This document was developed by the SFF Committee prior to it becoming the SFF TA (Technology Affiliate) TWG (Technical Working Group) of the SNIA (Storage Networking Industry Association) in 2016.

*The information below should be used instead of the equivalent herein.*

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**POINTS OF CONTACT:** SFF TA TWG Chair Email: sff-chair@snia.org.
**LOCATION OF SFF DOCUMENTS:** http://www.snia.org/sff/specifications.

Suggestions for improvement of this specification are welcome and should be submitted to http://www.snia.org/feedback.

If you are interested in participating in the activities of the SFF TA TWG, additional information and the membership application can be found at: http://www.snia.org/sff.

SFF specifications are available at http://www.snia.org/sff/specifications

SFF Committee

**SFF-9401**

Specification for

**Universal Multi-Protocol Single Cable for SAS/PCIe**

Rev 1.0 November 30, 2016

Secretariat: SFF Committee

Abstract: This specification recommends the pinouts to enable a universal internal SAS-4 (pre Rev 0.7) (MiniLink) / PCIe (OCuLink) cable assembly. It also recommends the pinouts enabling universal cables employing previous SAS connectors.

This specification provides a common reference for systems manufacturers, system integrators, and suppliers. This is an internal working specification of the SFF Committee, an industry ad hoc group.

This specification is made available for public review, and written comments are solicited from readers. Comments received will be considered for inclusion in future revisions of this specification.

Support: This specification is supported by the identified member companies of the SFF Committee.

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**Change History**

Rev 0.1
- Presentation incorporated as an i-specification

Rev 0.2
- Introduced as a Development project

Rev 0.3
- Formatted to the current style

Rev 0.4
- Recognized contributor of pinout tables
- Updated Figure 3-1
- Corrected typos and software translation errors within the tables
- Created Section 4
- Added Table 4-4 and Table 4-5

Rev 0.5
- Changed Table 4-1, 4-2 and 4-3 color tones

Rev 0.6
- Changed title

Rev 0.8
- Changed Abstract to be more descriptive of the content of the specification
- Renamed Section 4 to match purpose
- Reordered the Implementation notes and added space between them to improve readability
- Reordered the tables to put the examples first
- Corrected Table 4-1 column 2 to add color bars back that did not transfer in a previous Revision
- Corrected Ground symbols in Tables column 6 (CABLE) that did not transfer properly in a previous Revision
- Updated 9400 sideband naming convention per HP feedback
- Added note re 8X sideband pin assignments

Rev 0.9
- Renamed the Specification for clarity
- Reordered the tables and reformatted the presentation of the tables for clarity based on input from members; no sidebands were reassigned
- Reordered the notes and revised for clarity, added column for SFF-9400
- Added references to SFF-9402

Rev 1.0
- Superseded by SFF-9402

**Foreword**

The development work on this specification was done by the SFF Committee, an industry group. The membership of the committee since its formation in August 1990 has included a mix of companies which are leaders across the industry.

When 2 1/2" diameter disk drives were introduced, there was no commonality on external dimensions e.g. physical size, mounting locations, connector type, connector location, between vendors.

The first use of these disk drives was in specific applications such as laptop portable computers and system integrators worked individually with vendors to develop the packaging. The result was wide diversity, and incompatibility.

The problems faced by integrators, device suppliers, and component suppliers led to the formation of the SFF Committee as an industry ad hoc group to address the marketing and engineering considerations of the emerging new technology.

During the development of the form factor definitions, other activities were suggested because participants in the SFF Committee faced more problems than the physical form factors of disk drives. In November 1992, the charter was expanded to address any issues of general interest and concern to the storage industry. The SFF Committee became a forum for resolving industry issues that are either not addressed by the standards process or need an immediate solution.

Those companies which have agreed to support a specification are identified in the first pages of each SFF Specification. Industry consensus is not an essential requirement to publish an SFF Specification because it is recognized that in an emerging product area, there is room for more than one approach. By making the documentation on competing proposals available, an integrator can examine the alternatives available and select the product that is felt to be most suitable.

SFF Committee meetings are held during T10 weeks (see www.t10.org), and Specific Subject Working Groups are held at the convenience of the participants. Material presented at SFF Committee meetings becomes public domain, and there are no restrictions on the open mailing of material presented at committee meetings.

Most of the specifications developed by the SFF Committee have either been incorporated into standards or adopted as standards by EIA (Electronic Industries Association), ANSI (American National Standards Institute) and IEC (International Electrotechnical Commission).

If you are interested in participating or wish to follow the activities of the SFF Committee, the signup for membership and/or documentation can be found at:

www.sffcommittee.com/ie/join.html

The complete list of SFF Specifications which have been completed or are currently being worked on by the SFF Committee can be found at:

ftp://ftp.seagate.com/sff/SFF-8000.TXT

If you wish to know more about the SFF Committee, the principles which guide the activities can be found at:

ftp://ftp.seagate.com/sff/SFF-8032.TXT

Suggestions for improvement of this specification will be welcome. They should be sent to the SFF Committee, 14426 Black Walnut Ct, Saratoga, CA 95070.

**CONTENTS**



**FIGURES**



**TABLES**

## 1. Scope

Industry storage solutions are implementing both SAS and PCIe within the same or similar enclosures. This specification recommends the pinning out of standardized connectors to accommodate multiple protocols.

## 2. References

### 2.1 Industry Documents

- OCuLink Spec Rev 1.0
- SFF-8087 Mini Multilane 4X Unshielded Connector Shell and Plug
- SFF-8448 SAS Sideband Signal Assignments
- SFF-8611 MiniLink 4/8X I/O Cable Assemblies
- SFF-8612 MiniLink 4/8X Shielded Connector
- SFF-8613 Mini Multilane 4/8X Unshielded Connector (HDun)
- SFF-8654 0.6mm 4/8X Unshielded I/O Connector
- SFF-9400 Universal 4/8X Pinout
- SFF-9402 Universal Multi-Protocol Dual Cable for SAS/PCIe

### 2.2 SFF Specifications

There are several projects active within the SFF Committee. The complete list of specifications which have been completed or are still being worked on are listed in the specification at ftp://ftp.seagate.com/sff/SFF-8000.TXT

### 2.3 Sources

Those who join the SFF Committee as an Observer or Member receive electronic copies of the minutes and SFF specifications (http://www.sffcommittee.com/ie/join.html).

Copies of ANSI standards may be purchased from the InterNational Committee for Information Technology Standards (http://www.techstreet.com/incitsgate.tmpl).

## 3. General Description

The connector figures below are shown for reference only to show how the pinouts shown in the tables relate to the physical locations of the pins for each of the connector styles. These pinouts comply with the SAS pinouts defined in SFF-8448 and in the PCIe pinouts defined by OCuLink. All are based on the fixed end definitions of the pin assignments.

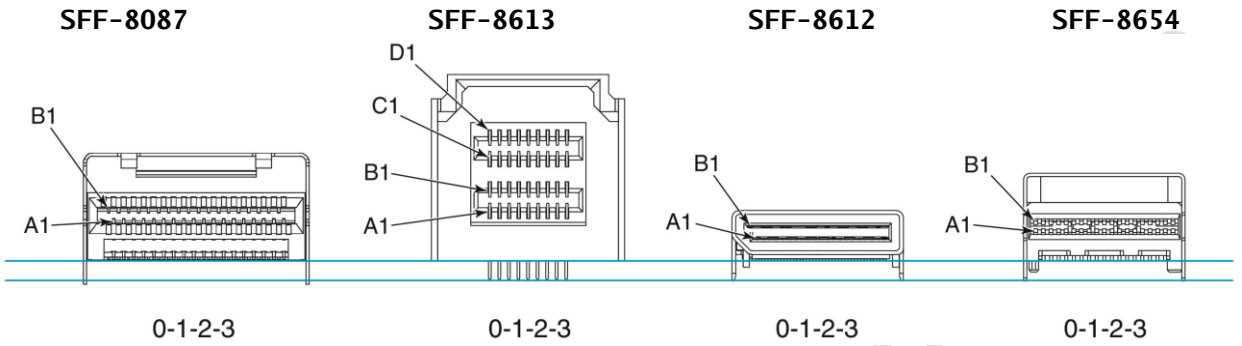


**FIGURE 3-1 CONNECTOR VIEWS**

## 4. Pinout Tables with System Compatibility Issues and Implementation Notes

The following notes provide the background information required to implement a universal multiprotocol single cable for SAS and PCIe (SAS/PCIE).

