RS-224-09 SAS4 Hybrid Backplane User Guide

P/N : 2RAKVI016700

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1. Introduction

1.1 Purpose of this Document

This user guide provides detailed information on the In-Win RS-224-09 SAS4 Hybrid Backplane, including its features, connectors, installation procedures, and operational guidelines. It is intended for system integrators, service engineers, and end users who need to install and maintain the backplane within a server or storage enclosure.

1.2 Product Overview

The In-Win RS-224-09 Backplane is designed to support a total of 24 drives, with 12 of those bays capable of both SAS/SATA and NVMe. This design leverages two high-performance storage technologies—Serial Attached SCSI (SAS4) and Non-Volatile Memory Express (NVMe) Gen5—to maximize flexibility and throughput for modern data center, cloud, and enterprise environments.

1.2.1 SAS4 Overview

- High Throughput: SAS4 (also referred to as 24 G SAS) supports up to 22.5–24 Gb/s per physical link, effectively doubling the throughput of the previous SAS3 generation.
- Backward Compatibility: SAS4 retains backward compatibility with earlier generations of SAS (such as SAS3, SAS2), protecting your existing storage investments.
- Enterprise Features: SAS offers robust enterprise-class features like dual-port redundancy, full-duplex data transfers, and comprehensive enclosure management (SES/SGPIO).
- Scalability: With the ability to daisy-chain multiple devices and an advanced expander architecture (like the Broadcom SAS4x40 module), SAS4 provides excellent scalability in high-capacity server and storage deployments.

1.2.2 NVMe Gen5 Overview

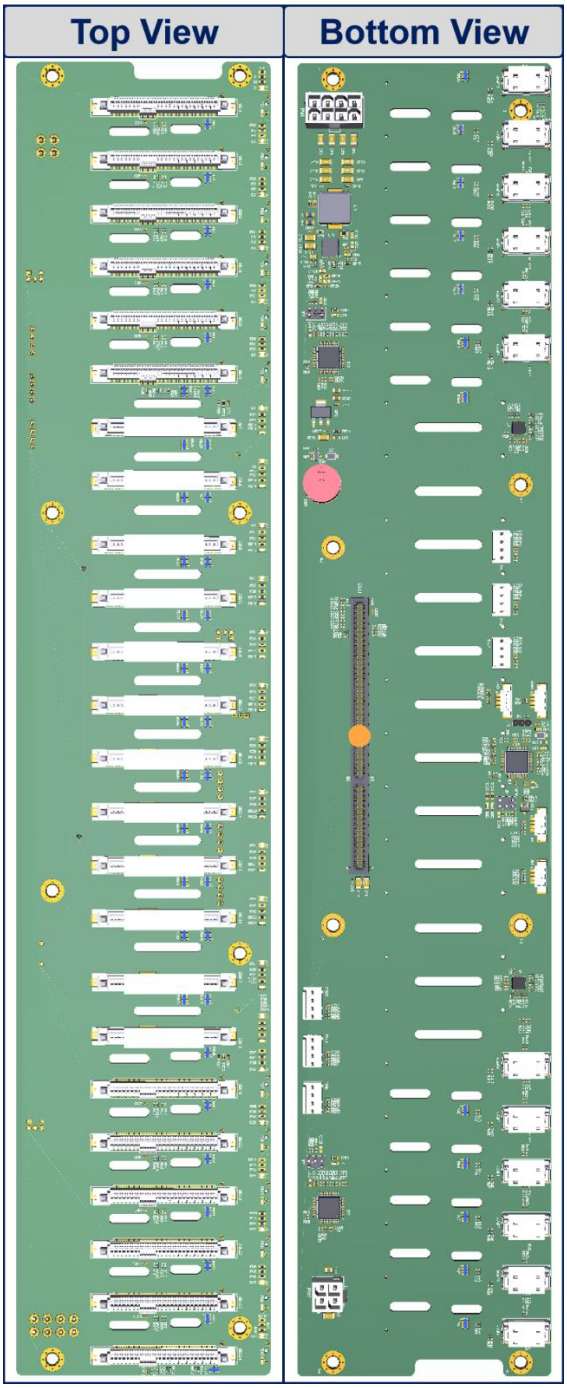
- Cutting-Edge Speed: NVMe Gen5 runs on PCI Express Gen5 (PCIe Gen5), delivering up to 32 GT/s (GigaTransfers per second) per lane—doubling Gen4

