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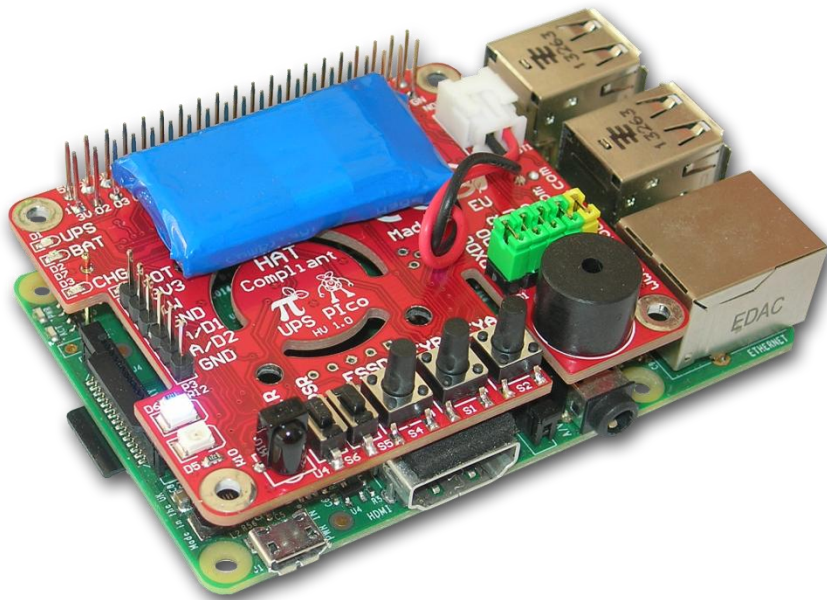# UPS PIco

Uninterruptible Power Supply

with Peripherals and I^{2}C control Interface

to be used with

Raspberry Pi® B+, A+, B, and A

HAT Compliant

"Raspberry Pi" is a trademark of the Raspberry Pi® Foundation

Frequently Asked Questions V1.0

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Intelligent Modules for your Raspberry Pi®

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System Overview

Introduction

The **UPS PIco** Module is an advanced uninterruptible power supply for the Raspberry Pi® that adds a wealth of innovative power back-up functionality and development features to the innovative microcomputer!

The standard **UPS PIco** Module is equipped with a 300mAh LiPO battery specially designed to enable safe shutdown during a power cut. Additionally, this can be easily upgraded to the extended 3000mAh version, which enables prolonged use of a Raspberry Pi for **up to 8 hours** without a power supply connected!

The **UPS PIco** Module features an embedded measurement system that continuously checks the powering voltage of the Raspberry Pi®. When the cable power on the Raspberry Pi® is absent, insufficient, or the device detects a power failure, the **UPS PIco** Module automatically switches to the unit's battery source. The module then continues to check the voltage on the Pi and switches automatically back to the regular cable supply when power is once again available.

The **UPS PIco** Module is powered and the battery pack intelligently charged via the GPIO pins on the Raspberry Pi®, so no additional cabling or power supply is required.

The **UPS PIco** Module is designed to be 100% compliant with **HAT standards** for the Raspberry Pi® B+ and A+, and is mechanically compatible with the original Raspberry Pi® models A and B when an extension header is used. In addition to this, because the **UPS PIco** Module requires no external powering and fits within the footprint of the Raspberry Pi®, it is compatible with most cases.

The **UPS PIco** Module can also be equipped with an optional **Infra-Red Receiver** which is routed directly to GPIO18 via the PCB. This opens the door for remote operation of the Raspberry Pi®and **UPS PIco** Module!

Finally, the **UPS PIco** Module features an implemented Automatic Temperature Control **PWM FAN controller**, and can be equipped with a micro fan kit, which enables the use of the Raspberry Pi® in extreme conditions including very high temperature environments.

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Applications

UPS PIco Module is equipped with plenty of features which make it an extremely useful tool for Raspberry Pi® project development. It not only provides powering continuity, but also offers extra user programmable LEDs, Sensors, buttons and I/O's. The unit also features a dedicated **10-bit analogue to digital converter** with two channels making it the perfect board for remote and unmanned sensor deployment. These extra features result in the **UPS PIco** Module being a superior all-in-one device perfect for many innovative projects, and embedded applications.

