Broadcom® 96xx PCIe 4.0, 24G SAS MegaRAID™ and eHBA Tri-Mode Storage Adapters

User Guide
Version 2.3

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Broadcom PCIe 4.0, 24G SAS MegaRAID and eHBA Tri-Mode Storage Adapters

This document is the primary reference and user guide for the Broadcom® PCIe 4.0, 24G SAS MegaRAID™ tri-mode storage adapters and enhanced HBA (eHBA) tri-mode storage adapters, based on the Broadcom PCIe 4.0, 24G SAS tri-mode controllers. This document contains the complete installation instructions and specifications for the following tri-mode storage adapters, referred to as adapters:

- MegaRAID 9670W-16i
- MegaRAID 9670-24i
- MegaRAID 9660-16i
- eHBA 9620-16i
- eHBA 9600-24i
- eHBA 9600-16i
- eHBA 9600-8i8e
- eHBA 9600W-16e
- eHBA 9600-16e

Overview

The adapters, based on a 24G SAS tri-mode controller, are high-performance PCIe-to-SATA/SAS/PCIe (tri-mode) storage adapters. Broadcom tri-mode SerDes technology enables operation of SAS, SATA, or PCIe (NVMe) storage devices in a single drive bay. A single controller can operate in all three modes concurrently: SAS, SATA, and PCIe/NVMe. The adapters negotiate between the speeds and the protocols to recognize and concurrently interface with these three storage device types.

The adapters provide the following storage interface data transfer rates:

- SAS data transfer rates of 22.5Gb/s, 12Gb/s, 6Gb/s, and 3Gb/s per phy
- SAS data transfer rates of 12Gb/s, 6Gb/s, and 3Gb/s per phy
- PCIe (NVMe) data transfer rates of 16 GT/s, 8 GT/s, 5 GT/s, and 2.5 GT/s per lane

The following tables summarize key adapter features.

Table 1: MegaRAID Tri-Mode Storage Adapter and eHBA 9620-16i Features

Adapter	9670W-16i	9670-24i	9660-16i	9620-16i
Ports	16 internal	24 internal	16 internal	16 internal
I/O Processor	SAS4116W	SAS4124	SAS4116	SAS4016
Host Interface	x16 PCIe 4.0	x8 PCIe 4.0	x8 PCIe 4.0	x8 PCIe 4.0
Storage Interface	SAS, SATA, and PCIe (NVMe)	SAS, SATA, and PCIe (NVMe)	SAS, SATA, and PCIe (NVMe)	SAS, SATA, and PCIe (NVMe)
Form Factor	FH-MD2	FH-MD2	LP-MD2	LP-MD2
RAID Levels	0, 1, 5, and 6	0, 1, 5, and 6	0, 1, 5, and 6	0 and 1
Cache Memory	8 GB, dual channel, 3200 MT/s, DDR4 SDRAM	8 GB, dual channel, 3200 MT/s, DDR4 SDRAM	4 GB, single channel, 3200 MT/s, DDR4 SDRAM	—

Adapter	9670W-16i	9670-24i	9660-16i	9620-16i
Storage Interface Connectors	Two SFF-8654 x8	Three SFF-8654 x8	Two SFF-8654 x8	Two SFF-8654 x8
Cache Protection	Yes	Yes	Yes	—
Energy Backup	CVPM05 module	CVPM05 module	CVPM05 module	—

Table 2: eHBA Tri-Mode Storage Adapter Features

Adapter	9600-24i	9600-16i	9600-8i8e	9600W-16e	9600-16e
Ports	24 internal	16 internal	8 internal 8 external	16 external	16 external
I/O Processor	SAS4024	SAS4016	SAS4016	SAS4016W	SAS4016W
Host Interface	x8 PCIe 4.0	x8 PCIe 4.0	x8 PCIe 4.0	x16 PCIe 4.0	x8 PCIe 4.0
Form Factor	LP-MD2	LP-MD2	LP-MD2	LP-MD2	LP-MD2
Storage Interface	SAS, SATA, and PCIe (NVMe)	SAS, SATA, and PCIe (NVMe)	SAS, SATA, and PCIe (NVMe)	SAS, SATA, and PCIe	SAS, SATA, and PCIe
Storage Interface Connectors	Three SFF-8654 x8	Two SFF-8654 x8	One SFF-8654 x8 Two SFF-8674 x4	Four SFF-8674 x4	Four SFF-8674 x4

Features

RAID and eHBA Features

The following sections list primary RAID and eHBA features that the adapters support. For a full description of the RAID features, refer to the *MegaRAID Tri-Mode Software User Guide*, which can be found in the Support Documents and Downloads section of the Broadcom website.

MegaRAID 9670W-16i, 9670-24i, and 9660-16i Adapter RAID Features

The MegaRAID 9670W-16i, MegaRAID 9670-24i, and MegaRAID 9660-16i adapters support the following RAID features:

- RAID levels 0, 1, 5, and 6
- RAID spans 10, 50, and 60
- SAS/SATA drives: 240
- NVMe SSDs: 32
- JBOD physical drive (PD) state for SDS environments
- Online Capacity Expansion (OCE)
- Auto resume after loss of system power during array rebuild or OCE
- Single controller multipathing
- Load balancing
- Fast initialization for quick array setup
- Check Consistency for background data integrity
- SSD support with SSD Guard™ technology
- Patrol read for media scanning and repairing
- Sixty-four virtual drive support
- Disk data format (DDF)-compliant Configuration on Disk (COD)
- Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T) support
- Global and dedicated hot spare with revertible hot spare support:
  - Automatic rebuild
  - Enclosure affinity
  - Emergency SATA hot spare for SAS arrays
- Enclosure management support:
  - Universal Backplane Management (UBM)
  - SES (inband)
  - SGPIO (sideband)
  - VPP
- DataBolt bandwidth optimizer technology support for compatible expander-based enclosures
- Shield state drive diagnostic technology
- MegaRAID SafeStore™ software for SED key management

MegaRAID 9620-16i eHBA Features

The MegaRAID 9620-16i adapter supports the following features:

- RAID levels 0 and 1
- RAID span 10
- SAS/SATA drives: 32
- NVMe SSDs: 32
- JBOD PD state for SDS environments
- Single controller multipathing
- Load balancing
- Fast initialization for quick array setup
- Check Consistency for background data integrity
- SSD support with SSD Guard technology
- Patrol read for media scanning and repairing
- Four virtual drive support
- DDF-compliant COD
- S.M.A.R.T support
- Global and dedicated hot spare with revertible hot spare support:
  - Automatic rebuild
  - Emergency SATA hot spare for SAS arrays
- Enclosure management support:
  - Universal Backplane Management (UBM)
  - SES (inband)
  - SGPIO (sideband)
  - VPP
- DataBolt bandwidth optimizer technology support for compatible expander-based enclosures
- Shield state drive diagnostic technology
- MegaRAID SafeStore software for SED key management

eHBA 9600 Adapter Features

The eHBA 9600 adapters support the following eHBA features.

- SAS/SATA devices: 240
- NVMe SSDs: 32
- Shingled magnetic recording (SMR) drive support
- Multi-actuator (MA) drive support

Operating System Support

The tri-mode storage adapters support the operating systems in the following list. For specific version information, refer to the *MegaRAID Tri-Mode Device Driver Installation User Guide*, located at http://www.broadcom.com/support/download-search.

- Microsoft Windows
- VMware vSphere/ESXi
- Red Hat Enterprise Linux
- SuSE Linux
- Ubuntu Linux
- Citrix XenServer
- CentOS Linux
- Debian Linux
- Oracle Enterprise Linux
- Fedora
- FreeBSD

The firmware and drivers are routinely updated and made available on the Broadcom Support and Download center. Visit http://www.broadcom.com/support/download-search and download the latest firmware and driver for the adapter.

PCIe Host Interface

The adapter's PCIe 4.0 host interface provides maximum transmission and reception rates of up to 128 GT/s (16GB/s per lane). The tri-mode controller uses a packet-based communication protocol to communicate over the serial interconnect. Other PCIe host interface features include the following:

- Eight-lane or 16-lane PCIe host interface
- PCIe Hot-Plug
- Power management:
  - Supports the *PCI Bus Power Management Interface Specification Revision 1.2*
  - Supports Active State Power Management, including the L0 states, by placing links in a power-saving mode during times of no link activity
- Error handling
- High bandwidth per pin with low overhead and low latency
- Lane reversal and polarity inversion
- Single-phy (one-lane) link transfer rate of 16 GT/s, 8 GT/s, 5 GT/s, and 2.5 GT/s in each direction
- Eight-lane aggregate bandwidth of up to 16GB/s (16,000 MB/s)
- Sixteen-lane aggregate bandwidth of up to 32GB/s (32,000 MB/s)
- Support of x16, x8, x4, x2, and x1 link widths

LED Management

The internal adapters offer LED management support for SAS/SATA backplanes and (PCIe) NVMe backplanes. External connect adapters offer enclosure LED management support for enclosure implementations through SES. See Backplane Management for more information.

Tri-Mode Storage Interface Features

The adapter's storage interface supports concurrent operation with SAS, SATA, and PCIe (NVMe) devices to provide a fully functional solution for any storage environment.

- PCIe (NVMe) interface features:
  - Up to sixteen x1, eight x2, or four x4 NVMe direct-attach drive support
  - Data transfer at 16 GT/s, 8 GT/s, 5 GT/s, and 2.5 GT/s
  - Independent resets and configuration
  - Common reference clock and separate reference clock independent SSC (SRIS) support
- SAS features:

  - SAS data transfers at 22.5Gb/s, 12Gb/s, and 6Gb/s
  - DataBolt technology on all SAS phys to improve performance
  - Serial, point-to-point, enterprise-level storage interface
  - Wide ports that contain multiple phys
  - Narrow ports that contain a single phy
  - SAS phy power management
  - Data transfer by using SCSI information units
  - T10 data protection management
  - Support for persistent connection capability
  - Support for SPL-3 initiate close capability
  - Configurable Rx and Tx polarity inversion
  - Configurable phy-to-disk mapping
  - Configurable SSC
- SATA interface features:
  - SATA and STP data transfers at 6Gb/s
  - Addressing of multiple SATA targets through an expander

Tri-Mode Storage Interface

The tri-mode interface groups phys into two CSW blocks that contain 16 phys each. Depending on the adapter, either one or both CSW blocks are used for the storage interface. Limitations exist on how the phys can be grouped to create wide ports for SAS/SATA or multilane ports for PCIe.

The following table indicates how the connectors map to the phys within each CSW. Card layout figures in Broadcom MegaRAID and eHBA Tri-Mode Storage Adapter Characteristics show the connector designations for each adapter.

Table 3: Adapter Connector-to-CSW Port Associations

Adapter	Connector 0	Connector 1	Connector 2	Connector 3
9670W-16i	CSW1[0:7]	CSW1[8:15]	—	—
9670-24i	CSW1[0:7]	CSW1[8:15]	CSW0[8:15]	—
9660-16i	CSW0[0:7]	CSW1[0:7]	—	—
9620-16i	CSW1[8:15]	CSW0[8:15]	—	—
9600-24i	CSW1[8:15]	CSW0[8:15]	CSW1[0:7]	—
9600-16i	CSW1[8:15]	CSW0[8:15]	—	—
9600-8i8e	CSW1[0:7]	CSW0[12:15]	CSW0[8:11]	—
9600W-16e	CSW0[12:15]	CSW0[8:11]	CSW0[4:7]	CSW0[0:3]
9600-16e	CSW0[12:15]	CSW0[8:11]	CSW0[4:7]	CSW0[0:3]

The internal adapters can direct attach to SAS, SATA, or NVMe drives. The internal and external adapters support drive attach through PCIe switches or expanders.

NOTE

Carefully assess any decision to mix SAS and SATA drives within the same virtual drive (VD). Although you can mix drives, the practice is discouraged.

MegaRAID does not permit mixing SAS and NVMe drives or SATA and NVMe drives within the same VD. To mix NVMe and SAS/SATA drives on a MegaRAID adapter, you must configure the drives in separate VDs.

The following sections describe the connector options for a single direct-attach type solution. Adhere to the same guidelines if you combine device types.

SAS/SATA Support

The storage interface is comprised of either 24 phys or 16 phys, depending on the adapter. Dedicated SAS phy management hardware manages the phys in groups of eight within each CSW: CSW0[0:7], CSW0[8:15], CSW1[0:7], and CSW1[8:15]. Depending on the adapter, one or more of these CSW groups are used for the SAS/SATA interfaces and these SAS phy management hardware instances cannot communicate with each other.

When you configure a wide port, the connections must attach exclusively to phys all managed by the same CSW group. If the ports are not managed by the same CSW group, unexpected controller and host behavior occurs. You can create combinations of a x1 to x8 wide link within CSW0[0:7], CSW0[8:15], CSW1[0:7], or CSW1[8:15]. You cannot create a wide link by spanning RX/TX pairs between CSW0 and CSW1 or between phys 8:15 and 0:7 within the same CSW group.

PCIe (NVMe) Support

The following table shows how many NVMe drives or Broadcom PEX88000-series switches can directly attach to each adapter. The 9600W-16e adapter, 9600-16e adapter, and 9600-8i8e adapter (external ports) do not support direct attach to NVMe drives. The expected topology for these adapters is a typical JBOF scenario that uses a switch to connect the NVMe drives.

NOTE

Connected NVMe drives must support End to End CRC (ECRC).

Table 4: NVMe Device or PCIe Switch Direct-Attach Options Supported for Each Adapter

Adapter	x4 NVMe Drives	x2 NVMe Drives	x1 NVMe Drives	x16 Switch	x8 Switches	x4 Switches
9670W-16i	4	8	16	1	2	4
9670-24i	6	12	24	1	3	6
9660-16i	4	8	16	0	2	4
9620-16i	4	8	16	0	2	2
9600-24i	6	12	24	0	3	6
9600-16i	4	8	16	0	2	4
9600-8i8e[a]	2	4	8	0	2	4
9600W-16e	0	0	0	1	2	4
9600-16e	0	0	0	1	2	4

The adapter phys are grouped into two CSWs: CSW1[0:15] and CSW0[0:15]. Depending on the adapter, 8 or 16 of these phys are used consecutively for the PCIe host interface and the remaining tri-mode phys are available for connection to any supported SAS, SATA, or PCIe (NVMe) storage devices. The following tables indicate supported topologies. Typical backplane designs naturally align to these topology rules, but you must take care not to design anything atypical that might interfere with the adapter's operation.

Table 5: 9670W-16i Adapter PCIe Topology Configuration Combinations

Connector 0								Connector 1							
CSW1[0:7]								CSW1[8:15]							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
x16															
x8								x8							
x8								x4				x4			
x4				x4				x4				x4			
x8								x2		x2		x2		x2	
x4				x4				x2		x2		x2		x2	
x2		x2		x2		x2		x2		x2		x2		x2	
x8								x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x1	x1	x1	x1	x1	x1	x1	x1

a. Only internal internal ports support direct-attach NVMe drives.

Connector 0								Connector 1							
CSW1[0:7]								CSW1[8:15]							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x8							
x2		x2		x2		x2		x8							
x1	x1	x1	x1	x1	x1	x1	x1	x8							
x2		x2		x2		x2		x4				x4			
x1	x1	x1	x1	x1	x1	x1	x1	x4				x4			

Table 6: 9660-16i Adapter PCIe Topology Configuration Combinations

Connector 0								Connector 1							
CSW0[0:7]								CSW1[0:7]							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
x8								x8							
x8								x4				x4			
x4				x4				x4				x4			
x8								x2		x2		x2		x2	
x4				x4				x2		x2		x2		x2	
x2		x2		x2		x2		x2		x2		x2		x2	
x8								x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x1	x1	x1	x1	x1	x1	x1	x1
x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x8							
x2		x2		x2		x2		x8							
x1	x1	x1	x1	x1	x1	x1	x1	x8							
x2		x2		x2		x2		x4				x4			
x1	x1	x1	x1	x1	x1	x1	x1	x4				x4			

Table 7: 9670-24i Adapter PCIe Topology Configuration Combinations

Connector 0								Connector 1								Connector 2							
CSW1[0:7]								CSW1[8:15]								CSW0[8:15]							
8	9	10	11	12	13	14	15									00	11	22	33	44	55	66	77
x16 (paired with Connector 2)								x8								x16 (paired with Connector 0)							
x16 (paired with Connector 2)								x4				x4				x16 (paired with Connector 0)							
x16 (paired with Connector 2)								x2		x2		x2		x2		x16 (paired with Connector 0)							

Connector 0								Connector 1								Connector 2							
CSW1[0:7]								CSW1[8:15]								CSW0[8:15]							
8	9	10	11	12	13	14	15									00	11	22	33	44	55	66	77
x16 (paired with Connector 2)								x1	x1	x1	x1	x1	x1	x1	x1	x16 (paired with Connector 0)							
Use any row from the previous 9660-16i Adapter PCIe Topology Configuration Combinations table.																x8							
Use any row from the previous 9660-16i Adapter PCIe Topology Configuration Combinations table.																x4				x4			
Use any row from the previous 9660-16i Adapter PCIe Topology Configuration Combinations table.																x2		x2		x2		x2	
Use any row from the previous 9660-16i Adapter PCIe Topology Configuration Combinations table.																x1	x1	x1	x1	x1	x1	x1	x1

Table 8: 9600-16i Adapter and 9620-16i Adapter PCIe Topology Configuration Combinations

Connector 0								Connector 1							
CSW1[8:15]								CSW0[8:15]							
								88	99	1010	1111	1212	1313	1414	1515
x8								x8							
x8								x4				x4			
x4				x4				x4				x4			
x8								x2		x2		x2		x2	
x4				x4				x2		x2		x2		x2	
x2		x2		x2		x2		x2		x2		x2		x2	
x8								x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x1	x1	x1	x1	x1	x1	x1	x1
x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x8							
x2		x2		x2		x2		x8							
x1	x1	x1	x1	x1	x1	x1	x1	x8							
x2		x2		x2		x2		x4				x4			
x1	x1	x1	x1	x1	x1	x1	x1	x4				x4			

Table 9: 9600-24i Adapter PCIe Topology Configuration Combinations

Connector 0								Connector 1								Connector 2							
CSW1[8:15]								CSW0[8:15]								CSW1[0:7]							
8	9	10	11	12	13	14	15	8	9	10	11	12	13	14	15	0	1	2	3	4	5	6	7
x8								x8								x8							
x8								x4				x4				x4				x4			
x4				x4				x2		x2		x2		x2		x2		x2		x2		x2	
x8								x2		x2		x2		x2		x1	x1	x1	x1	x1	x1	x1	x1
x4				x4				x2		x2		x2		x2		Combine with any of the first four configurations in this column.							
x2		x2		x2		x2		x1	x1	x1	x1	x1	x1	x1	x1	Combine with any of the first four configurations in this column.							
x8								x1	x1	x1	x1	x1	x1	x1	x1	Combine with any of the first four configurations in this column.							
x4				x4				x1	x1	x1	x1	x1	x1	x1	x1	Combine with any of the first four configurations in this column.							
x1	x1	x1	x1	x1	x1	x1	x1	x8								Combine with any of the first four configurations in this column.							
x4				x4				x8								Combine with any of the first four configurations in this column.							
x2		x2		x2		x2		x8								Combine with any of the first four configurations in this column.							
x1	x1	x1	x1	x1	x1	x1	x1	x4				x4				Combine with any of the first four configurations in this column.							
x2		x2		x2		x2		x4				x4				Combine with any of the first four configurations in this column.							
x1	x1	x1	x1	x1	x1	x1	x1	x4				x4				Combine with any of the first four configurations in this column.							

Table 10: 9600W-16e Adapter and 9600-16e Adapter PCIe Topology Configuration Combinations

Connector 0				Connector 1				Connector 2				Connector 3			
CSW0[12:15]				CSW0[8:11]				CSW0[4:7]				CSW0[0:3]			
12	13	14	15	8	9	10	11	4	5	6	7	0	1	2	3
x16															
x8								x8							
x4				x4				x4				x4			

Table 11: 9600-8i8e Adapter PCIe Topology Configuration Combinations

Connector 0								Connector 1				Connector 2			
CSW1[0:7]								CSW0[12:15]				CSW0[8:11]			
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**12**	**13**	**14**	**15**	**8**	**9**	**10**	**11**
x8								x8							
x4				x4				x4				x4			
x2		x2		x2		x2		—							
x1	x1	x1	x1	x1	x1	x1	x1	—							

Common REFCLK Support

The adapter uses x8 SFF-8654 (SlimSAS) connectors. Each connector is divided into two quadrants. For connections that require a common REFCLK, one REFCLK is supplied for each quadrant. For x4 NVMe or PCIe switch connections, the REFCLK sourced by each quadrant directly clocks each attached x4 PCIe connection.

To directly attach x2 or x1 NVMe drives that require a common REFCLK, where more than one drive is sourced from a single quadrant, you must properly fan out the shared REFCLK on the backplane. For x2 and x1 NVMe connections, use SRIS-enabled drives to avoid fanning the clock out on the backplane.

Backplane Management

The SFF-8448 standard defines how to detect whether the backplane supports a SGPIO or two-wire interface (I^2C) for SAS/SATA usage. SFF-9402 is a superset of SFF-8448, adding the PCIe-defined sideband signal, which means that SAS/SATA users see no change in backplane management detection when using the adapters.

Universal Backplane Management

The adapters provide LED operation and other backplane management of NVMe only, SAS/SATA only, or mixed-protocol backplanes based on the SFF-TA-1005 specification. SFF-TA-1005 is an industry-standard backplane management specification commonly known as Universal Backplane Management (UBM). As long as the backplane management controller is designed in accordance with the UBM specification, the adapter automatically detects the backplane type and functions appropriately.

