected to. For Pi-Zero, 11 mm or 15 mm spacers recommended	For Pi-Zero, 11 mm spacers recommended	For a Pi-3 or Pi-4, 20mm spacers recommended
Board weight	15 grams	20 grams	50 grams
UPC Code	708088352553	708088352577	708088352584

Specifications

General Information

Model Number: PiZ-UpTime 2.0

Raspberry Pi Models supported

Any Raspberry Pi or SBC with a 40-pin header compliant to Raspberry Pi Foundation header definition. Pins 2,4 are used for power. I²C is used to control operating parameters. Designed for Pi Zero devices. PiZ-UpTime 2.0 can also be used with other Pi 2 family, Pi 3 family, Pi Zero family, Odroid, Asus Tinker, etc. Other boards can be powered using USB out port.

Power

Input Power: Power-in via micro USB connector on PiZ-UpTime 2.0. 5V, 3.5A power adapter recommended. Batteries are charged only when power is provided to Power In connector on PiZ-UpTime 2.0.

Power Adapter: 5V, 3.5A USB power recommended. Power adapter not included.

Maximum Charge Current: Maximum of 0.5 Amps.

Maximum Current: 2.0A.

Maximum UPS current: 2.0A

Ripple: Less than 25mV p-p.

Battery Low shutdown: 3.1V. Can be changed in the Python Code provided.

Input Operating range: 4.8 V to 5.5V. Above 5.5V the circuit will be damaged.

Output

UPS Power: 4.8 V to 5.1 V via OTG micro-USB and 2x4 pin header. Power provided to the Raspberry Pi via the 8-pin header, pins 2,4.

Output Step up (Boost) Frequency: 2 MHz

Batteries

Recommended Batteries: Adafruit Part number 3898 or other similar batteries, PKCell 803020 or Li-Ion battery with wires for connection. Run time and charge time varies on capacity of the battery.

Batteries: One Lithium Ion or Lithium Polymer non-protected battery connected via terminal blocks J7/J8 (not supplied or attached). Use only one battery. Using multiple batteries can cause current loops and damage the circuitry.

Battery capacity: Battery capacity will depend on your use. The higher the capacity, the longer the UPS run time, the longer the charge time.

LEDs: Battery charging (Yellow), off when battery is charged.

Battery polarity: Marked on terminal blocks / board. **Inserting batteries incorrectly will damage the electronics and can cause the board to get very hot.**

Terminal Blocks recommended/used: Two Position Wire-to-Board Terminal Block, Horizontal with Board, 2.54mm (0.1inch) pitch, green color (color may vary), Thermoplastic, -30°C ~ 105°C, 6A, 125V. 20-30AWG wire can be used. Steel Zinc Screws, max torque 0.15 Nm (1.3 lb-in). Brass contact and clam material. RoHS 2 compliant. Recommend Onshore Technology Inc OSTVN02A150 Terminal blocks. Other manufacturers also provide equivalent terminal blocks, which can also be used.

Safety: Onboard circuitry prevent over charging and negative flow (from battery to power supply). If the battery is depleted, the charging is done slowly initially. After safe level, the CCCV charging method is initiated.

Battery Charging: Uses CCCV charging method. Safe operating temperature range recommended is from 0°C to 50°C.

Depleted Batteries: Senses depleted batteries and uses low current charging to bring charge level up and then CCCV charging. Initial charging for depleted batteries is a max of 100mA.

Monitoring: Monitor Input V, Output V, Battery V and board temperature using an on-board ADC. Sample Python Code provides capabilities to monitor ADC and shutdown the Pi when the battery V is low.

ADC capabilities: A 12-bit, delta-sigma ($\Delta\Sigma$) analog-to-digital converter (ADC). Three I²C addresses are available, jumper selectable. Minimum measurement sensitivity is 3mV.

Battery Full Charge Voltage: Li-Ion, Li-Polymer 4.2 V.
Nominal 3.7V.

Spacers

M2.5x11m, not included. Spacers are recommended for mechanical stability and provide ambient cooling air space.

Connection Points

Connection points are spaced 2.54mm (0.1 inches) apart. Jumper studs, terminal-blocks or JST connectors can be used for connections. Connections are marked on the board top layer as well as on the bottom layer.

Power on/off Switch

Reset: Turn power off by pulling out Power On/Off jumper shunt. Turn power back on by inserting jumper shunt. Power shunt remove-reinsert sequence causes a power reset and a reboot.

External Switch: Instead of a shunt, an external on/off switch can be connected to the jumpers. The jumpers are 2.54mm – any 2.54mm connector can be used. Please make sure the switch can sustain a minimum of 5V, 2A.

On/Off Switch cable: Available at several web sites. An example is via Amazon, product-id B07FXXDN2M.

Dimensions

Board dimensions: 65mm x 30mm x 12mm (2.6" x 1.2" x 0.5").

Weight: About 20g (0.7 oz.) without batteries. Note each battery adds approximately 30 grams of weight.

Header: Female pins on bottom. Pin thickness appx. 0.6mm. Female pin height appx 8.5 mm. No male pins on the top.

Warranty

90-day limited warranty. Warranty voided by improper use.

Other Information

Temperature:

Battery Charging Temperature: 0°C to +50°C, outside this range, battery charging is not recommended. Since the battery is separate from the board, battery temperature is not monitored. Only the board temperature is monitored.

Board Operating Temperature: -40°C to +80°C

Operating Humidity: 10% to 80% non-condensing.

RoHS etc.

RoHS Compliance: Electronic components, board etc. are all RoHS compliant.

Other: CE Compliance certificate available on request.

Recommended peripherals:

Please visit www.alchemy-power.com/products for recommended products.

Code download: www.alchemypower.com

Product Video: none at this time.

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Alchemy Power Inc.

2098 Walsh Avenue, Suite A, Santa Clara,
CA 95050-2544.

Phone: 650.823.2316

Email: sales@alchemypower.com

www.alchemypower.com