### System Compatibility Issues

1. Present PCI Express legacy internal implementations using SFF-8643/73 connectors are vendor specific (Not standardized) and do not align with legacy SAS/SATA implementations. Some are 85Ω; some have a white ring on fixed ends. As a result, PCIe cables utilizing SFF-8643/73 connectors can currently be plugged into legacy SAS/SATA implementations resulting in signal incompatibilities.

2. Legacy SAS/SATA internal pin assignments for SFF-8673 connectors are based on SAS 2.1/ SAS-3 T-10 standards and SFF-8448.

3. SFF-9402 enables a two cable solution for SAS specific and PCIe specific implementations

4. SAS standards can incorporate SGPIO or SCSI Enclosure Services (SES) depending on the physical sideband protocol utilized. SES provides a method to bridge the multiprotocol environment via 2Wire interface to discover what backplane/end point is present prior to any in-band communication/operation.

5. Controllers and Backplanes that are designed to be aware of 9401 can avoid incompatibility issues with signal levels when migrating from legacy to MiniLink, Slimline SAS and OCuLink.

6. SFF-9401 signal assignments are controlled by the Fixed side initiator and Fixed side backplane only. PCIe OCuLink 1.0 defines the signals based on the Fixed ends of the interface; SFF-8448 defines them for SAS. SFF-9400 defines the basic locations of undefined High Speed and Vendor Specific signals for the SFF-8612 and 8654 connectors.

7. PCIe mini-SAS HD vendor specific/sideband assignments are based on OCuLink 1.0 definitions.

8. SFF-9401 aligns both PCIe and SAS sideband assignments via SFF-8448 (SBO-9). The addition of “Other Bus Types” to SFF-8448 Rev 1.0 facilitates a common 2W interface and BP Type for both SAS and PCIe for determining bus type operation. Note – because the use of sideband signals differs between protocols, each sideband signal must be isolated i.e. not commoned in the cable.

Implementation Notes:

9. The pinouts in this spec define full crossover cables (The A row on one end crosses over to the B row on the other end).

10. New SAS cables built to this pinout will still work on old initiators and backplanes that were pinned out to the appropriate SAS standard.

11. The sideband pin assignments for the SFF-8643/73 connector have been optimized to support PCIe sideband (REFCLK) signals if required, and would revert back to the SAS definitions for SAS applications.

12. The tables define the lane and polarity of the high speed pairs.

13. Lane reversal is not mandatory for end point devices (See the PCI Express CEM Spec).

14. Multiple implementations exist for PCI Express based on SFF-8087 and SFF-8643/73. This specification was created to enable a common cable across multiple interfaces; therefore the previous protocol specific pinouts may not apply.

15. Care should be taken to drive all signals as defined by the pinouts in SFF-9401 to enable the benefits of the design.

16. On the x8 sideband pin assignments the “A-Side” is associated with lanes 0-3 and the “B-side” with 4-7. Both are considered independent out of band interfaces.