The adapter supports the industry-standard *SFF-TA-1005 Specification for Universal Backplane Management (UBM)*. UBM provides the following key features:

- Reports the backplane capabilities, including the following:
  - NVMe drive widths
  - Common REFCLK or separate REFCLK support
  - Maximum speeds
  - Designed slot power
- Supports cable order independence, that is, the drive LED control and slot ID are not dependent on cable order.
- Enables drive hot plug insertion through control of PERST# timing.

For existing SAS/SATA backplanes, if BP_TYPE = 0, the adapter uses SGPIO for legacy backplane management. Refer to the SFF-8485 specification for functionality details. Design new backplanes with the industry-standard SFF-TA-1005 (UBM) specification for backplane management.

Virtual Pin Port Management

Broadcom requires new designs to enable UBM for backplane management. The adapter maintains support for Virtual Pin Port (VPP) backplane management for legacy implementations. The adapters provide LED operation for NVMe devices based on the VPP over I^2C definition. Standard VPP implementation calls for one PCA9555 target per two devices. For each drive pair, the adapter expects to see one PCA9555 target responding to address 0x4C on each pair of NVMe drives.

Sideband Signals

The internal adapters have one or two x8 SFF-8654 connectors. Each x8 connector provides two sets of sidebands. This section describes the sideband signal usage. The following table defines the sideband signal's pins on the SFF-8654 connector. The last column in the table indicates the strength of the pull-up resistor or pull-down resistor values on the adapter. See Table 13, Sideband Management Pin Settings, for the signal descriptions, and see Table 14, Internal x8 SFF-8654 Connector Pinout, for a complete connector pinout.

Table 12: Sideband Signal Pinout

Connector A Side	Connector B Side	Sideband or Vendor Specific Pin Number	UBM Assignments	Direction	Resistor Value
A8	A26	7	BP_TYPE	Input	100 kΩ pull-down
A9	A27	4	2W_RESET#	Output	2.0 kΩ pull-up
A10	A28	3	GND	—	—
A11	A29	+	REFCLK+	Output	—
A12	A30	–	REFCLK-	Output	—
B8	B26	0	2W_CLK	Input/Output	2.0 kΩ pull-up
B9	B27	1	2W_DATA	Input/Output	2.0 kΩ pull-up
B10	B28	2	GND	—	—
B11	B29	5	PERST#	Input/Output	2.0 kΩ pull-up
B12	B30	6	C_TYPE, D_INPL#, CHANGE_DET#	Input/Output	10 kΩ pull-up

The following table describes the sideband signal pin settings.

Table 13: Sideband Management Pin Settings

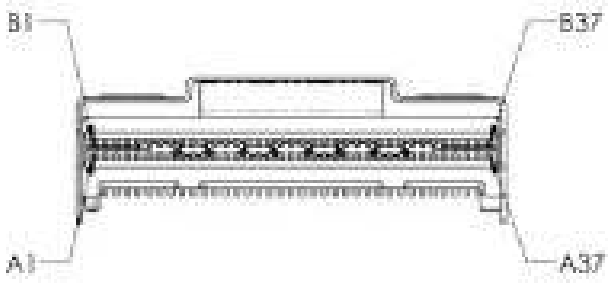
Pin Name	Settings	Description
BP_TYPE	• 0: SGPIO • 1: Two-wire interface	Indicates if the backplane uses SGPIO or two-wire interface for management. To maintain backwards compatibility with SPGIO-based backplanes, the adapter has a weak pull-down to default to SGPIO if the backplane does not explicitly drive the signal.
2W_RESET#	• 0: Reset is asserted • 1: Reset is not asserted	Optional reset driven by the host if the UBM target reports that the target can be reset.
REFCLK+/-	—	PCIe REFCLK HCSL 100-MHz clock driven by the device side ports to PCIe devices that require REFCLK. If D_INPL# is 0 and BP_TYPE is 1, the adapter enables the REFCLK outputs for that quad of high-speed lanes. When BP_TYPE is 0 or the UBM Clock Routing bit on the backplane is 0, this output is turned off.
2W_CLK	—	The two-wire interface clock signal.
2W_DATA	—	The two-wire interface data signal.
PERST#	• 0: Reset is asserted • 1: Reset is not asserted	The adapter drives the PCIe RESET# signal. This signal uses a clamp to ground so that the signal on the adapter powers up LOW until backplane detection warrants the release of this signal for open-drain use. This method ensures that PERST# does not deassert until the directly connected NVMe drive is successfully detected.

Pin Name	Settings	Description
C_TYPE, D_INPL#, CHANGE_DET#	—	Open collector/drain input or output signal. • C_TYPE. If BP_TYPE is 0, the adapter drives this signal LOW. If BP_TYPE is 1, this signal adheres to the SFF-8448 requirement to drive this signal to 1 in response to floating the signal. Because this signal is an open drain signal, *driving* to 1 is when a pull-up resistor pulls this signal HIGH. • D_INPL#. When C_TYPE is HIGH, the backplane pulls this signal to ground to indicate an NVMe device is connected and a two-wire interface backplane management target might be on the sideband's two-wire interface. • CHANGE_DET#. If D_INPL# is 0 and a UBM FRU device is discovered on the two-wire interface, the UBM FRU data can inform the adapter that the device is CHANGE_DET# feature capable. The adapter can rely on this signal as the CHANGE_DET# signal as described in the UBM specification. In this mode, the UBM controller drives this signal LOW to assert CHANGE_DET#.

Cables and Cabling Configurations

The internal adapter follows the SFF-9402 standard for connector signal assignments. Each x8 connector includes eight PCIe transmit and receive lanes and two sets of sidebands designated as A and B, in accordance with the SFF-9402 specification. The following figure shows the x8 SFF-8654 pin designations.

Figure 1: x8 SFF-8654 Pin Designations



The following table defines the adapter's internal x8 SFF-8654 connector pinouts.

Table 14: Internal x8 SFF-8654 Connector Pinout

Pin	Name	Pin	Name
A1	GND	B1	GND
A2	PERp0, RX0+	B2	PETp0, TX0+
A3	PERn0, RX0-	B3	PETn0, TX0-
A4	GND	B4	GND
A5	PERp1, RX1+	B5	PETp1, TX1+
A6	PERn1, RX1-	B6	PETn1, TX1-
A7	GND	B7	GND
A8	BP_TYPEA	B8	2W-CLKA, SClockA
A9	2W_RESETA,SDataOutA	B9	2W-DATAA, SloadA
A10	GND	B10	GND
A11	REFCLKA+	B11	PERSTA#, SDatainA
A12	REFCLKA-	B12	CPRSNTA#, CNTRLR_TYPEA
A13	GND	B13	GND
A14	PERp2, RX2+	B14	PETp2, TX2+
A15	PERn2, RX2-	B15	PETn2, TX2-
A16	GND	B16	GND
A17	PERp3, RX3+	B17	PETp3, TX3+
A18	PERn3, RX3-	B18	PETn3, TX3-
A19	GND	B19	GND
A20	PERp0, RX4+	B20	PETp0, TX4+

Pin	Name	Pin	Name
A21	PERn0, RX4-	B21	PETn0, TX4-
A22	GND	B22	GND
A23	PERp1, RX5+	B23	PETp1, TX5+
A24	PERn1, RX5-	B24	PETn1, TX5-
A25	GND	B25	GND
A26	BP_TYPEB	B26	2W-CLKB, SClockB
A27	2W_RESETB,SDataOutB	B27	2W-DATAB, SLoadB
A28	GND	B28	GND
A29	REFCLKB+	B29	PERSTB#, SDataInB
A30	REFCLKB-	B30	CPRSNTB#, CNTRLR_TYPEB
A31	GND	B31	GND
A32	PERp2, RX6+	B32	PETp2, TX6+
A33	PERn2, RX6-	B33	PETn2, TX6-
A34	GND	B34	GND
A35	PERp3, RX7+	B35	PETp3, TX7+
A36	PERn3, RX7-	B36	PETn3, TX7-
A37	GND	B37	GND

Storage Interface Cabling

Choose the proper cable for the given backplane type and connectors. The correct choice is especially important for backplanes that use SFF-8643 for the NVMe connectors. Many of these backplanes use an older legacy-recommended pinout for the NVMe connector instead of a connector pinout based on the SFF-9402 specification. Most backplanes that use either SFF-8612 or SFF-8654 connectors follow the SFF-9402 specification. The pinout recommended in the *PCI Express OCuLink Specification* is equivalent to that recommended for SFF-9402. Verify the connector pinout for the intended backplane to make sure the proper cable is used when connecting to NVMe drives.

Broadcom provides the following cables to use for the adapter. Use the MPN listed to order a cable from Broadcom. If you source your own cables, use the Broadcom part number from the following table, and the drawings and pinouts in Cable Drawings and Pinouts.

Table 15: Internal Adapter Cables

MPN	Broadcom Cable Part No.	Cable Description	Backplane Connector
05-60001-00	5067-6865	x8 8654 to 2x4 8612, AltWiring 1M	Two x4 SFF-8612 (OCuLink)
05-60002-00	5067-6862	x8 8654 to 2x4 8643 (W), SMC 1M	Two x4 SFF-8643 (mini-SAS HD)
05-60003-00	5067-6866	x8 8654 to 2x4 8643, 9402 SAS 1M	Two x4 SFF-8643 (mini-SAS HD)
05-60004-00	5067-6103	x8 8654 to 2x4 8654, 9402 1M	Two x4 SFF-8654 (SlimSAS)
05-60005-00	5067-6682	x8 8654 to 2xU.2 Direct, 1M	Two U.2 SFF-8639
05-60006-00	5067-7542	x8 8654 to 8xU.3 Direct, 1M	Eight U.3 SFF-8639
05-60007-00	5067-6869	x8 8654 to 1x8 8654, 9402 1M	One x8 SFF-8654 (SlimSAS)

Table 16: Adapter Broadcom Cable Use Cases

MPN	Type	Description
05-60001-00	SAS/SATA and NVMe	Use for backplanes with x4 SFF-8612 connectors with pinouts that follow the SFF-9402 specification.
05-60002-00	NVMe	Specialty cable that provides NVMe connections for SuperMicro Purley backplanes. This cable has white SFF-8643 connectors to indicate that it must connect to the white SFF-8643 connectors on the SuperMicro Purley backplanes.
05-60003-00	SAS/SATA	Use for traditional SAS/SATA connections. Usually backplanes designed to support SAS/SATA only or are double plumbed for U.2 and SAS/SATA drives use SFF-8643 connectors.
05-60004-00	SAS/SATA and NVMe	Use for backplanes with x4 SFF-8654 connectors with pinouts that follow the SFF-9402 specification.
05-60005-00	NVMe	Enables direct connect from the adapter to a U.2 NVMe drive. Use for proof-of-concept type applications.
05-60006-00	SAS/SATA and NVMe	Enables direct connect from the adapter to a U.3 NVMe or SAS/SATA drive. This cable does not send a PCIe REFCLK or PERST# to each drive connector; that is, the U.3 drive must support SRIS and not require PERST#. Use for proof-of-concept type applications.
05-60007-00	SAS/SATA and NVMe	Use for backplanes with x8 SFF-8654 connectors with pinouts that follow the SFF-9402 specification.

Backplane Connectors

The SFF-8612 or SFF-8654 connectors are the preferred connectors to use for the NVMe backplane or multiprotocol backplanes, based on the SFF-TA-1001 universal bay definition.

Backplanes that use OCuLink connectors should follow the *PCI Express OCuLink Specification*. This pinout is also equivalent to the SFF-9402 specification recommendations. Verify the backplane connector pinout to make sure you use proper cabling to the NVMe drive. Refer to the *PCI Express OCuLink Specification* and the SFF-9402 specification for backplane NVMe connector pinout information.

External Adapter Connector Pinout

External adapters support SAS and PCIe connections. The PCIe cable specification swaps lanes 0 and 1 compared to the SAS specification. For PCIe connections, this swap means the external pinout must place lanes 0 and 1 on the same pins as the JBOF. This swap does not impact SAS connections because lane ordering does not impact SAS designs.

For external PCIe JBOF connections, as defined by the *PCI Express External Cabling Specification*, the adapter does not connect REFCLK and PERST#. The adapter only supports an SRIS-capable endpoint, that is, no REFCLK. The JBOF handles the drive (connected to the JBOF switch) start-of-day reset, hot insertion, and clocking requirements.

The adapter expects a local (single master) two-wire bus connection to the cable or active module's EEPROM. A cable requires a local EEPROM on each end to identify cable properties, such as length, loss budget, ganging, and so on. The adapter supports no direct communication to the enclosure over two-wire. SES performs enclosure management.

When using active cables with the 9600-16e adapter, eHBA 9600-8e adapter, and eHBA9600-8i8e adapter, the adapter toggles the active cable's Vact port (active cable power), but not the Vman port (management interface power) when doing an online firmware update or for other conditions that result in a soft reset. If your active cable requires Vman to be toggled, the cable must be removed and reinserted, or power to the card slot must be cycled. If neither action is done, the storage link will not be restored. If the active cable requires that only Vact toggle, no power cycle or cable re-insertion is needed.

When using active cables with the 9600-16e adapter, eHBA 9600-8e adapter, or eHBA 9600-8i8e adapter, you must implement an additional step if your active cable requires that the Vman port (management interface power) be toggled. The Broadcom adapter toggles the active cable's Vact port (active cable power), but not the Vman port after an online firmware update or for other conditions that result in a soft reset. If your active cable requires that the Vman port be toggled, the cable must be removed and reinserted, or power to the card slot must be cycled. If neither action is done, the PCIe/SAS link will not be restored. If the active cable requires that only the Vact port toggle, no power cycle or cable re-insertion is needed.

The following table shows the cable pinout for the cable that Broadcom provides for the external adapter. See Cable Drawings and Pinouts for drawings and pinouts of each listed cable. Use the drawings if you source your own cables.

Table 17: External Adapter Cable Pinout

Pin	Signal	Pin	Signal
A1	No Connect	C1	CMICLK
A2	CINT#	C2	CMIDAT
A3	GND	C3	GND
A4	PERp0, RX0+	C4	PETp0, TX0+
A5	PERn0, RX0-	C5	PETn0, TX0-
A6	GND	C6	GND
A7	PERp3, RX3+	C7	PETp3, TX3+
A8	PERn3, RX3-	C8	PETn3, TX3-
A9	GND	C9	GND
B1	PWR	D1	PWR
B2	CBLPRSNT#	D2	MGTPWR
B3	GND	D3	GND
B4	PERp1, RX1+	D4	PETp1, TX1+
B5	PERn1, RX1-	D5	PETn1, TX1-
B6	GND	D6	GND
B7	PERp2, RX2+	D7	PETp2, TX2+
B8	PERn2, RX2-	D8	PETn2, TX2-
B9	GND	D9	GND

Broadcom provides the following cable to use for external adapters. Use the MPN listed to order the cable from Broadcom. If you source your own cables, use the Broadcom part number from the following table, and the drawings and pinouts in Cable Drawings and Pinouts.

Table 18: External Adapter Cable

MPN	Broadcom Cable Part No.	Cable Description	Backplane Connector
05-60009-00	5067-9643	G4/S4 x4 8644 to x4 8644, 3M	Two x4 SFF-8674

CacheVault Data Protection

The MegaRAID Tri-Mode storage adapters support data retention by using NAND flash memory down on the adapter, backed up by a CacheVault™ Power Module 05 (CVPM05).

The CVPM05 module is a super-capacitor pack that provides power for the backup of your data in case of host power loss or server failure. The CVPM05 module connects to the controller remotely by cable. The data is backed up to the NAND flash memory available on the MegaRAID storage adapter.

NOTE
If you do not use the remote mount board or clip included with the CacheVault kit, do not damage the CVPM05 module when mounting in the system. For more information on mounting the CVPM05 module, refer to*CVPM02, CVPM05 Power Modules | CVFM04 Cache Module MegaRAID CacheVault Protection Products User Guide*.

In the event of host power loss or server failure, any data available in the cache is offloaded to the onboard NAND memory. During this process, the CVPM05 power module powers the necessary components needed for offload.

NOTE

You cannot hot plug CVPM05 modules. Removing or inserting a CVPM05 module with the adapter powered on might damage the board and the super-capacitor functionality. To attach or remove a CVPM05 module from an adapter, you must fully power down the adapter before you attach the module to or remove the module from its mating connector.

For more information on installation of the CVPM05 module, refer to the *CacheVault Power Module 05 Getting Started Guide* available at http://www.broadcom.com/support/download-search.

Adapter Security

The adapters provide two security features to protect your system from malicious activity:

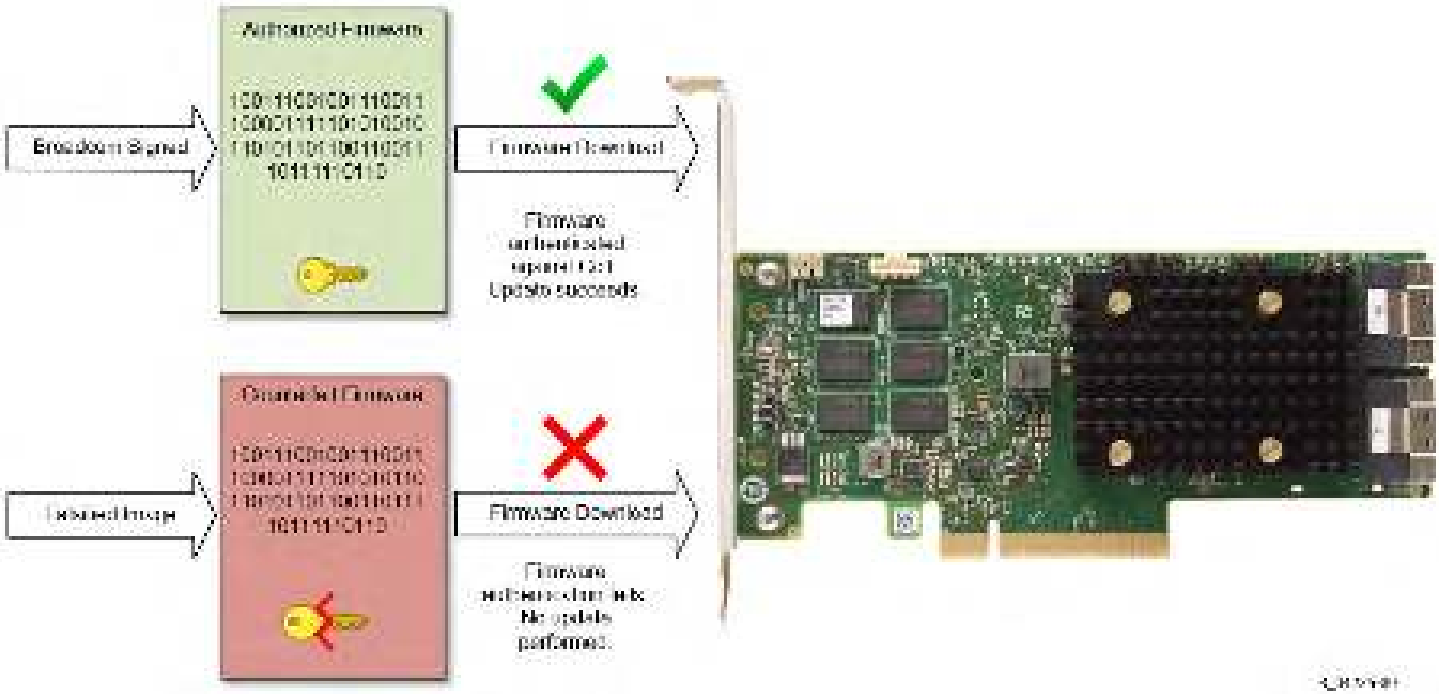
- Hardware secure boot – Permits only authenticated firmware to execute on the adapter
- Device authentication – Enables another entity in the server to authenticate the adapter

The following sections provide details about each security feature.

Hardware Secure Boot

Hardware secure boot permits only authenticated firmware to execute on the adapter. The adapter boots from an internal boot ROM, which establishes the initial root of trust (RoT). Hardware secure boot authenticates and builds a chain of trust (CoT) with succeeding firmware images by using the RoT, meaning only authorized firmware executes on the adapter.

Figure 2: Authenticated Firmware Example



Hardware secure boot requires that each image be signed with a valid digital signature; otherwise, the image is considered invalid and does not execute. The adapter ships with a valid signed firmware image. All Broadcom-supplied firmware includes a valid digital signature; therefore, the hardware secure boot process is transparent unless the adapter encounters a counterfeit image. If the adapter downloads a counterfeit image, the image authentication fails and the download utility, such as StorCLI2, displays the appropriate failure messages. Contact Broadcom Technical Support for assistance.

Device Authentication

Device authentication allows the adapter to prove its unique device identity to another entity in the server as part of a platform attestation implementation. The adapter proves its unique device identity with a device ID certificate and a challenge protocol.

The device authentication process includes a platform RoT device (a baseboard management controller [BMC] or a discreet component) and the adapter (the attested device). The platform RoT device requests the device certificate from the controller on the adapter for authentication. If the device authentication process fails, the platform RoT device operates in accordance with its platform security policy.

Device Certificate

The controller on the adapter uses a device certificate and associated certificate chain to present evidence of its device identity. The certificate chain is based on the X.509 v3 standards and the *Security Protocol and Data Model (SPDM) Specification*, version 1.1.0.

The device certificate contains identifying information about the controller, including the device serial number. The private key of a parent and intermediate signing certificate signs the device certificate. The device certificate cannot be modified after manufacture.

Broadcom manufacturing provisions each board with its device certificate. Every 96xx adapter manufactured is provisioned with a certificate chain. When the SPDM `GET_CERTIFICATE` command queries the controller, the controller returns the device certificate chain, which includes a hash of the root certificate.