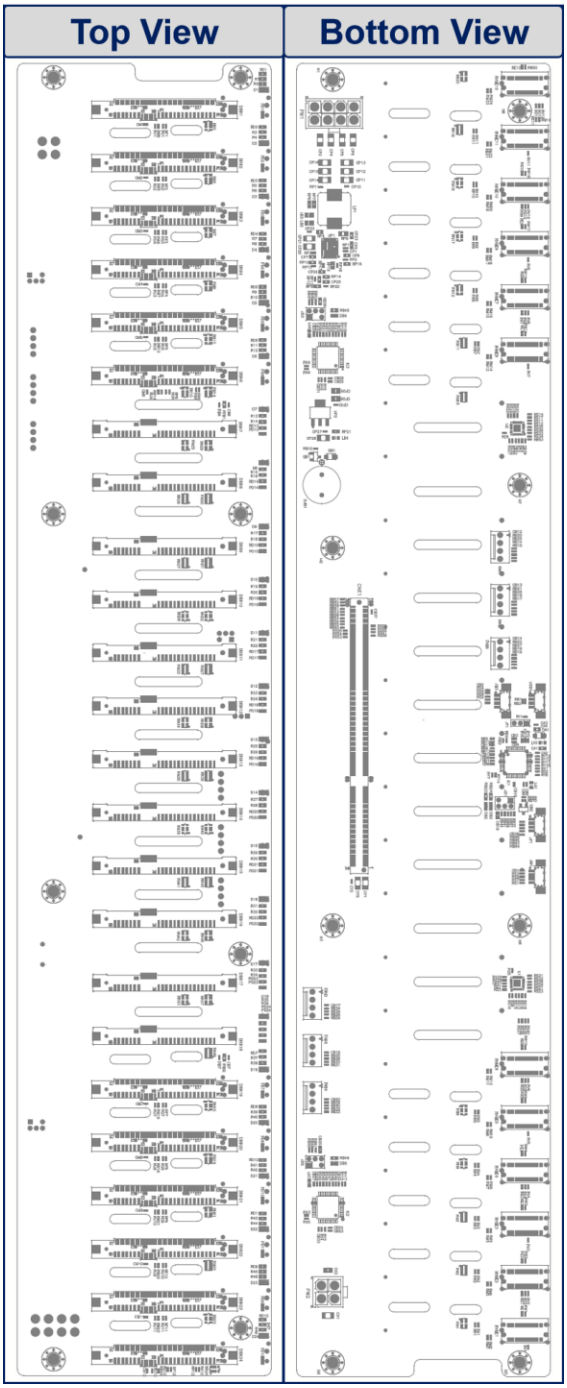
speeds. An x4 PCIe Gen5 NVMe link can theoretically offer up to ~128 Gb/s of raw bandwidth for extremely fast I/O operations.

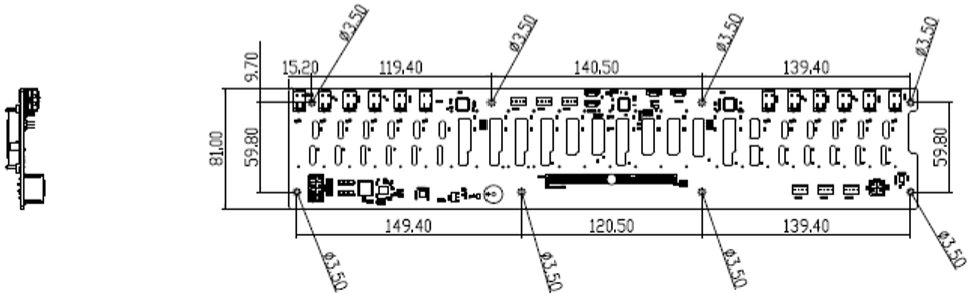
- Low Latency, High IOPS: NVMe is designed to reduce latency and overhead compared to legacy protocols, enabling significantly higher input/output operations per second (IOPS) and faster response times.
- Optimized for Flash Storage: NVMe is purpose-built for non-volatile memory technologies taking advantage of their low-latency characteristics and parallelism.
- Scalable Architecture: NVMe supports multi-queueing, meaning each core of the CPU can directly submit I/O commands, drastically improving performance in multi-tenant or high-transaction environments.

