EMBEDDEDCI

BenchPod Wi-Fi bridge

Ethernet-to-Wi-Fi bridge accessory for BenchPod

Datasheet · Rev A · November 2026 · Board rev2 · US and Canada

Overview

BenchPod has no radio. The Wi-Fi bridge gives it a Wi-Fi uplink: it plugs into the pod's ETHERNET port with a short patch cord and takes 5 V from the pod's BRIDGE POWER port. The pod reaches the network through the bridge as if it were wired.

The bridge forwards the pod's traffic at layer 2, using the pod's own MAC address on Wi-Fi. The router sees the pod itself, so DHCP, mDNS and the EmbeddedCI cloud connection work as on a cable. The bridge has no IP address and no open ports.

Everything is managed through the pod: Wi-Fi setup, status and firmware updates. There is nothing to configure on the bridge itself.

Key features

- **Radio**: pre-certified Espressif ESP32-WROOM-32E-N8 module, PCB antenna, 2.4 GHz Wi-Fi
- **Security**: WPA2 and WPA3 Personal; paired with one pod; Wi-Fi passphrase sent encrypted; signed firmware
- **Transparent**: layer-2 bridge for the pod's MAC only, no IP address, no open ports, no access point mode
- **Managed by the pod**: setup from the web app or the CLI, status in the pod's status
- **Safe updates**: through the pod, signed images, automatic rollback, factory image as a fallback
- **Power**: 5 V from the pod over USB-C, about 0.8 W idle
- **Small**: 70 x 52 mm board

How it connects

```
Wi-Fi access point )))  [ Wi-Fi bridge ]  ETHERNET ======= patch cord ======= ETHERNET  [ BenchPod ]
                                            POWER (USB-C) <-- USB-A to USB-C -- BRIDGE POWER (USB-A)
```

Specifications

Radio

Parameter	Value
Module	Espressif ESP32-WROOM-32E-N8 (8 MB flash), PCB antenna
Standards	IEEE 802.11 b/g/n, 2.4 GHz
Channels	1 to 11 (2412 to 2462 MHz), US country setting
Transmit power	The module's normal maximum, set by its calibration data; never raised by the firmware
Security	WPA2-Personal, WPA3-Personal (SAE), or an open network. No WEP or WPA1
Bluetooth	Not used (off in the firmware)
Module approvals	FCC ID 2AC7Z-ESP32WROOM32E (single modular approval), ISED 21098-ESPWROOM32E

Network

Parameter	Value
Ethernet	10/100 Mbit/s, RJ45 with magnetics and link/activity LEDs (Microchip LAN8742A PHY)
Function	Layer-2 bridge for one device: the paired pod's MAC
Throughput (measured)	Pod to host 7.9 to 8.7 Mbit/s; host to pod 1.9 Mbit/s, limited by the pod's own network stack
Wi-Fi join	About 3 s
Back on the network after a bridge restart	About 10 s

Power

Parameter	Value
Input	5 V on USB-C (power only, no data), from the pod's BRIDGE POWER port
Joined, idle	0.154 A (0.77 W)
Joined, 7.9 Mbit/s traffic	0.200 A (1.0 W)
No pod for 30 s, Wi-Fi off	0.061 A (0.31 W)
Supply margin	Keeps running under full traffic down to 3.6 V input (measured)
Regulator	TLV62569 buck, 5 V to 3.3 V

Mechanical

Parameter	Value
Board	70 x 52 mm, 1.6 mm, 4 layers
Mounting holes	4x M2 (2.2 mm)
Supplied as	Bare board (plastic case planned)
Board revision	rev2, printed on the silkscreen

Ports and controls

Name	Type	Use
ETHERNET	RJ45	To the pod's ETHERNET port with the supplied patch cord
POWER	USB-C, power only	5 V from the pod's BRIDGE POWER port with the supplied USB-A to USB-C cable
PAIR	Button, board edge	Forgets the paired pod; the next pod that connects is trusted
FACTORY	Button, board edge	Hold 5 s while running: clears the Wi-Fi settings. Hold 5 s while powering up: returns to the factory firmware and clears the pairing
Programming pads	Tag-Connect TC2030	Factory programming and debug only, not a user port

The board has no status LEDs. The RJ45 LEDs show the Ethernet link, and the pod reports the bridge's state in its status and in the web app's Settings.