17. In a x8 only implementation, the sidebands designated as “A” are considered to be primary.

## TABLE 4-1 PINOUT FOR A 4X INTERFACE WITH SIDEBANDS

| | Controller / Initiator / *Root* (Downstream) | | | | | | | | | Backplane/ *Endpoint* (Upstream) | | | | | | | | *DEVICE* | DEVICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9400 Rev 0.2 | 8087 | 8643 | *mini-SAS HD* | 8654 | *SlimLine SAS* | 8612 | *OCuLink 1.0* | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | CABLE | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | *OCuLink 1.0* | 8612 | *SlimLine SAS* | 8654 | *mini-SAS HD* | 8643 | 8087 | *SFF-8639* | MultiLink |
| Type 1 4X | SAS-2.1 | SAS-2.1, 3 | *PCIE* | SAS-4 | *PCIE* | SAS-4 | *PCIE* | 4X Single Cable *OCuLink 1.0* / SFF-8448 | | 4X Single Cable SFF-8448/*OCuLink 1.0* | *PCIE* | SAS-4 | *PCIE* | SAS-4 | *PCIE* | SAS-2.1, 3 | SAS-2.1 | *PCIE* | SAS |
| | PIN | PIN | *PIN* | PIN | *PIN* | PIN | *PIN* | *ROOT* / Controller | DIR | Backplane/ *END Point* | *PIN* | PIN | *PIN* | PIN | *PIN* | PIN | PIN | *PIN* | PIN |
| RSV | | | | | | A1(RSVD) | *A1(RESERVED)* | RESERVED | NC | RESERVED | *B1(RESERVED)* | B1(RSVD) | | | | | | | |
| GND | A1 | B3 | *B3* | A1 | *A1* | A2 | *A2* | GROUND | ..... | GROUND | *B2* | B2 | *B1* | B1 | *D3* | D3 | B1 | | |
| HS | A2 | B4 | *B4* | A2 | *A2* | A3 | *A3* | PER(RX)p0 | ← | PET(TX)p0 | *B3* | B3 | *B2* | B2 | *D4* | D4 | B2 | *E14 (PERp0)* | S6 (TX0+) |
| HS | A3 | B5 | *B5* | A3 | *A3* | A4 | *A4* | PER(RX)n0 | ← | PET(TX)n0 | *B4* | B4 | *B3* | B3 | *D5* | D5 | B3 | *E13 (PERn0)* | S5 (TX0-) |
| GND | A4 | A3 | *A3* | A4 | *A4* | A5 | *A5* | GROUND | ..... | GROUND | *B5* | B5 | *B4* | B4 | *C3* | C3 | B4 | | |
| HS | A5 | A4 | *A4* | A5 | *A5* | A6 | *A6* | PER(RX)p1 | ← | PET(TX)p1 | *B6* | B6 | *B5* | B5 | *C4* | C4 | B5 | *S21 (PERp1)* | S13 (TX1+) |
| HS | A6 | A5 | *A5* | A6 | *A6* | A7 | *A7* | PER(RX)n1 | ← | PET(TX)n1 | *B7* | B7 | *B6* | B6 | *C5* | C5 | B6 | *S20 (PERn1)* | S12 (TX1-) |
| GND | A7 | A6 | *A6* | A7 | *A7* | A8 | *A8* | GROUND | ..... | GROUND | *B8* | B8 | *B7* | B7 | *C6* | C6 | B7 | | |
| SB | A8(SB7) | A1(SB7) | *A1(VSP7)* | A8(SB7) | *A8(VSP7)* | A9(SB7) | *A9(BP_TYPE)* | *BP_TYPE(VSP7)* / BP_TYPE(SB7) | ← | (SB7)BP_TYPE/ *(VS7)BP_TYPE* | *B9 (BP_TYPE)* | B9(SB7) | *B8(VSP7)* | B8(SB7) | *A2(VSP7)* | A2(SB7) | B8(SB7) | | |
| SB | A9(SB3) | B1(SB3) | *B1(VSP3)* | A9(SB3) | *A9(VSP3)* | A10(SB3) | *A10(CWAKE#/OBFF)* | *CWAKE#,OBFF(VSP3)* / GND(SB3) | ↔ | (SB3)GND / *(VSP3)CWAKE#,OBFF* | *B10 (CWAKE#/OBFF)* | B10(SB3) | *B9(VSP3)* | B9(SB3) | *B2(VSP3)* | B2(SB3) | B9(SB3) | *P1 (WAKE#)* | |
| SB | | | | A10(SB9) | *A10(VSP9)* | A11 (SB9) | *A11(GND)* | *GND(VSP9)* / GND(SB9) | ..... | (SB9)GND/ *(VSP9)GND* | *B11(GND)* | B11(SB9) | *B10(VSP9)* | B10(SB9) | | | | | |
| SB | A10(SB4) | C1(SB4) | *C1(VSP4)* | A11(SB4) | *A11(VSP4)* | A12(SB4) | *A12(VSP)(REFCLK+)* | *REFCLK+(VSP4)* / RESET, SDataOut(SB4) | → | (SB4)SDataOut,RESET/ *(VSP4)REFCLK+* | *B12 (VSP)REFCLK+)* | B12(SB4) | *B11(VSP4)* | B11(SB4) | *C2(VSP4)* | C2(SB4) | B10(SB4) | *E7 (REFCLK+)* | |
| SB | A11(SB5) | D1(SB5) | *D1(VSP5)* | A12(SB5) | *A12(VSP5)* | A13(SB5) | *A13(VSP)(REFCLK-)* | *REFCLK-(VSP5)* / ADD, SDataIn(SB5) | ↔ | (SB5)SDataIn,ADD/ *(VSP5)REFCLK-* | *B13(VSP)(REFCLK-)* | B13(SB5) | *B12(VSP5)* | B12(SB5) | *D2(VSP5)* | D2(SB5) | B11(SB5) | *E8 (REFCLK-)* | |
| GND | A12 | B6 | *B6* | A13 | *A13* | A14 | *A14* | GROUND | ..... | GROUND | *B14* | B14 | *B13* | B13 | *D6* | D6 | B12 | | |
| HS | A13 | B7 | *B7* | A14 | *A14* | A15 | *A15* | PER(RX)p2 | ← | PETp2 | *B15* | B15 | *B14* | B14 | *D7* | D7 | B13 | *S27 (PERp2)* | S21 (TX2+) |
| HS | A14 | B8 | *B8* | A15 | *A15* | A16 | *A16* | PER(RX)n2 | ← | PETn2 | *B16* | B16 | *B15* | B15 | *D8* | D8 | B14 | *S26 (PERn2)* | S20 (TX2-) |
| GND | A15 | B9 | *B9* | A16 | *A16* | A17 | *A17* | GROUND | ..... | GROUND | *B17* | B17 | *B16* | B16 | *D9* | D9 | B15 | | |
| HS | A16 | A7 | *A7* | A17 | *A17* | A18 | *A18* | PER(RX)p3 | ← | PET(TX)p3 | *B18* | B18 | *B17* | B17 | *C7* | C7 | B16 | *E21 (PERp3)* | S27 (TX3+) |
| HS | A17 | A8 | *A8* | A18 | *A18* | A19 | *A19* | PER(RX)n3 | ← | PET(TX)n3 | *B19* | B19 | *B18* | B18 | *C8* | C8 | B17 | *E20 (PERn3)* | S26 (TX3-) |
| GND | A18 | A9 | *A9* | A19 | *A19* | A20 | *A20* | GROUND | ..... | GROUND | *B20* | B20 | *B19* | B19 | *C9* | C9 | B18 | | |
| RSV | | | | | | A21(RSVD) | *A21(RESERVED)* | RESERVED | NC | RESERVED | *B21(RESERVED)* | B21(RSVD) | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| RSV | | | | | | B1(RSVD) | *B1(RESERVED)* | RESERVED | NC | RESERVED | *A1(RESERVED)* | A1(RSVD) | | | | | | | |
| GND | B1 | D3 | *D3* | B1 | *B1* | B2 | *B2* | GROUND | ..... | GROUND | *A2* | A2 | *A1* | A1 | *B3* | B3 | A1 | | |
| HS | B2 | D4 | *D4* | B2 | *B2* | B3 | *B3* | PET(TX)p0 | → | PER(RX)p0 | *A3* | A3 | *A2* | A2 | *B4* | B4 | A2 | *E10 (PETp0)* | S2 (RX0+) |
| HS | B3 | D5 | *D5* | B3 | *B3* | B4 | *B4* | PET(TX)n0 | → | PER(RX)n0 | *A4* | A4 | *A3* | A3 | *B5* | B5 | A3 | *E11 (PETn0)* | S3 (RX0-) |
| GND | B4 | C3 | *C3* | B4 | *B4* | B5 | *B5* | GROUND | ..... | GROUND | *A5* | A5 | *A4* | A4 | *A3* | A3 | A4 | | |
| HS | B5 | C4 | *C4* | B5 | *B5* | B6 | *B6* | PET(TX)p1 | → | PER(RX)p1 | *A6* | A6 | *A5* | A5 | *A4* | A4 | A5 | *S17 (PETp1)* | S9 (RX1+) |
| HS | B6 | C5 | *C5* | B6 | *B6* | B7 | *B7* | PET(TX)n1 | → | PER(RX)n1 | *A7* | A7 | *A6* | A6 | *A5* | A5 | A6 | *S18 (PETn1)* | S10 (RX1-) |
| GND | B7 | C6 | *C6* | B7 | *B7* | B8 | *B8* | GROUND | ..... | GROUND | *A8* | A8 | *A7* | A7 | *A6* | A6 | A7 | | |
| SB | B8(SB0) | A2(SB0) | *A2(VSP0)* | B8(SB0) | *B8(VSP0)* | B9(SB0) | *B9 (2W-CLK)* | *2W-CLK(VSP0)* / 2W-CLK(SB0) | ↔ | (SB0)2W-CLK)/*(VSP0)2W-CLK* | *A9 (2W-CLK)* | A9(SB0) | *A8(VSP0)* | A8(SB0) | *A1(VSP0)* | A1(SB0) | A8(SB0) | | |
| SB | B9(SB1) | B2(SB1) | *B2(VSP1)* | B9(SB1) | *B9(VSP1)* | B10(SB1) | *B10 (2W-DATA)* | *2W-DATA(VSP1)* / 2W-DATA(SB1) | ↔ | (SB1)2W-DATA/ *(VSP1)2W-DATA* | *A10 (2W-DATA)* | A10(SB1) | *A9(VSP1)* | A9(SB1) | *B1(VSP1)* | B1(SB1) | A9(SB1) | | |
| SB | | | | B10(SB8) | *B10(VSP8)* | B11(SB8) | *B11 (GND)* | *GND(VSP8)* / GND(SB8) | ..... | (SB8)GND/ *(VSP8)GND* | *A11 (GND)* | A11(SB8) | *A10(VSP8)* | A10(SB8) | | | | | |
| SB | B10(SB2) | C2(SB2) | *C2(VSP2)* | B11(SB2) | *B11(VSP2)* | B12(SB2) | *B12 (PERST#)* | *PERST#(VSP2)* / GND(SB2) | → | (SB2)GND/ *(VSP2)PERST#* | *A12 (PERST#)* | A12(SB2) | *A11(VSP2)* | A11(SB2) | *C1(VSP2)* | C1(SB2) | A10(SB2) | *E5 (PERST#)* | |
| SB | B11(SB6) | D2(SB6) | *D2(VSP6)* | B12(SB6) | *B12(VSP6)* | B13(SB6) | *B13 (CPRSNT#)* | *CPRSNT#(VSP6)* / CNTRLR_TYPE(SB6) | ↔ | (SB6)CNTRLR_TYPE/ *(VSP6)CPRSNT#* | *A13 (CPRSNT#)* | A13(SB6) | *A12(VSP6)* | A12(SB6) | *D1(VSP6)* | D1(SB6) | A11(SB6) | | |
| GND | B12 | D6 | *D6* | B13 | *B13* | B14 | *B14* | GROUND | ..... | GROUND | *A14* | A14 | *A13* | A13 | *B6* | B6 | A12 | | |
| HS | B13 | D7 | *D7* | B14 | *B14* | B15 | *B15* | PET(TX)p2 | → | PER(RX)p2 | *A15* | A15 | *A14* | A14 | *B7* | B7 | A13 | *S23 (PETp2)* | S17 (RX2+) |
| HS | B14 | D8 | *D8* | B15 | *B15* | B16 | *B16* | PET(TX)n2 | → | PER(RX)n2 | *A16* | A16 | *A15* | A15 | *B8* | B8 | A14 | *S24 (PETn2)* | S18 (RX2-) |
| GND | B15 | D9 | *D9* | B16 | *B16* | B17 | *B17* | GROUND | ..... | GROUND | *A17* | A17 | *A16* | A16 | *B9* | B9 | A15 | | |
| HS | B16 | C7 | *C7* | B17 | *B17* | B18 | *B18* | PET(TX)p3 | → | PER(RX)p3 | *A18* | A18 | *A17* | A17 | *A7* | A7 | A16 | *E17 (PETp3)* | S23 (RX3+) |
| HS | B17 | C8 | *C8* | B18 | *B18* | B19 | *B19* | PET(TX)n3 | → | PER(RX)n3 | *A19* | A19 | *A18* | A18 | *A8* | A8 | A17 | *E18 (PETn3)* | S24 (RX3-) |
| GND | B18 | C9 | *C9* | B19 | *B19* | B20 | *B20* | GROUND | ..... | GROUND | *A20* | A20 | *A19* | A19 | *A9* | A9 | A18 | | |
| RSV | | | | | | B21(RSVD) | *B21(RESERVED)* | RESERVED | NC | RESERVED | *A21(RESERVED)* | A21(RSVD) | | | | | | | |
| | | | | | | | | | | | | | | | | | 4x SHEET 1 OF 1 | | |

