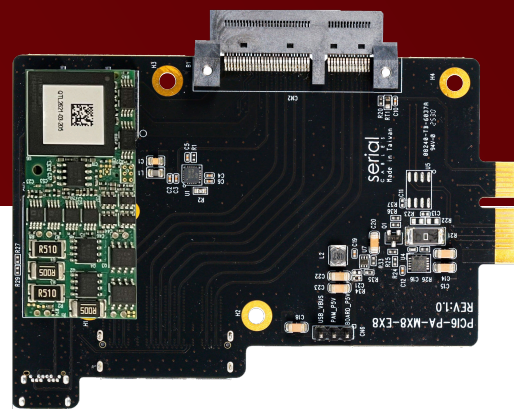




8-Bays Passive JBOF Hydra

TECHNICAL MANUAL



Modular Paddle Cards



CLI/GUI For Testing



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Product Overview

The Serial Cables Hydra is the first Gen6 JBOF solution for PCIe, NVMe, and CXL testing. Purpose-built for validation, it provides a compact 8-bay passive enclosure, engineered for precise control, reliable connectivity, and repeatable test results.

Hydra moves test setups off the open bench into a controlled environment with advanced power sequencing, airflow management, and sideband signaling. Its modular paddle card design maintains full Gen6 signal integrity while supporting direct connectivity through MCIO interfaces and CXL or NVMe drives.

Designed to integrate seamlessly into automated validation workflows, Hydra supports a Python-based UI, CLI, and API, allowing users to monitor metrics, send commands, and run test sequences programmatically. It's an automation-ready testing platform that connects effortlessly with Quarch PAM through a dedicated mezzanine board for detailed power and signal analysis – without interrupting the data path.

Key Features

- **8-Bay Passive Gen6 JBOF** – Supports PCIe, NVMe, and CXL devices with EDSFF form factors (E3.S, E3.L, U.2/U.3, and M.2 NVMe).
- **Independent Paddle Card Architecture** – Eliminates SI complications of shared backplanes and enables direct integration with Quarch PAM via mezzanine interface.
- **Advanced Power & Cooling** – 500W PSU with staggered sequencing and dual 36CFM fans with CLI speed control.
- **Telemetry & Automation Control** – Python-based GUI, CLI, and API with real-time drive power, temperature, and performance monitoring.
- **Diagnostic & Alert Functions** – Includes temperature, voltage, and current monitoring with buzzer alerts and LED fault indicators.
- **Signal & Power Analysis Ready** – Quarch PAM and Breakers integration allow detailed electrical and protocol-level diagnostics without disrupting data paths.
- **Toolchain-Agnostic Automation** – Compatible with existing test frameworks; supports automated sequences, NVMe-MI and MCTP command testing, and telemetry export for regression or compliance automation.



Safety, Handling, and Compliance

The PCIe Gen6 8-Bays Passive JBOF is designed for use in professional IT environments. Please follow all guidelines when operating or servicing the unit to ensure your drives and hardware are safe.

Electrical Safety

- Always disconnect the AC power source before installing or removing any SSD, interposer card, or internal component.
- Do not open or service the power supply unit or internal circuitry while the unit is powered.
- Use a properly grounded AC outlet and ensure the chassis is connected to system ground.

ESD Protection

- Handle all SSDs and interposer cards in an ESD-safe environment.
- Use a grounded wrist strap and avoid touching connector pins or exposed circuitry.
- Keep components in anti-static packaging until installation.

Thermal and Airflow Considerations

- Maintain unobstructed airflow at the rear exhaust vents and allow sufficient clearance around the fans.
- Operate the unit only within the recommended temperature range (0 °C – 50 °C typical).
- If fans fail or airflow is restricted, system temperature may exceed operational limits, triggering audible or LED fault indicators.

Compliance

This product is manufactured in accordance with standard international safety and environmental regulations:

- **CE** – Conforms to applicable European EMC and low-voltage directives.
- **FCC Class A** – Intended for use in commercial or industrial environments.
- **RoHS 3** – Compliant with the Restriction of Hazardous Substances directive.

Packing List

Verify all components are included before installation:

1. PCIe Gen6 8-Bays JBOF enclosure
2. AC power cord
3. Power cord clip for PSU
4. Screws and copper pillars (for M.2 SSD installation)
5. Screws for interposer cards (U.2 / U.3 / E3 SSDs)