2. Features and Specification

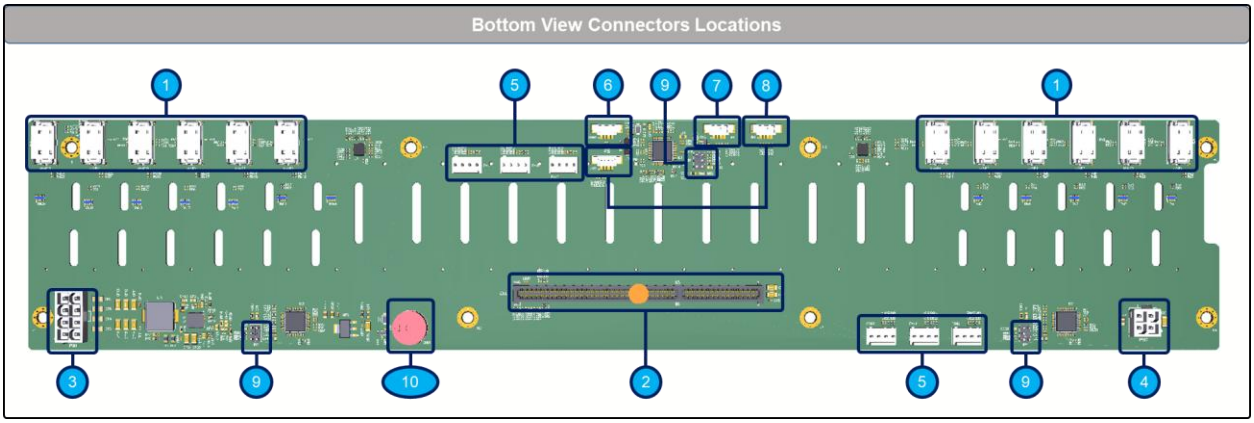
2.1 Physical Outlook



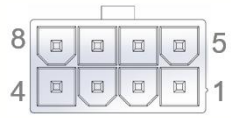




2.2 Connector and Component Locations

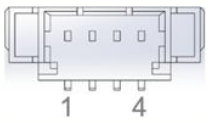


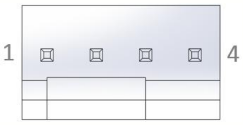
No	Description	No	Description
1	Host Facing Interface: NVME1~NVME12	6	External USB: USB1
2	Expander Connector: CNE1	7	M/B Fan Speed Control Connector: JF1
3	Main Power Connector: PW1	8	Firmware ICE Connector: JD1/JD2/JD3
4	Output Power Connector: PW2	9	BMC SMBUS Connector: JM1/JM2
5	FAN Connector: FAN1~FAN6	10	Buzzer

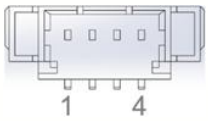
PW1	Power 2x4-Pin Connector	
	PIN #	Definition
	1~4	Ground
	5~8	+12V

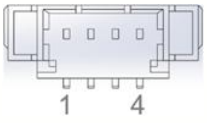
PW2	Power 2x3-Pin Connector	
	PIN #	Definition
	1/2	Ground
	3/4	+12V/+5V

JD1/JD2	MCU ICE Connector			
	PIN #	Definition	PIN No#	Definition
	2	ICE_CLK	1	VCC
	4	ICE_DATA	3	#Key
	6	ICE_RST	5	Ground