## TABLE 4-2 EXAMPLE PINOUT FROM SAS SFF-8643 TO SAS SFF-8612

| | Controller (Downstream) | | | Backplane (Upstream) | | | DEVICE |
|---|---|---|---|---|---|---|---|
| 9400 Rev 0.2 | 8643 | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | CABLE | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | 8612 | 8654 | MultiLink |
| Type 1 4X | SAS-2.1, 3 | 4X Single Cable SFF-8448 | | 4X Single Cable SFF-8448 | SAS-4 | SAS-4 | SAS |
| | PIN | Controller | DIR | Backplane | PIN | PIN | PIN |
| RSV | | RESERVED | NC | RESERVED | B1(RSVD) | | |
| GND | B3 | GROUND | ..... | GROUND | B2 | B1 | |
| HS | B4 | PER(RX)p0 | ← | PET(TX)p0 | B3 | B2 | S6 (TX0+) |
| HS | B5 | PER(RX)n0 | ← | PET(TX)n0 | B4 | B3 | S5 (TX0-) |
| GND | A3 | GROUND | ..... | GROUND | B5 | B4 | |
| HS | A4 | PER(RX)p1 | ← | PET(TX)p1 | B6 | B5 | S13 (TX1+) |
| HS | A5 | PER(RX)n1 | ← | PET(TX)n1 | B7 | B6 | S12 (TX1-) |
| GND | A6 | GROUND | ..... | GROUND | B8 | B7 | |
| SB | A1(SB7) | BP_TYPE(SB7) | ← | (SB7)BP_TYPE | B9(SB7) | B8(SB7) | |
| SB | B1(SB3) | GND(SB3) | ↔ | (SB3)GND | B10(SB3) | B9(SB3) | |
| SB | | GND(SB9) | ..... | (SB9)GND | B11(SB9) | B10(SB9) | |
| SB | C1(SB4) | RESET, SDataOut(SB4) | → | (SB4)SDataOut,RESET | B12(SB4) | B11(SB4) | |
| SB | D1(SB5) | ADD, SDataIn(SB5) | ↔ | (SB5)SDataIn,ADD | B13(SB5) | B12(SB5) | |
| GND | B6 | GROUND | ..... | GROUND | B14 | B13 | |
| HS | B7 | PER(RX)p2 | ← | PETp2 | B15 | B14 | S21 (TX2+) |
| HS | B8 | PER(RX)n2 | ← | PETn2 | B16 | B15 | S20 (TX2-) |
| GND | B9 | GROUND | ..... | GROUND | B17 | B16 | |
| HS | A7 | PER(RX)p3 | ← | PET(TX)p3 | B18 | B17 | S27 (TX3+) |
| HS | A8 | PER(RX)n3 | ← | PET(TX)n3 | B19 | B18 | S26 (TX3-) |
| GND | A9 | GROUND | ..... | GROUND | B20 | B19 | |
| RSV | | RESERVED | NC | RESERVED | B21(RSVD) | | |
| | | | | | | | |
| RSV | | RESERVED | NC | RESERVED | A1(RSVD) | | |
| GND | D3 | GROUND | ..... | GROUND | A2 | A1 | |
| HS | D4 | PET(TX)p0 | → | PER(RX)p0 | A3 | A2 | S2 (RX0+) |
| HS | D5 | PET(TX)n0 | → | PER(RX)n0 | A4 | A3 | S3 (RX0-) |
| GND | C3 | GROUND | ..... | GROUND | A5 | A4 | |
| HS | C4 | PET(TX)p1 | → | PER(RX)p1 | A6 | A5 | S9 (RX1+) |
| HS | C5 | PET(TX)n1 | → | PER(RX)n1 | A7 | A6 | S10 (RX1-) |
| GND | C6 | GROUND | ..... | GROUND | A8 | A7 | |
| SB | A2(SB0) | 2W-CLK(SB0) | ↔ | (SB0)2W-CLK) | A9(SB0) | A8(SB0) | |
| SB | B2(SB1) | 2W-DATA(SB1) | ↔ | (SB1)2W-DATA | A10(SB1) | A9(SB1) | |
| SB | | GND(SB8) | ..... | (SB8)GND | A11(SB8) | A10(SB8) | |
| SB | C2(SB2) | GND(SB2) | → | (SB2)GND | A12(SB2) | A11(SB2) | |
| SB | D2(SB6) | CNTRLR_TYPE(SB6) | ↔ | (SB6)CNTRLR_TYPE | A13(SB6) | A12(SB6) | |
| GND | D6 | GROUND | ..... | GROUND | A14 | A13 | |
| HS | D7 | PET(TX)p2 | → | PER(RX)p2 | A15 | A14 | S17 (RX2+) |
| HS | D8 | PET(TX)n2 | → | PER(RX)n2 | A16 | A15 | S18 (RX2-) |
| GND | D9 | GROUND | ..... | GROUND | A17 | A16 | |
| HS | C7 | PET(TX)p3 | → | PER(RX)p3 | A18 | A17 | S23 (RX3+) |
| HS | C8 | PET(TX)n3 | → | PER(RX)n3 | A19 | A18 | S24 (RX3-) |
| GND | C9 | GROUND | ..... | GROUND | A20 | A19 | |
| RSV | | RESERVED | NC | RESERVED | A21(RSVD) | | |
| | | | | | | 4x | SHEET 1 OF 1 |