1



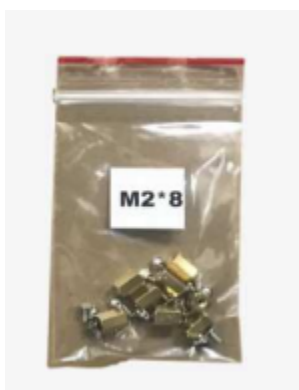
2



3



4



5



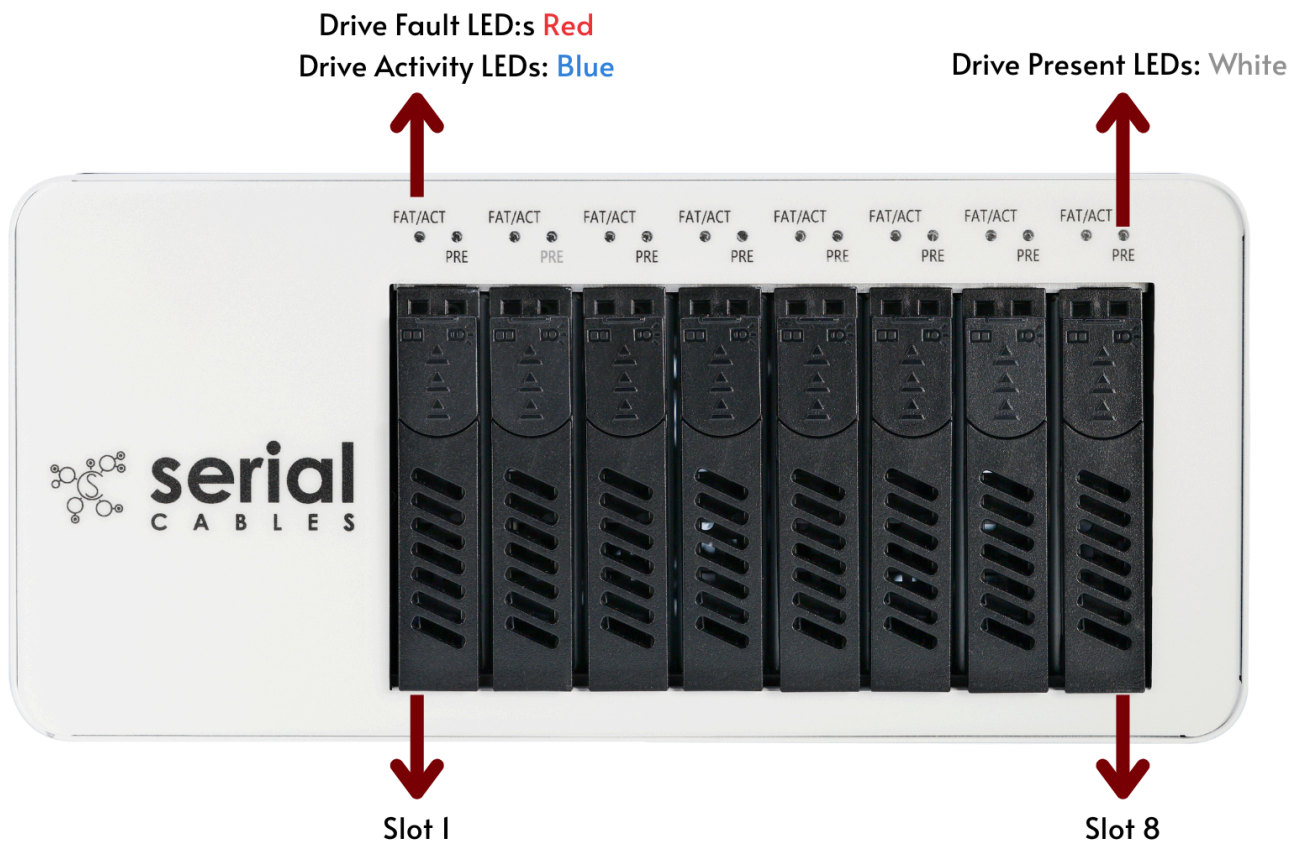
Hardware Overview

The PCIe Gen6 8-Bay Passive JBOD enclosure provides eight independent NVMe drive bays in a compact, serviceable chassis. Each bay connects directly to a host through an MCIO x8 interface and is monitored by the onboard MCU for power, status, and temperature.

Front View

There are eight **front-access drive bays**, numbered left to right from Slot 1 to Slot 8. Each bay includes individual status LEDs that indicate the state of the installed drive:

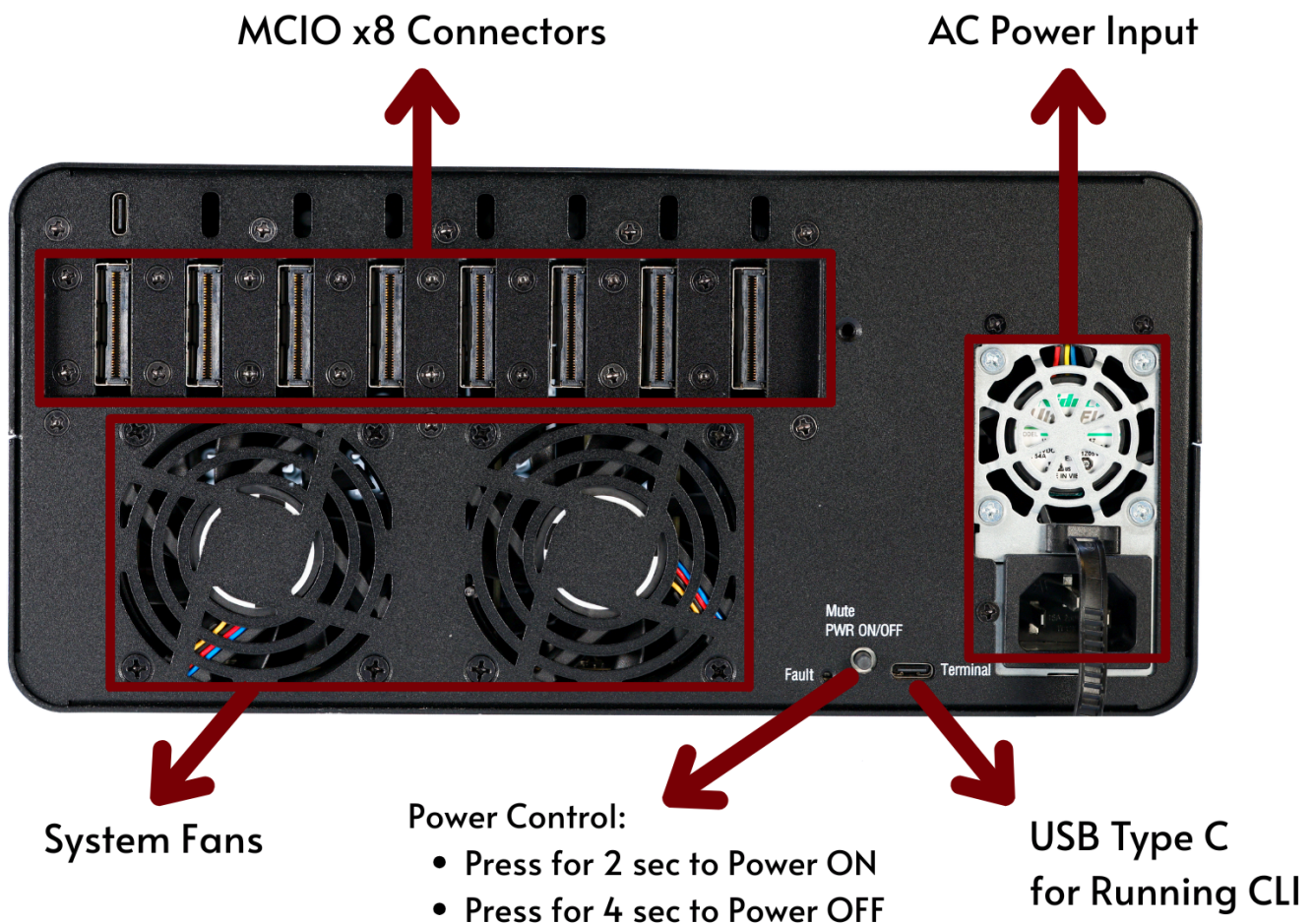
- **Drive Detected** – White
- **Drive Active** – Blue
- **Drive Fault** – Red



Rear View

The rear panel provides all system I/O, cooling, and power connections:

- Each of the eight **MCIO x8 connectors** corresponds directly to one of the eight front drive bays.
- A **USB Type-C port** is located on the rear panel for connecting to the MCU Command-Line Interface (CLI) to monitor system status, control power, and manage fans.
- Two **system fans** provide active cooling and are automatically regulated by the MCU using PWM control.
- The **AC power input** accepts a standard IEC power cable and includes a clip retainer to prevent accidental disconnection.



Internal Layout

Each drive slot connects through a removable paddle interposer board, which adapts between the SSD connector type (E3, U.2/U.3, or M.2) and the backplane. These paddles manage PCIe signal routing and 12 V power delivery for each slot.

Supported paddle configurations include:

- **E3 Paddle** – Used for **E3.S** and **E3.L** drives. Secures directly to the tray and aligns with the E3 connector on the backplane.
- **U.2 / U.3 Paddle** – Used for **2.5-inch NVMe SSDs**. Mounts with bracket adjustment screws and provides full pin compatibility with both U.2 and U.3 drives.
- **M.2 Paddle** – Used for **M.2 2280 or similar modules**. Includes copper standoffs for mechanical support and a screw mount for drive retention.



Installing Interposer Cards and SSDs

The JBOF enclosure supports multiple NVMe form factors through interchangeable interposer (paddle) cards. Each interposer adapts the drive's connector type to the backplane, ensuring proper electrical and mechanical fit.

Before installation, disconnect power, handle all components in an ESD-safe environment, and verify that the correct interposer type is selected for your SSD.



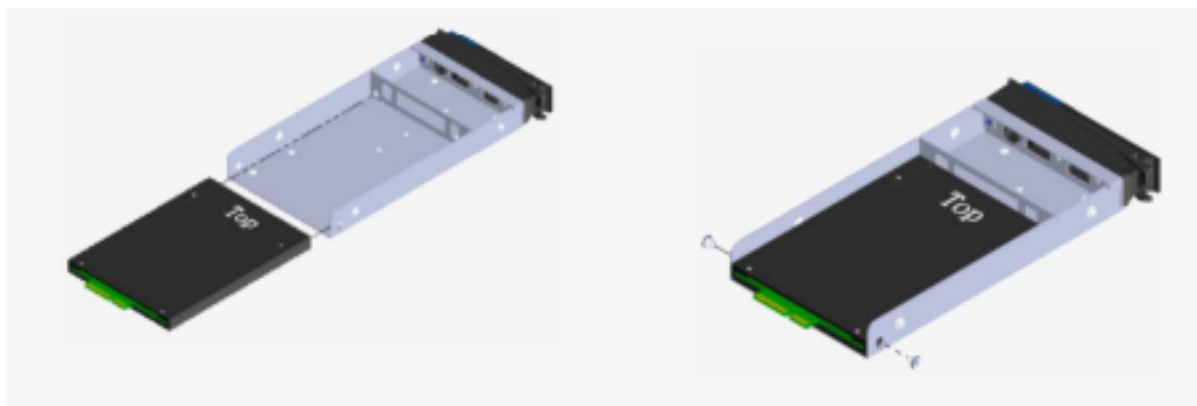
Drives must be installed from Slot 1 (left) to Slot 8 (right) for proper bay numbering in system management tools.