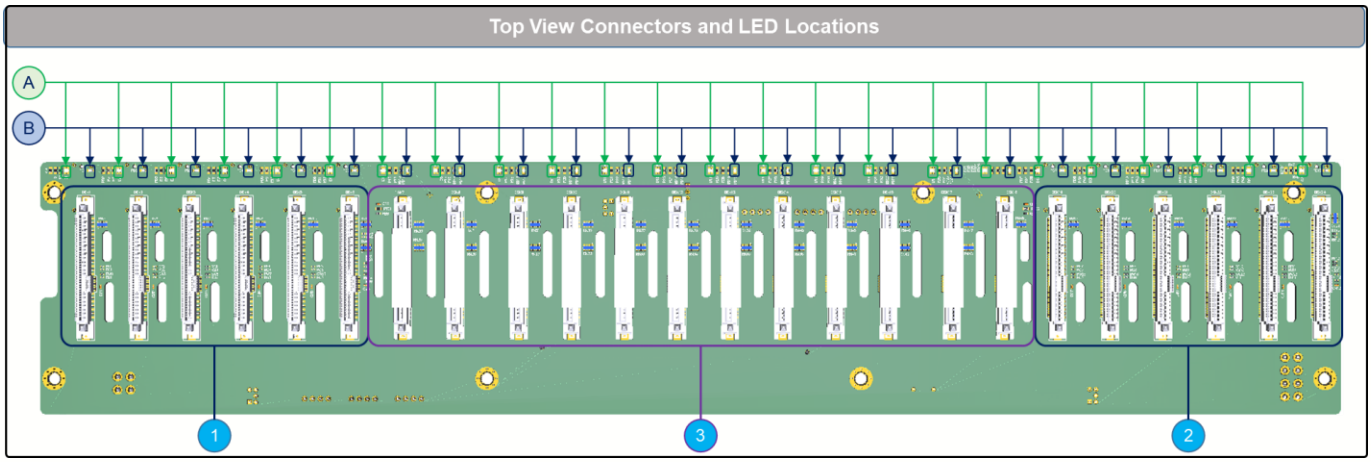
USB1	USB Connector	
	PIN #	Definition
	1	+5V
	2	USB_DN
	3	USB_DP
	4	Ground

FAN1~FAN6	FAN Connector	
	PIN #	Definition
	1	Ground
	2	+12V
	3	Tachometer
	4	PWM

JF1	MB FSC Connector	
	PIN #	Definition
	1	FAN_12V
	2	TO_MB_TAC
	3	MB_PWM
	4	Ground

JM1/JM2	BMC SMBUS Connector	
	PIN #	Definition
	1	+3.3V
	2	BMC_SMB_CLK
	3	BMC_SMB_DAT
	4	Ground

2.3 LED Location



Connector Locations

#	Location	Description
1	DISK01~ DISK06 (NVME1~NVME6)	NVMe SSD or SATA/SAS Disk #1~#6
2	DISK19~ DISK24 (NVME7~NVME12)	NVMe SSD or SATA/SAS Disk #19~#24
3	DISK07~ DISK18	SATA/SAS Disk #7~#18

LED Indicators

#	Location	Description
A	D1~D24	DISK01~DISK24 Activity/Failure LED
B	PD1~PD24	DISK01~DISK24 Power LED

2.4 Connector Detail

2.4.1 Expander Interface

Connector**:** High Speed Connector HSEC8-1100-01-L-DV-A-K
Function:

- Connects to the Broadcom SAS4×40 expander module
- Supports 24 SAS4 PHY signals (24 Gb/s per link)
- Carries SGPIO and I²C signals for enclosure management

2.4.2 Drive Interfaces

SAS/SATA Bays

- Interface Standard
  Bays 7–18: SFF-8680 (29-pin) for 2.5” SAS4/SATA
- Throughput
  Up to 24 Gb/s per SAS4 link
  Up to 6 Gb/s for SATA
- Advantages
  Dual-porting, backward compatibility, robust management features

Hybrid NVMe/SAS/SATA Bays

- Interface Standard
  Bays 1–6, 19–24: SFF-8639 (U.2) (68-pin) for 2.5” SAS4/SATA or NVMe drives
- NVMe Link
  MCIO (PCIe Gen5) cables from the host motherboard
- Performance Highlights
  NVMe Gen5 up to 32 GT/s per lane for extremely fast throughput
- Max Supported Drives
  12 hybrid bays with SAS4/SATA/NVMe support

