DC-UPS-2CH

Backup power supply for networking equipment

TECHNICAL PASSPORT
USER MANUAL
SERVICE INSTRUCTIONS
WARRANTY CARD

Model:	DC-UPS-2CH v2.1
Firmware version:	2026.09.02-v6
Document revision:	2026-09-04 / 190fc6b
Serial number:	_____
Date of manufacture:	_____
Manufacturer / integrator:	_____
Contact:	_____

This document is intended for the owner of the unit and for scheduled maintenance.
Keep together with the device. Applies to firmware 2026.09.02-v6 (build 190fc6b, 2026-09-04).

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1. General information

1.1. Purpose

DC-UPS-2CH is a dual-channel DC backup power supply for networking and low-current equipment. The device is intended to keep a Wi-Fi router, an ONT / optical terminal, a modem or any other compatible load running when 230 V mains is interrupted.

The unit combines an internal 24 V AC/DC brick, a charge converter, a sealed 12 V battery, two independent output DC/DC channels and an ESP32 controller. The controller monitors mains and battery, drives the two outputs, keeps an event log, performs automatic connectivity recovery and exposes a web interface.

1.2. Main functions

- automatic mains-to-battery transition without manual switching;
- float charging with a current limit;
- two independent managed output channels: ROUTER and ONT;
- low-voltage disconnect protection (LVD) for the battery;
- emergency deep sleep for the controller after the load is dropped;
- periodic mains-return probe during emergency deep sleep;
- separate Shelf Sleep mode: both outputs and Wi-Fi off, wake only by physical button;
- Wi-Fi and internet reachability monitoring;
- automatic power-cycle of output channels on connectivity failure;
- local web interface;
- mDNS address `http://dc-ups.local/`;
- service access point `DC-UPS-Setup`;
- ntfy push notifications;
- read-only commands through the same ntfy topic: `!ups`, `!ups status`, `!ups ping`;
- RAM event log with persistent tail across reboots;
- local tact button: status, setup AP and Shelf Sleep;
- mains and battery indication LEDs.

Important

Dangerous 230 V mains voltage is present inside the enclosure. Disassembly, adjustment and replacement of internal components are only permitted with the mains supply and the battery disconnected.

2. Technical specifications

2.1. Main parameters

Parameter	Value
Product type	Dual-channel DC UPS for low-current equipment
Mains input	230 V AC, 50 Hz
Intermediate bus	24 V DC from the internal AC/DC module
Battery rating	12 V, 7 Ah, sealed AGM/SLA
Installed battery model	_____
Float charge voltage	13.8 V at the battery terminals (trimmable)
Charge current limit	1.5 A
Charger DC/DC module	XL4016 CC/CV or an installed equivalent
Number of outputs	2 independent channels
Output DC/DC modules	2 × XL6009 buck-boost or an installed equivalent
Controller	ESP32
Firmware version at release	2026.09.02-v6
Battery sensing	ADC, GPIO35, divider 100 kΩ / 10 kΩ
24 V rail sensing	ADC, GPIO34, divider 100 kΩ / 10 kΩ
ROUTER channel	GPIO32 → NPN 2N2222 → P-MOSFET
ONT channel	GPIO25 → NPN 2N2222 → P-MOSFET
Service button	GPIO14, short to GND, INPUT_PULLUP; RTC GPIO / EXT0 wake in Shelf Sleep
Mains LED	GPIO13
Battery / fault LED	GPIO12
P-MOSFET gate pull-up	10 kΩ gate–source (per the current schematic)
P-MOSFET model	IRF9Zxx / actually installed: _____
Battery fuse	recommended 5 A, mounted directly at the positive terminal

2.2. Output parameters for this unit

Channel	Purpose / connected device	U, V	I nom, A	I max, A
ROUTER	_____	_____	_____	_____
ONT	_____	_____	_____	_____

Note on output current

The maximum permissible current of each output is determined by the actual DC/DC module installed, its cooling, wiring, connectors and the P-MOSFET. Before handover the values must be established from a load test and recorded both in the table above and on the enclosure label. Do not use the “advertised maximum” of the XL6009 module as the label value.