Features

The list of features of the **UPS PIco** Module is as follows:

- Raspberry Pi B+ **HAT Compliant**
- **Plug and Play**
- **Smart Uninterruptible Power Supply (UPS)**
- **Integrated LiPO Battery** (8-10 Minutes of Power Back-Up)
- **Intelligent Automatic Charger**
- **No Additional External Power Required**
- **Optional 3000 mAh** Battery for 8 Hours Run-Time (Not Included)
- **5V 2A Power Backup (Peak Output 5V 3A)**
- Integrated Software Simulated **Real Time Clock (RTC)** with Battery Back-Up
- **File Safe Shutdown** Functionality
- Raspberry Pi B+ **Activity Pin**
- **PWM FAN control** (Fan Not Included)
- **2 User Defined LEDs**
- **2 User Defined Buttons**
- **Integrated Buzzer** for UPS and User Applications
- **Status Monitoring** - Powering Voltage, UPS Battery Voltage and Temperature
- **I2C PICo Interface** for Control and Monitoring
- **RS232 Raspberry Pi** Interface for Control and Monitoring
- **XTEA Based** Cryptography User Software Protection
- 2 Level **Watch-dog Functionality** with **FSSD and Hardware Reset**
- **Raspberry Pi B+ Hardware Reset Button via Spring Test Pin** (Not Included)
- **Jumpers for Raspberry Pi B+ Pin** Functionality Selection
- **Stackable Header** for Add-On Boards
- **Boot Loader** for Live Firmware Update
- Compatible with **Intelligent IR Remote Power ON/OFF (PowerMyPi)**
- **Integrated ESD-Protected 2 Channel A/D 10 Bit Converters 0-5.2V**
- **Integrated ESD-Protected 1-Wire Interface**
- **Labeled J8 Raspberry Pi B+ GPIO Pins** for Easy Plug & Play
- **Infra Red Receiver** Sensor Interface (IR Not Included)
- **Upgradable** with **PIco Add-on Boards**
- **Fits Inside Most Existing Cases**

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Frequently

Asked

Questions

Version 1.0

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Q: Why do I need to use the UPS PIco Module?

A: Because while you work on the Raspberry Pi®, operating system and user files are continuously written onto the SD card. An unexpected lack of powering during the writing of files can cause loss and/or inconsistency of data, up to possible corruption of the Operating System itself. **UPS PIco** Module handles such powering losses and provides battery powering; in addition to this, **UPS PIco** Module provides plenty of extra features that make it a very friendly tool for beginners and advanced users. Our company spent a very long time carefully designing the **UPS PIco** Module in order to provide to the user **as many as possible features** at the **lowest price possible.**

Q: Is the UPS PIco Module true Plug and Play?

A: Yes, the **UPS PIco** Module is 100% Plug and Play. You do not need to do any configuration to it: just plug it on top of your Raspberry Pi®and go. You even don't need to change the micro USB power connection plugged to your Raspberry Pi®. In fact there is **no other micro USB connector** available like in other UPS modules available for the Raspberry Pi®. You will just plug-in the **UPS PIco** Module to the **J8 (P1 for model B/A)** connector on the top of your **Raspberry Pi®** and use it. As far as software configuration is concerned, all you must do is to install a small Python script on the Raspberry Pi®, that will take care to safely shutdown the Raspberry Pi® and will inform your **UPS PIco** Module that Raspberry Pi® is running. It will solve all of your possible powering problems and offer battery backup.

Q: Is the UPS PIco Module fits to existing cases?

A: Many. UPS PIco Module requires no external powering cables and fits within the footprint of the Raspberry Pi®, so it is compatible with most cases.

Q: Is the UPS PIco Module compatible with other models of the Raspberry Pi?

A: Yes. The **UPS PIco** Module Module is 100% compatible with Raspberry Pi® model B+ and A+. It is also compatible with the Raspberry Pi® B and A models, if the required extension connector is used.

Q: How is it possible that UPS PIco Module has no need of additional micro USB power input like other Raspberry Pi ® UPS available to the market?

A: UPS PIco Module has a bidirectional power connection with the Raspberry Pi®. Through that connection it receives power, when present, from the Raspberry Pi®, and keeps its battery charged. It continuously analyzes powering conditions with

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proprietary powering analysis algorithms, detects power losses and power restoral and decides within 100 uS to switch between **internal battery** and **cable powering.**

Q: Can I use the UPS Pico Module with other boards?

A: Yes. Just plug them on top of it, or use the version of the **UPS Pico** Module with extended **J8** (**P1 for model B/A)** connector, and then plug-in the other board on top of it. The **UPS Pico** Module will power also your additional boards and other existing peripherals.

Q: How long power loses UPS Pico Module recognizes and filters?

A: Any luck of power on the **J8** (**P1 for model B/A)** connector that takes more than 100 uS, or continuously dropping of powering voltage within time frame of 500uS, or drop of powering voltage below of USB recommendations will automatically initiate the battery powering back up and filter it, providing continuously powering to the Raspberry Pi®.

