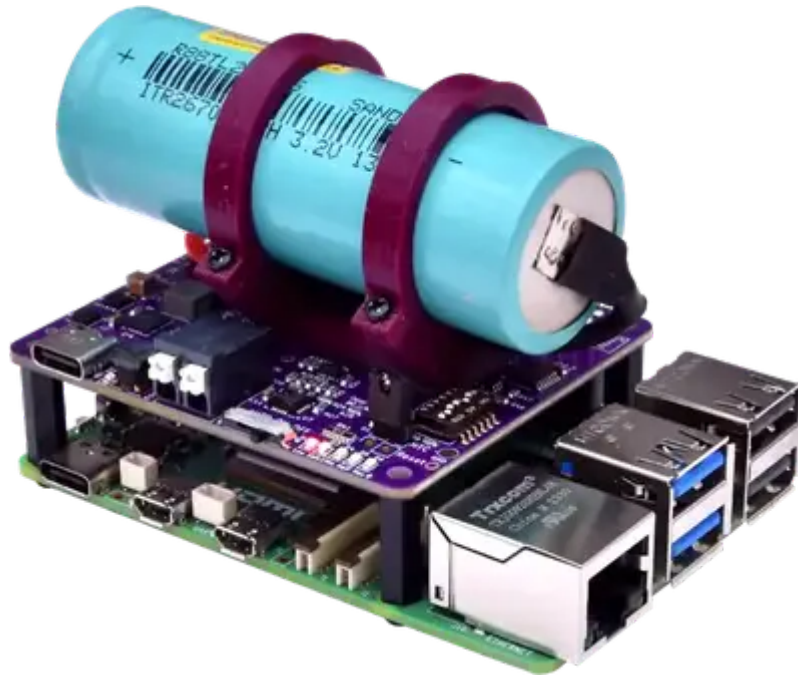


Technical Data Sheet: qUPS-P-BC v2.0

Smart Battery-Buffered UPS HAT for Raspberry Pi

Official Product Page: <https://aqex.eu/qups-p-bc-raspberry-pi-ups-hat-with-battery.html>



1. Product Concept & Strategic Advantages

The **qUPS-P-BC** is a professional-grade uninterruptible power supply designed to provide extended backup runtimes for Raspberry Pi and other 5V DC devices. Unlike supercapacitor-based solutions, the battery-buffered topology of the qUPS-P-BC allows for hours or even days of operation during a power outage, depending on the connected battery capacity.

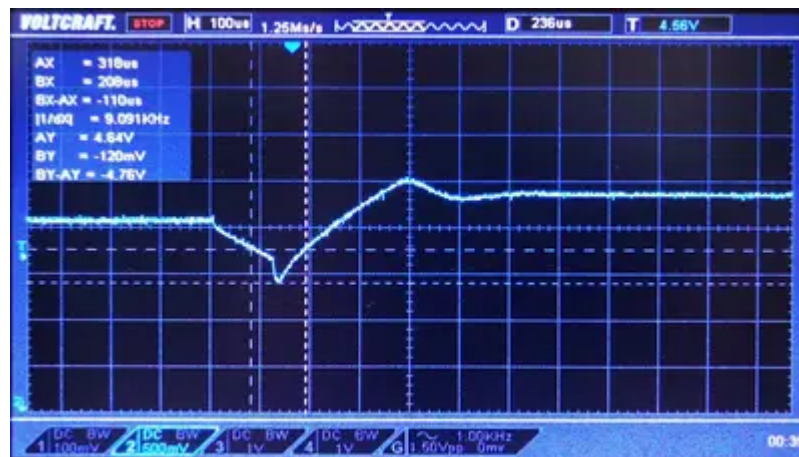
Key strategic advantages include:

- **Multi-Chemistry Support:** Native compatibility with Li-ion, Li-Po, LiFePo4, and Sodium-ion batteries.
- **Intelligent AUTO Mode:** Features "Safe-Start" logic that only powers the Pi when sufficient energy is available for a complete boot and safe shutdown cycle.
- **Industrial Input Range:** Supports high-voltage external input (up to 28V) via industrial terminals.
- **Deep Discharge Protection:** Integrated safety circuits prevent battery damage by disconnecting the load at critical voltage levels.