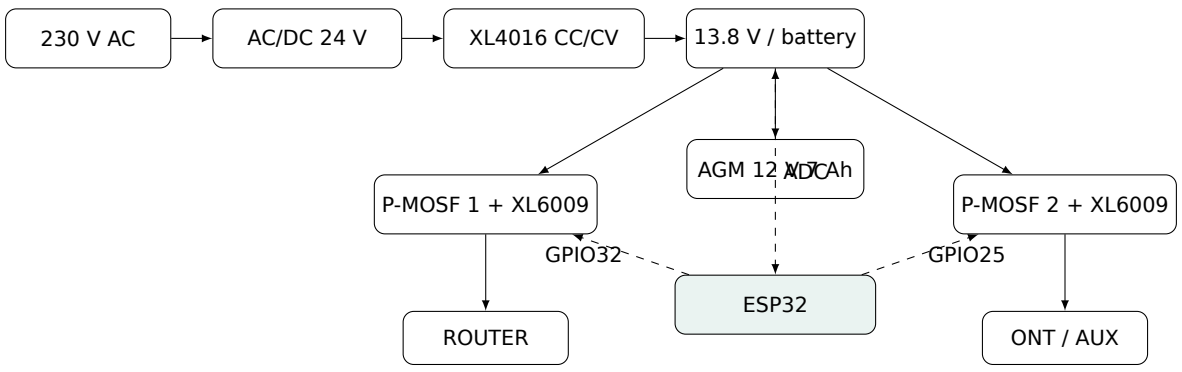
2.3. Protection thresholds

Function	Default	Purpose
Battery early warning	11.5 V	Notification of an approaching discharge
LVD / load disconnect	11.0 V	Cuts ROUTER and ONT when mains is absent
Post-LVD recovery	12.5 V	Allows re-enable after battery recovery
Fallback low-voltage sleep	10.8 V	Second layer of low-voltage protection
Delay before deep sleep	30 s	Time to finish notifications and settle state
Wake period in emergency sleep	30 s	Checks 24 V rail and battery state
Shelf Sleep / storage mode	no periodic timer	Wake only by GPIO14 button (EXT0)
“Mains present” hysteresis high	above 15.0 V on the 24 V rail	Upper hysteresis threshold
“Mains lost” hysteresis low	below 10.0 V on the 24 V rail	Lower hysteresis threshold
Mains debounce	3 s	Suppresses spurious transitions

All values above (except hardware-fixed ones) can be changed from the web interface. The values in this document match firmware defaults.

3. Structure and principle of operation

3.1. Simplified block diagram



3.2. Normal mode

With mains present the internal AC/DC module produces 24 V. The XL4016 charger steps it down and holds the battery-side bus at the trimmed 13.8 V with a total current limit of 1.5 A. The load and the battery are powered from a shared bus behind a blocking diode according to the specific build.

3.3. Battery mode

When the 24 V rail collapses the battery automatically becomes the source for the shared bus. No separate transfer relay is required. The controller detects the mains loss, keeps the enabled channels powered and sends a notification if a network path is available.

3.4. Deep-discharge protection

While running on battery the controller compares the battery voltage with the configured thresholds. When LVD is reached both outputs are shut off. Re-enable is not allowed until either the recovery threshold is reached or the mains returns.

After LVD and load release, the controller waits the configured delay and then enters **emergency deep sleep**. The controller does not wait for a second dip on the unloaded battery “bounce”. In this mode the ESP32 only wakes on a timer to measure battery voltage and the 24 V rail. Full boot happens only when the mains returns or when the battery recovers above the re-enable threshold.

3.5. Two sleep modes

Emergency deep sleep is entered automatically on low battery with the mains absent. Both outputs are off, Wi-Fi is off, the controller wakes on a timer (30 s by default), quickly measures the battery and the 24 V rail, and sleeps again if recovery conditions are not met.

Shelf Sleep is entered only from a long service-button hold. Both outputs, Wi-Fi, mDNS and the setup AP are shut down and the wake-up timer is disabled. The only wake source is the physical button on GPIO14 via EXT0. Restoring 230 V mains **does not** bring the device out of Shelf Sleep — the button must be pressed.