2.4.3 Indicators

Bay Slot Power LED (PD1–PD24)

- Steady Blue: Drive is present

Dual-Color Status LED (D1–D24)

- Green (Blinking): Drive activity
- Red (Blinking/Steady): Fail or locate indication

2.4.4 Environmental Control

Fan Connectors (FAN1–FAN6)

- Each PWM fan connector supports automatic speed control for optimal cooling.

Temperature Sensors (RTB1, RTB2)

- Monitors backplane and drive bay temperature.

2.4.5 Host NVMe Connector

MCIO-4i Connector

- Supports up to 12 hybrid bays at PCIe Gen5 speeds
- Ensures high-bandwidth connections for NVMe drives

2.4.6 Power and Signal Connectors

- Disk Drive Power (PW1): +12 V
- Output Power (PW2): +12 V, +5 V, and ground
- VCOM (USB1.1): USB-UART control interface for enclosure management
- JD1, JD2, JD3: Reserved for MCU ICE programming (firmware updates or advanced diagnostics)

2.4.7 Physical Dimensions (2U Form Factor)

- The backplane is designed to fit in a 2U enclosure.
- Approximate overall length and width (excluding connectors) allow for easy integration into standard 2U server or storage chassis.
- Refer to mechanical drawings for exact dimensions, mounting hole patterns, and clearances.

3. System Requirements

- Chassis
  RS-224-09 can accommodate 24× 2.5” drive bays and support regular 2U server motherboards
- Compatible Drives
  Up to 24 total 2.5” SAS4/SATA drives.
  Up to 12 NVMe drives in hybrid bays.
  Consult the hardware compatibility list for validated drive models.
- Host Controller
  Requires a motherboard or PCIe card that provides SAS4 connectivity (for SAS/SATA) and MCIO connectors (for NVMe).
  Verify that the host environment supports the required PCIe Gen5 or SAS4 throughput.
- Power Supply
  Adequate +12 V and +5 V rails to support all installed drives.
  Verify total wattage requirements with the chosen number of SSDs, fans, and other chassis components.

4. Installation and Setup

4.1 Safety Precautions

- Power off and unplug all equipment before working on the system.
- Use proper ESD protection to avoid damage to sensitive components.
- Follow local regulations and company guidelines when installing hardware.

4.2 Mounting the Backplane

- Align the backplane’s mounting holes with the RS-224-09 chassis standoffs.
- Secure the backplane using the In-Win recommended screws.

4.3 Connecting the Expander Module

- Insert the In-Win SAS4×40 expander module into the HSEC8-1100-01-L-DV-A-K connector.
- Verify proper alignment of pins; secure any retention clips or screws if applicable.

4.4 Connecting Drives

- For Bays 7–18, attach the 2.5” SAS/SATA drives to the SFF-8680 connectors.
- For Bays 1–6 and 19–24, attach either NVMe or SAS/SATA drives to the SFF-8639 (U.2) connectors.
- If installing NVMe drives, ensure MCIO cables from the motherboard are properly attached to the backplane.

4.5 Power and Signal Cable Connections

- Connect the main power supply cable to PW1 (+12 V).
- Connect additional power or combined signal/power cable as required to PW2 (+12 V, +5 V, ground).
- (Optional) If remote management or a console is required, connect a USB cable to the VCOM port for UART-over-USB access.

4.6 Fan and Temperature Sensor Connections

- Plug system fans into FAN1–FAN6.
- Ensure the temperature sensors RTB1 and RTB2 are properly seated and connected to the monitoring circuit (if removable/extended).

4.7 Jumpers / Programming Headers

- JD1, JD2, JD3
  Reserved for MCU in-circuit emulation or firmware programming. Leave these headers unconnected during normal operation unless instructed by support.

5. Operation

5.1 Power On and Initialization

- Confirm all fans, drives, and cables are secured.
- Power on the system; the backplane will initialize along with the expander module.
- Check the LED indicators to ensure all drives are detected and powered.