Select the appropriate drive type to view installation instructions:

- **E3.S Drives**
- **E3.L Drives**
- **U.2 / U.3 Drives**
- **M.2 Drives**

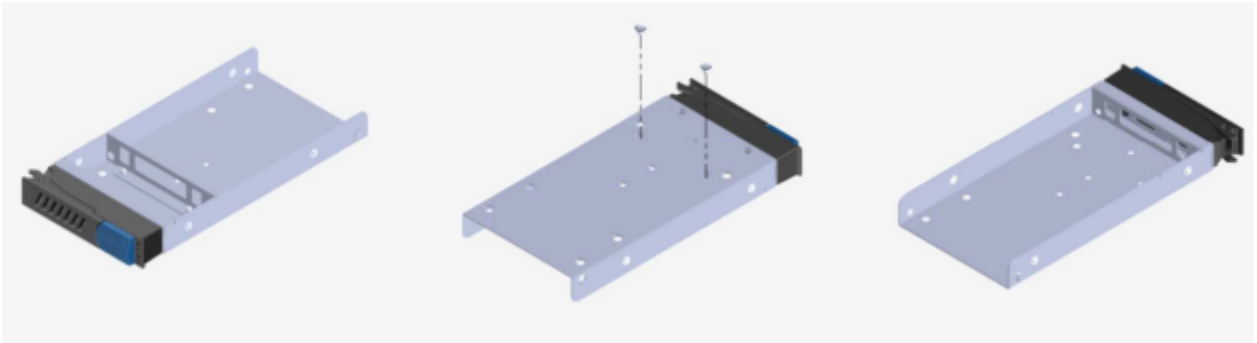
E3.S Drives

1. Insert the E3.S SSD into its tray and align the connector with the paddle card socket.
2. Slide the tray fully into the slot until it clicks into place.
3. Tighten the retaining screws if required.