4. Controls and indication

4.1. LEDs

Indicator	Purpose
Green, GPIO13	Indicates external power / mains state
Red, GPIO12	Indicates battery state, warning or emergency mode

Additional patterns:

- green blinking at ≈2 Hz — the ESP32 has booted and is trying to join Wi-Fi;
- both LEDs alternating slowly (500 ms each) — the setup AP is active.

4.2. Service button on GPIO14

The button is wired between GPIO14 and GND. The internal `INPUT_PULLUP` is used in normal operation. GPIO14 is chosen because it is also an RTC GPIO usable for EXT0 wake from Shelf Sleep.

Gesture	Function
One short press	Send the full current status to the configured ntfy topic. On success the green LED blinks 2 times; if Wi-Fi / ntfy is unreachable the red LED blinks 3 times.
Double press	Open `DC-UPS-Setup` for about 15 minutes. Acknowledged by a short simultaneous flash of both LEDs.
Hold for 10 s	Enter Shelf Sleep. Before shutdown the red LED blinks 3 times; then ROUTER and ONT are shut off, Wi-Fi goes down and the ESP32 sleeps with no periodic timer.
Press while in Shelf Sleep	Wake the device. The held press is ignored until release, after which a normal start-up runs.

Important: Shelf Sleep

In Shelf Sleep the device **does not** wake on the return of 230 V mains. It intentionally stays off until the button is physically pressed. This is a long-term storage / transport mode, not an emergency battery mode.

4.3. Manual output switches

If separate mechanical switches for ROUTER and ONT are installed on the enclosure, they act as local hardware disconnects for the corresponding output. Their state has priority at the electrical level: software cannot restore power while a mechanical switch is open.

5. Web interface and networking

5.1. Access

With a normal LAN connection the panel is available at:

`http://dc-ups.local/`

It is also reachable at the IP address issued by the router. On every successful Wi-Fi connection the firmware may publish the current IP to ntfy.

5.2. Service access point

Default SSID: `DC-UPS-Setup`.
Default password: `dc-ups-setup`.
Both parameters can be changed by the owner through the web interface.

Recommendation

The setup-AP password and the web admin password should not be printed on the outside label. Deliver them separately and change them at commissioning.

5.3. Bidirectional ntfy

In addition to outgoing notifications the firmware polls the same ntfy topic periodically (roughly every 15 s) and accepts only safe, read-only status commands:

```
!ups    !ups status    !ups ping
```

The `!ups` and `!ups status` commands send the full status. The `!ups ping` command answers with “PONG” and the same set of parameters. The reply includes battery voltage, 24 V rail, mains state, ROUTER/ONT, internet, recovery, uptime, outage count, RSSI, IP and the mDNS address.

Remote enable/disable of the outputs through ntfy is **not implemented** on purpose: the topic is intentionally a read-only status channel. Commands only work while the ESP32 is awake, connected to Wi-Fi and has access to ntfy. In Shelf Sleep and in emergency deep sleep the Wi-Fi radio is off, so commands are unavailable.

ntfy security

The topic name is effectively a secret URL. Use a long, hard-to-guess name and do not print it on the outside label.

5.4. Available panel features

- battery voltage and 24 V rail;
- mains presence;
- ROUTER and ONT states separately;
- ON / OFF / AUTO mode per channel;
- independent restart of ROUTER and restart of ONT;
- joint restart of both channels;
- Wi-Fi state and RSSI;
- internet-check state and auto-recovery status;
- emergency-sleep state and parameters;
- Shelf Sleep and service-button reference;
- ADC calibration against a multimeter;
- Wi-Fi, ntfy and protection settings;
- help on inbound ntfy commands;
- event log;
- manual ESP32 reboot.