## TABLE 4-3 EXAMPLE PINOUT FROM MINI-SAS HD SFF-8613 TO OCULINK 1.0

| | *Root* (Downstream) | | | *Endpoint* (Upstream) | | | *DEVICE* |
|---|---|---|---|---|---|---|---|
| 9400 Rev 0.2 | *mini-SAS HD* | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | CABLE | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | *OCuLink 1.0* | *SlimLine SAS* | *SFF-8639* |
| Type 1 4X | *PCIE* | 4X Single Cable *OCuLink 1.0* | | 4X Single Cable *OCuLink 1.0* | *PCIE* | *PCIE* | *PCIE* |
| | *PIN* | *ROOT* | DIR | *END Point* | *PIN* | *PIN* | *PIN* |
| RSV | | RESERVED | NC | RESERVED | *B1(RESERVED)* | | |
| **GND** | ***B3*** | **GROUND** | ..... | **GROUND** | ***B2*** | ***B1*** | |
| HS | *B4* | PER(RX)p0 | ← | PET(TX)p0 | *B3* | *B2* | *E14 (PERp0)* |
| HS | *B5* | PER(RX)n0 | ← | PET(TX)n0 | *B4* | *B3* | *E13 (PERn0)* |
| **GND** | ***A3*** | **GROUND** | ..... | **GROUND** | ***B5*** | ***B4*** | |
| HS | *A4* | PER(RX)p1 | ← | PET(TX)p1 | *B6* | *B5* | *S21 (PERp1)* |
| HS | *A5* | PER(RX)n1 | ← | PET(TX)n1 | *B7* | *B6* | *S20 (PERn1)* |
| **GND** | ***A6*** | **GROUND** | ..... | **GROUND** | ***B8*** | ***B7*** | |
| SB | *A1(VSP7)* | *BP_TYPE(VSP7)* | ← | *(VSP7)BP_TYPE* | *B9 (BP_TYPE)* | *B8(VSP7)* | |
| SB | *B1(VSP3)* | *CWAKE#,OBFF(VSP3)* | ↔ | *(VSP3)CWAKE#,OBFF* | *B10 (CWAKE#/OBFF)* | *B9(VSP3)* | *P1 (WAKE#)* |
| SB | | *GND(VSP9)* | ..... | *(VSP9)GND* | *B11(GND)* | *B10(VSP9)* | |
| SB | *C1(VSP4)* | *REFCLK+(VSP4)* | → | *(VSP4)REFCLK+* | *B12 (VSP)REFCLK+)* | *B11(VSP4)* | *E7 (REFCLK+)* |
| SB | *D1(VSP5)* | *REFCLK-(VSP5)* | ↔ | *(VSP5)REFCLK-* | *B13(VSP)(REFCLK-)* | *B12(VSP5)* | *E8 (REFCLK-)* |
| **GND** | ***B6*** | **GROUND** | ..... | **GROUND** | ***B14*** | ***B13*** | |
| HS | *B7* | PER(RX)p2 | ← | PETp2 | *B15* | *B14* | *S27 (PERp2)* |
| HS | *B8* | PER(RX)n2 | ← | PETn2 | *B16* | *B15* | *S26 (PERn2)* |
| **GND** | ***B9*** | **GROUND** | ..... | **GROUND** | ***B17*** | ***B16*** | |
| HS | *A7* | PER(RX)p3 | ← | PET(TX)p3 | *B18* | *B17* | *E21 (PERp3)* |
| HS | *A8* | PER(RX)n3 | ← | PET(TX)n3 | *B19* | *B18* | *E20 (PERn3)* |
| **GND** | ***A9*** | **GROUND** | ..... | **GROUND** | ***B20*** | ***B19*** | |
| RSV | | RESERVED | NC | RESERVED | *B21(RESERVED)* | | |
| | | | | | | | |
| RSV | | RESERVED | NC | RESERVED | *A1(RESERVED)* | | |
| **GND** | ***D3*** | **GROUND** | ..... | **GROUND** | ***A2*** | ***A1*** | |
| HS | *D4* | PET(TX)p0 | → | PER(RX)p0 | *A3* | *A2* | *E10 (PETp0)* |
| HS | *D5* | PET(TX)n0 | → | PER(RX)n0 | *A4* | *A3* | *E11 (PETn0)* |
| **GND** | ***C3*** | **GROUND** | ..... | **GROUND** | ***A5*** | ***A4*** | |
| HS | *C4* | PET(TX)p1 | → | PER(RX)p1 | *A6* | *A5* | *S17 (PETp1)* |
| HS | *C5* | PET(TX)n1 | → | PER(RX)n1 | *A7* | *A6* | *S18 (PETn1)* |
| **GND** | ***C6*** | **GROUND** | ..... | **GROUND** | ***A8*** | ***A7*** | |
| SB | *A2(VSP0)* | *2W-CLK(VSP0)* | ↔ | *(VSP0)2W-CLK* | *A9 (2W-CLK)* | *A8(VSP0)* | |
| SB | *B2(VSP1)* | *2W-DATA(VSP1)* | ↔ | *(VSP1)2W-DATA* | *A10 (2W-DATA)* | *A9(VSP1)* | |
| SB | | *GND(VSP8)* | ..... | *(VSP8)GND* | *A11 (GND)* | *A10(VSP8)* | |
| SB | *C2(VSP2)* | *PERST#(VSP2)* | → | *(VSP2)PERST#* | *A12 (PERST#)* | *A11(VSP2)* | *E5 (PERST#)* |
| SB | *D2(VSP6)* | *CPRSNT#(VSP6)* | ↔ | *(VSP6)CPRSNT#* | *A13 (CPRSNT#)* | *A12(VSP6)* | |
| **GND** | ***D6*** | **GROUND** | ..... | **GROUND** | ***A14*** | ***A13*** | |
| HS | *D7* | PET(TX)p2 | → | PER(RX)p2 | *A15* | *A14* | *S23 (PETp2)* |
| HS | *D8* | PET(TX)n2 | → | PER(RX)n2 | *A16* | *A15* | *S24 (PETn2)* |
| **GND** | ***D9*** | **GROUND** | ..... | **GROUND** | ***A17*** | ***A16*** | |
| HS | *C7* | PET(TX)p3 | → | PER(RX)p3 | *A18* | *A17* | *E17 (PETp3)* |
| HS | *C8* | PET(TX)n3 | → | PER(RX)n3 | *A19* | *A18* | *E18 (PETn3)* |
| **GND** | ***C9*** | **GROUND** | ..... | **GROUND** | ***A20*** | ***A19*** | |
| RSV | | RESERVED | NC | RESERVED | *A21(RESERVED)* | | |
| | | | | | | **4x** | **SHEET 1 OF 1** |