Attestation Procedure

Attestation is the process in which the server's BMC, or other discrete logic, challenges the adapter for proof of authenticity. Using attestation in the server is optional. The adapter functions without performing attestation. If attestation fails, the adapter continues to function normally. You must determine the next steps for your system if the adapter fails attestation.

Figure 3: Attestation Procedure Example

To support attestation, you must obtain the external root certificate authority to configure the platform RoT, such as BMC. You can download the external root certificate from Support Documents and Downloads.

SPDM Capabilities

Security Protocol and Data Model (SPDM) Specification v1.1.0 enables the Requester (BMC/discrete logic) and the Responder (adapter) to exchange keys to enable encryption support for the management interface information exchange. By default, if the Requester asks, the adapter enables authenticated encryption of the management interface. This process occurs dynamically between the Requester and Responder as part of the attestation procedure and requires no change to the adapter's settings.

The following table lists the SPDM v1.1 endpoint CAPABILITIES response message flags. Flags listed as supported respond to the GET_CAPABILITIES request message.

Table 19: SPDM CAPABILITIES Response Message Support

CAPABILITIES Response Flags Field	Value
CACHE_CAP	0
CERT_CAP	1
CHAL_CAP	1
MEAS_CAP	10
MEAS_FRESH_CAP	0
ENCRYPT_CAP	1
MAC_CAP	1
MUT_AUTH_CAP	1
KEY_EX_CAP	1
PSK_CAP	00
ENCAP_CAP	1
HBEAT_CAP	1
KEY_UPD_CAP	1
HANDSHAKE_IN_THE_CLEAR_CAP	0/1
PUB_KEY_ID_CAP	0

The adapter supports SPDM mutual authentication. The HANDSHAKE_IN_THE_CLEAR_CAP capability bit is shown as 0/1 because the value is subject to negotiation. The firmware sets the HANDSHAKE_IN_THE_CLEAR_CAP bit to 0, but the firmware can set the bit to 1 if the Requester sets the bit to 1. While the adapter supports all capabilities listed in the previous table, the Requester might not support the same capabilities. The adapter correctly negotiates its capabilities with that of the Requester. Refer to the *StorCLI2 Utility User Guide* for additional security command information.

Adapter Installation Instructions

Use the following steps to install the adapter:

1. **Unpack your adapter.**

   Unpack and remove the adapter. Inspect the adapter for damage. If it appears damaged, contact Broadcom Technical Support.

   ATTENTION
   To avoid the risk of data loss, back up your data before you change your system configuration.

2. **Turn off the power to the system.**

   Turn off the power to the computer and disconnect the AC power cord. Remove the computer cover. Refer to the system documentation for instructions. Before you install the adapter, make sure that the computer is disconnected from the power and from any networks.

   CAUTION
   Disconnect the computer from the power supply and from any networks to which you will install the adapter, or you risk damaging the system or experiencing electrical shock.

3. **Review the adapter connectors.** See Broadcom MegaRAID and HBA Tri-Mode Storage Adapter Characteristics for descriptions of the adapters that show their connectors.

4. **Check the mounting bracket on the adapter.**

   If required for your system, replace the full-profile mounting bracket that ships on the adapter with the low-profile bracket supplied. Complete the following steps to attach the low-profile bracket:

   a) Using a No. 1 Phillips screwdriver that is ESD safe, remove the two Phillips screws that connect the full-profile bracket to the board. Unscrew the two screws located at the top and bottom edges of the board. Avoid touching any board components with the screwdriver or the bracket.
   b) Remove the full-profile bracket. Do not damage the adapter.
   c) Place the adapter on top of the low-profile bracket. Position the bracket so that the screw holes in the tabs align with the openings in the board.
   d) Using a No. 1 Phillips torque screwdriver that is ESD safe, set to a maximum torque of 4.8 ±0.5 inch-pounds. Replace the two Phillips screws removed in Step a.

      ATTENTION

      Exceeding this torque specification can damage the board, connectors, or screws, and can void the warranty on the board.

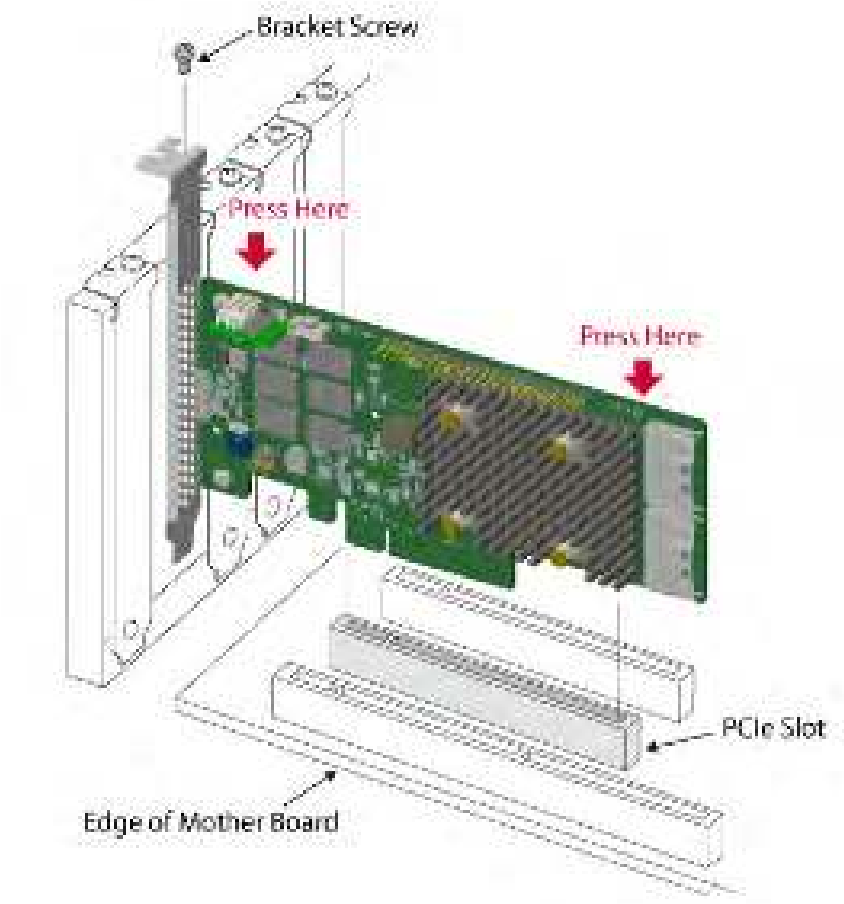
      ATTENTION

      Damage caused to the board as a result of changing the bracket can void the warranty on the board. Adapters returned without a bracket mounted on the board will be sent back without return merchandise authorization (RMA) processing.

5. **Insert the adapter into an available PCIe slot.** Select a PCIe slot, and align the adapter's PCIe bus connector to the slot, as shown in the following figure. Press down gently, but firmly, to make sure that the adapter is seated correctly in the slot. Secure the bracket to the computer chassis with the bracket screw.

   NOTE
   Adapters with a x8 host interface can operate in x8 or x16 slots. However, some x16 PCIe slots support only PCIe graphics cards; an adapter installed in one of these slots will not function. Refer to the guide for your motherboard for information about the PCIe slots.

Figure 4: Installing an Adapter in a PCIe Slot



6. **Configure and install the SAS, SATA, and PCIe (NVMe) devices in the host computer case.**

   Refer to documentation for the devices for any preinstallation configuration requirements.

7. **Connect the adapter to the devices.** Connect the appropriate cable with the connectors on one end to connect to the adapter and the appropriate connector on the other end to attach to the backplane connector.

   The maximum cable length is 1 meter (39.37 in.). A single wide-port SAS or multilane PCIe (NVMe) device cannot connect to phys controlled by different CSWs. See Tri-Mode Storage Interface for more information.

8. **Provide the required airflow for the installed adapter.** See Operating and Non-operating Conditions to find the adapter's cooling requirements.

9. **Turn on the power to the system.** Reinstall the computer cover, and reconnect the AC power cords. Make sure that the power is turned on to the storage devices before or at the same time that the power is turned on to the host computer. Turn on power to the host computer. If the computer is powered on before these devices, the devices might not be recognized.

   During boot, a BIOS message appears. The firmware takes several seconds to initialize. The configuration utility prompt times out after several seconds. The second portion of the BIOS message shows the adapter controller number, firmware version, and cache SDRAM size. The numbering of the adapters follows the PCIe slot scanning order used by the host motherboard.

10. **Choose the correct storage profile.** Refer to the *MegaRAID Tri-Mode Software User Guide* and *LSI® Storage Authority Software User Guide* for details about setting up your adapter.
11. **Install the operating system driver.** The adapters can operate under various operating systems. To operate under these operating systems, you must install the software drivers. The firmware and drivers are routinely updated and made available on the Support and Download center. Visit http://www.broadcom.com/support/download-search, and download the latest firmware and driver for the adapter.

The hardware installation of your adapter is complete.

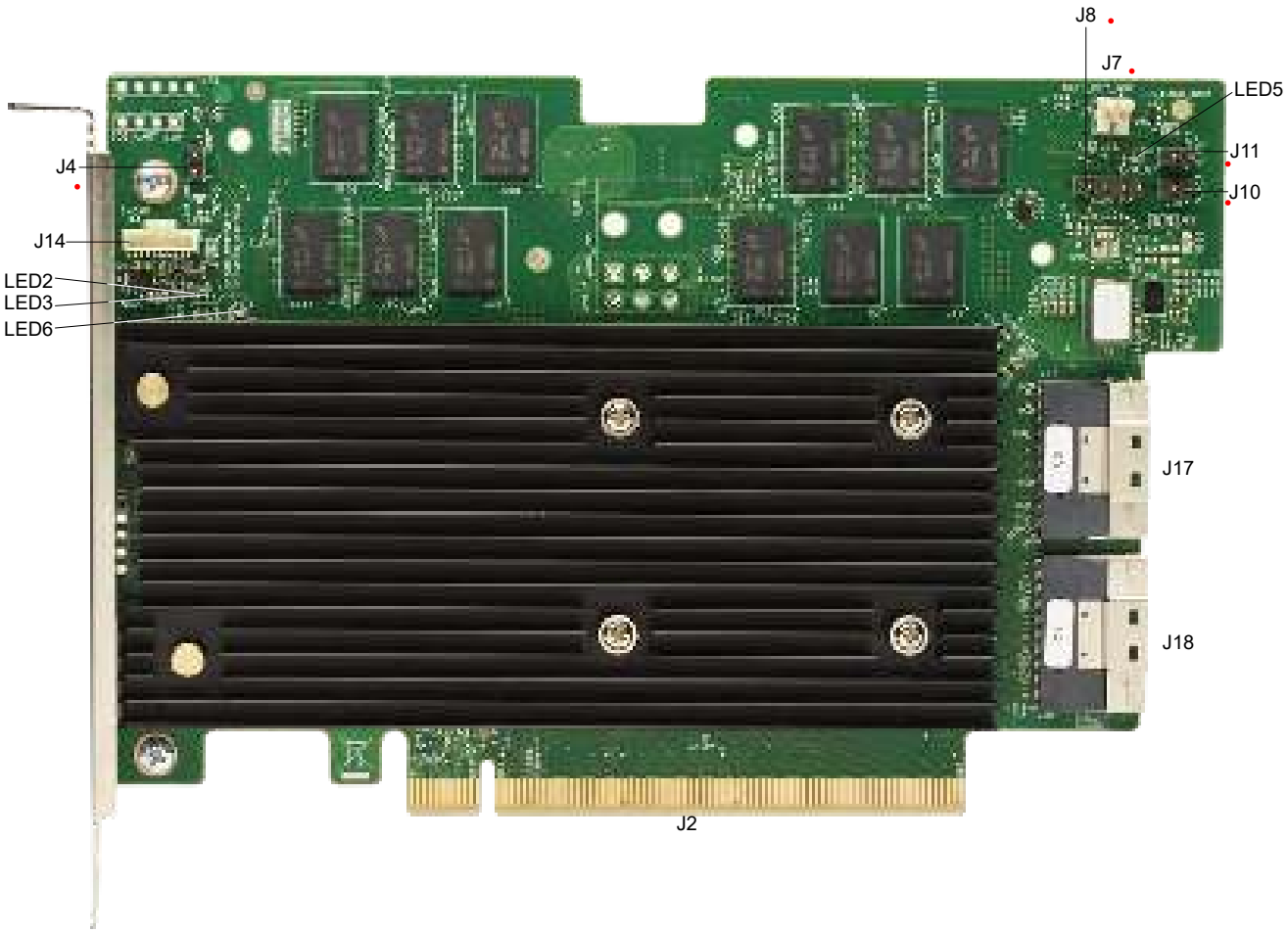
Broadcom MegaRAID and HBA Tri-Mode Storage Adapter Characteristics

MegaRAID 9670W-16i Adapter – Connector and LED Designations

The adapter is a 167.52 (±0.13) mm × 111.15 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

The following figure shows the connectors and LED locations on the adapter. Pin 1 on the headers and connectors is highlighted in red in the figure.

Figure 5: Card Layout for the MegaRAID 9670W-16i Tri-Mode Storage Adapter



The following table describes the headers and connectors on the adapter.

Table 20: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the Intelligent Platform Management Interface (IPMI).
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J7	Advanced software options hardware key header	2-pin connector. Enables support for selected advanced features.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J10	Global HDD activity LED header	2-pin connector. Connects to an LED that indicates activity on the drives connected to the adapter.
J11	Global drive fault LED header	2-pin connector. Connects to an LED that indicates whether a drive is in a fault condition.
J14	CacheVault power module interface	9-pin connector. Connects the adapter to a CacheVault power module.
J17, J18	Storage interface connectors	Two SFF-8654 8-port internal connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter.

Table 21: LED Designations

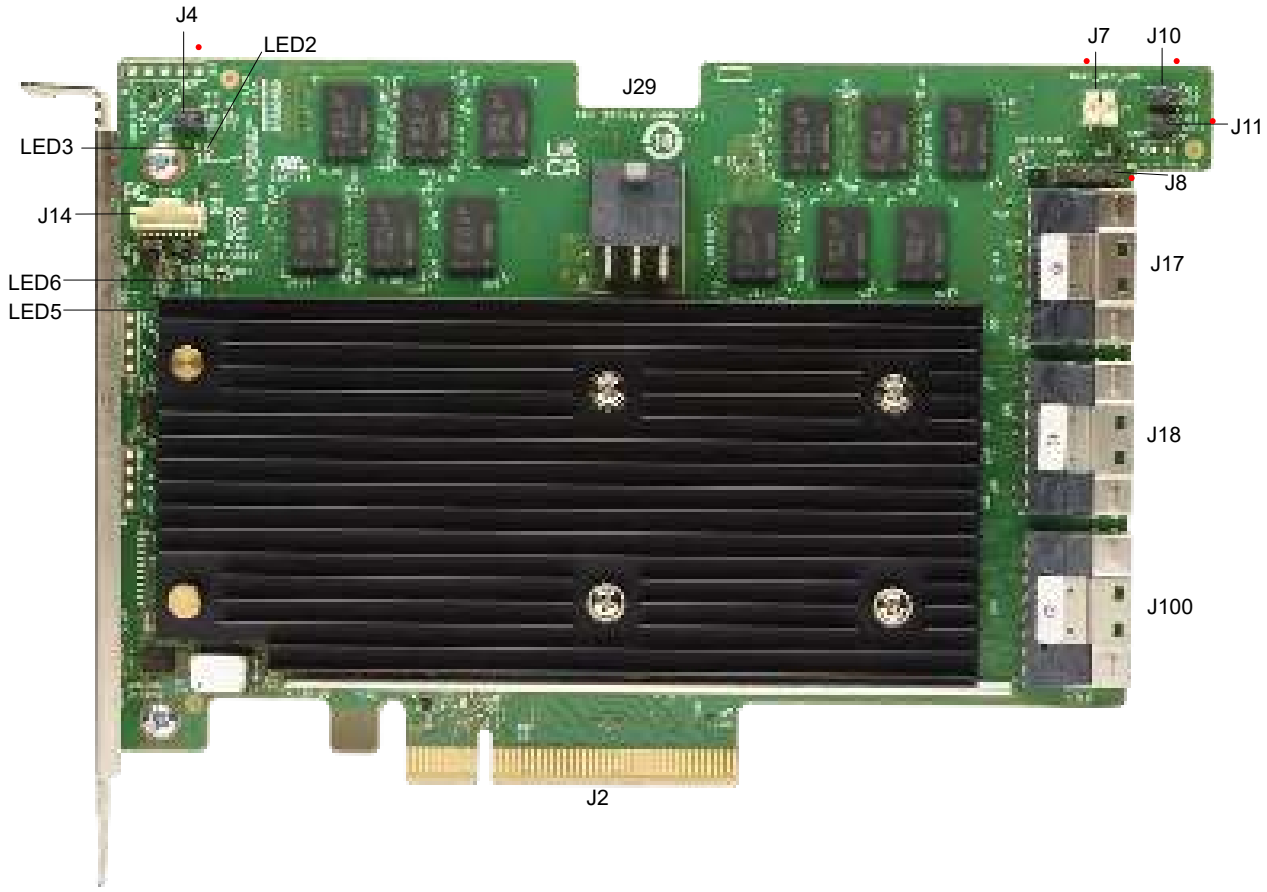
LED	Type	Description
LED2	Yellow controller overtemperature	Stays on solid to indicate that the SAS4116W RoC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off.
LED3	Green system heartbeat	Indicates that the SAS4116W RoC ASIC is operating normally. This LED blinks at 1 Hz.
LED5	Yellow supercap fault	Indicates that the CacheVault power module is in fault state or is overtemperature. When the energy pack is in the FAULT condition or is missing, this LED is on.
LED6	Green ONFI activity	Indicates when the ONFI is active for cache offload or recovery.

MegaRAID 9670-24i Adapter – Connector and LED Designations

The adapter is a 167.65 (±0.13) mm × 111.15 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

The following figure shows the connectors and LED locations on the adapter. Pin 1 on the headers and connectors is highlighted in red in the figure.

Figure 6: Card Layout for the MegaRAID 9670-24i Tri-Mode Storage Adapter



The following table describes the headers and connectors on the adapter.

Table 22: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the Intelligent Platform Management Interface (IPMI).
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J7	Advanced software options hardware key header	2-pin connector. Enables support for selected advanced features.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J10	Global HDD activity LED header	2-pin connector. Connects to an LED that indicates activity on the drives connected to the adapter.
J11	Global drive fault LED header	2-pin connector. Connects to an LED that indicates whether a drive is in a fault condition.

Connector	Type	Description
J14	CacheVault power module interface	9-pin connector. Connects the adapter to a CacheVault power module.
J17, J18, J100	Storage interface connectors	Three SFF-8654 8-port internal connectors. Connect the adapter by cable to the storage devices.
J29	Auxiliary power connector	6-pin connector.

The following table describes the LEDs on the adapter.

Table 23: LED Designations

LED	Type	Description
LED 2	Yellow controller overtemperature	Stays on solid to indicate that the SAS4124 RoC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off.
LED 3	Green system heartbeat	Indicates that the SAS4124 RoC ASIC is operating normally. This LED blinks at 1 Hz.
LED 5	Yellow supercap fault	Indicates that the CacheVault power module is in fault state or is overtemperature. When the energy pack is in the FAULT condition, this LED is on.
LED 6	Green ONFI activity	Indicates when the ONFI is active for cache offload or recovery.

Auxiliary Power Connector

The MegaRAID 9670-24i adapter supports the *PCI Express Card Electromechanical Specification* defined 2×3 auxiliary power connector. Connect the auxiliary power connector if the slot cannot supply the required power as defined in MegaRAID Tri-Mode Storage Adapter Power Supply Requirements. The power check algorithm detects if auxiliary power is connected to the adapter. If auxiliary power is connected, the power check is bypassed and the card is fully enabled. The auxiliary power connector's pin definition meets the PCIe CEM specification and the following table is included for reference. The following figure shows the connector's pin designations.