Getting started

1. Connect the bridge's ETHERNET to the pod's ETHERNET with the patch cord.
2. Connect the bridge's POWER to the pod's BRIDGE POWER with the USB-A to USB-C cable.
3. The pod pairs with the bridge by itself within a few seconds.
4. Set the Wi-Fi network from the web app (Settings), or from the CLI with the pod on USB:

```
benchpod set-wifi
```

The pod reports when the bridge has joined, or why it could not (network not found, wrong passphrase). Only the bridge stores the Wi-Fi settings.

Security

- **Paired with one pod.** The first pod that connects is trusted. The pairing key is agreed with X25519 and never sent over the cable. The bridge only accepts signed, replay-protected requests from that pod (HMAC-SHA256), and only from the Ethernet side, never from Wi-Fi.
- **The Wi-Fi passphrase is never in the clear.** The pod sends it encrypted (XChaCha20). No command reads it back. Production units store it with ESP32 flash encryption.
- **Signed firmware only.** The bridge installs an image only with a valid signature from EmbeddedCI's release keys. Production units also use ESP32 secure boot.
- **Nothing to attack on the network.** The bridge has no IP address, no open ports and no access point mode. It forwards frames for the paired pod's MAC address only.

Firmware updates and recovery

The pod updates the bridge automatically when a new bridge firmware comes with a pod firmware release. The bridge keeps two update slots plus a read-only factory image. A new image must prove itself by talking to the pod within 120 s, or the bridge returns to the previous image on its own.

If the bridge stops working:

1. Power-cycle it (unplug POWER, or restart the pod). A broken new image rolls back by itself.
2. Still not working: hold FACTORY, plug in POWER, keep holding 5 s, then release. The bridge starts its factory firmware with no Wi-Fi settings and no pairing.
3. The pod pairs again by itself and updates the bridge. Set the Wi-Fi network again.

Usage notes

- **Keep at least 20 cm between the bridge and people.** This is a condition of the radio module's approval.
- **US and Canada only.** The bridge is not sold in the EU or the UK.
- **2.4 GHz networks only.** The bridge does not join 5 GHz networks, WPA2-Enterprise, or captive-portal networks.
- **Indoor use, short cables.** Use the supplied patch cord and USB cable, and keep the bridge next to the pod.
- **One pod per bridge.** Press PAIR to move the bridge to another pod.
- **Do not cover the antenna.** Keep metal away from the module's antenna end.

Information for test labs

The bridge is tested mounted on BenchPod as shipped (configuration 2 of the BenchPod EMC test plan, a separate document). For testing, the bridge runs an EMC test firmware: from power-on it transmits continuously on channel 6 at 1 Mbit/s and the module's normal maximum power, without an access point, and carries the pod's test traffic on the air. Its debug console on the programming pads can change the channel, rate and power, and stop or start the transmitter.

Port classification

Port	Type	Notes
ETHERNET	Wired network port	10/100 Mbit/s, to the pod only, supplied patch cord
POWER	DC power port (input)	5 V on USB-C from the pod, supplied cable; no data
Antenna	Radio	Module PCB antenna, not removable

There is no mains port: the bridge runs from the pod's 5 V output.

Internal frequencies

Source	Frequency
Wi-Fi radio	2412 to 2462 MHz (channels 1 to 11)
ESP32 CPU	240 MHz
ESP32 module crystal	40 MHz
ESP32 module flash	40 MHz
RMII reference oscillator	50 MHz
TLV62569 buck	About 1.5 MHz switching

Radio module approvals

Region	Identifier
US (FCC Part 15C, modular approval)	FCC ID 2AC7Z-ESP32WROOM32E, granted 2020-04-10
Canada (ISED)	IC 21098-ESPWROOM32E

Host labeling: "Contains FCC ID: 2AC7Z-ESP32WROOM32E" and "Contains IC: 21098-ESPWROOM32E". The module antenna and its power settings are used unchanged.

Compliance

In progress, together with BenchPod: FCC Part 15B and ICES-003 Class B for the host, with a host-integration check of the radio module. Current status: embeddedci.com/compliance.

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