## TABLE 4-4 PINOUT FOR AN 8X INTERFACE WITH SIDEBANDS (1 OF 2)

| | Controller / Initiator / *Root* (Downstream) | | | | | | | | | Backplane/ *Endpoint* (Upstream) | | | | | | | | DEVICE | DEVICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9400 Rev 0.2 | 8087 | 8643 | *mini-SAS HD* | 8654 | *SlimLine SAS* | 8612 | *OCuLink* | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | CABLE | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | *OCuLink* | 8612 | *SlimLine SAS* | 8654 | *mini-SAS HD* | 8643 | 8087 | *SFF-8639* | MultiLink |
| Type 1 8X | SAS-2.1 x4 | SAS-2.1, 3 x4 | *PCIE x4* | SAS-4 x8 | *PCIE x8* | SAS-4 x8 | *PCIE x8* | 8X Single Cable *OCuLink 1.0* / SFF-8448 | | 8X Single Cable SFF-8448/*OCuLink 1.0* | *PCIE x8* | SAS-4 x8 | *PCIE x8* | SAS-4 x8 | *PCIE x4* | SAS-2.1, 3 x4 | SAS-2.1 x4 | *PCIE* | SAS |
| | PIN | PIN | *PIN* | PIN | *PIN* | PIN | *PIN* | *ROOT* / Controller | DIR | Backplane/ *END Point* | *PIN* | PIN | *PIN* | PIN | *PIN* | PIN | PIN | *PIN* | PIN |
| **GND** | **A1** | **B3** | ***B3*** | **A1** | ***A1*** | **A1** | ***A1*** | **GROUND** | ..... | **GROUND** | ***B1*** | ***B1*** | ***B1*** | ***B1*** | ***D3*** | ***D3*** | ***B1*** | | |
| HS | A2 | B4 | *B4* | A2 | *A2* | A2 | *A2* | PER(RX)p0 | ← | PET(TX)p0 | *B2* | B2 | *B2* | B2 | *D4* | D4 | B2 | *E14 (PERp0)* | S6 (TX0+) |
| HS | A3 | B5 | *B5* | A3 | *A3* | A3 | *A3* | PER(RX)n0 | ← | PET(TX)n0 | *B3* | B3 | *B3* | B3 | *D5* | D5 | B3 | *E13 (PERn0)* | S5 (TX0-) |
| **GND** | **A4** | **A3** | ***A3*** | **A4** | ***A4*** | **A4** | ***A4*** | **GROUND** | ..... | **GROUND** | ***B4*** | ***B4*** | ***B4*** | ***B4*** | ***C3*** | ***C3*** | ***B4*** | | |
| HS | A5 | A4 | *A4* | A5 | *A5* | A5 | *A5* | PER(RX)p1 | ← | PET(TX)p1 | *B5* | B5 | *B5* | B5 | *C4* | C4 | B5 | *S21 (PERp1)* | S13 (TX1+) |
| HS | A6 | A5 | *A5* | A6 | *A6* | A6 | *A6* | PER(RX)n1 | ← | PET(TX)n1 | *B6* | B6 | *B6* | B6 | *C5* | C5 | B6 | *S20 (PERn1)* | S12 (TX1-) |
| **GND** | **A7** | **A6** | ***A6*** | **A7** | ***A7*** | **A7** | ***A7*** | **GROUND** | ..... | **GROUND** | ***B7*** | ***B7*** | ***B7*** | ***B7*** | ***C6*** | ***C6*** | ***B7*** | | |
| SB | A8(SB7) | A1(SB7) | *A1(VSP7)* | A8(SB7A) | *A8(VSP7A)* | A8(SB7A) | *A8(BP_TYPEA)* | *BP_TYPEA(VSP7A)* / BP_TYPEA(SB7A) | ← | (SB7A)BP_TYPEA/ *(VSP7A)BP_TYPEA* | *B8 [BP_TYPEA)* | B8(SB7A) | *B8(VSP7A)* | B8(SB7A) | *A2(VSP7)* | A2(SB7) | B8(SB7) | | |
| SB | A9(SB3) | B1(SB3) | *B1(VSP3)* | A9(SB3A) | *A9(VSP3A)* | A9(SB3A) | *A9(CWAKEA#/OBFFA)* | *CWAKEA#,OBFFA(VSP3A)* / GND(SB3A) | ↔ | (SB3A)GND/ *(VSP3A)CWAKEA#,OBFFA* | *B9 (CWAKEA#/OBFFA)* | B8(SB3A) | *B9(VSP3A)* | B9(SB3A) | *B2(VSP3)* | B2(SB3) | B9(SB3) | *P1 (WAKE#)* | |
| SB | | | | A10(SB9A) | *A10(VSP9A)* | A10(SB9A) | *A10(GND)* | *GND(VSP9A)* /GND(SB9A) | ..... | (SB9A)GND/ *(VSP9A)GND* | *B10 (GND)* | B10(SB9A) | *B10(VSP9A)* | B10(SB9A) | | | | | |
| SB | A10(SB4) | C1(SB4) | *C1(VSP4)* | A11(SB4A) | *A11(VSP4A)* | A11(SB4A) | *A11(VSPA)(REFCLKA+)* | *REFCLK+(VSP4A)* / RESETA, SDataOutA(SB4A) | → | (SB4A)SDataOutA,RESETA/ *(VSP4A)REFCLKA+* | *B11(VSPA)(REFCLKA+)* | B11(SB4A) | *B11(VSP4A)* | B11(SB4A) | *C2(VSP4)* | C2(SB4) | B10(SB4) | *E7 (REFCLK+)* | |
| SB | A11(SB5) | D1(SB5) | *D1(VSP5)* | A12(SB5A) | *A12(VSP5A)* | A12(SB5A) | *A12(VSPA)(REFCLKA-)* | *REFCLK-(VSP5A)* / ADDA, SDataInA(SB5A) | ↔ | (SB5A)SDataInA,ADDA/ *(VSP5A)REFCLKA-* | *B12(VSPA)(REFCLKA-)* | B12(SB5A) | *B12(VSP5A)* | B12(SB5A) | *D2(VSP5)* | D2(SB5) | B11(SB5) | *E8 (REFCLK-)* | |
| **GND** | **A12** | **B6** | ***B6*** | **A13** | ***A13*** | **A13** | ***A13*** | **GROUND** | ..... | **GROUND** | ***B13*** | ***B13*** | ***B13*** | ***B13*** | ***D6*** | ***D6*** | ***B12*** | | |
| HS | A13 | B7 | *B7* | A14 | *A14* | A14 | *A14* | PER(RX)p2 | ← | PETp2 | *B14* | B14 | *B14* | B14 | *D7* | D7 | B13 | *S27 (PERp2)* | S21 (TX2+) |
| HS | A14 | B8 | *B8* | A15 | *A15* | A15 | *A15* | PER(RX)n2 | ← | PETn2 | *B15* | B15 | *B15* | B15 | *D8* | D8 | B14 | *S26 (PERn2)* | S20 (TX2-) |
| **GND** | **A15** | **B9** | ***B9*** | **A16** | ***A16*** | **A16** | ***A16*** | **GROUND** | ..... | **GROUND** | ***B16*** | ***B16*** | ***B16*** | ***B16*** | ***D9*** | ***D9*** | ***B15*** | | |
| HS | A16 | A7 | *A7* | A17 | *A17* | A17 | *A17* | PER(RX)p3 | ← | PET(TX)p3 | *B17* | B17 | *B17* | B17 | *C7* | C7 | B16 | *E21 (PERp3)* | S27 (TX3+) |