Figure 7: Auxiliary Power Connector

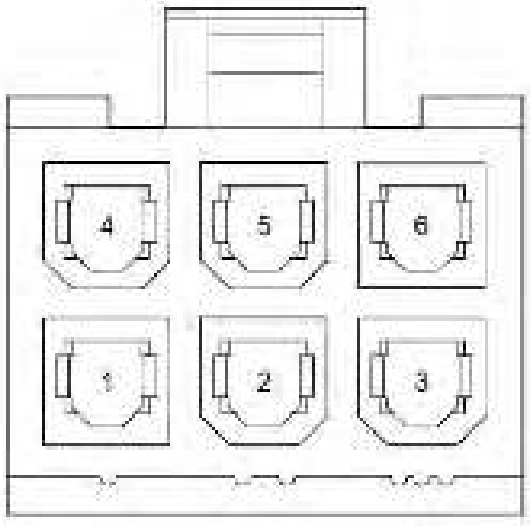


Table 24: Auxiliary Power Connector Pin Definition

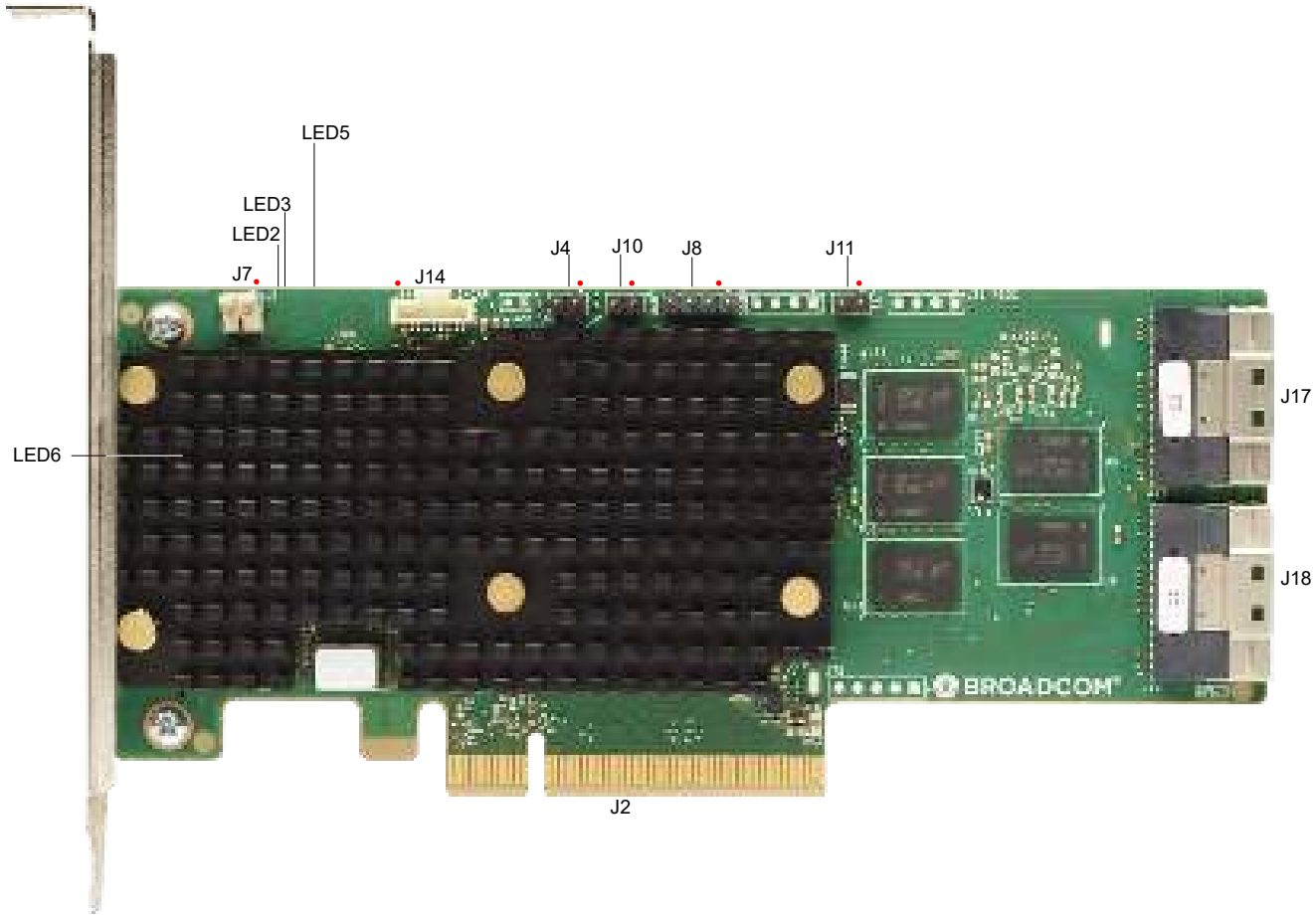
Pin	Signal
1	+12V
2	+12V
3	+12V
4	Ground
5	Sense
6	Ground

MegaRAID 9660-16i Adapter – Connector and LED Designations

The adapter is a 155.52 (±0.13) mm × 68.77 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

The following figure shows the connectors and LED locations on the adapter. Pin 1 on the headers and connectors is highlighted in red in the figure.

Figure 8: Card Layout for the MegaRAID 9660-16i Tri-Mode Storage Adapter



The following table describes the headers and connectors on the adapter.

Table 25: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the Intelligent Platform Management Interface (IPMI).
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J7	Advanced software options hardware key header	2-pin connector. Enables support for selected advanced features.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J10	Global HDD activity LED header	2-pin connector. Connects to an LED that indicates activity on the drives connected to the adapter.

Connector	Type	Description
J11	Global drive fault LED header	2-pin connector. Connects to an LED that indicates whether a drive is in a fault condition.
J14	CacheVault power module interface	9-pin connector. Connects the adapter to a CacheVault power module.
J17, J18	Storage interface connectors	Two SFF-8654 8-port internal connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter. These LEDs reside on the nonheat-sink side of the board.

Table 26: LED Designations

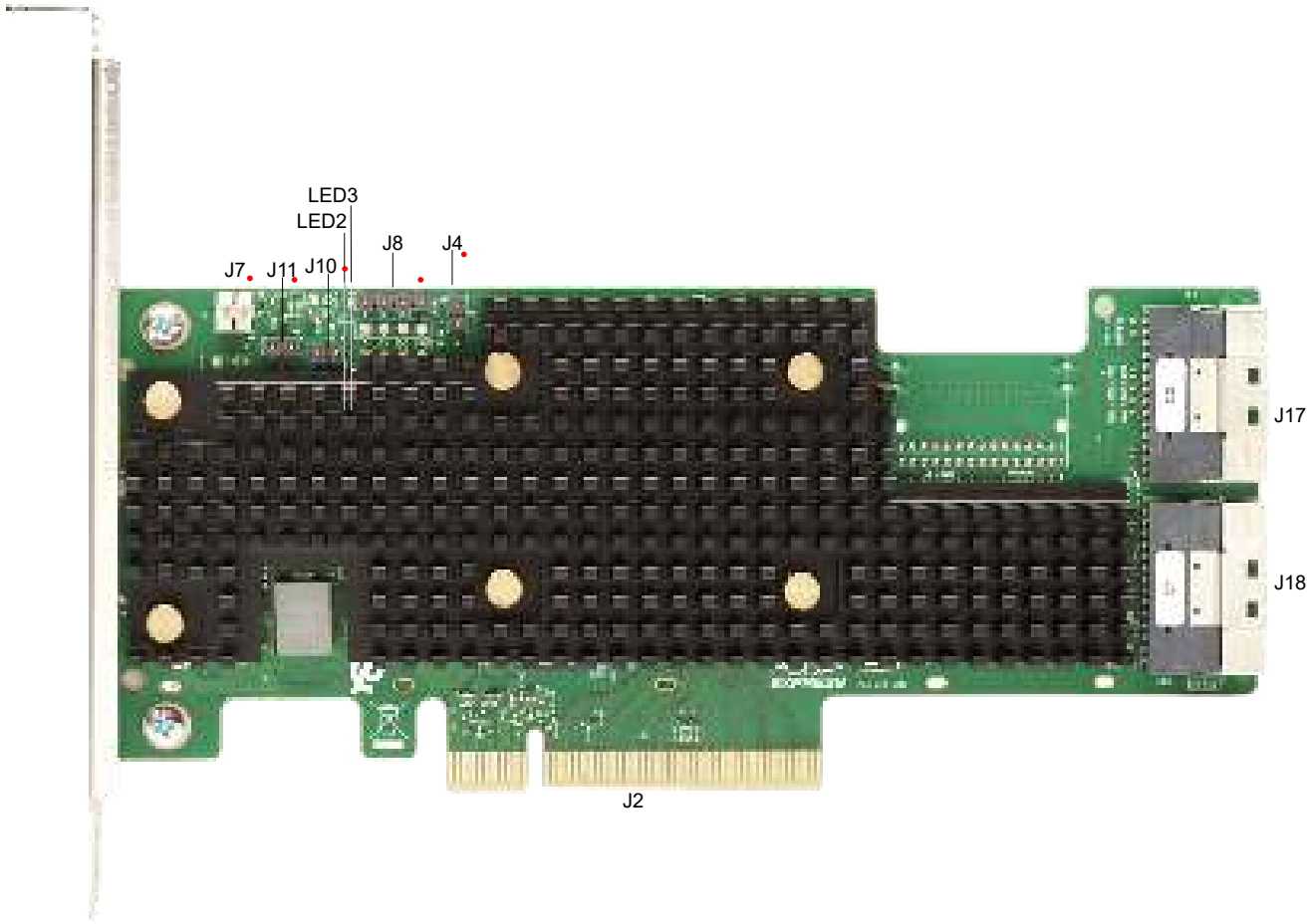
LED	Type	Description
LED2	Yellow controller overtemperature	Stays on solid to indicate that the SAS4116 device temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off.
LED3	Green system heartbeat	Indicates that the SAS4116 RoC ASIC is operating normally. This LED blinks at 1 Hz.
LED5	Yellow supercap fault	Indicates that the CacheVault power module is in fault state or is overtemperature. When the energy pack is in the FAULT condition or is missing, this LED is on.
LED6	Green ONFI activity	Indicates when the ONFI is active for cache offload or recovery.

eHBA 9620-16i Adapter – Connector and LED Designations

The adapter is a 155.52 (±0.13) mm × 68.77 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

The following figure shows the connectors and LED locations on the adapter. Pin 1 on the headers and connectors is highlighted in red in the figure.

Figure 9: Card Layout for the eHBA 9620-16i Storage Adapter



The following table describes the headers and connectors on the adapter.

Table 27: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the Intelligent Platform Management Interface (IPMI).
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J10	Global HDD activity LED header	2-pin connector. Connects to an LED that indicates activity on the drives connected to the adapter.
J11	Global drive fault LED header	2-pin connector. Connects to an LED that indicates whether a drive is in a fault condition.

Connector	Type	Description
J17, J18	Storage interface connectors	Two SFF-8654 8-port internal connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter.

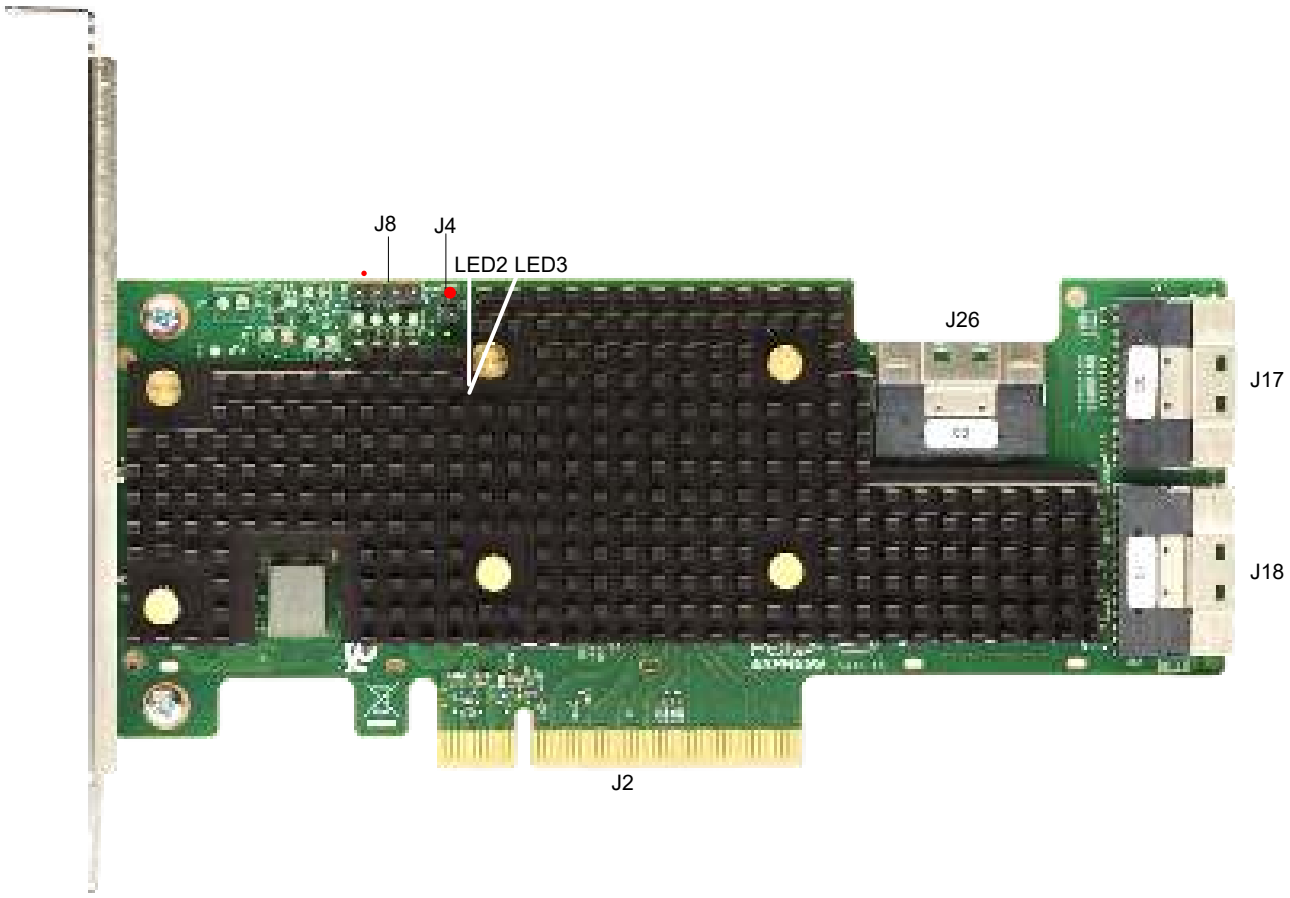
Table 28: LED Designations

LED	Type	Description
LED2	Yellow controller overtemperature	Stays on solid to indicate that the SAS4116 device temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off.
LED3	Green system heartbeat	Indicates that the SAS4116 RoC ASIC is operating normally. This LED blinks at 1 Hz.

eHBA 9600-24i Adapter – Connector and LED Designations

The adapter is a 155.52 (±0.13) mm × 68.77 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

Figure 10: Card Layout of the eHBA 9600-24i Tri-Mode Storage Adapter



The following table describes the connectors on the adapter.

Table 29: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the IPMI.
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J17, J18, J26	Storage interface connectors	Three SFF-8654 8-port internal connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter.

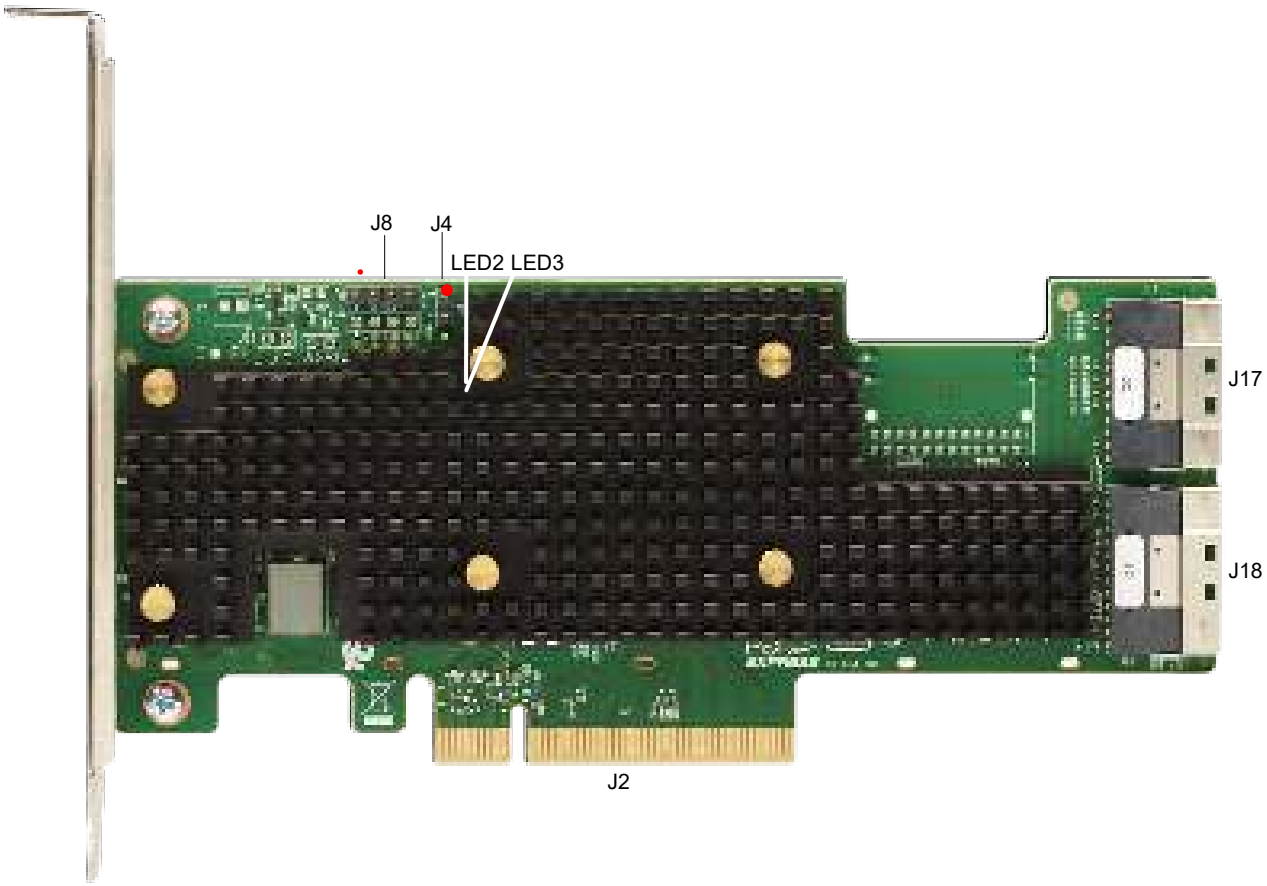
Table 30: LED Designations

LED	Type	Description
LED2	Yellow IOC overtemperature	Stays on solid to indicate that the SAS4024 IOC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off. This LED resides on the nonheat-sink side of the board.
LED3	Green system heartbeat	Indicates that the SAS4024 IOC is operating normally. This LED resides on the nonheat-sink side of the board.

eHBA 9600-16i Adapter – Connector and LED Designations

The adapter is a 155.52 (±0.13) mm × 68.77 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

Figure 11: Card Layout of the eHBA 9600-16i Tri-Mode Storage Adapter



The following table describes the connectors on the adapter.

Table 31: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the IPMI.
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J17, J18	Storage interface connectors	Two SFF-8654 8-port internal connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter.

Table 32: LED Designations

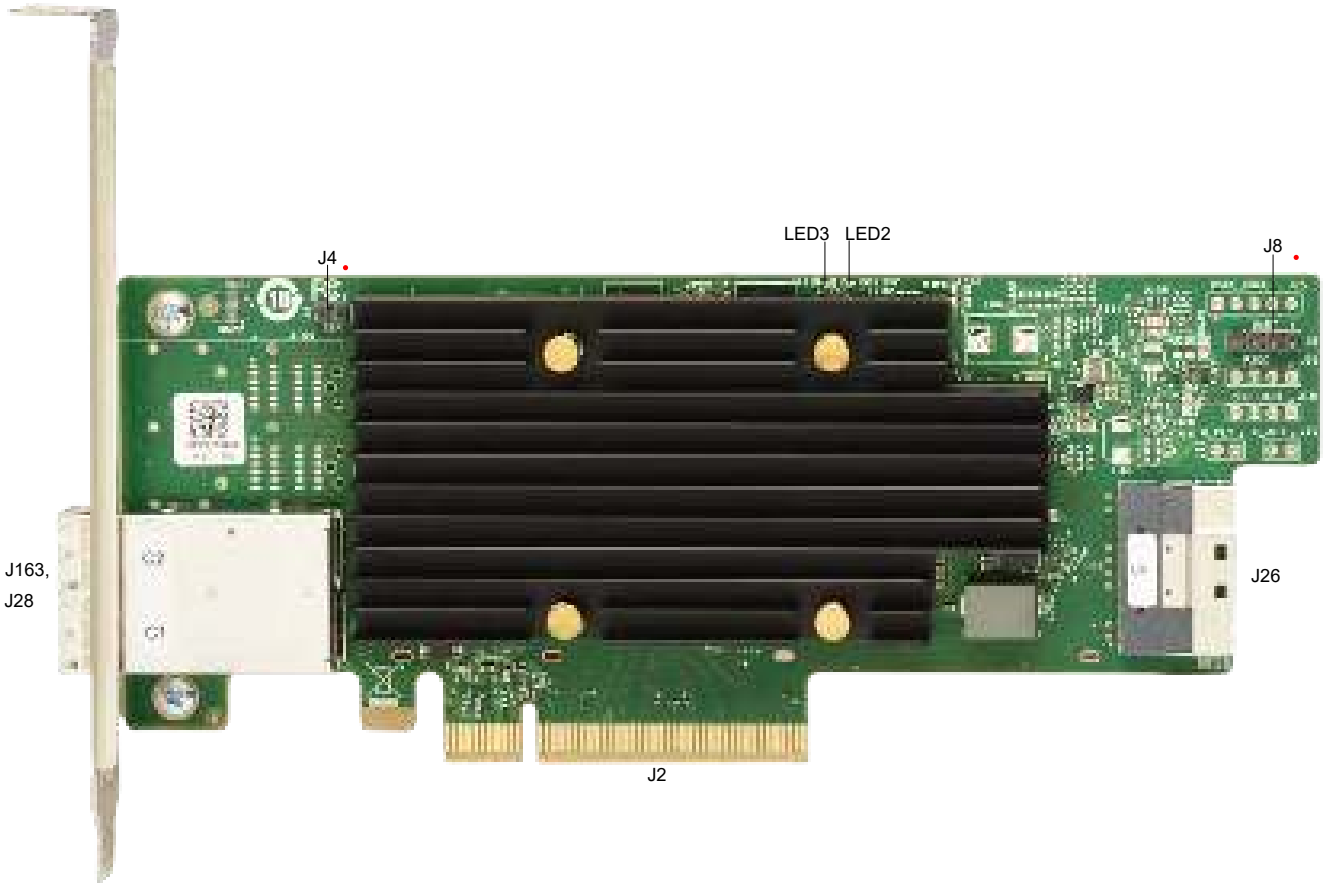
LED	Type	Description
LED2	Yellow IOC overtemperature	Stays on solid to indicate that the SAS4016 IOC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off. This LED resides on the nonheat-sink side of the board.
LED3	Green system heartbeat	Indicates that the SAS4016 IOC is operating normally. This LED resides on the nonheat-sink side of the board.

eHBA 9600-8i8e Adapter – Connector and LED Designations

The adapter is a 167.51 (±0.13) mm × 68.78 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

The following figure shows the connectors and LED locations on the adapter. A red circle near each header and connector identifies pin 1 in the figure.