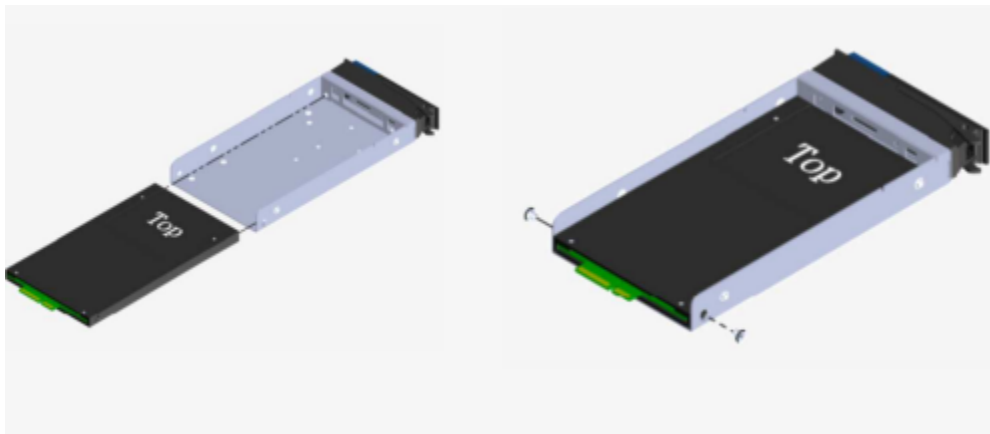


E3.L Drives

1. Adjust the bracket position to accommodate E3.L dimensions.

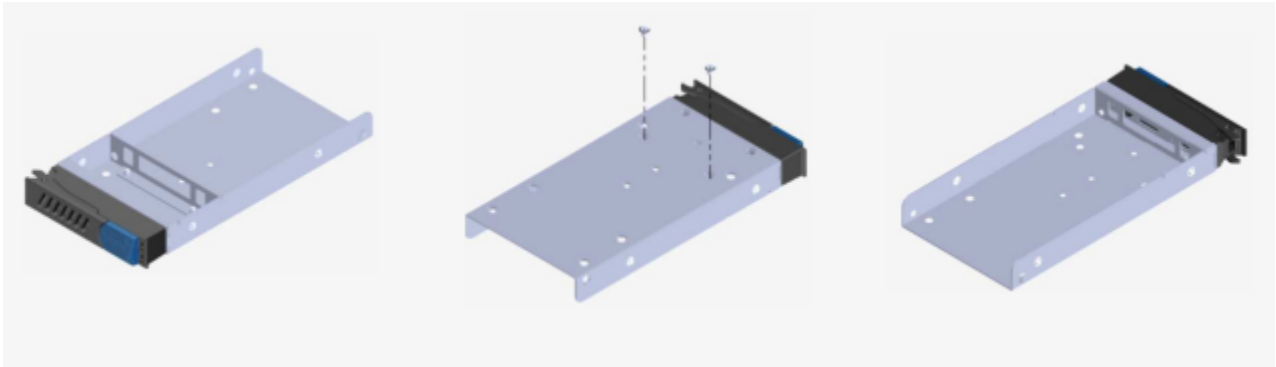


2. Secure the SSD in the tray and insert it into the slot.

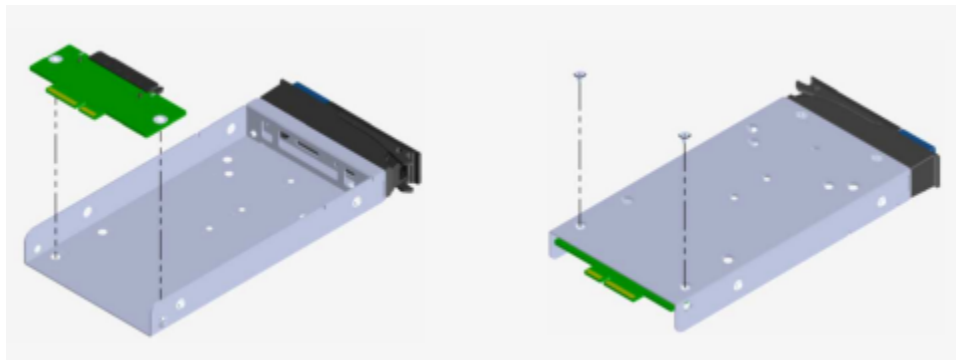


U.2 / U.3 Drives

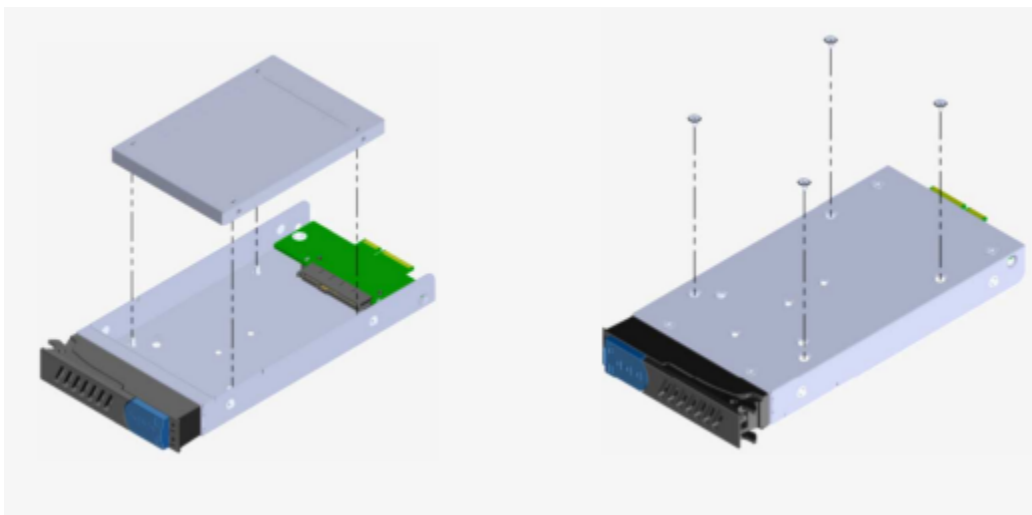
1. Adjust the bracket position for U.2 / U.3 form factors.