6. Automatic connectivity recovery

The firmware distinguishes between Wi-Fi loss and loss of internet reachability. Typical logic:

1. If the ESP32 is not associated with Wi-Fi after the allowed waiting period, a reconnect is attempted.
2. On persistent Wi-Fi failure the ROUTER channel is power-cycled first.
3. If Wi-Fi is up but the internet is unreachable, the ONT channel is power-cycled first.
4. On continued failure the next recovery cycle is allowed, including a joint power-cycle of both channels.
5. The number of automatic power cycles is capped to avoid endless equipment toggling.
6. After a long period of stable connectivity the auto-recovery counters are reset.
7. On low battery all automatic power cycles are inhibited to preserve residual charge.

7. Installation and commissioning

7.1. Pre-flight

Before the first power-up or after servicing:

1. Check the battery polarity.
2. Check the presence and rating of the battery fuse.
3. Check that no wires and no live parts are loose.
4. With a multimeter, set and verify the output voltage of every XL6009 **before** connecting a load.
5. Confirm that the DC connector polarity matches the connected equipment.
6. Confirm that the ROUTER and ONT voltages are recorded in the passport and on the label.
7. Apply 230 V and check the voltage at the battery terminals.
8. Verify the mains-to-battery transition by briefly disconnecting 230 V.

7.2. Acceptance test before handover

Check	Result	Note
Battery charge voltage 13.8 V	☐ yes ☐ no	
ROUTER ON/OFF/AUTO	☐ yes ☐ no	
ONT ON/OFF/AUTO	☐ yes ☐ no	
Restart ROUTER from the panel	☐ yes ☐ no	
Restart ONT from the panel	☐ yes ☐ no	
Mains → battery transition	☐ yes ☐ no	
LVD	☐ yes ☐ no	
Emergency deep sleep and periodic wake-ups	☐ yes ☐ no	
Mains return after emergency deep sleep	☐ yes ☐ no	
Shelf Sleep: entry by 10 s hold	☐ yes ☐ no	
Shelf Sleep: wake only by button	☐ yes ☐ no	
Button: 1x status / 2x setup AP	☐ yes ☐ no	
Wi-Fi / mDNS	☐ yes ☐ no	
ntfy: outgoing notifications	☐ yes ☐ no	
ntfy: `!ups status` / `!ups ping`	☐ yes ☐ no	
Load test on both channels	☐ yes ☐ no	

8. Disassembly and battery replacement

Hazardous voltage

Before removing the cover always disconnect the unit from 230 V mains, unplug the mains cord, disconnect the load and open the battery circuit. Even with the mains removed the battery remains an energy source capable of delivering high short-circuit currents.

8.1. Procedure

1. Disconnect 230 V and make sure the mains inlet is physically detached.
2. Turn off the external ROUTER and ONT loads.
3. Remove the cover following the illustrations in Section 8.3.
4. Remove the battery fuse or connector.
5. First disconnect the terminal called out by the service diagram of the specific build; keep the tool from bridging “+” to the case / “-”.
6. Disconnect the second terminal and take the battery out.
7. Install a new AGM/SLA battery 12 V 7 Ah of a compatible size and terminal type.
8. Connect polarity strictly by the marking: red cable to “+”, black cable to “-”.

9. Reinstall the fuse, check the voltage with a multimeter, and reassemble the enclosure.
10. Perform a control mains → battery transition.

8.2. Replacement battery requirements

- nominal voltage 12 V;
- AGM/SLA (sealed lead-acid) technology;
- nominal capacity 7 Ah or another value permitted by the enclosure and the charge regime;
- compatible dimensions, terminal layout and terminal type;
- no bulging, cracks or leakage marks.

8.3. Service images and 3D model

Assembly views are exported from the public Onshape model (see the 3D-model subsection in the project README). The full STEP files live in `hardware/enclosure/step/` in the repository.