Figure 12: Card Layout of the eHBA 9600-8i8e Tri-Mode Storage Adapter



The following table describes the connectors on the adapter.

Table 33: Headers and Connectors

Connector	Type	Description
J2	Standard edge card connector	The interface between the storage adapter and the host system. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the IPMI.
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J26	Storage interface connector	One SFF-8654 8-port internal connector. Connect the adapter by cable to the storage devices.
J163, J28	Storage interface connectors	Two SFF-8674 4-port external connectors.

The following table describes the LEDs on the adapter.

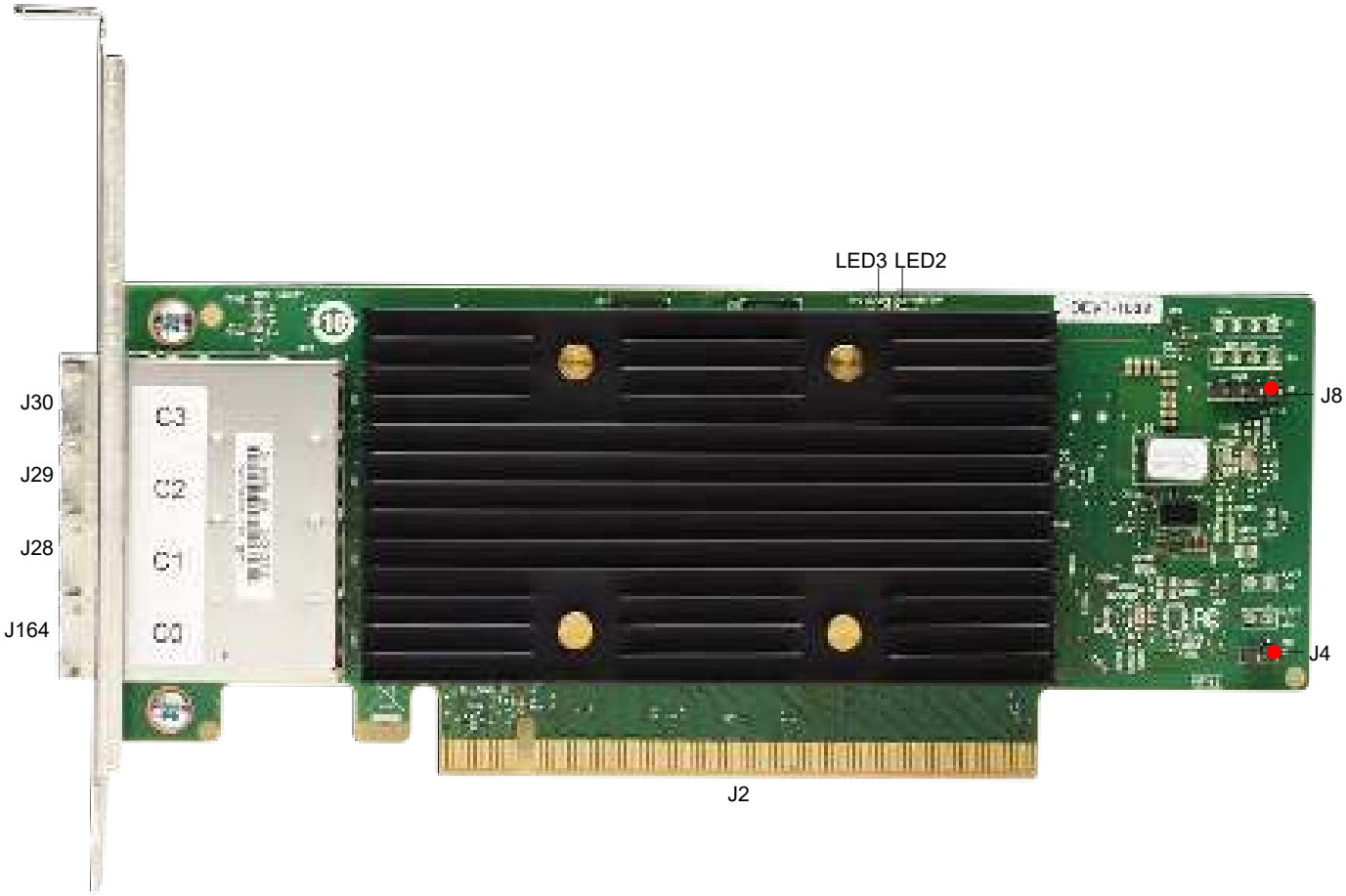
Table 34: LED Designations

LED	Type	Description
LED2	Yellow IOC overtemperature	Stays on solid to indicate that the SAS4016 IOC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off. This LED resides on the nonheat-sink side of the board.
LED3	Green system heartbeat	Indicates that the SAS4016 IOC is operating normally. This LED resides on the nonheat-sink side of the board.

eHBA 9600W-16e Adapter – Connector and LED Designations

The adapter is a 167.51 (±0.13) mm × 68.78 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

Figure 13: Card Layout of the eHBA 9600W-16e Storage Adapter



The following table describes the headers and connectors on the adapter.

Table 35: Connectors

Connector	Type	Description
J2	Standard board edge connector	PCIe x8 board edge connector. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the IPMI.
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J164, J28, J29, J30	Storage interface connectors	Four SFF-8674 external connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter.

Table 36: LED Designations

LED	Type	Description
LED2	Yellow IOC overtemperature	Stays on solid to indicate that the SAS4016W IOC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off.
LED3	Green system heartbeat	Indicates that the SAS4016W IOC is operating normally.

eHBA 9600-16e Adapter – Connector and LED Designations

The adapter is a 167.51 (±0.13) mm × 68.77 (±0.13) mm board. The component height on the top and bottom of the adapter complies with the PCIe specification.

The following figure shows the connectors and LED locations on the adapter. A red circle near each header and connector identifies pin 1 in the figure.

Figure 14: Card Layout of the eHBA 9600-16e Storage Adapter

The following table describes the headers and connectors on the adapter.

Table 37: Connectors

Connector	Type	Description
J2	Standard board edge connector	PCIe x8 board edge connector. With the PCIe interface, this connector provides power to the board and an I^2C interface connected to the I^2C bus for the IPMI.
J4	Default SBR header	2-pin connector. Reserved for Broadcom use.
J8	Onboard serial UART connector	4-pin connector. Reserved for Broadcom use.
J30, J29, J28, J163	Storage interface connectors	Four SFF-8674 external connectors. Connect the adapter by cable to the storage devices.

The following table describes the LEDs on the adapter.

Table 38: LED Designations

LED	Type	Description
LED2	Yellow IOC overtemperature	Stays on solid to indicate that the SAS4016 IOC temperature sensor is over the temperature threshold. When the device is in the proper temperature range, this LED is off.
LED3	Green system heartbeat	Indicates that the SAS4016 IOC is operating normally.

Tri-Mode Storage Adapter Technical Specifications

Operating and Non-operating Conditions

The following table lists the operating (thermal and atmospheric) conditions and non-operating (such as storage and transit) environment for the storage adapters. The minimum airflow, measured as linear feet per minute (LFPM) at 55°C, must be met to avoid operating the controller's processor and board components above their maximum junction temperatures.

Table 39: Operating and Non-operating Conditions

Adapter	Operating Conditions			Non-operating Environment	
	Relative Humidity Range (Non-condensing)	Minimum LFPM	Temperature Range[a]	Relative Humidity Range (Non-condensing)	Temperature Range
9670W-16i	5% to 90%	200	0°C to +55°C	5% to 95%	–40°C to +70°C
9670-24i	5% to 90%	200	0°C to +55°C	5% to 95%	–40°C to +70°C
9660-16i	5% to 90%	250	0°C to +55°C	5% to 95%	–40°C to +70°C
9620-16i	5% to 90%	150	0°C to +55°C	5% to 95%	–40°C to +70°C
9600-24i	5% to 90%	150	0°C to +55°C	5% to 95%	–40°C to +70°C
9600-16i	5% to 90%	150	0°C to +55°C	5% to 95%	–40°C to +70°C
9600-8i8e	5% to 90%	200	0°C to +55°C	5% to 95%	–40°C to +70°C
9600W-16e	5% to 90%	200	0°C to +55°C	5% to 95%	–40°C to +70°C
9600-16e	5% to 90%	200	0°C to +55°C	5% to 95%	–40°C to +70°C

Tri-Mode Storage Adapter Power Supply Requirements

All power is supplied to the tri-mode storage adapter through the PCIe 3.3V rails (3.3V ±9%) and the 12V rail (12V ±8%). Onboard switching regulator circuitry operates from the 3.3V rails and the 12V rail provides the necessary voltages.

Typical power is measured with maximum I/O traffic, typical silicon process material, and nominal voltages operating the card at an ambient temperature of 45°C with required airflow.

The system might transmit a PCI Set Slot Power Limit Message that indicates the maximum amount of power that the adapter might use. During the start-up procedure, the adapter's power consumption is limited to 25W because the storage phys are not enabled until the Auto Port Enable procedure begins. When this procedure begins, the adapter's power check algorithm compares the power allocated by the SET_SLOT_POWER_LIMIT message to the adapter's slot power requirement. If the SET_SLOT_POWER_LIMIT message indicates that the slot's power budget is at or greater than the adapter's requirement, Auto Port Enable proceeds. Refer to *SAS95xx Adapters and SAS96xx Adapters Slot Power Limit Settings Specification* for more information on slot power requirements.

In the case that no SET_SLOT_POWER_LIMIT message is received by the time Auto Port Enable is to start, the adapter continues with port enable. You must make sure enough power is available to the slot if the SET_SLOT_POWER_LIMIT message is not used. For adapters with auxiliary power connectors, the slot power check is bypassed if the auxiliary power connector is connected. For more information on the auxiliary power connector see Auxiliary Power Connector.

a. For adapters with a CVPM, this range applies with or without the CVPM attached.

MegaRAID Tri-Mode Storage Adapter Power Supply Requirements

The following table describes the typical power consumption of the MegaRAID adapters.

Table 40: MegaRAID Tri-Mode Storage Adapter Typical Power Consumption

Adapter	Typical Power (W)
9670W-16i	28
9670-24i	28
9660-16i	20

During the transparent learn cycle, the CacheVault power module consumes up to an additional 8W. The PCIe 3.3V rail supplies the power for the learn cycle.

eHBA Tri-Mode Storage Adapter Power Supply Requirements

The following table describes the typical power consumption of the eHBAs.

Table 41: eHBA Tri-Mode Storage Adapter Typical Power Consumption

Adapter	Typical Power (W)
9620-16i	17
9600-24i	20
9600-16i	17
9600-8i8e	17
9600W-16e	20
9600-16e	17

Overtemperature Behavior

The adapter supports the following temperature threshold events to alert of overtemperature situations when sufficient airflow is not provided. If supported, the system can use the events generated in the Persistent Event Log (PEL) to manage fan speed and mitigate overtemperature conditions. While these events assist in managing overtemperature conditions, potential damage can occur if sufficient airflow is not provided to the adapter.

Table 42: Temperature Threshold Events

Condition	RoC or IOC Junction Temperature (°C)	Result
Warning	105	Generate a PEL event.
Critical	107	Generate a PEL event and decrease device-side ports to their slowest operating speed. The junction temperature must return to 104°C, or lower, to resume normal operation.
Fatal	115	Generate a PEL event and fault the adapter. The junction temperature must return to 104°C, or lower, and the adapter must be reset to resume normal operation.

Marks, Certifications, Compliance, and Safety Characteristics

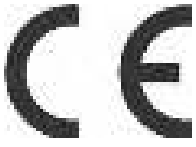
Marks, Certifications, and Compliance

The design and implementation of the adapters minimize electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The following adapters show the marks and certifications included in Table 44, Adapter Marks and Certifications.

Table 43: Adapter Models

Adapter	Model Number
MegaRAID 9670W-16i	50113
MegaRAID 9660-16i	50107
eHBA 9600-24i eHBA 9600-16i HBA 9620-16i	50111
eHBA 9600 8i8e	50145
eHBA 9600W-16e	50108
eHBA 9600-16e	50118

Table 44: Adapter Marks and Certifications

Mark	Symbol	Description
Australia and New Zealand RCM		Meets the following standards: • AS/NZS CISPR 32 • CISPR 32:2015, Class A • AS/NZS CISPR 32:2015, Class A
Canada EMC	CANADA ICES-OO3 CLASS A CANADA NMB-003 CLASSE A CAN ICES-3 (A)/NMB-3 (A)	Meets the following standards: • ICES-003:2016 Issue 6: 2016, Class A • CAN/CSA CISPR 22-10 • CISPR 22:2008
Europe (CE)		Meets the following standards: • EN 55024, EN 55032, EN 55035 • EN 55032:2015 +AC:2016, Class A • EN 55024:2010 +A1:2015 • EN 55035:2017 +A11:2020

Mark	Symbol	Description
Korea (RRL)		xxxxx = model number Meets the KN32/KN35 testing requirements.
Taiwan (BSMI)		Meets the following standards: • CNS 13438 • CNS15663
USA / Canada Safety (UL Listed)		For use with UL listed ITE equipment only. Meets the following standards: • UL 62368-1, Second Edition • CAN/CSA C22.2 No. 62368-1-14
CB Scheme Safety	—	Meets the following standards: • IEC 62368-1:2014 (Second edition) • EN 62368-1:2014+A11: 2017
Japan (VCCI)		Meets the following standards: • V-3/2015.04, Class A • V-4/2012.04 • VCCI-CISPR 32:2016 • CISPR 32:2015
USA / Canada (FCC)		Meets the following standards: • 47 CFR FCC Part 15, Subpart B, Class A • ANSI C63.4:2014 • CISPR 32:2008
Morocco (CMIM)		Meets the following standards: • EN 55024, EN 55032, EN 55035 • EN 55032:2015 +AC:2016, Class A • EN 55024:2010 +A1:2015 • EN 55035:2017 +A11:2020
Country of Origin	Made in XXXX	XXXX indicates the country of origin.

Safety Characteristics

All tri-mode storage adapters meet or exceed the requirements of UL flammability rating 94 V0. Each bare board is also marked with the supplier name or trademark, type, and UL flammability rating. For the boards installed in a PCIe bus slot, all voltages are lower than the SELV 42.4V limit.

Cable Drawings and Pinouts

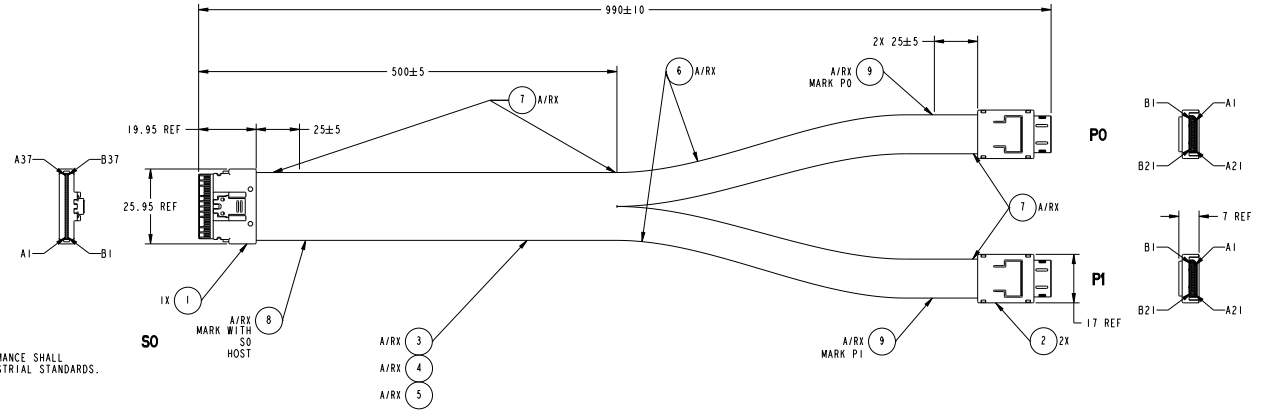
Use the cable drawings and pinouts in this appendix if your design requires you to design your own cables.

Cable 05-60001-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60001-00, a x8 SFF-8654 to 2 x4 SFF-8612 connection.

Figure 15: Cable 05-60001-00 Drawing and Pinout

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
001		PRELIMINARY RELEASE	26FEB18	
002	175141	UPDATE WIRE GAUGE AND IMPEDANCE TOLERANCE ITEM 3. REVISE MARKING REQUIREMENTS NOTE 3.	21NOV19	



NOTES:

1. DRAWING NOT TO SCALE.
2. ELECTRICAL AND MECHANICAL PERFORMANCE SHALL MEET PCIE GEN 4 AND SAS 4.0 INDUSTRIAL STANDARDS.
3. MARK LABEL (ITEM 8) WITH:
   SLIMSAS Y (PCIE)
   BROADCOM PART NUMBER
   BROADCOM REVISION XXX
   DATE CODE DD/MMM/YY

   SECONDARY MARKING WITH MANUFACTURER PART NUMBER AND REVISION ACCEPTABLE.
4. SEE CABLE WIRING TABLE AND RELATED NOTES.

ITEM	CALLOUT	DESCRIPTION	QUANTITY	NOTES
9	LABEL	LABEL, 40X14MM, WHITE, R2, HF	A/R	
8	LABEL	LABEL, 70X26MM, WHITE, R2, HF	A/R	SEE NOTE 3
7	TAPE	ACETATE TAPE: W=1 INCH	A/R	
6	SLEEVING	EXPANDO TUBE: OD=7MM, GREEN, VW-1, HF	A/R	
5	SLEEVING	EXPANDO TUBE: OD=10MM, GREEN, VW-1, HF	A/R	
4	WIRE	UL1061, STRANDED	A/R	SEE NOTE 4
3	CABLE	SAS CABLE: UL20744, 28-32AWG, 92.5Ω ±10% DIFF, SAS4, PCIE GEN 4, VW-1, NATURAL, HF	A/R	
2	CONNECTOR	SFF-8612, 42P, STRAIGHT, ACTIVE LATCH, X4, SAS 4.0, PCIE GEN 4	2	SEE NOTE 4
1	CONNECTOR	SFF-8654, 74P, STRAIGHT, X8, SAS 4.0, PCIE GEN 4	1	SEE NOTE 4

APPROVALS	DATE
DRAWN BY	06FEB18
APPROVED BY	26FEB18

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS. TOLERANCES: X.X ± 0.2 MM, X.XX ± 0.15 MM, X.XXX ± 0.050 MM, ANGLES ± 1°

SCALE 1.500

BROADCOM

TITLE: CABLE, SFF-8654 X8 TO 2X SFF-8612 X4, PCIE, IM

SIZE D | DWG NO. 5067-6865 | REV 002 | SHEET

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
NC	S0 HOST			P0 BACKPLANE	B1	NC		
GND		A1			B2	GND	ITEM 3	
Rx0+		A2			B3	Tx0+	ITEM 3	
Rx0-		A3			B4	Tx0-	ITEM 3	
GND		A4			B5	GND	ITEM 3	
Rx1+		A5			B6	Tx1+	ITEM 3	
Rx1-		A6			B7	Tx1-	ITEM 3	
GND		A7			B8	GND	ITEM 3	
SB7A		A8				NC		NOTE 2
SB4A		A9			B10	CWAKE#	ITEM 4	NOTE 1
SB3A		A10			B9	CBL_ID	ITEM 4	NOTE 1
SB3A		A10			B11	GND	ITEM 3	
SBA+		A11			B12	REFCLK+	ITEM 3	
SBA-		A12			B13	REFCLK-	ITEM 3	
GND		A13			B14	GND	ITEM 3	
Rx2+		A14			B15	Tx2+	ITEM 3	
Rx2-		A15			B16	Tx2-	ITEM 3	
GND		A16			B17	GND	ITEM 3	
Rx3+		A17			B18	Tx3+	ITEM 3	
Rx3-		A18			B19	Tx3-	ITEM 3	
GND		A19			B20	GND	ITEM 3	
NC					B21	NC		
NC					A1	NC		
GND		B1			A2	GND	ITEM 3	
Tx0+		B2			A3	Rx0+	ITEM 3	
Tx0-		B3			A4	Rx0-	ITEM 3	
GND		B4			A5	GND	ITEM 3	
Tx1+		B5			A6	Rx1+	ITEM 3	
Tx1-		B6			A7	Rx1-	ITEM 3	
GND		B7			A8	GND	ITEM 3	
SB0A		B8			A9	SCL	ITEM 4	NOTE 1
SB1A		B9			A10	SDA	ITEM 4	NOTE 1
SB2A		B10			A11	GND	ITEM 3	
SB5A		B11			A12	PERST#	ITEM 3	
SB6A		B12			A13	D_INPL#	ITEM 3	
GND		B13			A14	GND	ITEM 3	
Tx2+		B14			A15	RX2+	ITEM 3	
Tx2-		B15			A16	Rx2-	ITEM 3	
GND		B16			A17	GND	ITEM 3	
Tx3+		B17			A18	Rx3+	ITEM 3	
Tx3-		B18			A19	Rx3-	ITEM 3	
GND		B19			A20	GND	ITEM 3	
NC					A21	NC		