2. Mount the appropriate interposer card.

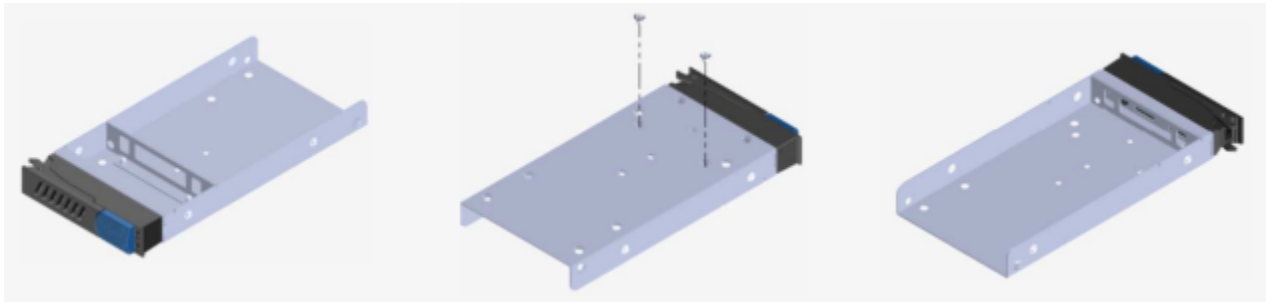


3. Secure the SSD using the supplied screws.

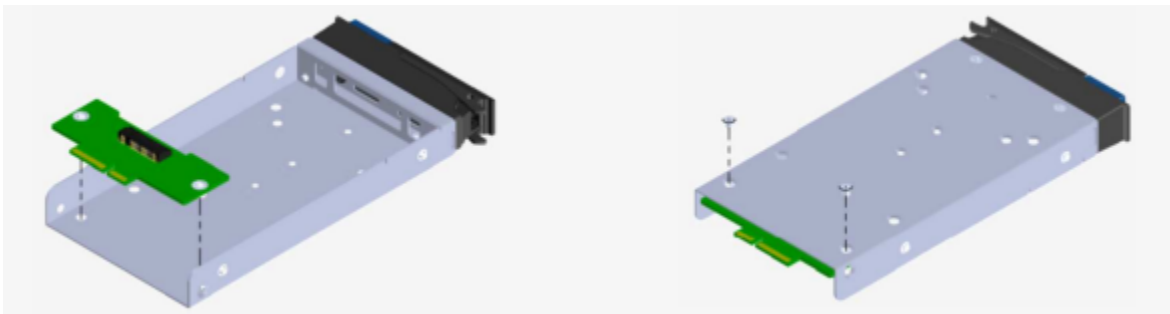


M.2 Drives

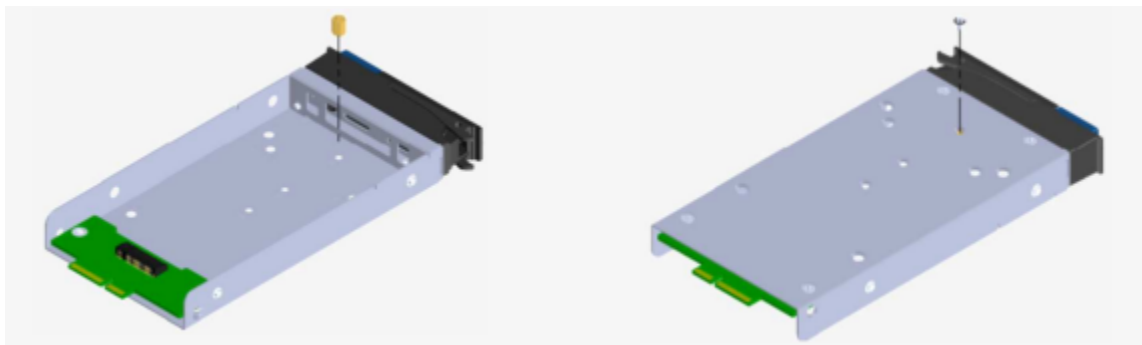
1. Adjust brackets as required.



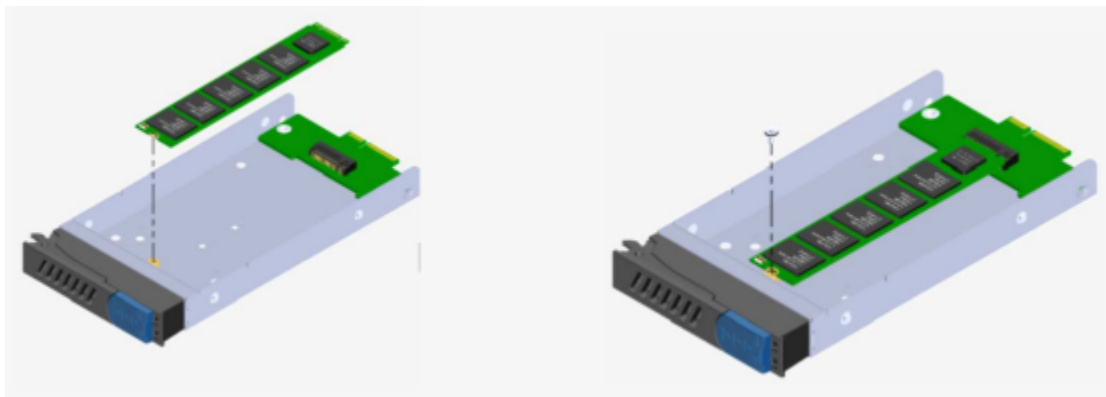
2. Mount M.2 interposer cards to the slot frame.



3. Secure the copper pillar to support the SSD.



4. Attach the M.2 drive using the provided screw.



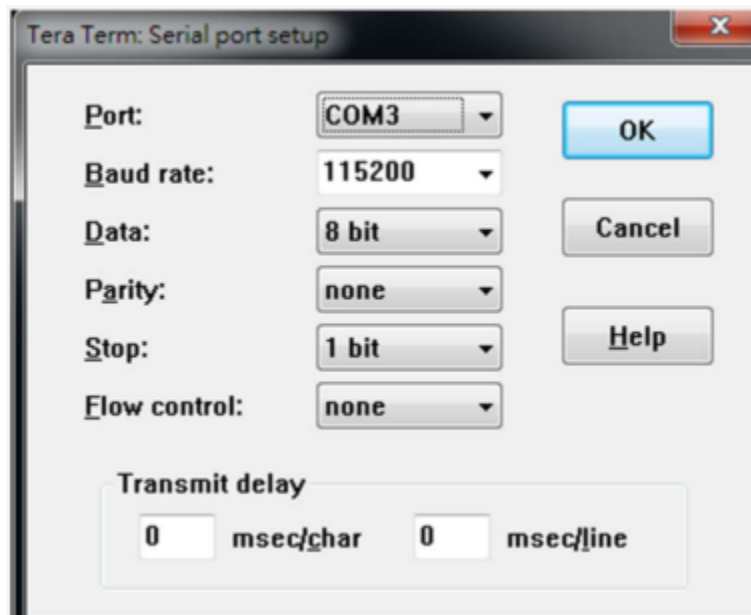
Always ensure the drive connector aligns correctly before inserting to prevent damage.

MCU Command-Line Interface (CLI) Setup

The onboard MCU includes a USB Type-C serial interface offering low-level access to enclosure controls and monitoring. Through the CLI, users can manage power sequencing, issue PERST# resets, toggle PWRDIS and dual-port states, adjust fan duty cycles, and query voltage, current, and temperature sensors in real time.

Connection Steps

1. Connect USB Type-C between the enclosure and a host PC.
2. Launch the terminal application [Tera Term](#) or [HyperTerminal](#) (v3.0 or later).
3. To ensure reliable communication between the host adapter and the VT100 terminal emulation, configure the serial interface using the following parameters:



4. Click OK (or open the session) to establish the connection.
5. Type **help** to view the list of all available commands.