Q: Is it possible that UPS PIco Module switches to battery during "normal" usage of the Raspberry Pi®, i.e. when no power loss took place?

A: YES, even within "normal" usage of the Raspberry Pi® some voltage drops can happen that will be recognized by the **UPS PIco** Module and cause automatically switch to battery source. This can happen for instance in case of sudden increase of the power consumption by the Raspberry Pi®, or power glitches on the network. It happens quite rarely and does not impact adversely the operation of the Raspberry Pi®, on the contrary it offers better powering. After a short time battery running the **UPS PIco** Module automatically switches back to the cable powering.

Q: How Raspberry Pi® is protected from direct powering provided to the J8 (**P1 for model B/A) connector?**

A: Following Raspberry Pi® HAT recommendations there are implemented 3 level of powering protection:

1. **ZVD circuit**
2. **PPTC Fuse of 2.6A**
3. **Ultra Fast FET based Analog Power Switch micro controller supervised**

Q: What is the maximum current that Raspberry Pi® can draw from the UPS PIco Module?

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A: Raspberry Pi® HAT recommendations mandate that the **UPS PIco** Module be able to provide continuously 1.4A. **We have increased this level to 2A,** which **UPS PIco** Module can provide with continuity, also allowing very short peaks up to 3A

Q: What type of battery is used by the UPS PIco Module?

A: The standard **UPS PIco** Modules shipped to the user equipped with a LiPO battery of **300 mA.**

Q: Is it possible to use a battery with bigger capacity on the UPS PIco Module?

A: YES, our company offers tested and approved LiPO batteries with capacity up to **3000 mA.**

Q: How is the battery charged on the UPS PIco Module?

A: The **UPS PIco** Module is equipped with intelligent automatic charger that takes care to keep the battery always charged to the full level of capacity, recognizes various charging conditions and monitors the battery temperature, as well as environmental temperature. If powering conditions become not sufficient, **UPS PIco** Module automatically stops the battery charging in order to provide the available power to the Raspberry Pi®

Q: How long can the Raspbeerry Pi® run with standard battery in case of power lack?

A: It depends from the current load of the system; on average, we estimate that the **UPS PIco** Module can supply a Raspberry Pi® (without extra modules) for about 8 – 10 minutes with the standard battery of 300 mAh and about 8 hours with the high capacity battery (3000 mAh).

Q: Is it possible to have batteries with higher capacity, and how long do they last?

A: YES, practically any LiPO battery with higher capacity can be used, provided that it complies with the required specifications which are: charging voltage 4.2 V, nominal voltage 3.7V, and minimum provided current 6A. However bear in mind that the charging current is 212 mA, therefore batteries with capacity higher than 4200 mAh will take more than 20 hours to charge completely.

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Q: Is the UPS PIco Module integrated battery protected?

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A: Yes, the **UPS PIco** Module has a built in multiple battery monitoring and protection systems that features <u>over current</u>, <u>overcharge</u> and <u>over discharge</u> battery protection. In addition, the battery temperature is also monitored, and the system takes care to react when that temperature becomes too high or too low.

Q: I need my Raspbeerry Pi® to run on battery for a longer time: days and days. Does the UPS PIco Module provide any other way to extend the battery runtime?

A: YES, the **UPS PIco** Module provides two features that can help in this case:

- the embedded internal **timed ON** feature allows the **UPS PIco** to automatically switch ON the Raspberry Pi® at a given time;
- once it starts, the Raspberry Pi® can invoke the File Safe Shutdown procedure at a preprogrammed time and shut itself down. At the end of shutdown, the **UPS PIco** Module will sense the halt state of the Raspberry Pi® and will switch it off (remove power).

By using these two features, the Raspberry Pi® can be activated only during requested time slots, and be switched off for the rest of time. With this approach you can save a lot of energy and keep your Raspberry Pi® functional on battery for days and days.

Q: Can I use the UPS PIco Module with other chemistry types of batteries?

A: NO, the **UPS PIco** Module has been designed exclusively for the LiPO batteries with nominal voltage of 3.7V and charging voltage of 4.2 V. <u>The use of different chemistry types of batteries is not allowed.</u>

Q: What is the PICo Interface?

A: The **P**eripherals **I**^{2}C **Co**ntrol – The **PICo Interface** – is an implementation of **I**^{2}C interface adapted to easy control of the peripheral connected to the Raspberry Pi® via command line. By using human understandable simple commands, control of peripherals is made extremely simple. Control at programming language level is also possible and easy. The core concept of the **PICo interface** is that all peripheral device control and data exchange between it and Raspberry Pi® variables are common for the **I**^{2}**C interface** as also for the peripheral itself. Therefore any change of them by either party, Raspberry Pi® and the peripheral, causes immediate update and action.