| HS | A17 | A8 | *A8* | A18 | *A18* | A18 | *A18* | PER(RX)n3 | ← | PET(TX)n3 | *B18* | B18 | *B18* | B18 | *C8* | C8 | B17 | *E20 (PERn3)* | S26 (TX3-) |
| **GND** | **A18** | **A9** | ***A9*** | **A19** | ***A19*** | **A19** | ***A19*** | **GROUND** | ..... | **GROUND** | ***B19*** | ***B19*** | ***B19*** | ***B19*** | ***C9*** | ***C9*** | ***B18*** | | |
| RSV | | | | | | A20(RSVD) | *A20(RESERVED)* | RESERVED | NC | RESERVED | *B20(RESERVED)* | B20(RSVD) | | | | | | | |
| RSV | | | | | | A21(RSVD) | *A21(RESERVED)* | RESERVED | NC | RESERVED | *B21(RESERVED)* | B21(RSVD) | | | | | | | |
| **GND** | **A1** | **B3** | ***B3*** | | | **A22** | ***A22*** | **GROUND** | ..... | **GROUND** | ***B22*** | ***B22*** | | | ***D3*** | ***D3*** | ***B1*** | | |
| HS | A2 | B4 | *B4* | A20 | *A20* | A23 | *A23* | PER(RX)p4 | ← | PET(TX)p4 | *B23* | B23 | *B20* | B20 | *D4* | D4 | B2 | *E14 (PERp0)* | S6 (TX0+) |
| HS | A3 | B5 | *B5* | A21 | *A21* | A24 | *A24* | PER(RX)n4 | ← | PET(TX)n4 | *B24* | B24 | *B21* | B21 | *D5* | D5 | B3 | *E13 (PERn0)* | S5 (TX0-) |
| **GND** | **A4** | **A3** | ***A3*** | **A22** | ***A22*** | **A25** | ***A25*** | **GROUND** | ..... | **GROUND** | ***B25*** | ***B25*** | ***B22*** | ***B22*** | ***C3*** | ***C3*** | ***B4*** | | |
| HS | A5 | A4 | *A4* | A23 | *A23* | A26 | *A26* | PER(RX)p5 | ← | PET(TX)p5 | *B26* | B26 | *B23* | B23 | *C4* | C4 | B5 | *S21 (PERp1)* | S13 (TX1+) |
| HS | A6 | A5 | *A5* | A24 | *A24* | A27 | *A27* | PER(RX)n5 | ← | PET(TX)n5 | *B27* | B27 | *B24* | B24 | *C5* | C5 | B6 | *S20 (PERn1)* | S12 (TX1-) |
| **GND** | **A7** | **A6** | ***A6*** | **A25** | ***A25*** | **A28** | ***A28*** | **GROUND** | ..... | **GROUND** | ***B28*** | ***B28*** | ***B25*** | ***B25*** | ***C6*** | ***C6*** | ***B7*** | | |
| SB | A8(SB7) | A1(SB7) | *A1(VSP7)* | A26(SB7B) | *A26(VSP7B)* | A29(SB7B) | *A29(BP_TYPEB)* | *BP_TYPEB(VSP7B)* / BP_TYPEB(SB7B) | ← | (SB7B)BP_TYPEB/ *(VSP7B)BP_TYPEB* | *B29 (BP_TYPEB)* | B29(SB7B) | *B26(VSP7B)* | B26(SB7B) | *A2(VSP7)* | A2(SB7) | B8(SB7) | | |
| SB | A9(SB3) | B1(SB3) | *B1(VSP3)* | A27(SB3B) | *A27(VSP3B)* | A30(SB3B) | *A30(CWAKEB#/OBFFB)* | *CWAKEB#,OBFFB(VSP3B)* / GND(SB3B) | ↔ | (SB3B)GND/ *(VSP3B)WAKEB#,OBFFB* | *B30 (CWAKEB#/OBFFB)* | B30(SB3B) | *B27(VSP3B)* | B27(SB3B) | *B2(VSP3)* | B2(SB3) | B9(SB3) | *P1 (WAKE#)* | |
| SB | | | | A28(SB9B) | *A28(VSP9B)* | A31(SB9B) | *A31(GND)* | *GND(VSP9B)* /GND(SB9B) | ..... | (SB9B)GND/ *(VSP9B)GND* | *B31 (GND)* | B31(SB9B) | *B28(VSP9B)* | B28(SB9B) | | | | | |
| SB | A10(SB4) | C1(SB4) | *C1(VSP4)* | A29(SB4B | *A29(VSP4B)* | A32(SB4B) | *A32(VSPB)(REFCLKB+)* | *REFCLK+(VSP4B)* / RESETB, SDataOutB(SB4B) | → | (SB4B)SDataOutB,RESETB/ *(VSP4B)REFCLKB+* | *B32(VSPB)(REFCLKB+)* | B32(SB4B) | *B29(VSP4B)* | B29(SB4B) | *C2(VSP4)* | C2(SB4) | B10(SB4) | *E7 (REFCLK+)* | |
| SB | A11(SB5) | D1(SB5) | *D1(VSP5)* | A30(SB5B) | *A30(VSP5B)* | A33(SB5B) | *A33(VSPB)(REFCLKB-)* | *REFCLK-(VSP5B)* / ADDB, SDataInB(SB5B) | ↔ | (SB5B)SDataInB,ADDB/ *(VSP5B)REFCLKB-* | *B33(VSPB)(REFCLKB-)* | B33(SB5B) | *B30(VSP5B)* | B30(SB5B) | *D2(VSP5)* | D2(SB5) | B11(SB5) | *E8 (REFCLK-)* | |
| **GND** | **A12** | **B6** | ***B6*** | **A31** | ***A31*** | **A34** | ***A34*** | **GROUND** | ..... | **GROUND** | ***B34*** | ***B34*** | ***B31*** | ***B31*** | ***D6*** | ***D6*** | ***B12*** | | |
| HS | A13 | B7 | *B7* | A32 | *A32* | A35 | *A35* | PER(RX)p6 | ← | PETp6 | *B35* | B35 | *B32* | B32 | *D7* | D7 | B13 | *S27 (PERp2)* | S21 (TX2+) |
| HS | A14 | B8 | *B8* | A33 | *A33* | A36 | *A36* | PER(RX)n6 | ← | PETn6 | *B36* | B36 | *B33* | B33 | *D8* | D8 | B14 | *S26 (PERn2)* | S20 (TX2-) |
| **GND** | **A15** | **B9** | ***B9*** | **A34** | ***A34*** | **A37** | ***A37*** | **GROUND** | ..... | **GROUND** | ***B37*** | ***B37*** | ***B34*** | ***B34*** | ***D9*** | ***D9*** | ***B15*** | | |
| HS | A16 | A7 | *A7* | A35 | *A35* | A38 | *A38* | PER(RX)p7 | ← | PET(TX)p7 | *B38* | B38 | *B35* | B35 | *C7* | C7 | B16 | *E21 (PERp3)* | S27 (TX3+) |
| HS | A17 | A8 | *A8* | A36 | *A36* | A39 | *A39* | PER(RX)n7 | ← | PET(TX)n7 | *B39* | B39 | *B36* | B36 | *C8* | C8 | B17 | *E20 (PERn3)* | S26 (TX3-) |
| **GND** | **A18** | **A9** | ***A9*** | **A37** | ***A37*** | **A40** | ***A40*** | **GROUND** | ..... | **GROUND** | ***B40*** | ***B40*** | ***B37*** | ***B37*** | ***C9*** | ***C9*** | ***B18*** | | |
| | | | | | | | | | | | | | | | | | 8x | SHEET 1 OF 2 | |