If no prompt appears, confirm the correct COM port and ensure the cable is securely connected to the enclosure's USB Type-C console port.

MCU Command Reference

Commands	Description
help	Display all available commands
syspwr [on/off]	Power ON or OFF the JBOF enclosure
fdl	Upgrade MCU firmware via XMODEM
lsd	Show environmental info: fan RPM, voltages, currents, temperatures
ssdpwr [slot all] [on/off]	Enable/disable 12 V power to specific slots
showslot	Display slot information and drive presence
ssdrst <slot all> [a/b]	Send PERST# reset signal to selected slot(s)
dual [slot all] [on/off]	Toggle SSD dual-port enable line
pwrdis [slot all] [h/l]	Control PWRDIS signal (H = disable, L = enable)
hled [slot all] [on/off]	Control host LED on EDSFF drives
flcd [slot all] [on/off]	Control fault LEDs
buz [on/off/en/dis]	Control or enable buzzer for fault alerts
bist	Run on-board device diagnostics
iicwr	Read SMBus data from slot devices
iicw	Write SMBus data to slot devices
pwmctrl <fan_id> <duty>	Set fan PWM duty (50–100 %)
ver	Display product and firmware version info
sysinfo	Show complete system summary (ver, lsd, ssdpwr, etc.)
reset	Reset the JBOF enclosure

Command Usage Notes

System Power – **syspwr**

Turns full enclosure power on or off. This command controls the main 12 V power rail for all slots and system fans.

- **syspwr on** – Power on the entire enclosure
- **syspwr off** – Shut down all power outputs

Firmware Upgrade – **fdl**

Initiates MCU firmware upgrades via XMODEM transfer. After running the command, the MCU waits for incoming data from the terminal software.

To upgrade firmware:

1. Type **fdl mcu** at the CLI prompt.
2. In the terminal application, select **Transfer** → **Send File**.
3. Set **Protocol: XMODEM**, then start the transfer.

The update typically completes within a few seconds.

Maintain a stable USB connection during the transfer. Power interruptions or serial disconnects may corrupt the firmware image.

Environmental Monitoring – **lsd**

The **lsd** command displays system health and environment data, including fan speed, voltage, current, and temperature readings for each slot.

The output of this command will appear similar to this example (but in separate tables for each sensor):

Switch FAN1: 5500 RPM
Slot1 Temp: 25°C
Slot2 Temp: 32°C
12V Voltage: 12.420V
Slot 1 Bus Voltage: 12.23V

Drive Slot Power Control – **ssdpwr**

This turns the 12V power rail on or off for each slot, which is useful when replacing drives without fully powering down the enclosure.

Enter the command **ssdpwr** followed by the slot number (1–8) or **all**, and then **on** or **off** to control slot power. For example:

- **ssdpwr 1 off** – Powers off slot 1 only
- **ssdpwr all off** – Disables power for all slots
- **ssdpwr 3 on** – Re-enables slot 3 power

Show Slot Information – **showslot**

The enclosure supports U.2, U.3, and M.2 SSDs through interchangeable E3 interposer cards (E3-to-U.2, E3-to-U.3, and E3-to-M.2). It also supports EDSFF (E3) drives directly, including E3.S, E3.L, and E3.S.2T formats.

The **showslot** command displays the detected drive and interposer information for each slot. Use it after installation to confirm the enclosure recognizes each SSD. A status of **present** indicates that the enclosure detects physical connection and power to the slot, even if the SSD itself is not yet fully initialized.

The output will look like this:

```
slot01: present Yes, ssd type: U2_TYPE
slot02: present Yes, ssd type: U3X4_TYPE
slot03: present Yes, ssd type: U3X2_TYPE
slot04: present Yes, ssd type: M2_TYPE
slot05: present Yes, ssd type: X4_EDSFF_TYPE
slot06: present Yes, ssd type: X8_EDSFF_TYPE
slot07: present Yes, ssd type: U2_TYPE
slot08: present Yes, ssd type: U2_TYPE
```

Slot Reset — **ssdrst**

Sends a 300 ms PERST# signal to the selected slot(s), resetting attached drives. Supports per-slot and per-channel (A/B) operations.

Enter the command **ssdrst** followed by the slot number (1–8) or **all** and optionally **a** or **b** to reset the corresponding channel. For example:

- **ssdrst 1** – Resets both channels in Slot 1
- **ssdrst 1 a** – Resets Channel A in Slot 1
- **ssdrst all** – Resets all slots
- **ssdrst all a** – Resets all Channel A lines

Dual Port Control — **dual**

Enables or disables the SSD's dual-port mode for redundancy testing or topology verification. This determines whether both PCIe channels (A and B) are active. When disabled (**off**), the port operates in single-link mode, typically used for debugging or single-host environments.

Enter the command **dual** followed by the slot number (1–8) or **all**, and then **on** or **off** to toggle the dual-port signal. For example:

- **dual all on** – Enables dual-port mode for all slots
- **dual 1 on** – Enables dual-port mode for Slot 1

Power Disable Pin Control — **pwrdis**

Controls the PWRDIS (Power Disable) signal on EDSFF connector pin 3, used to remotely cut or restore SSD power. This feature is primarily used for drive-level power cycling or power-fault simulations in validation setups.