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
NC	S0 HOST			P1 BACKPLANE	B1	NC		
GND		A19			B2	GND	ITEM 3	
Rx4+		A20			B3	Tx0+	ITEM 3	
Rx4-		A21			B4	Tx0-	ITEM 3	
GND		A22			B5	GND	ITEM 3	
Rx5+		A23			B6	Tx1+	ITEM 3	
Rx5-		A24			B7	Tx1-	ITEM 3	
GND		A25			B8	GND	ITEM 3	
SB7B		A26				NC		NOTE 3
SB4B		A27			B10	CWAKE#	ITEM 4	NOTE 1
SB3B		A28			B9	CBL_ID	ITEM 4	NOTE 1
SB3B		A28			B11	GND	ITEM 3	
SBB+		A29			B12	REFCLK+	ITEM 3	
SBB-		A30			B13	REFCLK-	ITEM 3	
GND		A31			B14	GND	ITEM 3	
Rx6+		A32			B15	Tx2+	ITEM 3	
Rx6-		A33			B16	Tx2-	ITEM 3	
GND		A34			B17	GND	ITEM 3	
Rx7+		A35			B18	Tx3+	ITEM 3	
Rx7-		A36			B19	Tx3-	ITEM 3	
GND		A37			B20	GND	ITEM 3	
NC					B21	NC		
NC					A1	NC		
GND		B19			A2	GND	ITEM 3	
Tx4+		B20			A3	Rx0+	ITEM 3	
Tx4-		B21			A4	Rx0-	ITEM 3	
GND		B22			A5	GND	ITEM 3	
Tx5+		B23			A6	Rx1+	ITEM 3	
Tx5-		B24			A7	Rx1-	ITEM 3	
GND		B25			A8	GND	ITEM 3	
SB0B		B26			A9	SCL	ITEM 4	NOTE 1
SB1B		B27			A10	SDA	ITEM 4	NOTE 1
SB2B		B28			A11	GND	ITEM 3	
SB5B		B29			A12	PERST#	ITEM 3	
SB6B		B30			A13	D_INPL#	ITEM 3	
GND		B31			A14	GND	ITEM 3	
Tx6+		B32			A15	RX2+	ITEM 3	
Tx6-		B33			A16	Rx2-	ITEM 3	
GND		B34			A17	GND	ITEM 3	
Tx7+		B35			A18	Rx3+	ITEM 3	
Tx7-		B36			A19	Rx3-	ITEM 3	
GND		B37			A20	GND	ITEM 3	
NC					A21	NC		

NOTES:

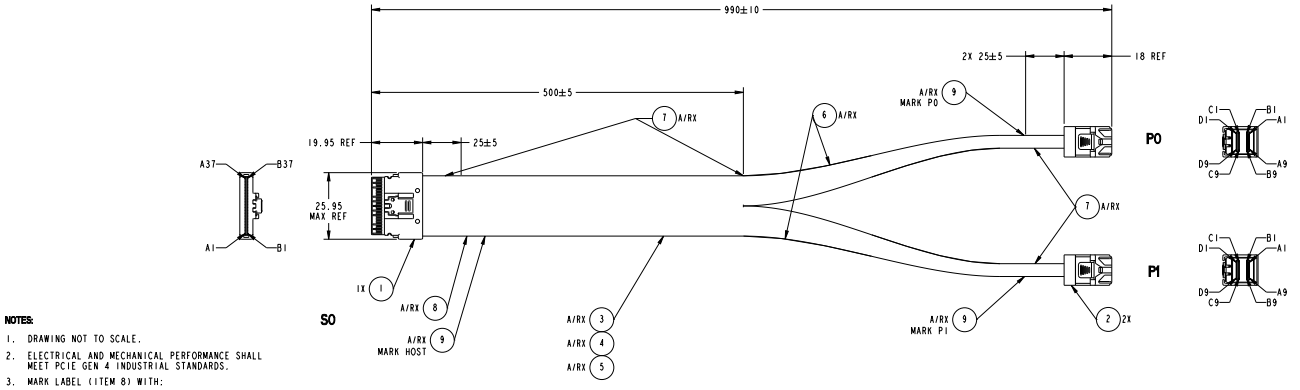
1. END TO END RESISTANCE OF INDICATED CONNECTION SHALL BE 750 MILLIOHM MAX.
2. SHORT PIN/PAD S0-A8 TO S0-B9. NO DIRECT CONNECT S0-A8 TO CONNECTOR P0.
3. SHORT PIN/PAD S0-A26 TO S0-B27. NO DIRECT CONNECT S0-A26 TO CONNECTOR P1.

Cable 05-60002-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60002-00, a x8 SFF-8654 to 2 x4 SFF-8643 connection. Use this cable for NVMe connections on SuperMicro Purley backplanes.

Figure 16: Cable 05-60002-00 Drawing and Pinout

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
001		PRELIMINARY RELEASE	09FEB18	
002	141562	PRELIMINARY RELEASE. UPDATE WIRE GAUGE AND IMPEDANCE TOLERANCE ITEM 3. REVISE MARKING REQUIREMENTS NOTE 3. ADD HOST CONNECTOR LABEL. ADD HOST AND TARGET WIRING TABLE. WIRING CHANGES TO FOLLOWING PIN/PAD(S) IN WIRING TABLE: S0: B8-B10, B26-B28. P0: B1, C1-C2, D1-D2. P1: B1, C1-C2, D1-D2	13JUL18	
003	175141	INITIAL RELEASE. REMOVE WATERMARK.	21NOV19	



NOTES:

1. DRAWING NOT TO SCALE.
2. ELECTRICAL AND MECHANICAL PERFORMANCE SHALL MEET PCIE GEN 4 INDUSTRIAL STANDARDS.
3. MARK LABEL (ITEM 8) WITH:
   SLIMSAS Y (PCIE ONLY)
   BROADCOM PART NUMBER
   BROADCOM REVISION XXX
   DATE CODE DD/MMM/YY
   SECONDARY MARKING WITH MANUFACTURER PART NUMBER AND REVISION ACCEPTABLE.
4. SEE CABLE WIRING TABLE AND RELATED NOTES.

ITEM	CALLOUT	DESCRIPTION	QUANTITY	NOTES
9	LABEL	LABEL, 40X14MM, WHITE, R2, HF	A/R	
8	LABEL	LABEL, 70X26MM, WHITE, R2, HF	A/R	SEE NOTE 3
7	TAPE	ACETATE TAPE: W=1 INCH	A/R	
6	SLEEVING	EXPANDO TUBE: OD=7MM, GREEN, VW-1, HF	A/R	
5	SLEEVING	EXPANDO TUBE: OD=10MM, GREEN, VW-1, HF	A/R	
4	WIRE	UL1061, STRANDED	A/R	SEE NOTE 4
3	CABLE	SAS CABLE: UL20744, 28-32AWG, 92.5Ω ±10% DIFF, PCIE GEN 4, VW-1, NATURAL, HF	A/R	
2	CONNECTOR	SFF-8643, 36P, STRAIGHT, X4, WHITE, SHORT, PCIE GEN 4	2	SEE NOTE 4
1	CONNECTOR	SFF-8654, 74P, STRAIGHT, X8, SAS 4.0, PCIE GEN 4	1	SEE NOTE 4

APPROVALS	DATE
DRAWN BY	05FEB18
APPROVED BY	09FEB18

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UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS. TOLERANCES: X.X ± 0.2 MM, X.XX ± 0.15 MM, X.XXX ± 0.050 MM, ANGLES ± 1°

BROADCOM®

TITLE: CABLE, SFF-8654 X8 TO 2X SFF-8643 X4 (W), IM

SCALE: 1.500 | SIZE: D | DWG NO.: 5067-6862 | REV: 003 | SHEET:

CONNECTOR SIGNAL	CONNECTOR (HOST)	PIN/PAD		CONNECTOR (TARGET)	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE
GND	S0	A1		P0	D3	GND	ITEM 3
Rx0+		A2			D4	Tx0+	ITEM 3
Rx0-		A3			D5	Tx0-	ITEM 3
GND		A4			C3/D6	GND	ITEM 3, NOTE 2
Rx1+		A5			C4	Tx1+	ITEM 3
Rx1-		A6			C5	Tx1-	ITEM 3
GND		A7			C6	GND	ITEM 3
SB7A		A8				NC	NOTE 3
SB4A		A9				NC	
SB3A		A10			A3	GND	ITEM 3
SBA+		A11			A2	REFCLK+	ITEM 3
SBA-		A12			A1	REFCLK-	ITEM 3
GND		A13			D6	GND	ITEM 3
Rx2+		A14			D7	Tx2+	ITEM 3
Rx2-		A15			D8	Tx2-	ITEM 3
GND		A16			D9/C6	GND	ITEM 3, NOTE 2
Rx3+		A17			C7	Tx3+	ITEM 3
Rx3-		A18			C8	Tx3-	ITEM 3
GND		A19			C9	GND	ITEM 3
GND		B1			B3	GND	ITEM 3
Tx0+		B2			B4	Rx0+	ITEM 3
Tx0-		B3			B5	Rx0-	ITEM 3
GND		B4			B6/A3	GND	ITEM 3, NOTE 2
Tx1+		B5			A4	Rx1+	ITEM 3
Tx1-		B6			A5	Rx1-	ITEM 3
GND		B7			A6	GND	ITEM 3
SB0A		B8			D1	2W_CLK	ITEM 4, NOTE 1
SB1A		B9			D2	2W_SDA	ITEM 4, NOTE 1
SB2A		B10				NC	SHORT TO GND
SB5A		B11			B2	PERST#	ITEM 4, NOTE 1
SB6A		B12				NC	SHORT TO GND
GND		B13			B6	GND	ITEM 3
Tx2+		B14			B7	RX2+	ITEM 3
Tx2-		B15			B8	Rx2-	ITEM 3
GND		B16			B9/A6	GND	ITEM 3, NOTE 2
Tx3+		B17			A7	Rx3+	ITEM 3
Tx3-		B18			A8	Rx3-	ITEM 3
GND		B19			A9	GND	ITEM 3
					C1	NC	
					C2	NC	
					B1	NC	

CONNECTOR SIGNAL	CONNECTOR (HOST)	PIN/PAD		CONNECTOR (TARGET)	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE
GND	S0	A19		P1	D3	GND	ITEM 3
Rx4+		A20			D4	Tx0+	ITEM 3
Rx4-		A21			D5	Tx0-	ITEM 3
GND		A22			C3/D6	GND	ITEM 3, NOTE 2
Rx5+		A23			C4	Tx1+	ITEM 3
Rx5-		A24			C5	Tx1-	ITEM 3
GND		A25			C6	GND	ITEM 3
SB7B		A26				NC	NOTE 5
SB4B		A27				NC	
SB3B		A28			A3	GND	ITEM 3
SBB+		A29			A2	REFCLK+	ITEM 3
SBB-		A30			A1	REFCLK-	ITEM 3
GND		A31			D6	GND	ITEM 3
Rx6+		A32			D7	Tx2+	ITEM 3
Rx6-		A33			D8	Tx2-	ITEM 3
GND		A34			D9/C6	GND	ITEM 3, NOTE 2
Rx7+		A35			C7	Tx3+	ITEM 3
Rx7-		A36			C8	Tx3-	ITEM 3
GND		A37			C9	GND	ITEM 3
GND		B19			B3	GND	ITEM 3
Tx4+		B20			B4	Rx0+	ITEM 3
Tx4-		B21			B5	Rx0-	ITEM 3
GND		B22			B6/A3	GND	ITEM 3, NOTE 2
Tx5+		B23			A4	Rx1+	ITEM 3
Tx5-		B24			A5	Rx1-	ITEM 3
GND		B25			A6	GND	ITEM 3
SB0B		B26			D1	2W_CLK	ITEM 4, NOTE 1
SB1B		B27			D2	2W_SDA	ITEM 4, NOTE 1
SB2B		B28				NC	SHORT TO GND
SB5B		B29			B2	PERST#	ITEM 4, NOTE 1
SB6B		B30				NC	SHORT TO GND
GND		B31			B6	GND	ITEM 3
Tx6+		B32			B7	RX2+	ITEM 3
Tx6-		B33			B8	Rx2-	ITEM 3
GND		B34			B9/A6	GND	ITEM 3, NOTE 2
Tx7+		B35			A7	Rx3+	ITEM 3
Tx7-		B36			A8	Rx3-	ITEM 3
GND		B37			A9	GND	ITEM 3
					C1	NC	
					C2	NC	
					B1	NC	

NOTES:

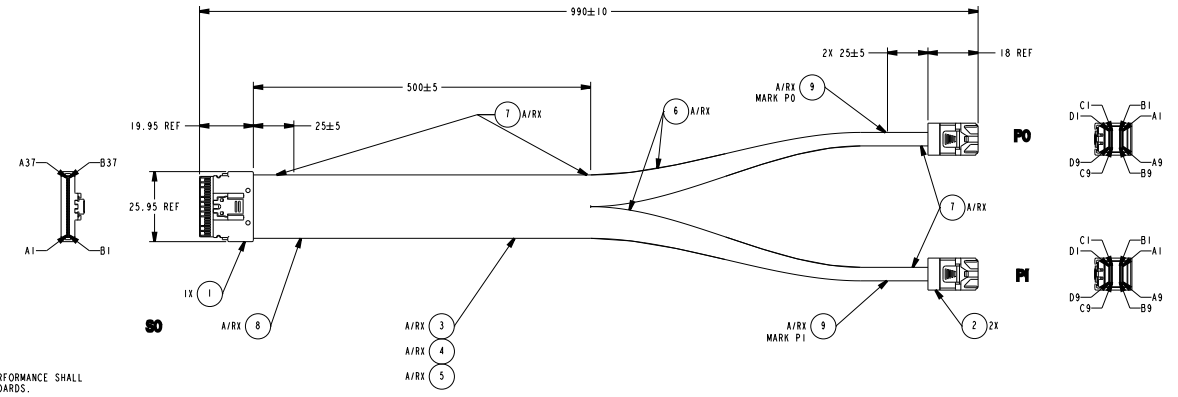
1. END TO END RESISTANCE OF INDICATED CONNECTION SHALL BE 750 MILLIOHM MAX.
2. CONNECT SHIELD OF DIFFERENTIAL PAIR TO INDICATED PIN/PAD AND SHORT TO SECOND INDICATED PIN/PAD.
3. SHORT PIN/PAD S0-A8 TO S0-B9. NO DIRECT CONNECT S0-A8 TO CONNECTOR P0.
4. DELETED
5. SHORT PIN/PAD S0-A26 TO S0-B27. NO DIRECT CONNECT S0-A26 TO CONNECTOR P1.
6. DELETED

Cable 05-60003-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60003-00, a x8 SFF-8654 to 2 x4 SFF-8643 connection.

Figure 17: Cable 05-60003-00 Drawing and Pinout

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
001		PRELIMINARY RELEASE	28FEB18	
002	175141	UPDATE WIRE GAUGE AND IMPEDANCE TOLERANCE ITEM 3. REVISE MARKING REQUIREMENTS NOTE 3.	21NOV19	



NOTES:
1. DRAWING NOT TO SCALE.
2. ELECTRICAL AND MECHANICAL PERFORMANCE SHALL MEET SAS 4.0 INDUSTRIAL STANDARDS.
3. MARK LABEL (ITEM 8) WITH:
   SLIMSAS Y (SFF-9402 SAS)
   BROADCOM PART NUMBER
   BROADCOM REVISION XXX
   DATE CODE DD/MMM/YY
   SECONDARY MARKING WITH MANUFACTURER PART NUMBER AND REVISION ACCEPTABLE.
4. SEE CABLE WIRING TABLE AND RELATED NOTES.

ITEM	CALLOUT	DESCRIPTION	QUANTITY	NOTES
9	LABEL	LABEL, 40X14MM, WHITE, R2, HF	A/R	
8	LABEL	LABEL, 70X26MM, WHITE, R2, HF	A/R	SEE NOTE 3
7	TAPE	ACETATE TAPE: W=1 INCH	A/R	
6	SLEEVING	EXPANDO TUBE: OD=7MM, BLACK, VW-1, HF	A/R	
5	SLEEVING	EXPANDO TUBE: OD=10MM, BLACK, VW-1, HF	A/R	
4	WIRE	UL1061, STRANDED	A/R	SEE NOTE 4
3	CABLE	SAS CABLE: UL20744, 28-32AWG, 92.5Ω ±10% DIFF, PCIE GEN 4, VW-1, NATURAL, HF	A/R	
2	CONNECTOR	SFF-8643, 36P, STRAIGHT, X4, BLACK, SHORT, SAS 4.0	2	SEE NOTE 4
1	CONNECTOR	SFF-8654, 74P, STRAIGHT, X8, SAS 4.0, PCIE GEN 4	1	SEE NOTE 4

APPROVALS	DATE
DRAWN BY	15FEB18
APPROVED BY	28FEB18

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES:
X.X ± 0.2 MM
X.XX ± 0.15 MM
X.XXX ± 0.050 MM
ANGLES ± 1°

BROADCOM

TITLE	CABLE, SFF-8654 X8 TO 2X SFF-8643 X4, 1M			
SCALE	SIZE	DWG NO	REV	SHEET
1.500	D	5067-6866	002	

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0	A1		P0	D3	GND	ITEM 3	
Rx0+		A2			D4	Tx0+	ITEM 3	
Rx0-		A3			D5	Tx0-	ITEM 3	
GND		A4			C3/D6	GND	ITEM 3	NOTE 2
Rx1+		A5			C4	Tx1+	ITEM 3	
Rx1-		A6			C5	Tx1-	ITEM 3	
GND		A7			C6	GND	ITEM 3	
SB7A		A8			A2	SB7	ITEM 4	NOTE 1
SB4A		A9			C2	SB4	ITEM 4	NOTE 1
SB3A		A10			B2	SB3	ITEM 4	NOTE 1
SBA+		A11				NC		
SBA-		A12				NC		
GND		A13			D6	GND	ITEM 3	
Rx2+		A14			D7	Tx2+	ITEM 3	
Rx2-		A15			D8	Tx2-	ITEM 3	
GND		A16			D9/C6	GND	ITEM 3	NOTE 2
Rx3+		A17			C7	Tx3+	ITEM 3	
Rx3-		A18			C8	Tx3-	ITEM 3	
GND		A19			C9	GND	ITEM 3	
GND		B1			B3	GND	ITEM 3	
Tx0+		B2			B4	Rx0+	ITEM 3	
Tx0-		B3			B5	Rx0-	ITEM 3	
GND		B4			B6/A3	GND	ITEM 3	NOTE 2
Tx1+		B5			A4	Rx1+	ITEM 3	
Tx1-		B6			A5	Rx1-	ITEM 3	
GND		B7			A6	GND	ITEM 3	
SB0A		B8			A1	SB0	ITEM 4	NOTE 1
SB1A		B9			B1	SB1	ITEM 4	NOTE 1
SB2A		B10			C1	SB2	ITEM 4	NOTE 1
SB5A		B11			D2	SB5	ITEM 4	NOTE 1
SB6A		B12			D1	SB6	ITEM 4	NOTE 1
GND		B13			B6	GND	ITEM 3	
Tx2+		B14			B7	RX2+	ITEM 3	
Tx2-		B15			B8	Rx2-	ITEM 3	
GND		B16			B9/A6	GND	ITEM 3	NOTE 2
Tx3+		B17			A7	Rx3+	ITEM 3	
Tx3-		B18			A8	Rx3-	ITEM 3	
GND		B19			A9	GND	ITEM 3	

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0	A19		P1	D3	GND	ITEM 3	
Rx4+		A20			D4	Tx0+	ITEM 3	
Rx4-		A21			D5	Tx0-	ITEM 3	
GND		A22			C3/D6	GND	ITEM 3	NOTE 2
Rx5+		A23			C4	Tx1+	ITEM 3	
Rx5-		A24			C5	Tx1-	ITEM 3	
GND		A25			C6	GND	ITEM 3	
SB7B		A26			A2	SB7	ITEM 4	NOTE 1
SB4B		A27			C2	SB4	ITEM 4	NOTE 1
SB3B		A28			B2	SB3	ITEM 4	NOTE 1
SBB+		A29				NC		
SBB-		A30				NC		
GND		A31			D6	GND	ITEM 3	
Rx6+		A32			D7	Tx2+	ITEM 3	
Rx6-		A33			D8	Tx2-	ITEM 3	
GND		A34			D9/C6	GND	ITEM 3	NOTE 2
Rx7+		A35			C7	Tx3+	ITEM 3	
Rx7-		A36			C8	Tx3-	ITEM 3	
GND		A37			C9	GND	ITEM 3	
GND		B19			B3	GND	ITEM 3	
Tx4+		B20			B4	Rx0+	ITEM 3	
Tx4-		B21			B5	Rx0-	ITEM 3	
GND		B22			B6/A3	GND	ITEM 3	NOTE 2
Tx5+		B23			A4	Rx1+	ITEM 3	
Tx5-		B24			A5	Rx1-	ITEM 3	
GND		B25			A6	GND	ITEM 3	
SB0B		B26			A1	SB0	ITEM 4	NOTE 1
SB1B		B27			B1	SB1	ITEM 4	NOTE 1
SB2B		B28			C1	SB2	ITEM 4	NOTE 1
SB5B		B29			D2	SB5	ITEM 4	NOTE 1
SB6B		B30			D1	SB6	ITEM 4	NOTE 1
GND		B31			B6	GND	ITEM 3	
Tx6+		B32			B7	RX2+	ITEM 3	
Tx6-		B33			B8	Rx2-	ITEM 3	
GND		B34			B9/A6	GND	ITEM 3	NOTE 2
Tx7+		B35			A7	Rx3+	ITEM 3	
Tx7-		B36			A8	Rx3-	ITEM 3	
GND		B37			A9	GND	ITEM 3	

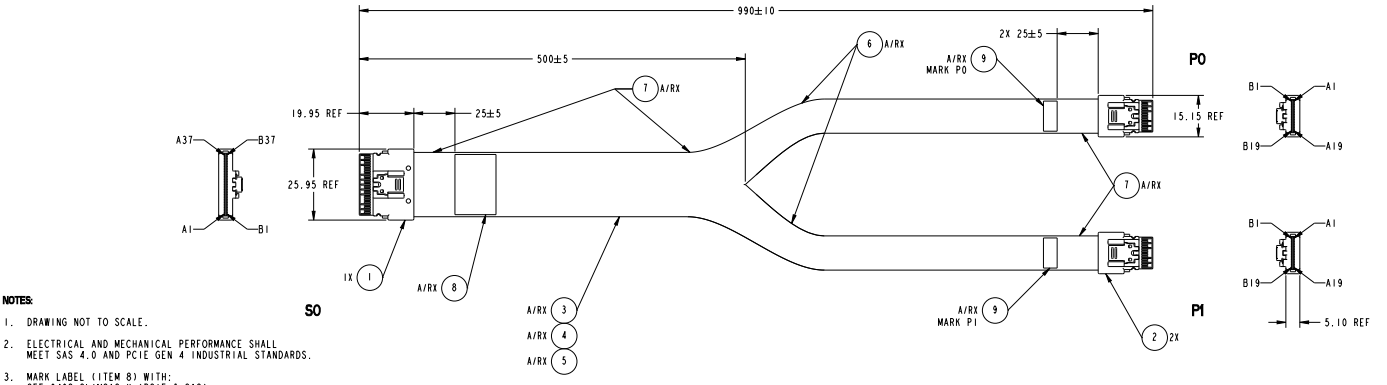
NOTES:
1. END TO END RESISTANCE OF INDICATED CONNECTION SHALL BE 750 MILLIOHM MAX.
2. CONNECT SHIELD OF DIFFERENTIAL PAIR TO INDICATED PIN/PAD AND SHORT TO SECOND INDICATED PIN/PAD.

