M.2 UPS PMH

Technical Specifications

Standard and Advanced models for Raspberry Pi 5
Revision 2.0 | 25 October 2026

This specification describes the fitted hardware and the functions available with application V8B5. The two models share the UPS and M.2 storage functions; Advanced adds power inputs and application connections. Use the matching Linux tools and follow the installation manual before commissioning.

Host and M.2 interface

Feature	Standard PM_590	Advanced / Passive PoE PM_591
Compatible host	Raspberry Pi 5	Raspberry Pi 5
Board dimensions	85 × 56 mm	85 × 56 mm
HAT identification EEPROM	Not fitted	Not fitted
M.2 connection	PCIe M-key through 16-contact Pi FPC cable	PCIe M-key through 16-contact Pi FPC cable
SSD lengths	2230 / 2242 / 2280	2230 / 2242 / 2280
SSD height reference	3.2 mm from the supplied mechanical specification; verify assembly clearance	3.2 mm from the supplied mechanical specification; verify assembly clearance
SSD power path	Independent battery-backed supply; 3 A capability specified for the M.2 rail	Independent battery-backed supply; 3 A capability specified for the M.2 rail
SSD reference signal	SUSCLK 32.768 kHz	SUSCLK 32.768 kHz
SSD indicators	ACT and M.2 power	ACT and M.2 power
Active cooler compatibility	Air opening aligned with the official Raspberry Pi 5 active cooler	Air opening aligned with the official Raspberry Pi 5 active cooler

M.2 rail capability and the total UPS output are different ratings. Include the Pi, SSD and all peripherals in the complete power budget. Storage performance depends on the Pi, SSD, operating system and PCIe configuration; no transfer-rate guarantee is specified here.

Software baseline: application V8B5 (0x08B5), protected bootloader V88 at 38400 bit/s, daemon v1.6, installer V08, configurator 06, monitor 0B and Web Panel V02.

Power inputs and charging

Feature	Standard PM_590	Advanced / Passive PoE PM_591
Normal USB-C supply	Via the Raspberry Pi 5 V power path	Via the Raspberry Pi 5 V power path
External DC input	Not fitted	Designated EPR input, 5–32 V DC
Passive PoE	Not fitted	Dedicated 5–32 V DC arrangement; confirm variant, injector wiring and polarity
External output capability	Not applicable	EPR conversion: 5 V, up to 5 A, subject to input power and thermal conditions
Battery backup output	5.25 V, up to 5 A continuous	5.25 V, up to 5 A continuous
Power-return startup	Supported according to normal/switch operating mode and cable qualification	Supported according to normal/switch operating mode and cable qualification
Backup connections	Cable source or one 18650 cell; one source at a time	Cable source or one 18650 cell; one source at a time
Supported profiles	LiPo, Li-ion, $LiFePO_4$ and designated supercapacitor	LiPo, Li-ion, $LiFePO_4$ and designated supercapacitor
Supercapacitor option	4000 F / 4.2 V designated module	4000 F / 4.2 V designated module
Maximum charge current	580 mA	1.1 A
Charge-current range	100–580 mA; automatic adaptation to available power	100 mA–1.1 A; automatic adaptation to available power
Charger permission	Runtime enable/disable; permission does not guarantee charging current	Runtime enable/disable; permission does not guarantee charging current
Auxiliary backed supplies	Not fitted	3.3 V / 200 mA and 5 V / 200 mA

Use a source with suitable chemistry, charge acceptance, protection and continuous discharge capability. A 650 mAh high-current LiPo is one documented assembly option; the ordered backup source is not defined by this document. Do not connect the cable battery and an 18650 cell simultaneously.

Passive PoE is not IEEE 802.3af/at/bt PoE. Apply more than 5 V only to the designated Advanced EPR or passive-PoE power input. Charging competes with the running system for available input power. Runtime depends on usable source energy and load; a firmware timer does not establish battery capacity.