## TABLE 4-5 PINOUT FOR AN 8X INTERFACE WITH SIDEBANDS (2 OF 2)

| | Controller / Initiator / *Root* (Downstream) | | | | | | | | | Backplane/ *Endpoint* (Upstream) | | | | | | | | *DEVICE* | DEVICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9400 Rev 0.2 | 8087 | 8643 | *mini-SAS HD* | 8654 | *SlimLine SAS* | 8612 | *OCuLink* | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | CABLE | 9401 Universal Multi-Protocol Single Cable for SAS/PCIe | *OCuLink* | 8612 | *SlimLine SAS* | 8654 | *mini-SAS HD* | 8643 | 8087 | *SFF-8639* | MultiLink |
| Type 1 8X | SAS-2.1 x4 | SAS-2.1, 3 x4 | *PCIE x4* | SAS-4 x8 | *PCIE x8* | SAS-4 x8 | *PCIE x8* | 8X Single Cable *OCuLink 1.0* / SFF-8448 | | 8X Single Cable SFF-8448/*OCuLink 1.0* | *PCIE x8* | SAS-4 x8 | *PCIE x8* | SAS-4 x8 | *PCIE x4* | SAS-2.1, 3 x4 | SAS-2.1 x4 | *PCIE* | SAS |
| | PIN | PIN | *PIN* | PIN | *PIN* | PIN | *PIN* | *ROOT* / Controller | DIR | Backplane/ *END Point* | *PIN* | PIN | *PIN* | PIN | *PIN* | PIN | PIN | *PIN* | PIN |
| **GND** | **B1** | **D3** | ***D3*** | **B1** | ***B1*** | **B1** | ***B1*** | ***GROUND*** | ..... | ***GROUND*** | ***A1*** | ***A1*** | ***A1*** | ***A1*** | ***B3*** | ***B3*** | ***A1*** | | |
| HS | B2 | D4 | *D4* | B2 | *B2* | B2 | *B2* | PET(TX)p0 | → | PER(RX)p0 | *A2* | A2 | *A2* | A2 | *B4* | B4 | A2 | *E10 (PETp0)* | S2 (RX0+) |
| HS | B3 | D5 | *D5* | B3 | *B3* | B3 | *B3* | PET(TX)n0 | → | PER(RX)n0 | *A3* | A3 | *A3* | A3 | *B5* | B5 | A3 | *E11 (PETn0)* | S3 (RX0-) |
| **GND** | **B4** | **C3** | ***C3*** | **B4** | ***B4*** | **B4** | ***B4*** | ***GROUND*** | ..... | ***GROUND*** | ***A4*** | ***A4*** | ***A4*** | ***A4*** | ***A3*** | ***A3*** | ***A4*** | | |
| HS | B5 | C4 | *C4* | B5 | *B5* | B5 | *B5* | PET(TX)p1 | → | PER(*RX*)p1 | *A5* | A5 | *A5* | A5 | *A4* | A4 | A5 | *S17 (PETp1)* | S9 (RX1+) |
| HS | B6 | C5 | *C5* | B6 | *B6* | B6 | *B6* | PET(TX)n1 | → | PER(RX)n1 | *A6* | A6 | *A6* | A6 | *A5* | A5 | A6 | *S18 (PETn1)* | S10 (RX1-) |
| **GND** | **B7** | **C6** | ***C6*** | **B7** | ***B7*** | **B7** | ***B7*** | ***GROUND*** | ..... | ***GROUND*** | ***A7*** | ***A7*** | ***A7*** | ***A7*** | ***A6*** | ***A6*** | ***A7*** | | |
| SB | B8(SB0) | A2(SB0) | *A2(VSP0)* | B8(SB0A) | *B8(VSP0A)* | B8(SB0A) | *B8(2W-CLKA)* | *2W-CLKA(VSP0A)* / 2W-CLKA(SB0A) | ↔ | (SB0A)2W-CLKA/ *(VSP0A)2W-CLKA* | *A8(2W-CLKA)* | A8(SB0A) | *A8(VSP0A)* | A8(SB0A) | *A1(VSP0)* | A1(SB0) | A8(SB0) | | |
| SB | B9(SB1) | B2(SB1) | *B2(VSP1)* | B9(SB1A) | *B9(VSP1A)* | B9(SB1A) | *B9 (2W-DATAA)* | *2W-DATAA(VSP1A)* / 2W-DATAA(SB1A) | ↔ | (SB1A)2W-DATAA/ *(VSP1A)2W-DATAA* | *A9(2W-DATAA)* | A9(SB1A) | *A9(VSP1A)* | A9(SB1A) | *B1(VSP1)* | B1(SB1) | A9(SB1) | | |
| SB | | | | B10(SB8A) | *B10(VSP8A)* | B10(SB8A) | *B10(GND)* | *GND(VSP8A)* / GND(SB8A) | ..... | (SB8A)GND/ *(VSP8A)GND* | *A10(GND)* | A10(SB8A) | *A10(VSP8A)* | A10(SB8A) | | | | | |
| SB | B10(SB2) | C2(SB2) | *C2(VSP2)* | B11(SB2A) | *B11(VSP2A)* | B11(SB2A) | *B11 (PERSTA#)* | *PERSTA#(VSP2A)* / GND(SB2A) | → | (SB2A)GND/ *(VSP2A)PERSTA#* | *A11(PERSTA#)* | A11(SB2A) | *A11(VSP2A)* | A11(SB2A) | *C1(VSP2)* | C1(SB2) | A10(SB2) | *E5 (PERST#)* | |
| SB | B11(SB6) | D2(SB6) | *D2(VSP6)* | B12(SB6A) | *B12(VSP6A)* | B12(SB6A) | *B12 (CPRSNTA#)* | *CPRSNTA#(VSP6A)* / CNTRLR_TYPEA(SB6A) | ↔ | (SB6A)CNTRLR_TYPEA/ *(VSP6A)CPRSNTA#* | *A12(CPRSNTA#)* | A12(SB6A) | *A12(VSP6A)* | A12(SB6A) | *D1(VSP6)* | D1(SB6) | A11(SB6) | | |
| **GND** | **B12** | **D6** | ***D6*** | **B13** | ***B13*** | **B13** | ***B13*** | ***GROUND*** | ..... | ***GROUND*** | ***A13*** | ***A13*** | ***A13*** | ***A13*** | ***B6*** | ***B6*** | ***A12*** | | |
| HS | B13 | D7 | *D7* | B14 | *B14* | B14 | *B14* | PET(TX)p2 | → | PER(RX)p2 | *A14* | A14 | *A14* | A14 | *B7* | B7 | A13 | *S23 (PETp2)* | S17 (RX2+) |
| HS | B14 | D8 | *D8* | B15 | *B15* | B15 | *B15* | PET(TX)n2 | → | PER(RX)n2 | *A15* | A15 | *A15* | A15 | *B8* | B8 | A14 | *S24 (PETn2)* | S18 (RX2-) |
| **GND** | **B15** | **D9** | ***D9*** | **B16** | ***B16*** | **B16** | ***B16*** | ***GROUND*** | ..... | ***GROUND*** | ***A16*** | ***A16*** | ***A16*** | ***A16*** | ***B9*** | ***B9*** | ***A15*** | | |
| HS | B16 | C7 | *C7* | B17 | *B17* | B17 | *B17* | PET(TX)p3 | → | PER(RX)p3 | *A17* | A17 | *A17* | A17 | *A7* | A7 | A16 | *E17 (PETp3)* | S23 (RX3+) |
| HS | B17 | C8 | *C8* | B18 | *B18* | B18 | *B18* | PET(TX)n3 | → | PER(RX)n3 | *A18* | A18 | *A18* | A18 | *A8* | A8 | A17 | *E18 (PETn3)* | S24 (RX3-) |
| **GND** | **B18** | **C9** | ***C9*** | **B19** | ***B19*** | **B19** | ***B19*** | ***GROUND*** | ..... | ***GROUND*** | ***A19*** | ***A19*** | ***A19*** | ***A19*** | ***A9*** | ***A9*** | ***A18*** | | |
| RSV | | | | | | B20(RSVD) | *B20(RESERVED)* | RESERVED | NC | RESERVED | *A20(RESERVED)* | A20(RSVD) | | | | | | | |
| RSV | | | | | | B21(RSVD) | *B21(RESERVED)* | RESERVED | NC | RESERVED | *A21(RESERVED)* | A21(RSVD) | | | | | | | |
| **GND** | **B1** | **D3** | ***D3*** | | | **B22** | ***B22*** | ***GROUND*** | ..... | ***GROUND*** | ***A22*** | ***A22*** | | | ***B3*** | ***B3*** | ***A1*** | | |
| HS | B2 | D4 | *D4* | B20 | *B20* | B23 | *B23* | PET(TX)p4 | → | PER(RX)p4 | *A23* | A23 | *A20* | A20 | *B4* | B4 | A2 | *E10 (PETp0)* | S2 (RX0+) |
| HS | B3 | D5 | *D5* | B21 | *B21* | B24 | *B24* | PET(TX)n4 | → | PER(RX)n4 | *A24* | A24 | *A21* | A21 | *B5* | B5 | A3 | *E11 (PETn0)* | S3 (RX0-) |
| **GND** | **B4** | **C3** | ***C3*** | **B22** | ***B22*** | **B25** | ***B25*** | ***GROUND*** | ..... | ***GROUND*** | ***A25*** | ***A25*** | ***A22*** | ***A22*** | ***A3*** | ***A3*** | ***A4*** | | |
| HS | B5 | C4 | *C4* | B23 | *B23* | B26 | *B26* | PET(TX)p5 | → | PER(*RX*)p5 | *A26* | A26 | *A23* | A23 | *A4* | A4 | A5 | *S17 (PETp1)* | S9 (RX1+) |
| HS | B6 | C5 | *C5* | B24 | *B24* | B27 | *B27* | PET(TX)n5 | → | PER(RX)n5 | *A27* | A27 | *A24* | A24 | *A5* | A5 | A6 | *S18 (PETn1)* | S10 (RX1-) |
| **GND** | **B7** | **C6** | ***C6*** | **B25** | ***B25*** | **B28** | ***B28*** | ***GROUND*** | ..... | ***GROUND*** | ***A28*** | ***A28*** | ***A25*** | ***A25*** | ***A6*** | ***A6*** | ***A7*** | | |
| SB | B8(SB0) | A2(SB0) | *A2(VSP0)* | B26(SB0B) | *B26(VSP0B)* | B29(SB0B) | *B29 (2W-CLKB)* | *2W-CLKB(VSP0B)* / 2W-CLKB(SB0B) | ↔ | (SB0B)2W-CLKB/ *(VSP0B)2W-CLKB* | *A29(2W-CLKB)* | A29(SB0B) | *A26(VSP0B)* | A26(SB0B) | *A1(VSP0)* | A1(SB0) | A8(SB0) | | |
| SB | B9(SB1) | B2(SB1) | *B2(VSP1)* | B27(SB1B) | *B27(VSP1B)* | B30(SB1B) | *B30 (2W-DATAB)* | *2W-DATAB(VSP1B)* / 2W-DATAB(SB1B) | ↔ | (SB1B)2W-DATAB/ *(VSP1B)2W-DATAB* | *A30(2W-DATAB)* | A30(SB1B) | *A27(VSP1B)* | A27(SB1B) | *B1(VSP1)* | B1(SB1) | A9(SB1) | | |
| SB | | | | B28(SB8B) | *B28(VSP8B)* | B31(SB8B) | *B31 (GND)* | *GND(VSP8B)* / GND(SB8B) | ..... | (SB8B)GND/ *(VSP8B)GND* | *A31(GND)* | A31(SB8B) | *A28(VSP8B)* | A28(SB8B) | | | | | |
| SB | B10(SB2) | C2(SB2) | *C2(VSP2)* | B29(SB2B) | *B29(VSP2B)* | B32(SB2B) | *B32 (PERSTB#)* | *PERSTB#(VSP2B)* / GND(SB2B) | → | (SB2B)GND/ *(VSP2B)PERSTB#* | *A32(PERSTB#)* | A32(SB2B) | *A29(VSP2B)* | A29(SB2B) | *C1(VSP2)* | C1(SB2) | A10(SB2) | *E5 (PERST#)* | |
| SB | B11(SB6) | D2(SB6) | *D2(VSP6)* | B30(SB6B) | *B30(VSP6B)* | B33(SB6B) | *B33 (CPRSNTB#)* | *CPRSNTB#(VSP6B)* / CNTRLR_TYPEB(SB6B) | ↔ | (SB6B)CNTRLR_TYPEB/ *(VSP6B)CPRSNTB#* | *A33(CPRSNTB#)* | A33(SB6B) | *A30(VSP6B)* | A30(SB6B) | *D1(VSP6)* | D1(SB6) | A11(SB6) | | |
| **GND** | **B12** | **D6** | ***D6*** | **B31** | ***B31*** | **B34** | ***B34*** | ***GROUND*** | ..... | ***GROUND*** | ***A34*** | ***A34*** | ***A31*** | ***A31*** | ***B6*** | ***B6*** | ***A12*** | | |
| HS | B13 | D7 | *D7* | B32 | *B32* | B35 | *B35* | PET(TX)p6 | → | PER(RX)p6 | *A35* | A35 | *A32* | A32 | *B7* | B7 | A13 | *S23 (PETp2)* | S17 (RX2+) |
| HS | B14 | D8 | *D8* | B33 | *B33* | B36 | *B36* | PET(TX)n6 | → | PER(RX)n6 | *A36* | A36 | *A33* | A33 | *B8* | B8 | A14 | *S24 (PETn2)* | S18 (RX2-) |
| **GND** | **B15** | **D9** | ***D9*** | **B34** | ***B34*** | **B37** | ***B37*** | ***GROUND*** | ..... | ***GROUND*** | ***A37*** | ***A37*** | ***A34*** | ***A34*** | ***B9*** | ***B9*** | ***A15*** | | |
| HS | B16 | C7 | *C7* | B35 | *B35* | B38 | *B38* | PET(TX)p7 | → | PER(RX)p7 | *A38* | A38 | *A35* | A35 | *A7* | A7 | A16 | *E17 (PETp3)* | S23 (RX3+) |
| HS | B17 | C8 | *C8* | B36 | *B36* | B39 | *B39* | PET(TX)n7 | → | PER(RX)n7 | *A39* | A39 | *A36* | A36 | *A8* | A8 | A17 | *E18 (PETn3)* | S24 (RX3-) |
| **GND** | **B18** | **C9** | ***C9*** | **B37** | ***B37*** | **B40** | ***B40*** | ***GROUND*** | ..... | ***GROUND*** | ***A40*** | ***A40*** | ***A37*** | ***A37*** | ***A9*** | ***A9*** | ***A18*** | | |
| | | | | | | | | | | | | | | | | 8x SHEET 2 OF 2 | | | |