Cable 05-60004-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60004-00, a x8 SFF-8654 to 2 x4 SFF-8654 connection.

Figure 18: Cable 05-60004-00 Drawing and Pinout

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
001		INITIAL RELEASE	02JAN18	



NOTES:

1. DRAWING NOT TO SCALE.
2. ELECTRICAL AND MECHANICAL PERFORMANCE SHALL MEET SAS 4.0 AND PCIE GEN 4 INDUSTRIAL STANDARDS.
3. MARK LABEL (ITEM 8) WITH:
   SFF-9402 SLIMSAS Y (PCIE & SAS)
   PART NUMBER
   REVISION XXX
   DATE CODE DD/MMM/YY
4. SEE CABLE WIRING TABLE.

ITEM	CALLOUT	DESCRIPTION	QUANTITY	NOTES
9	LABEL	LABEL, 40X14MM, WHITE, R2, HF	A/R	
8	LABEL	LABEL, 70X26MM, WHITE, R2, HF	A/R	SEE NOTE 3
7	TAPE	ACETATE TAPE: W=1 INCH	A/R	
6	SLEEVING	EXPANDO TUBE: OD=7MM, GREEN, VW-1, HF	A/R	
5	SLEEVING	EXPANDO TUBE: OD=10MM, GREEN, VW-1, HF	A/R	
4	WIRE	UL1061, 32AWG, STRANDED	A/R	
3	CABLE	SAS CABLE: UL20744, 32AWG, 85OHM DIFF, SAS4, PCIE GEN 4, VW-1, NATURAL, HF	A/R	
2	CONNECTOR	SFF-8654, 38P, STRAIGHT, X4, SAS 4.0, PCIE GEN 4	2	SEE NOTE 4
1	CONNECTOR	SFF-8654, 74P, STRAIGHT, X8, SAS 4.0, PCIE GEN 4	1	SEE NOTE 4

APPROVALS	DATE
DRAWN BY	27DEC17
APPROVED BY	02JAN18

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES:
X.X ± 0.2 MM
X.XX ± 0.15 MM
X.XXX ± 0.050 MM
ANGLES ± 1°

SCALE 1.500

BROADCOM®

TITLE: CABLE, SFF-8654 X8 TO 2X SFF-8654 X4, 1M

SIZE D | DWG NO. 5067-6103 | REV 001 | SHEET

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE
GND	S0	A1		P0	B1	GND	ITEM 3
Rx0+		A2			B2	Tx0+	ITEM 3
Rx0-		A3			B3	Tx0-	ITEM 3
GND		A4			B4	GND	ITEM 3
Rx1+		A5			B5	Tx1+	ITEM 3
Rx1-		A6			B6	Tx1-	ITEM 3
GND		A7			B7	GND	ITEM 3
SB7A		A8			B8	SB7	ITEM 4
SB4A		A9			B9	SB4	ITEM 4
GND(SB3A)		A10			B10	GND(SB3)	ITEM 3
SBA+		A11			B11	SBA+	ITEM 3
SBA-		A12			B12	SBA-	ITEM 3
GND		A13			B13	GND	ITEM 3
Rx2+		A14			B14	Tx2+	ITEM 3
Rx2-		A15			B15	Tx2-	ITEM 3
GND		A16			B16	GND	ITEM 3
Rx3+		A17			B17	Tx3+	ITEM 3
Rx3-		A18			B18	Tx3-	ITEM 3
GND		A19			B19	GND	ITEM 3, NOTE 1
GND		B1			A1	GND	ITEM 3
Tx0+		B2			A2	Rx0+	ITEM 3
Tx0-		B3			A3	Rx0-	ITEM 3
GND		B4			A4	GND	ITEM 3
Tx1+		B5			A5	Rx1+	ITEM 3
Tx1-		B6			A6	Rx1-	ITEM 3
GND		B7			A7	GND	ITEM 3
SB0A		B8			A8	SB0	ITEM 4
SB1A		B9			A9	SB1	ITEM 4
GND(SB2A)		B10			A10	GND(SB2)	ITEM 3
SB5A		B11			A11	SB5	ITEM 3
SB6A		B12			A12	SB6	ITEM 3
GND		B13			A13	GND	ITEM 3
Tx2+		B14			A14	RX2+	ITEM 3
Tx2-		B15			A15	Rx2-	ITEM 3
GND		B16			A16	GND	ITEM 3
Tx3+		B17			A17	Rx3+	ITEM 3
Tx3-		B18			A18	Rx3-	ITEM 3
GND		B19			A19	GND	ITEM 3

NOTES:
1. PIN/PAD ON CONNECTOR S0 SHARED ON CONNECTORS P0 AND P1.

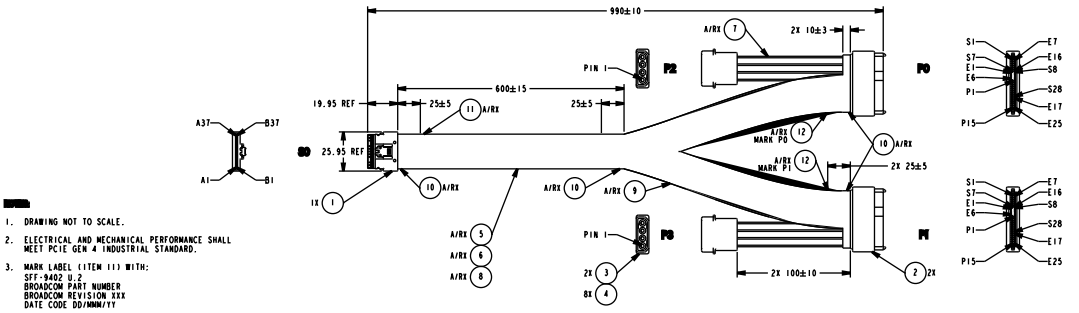
CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE
GND	S0	A19		P1	B1	GND	ITEM 3, NOTE 1
Rx4+		A20			B2	Tx0+	ITEM 3
Rx4-		A21			B3	Tx0-	ITEM 3
GND		A22			B4	GND	ITEM 3
Rx5+		A23			B5	Tx1+	ITEM 3
Rx5-		A24			B6	Tx1-	ITEM 3
GND		A25			B7	GND	ITEM 3
SB7B		A26			B8	SB7	ITEM 4
SB4B		A27			B9	SB4	ITEM 4
GND(SB3B)		A28			B10	GND(SB3)	ITEM 3
SBB+		A29			B11	SBA+	ITEM 3
SBB-		A30			B12	SBA-	ITEM 3
GND		A31			B13	GND	ITEM 3
Rx6+		A32			B14	Tx2+	ITEM 3
Rx6-		A33			B15	Tx2-	ITEM 3
GND		A34			B16	GND	ITEM 3
Rx7+		A35			B17	Tx3+	ITEM 3
Rx7-		A36			B18	Tx3-	ITEM 3
GND		A37			B19	GND	ITEM 3
GND		B19			A1	GND	ITEM 3, NOTE 1
Tx4+		B20			A2	Rx0+	ITEM 3
Tx4-		B21			A3	Rx0-	ITEM 3
GND		B22			A4	GND	ITEM 3
Tx5+		B23			A5	Rx1+	ITEM 3
Tx5-		B24			A6	Rx1-	ITEM 3
GND		B25			A7	GND	ITEM 3
SB0B		B26			A8	SB0	ITEM 4
SB1B		B27			A9	SB1	ITEM 4
GND(SB2B)		B28			A10	GND(SB2)	ITEM 3
SB5B		B29			A11	SB5	ITEM 3
SB6B		B30			A12	SB6	ITEM 3
GND		B31			A13	GND	ITEM 3
Tx6+		B32			A14	RX2+	ITEM 3
Tx6-		B33			A15	Rx2-	ITEM 3
GND		B34			A16	GND	ITEM 3
Tx7+		B35			A17	Rx3+	ITEM 3
Tx7-		B36			A18	Rx3-	ITEM 3
GND		B37			A19	GND	ITEM 3

Cable 05-60005-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60005-00, a x8 SFF-8654 to 2 U.2 SFF-8639 connection.

Figure 19: Cable 05-60005-00 Drawing and Pinout

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
001		PRELIMINARY RELEASE	30JAN18	
002	158550	ADDED AWG RANGE AND IMPEDANCE TOLERANCE TO ITEM 5, DESCRIPTION. REVISED NOTE 3 FOR LABEL MARKING	30APR19	



1. DRAWING NOT TO SCALE.
2. ELECTRICAL AND MECHANICAL PERFORMANCE SHALL MEET PCIE GEN 4 INDUSTRIAL STANDARD.
3. MARK LABEL (ITEM 11) WITH:
   SFF-9402 U.2
   BROADCOM PART NUMBER
   BROADCOM REVISION XXX
   DATE CODE DD/MMM/YY

   SECONDARY MARKING WITH MANUFACTURER PART NUMBER AND REVISION ACCEPTABLE.
4. SEE CABLE WIRING TABLES AND RELATED NOTES.

ITEM	CALLOUT	DESCRIPTION	QUANTITY	NOTES
12	LABEL	LABEL, 40X14MM, WHITE, R2, HF	A/R	
11	LABEL	LABEL, 70X26MM, WHITE, R2, HF	A/R	SEE NOTE 3
10	TAPE	ACETATE TAPE: W=1 INCH	A/R	
9	SLEEVING	EXPANDO TUBE: OD=7MM, GREEN, VW-1, HF	A/R	
8	SLEEVING	EXPANDO TUBE: OD=10MM, GREEN, VW-1, HF	A/R	
7	WIRE	UL1007, 18AWG, 41C, BLK/RED/YEL	A/R	
6	WIRE	UL1061, STRANDED	A/R	SEE NOTE 4
5	CABLE	SAS CABLE: UL20744, 92.5Ω ±10% DIFF,28-32AWG, PCIE GEN 4, VW-1, NATURAL, HF	A/R	
4	CONNECTOR TERMINALS	LP4 CONNECTOR TERMINALS, POWER, MALE, BRS, TIN, 18-24#	8	
3	CONNECTOR HOUSING	LP4 CONNECTOR HOUSING, POWER, FEMALE	2	SEE NOTE 4
2	CONNECTOR	SFF-8639, PCIE, 68 POS, STR	2	SEE NOTE 4
1	CONNECTOR	SFF-8654, 74P, STRAIGHT, X8, PCIE GEN 4	1	SEE NOTE 4

APPROVALS	DATE
DRAWN BY	23JAN18
APPROVED BY	30JAN18

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES:
X.X ± 0.2 MM
X.XX ± 0.15 MM
X.XXX ± 0.050 MM
ANGLES ± 1°

BROADCOM

TITLE	CABLE, X8 SFF-8654 TO 2X SFF-8639 (U.2), WITH POWER, 1M		
SCALE 1.000	SIZE D	DWG NO. 5067-6682	REV 002

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD	CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE
GND	S0	A1	P0	E15	GND	ITEM 5
Rx0+		A2		E14	PERp0	ITEM 5
Rx0-		A3		E13	PERn0	ITEM 5
GND		A4		E12/S22	GND	ITEM 5, NOTE 1
Rx1+		A5		S21	PERp1	ITEM 5
Rx1-		A6		S20	PERn1	ITEM 5
GND		A7		S19	GND	ITEM 5
SB7A		A8			NC	NOTE 2
SB4A		A9			NC	
GND/SB3A		A10		E9	GND	ITEM 5
SBA+		A11		E7	REFCLK+	ITEM 5
SBA-		A12		E8	REFCLK-	ITEM 5
GND		A13		S28	GND	ITEM 5
Rx2+		A14		S27	PERp2	ITEM 5
Rx2-		A15		S26	PERn2	ITEM 5
GND		A16		E22/S25	GND	ITEM 5, NOTE 1
Rx3+		A17		E21	PERp3	ITEM 5
Rx3-		A18		E20	PERn3	ITEM 5
GND		A19		E19	GND	ITEM 5
GND		B1		E9	GND	ITEM 5
Tx0+		B2		E10	PETp0	ITEM 5
Tx0-		B3		E11	PETn0	ITEM 5
GND		B4		E12/S16	GND	ITEM 5, NOTE 1
Tx1+		B5		S17	PETp1	ITEM 5
Tx1-		B6		S18	PETn1	ITEM 5
GND		B7		S19	GND	ITEM 5
SB0A		B8		E23	SMCLK	ITEM 6, NOTE 4
SB1A		B9		E24	SMDAT	ITEM 6, NOTE 4
GND/SB2A		B10		E22	GND	ITEM 6, NOTE 4
SB5A		B11		E5	PERST#	ITEM 6, NOTE 4
SB6A		B12		P4	1FDET#	ITEM 6, NOTE 4
GND		B13		S22	GND	ITEM 5
Tx2+		B14		S23	PETp2	ITEM 5
Tx2-		B15		S24	PETn2	ITEM 5
GND		B16		S25/S28	GND	ITEM 5, NOTE 1
Tx3+		B17		E17	PETp3	ITEM 5
Tx3-		B18		E18	PETn3	ITEM 5
GND		B19		E19	GND	ITEM 5

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD	CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE
GND	S0	A19	P1	E15	GND	ITEM 5
Rx4+		A20		E14	PERp0	ITEM 5
Rx4-		A21		E13	PERn0	ITEM 5
GND		A22		E12/S22	GND	ITEM 5, NOTE 1
Rx5+		A23		S21	PERp1	ITEM 5
Rx5-		A24		S20	PERn1	ITEM 5
GND		A25		S19	GND	ITEM 5
SB7B		A26			NC	NOTE 3
SB4B		A27			NC	
GND/SB3B		A28		E9	GND	ITEM 5
SBB+		A29		E7	REFCLK+	ITEM 5
SBB-		A30		E8	REFCLK-	ITEM 5
GND		A31		S28	GND	ITEM 5
Rx6+		A32		S27	PERp2	ITEM 5
Rx6-		A33		S26	PERn2	ITEM 5
GND		A34		S25/E22	GND	ITEM 5, NOTE 1
Rx7+		A35		E21	PERp3	ITEM 5
Rx7-		A36		E20	PERn3	ITEM 5
GND		A37		E19	GND	ITEM 5
GND		B19		E9	GND	ITEM 5
Tx4+		B20		E10	PETp0	ITEM 5
Tx4-		B21		E11	PETn0	ITEM 5
GND		B22		E12/S16	GND	ITEM 5, NOTE 1
Tx5+		B23		S17	PETp1	ITEM 5
Tx5-		B24		S18	PETn1	ITEM 5
GND		B25		S19	GND	ITEM 5
SB0B		B26		E23	SMCLK	ITEM 6, NOTE 4
SB1B		B27		E24	SMDAT	ITEM 6, NOTE 4
GND/SB2B		B28		E22	GND	ITEM 6, NOTE 4
SB5B		B29		E5	PERST#	ITEM 6, NOTE 4
SB6B		B30		P4	1FDET#	ITEM 6, NOTE 4
GND		B31		S22	GND	ITEM 5
Tx6+		B32		S23	PETp2	ITEM 5
Tx6-		B33		S24	PETn2	ITEM 5
GND		B34		S25/S28	GND	ITEM 5, NOTE 1
Tx7+		B35		E17	PETp3	ITEM 5
Tx7-		B36		E18	PETn3	ITEM 5
GND		B37		E19	GND	ITEM 5

1. CONNECT SHIELD OF DIFFERENTIAL PAIR TO INDICATED PIN/PAD AND SHORT TO SECOND INDICATED PIN/PAD.
2. SHORT PIN/PAD S0-A8 TO S0-B9. NO DIRECT CONNECT S0-A8 TO CONNECTOR P0.
3. SHORT PIN/PAD S0-A26 TO S0-B27. NO DIRECT CONNECT S0-A26 TO CONNECTOR P1.
4. END TO END RESISTANCE OF INDICATED CONNECTION SHALL BE 750 MILLIOHM MAX.

CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	NOTES
P0/P1	S2	SOT+	NO CONNECT PIN/PAD SHALL NOT BE CONNECTED VIA CONNECTOR INTERNALS NOR VIA WIRE
	S3	SOT-	
	S5	SOR-	
	S6	SOR+	
	S9	SIT+	
	S10	SIT-	
	S12	SIR-	
	S13	SIR+	
	S15	RSVD	
	E1	RefClk1+	
	E2	RefClk1-	
	E3	3.3Vaux	
	E4	ePERST1#	
	E6	RSVD	
	E16	RSVD	
	E25	DualPortEn#	
	P1	RSVD	
	P2	sPCIeRst	
	P3	RSVD	
	P10	PRSNT1#	
	P11	Activity	

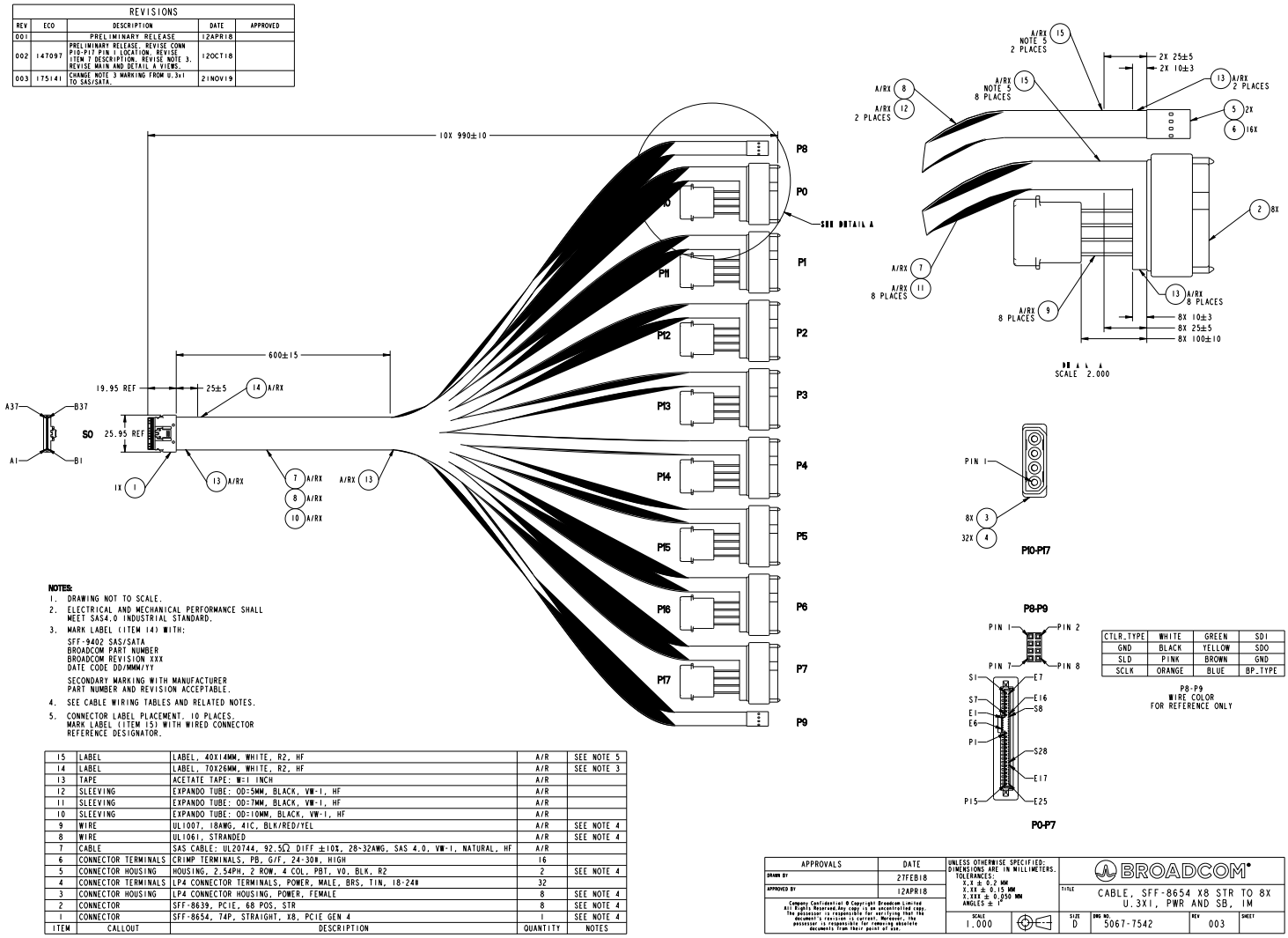
CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	NOTES
P0/P1	S1	GND	GROUND ALL PIN/PAD SHALL BE CONNECTED TO COMMON INDIVIDUAL CONNECTOR GROUND
	S4	GND	
	S7	GND	
	S8	GND	
	S11	GND	
	S14	GND	
	P5	GND	
	P6	GND	
	P12	GND	

POWER WIRING TABLE						
POWER CONNECTOR	PIN	SYMBOL	CONNECTOR	PIN	WIRE	COLOR
P2	1	12V	P0	P13, P14, P15	ITEM 7	YELLOW
	2	GND		P12	ITEM 7	BLACK
	3	GND		P6	ITEM 7	BLACK
	4	5V		P7, P8, P9	ITEM 7	RED
P3	1	12V	P1	P13, P14, P15	ITEM 7	YELLOW
	2	GND		P12	ITEM 7	BLACK
	3	GND		P6	ITEM 7	BLACK
	4	5V		P7, P8, P9	ITEM 7	RED

Cable 05-60006-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60006-00, a x8 SFF-8654 to x8 U.3 SFF-8639 connection.