Q: What do I have available additionally to the UPS functionality?

A: The **UPS PIco** - **U**ninterruptible **P**ower **S**upply with **P**eripherals and **I**^{2}**C co**ntrol **Interface** is an advanced uninterruptible power supply for the Raspberry Pi® that

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adds a wealth of innovative power back-up functionality and development features. Please refer to the User Guide to see them all.

Q: What GPIO Pins are required to have the UPS PIco Module running?

A: For the Basic operation, **UPS PIco** Module uses only the **5 VDC** and **GND** pins and interacts with the Raspberry Pi® through GPIO_GEN22 and GPIO_GEN27. Some specialized features require in addition RS232 and I2C. In addition if the 1-wire device and IR Receiver are used, there are directly routed to GPIO_GEN04 and GPIO_GEN18 respectively.

Q: Do I have any indications about the UPS PIco Module status?

A: Yes. You have LEDs informing you about the powering source, battery status, charger status, system temperature as 2 extra LEDs available for user application. All the indications provided by the LEDs, as also much more, are available via RS232 and I^{2}C interface as well.

Q: Can I control my UPS PIco Module via scripting commands?

A: Yes. There are plenty of commands for full system control. Thanks to the implemented bootloader, the set of commands can be constantly enhanced with new ones, as we release more of them. We are open to customer suggestions about new commands to implement. Customers can propose new commands by e-mail or on our forum: if we find them generally useful, then we will implement them for free and distribute them via our bootloader system. Customized versions of the firmware featuring customer-specific commands are also possible.

Q: What is the bootloader system, why do we need it?

A: Bootloader System is a live updating procedure for the embedded microcontroller on the **UPS PIco** Module. This system gives you access to any new version of the firmware every time that it becomes available.

Q: How can I upload new firmware to the UPS PIco Module?

A: Just download the. HEX file from our website, store it onto the Raspberry Pi® and then update the **UPS PIco** Module directly from the Raspberry Pi® using a simple python script**.**

Q: What is the Analog Temperature Sensor?

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A: The **Analog Temperature Sensor** is placed near the **J8** connector on the **UPS PIco** Module and can be read by the user via I^{2}C or RS232. The resolution is 1 degree Celsius and it is mainly used for battery temperature monitoring (for safety reasons), however it can also be used to monitor the Raspberry Pi® temperature. If e.g. the temperature is too high, then the Raspberry Pi® can be shutdown, or a **PIco fan** can be automatically started (via **PIco fan Kit Module**). It is very useful if you are using the Raspberry Pi® in the outside environment.

Q: What RTC IC does the UPS PIco Module use?

A: There is no physical RTC IC. The microcontroller controlling all the **UPS PIco** Module functionalities emulates the RTC chip. Currently the RTC chip that is emulated is the DS1307, however in the future other chips may be emulated by the firmware, which can be uploaded to your **UPS PIco** Module via bootloader procedure. The RTC system has its own crystal of 32768 Hz and is powered from the **UPS PIco** Module embedded LiPO battery.

Q: How can I use additional embedded features of the UPS PIco Module?

A: The **UPS PIco** Module has additional 2 LEDs, 2 Buttons, Buzzer, 2 x 10bits A/D converters. Each of these extra features can be accessed via I2C or RS232 port and embedded to the user applications. In addition there are 1-wire interface directly connected to the Raspberry Pi® as also IR receiver interface. These set of additional features make this board ideal for rapid prototyping and final project deployment.

Q: What is the PWM fan control interface?

A: The **UPS PIco** Module has an embedded interface for PWM fan control. The PWM (Pulse Width Modulation) technology allows changing the embedded fan rotation speed, thus achieving different levels of speed, noise, and current. The **UPS PIco** Module implements 5 possible levels: 0%, 25%, 50%, 75%, and 100% of speed.

Q: Is the embedded fan necessary?

A: No. Nevertheless it's very useful, as it can guarantee that Raspberry Pi®, **UPS PIco** Module and any additional board never get too hot.

Q: What is the ESD protection that provides the UPS PIco Module?

A: The ESD (Electrostatic Discharge) protection is provided on each I/O pin that is handled by the UPS PIco (1-wire, and both A/D interfaces).

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Q: Can I become a distributor of your products? If so, how?

A: Very simple: just send us an e-mail with your request to b2b@pimodules.com