5.2 Drive Status LED Interpretation

- Power LED (PD1–PD24): Should be steady blue if a drive is present.
- Activity LED (Green Blink): Flashes during read/write.
- Fail/Locate LED (Red Blink or Steady Red): Indicates a drive failure or a user-initiated locate command.

5.3 Fan and Thermal Control

- The system’s BIOS or BMC typically controls PWM fans connected to FAN1–FAN6.
- If the temperature sensors detect high heat, the fans will ramp up to protect the drives.

5.4 System Management via VCOM

- If connected to VCOM, use a terminal application (e.g., TeraTerm) to access the backplane’s management console (if supported).
- Configure or monitor enclosure status, firmware updates, or debug logs.

6. Maintenance and Troubleshooting

6.1 Preventive Maintenance

- Keep the RS-224-09 and vents free from dust buildup.
- Check fan functionality regularly.
- Update the expander module firmware to the latest recommended version.

6.2 Common Issues and Resolutions

- Drive Not Recognized
    1. Check power and data cables.
    2. Reseat the drive or test on a known-working port.
- Overheating
    1. Ensure fans are operational, unobstructed, and spinning at proper speed.
    2. Monitor temperature sensor readings via system or management console.
- LEDs Not Lit
    1. Confirm drive presence and power connector seating.
    2. Verify the expander module is fully inserted.

6.3 Technical Support

If further assistance is required, gather the following information before contacting support

- In-Win backplane model and serial number
- Firmware version of the expander module
- Operating system / Host configuration details
- Any relevant error messages or LED states

7. Technical Specifications

Feature	***Details***
Expander Interface	HSEC8-1100-01-L-DV-A-K (2×100 pins) with SAS4×40 support
Drive Interfaces	SFF-8680 (29-pin) for 2.5” SAS4/SATA (Bays 7–18) - SFF-8639 (U.2) (68-pin) for SAS4/SATA/NVMe (Bays 1–6, 19–24)
Max Drives	24 total (all SAS/SATA), 12 of which can also be NVMe
Indicators	Power LED (Blue) x24, Dual-color LED x24 (Green/Red)
Environmental Control	FAN1–FAN6 (PWM), Temperature Sensors RTB1/RTB2
Host NVMe Connector	MCIO-4i for up to 12 NVMe bays (PCIe Gen5)
Power Connectors	PW1 (+12 V), PW2 (+12 V, +5 V, GND)
Management	VCOM (USB-UART)
Programming Headers	JD1, JD2, JD3 (MCU ICE)
Operating Temperature	0 °C to 60 °C (recommended 10 °C to 35 °C for optimal performance)

8. Annex – Using a Tri-Mode HBA with a Y-Cable to Blink NVMe SSD Locate LEDs

A.1 Overview of Tri-Mode HBA in Direct-Attach Scenarios

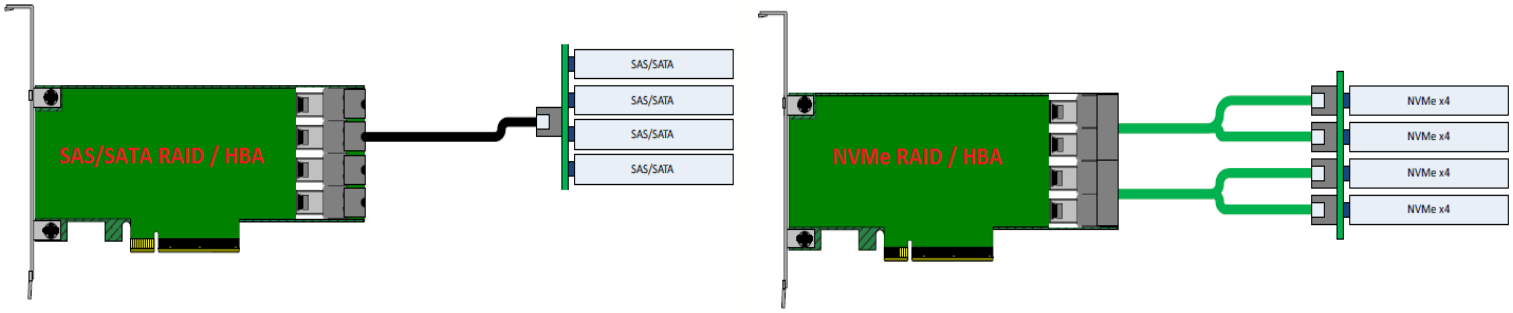
A tri-mode host bus adapter (HBA), such as the Broadcom 9600 Series, supports SAS, SATA, and NVMe protocols on a single controller. In some systems, these HBAs connect directly to the backplane rather than through a SAS expander. When NVMe drives are in use, MCIO connectors on the backplane must be employed for high-speed data transfer, sideband signals, and LED management.