Figure 20: Cable 05-60006-00 Drawing and Pinout



CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A1		P0 TARGET	S7	GND	ITEM 7	
Rx0+		A2			S6	D0_TX0+	ITEM 7	
Rx0-		A3			S5	D0_TX0-	ITEM 7	
GND		A4			S4	GND	ITEM 7	NOTE 2, NOTE 3
GND		B1			S1	GND	ITEM 7	
Tx0+		B2			S2	D0_RX0+	ITEM 7	
Tx0-		B3			S3	D0_RX0-	ITEM 7	
GND		B4			S4	GND	ITEM 7	NOTE 2, NOTE 3
12V	P10	1		P0 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P0 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A16		P3 TARGET	S7	GND	ITEM 7	NOTE 2
Rx3+		A17			S6	D3_TX0+	ITEM 7	
Rx3-		A18			S5	D3_TX0-	ITEM 7	
GND		A19			S4	GND	ITEM 7	NOTE 2, NOTE 3
GND		B16			S1	GND	ITEM 7	NOTE 2
Tx3+		B17			S2	D3_RX0+	ITEM 7	
Tx3-		B18			S3	D3_RX0-	ITEM 7	
GND		B19			S4	GND	ITEM 7	NOTE 2, NOTE 3
12V	P13	1		P3 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P3 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A4		P1 TARGET	S7	GND	ITEM 7	NOTE 2
Rx1+		A5			S6	D1_TX0+	ITEM 7	
Rx1-		A6			S5	D1_TX0-	ITEM 7	
GND		A7			S4	GND	ITEM 7	NOTE 3
GND		B4			S1	GND	ITEM 7	NOTE 2
Tx1+		B5			S2	D1_RX0+	ITEM 7	
Tx1-		B6			S3	D1_RX0-	ITEM 7	
GND		B7			S4	GND	ITEM 7	NOTE 3
12V	P11	1		P1 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P1 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A19		P4 TARGET	S7	GND	ITEM 7	NOTE 2
Rx4+		A20			S6	D4_TX0+	ITEM 7	
Rx4-		A21			S5	D4_TX0-	ITEM 7	
GND		A22			S4	GND	ITEM 7	NOTE 2, NOTE 3
GND		B19			S1	GND	ITEM 7	NOTE 2
Tx4+		B20			S2	D4_RX0+	ITEM 7	
Tx4-		B21			S3	D4_RX0-	ITEM 7	
GND		B22			S4	GND	ITEM 7	NOTE 2, NOTE 3
12V	P14	1		P4 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P4 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A13		P2 TARGET	S7	GND	ITEM 7	
Rx2+		A14			S6	D2_TX0+	ITEM 7	
Rx2-		A15			S5	D2_TX0-	ITEM 7	
GND		A16			S4	GND	ITEM 7	NOTE 2, NOTE 3
GND		B13			S1	GND	ITEM 7	
Tx2+		B14			S2	D2_RX0+	ITEM 7	
Tx2-		B15			S3	D2_RX0-	ITEM 7	
GND		B16			S4	GND	ITEM 7	NOTE 2, NOTE 3
12V	P12	1		P2 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P2 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A22		P5 TARGET	S7	GND	ITEM 7	NOTE 2
Rx5+		A23			S6	D5_TX0+	ITEM 7	
Rx5-		A24			S5	D5_TX0-	ITEM 7	
GND		A25			S4	GND	ITEM 7	NOTE 3
GND		B22			S1	GND	ITEM 7	NOTE 2
Tx5+		B23			S2	D5_RX0+	ITEM 7	
Tx5-		B24			S3	D5_RX0-	ITEM 7	
GND		B25			S4	GND	ITEM 7	NOTE 3
12V	P15	1		P5 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P5 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A31		P6 TARGET	S7	GND	ITEM 7	
Rx6+		A32			S6	D6_TX0+	ITEM 7	
Rx6-		A33			S5	D6_TX0-	ITEM 7	
GND		A34			S4	GND	ITEM 7	NOTE 2, NOTE 3
GND		B31			S1	GND	ITEM 7	
Tx6+		B32			S2	D6_RX0+	ITEM 7	
Tx6-		B33			S3	D6_RX0-	ITEM 7	
GND		B34			S4	GND	ITEM 7	NOTE 2, NOTE 3
12V	P16	1		P6 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P6 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0 HOST	A34		P7 TARGET	S7	GND	ITEM 7	NOTE 2
Rx7+		A35			S6	D7_TX0+	ITEM 7	
Rx7-		A36			S5	D7_TX0-	ITEM 7	
GND		A37			S4	GND	ITEM 7	NOTE 3
GND		B34			S1	GND	ITEM 7	NOTE 2
Tx7+		B35			S2	D7_RX0+	ITEM 7	
Tx7-		B36			S3	D7_RX0-	ITEM 7	
GND		B37			S4	GND	ITEM 7	NOTE 3
12V	P17	1		P7 TARGET	P13, P14, P15	12V	ITEM 9	YELLOW
GND		2			P12	GND	ITEM 9	BLACK
GND		3			P5, P6	GND	ITEM 9	BLACK
5V		4			P7, P8, P9	5V	ITEM 9	RED
NC				P7 TARGET	P1	RSVD		NOTE 4
NC					P2	sPCIeRst		NOTE 4

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
SB7A	S0 HOST	A8		P8	8	BP_TYPEA	ITEM 8	NOTE 1, BLUE
SB4A		A9		P8	4	SDOA	ITEM 8	NOTE 1, YELLOW
GND/SB3A		A10		P8	6	GND	ITEM 8	NOTE 1, BROWN
SBA+		A11				NC		
SBA-		A12				NC		
SB0A		B8		P8	7	SCLKA	ITEM 8	NOTE 1, ORANGE
SB1A		B9		P8	5	SLDA	ITEM 8	NOTE 1, PINK
GND/SB2A		B10		P8	3	GND	ITEM 8	NOTE 1, BLACK
SB5A		B11		P8	2	SDIA	ITEM 8	NOTE 1, GREEN
SB6A		B12		P8	1	CTLR_TYPEA	ITEM 8	NOTE 1, WHITE
SB7B	S0 HOST	A26		P9	8	BP_TYPEB	ITEM 8	NOTE 1, BLUE
SB4B		A27		P9	4	SDOB	ITEM 8	NOTE 1, YELLOW
GND/SB3B		A28		P9	6	GND	ITEM 8	NOTE 1, BROWN
SBB+		A29				NC		
SBB-		A30				NC		
SB0B		B26		P9	7	SCLKB	ITEM 8	NOTE 1, ORANGE
SB1B		B27		P9	5	SLDB	ITEM 8	NOTE 1, PINK
GND/SB2B		B28		P9	3	GND	ITEM 8	NOTE 1, BLACK
SB5B		B29		P9	2	SDIB	ITEM 8	NOTE 1, GREEN
SB6B		B30		P9	1	CTLR_TYPEB	ITEM 8	NOTE 1, WHITE

CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	NOTES
P0-P7 TARGET	S9	S1T+	NO CONNECT PIN/PAD SHALL NOT BE CONNECTED VIA CONNECTOR INTERNALS NOR VIA WIRE
	S10	S1T-	
	S12	S1R-	
	S13	S1R+	
	S17	S2T+	
	S18	S2T-	
	S20	S2R-	
	S21	S2R+	
	S23	S3T+	
	S24	S3T-	
	S26	S3R-	
	S27	S3R+	
	P3	PWRDIS	
	P4	IFDET#	
	P10	PRSNT#	
	P11	Activity/DisableStaggeredSpinup	
	E1	RefClk+	
	E2	RefClk1-	
	E3	3.3Vaux	
	E4	ePERST1#	
	E5	ePERST0#	
	E6	IFDET2#	
	E7	RefClk0+	
	E8	RefClk0-	
	E9	GND	
	E10	PETp0	
	E11	PETn0	
	E12	GND	
	E13	PERn0	
	E14	PERp0	
	E15	GND	
	E16	HPTI	
	E17	PETp3	
	E18	PETn3	
	E19	GND	
	E20	PERn3	
	E21	PERp3	
	E22	GND	
	E23	SMClk	
	E24	SMDat	
	E25	DualPortEn#	
P0-P7 TARGET	S8	GND	GROUND ALL PIN/PAD SHALL BE CONNECTED TO COMMON INDIVIDUAL CONNECTOR GROUND
	S11	GND	
	S14	GND	
	S15	GND (HPT0)	
	S16	GND	
	S19	GND	
	S22	GND	
	S25	GND	
	S28	GND	

NOTES:

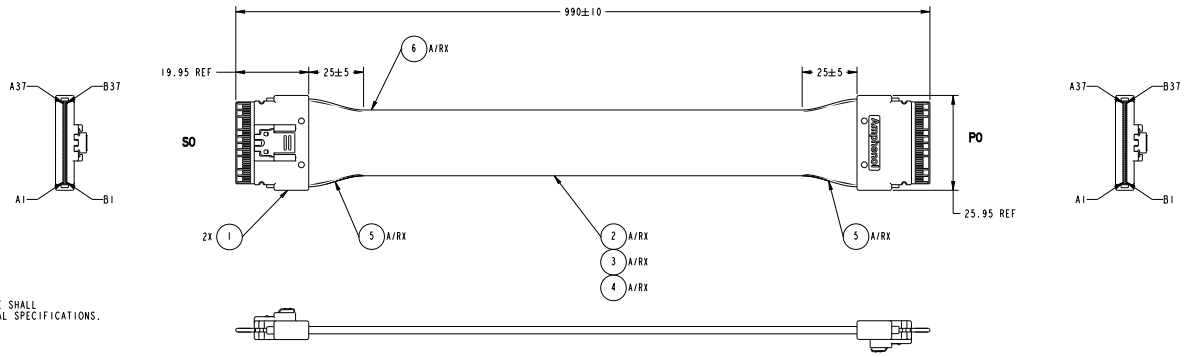
1. END TO END RESISTANCE OF INDICATED CONNECTION SHALL BE 750 MILLIOHM MAX.
2. SHARED PIN/PAD ON HOST (S0) CONNECTOR.
3. SHARED PIN/PAD ON INDICATED TARGET (P0-P7) CONNECTOR.
4. SHORT PIN/PAD P1 TO P2 OF INDICATED TARGET (P0-P7) CONNECTOR. NO CONNECT TO OTHER CONNECTORS.

Cable 05-60007-00

The following figure shows the drawing and pinout for Broadcom cable, 05-60007-00, a x8 SFF-8654 to x8 SFF-8654 connection.

Figure 21: Cable 05-60007-00 Drawing and Pinout

REVISIONS				
REV	ECO	DESCRIPTION	DATE	APPROVED
001		PRELIMINARY RELEASE	01MAY18	
002	175141	ADD WIRE GAUGE AND IMPEDANCE TOLERANCE ITEM 2. REVISE MARKING REQUIREMENTS NOTE 3.	21NOV19	



NOTES:

1. DRAWING NOT TO SCALE.
2. ELECTRICAL AND MECHANICAL PERFORMANCE SHALL MEET SAS 4.0 AND PCIE GEN 4 INDUSTRIAL SPECIFICATIONS.
3. MARK LABEL (ITEM 6) WITH:
   SFF-9402 SAS4/PCIE 4
   BROADCOM PART NUMBER
   BROADCOM REVISION XXX
   DATE CODE DD/MMM/YY
   SECONDARY MARKING WITH MANUFACTURER PART NUMBER AND REVISION ACCEPTABLE.
4. SEE CABLE WIRING TABLE AND RELATED NOTES.

ITEM	CALLOUT	DESCRIPTION	QUANTITY	NOTES
6	LABEL	LABEL, 70X26MM, WHITE, R2, HF	A/R	SEE NOTE 3
5	TAPE	ACETATE TAPE: W=1 INCH	A/R	
4	SLEEVING	EXPANDO TUBE: OD=10MM, GREEN, VW-1, HF	A/R	
3	WIRE	UL1061, STRANDED	A/R	SEE NOTE 4
2	CABLE	SAS CABLE: UL20744, 28-32AWG, 92.5Ω ±10% DIFF, SAS4, PCIE GEN 4, VW-1, NATURAL, HF	A/R	
1	CONNECTOR	SFF-8654, 74P, STRAIGHT, X8, STANDARD, SAS 4.0, PCIE GEN 4	2	SEE NOTE 4

APPROVALS	DATE
DRAWN BY	15FEB18
APPROVED BY	01MAY18

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES:
X.X ± 0.2 MM
X.XX ± 0.15 MM
X.XXX ± 0.050 MM
ANGLES ± 1°

SCALE 2.000

BROADCOM®

TITLE: CABLE, SFF-8654 TO SFF-8654, X8, STRAIGHT, IM

SIZE D | DWG NO. 5067-6869 | REV 002 | SHEET

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0	A1		P0	B1	GND	ITEM 3	
Rx0+		A2			B2	Tx0+	ITEM 3	
Rx0-		A3			B3	Tx0-	ITEM 3	
GND		A4			B4	GND	ITEM 3	
Rx1+		A5			B5	Tx1+	ITEM 3	
Rx1-		A6			B6	Tx1-	ITEM 3	
GND		A7			B7	GND	ITEM 3	
SB7A		A8			B8	SB7A	ITEM 4	NOTE 1
SB4A		A9			B9	SB4A	ITEM 4	NOTE 1
GND/SB3A		A10			B10	GND/SB3A	ITEM 3	
SBA+		A11			B11	SBA+	ITEM 3	
SBA-		A12			B12	SBA-	ITEM 3	
GND		A13			B13	GND	ITEM 3	
Rx2+		A14			B14	Tx2+	ITEM 3	
Rx2-		A15			B15	Tx2-	ITEM 3	
GND		A16			B16	GND	ITEM 3	
Rx3+		A17			B17	Tx3+	ITEM 3	
Rx3-		A18			B18	Tx3-	ITEM 3	
GND		A19			B19	GND	ITEM 3	
Rx4+		A20			B20	Tx4+	ITEM 3	
Rx4-		A21			B21	Tx4-	ITEM 3	
GND		A22			B22	GND	ITEM 3	
Rx5+		A23			B23	Tx5+	ITEM 3	
Rx5-		A24			B24	Tx5-	ITEM 3	
GND		A25			B25	GND	ITEM 3	
SB7B		A26			B26	SB7B	ITEM 4	NOTE 1
SB4B		A27			B27	SB4B	ITEM 4	NOTE 1
GND/SB3B		A28			B28	GND/SB3B	ITEM 3	
SBB+		A29			B29	SBB+	ITEM 3	
SBB-		A30			B30	SBB-	ITEM 3	
GND		A31			B31	GND	ITEM 3	
Rx6+		A32			B32	Tx6+	ITEM 3	
Rx6-		A33			B33	Tx6-	ITEM 3	
GND		A34			B34	GND	ITEM 3	
Rx7+		A35			B35	Tx7+	ITEM 3	
Rx7-		A36			B36	Tx7-	ITEM 3	
GND		A37			B37	GND	ITEM 3	

NOTES:

1. END TO END RESISTANCE OF INDICATED CONNECTION SHALL BE 750 MILLIOHM MAX.

CONNECTOR SIGNAL	CONNECTOR	PIN/PAD		CONNECTOR	PIN/PAD	CONNECTOR SIGNAL	WIRE/CABLE	NOTES
GND	S0	B1		P0	A1	GND	ITEM 3	
Tx0+		B2			A2	Rx0+	ITEM 3	
Tx0-		B3			A3	Rx0-	ITEM 3	
GND		B4			A4	GND	ITEM 3	
Tx1+		B5			A5	Rx1+	ITEM 3	
Tx1-		B6			A6	Rx1-	ITEM 3	
GND		B7			A7	GND	ITEM 3	
SB0A		B8			A8	SB0A	ITEM 4	NOTE 1
SB1A		B9			A9	SB1A	ITEM 4	NOTE 1
GND/SB2A		B10			A10	GND/SB2A	ITEM 3	
SB5A		B11			A11	SB5A	ITEM 3	
SB6A		B12			A12	SB6A	ITEM 3	
GND		B13			A13	GND	ITEM 3	
Tx2+		B14			A14	Rx2+	ITEM 3	
Tx2-		B15			A15	Rx2-	ITEM 3	
GND		B16			A16	GND	ITEM 3	
Tx3+		B17			A17	Rx3+	ITEM 3	
Tx3-		B18			A18	Rx3-	ITEM 3	
GND		B19			A19	GND	ITEM 3	
Tx4+		B20			A20	Rx4+	ITEM 3	
Tx4-		B21			A21	Rx4-	ITEM 3	
GND		B22			A22	GND	ITEM 3	
Tx5+		B23			A23	Rx5+	ITEM 3	
Tx5-		B24			A24	Rx5-	ITEM 3	
GND		B25			A25	GND	ITEM 3	
SB0B		B26			A26	SB0B	ITEM 4	NOTE 1
SB1B		B27			A27	SB1B	ITEM 4	NOTE 1
GND/SB2B		B28			A28	GND/SB2B	ITEM 3	
SB5B		B29			A29	SB5B	ITEM 3	
SB6B		B30			A30	SB6B	ITEM 3	
GND		B31			A31	GND	ITEM 3	
Tx6+		B32			A32	Rx6+	ITEM 3	
Tx6-		B33			A33	Rx6-	ITEM 3	
GND		B34			A34	GND	ITEM 3	
Tx7+		B35			A35	Rx7+	ITEM 3	
Tx7-		B36			A36	Rx7-	ITEM 3	
GND		B37			A37	GND	ITEM 3	

Revision History

Version 2.3, October 31, 2023

- Updated the address to 0x4C in Virtual Pin Port Management.
- Removed reference to LED4.

Version 2.2, September 27, 2023

- Updated the 9670-24i adapter connector-to-CSW port associations in Tri-Mode Storage Interface and PCIe (NVMe) Support.

Version 2.1, August 1, 2023

- Updated the adapter dimensions in Broadcom MegaRAID and HBA Tri-Mode Storage Adapter Characteristics.
- Updated External Adapter Connector Pinout.

Version 2.0, August 30, 2022

- Updated the resistor values in Sideband Signals.
- Revised Typical Power values in MegaRAID Tri-Mode Storage Adapter Power Supply Requirements and eHBA Tri-Mode Storage Adapter Power Supply Requirements.
- Changed SFF-8644 instances to SFF-8674.

Preliminary, Version 1.1, June 13, 2022

- Revised the NVMe SSD count in MegaRAID 9670W-16i, 9670-24i, and 9660-16i Adapter RAID Features.
- Updated the 05-60006-00 description in Storage Interface Cabling.
- Added Overtemperature Behavior.
- Updated the Adapter Marks and Certifications table in Marks, Certifications, and Compliance.
- Added the eHBA 9600-8i8e adapter.
- Renamed HBA to eHBA.

Preliminary, Version 1.0, March 8, 2022

- Updated the 9670-24i and 9600-24i adapters in the NVMe Device or PCIe Switch Direct-Attach Options Supported for Each Adapter table in PCIe (NVMe) Support.
- Updated the following tables in PCIe (NVMe) Support:
  - 9670-24i Adapter PCIe Topology Configuration Combinations
  - 9600-24i Adapter PCIe Topology Configuration Combinations
- Updated External Adapter Connector Pinout.
- Added board layout images.
- Updated Tri-Mode Storage Adapter Power Supply Requirements.
- Updated the values regarding the CacheVault power module in MegaRAID Tri-Mode Storage Adapter Power Supply Requirements.

Advance, Version 0.2, March 19, 2021

- Changed the 9660-16i cache memory description in the MegaRAID Tri-Mode Storage Adapter Features table in Overview.
- Updated the drive descriptions in the HBA Tri-Mode Storage Adapter Features table in Overview.
- Revised eHBA 9600 Adapter Features.
- Added a note to PCIe (NVMe) Support.
- Added Adapter Security.
- Added the MegaRAID 9670-24i adapter.

Advance, Version 0.1, April 27, 2020

Initial document release.