Application connections

Feature	Standard PM_590	Advanced / Passive PoE PM_591
Routine host interface	I²C on bus 1	I²C on bus 1
Default banks	0x68 RTC; 0x69 status; 0x6B commands	0x68 RTC; 0x69 status; 0x6B commands
External ADC	Not fitted	One shared 12-bit buffered ADC measurement; software-filtered reading
EXT0 range	Not fitted	P2 pin 11, 0–5.2 V
EXT1 range	Not fitted	P2 pin 12, 0–32 V
ADC connection rule	Not applicable	Connect EXT0 or EXT1 only; leave the unused input open
ADC scaling hardware	Not applicable	R75 = 1.00 kΩ; scale factors 2.4 for EXT0 and 20.6 for EXT1
ADC selection	Not applicable	Saved selector 0x6B:0x08; 0 EXT0, 1 EXT1
ADC voltage result	Not available	0x69:0x12 word, packed BCD in 0.01 V units; display resolution is not an accuracy guarantee
Protected 1-Wire	Not fitted	ESD-protected connector linked to Pi GPIO4; Linux w1-gpio/w1-therm setup required
DS18B20 software	No dedicated M.2 sensor connector	English 1-Wire reader, monitor 0B and web panel support detected sensors
Application KEY and IR	Use only documented Standard connections where available	Application KEY input and compatible IR receiver interface; decoding requires application software
Serial interface	Pi serial pins are used by the protected updater as configured	3.3 V logic-level serial/application connections; ± RS-232 requires a level converter

The two analogue terminals feed one measurement path. Range selection changes the conversion scale, not physical routing. R75 must match the documented value before applying the published ranges. D13 is the analogue ESD protection; D19 belongs to UART RX and is not connected to the analogue header input.

Firmware control and RTC functions

Feature	Standard PM_590	Advanced / Passive PoE PM_591
Application firmware	V8B5 / identifier 0x08B5	V8B5 / identifier 0x08B5
Normal UPS mode	0x6B:0x0C = 0x00; mode change sets runtime to 0x01	Same
Slide-switch mode	0x6B:0x0C = 0xAA; mode change sets runtime to 0xFF	Same
Battery runtime timer	0x6B:0x01; approximately 10 + 60 × value seconds, plus startup hold	Same
Default runtime	0x01, approximately 70 seconds before timed FSSD	Same
Unlimited timer setting	0xFF removes elapsed-time limit; low-battery protection remains	Same
Shutdown grace period	0x6B:0x0F; default 30 s	Same
Pi power control	Documented button-control wiring / POGO arrangement is required	Same
LPR standby	Low-power controller standby after the completed shutdown sequence	Same
No-host-activity timeout	Default 5 min; monitoring reads count as host activity	Same
M.2 hardware RTC	DS1307-compatible I^2C bank at 0x68; battery backed	Same
RTC synchronization	Daemon v1.6: NTP-confirmed UTC synchronization, hourly after success	Same
Pi RTC backup	Dedicated supply cable from the main M.2 backup supply to Pi RTC connector	Same
Pi RTC charging	Installer sets rtc_bbat_vchg=0 for the documented externally supplied RTC arrangement	Same

The optional switch controls the operating sequence; it is not complete electrical isolation of a Pi with USB-C still attached. Startup behavior also depends on the documented Raspberry Pi EEPROM configuration. Preserve unrelated boot settings and use the current manual for the supported combination.

Linux software and automatic installation

Component	Current version and role
Automatic installer	V08. Detects recognized installations; installs/upgrades dependencies and UPS applications; keeps backups; --check performs a read-only installation check.
Heartbeat/shutdown daemon	v1.6, M2_PMH_i2c.service. 250 ms heartbeat, orderly shutdown handling, 5-second Pi temperature/fan telemetry and NTP-confirmed RTC synchronization.
Terminal configurator	06, M2_PMH_config_06.py. Version-matched, supported settings with review and confirmation.
Terminal monitor	0B, M2_PMH_status_0B.py. V8B5 map, selected external ADC and detected DS18B20 readings where available.
1-Wire helper	M2_PMH_1wire.py. English DS18B20 reading with CRC checks; Linux 1-Wire must be enabled separately.
Optional browser panel	Web Panel V02. Responsive monitoring and supported configuration; separate installer and accounts.
UART updater	M2_PM_UPS_BL01D.py, used with protected V88 at 38400 bit/s.

Install or upgrade from the customer package

```
cd ~
unzip -o M2_UPS_PMH_Customer_V8B5.zip
cd ~/M2_UPS_PMH_Customer_V8B5/installer
sudo python3 install_M2_UPS_PMH.py --upgrade
```

Keep cable power connected. The installer backs up recognized previous files and stops for unknown service conflicts. It configures Linux; it does not flash the MCU or choose a new battery chemistry. Reboot only when requested, then run:

```
cd ~/M2_UPS_PMH_Customer_V8B5/installer
sudo python3 install_M2_UPS_PMH.py --check
```

Open the installed command-line tools

```
sudo python3 /opt/M2_UPS_PMH/M2_PMH_status.py
sudo python3 /opt/M2_UPS_PMH/M2_PMH_config.py
```

The matching tools reject incompatible register maps. Do not use old V8B2 scripts for V8B5. Install the optional web panel only after the main UPS service is running.