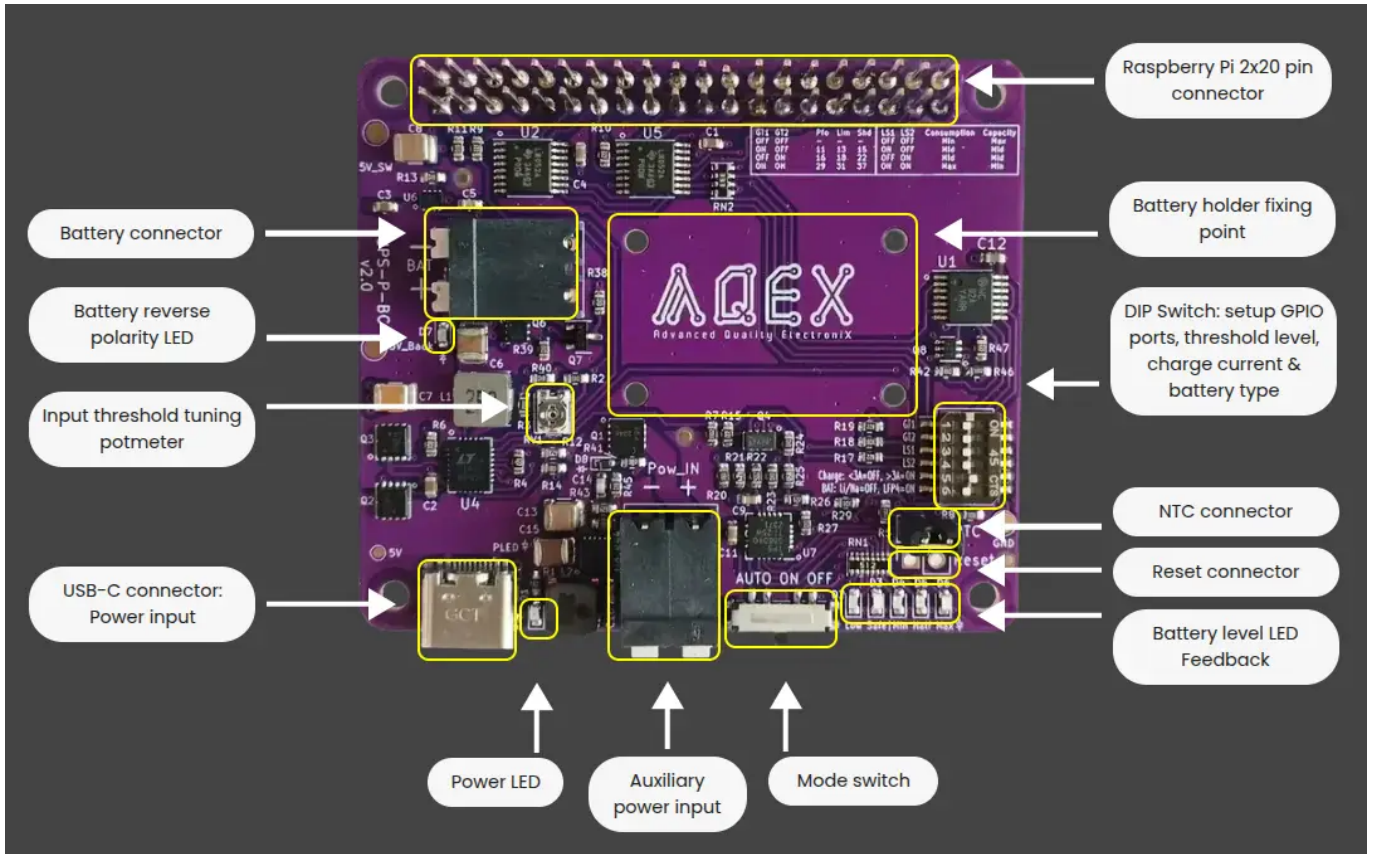
2. Comprehensive Technical Specifications