Enter the command **pwrdis** followed by the slot number (1–8) or **all**, and then **h** (disable power) or **l** (enable power). For example:

- **pwrdis all h** – Disables SSD power for all slots
- **pwrdis 1 l** – Enables SSD power for Slot 1

Host LED – **hled**

The **hled** command manually controls each slot's Host Activity LED, which normally indicates PCIe link status or traffic. It can be used to identify or test specific slots during maintenance.

Enter the command **hled** followed by the slot number (1–8) or **all**, and then **on** or **off** to toggle the Host LED. For example:

- **hled 1 on** – Turns on Host LED for Slot 1
- **hled all off** – Turns off all Host LEDs

Fault LED – **fled**

Controls the red fault LEDs on individual slots. This LED typically lights automatically when a slot reports a fault condition such as power loss, thermal overlimit, or drive failure. Manual control is useful for verification or identification during testing.

Enter the command **fled** followed by the slot number (1–8) or **all**, and then **on** or **off** to toggle the Fault LED. For example:

- **fled 1 on** – Turns on Fault LED for Slot 1
- **fled all off** – Turns off all Fault LEDs

Buzzer – **buz**

The **buz** command enables, disables, or immediately activates the system buzzer. The buzzer normally triggers automatically when the MCU detects a fan failure, voltage anomaly, or over-temperature condition.

Enter the command **buz** followed by one of the following options to adjust buzzer behavior:

- **buz on** – Activates buzzer immediately
- **buz off** – Silences buzzer immediately
- **buz en** – Enables automatic buzzer on fault events
- **buz dis** – Disables automatic buzzer notifications

Built-In Self-Test — **bist**

Runs a basic diagnostic routine for onboard sensors, MCU communication, and fan operation.

If any component fails, the CLI will report **Fail** or **NG** instead of **OK**:

Channel	Device	Address	Status
CH0	PCA9575-0	0x40	OK
CH1	AT24C64	0xA0	OK
CH1	PCA9575-1	0x40	OK
CH1	PCA9575-2	0x40	Fail
CH1	INA219A-8	0x80	OK

SMBus Read (write-then-read) — **iicwr**

The **iicwr** command performs a “write-then-read” SMBus transaction directly from the MCU’s command line. It first sends a single byte (often a register address or command code) to the device, then reads a specified number of bytes back. This is commonly used to read sensor data, EEPROM contents, or power monitor registers for diagnostics and validation.

Enter **iicwr** followed by the device address (hex), slot (1–8), read length (1–128), and a write data byte (hex). For example:

- **iicwr d4 1 8** – Reads 8 bytes starting at register 0x00 from device 0xD4 in Slot 1

SMBus Write — **iicw**

Writes data directly to an I²C/SMBus device in a selected slot. Commonly used to send configuration bytes, control signals, or register updates to devices such as sensors, EEPROMs, or expanders.

Enter the command **iicw** followed by the device address (hex), slot number (1–8), and one or more data bytes (hex) to be written. For example:

- **iicw d4 1 ff** – Writes 0xFF to the device at address 0xD4 in Slot 1

Fan Control — **pwmctrl**

Sets the PWM duty cycle for each fan, allowing for manual control during testing or thermal verification. When not manually set, fan speed is controlled automatically by the MCU.

Enter the command **pwmctrl** followed by the fan ID (1–2) and the desired duty cycle (50–100). For example:

- **pwmctrl 1 100** – Sets FAN1 to full speed
- **pwmctrl 2 70** – Sets FAN2 to 70% duty cycle

System Version — **ver**

Displays product name, MCU firmware version, and build information. Use this command to verify firmware version before upgrades or troubleshooting.

----- Product Info -----	
Company :	Serial Cables
Model :	PCIe Gen6 8Bays JBOF
Serial No. :	
----- App Info -----	
Version :	0.0.2
Build Time :	Aug 7 2025 14:39:36

System Information — **sysinfo**

Displays a complete summary of the enclosure's operational state, including firmware version, thermal and fan readings, voltage and current per slot, SSD power and dual-port status, and I²C device health.

This is effectively a sequence of several key commands (**ver**, **lsd**, **ssdpwr**, **dual**, **pwrdis**, **bist**), consolidated into a single report for quick system validation.

System Reset — **reset**

Performs a soft reset of the MCU and reinitializes all enclosure components. Drives remain powered but temporarily inaccessible during the reset cycle.

Use **reset** after configuration changes or firmware updates.

Maintenance & Diagnostics

The enclosure includes built-in tools for monitoring system health and diagnosing issues at the slot or board level. Regular checks help catch thermal, power, or device problems early.

- Run **lsd** to confirm all fans are spinning and temperature sensors are reading normally.
- Use **sysinfo** before and after maintenance to log current firmware, power, and environmental status.
- After swapping or reseating drives, check **showslot** or **ssdpwr** to confirm each slot powers up correctly.
- A persistent red LED usually indicates drive or slot failure. Run **sysinfo** or **bist** for detailed diagnostics.

Revision History

Revision	Description
1.2	Reformatted and restyled for brand consistency and readability. Rewritten for clarity. Added <i>Product Overview, Safety, Handling & Compliance, Maintenance & Diagnostics, and Contact Us</i> sections.
1.1	Added showslot , buz , and pwmctrl commands
1.0	Initial manual release.

Contact Us

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