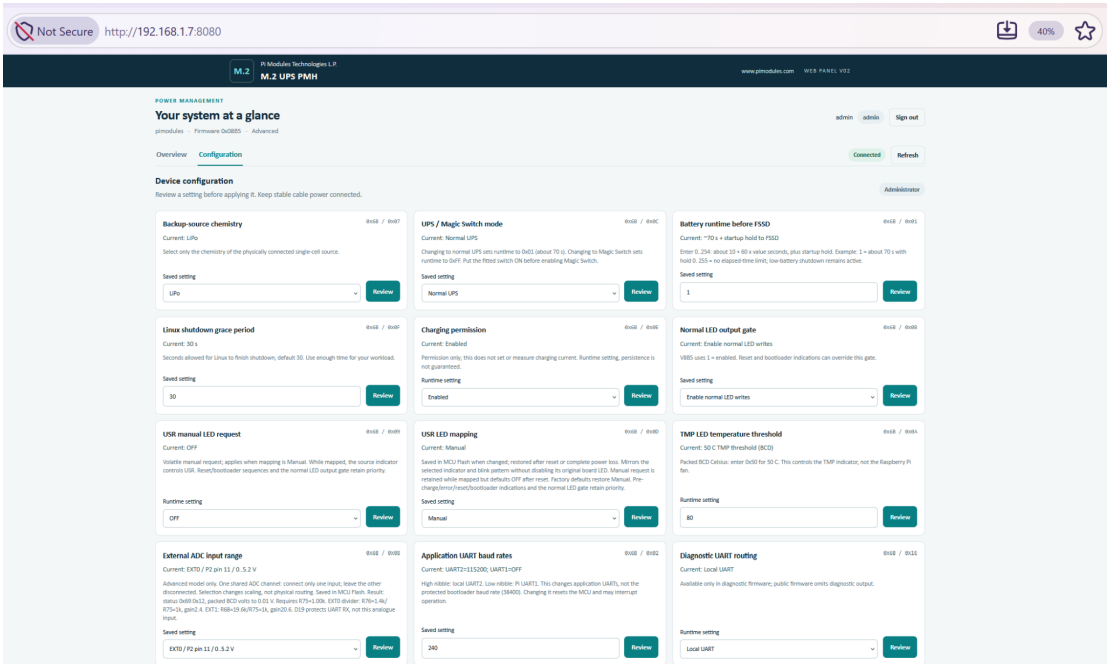
Web panel and private Internet access

Web Panel V02 runs on the Raspberry Pi and is accessible from modern Android, iOS, Windows, Linux and macOS browsers. Local and private remote connections use the same service on TCP port 8080 and the same panel accounts.

Capability	Implemented behavior
Local browser access	http://<Pi-LAN-IP>:8080 on the local network.
Private Internet access	Tailscale on the Pi and client, joined to the same authorized private network; http://<Pi-Tailscale-IP>:8080.
Readings	Power mode, battery voltage, UPS RTC, Pi CPU temperature, Linux fan state; Advanced external ADC and DS18B20 sensors when enabled.
Configuration	Administrator allowlist based on configurator 06: review, confirm YES, apply and verify. Viewer accounts do not write.
Refresh and activity	Typically 5-second refresh while an authenticated visible client polls. Reads count as host activity.
Scope	No browser firmware flashing, arbitrary register editor, public router exposure or remote start of an unpowered Pi.

```
cd ~/M2_UPS_PMH_Customer_V8B5/web_panel
sudo python3 install_webpanel.py --with-tailscale
```

Open the current authentication link printed in SSH to authorize the Pi. Install Tailscale on the remote phone or computer and join the same authorized network. The Tailscale identity and panel username/password are separate. The panel installer retains existing panel accounts during upgrades. The initial admin password is entered visibly and must contain at least 8 characters.



Actual Web Panel V02 configuration view. Interface-specific options depend on the assembly.

The Pi must remain powered, running the panel and online. Do not forward port 8080 publicly. Another active VPN can prevent Tailscale connectivity; diagnose its policy and routing without disabling unrelated protections.

Status and command interface

Use the V8B5 register map. Byte and word fields have different widths; multi-byte values use the documented order. Status readings do not prove that every reserved or historical slot contains an active measurement.