Parameter	Value	Condition / Detailed Notes
Input Voltage (USB-C)	5.0V – 5.2V	Standard 5V PSU (min. 3A recommended)
Input Voltage (Terminal)	5.2V – 28.0V DC	Polarity protected industrial input
Output Voltage	5.0V – 5.2V DC	Directly follows Pi power specifications
Max Continuous Load	3.5A (17.5W)	Optimized for RPi 4 and RPi 5
Max Battery Discharge	7.5A	Maximum current drawn from the battery
Charging Current	1A or 2A	User-selectable via DIP switch
Switchover Time	100 – 300 μ s	Near-instantaneous seamless transition

Design Note: The **Offline topology** ensures almost zero power loss and heat generation during standard operation. A momentary (<1ms) voltage transient occurs during power failure; however, the Raspberry Pi's internal regulation easily filters this, ensuring zero system instability or reboot.



3. qUPS-P-SC User Interfaces and Indicators



4. Supported Battery Technologies & Charging

Battery Type	Nominal Range	Charging Temp. Range
Li-Ion / Li-Po	3.0V – 4.2V	0°C to +40°C
LiFePo4	2.5V – 3.6V	-20°C to +60°C
Sodium-ion	1.8V – 4.0V	-30°C to +60°C

Design Note: For industrial environments or extreme temperatures, **LiFePo4** or **Sodium-ion** chemistry is highly recommended due to superior thermal stability.

5. GPIO Communication & DIP Switch Setup

The qUPS-P-BC features a flexible **GPIO Bank Selection** system via onboard **GT1-GT2 DIP switches** to prevent hardware conflicts with other HATs.

GT1 Switch	GT2 Switch	Power Good (PFO)	Battery Limit (LIM)	Shutdown (SHD)
OFF	OFF	Disabled	Disabled	Disabled
ON	OFF	GPIO 17 (Pin 11)	GPIO 27 (Pin 13)	GPIO 22 (Pin 15)
OFF	ON	GPIO 23 (Pin 16)	GPIO 24 (Pin 18)	GPIO 25 (Pin 22)
ON	ON	GPIO 5 (Pin 29)	GPIO 6 (Pin 31)	GPIO 26 (Pin 37)

- **PFO (Power Fail Out):** HIGH = External Power OK / LOW = Backup Mode active.
- **LIM (Limit):** Signals that the battery has reached the "Safe" threshold (Yellow LED).
- **SHD (Shutdown):** Handshake signal. Pull LOW after OS halt to cut output power.

6. Visual Diagnostics (LED Group)

LED	Color	Status / Meaning
External Power	Green	Primary power source detected on input.
Bad Polarity	Red	CRITICAL: Battery connected with reverse polarity!
Max	Green	Battery fully charged.
Min	Green	Sufficient energy for Boot + Shutdown cycle.
Safe	Yellow	Critical threshold; initiate OS shutdown.
Low	Red	Battery depleted. Power-off is imminent.

7. Intelligent Power Management (IPM)

- **Safe-Start Logic:** In AUTO mode, the Pi only boots when the "Min" threshold is reached.
- **Anti-Reboot Loop:** Prevents "zombie" restart cycles during brownouts.
- **Threshold Tuning:** A precision potentiometer allows manual calibration of the power-fail detection level to compensate for voltage drops in long cables.

8. Estimated Runtimes (4000mAh LiFePo4)

Raspberry Pi Model	No Load [min]	50% Load [min]	100% Load [min]
Raspberry Pi 2	530	365	280
Raspberry Pi 3	450	250	220
Raspberry Pi 4	312	190	144
Raspberry Pi 5	304	168	114

**Note: Final runtimes are dependent on battery capacity, age, and ambient temperature.*

9. Scalability & Software Support

- **Software Support:** Native **qups-guard** daemon (C/Python) for automated safe shutdown.
- **Repository:** github.com/aqexhu/qups-guard

HW Version: 2.0 | **Released:** 2024

Manufacturer: AQEX Electronics | aqex.eu