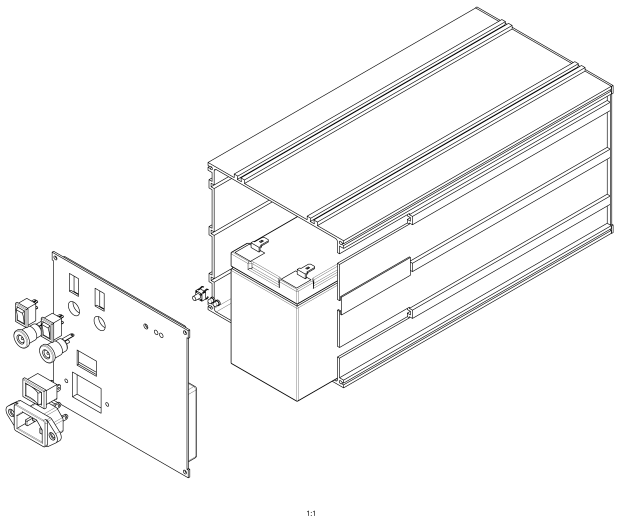


Figure 1. Exploded view — front side: aluminium extrusion enclosure, AGM 12 V 7 Ah battery installed inside, front panel with IEC C14 mains inlet, power switch and two DC output receptacles displaced to the left.

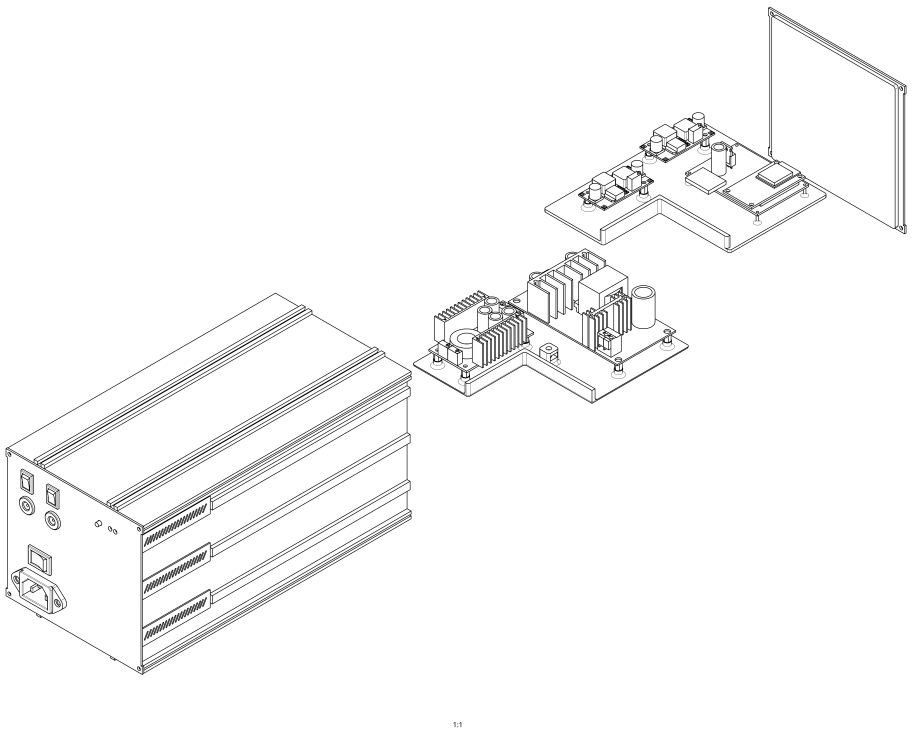


Figure 2. Exploded view — rear side: enclosure with the controls installed, rear panel removed, two-tier PCB assembly with the XL4016 charger, two XL6009 DC/DC modules and the ESP32 board displayed.

Figure 3. Cover fasteners / clips and disassembly direction

Insert screenshot / image

Figure 4. Position of the fuse and battery terminals

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Figure 5. Removal and installation of the battery

Insert screenshot / image

Figure 6. Close-up of XL4016, ESP32, both XL6009 and the power channels

Insert screenshot / image

9. Maintenance

Recommended interval: once every 3–6 months, and additionally after any prolonged outage or after the autonomous runtime shortens noticeably.

- visual inspection of the enclosure and cabling;
- check for heat, smell, discoloration or component deformation;
- terminal-torque check with the unit de-energised;
- battery charge voltage at the terminals;

- voltage on both outputs;
- battery-mode test;
- LVD and recovery test;
- check battery condition and installation date;
- review the event log and outgoing ntfy notifications;
- verify the reply to `!ups status`;
- verify Shelf Sleep entry and button wake.