Bank and offset	Access	Meaning
0x69:0x30 word	Read Only	Firmware identifier: 0x08B5.
0x69:0x00 byte	Read Only	Accepted mode: 0xF0 battery; 0xF1 cable.
0x69:0x06 word	Read Only	Battery voltage, packed BCD in 0.01 V units.
0x69:0x08 word	Read Only	Pi supply voltage, packed BCD in 0.01 V units.
0x69:0x12 word	Read Only	Selected Advanced external ADC voltage; 0xFFFF unavailable.
0x69:0x16 byte	Host telemetry	Pi CPU temperature, packed BCD Celsius; 0xFF unknown.
0x69:0x19 byte	Host telemetry	Linux fan state: 0 OFF, 1 ON, 0xFF unknown; not RPM feedback.
0x69:0x0C / 0x0E / 0x10	Read Only	PAC1720 channel 1 current, signed power field and voltage. Respect units and calibration.
0x6B:0x00 byte	Daemon handshake	Heartbeat and shutdown interaction; leave ownership to the running service.
0x6B:0x07 byte	Read/write saved	Backup profile: L LiPo, I Li-ion, F $LiFePO_4$, C designated supercapacitor.
0x6B:0x08 byte	Read/write saved	Advanced ADC selector: 0 EXT0, 1 EXT1.
0x6B:0x09 byte	Read/write volatile	Manual USR request: 0 OFF, 1 ON; applies when mapping is Manual.
0x6B:0x0D byte	Read/write saved	USR source: 0 Manual, 1 SYS, 2 BAT, 3 TMR, 4 FAN, 5 TMP.
0x6B:0x0E byte	Read/write runtime	Charging permission: 0 disabled, 1 enabled when conditions permit.

```
sudo i2cget -y 1 0x69 0x30 w
```

The monitor and web panel do not infer battery state of charge from voltage or treat charger permission as measured charging current. The PCB temperature slot is raw; no active conversion is guaranteed by the current map. Consult the full manual and REGISTER_MAP_V8B5.csv for all fields.

Indicators firmware recovery and integration

Feature	Standard PM_590	Advanced / Passive PoE PM_591
User LED	White USR; manual request or Flash-saved SYS/BAT/TMR/FAN/TMP source mapping	Same; external ULED available at P2 pin 5
External LED connection	Documented soldered-wire arrangement; on-board R7 = 3.6 kΩ	USR_LED_H at P2 pin 5; on-board R7 = 3.6 kΩ; documented ground return
Other board indicators	ACT, M.2, SYS, BAT, CHG, TMR, FAN, TMP	Same core indicators plus EPR where fitted
Temperature and fan indicators	Daemon supplies Pi temperature and fan state. TMP threshold does not control cooling.	Same
Protected bootloader	V88 UART, 38400 bit/s; separate from application UART baud setting	Same
Bootloader entry	Documented RESET + FSSD button sequence or supported software entry; cable-powered procedure	Same
Idle loader window	15 seconds for a normal requested loader session; transfer/recovery state determines continued loader operation	Same
Update verification	Application Flash readback and CRC32 verification through supplied updater	Same
Interrupted update	Protected recovery remains available; successful completion activates the application	Same
Cold recovery startup	Loader starts Pi once during the specified cold/brownout recovery of an incomplete application write	Same
PCB construction	Four layers, 2 oz copper, 6 mil track/gap, immersion-gold finish, lead-free assembly, thermal vias and cooler opening	Same
Power-path protection	Fitted PPTC and documented 5 V power-path / battery protection; use the specified source and polarity	Same, with documented EPR/passive-PoE ESD and reverse-polarity protection
Assembly identification	Model and PCB identification are separate from application and protected-loader versions	Same
Enclosure and accessories	Dedicated system enclosure, matching battery cap, RTC cable and supported controls	Same; check application-header cable exits and fitted input parts

Pi power-button control is a documented transistor/POGO arrangement, not an independent processor hard-reset input. Continuous USB-C power is still electrically present when the Pi is in standby. Backup-source protection and power-input ratings do not make signal headers tolerant of arbitrary voltage.

The supplied daemon does not implement email broadcasting, IR decoding or a general event scheduler. Reserved register slots and hardware interfaces must not be advertised as completed software functions. Application-specific extensions require corresponding software and connector checks.

Reference: M2_UPS_PMH_Manual_V99, Customer/Resources V8B5 packages and the matching register map. Product and assembly revisions are distinct from firmware identifiers. Raspberry Pi is a trademark of Raspberry Pi Technologies L.P.