A.2 Y-Cable Configuration: SlimSAS-8i to Dual MCIO-4i

Instead of a single cable end matching a single backplane port, a Y-cable splits one connector on the HBA side into two connectors on the backplane side:

1. HBA Side
   - SlimSAS-8i (often referred to as SFF-8654)
   - Carries up to 8 lanes for tri-mode operation (SAS, SATA, or NVMe)
2. Backplane Side:
   - Two MCIO-4i connectors, each carrying 4 lanes
   - Each MCIO-4i connector mates with a corresponding backplane port to provide NVMe PCIe lanes, power, and sideband signals (I^2C)

Note: This Y-cable approach allows splitting 8 total lanes from the HBA into two 4-lane connections. Each MCIO-4i port on the backplane can then connect to an individual or group of drives, depending on the backplane's design.



A.3 I²C VPP for LED Control

Many tri-mode HBAs support the I²C VPP (Virtual Pin Port) interface for managing backplane drive LEDs:

1. Sideband Signaling
   - The I²C lines included in each MCIO-4i segment can communicate locate, identify, and fail LED commands.
   - In a direct-attach configuration (no expander), this is the primary method for the HBA to blink or light the backplane's LEDs.
2. Locate (Identify) LED
   - Using Broadcom's management utilities (StorCLI, MegaCLI, or an OEM tool), you can trigger an LED Locate command on a specified drive.
   - The HBA sends signals over the I²C lines in the Y-cable, causing the backplane to blink or light the corresponding drive LED.
3. Fail LED
   - If the HBA detects a drive failure, it can illuminate the fail LED on the backplane via the same I²C interface.

A.4 Locating a Drive via I²C VPP

1. Open Management Tool
   - Use StorCLI or another Broadcom utility to identify the drive.
2. Issue Locate Command

   Example:

   storcli /cx/ex/sx set locate=on

   Where c is the HBA number, e is the enclosure (in direct attach, often enumerated as "-1" or "0"), and s is the slot number.
3. Observe LED
   - The corresponding LED on the backplane will blink or turn on, depending on the backplane's LED scheme.
   - Turn it off by setting locate=off when done.

A.5 Best Practices and Considerations

1. Cable Compatibility
   - Confirm that the SlimSAS-8i to dual MCIO-4i Y-cable is tri-mode capable (SAS/SATA/NVMe).
   - Check the lane speed rating if running PCIe Gen4 or Gen5.

2. Power & Signal Integrity
   - For Gen4 or Gen5 NVMe, pay attention to cable length limitations to avoid signal degradation.
3. Firmware & Driver Updates
   - Keep the tri-mode HBA's firmware up to date to ensure stable LED control and sideband communication over I²C VPP.
   - Install the correct driver for your operating system to leverage full tri-mode capabilities (SAS, SATA, NVMe).

A.6 Troubleshooting

- No Drive LED Activity
- Confirm that each MCIO-4i connector is properly seated on the backplane.
- Ensure the HBA's I²C sideband signals are enabled and the backplane is wired to accept those signals.
- Drive Not Detected
- Check that the correct lanes (x4 per MCIO-4i) are active in the HBA's BIOS/UEFI settings.
- Make sure the slot is designed for hybrid NVMe connections (not only SAS/SATA).