9.1. Expected battery service life

The life of a sealed lead-acid battery depends on temperature, depth and frequency of discharge and the quality of the float charge. The battery is a consumable and must be replaced when the actual autonomous runtime drops significantly, when the case deforms or when the terminal voltage becomes unstable under load.

10. Troubleshooting

Symptom	Possible cause	Action
No power on either output	OFF mode, LVD, missing battery, fuse or shared-bus failure	Check the web panel, battery voltage, fuse and terminals
No ROUTER	Channel 1 off, mechanical switch, channel-1 XL6009 or power stage	Check ROUTER mode and voltage before/after the corresponding DC/DC
No ONT	Channel 2 off, mechanical switch, channel-2 XL6009 or power stage	Check ONT mode and voltage before/after the corresponding DC/DC
Web panel not reachable	ESP failed to join Wi-Fi or the router is off	Use the service button, the setup AP and the serial port for diagnostics
Wi-Fi up, no internet	ONT / provider / WAN fault	Check the log; the device may automatically restart ONT
Battery discharges fast	Ageing battery or increased load	Measure the load current / power and run a capacity test
System went into deep sleep	Low battery after LVD with no mains	Restore 230 V and wait for the next periodic probe
Device did not start after 230 V was restored	Shelf Sleep is active	Press the service button; 230 V is intentionally not a wake source in this mode
Button caused 3 red blinks	Status could not be sent to ntfy	Check Wi-Fi, internet and topic configuration; the device continues to operate
`!ups status` does not reply	Device is sleeping, no Wi-Fi/internet or wrong topic	Wake the device if necessary; check Wi-Fi and topic; commands are polled about once every 15 s

Symptom	Possible cause	Action
Output voltage sags	XL6009 overload, poor contact, power stage or wiring	Remove the load, measure voltage across the chain, check current and heat

11. Package contents

#	Item	Note	Qty
1	DC-UPS-2CH	Main unit	1
2	Battery 12 V 7 Ah AGM/SLA	Installed in the enclosure	1
3	Passport and user manual	This document	1
4	Warranty card	Part of this document	1
5	Output power cables	_____	_____
6	Other	_____	_____

12. Certificate of acceptance

The DC-UPS-2CH v2.1 unit, serial number _____, has been assembled, tested and found fit for operation subject to compliance with this manual.

Date of manufacture: _____

Date of inspection: _____

Inspected by: _____

Signature: _____

13. Warranty card

Product:	DC-UPS-2CH v2.1
Serial number:	_____
Date of transfer:	_____
Manufacturer / integrator:	_____
Owner:	_____
Warranty period:	_____ months

The warranty covers

Manufacturing defects and internal component failures under compliance with the operating conditions, unless stated otherwise in writing at handover.

The warranty does not cover

- natural ageing and capacity loss of the battery;
- damage caused by reverse polarity, short circuits or connection of loads with wrong voltage;
- overloads beyond the ratings recorded in the passport;
- water ingress, condensation, fire, lightning or other external influence;
- mechanical damage;
- consequences of unauthorised modification of the power section or of settings beyond agreed limits;
- faults of the external router, ONT, provider network and connected cabling.

Repair record

Date	Work performed	Signature

Manufacturer’s signature: _____ Owner’s signature: _____

14. Quick reference for the owner

1. Under normal conditions no manual switching between mains and battery is needed.
2. On mains loss operation continues from the battery until the protection threshold is reached.
3. After LVD the device drops the load and enters emergency deep sleep to preserve the battery.
4. After mains return the device automatically exits **emergency** deep sleep, enables the allowed outputs and restores Wi-Fi.
5. Panel: `http://dc-ups.local/`.
6. Button: 1 short — status to ntfy; 2 shorts — setup AP for 15 minutes; hold 10 s — Shelf Sleep.
7. In Shelf Sleep the device wakes **only from the button**; restoring 230 V does not turn it on.
8. Status query through ntfy: `!ups`, `!ups status` or `!ups ping`.
9. Before connecting new equipment verify the required voltage and polarity.
10. Do not open the enclosure while 230 V mains or the battery is connected.

Quick jump to the local panel (works from the same LAN with mDNS support).